Energy Goes Green

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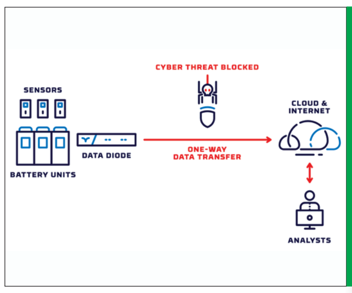
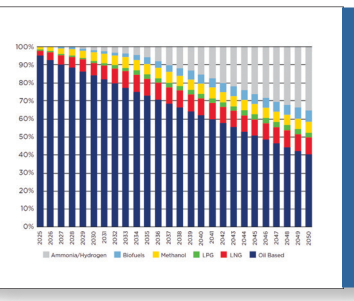


New tech to shield renewable systems
With renewable energy projected to grow exponentially, hardware-enforced cybersecurity technology can help it reach its full potential, while minimising risks – Page 9



Looking at methanol as marine fuel
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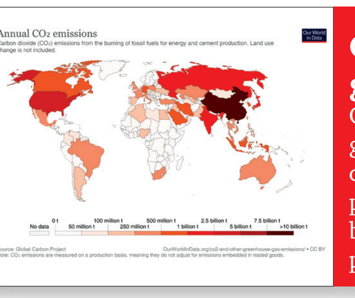

China owns 35pc global solar capacity
Globally, solar PV electricity generation is expected to increase by 145 TWh in 2021, pushing the share of renewables in the eneregy mix to 30 per cent – Page 14

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NEW TECH WILL SPUR GCC TRANSITION

Freddie Neve, Asia House Middle East Associate, argues that more investment is needed to support the Gulf's vision for global decarbonisation

THE lead up to COP26 in Glasgow saw the Gulf states enter a new era of climate diplomacy.

The UAE became the first Gulf state to announce a net-zero target, pledging to reach this by 2050. Saudi Arabia and Bahrain followed shortly afterwards with commitments of their own to become net-zero by 2060.

New Nationally Determined Contributions (NDCs) under the Paris climate accords were also announced, with Qatar, for example, committing to reduce greenhouse gas emissions by 25 per cent by 2030.

The Gulf states have also fostered greater intraregional dialogue on climate change over the last year.

Saudi Arabia, the region's largest oil producer, launched two ambitious climate change initiatives, 'The Saudi Green Initiative' (SGI) and 'The Middle East Green Initiative' (MGI). The latter aims to reduce Middle East carbon emissions by 60 per cent by 2030.

A UAE-led regional summit earlier in the year also brought together several leaders from the Middle East and North Africa to accelerate climate change action.

The recent announcement that Egypt and the UAE will host COP27 and COP28 respectively will ensure the Middle East will become an important centre for international dialogue on sustainability over the next couple of years.

One theme that will feature heavily in the Gulf's contribution to these discussions is the role of carbon capture utilisation and storage (CCUS) technologies in the global energy transition.

CCUS & GCC'S VISION FOR GLOBAL DECARBONISATION

The Gulf states are serious about developing their renewable energy sectors and reducing domestic emissions.

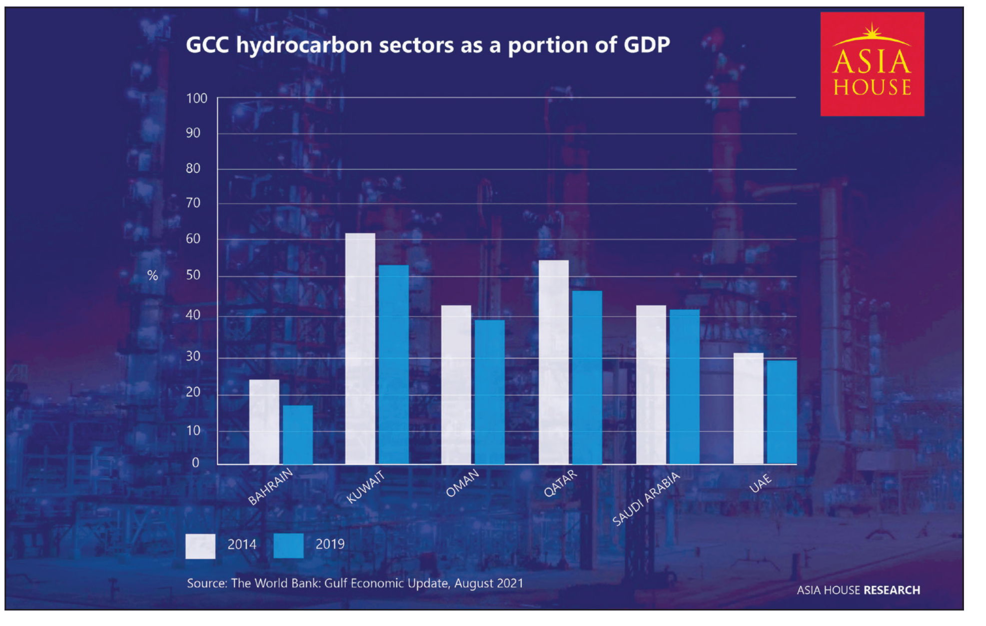
However, their vision for global decarbonisation is one where hydrocarbons remain a central part of the global energy mix, but with the negative environmental impact of their emissions reduced by CCUS technologies.

The Gulf states' determination to continue exporting hydrocarbons is underscored by Saudi Arabia's Energy Minister Prince Abdulaziz bin Salman's recent pledge to drill "every last molecule" of oil in Saudi Arabia, as well as recent announcements by major energy companies such as Abu Dhabi National Oil Company (Adnoc), Kuwait Oil Company, and Aramco, to invest in increased production.

Ultimately the Gulf states remain reliant on fossil fuel exports. While hydrocarbon GDP as a proportion of overall GDP has declined in all GCC economies between 2014 and 2019, it has not done so significantly.

The recent rise in oil prices to multi-year highs will probably further expand the hydrocarbon sector's contribution to GCC GDP over the short term.

Oil and gas exports are still crucial to meeting GCC revenue targets. Oil revenues still exceed 70 per cent of total government revenues in Kuwait, Qatar, Oman, and Bahrain,



Neve ... invest in CCUS tech

> *GCC investment in CCUS technology aims to reduce domestic emissions and advance the technology so that existing oil customers are persuaded that they can continue purchasing hydrocarbons while maintaining their climate change commitments*

meaning that even with increased focus on economic diversification, the GGC economies could still be dependent on hydrocarbon revenue for the foreseeable future.

The GCC's reliance on hydrocarbon revenue is encouraging the Gulf states to invest heavily in developing CCUS technologies and working with the international community to accept and promote CCUS as a tool to reduce carbon emissions.

One emerging application of CCUS is capturing the CO_2 emitted during the transformation of natural gas into ammonia, creating 'blue ammonia'.

Crucially, ammonia is a store of hydrogen and does not emit any CO_2 when burned and, therefore, could assist other countries with their energy transition.

There remains debate regarding blue ammonia's environmental impacts and risks.

Arguments have been put forward that using CO2 produced by blue ammonia, for enhanced oil recovery, is not as environment-friendly as storing the captured CO_2 underground.

Recent scientific research has also expressed concern over the risk of methane leakage during the production process.

Still, the Gulf states and other energy producers argue that blue ammonia can play a crucial role in decarbonisation by providing low-carbon fuel to a range of sectors such as shipping, steel production, and aluminium production.

BIG INVESTMENT

Gulf energy majors are investing heavily in the technology with, for example, Adnoc developing a 1,000 kiloton per annum 'world-scale' blue ammonia production facility.

Increasingly, in addition to its investments, GCC governments are demonstrating blue ammonia's real-world applications.

In September 2020, Saudi Arabia sent blue ammonia to Japan in a world-first shipment;

Continued on Page 6

COP26 ... world needs to deliver on climate commitments

Climate: Brouhaha or are we serious about it?

THE calls for fighting climate change have gotten louder and clearer. World leaders at a series of global events, mostly recently COP26 in Glasgow, Scotland, made yet another non-binding agreement to keep our hot planet from burning out.

Alok Sharma, the COP26 President, called the Glasgow Pact a collective dedication, adding, "We must now move forward together and deliver on the expectations set out in the … Pact."

Some 153 countries (of the nearly 200 participating countries) pledged new 2030 emissions targets. That's Over 90 per cent of world GDP now covered by net zero commitments.

To deliver on these targets, the commitments include moving away from coal power, halting and reversing deforestation, reducing methane emissions and speeding up the switch to electric vehicles (EVs).

COP26 sort of finalises the Paris Agreement of limiting temperature rise to between 1.5 and 2 deg C

In 2018, the Intergovernmental Panel on Climate Change (IPCC) found emissions cuts by industries would not be enough to attain the 1.5 deg C goal, saying so-called 'negative emissions' would be needed to hold temperatures down in case of an overshoot.

To keep from overshooting the 1.5 deg C target, emissions must fall 45 per cent this decade, the IPCC said (see page 12 for global emissions report).

Soon after COP26 was over, another key summit of the energy sector in Abu Dhabi echoed similar sentiments.

Adipec 2021, considered an influential event for the global energy industry, underscored the sectors' readiness to embrace the challenges of energy transition.

Mohammad Barkindo, Secretary-General, Opec, said: "The challenge is managing how to reduce greenhouse gas emissions that have been impacting our climate."

In this targeted race, technology will play the biggest role. Increasing investments have to be made in technologies like carbon capture (see report on page 17), hydrogen (see report on page 18), renewables (see report on page 14), and even nuclear (see report on page 11) to offset any disbalance that might occur from reducing our dependency on fossil fuel.

To be fair to the technologically less advanced countries, any useful technology in this regard must be unconditionally shared with them so they don't fall behind their commitments and at the same time meet their energy needs to viably run their economies.

For the GCC countries, which still depend heavily on oil and gas for their revenues, technology provides the only solution to them meeting their tall net-zero commitments.

Major oil producers like Saudi Arabia and the UAE are undertaking heavy investments in clean energy projects and climate-friendly technologies.

The GCC region is poised for a significant take-off in carbon capture and storage (CCS) activity over the next decade. It is estimated that facilities in the UAE and Saudi Arabia already account for 10 per cent of global CO2 captured each year, much more than Europe's four per cent.

Forums like COP26, ADIPEC and the Middle East Green Initiative serve as vital reminders of our shared interests and common future. They keep prompting us of time that's fast running out, and much needed action.

However, action on climate change is not just about making net-zero pledges, but working out the practical steps for how countries and companies can successfully achieve them.

Moving towards renewable energy and being more energy efficient is a huge undertaking that requires constant review, assessment and guidance.

Setting short term targets and reporting on progress, with transparency on what's working, and what can be improved, is essential to build trust, learn lessons and work collaboratively.

GCC is at forefront of net-zero, green investments

COUNTRIES in the Gulf region have made big announcements to reach net-zero emissions. The UAE, followed by Saudi Arabia, Bahrain and the rest have set goals that will see them invest in new energy technology.

• **UAE**: It was the first country in the Mena region to launch a roadmap to achieve its climate commitments. Its Net Zero by 2050 Strategic Initiative will oversee over $163 billion in investment in renewable energy.

The UAE has in the past 15 years invested $40 billion in clean energy. Its Barakah nuclear power plant aims to produce 14 GW of clean energy by 2030.

Globally, the major Opec member has committed to more than $1 billion dollars in development aid for clean energy projects in more than 70 developing countries, in addition to having invested over $17 billion in clean energy projects around the world, and another $400 million in renewables funding through the Energy Transition Accelerator Platform (ETAF).

The UAE is bidding to hosts the COP28 summit in 2023.

• **SAUDI ARABIA**: The Kingdom's plan is to reduce carbon emissions in the entire Middle East by more than 10 per cent through its Saudi Green Initiative (SGI) and Middle East Green Initiative (MGI) and with over $185 billion of investment.

It's heavily promoting its Circular Carbon Economy (CCE) initiative by reusing resources. For this a $10 billion fund will see CCE technologies deployed in the developing countries.

KSA has pledged to reduce emissions by 278 million tons per year by 2030 and limit methane emissions by 30 per cent.

It will also increase the share of renewables in its power mix to 50 per cent. Work is underway on one of the largest hydrogen hubs in the world at NEOM city where the Kingdom aspires to produce 4 million tons of green and blue hydrogen annually, and setting up the largest CCUS complex, with a capacity of 44 million tons per year by 2030.

• **OMAN**: As one of the most vulnerable countries in the region to the adverse impacts of climate change, Oman understands well the concerns of global warming.

The country has pledged to reduce greenhouse gas (GHG) emissions by 7 per cent by 2030.

Separately, Oman is home to one the world's largest swathes of peridotite, a rock that can soak up CO_2.

Scientists say the naturally occurring process can be supercharged to grow underground minerals that can permanently store 2 billion or more of the 30 billion tons of carbon dioxide emitted by human activity every year.

The region has enough peridotite to mineralise up to 50 trillion tons of CO2 – almost every single emission by humankind since the industrial revolution.

• **BAHRAIN**: The Kingdom has pledged commitment to reaching net zero by 2060, and hopes to reduced 30 per cent emissions by 2035 through decarbonisation and efficiency initiatives, increasing the deployment of renewables, quadrupling mangrove coverage, doubling tree coverage, and investing in carbon capture technologies.

• **QATAR**: The world's largest producer of liquefied natural gas (LNG) has a national climate change action plan aimed at achieving a 25 per cent reduction in GHG emissions by 2030.

Qatar also recently created an environment and climate change ministry, in addition to announcing the contribution of $100 million to support developing countries to deal with climate change and natural hazards.

• **KUWAIT**: The country has set a low carbon strategy for until 2050. The national strategy is based on CCE to promote the reduction, disposal, reuse and recycling of greenhouse gases.

New tech will spur gcc transition

Continued from Page 6

and in August 2021, Adnoc announcing three separate sales of blue ammonia to new Japanese customers, Idemitsu, Inpex, and Itochu.

The GCC's development of CCUS, and its associated technologies, aim to support the hydrocarbon sector, while simultaneously reducing the sector's environmental impact.

More GCC investment in renewable energy will reduce GCC domestic emissions and lower consumption of its own hydrocarbon resources. This will free more oil and natural gas that could be exported to markets outside the GCC, meaning until CCUS is further adopted at scale, Gulf oil exports will continue to generate CO2 emissions.

LOOKING AHEAD TO GREATER GREEN FINANCE

Increased Gulf focus on tackling climate change is a positive development that international governments and investors should continue to encourage.

But this alone will not prevent Gulf hydrocarbons from being exported to other markets and releasing emissions.

Global oil demand is still rising, with the International Energy Agency (IEA) recently forecasting global demand to increase significantly until 2026.

Oil remains central to the global economy and the Gulf states will not want to forgo any potential revenue from meeting this demand, leading to carbon emissions outside its borders.

GCC investment in CCUS technology aims to reduce domestic emissions and advance the technology so that existing oil customers are persuaded that they can continue purchasing hydrocarbons while maintaining their climate change commitments.

But the technology remains under-developed and further research and investment into CCUS technologies, as well as alternative fuels such as blue ammonia, are needed to encourage wider-spread adoption.

Increased demand for blue ammonia can assist with encouraging development in greener forms of the technology such as green ammonia, which is produced entirely from renewables.

International governments and Gulf governments should cooperate to identify opportunities to develop and share knowledge on CCUS, as well as identify projects that could benefit from investment.

There is a need for GCC governments and global financial institutions to elevate the financing and investment of CCUS. The Gulf states themselves are increasingly open to green finance.

The first half of 2021 also saw green financing for projects in Mena rise by 38 per cent to reach $6.4 billion.

Global financial institutions should work with the Gulf states to bring more of these projects to the market, and explore products structured around CCUS and/or blue ammonia investments, while simultaneously working with the Gulf states to develop standards for these technologies to increase investor confidence.

Energy industry has a lot to do in fight against climate change

Not only will the industry have to reduce emissions, it will also have to think broader while crafting its strategies, consider environmental challenges, and various stakeholders, Ali Kanoo and Manoj Tripathy from the Kanoo Group tell *OGN*

AS the world countries pledge to take action against climate change, the energy industry is now under pressure more than ever to decrease carbon emissions.

Technological innovation will play a big role in overcoming the environmental challenges and help the world avoid the catastrophic damage that rising temperatures could pose to humanity.

In an interview with Abdulaziz Khattak of ***OGN***, Ali Abdulla Kanoo, Deputy Chairman of Yusuf Bin Ahmed Kanoo Company, Saudi Arabia, and Manoj Kumar Tripathy, CEO - Kanoo Industrial & Energy Yusuf Bin Ahmed Kanoo Group, tell us how the future of energy will look like, and the challenges the industry faces.

What is your take on the global energy market and digital disruption in the sector?

Technology continues to possess the power to disrupt sectors like oil and gas, and energy in general, helping companies by finding operational proficiencies in addition to addressing the growing environmental concerns.

In the coming decades, the energy market will continue to witness disruption due to the popular digital trends like artificial intelligence (AI), machine learning (ML) and data analytics. These technologies have potentially resulted in improved productivity, safety, and sustainability.

The application of advanced technologies across the industry, transforms the nature of businesses and organisations, and requires new skills to address coming opportunities and risks.

Disruption driven by technological innovation and adoption of clean tech, particularly solar generation, along with the rise of electric vehicles (EVs), is creating major shifts.

It is estimated that the cost of solar will drop so much that by 2030 all innovation in energy will involve solar; EVs will gain more popularity and new vehicles will have driverless capabilities; and the energy grid will become an 'internet of energy'.

Kanoo and Tripathy (right) ... technological disruption is creating major shifts

The future will enable customers to upload and download energy on the grid, track transactions on apps built and run on blockchain architecture.

Today there are political, regulatory, technological, and economic forces driving the rapid adoption of clean, non-carbon-based alternative energy sources, namely nuclear, solar, hydrogen, etc.

The long-term demand has opened avenues for other environmental conscious technologies, including innovation in biofuels, autonomous vehicles, ride sharing, smart cities and fuel efficiency programmes.

How do you see the UAE's National Energy Strategy 2050?

The UAE government is committed to bringing a quality change in the culture of energy consumption. It is striving to diversify its sources of energy by enabling the contribution of clean energy and actively reducing energy consumption.

The strategy is focused on increasing the consumption of clean energy from 25-50 per cent, reduce carbon emission resulting from the power generation process by 70 per cent, and improve energy efficiency by 40 per cent by 2050.

The aim to invest Dh600 billion ($163 billion) to meet demands for energy to ensure the sustainability of growth in the UAE's economy is one of the key objectives.

This strategy will accelerate economic growth and investment in energy storage, contributing to reducing power consumption.

These efforts mark the beginning of the sustainability of the UAE's power sector and its commitment to achieve carbon neutrality.

These efforts also highlight the UAE leadership's position in facing climate change by embracing sustainability and using renewable and clean energy technologies.

What are the strategic challenges faced by the energy sector?

Renewable energy has become a mainstream part of the energy industry and with the fast-paced growth, it's seeking more robust policy structures. Regulators are expected to consider various factors ensuring financially viability for designing future energy systems.

Industries that cannot cut down their carbon emissions will have to face more scrutiny.

Industries will have to think broader while crafting their strategies, consider environmental challenges, and not just shareholders but and various stakeholders.

Energy companies will have to ramp up investment in innovative technologies to address environmental concerns and embrace digital technologies.

The world still lacks safe, low-carbon, and cheap large-scale energy alternatives to fossil fuels. Until we scale up those alternatives, the world will continue to struggle to overcome the challenges of carbon emission.

What are the challenges posed by new emissions targets?

The industry needs to minimise its own emissions – produced from production, processing, and logistics – which contributes approximately 20 per cent to the lifecycle along with 80 per cent emission due to fuel burnt by consumers.

There is an urgent need to address emissions that are released.

The cost of capital rises with the demand of oil increase, and carbon taxes also come into the play. Considering these factors, decarbonisation is indeed the key to retain the support of users and regulators.

Net-zero plans rely on promises of future carbon removal. It might not be practical to compensate for the cumulative emissions if the technologies anticipated to remove huge quantities of carbon in the future fail to work.

What are some of the latest technological innovations to address issues like lower carbon emissions?

With the growing urban areas and smart cities becoming the new reality, greenhouse gas emissions are likely to grow along with them.

The challenge is to ensure that our smart cities become greener while we manage the challenges imposed.

The advancements in renewable energy and EVs have already led to significant reductions in carbon emissions.

Carbon emissions are being reduced by making power on-site with renewables and other climate-friendly energy resources.

Some of the recent innovations like rooftop solar panels, solar water heating, small-scale wind generation, fuel cells powered by natural gas or renewable hydrogen are contributing positively to cope up with the issues of carbon emission.

Can you offer some insights about the new products and solutions in this regard?

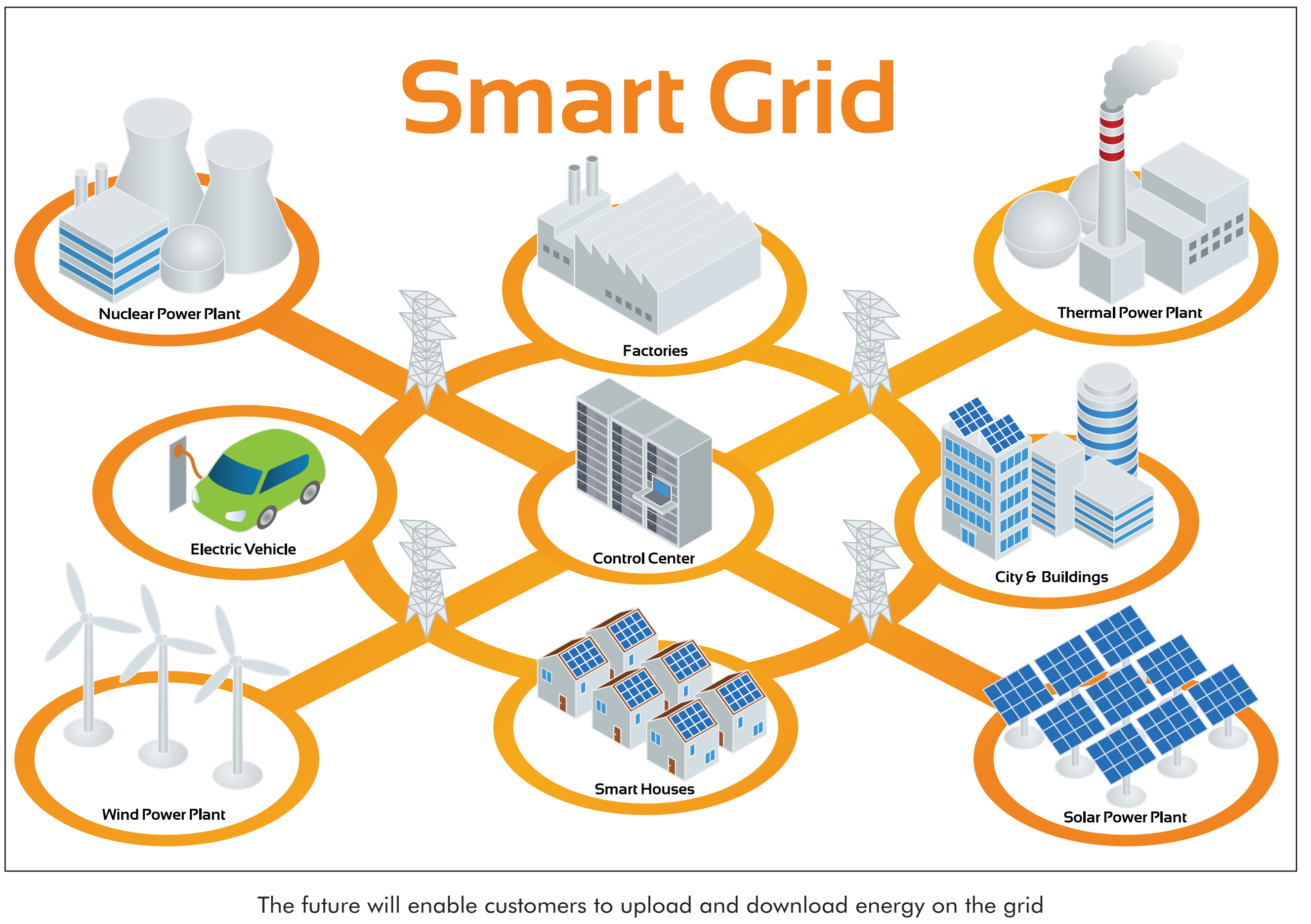
Direct air carbon capture and storage is a new technology that the world has the highest hope from, for removal of carbon dioxide from the atmosphere.

Since it would allow large amounts of CO_2 to be, in effect, trapped, this technology could play a very big role to reduce the greenhouse effect.

What is Kanoo Group's contribution in building the energy workforce of the future?

Kanoo Group is currently engaged in strategising, investing into new talent, building cooperation with various OEM's and clients to source new technologies and exchange expertise and know-how, as well as contributing to building national capacities in energy technologies.

This involves investing in renewable energy, gas fired power solutions, the Internet of Things (IoT), using artificial intelligence (AI) in energy production unit, 3D printing and additive manufacturing, etc.



The future will enable customers to upload and download energy on the grid

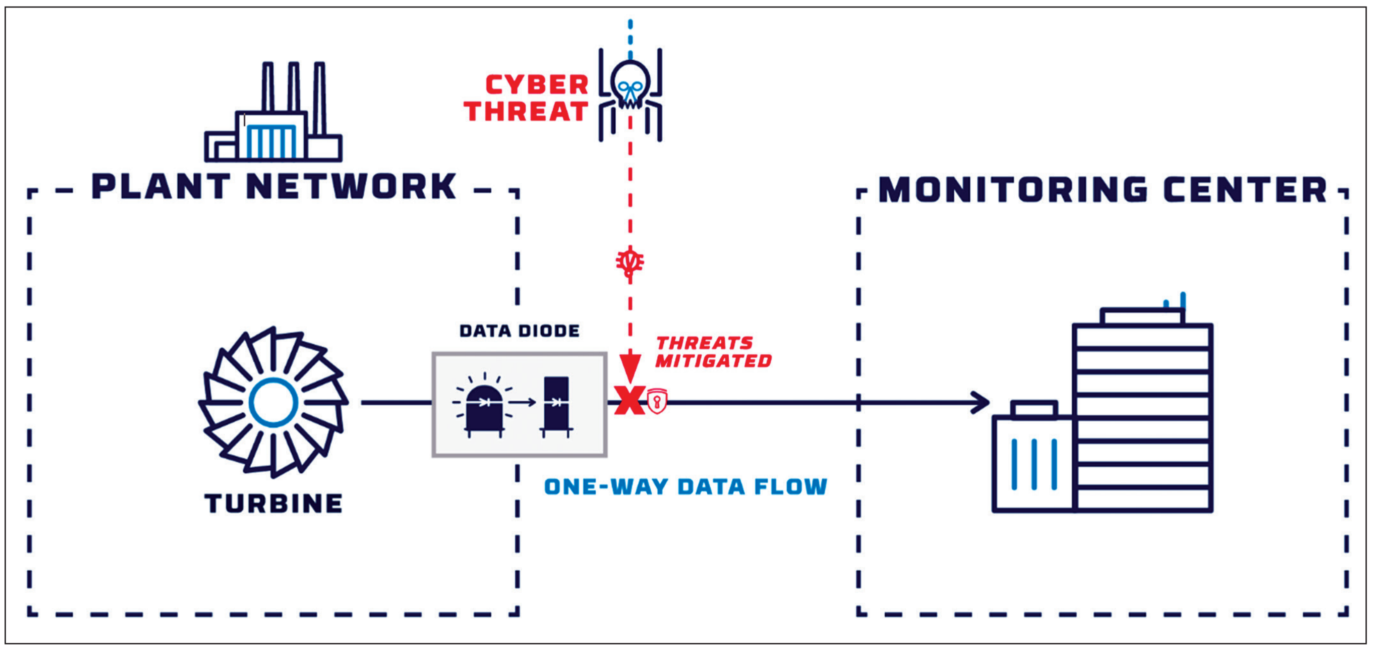
With renewable energy generation projected to grow exponentially in the coming decades, hardware-enforced cybersecurity technology can help it reach its full potential, while minimising risks to the infrastructure

New hardware tech can shield renewable energy systems

THE power industry is no stranger to cybersecurity. Given its essential role in every aspect of daily life, the industry follows strict guidelines for securing networks and devices that connect to the grid.

In fact, power generation, transmission, and distribution organisations are often years ahead of other industries in adopting new cybersecurity strategies and technologies.

But with the rapid growth of renewable energy, a new set of challenges is emerging. The unique characteristics of renewable power generation infrastructure are creating a need for low-maintenance, highly reliable security technology on an unprecedented scale.



Hardware enforced security ... a widely implemented hardware-enforced security solutions is the data diode

SECURING OPERATIONAL TECHNOLOGY

Before we look at what makes cybersecurity for renewables different, let's look at what it has in common with security for other critical infrastructure operations.

The fundamental security considerations for renewable energy are no different from those of conventional power generation, or any other critical infrastructure sector, for that matter.

The key principle is that critical infrastructure organisations need a significantly higher level of security than what might be acceptable for a retail chain or other commercial enterprise.

Operational technology (OT) networks and devices need extra protection against widespread cyber threats like ransomware because the consequences of a malware infection in an OT system are potentially severer than the consequences of the same infection in a corporate IT network.

Power outages and gas shortages, for example, disrupt life in a very different way than the loss of customer data.

OT systems also need protection against a second class of threats: hostile nations and other sophisticated groups who might launch cyberattacks directly against the devices that keep our electrical grid, fuel supply, and water systems operating.

SOFTWARE-BASED FIREWALLS: HIGH COST, LIMITED VALUE

Traditional security measures like software-based firewalls provide little protection against advanced threats. This is because firewalls run on commercial operating systems that have been studied by hackers for decades.

Threat actors have access to libraries of ready-made attack techniques that can compromise a firewall in a matter of seconds.

Organisations that depend on firewalls also have an ongoing need to keep their security software up to date, in an often useless attempt to stay ahead of new exploits and vulnerabilities.

The result is an expensive, never-ending cycle of firewall updates that provide little value in return.

AIR GAPS: NO LONGER A VIABLE OPTION

Another common approach to OT security is the air gap–a complete separation between critical OT systems and other networks. Since an air-gapped network can only be accessed by someone who is physically present at the facility, the systems within it are as safe as possible from external attack.

Air gaps create their own problems, however. Since remote access is not possible, routine tasks like updating and patching OT device software has to be done on site. This may not be an issue in a large plant with a full-time workforce, but routine maintenance becomes expensive and difficult when the systems are located at substations or other geographically remote, unstaffed facilities.

An even bigger issue is that air gaps trap important data, like device status and performance information, inside the system or network that generates it.

This has become a critical business problem for many organisations now that cloud-based analytics solutions are widely available.

Without a way to get data across an air gap and into a centralised database, organisations are unable to take advantage of the cost savings and performance enhancements that come from predictive maintenance, real-time device monitoring, and other activities that require OT-to-cloud connectivity.

DATA DIODES: HARDWARE ENFORCED SECURITY

To overcome the limitations of an air gap – without exposing critical systems to new risks – many organisations have turned to hardware-enforced security technology.

Hardware-enforced security uses electrical components that function in predetermined ways and are not vulnerable to the attack techniques commonly used to bypass (or take over) software-based security solutions.

One of the most widely implemented hardware-enforced security solutions is the data diode – a device that uses 'send only' and 'receive only' electrical components to transfer data out of an air-gapped system or facility.

Since the 'send' and 'receive' components cannot physically perform any other function, they cannot be used to send data backward into a protected network.

Unlike firewalls that depend on frequent software updates, data diodes can operate continuously for years with little to no maintenance, making them ideal for environments where taking systems offline would cause service disruptions or other unacceptable consequences.

SECURING RENEWABLE ENERGY INFRASTRUCTURE

As mentioned above, renewable power generation systems have the same fundamental cybersecurity requirements as any other critical infrastructure system: OT devices need to be isolated to protect against malware that might migrate across from IT systems, and to protect against attacks that aim to disrupt OT operations directly.

However, renewable energy operations – wind and solar power generation in particular – have attributes that create an even more compelling need for OT-to-cloud connectivity and make hardware-enforced cybersecurity even more essential.

• Geographic isolation: Conventional power generation facilities are often located near urban centres, and have dozens or even hundreds of employees on site at all times. Renewable power generation, on the other hand, tends to happen in large, widely dispersed facilities, with few (or no) full-time employees on site.

• Device counts: Renewable energy also tends to involve more individual devices than conventional power generation. A gas-fired power plant, for example, might generate 500 MW using two or three turbines. To generate the same amount of electricity, a wind farm might use 200 to 300 separate turbines.

• Natural fluctuations in output: As they depend on environmental conditions that are outside human control, renewable energy facility output cannot be predicted as precisely as conventional power generation.

Given these realities, energy companies face serious challenges in responding to maintenance needs or fluctuations in supply and demand without connecting their solar panels, wind turbines, and other OT equipment to the cloud.

And without hardware-enforced cybersecurity, organisations risk exposing their devices to a wide range of cyber threats, along with ongoing costs to keep a large number of software-based firewalls up to date.

Hardware-enforced cybersecurity technology provides the ideal solution.

With low-cost data diodes protecting each OT device, organisations can securely stream data to cloud-based services for real-time monitoring and analytics.

Not only do data diodes provide maximum protection against cyber threats, they create little to no additional expense for ongoing maintenance.

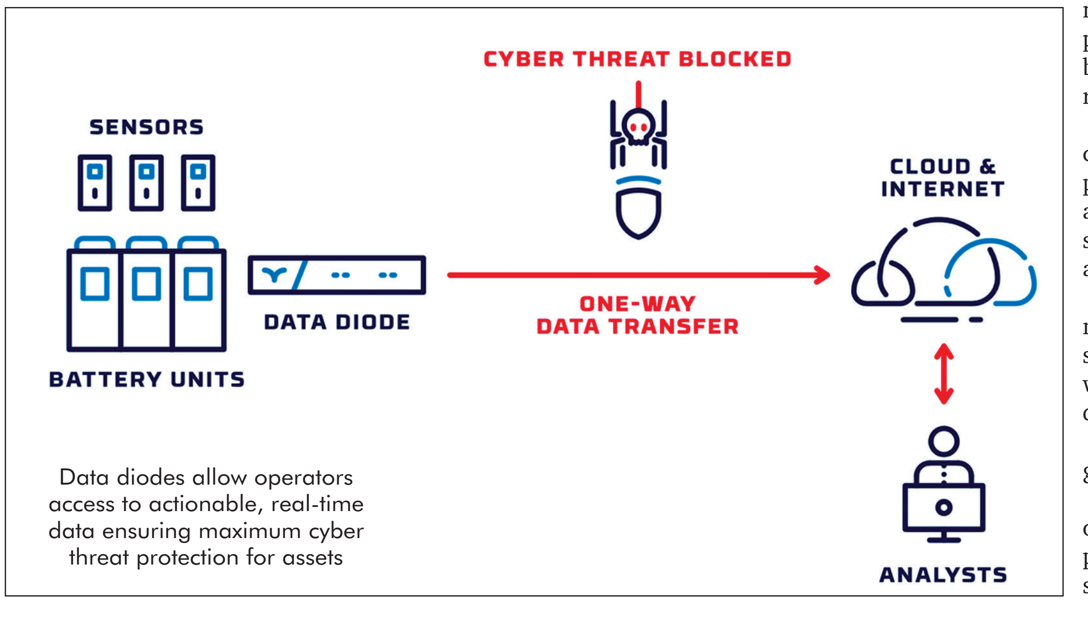
As an example, a renewable energy operator recently implemented data diodes to transfer battery status, performance, and environmental data from its battery banks to a remote cloud storage environment for research and analytics.

With this approach, the operator gained access to actionable, real-time data to enable performance optimisation and energy trading, and maintained network segmentation to ensure maximum cyber threat protection for its assets.

Similar implementations are becoming common as energy operators face the dual pressures of needing to extract essential data while avoiding threats to the systems that produce it.

Renewable energy generation is projected to grow exponentially in the coming decades.

Hardware-enforced cybersecurity technology will help renewable energy reach its full potential, while minimising risks to the infrastructure we all depend on.



Data diodes allow operators access to actionable, real-time data ensuring maximum cyber threat protection for assets

Amidst the maritime industry's challenges in adopting new technologies and practices to reduce carbon emissions and greenhouse gases, methanol as a marine fuel could be a near-term solution, Panos Koutsourakis of ABS tells *OGN*

Groundbreaking vessels brighten future of methanol as marine fuel

THE maritime industry faces challenges in adopting new technologies and operational practices to reduce emissions of carbon and other greenhouse gases.

However, a new ground-breaking series of eight large container vessels capable of being operated on carbon-neutral methanol ordered by Maersk, along with an option for a further four vessels, which are to be built to ABS Class, will mean vessels are capable of operating on carbon-neutral e-methanol or sustainable bio-methanol.

However, a new ground-breaking ABS Class eight large container vessels that can operate on carbon-neutral methanol will mean vessels are capable of operating on carbon-neutral e-methanol or sustainable bio-methanol.

The vessels, ordered by Maersk along with an option for a further four vessels, come with a dual fuel engine setup, which also enables operation on conventional low sulphur fuel.

Spearheading the development of tomorrow's fuel quality criteria, fuel supply system, and equipment specifications, are the early adopters of clean fuel technologies.

Methanol as a marine fuel is increasingly becoming a viable contributor in shipping's drive for a clean, sustainable fuel mix, and is providing the experience necessary for the development of stronger marine fuel standards on the seaward journey to decarbonisation.

Using methanol produced from natural gas offers a proven reduction of NOx and SOx emissions, and by producing methanol from renewable sources, shipping can substantially reduce its GHG emissions.

As with other new fuels entering the market, the concerns of shipowners and other stakeholders are focused on safety, fuel availability and meeting future GHG requirements.

One of the main challenges to owners during this fuel transition is to decide on an alternative fuel or fuels to prepare for 2050.

In November 2020, the Maritime Safety Committee of the International Maritime Organisation (IMO) adopted interim guidelines on the use of methanol as a marine fuel, making ethyl and methyl alcohols options for shipowners and operators. Twelve methanol powered ships are already in operation, with another 10 on order.

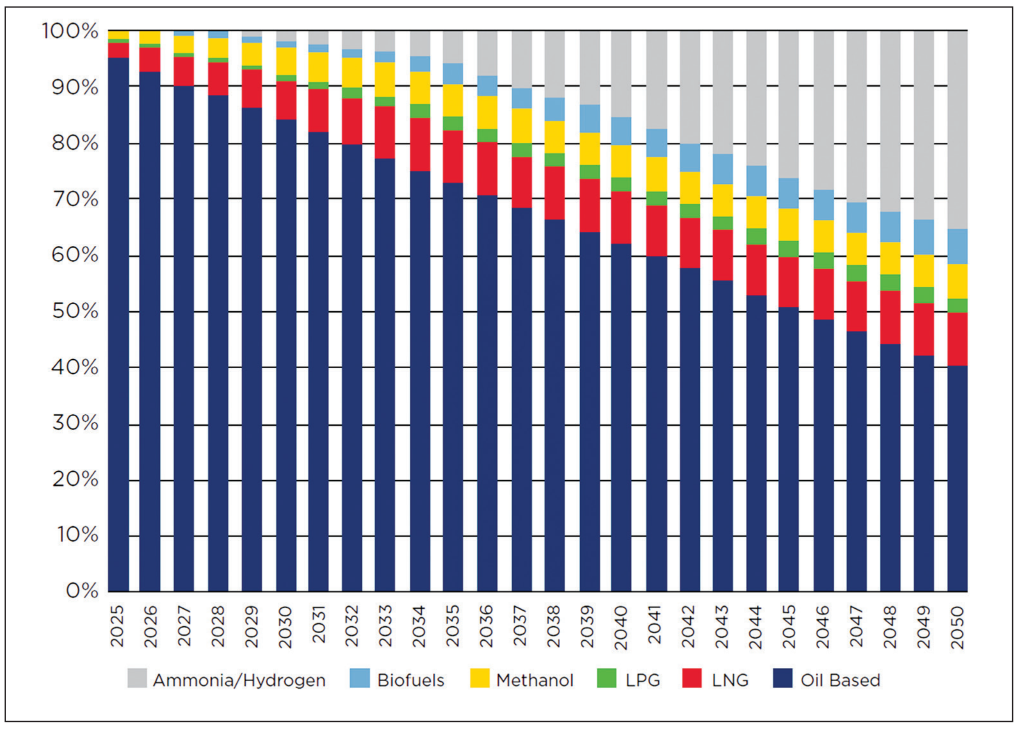
Early adoption of any new fuel depends on the demand and the supply landscape. In the case of methanol, even though its trade is evolved globally with more than 70 million tonnes produced annually, its use across many applications and industry sectors may restrict the actual volume needed for the shipping industry unless incentives are introduced.

This could mean methanol being produced synthetically, which could incur extra costs.

Methanol has the advantage of a liquid state and ability to repurpose existing infrastructure to include engines and vessels with efficient retrofits. Onboard containment of methanol is easier than LNG; the liquid fuel has a lower volumetric density than LNG, necessitating comparatively larger containment tanks.

As the main feedstock in methanol production is natural gas, methanol could be made 100 per cent renewable, as it can be produced from a variety of renewable sources such as biomass or electrolysis powered by renewable energy and supported with carbon capture technology.

This makes it a strong candidate fuel for a sustainable future in which shipping is powered by 100 per cent renewable fuels.



Projected fuel use by 2050 (Source: ABS)

FUEL PROPERTIES

Methanol is a colourless liquid at ambient temperature and pressure with a characteristic pungent odour. It is easier to store and handle than liquefied natural gas (LNG), ammonia and hydrogen fuels.

Methanol has the highest hydrogen-to-carbon ratio of any liquid fuel, a relationship that potentially lowers the CO_2 emissions from combustion when compared to conventional fuel oils.

When used as the primary fuel, methanol can reduce CO_2 emissions by around 10 per cent.

However, methanol has the potential to be a carbon-neutral fuel in the future if it is produced renewably through biomass/biogas or renewable electricity.

Methanol's specific energy of 19,700 kJ/kg is much lower than that of LNG and conventional liquid fuels.

For the same energy content, methanol requires about 2.54 times more storage volume than conventional fuels.

When comparing methanol to LNG, an overall decrease in the effective volumetric density of LNG is to be accounted for due to packaging factors for cylindrical tanks, insulation and filling factors, boil-off gas, and custody transfer losses.

METHANOL PROPERTY	VALUE
Energy density (MJ/L)	15.7
Heat of vaporization (kJ/kg)	1098
Autoignition temperature (°C)	450
Liquid density (kg/m3)	798
Adiabatic flame temperature at 1 bar (°C)	1980
Molecular weight (g/mol)	32.04
Melting point (°C)	-97.8
Boiling point at 1 bar (°C)	65
Critical temperature (°C)	239.4
Critical pressure (bar)	80.48
Flammable range in dry air (%)	6 - 36.5
Cetane number	< 5
Octane number	109
Flash point (°C)	12
Heavy Fuel Oil (HFO) equivalent volume	2.54

Methanol properties (Source: ABS)

If spilled or leaked into the environment, methanol has significantly less impact than conventional hydrocarbon fuels.

It dissolves readily in water, and only very high concentrations in the environment create lethal conditions or any changing effect on the local marine life.

This means that a methanol spill would result in limited damage to the environment except for the release of carbon into the marine ecosystem.

Methanol in the ocean is common, produced naturally by phytoplankton, and is readily consumed by bacteria microbes, thus entering and supporting the food chain.

REGULATORY APPROVAL

The general safety principles of the IMO's IGF and IGC Codes provide the framework for the use of low-flashpoint marine fuels such as methanol.

Common safety principles such as fuel tank protective location, double barriers on fuel supply lines, ventilation and gas detection, hazardous area classification, and explosion mitigation are equally applicable to all low-flashpoint fuels.

However, the specific fuel characteristics may require specific safety features.

For methanol, any fuel leaks produce heavier-than-air vapours requiring additional detectors that are necessary as the fuel is toxic if ingested or inhaled – fuel characteristics which would be considered during the risk assessment analyses.

The adoption in November 2020 of IMO Interim Guidelines for the Safety of Ships Using Methyl/Ethyl Alcohol as Fuel, covers considerations for ship design and arrangement, as well as fuel containment system, materials, pipe design, bunkering, fuel supply, power generation, fire safety, explosion prevention, hazard area classification, ventilation, electrical installations, control systems, crew training and operations.

The fuel itself does not have cryogenic complexity and it is a liquid at ambient conditions, making it simpler to handle and closer in operation to conventional bunker vessels.

VESSEL APPLICATIONS

The adoption of low carbon and net carbon-neutral fuels for large vessels is more challenging than for smaller ones.

Using fuels with low energy content, such as methanol, would require a significant redesign, not least because their fuel tanks would need to be expanded to store enough energy for longer deep-sea travel.

However, methanol is more suited to storage in near conventional fuel tanks, which can be easier to accommodate in ship designs than other low-flashpoint fuels, and under MSC.1/Circ.1621 5.2.1 can also be bound by a vessel's shell plating when stored below the lowest possible waterline.

The trade and regulatory landscape of short-sea vessels make them ideal candidates for early adoption of new technologies such as methanol.

Fuels such as methanol have strong potential to lower the carbon footprint of shipping, but one of methanol's challenges is its low energy content, and the comparatively lower amount of energy it can store in the tanks of a ship.

That said, compared against other alternate fuels, methanol is relatively efficient at energy storage by volume based on physical tank space.

Consequently, short-sea shipping can accommodate the use of fuels with low energy content – such as methanol – that require more frequent bunkering.

NEAR TERM POTENTIAL

The benefits of reduced emissions from burning methanol could be a significant contributor to reducing greenhouse gas emissions from the maritime industry.

Existing methanol trade infrastructure can also be an important factor for the cost and availability of methanol over other alternative fueling options.

Using methanol as a fuel in methanol carriers for propulsion and power generation, along with the development of efficient and feasible dedicated propulsion systems, has already seen an increase in new build cargo vessels powered by methanol.

If methanol is produced renewably, these tankers could have an even greater potential to reduce lifecycle emissions while concurrently improving the renewable methanol fuel supply chain for other applications.

The advantage of methanol over other gas fuels is its liquid state and ability to re-purpose existing infrastructure to include engines and vessels with efficient retrofits.

Retrofitting a vessel's tanks from conventional fuel oil, ballast, or slop to hold liquid methanol fuel is easier than installing LNG tanks.

Also, methanol is significantly easier and more economical to store on board than gas.

One of the challenges of methanol as an alternative fuel is the lower energy content when compared to conventional fuel oils.

However, as methanol is a liquid at ambient temperature and pressure, tanks can be converted with minor retrofitting to hold larger volumes of methanol that may be needed for an equivalent amount of energy.

Further methanol applications in marine fuel may only require a scale-up of existing trade, storage, and generation activities, while bunkering facilities and fuel supply systems are to be developed and scaled-up.

Putting nuclear at the heart of low-carbon power generation

Amidst a drive to decarbonise the electricity sector, nuclear power is more relevant than ever, and small modular reactors can make construction of nuclear power plants more affordable, Professor Michael Fitzpatrick tells *OGN*

NUCLEAR power has been a part of the global electricity generation for over 60 years.

Countries that invested heavily in nuclear power programmes have benefited greatly from low-carbon electricity generation, displacing fossil fuels long before renewable energy generation technologies reached their current levels of maturity, and providing a stable low-carbon base-load capability that mitigates the intermittent nature of solar and wind generation.

With the current emphasis on removing all reliance on fossil fuels, nuclear power has seen a resurgence of interest around the world. One of the main barriers to widespread uptake of nuclear power has been the high capital cost of building a nuclear power plant.

Hinkley Point C, currently under construction in the UK, is estimated to cost around £23 billion ($31 billion). However, the plant, when complete, will generate a very significant amount of electricity: over 3,000 MW of power, which is equivalent to perhaps 1,000 onshore wind turbines.

With a projected lifetime of 60 years, the upfront cost is more than offset by the electricity produced.

The costs are so high because a nuclear power plant is a highly complex piece of engineering.

The plant requires a stable base – the 'nuclear island' – of reinforced concrete. The pressure vessel that forms the core of the plant is a very large steel cylinder that will maintain its properties for the decades of operation.

The first reactor unit at the Hinkley Point C power station

There is a complex system of piping and heat exchangers to extract the heat from the core and deliver steam to power the turbines that produce the electricity.

The current interest in small modular reactors (SMRs) is driven by a desire to make individual nuclear power plants more affordable, so that less money is needed to be spent before electricity is delivered to the grid.

In the UK, the SMR design proposed by Rolls-Royce will deliver 470 MW of power: less than the output of Hinkley Point C, but for an estimated one-tenth of the cost.

Because the plant is smaller, construction is faster, and the area occupied by the plant is less too: the equivalent of a couple of football pitches.

The UK has several sites that were used for the first generation of nuclear reactors that are highly attractive for siting SMRs.

Rolls-Royce is hopeful that the first plant can begin operating by 2031, once the design has obtained regulatory approval.

Building more smaller plants has the additional advantage of developing a robust supply chain in the construction industry to support a continuing programme of new nuclear builds. Rolls-Royce envisages a production-line-style approach for the reactor vessels that will help in reducing costs as more plants are ordered.

** Professor Michael Fitzpatrick is Coventry University's Pro-Vice-Chancellor for Engineering, Environment and Computing, and an expert in the field of nuclear energy.*

For full report, visit www.ognnews.com

Mapping global CO2 emissions

FOSSIL fuels (coal, oil, gas) have, and continue to, play a dominant role in global energy systems. But they also come with several negative impacts.

When burned they produce CO2 (carbon dioxide) and are the largest driver of global climate change. They are also a major contributor to local air pollution, which is presumed to be linked to millions of premature deaths each year, data from Our World in Data shows.

In 2019, around 84 per cent of global primary energy came from coal, oil and gas.

• Coal has been a critical energy sources, and mainstay in global energy production for centuries.

It is still a dominant source of energy across the world today, especially within our electricity mix.

But coal is the world's dirtiest fuel – it not only emits the most carbon dioxide emissions per unit of energy, it has severe impacts on health through air pollution.

Many countries are, therefore, committing to phasing coal power out of their electricity mix.

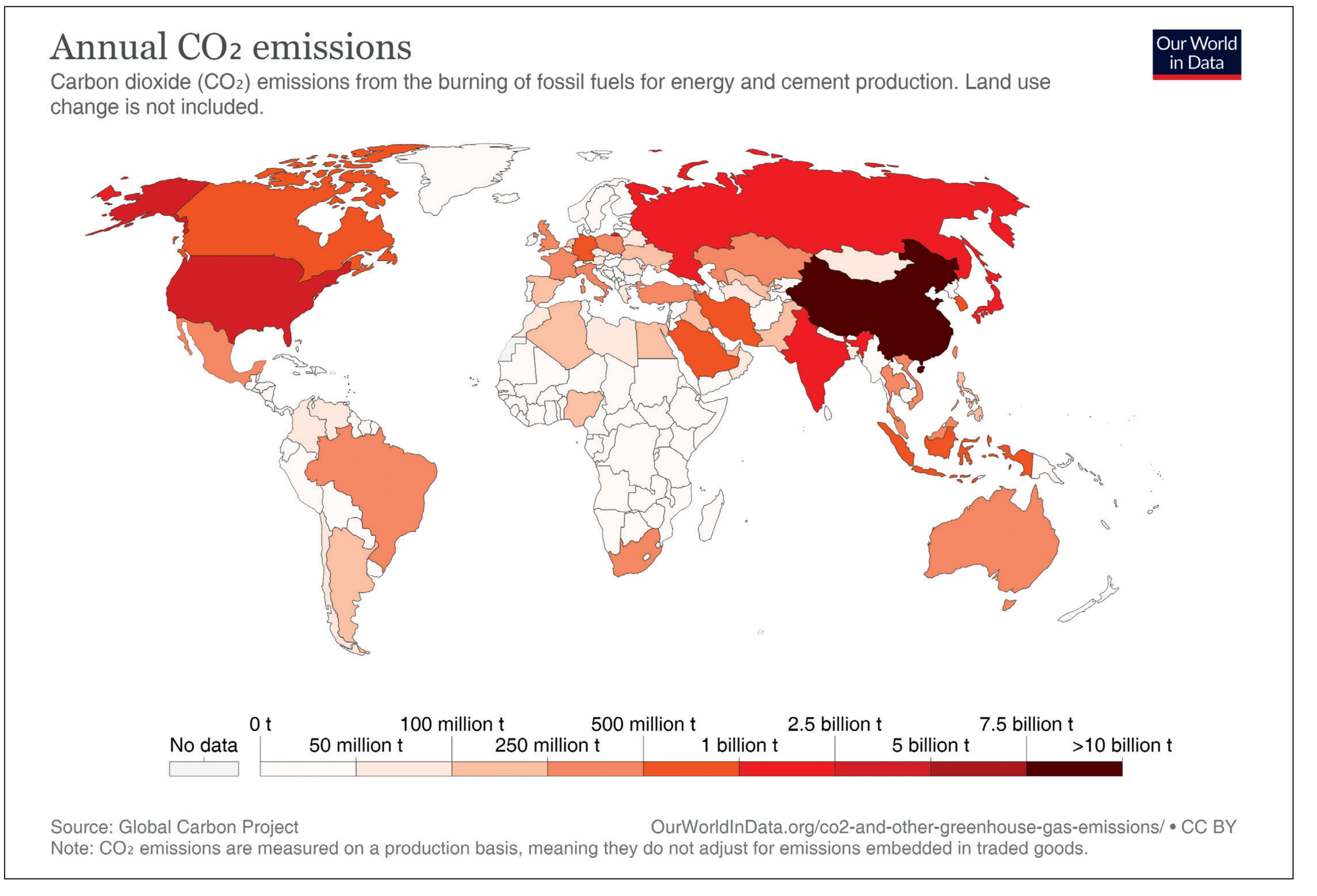
• Oil is the world's largest energy source today. It is the dominant source of energy for the transport sector in particular.

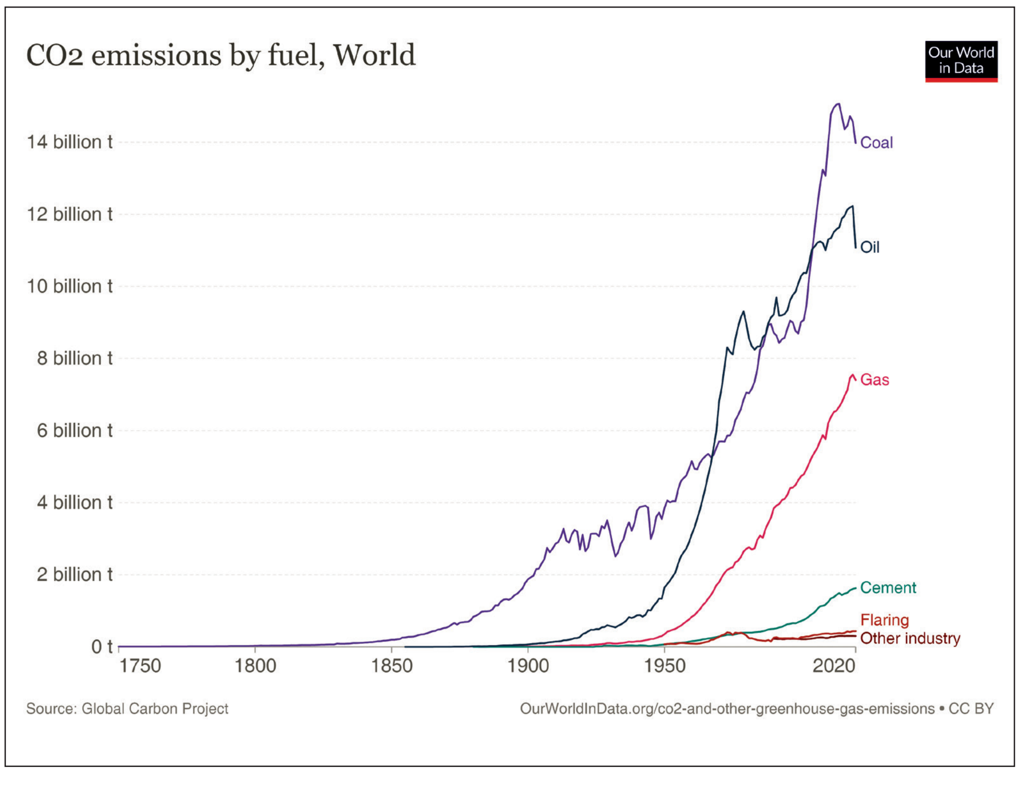
• Natural gas has, for decades, lagged behind coal and oil as an energy source. But its consumption is growing rapidly, often as a replacement for coal in the energy mix.

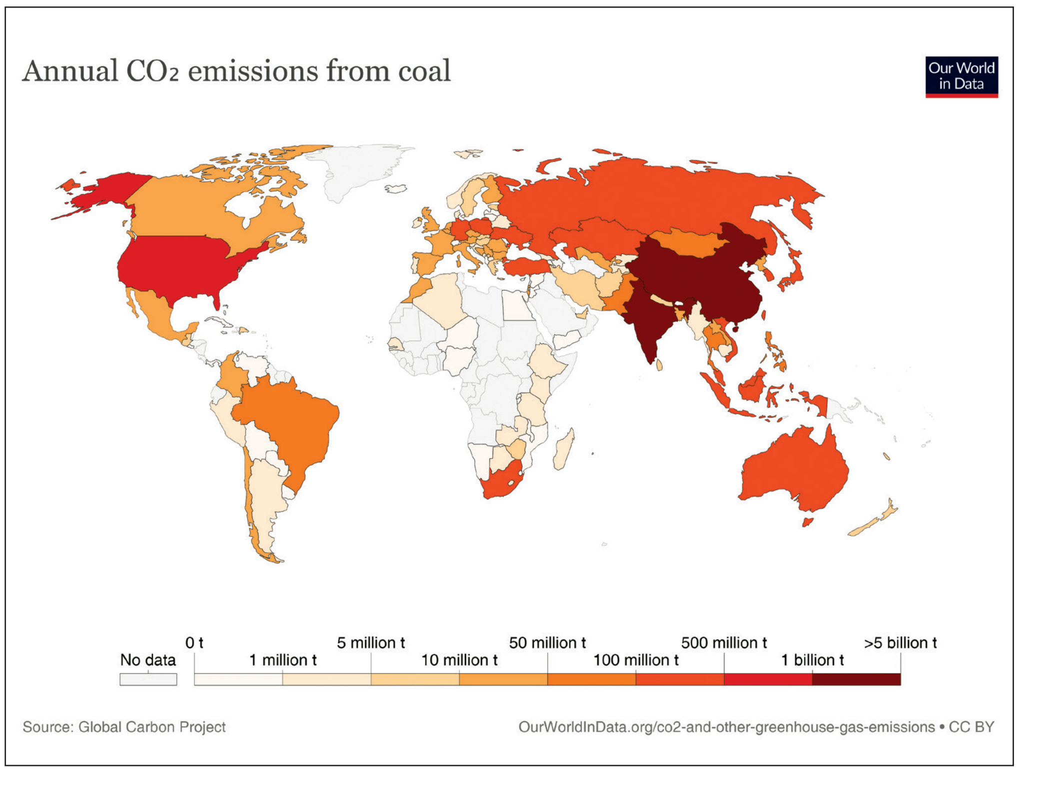
Gas is now the second largest source of electricity production globally. It is now the second largest source of electricity production globally.

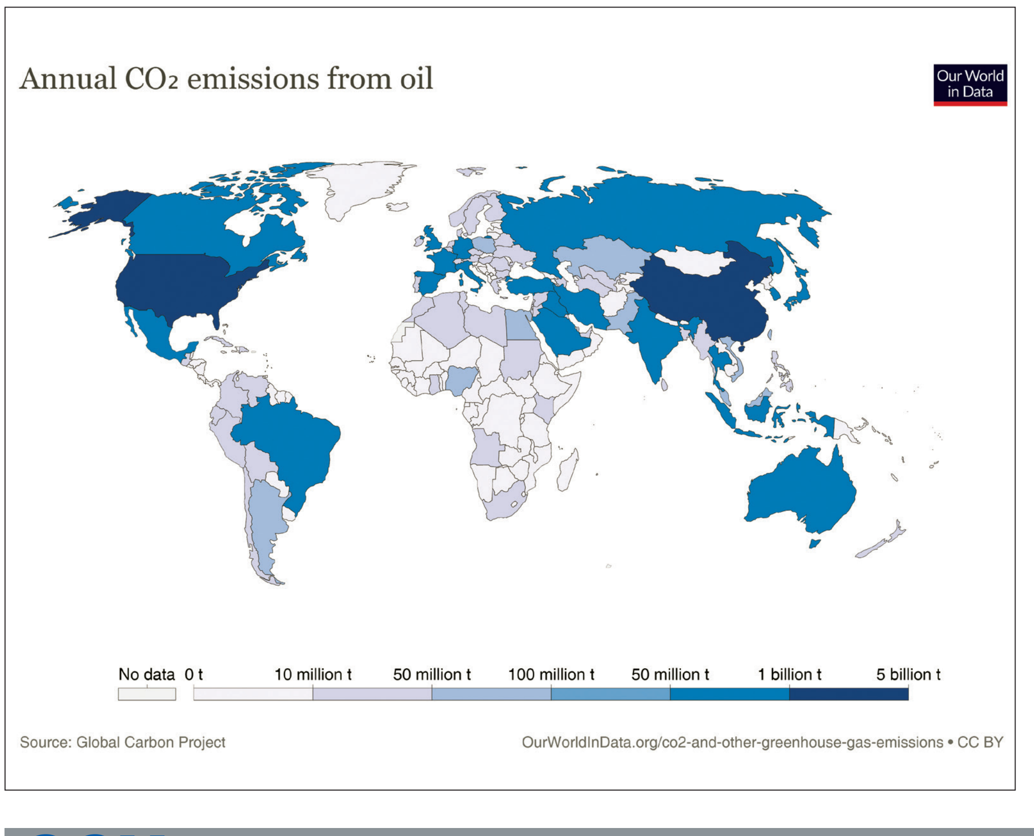
As low-carbon sources of energy – nuclear and renewables – become readily available, the world needs to rapidly transition away from fossil fuels.

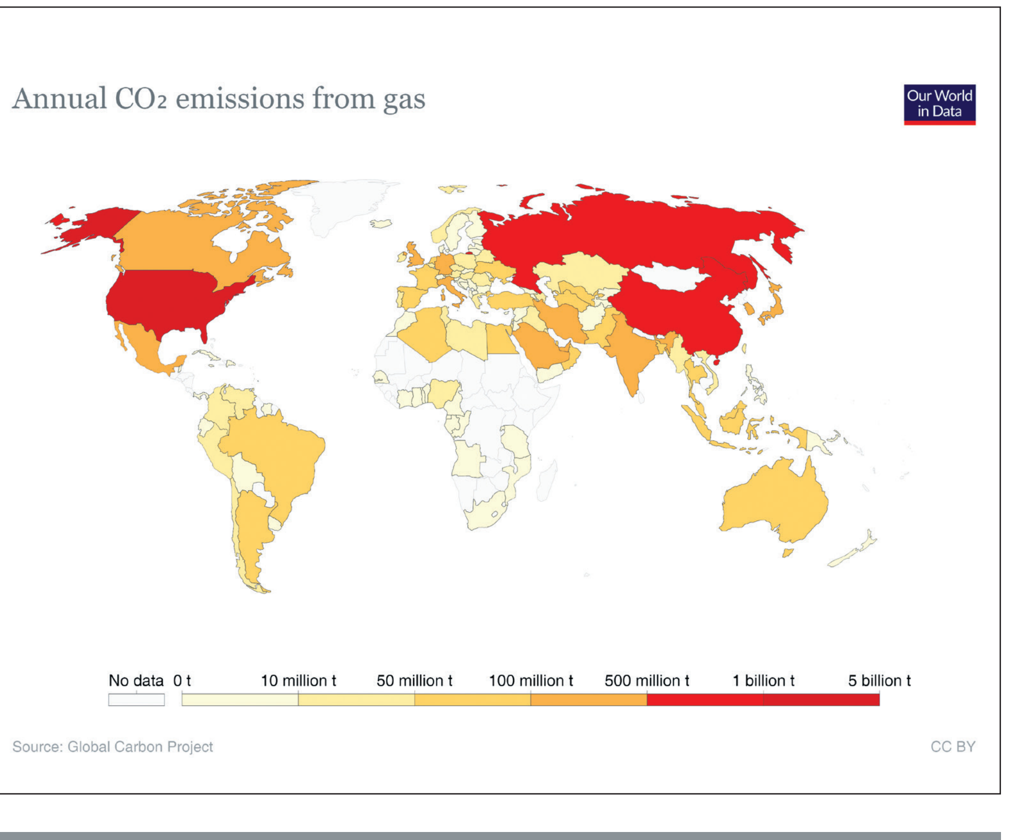
Moving away from coal energy is important for climate change as well as human health.











RO plants can be powered as stand-alone facilities and can produce carbon neutral water if run on renewable power thus overcoming thermal plant challenges, Jong Myong Hong, VP, Engineering Technical Services, Engie, tells *OGN*

Helping desalination plants in Mideast cut carbon footprint

DESALINATION is a separation process that is used to reduce the dissolved salt content of saline water to a usable level.

Desalination can be done either through a distillation process (which is akin to boiling water and collecting the steam through evaporation) or by a reverse osmosis (RO) process, which is done using a spiral wound polyamide membrane.

In the UAE, 83 per cent of desalinated water is produced at thermal plants.

The thermal desalination plant is usually coupled with the thermal power as a cogeneration plant to enhance the overall fuel efficiency by using the low-pressure steam left after producing power in desalination once more.

The challenge with thermal plants lies in the seasonality of the power and water demands; in summer both are near 100 per cent, but in winter water demand is around 80-90 per cent while power demand is lower than 50 per cent.

Hong ... rethinking RO plants

If the power demand is low while water demand is high, auxiliary boilers need to be operated to supply the steam to the thermal desalination which is inefficient.

Until the beginning of the 21st century, RO was considered an unreliable technology, where thermal desalination was the technology of choice due to its proven reliability in harsh and challenging seawater conditions.

Following improvement in the pre-treatment technologies and the membrane performances, the first successful utility scale RO desalination plant was built in Fujairah, UAE, in the early 2000s.

When the size of the power and water system in a country is relatively small, the cogeneration can provide the power and water economically.

However, as the size of the power and water system becomes bigger, the mismatch in demands widened and resulting inefficiencies require 'decoupling' between power and water.

RO desalination gained attention as it can run by electricity only as a stand-alone plant.

Moreover, the advent of low energy RO membranes and isobaric work exchangers halved the energy consumption of RO desalination.

Also in recent years, as countries in the region have been working on reducing their carbon footprint, RO desalination has gradually become the technology of choice in almost all new capacity additions.

The carbon emissions for RO desalination plants depend on the energy mix of the power grid, but it is generally much lower than with thermal desalination.

Many of ENGIE's RO plants are equipped with a solar PV plant within the asset that provides the electricity needed to run the plant.

Examples include two assets in Saudi Arabia currently under construction: the Jubail 3B IWP (570,000 cu m/day of seawater desalination plant) that has a 61-MWp capacity solar facility to help optimise electricity consumption and reduce grid reliance; and the Yanbu-4 IWP (450,000 cu m/day seawater desalination plant) that includes around 10 MWp of solar energy units to reduce grid electricity consumption throughout the desalination process.

Globally, solar PV electricity generation is expected to increase by 145 TWh to approach 1,000 TWh in 2021. This increase should push the share of renewables in the electricity generation mix to an all-time high of 30 per cent

Undisputed leader: China owns 35pc global solar capacity

THE world is in a promising race to install renewable energy facilities, as countries make an attempt to live up to their pledges of decarbonisation.

Last year, many countries added solar to their power mix. A record estimated 139 gigawatts (GW) was installed in 2020 worldwide, said a report by the International Renewable Energy Agency (IEA).

This brought the global total to an estimated 760 GW, including both on-grid and off-grid capacity.

According to the International Energy Agency (IEA), renewable energy use increased 3 per cent in 2020 as demand for all other fuels declined. The primary driver was an almost 7 per cent growth in electricity generation from renewable sources.

Renewable electricity generation in 2021 is set to expand by more than 8 per cent to reach 8,300 TWh, the fastest year-on-year growth since the 1970s.

Solar photovoltaic (PV) and wind are set to contribute two-thirds of renewables growth. China alone should account for almost half of the global increase in renewable electricity in 2021, followed by the United States, the European Union and India.

Currently, China has a substantial lead, housing over 35 per cent of the global capacity. It has 254,355 MW of installed capacity, with an additional 400,000 MW in the pipeline from the China Desert Project, which is underway in western China. One completed, this will be the world's largest wind and solar project.

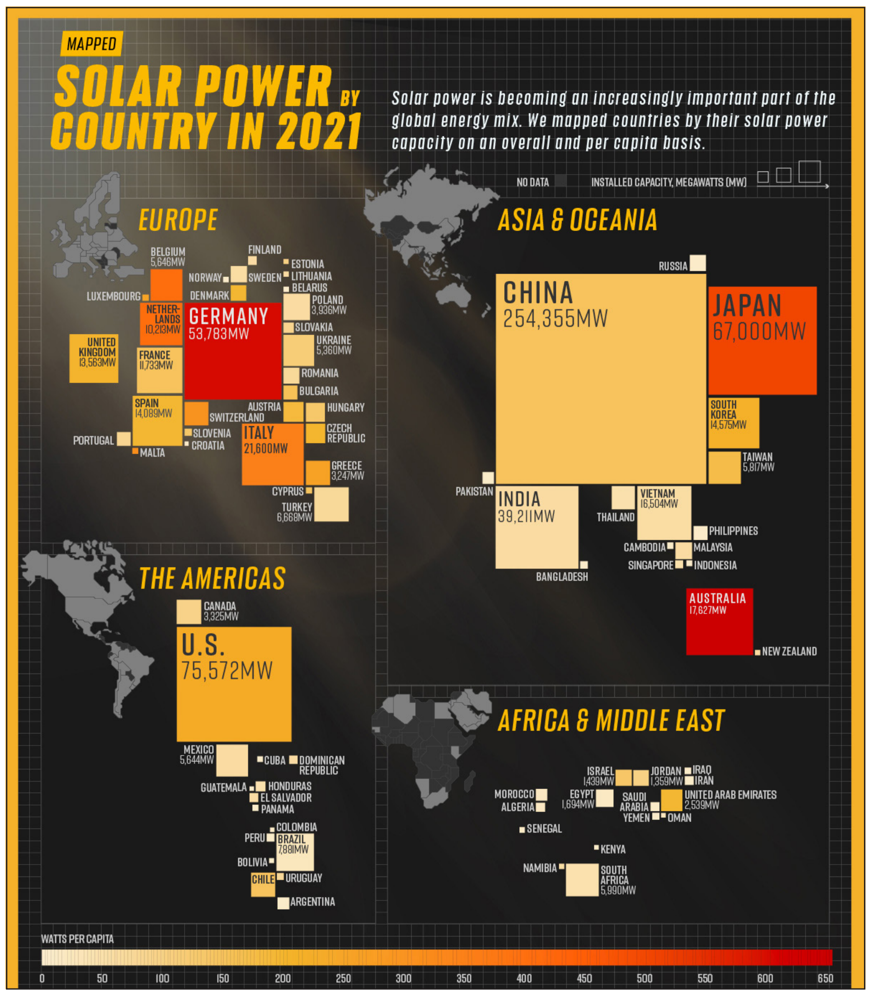
A distant second is the US with over 75,000 MW of installed capacity until last year. In early 2021, it added another 50,000 MW.

While China will remain the largest PV market, expansion will continue in the US with ongoing policy support at the federal and state level.

Having experienced a significant decline in new solar PV capacity additions in 2020 as a result of Covid-related delays, India's PV market is expected to recover rapidly in 2021, while increases in generation in Brazil and Vietnam are driven by strong policy supports for distributed solar PV applications.

Globally, solar PV electricity generation is expected to increase by 145 TWh, almost 18 per cent, to approach 1,000 TWh in 2021.

Increases in electricity generation from all renewable sources should push the share of renewables in the electricity generation mix to an all-time high of 30 per cent in 2021.



This infographic maps solar power capacity by country in 2021, including solar PV and concentrated solar power (CSP) capacity (Source: VC Elements)

EGA working with GE to switch gas turbines to hydrogen, CCUS

EMIRATES Global Aluminium has partnered with GE Gas Power to explore hydrogen as a fuel and carbon capture, utilisation, and storage (CCUS) solutions.

A roadmap will be developed to reduce greenhouse gas emissions from the operation of EGA's existing GE natural gas turbines.

A memorandum of understanding was signed by Abdulnasser Bin Kalban, CEO of EGA, and Joseph Anis, President and CEO of GE Gas Power Europe, Middle East, and Africa.

It is in line with the ambitions of the UAE government's Hydrogen Leadership Roadmap, unveiled earlier this month in Glasgow during COP26.

The roadmap will include development of a strategy to support low-carbon industries to contribute towards the achievement of the UAE's Net Zero by 2050 Strategic Initiative.

EGA has 33 GE natural gas turbines at Jebel Ali and Al Taweelah, with a total power generation capacity of 5,200 megawatts (MW). Electricity generation accounts for a significant proportion of EGA's total greenhouse gas emissions.

The MoU is the first GE Gas Power has entered globally to help explore potential solutions to lower the carbon footprint of power generation operations in the aluminium sector.

EGA and GE intend to set up a joint steering committee to create and drive the decarbonisation roadmap forward.

Commenting on the MOU, Kalban said: "Aluminium has an important role to play in the development of a more sustainable society, and it also matters how sustainably aluminium is made. Aluminium smelting is energy intensive, and generating the electricity required accounts for more than half the global aluminium industry's greenhouse gas emissions. This work with GE will enable us to determine how we can reduce the carbon intensity of our power generation over the years ahead including by switching to hydrogen, and is an important step in our journey to ensure EGA's aluminium can play its full part in helping the world tackle the generational challenge of climate change. It will also contribute to the achievement of the UAE's Hydrogen Leadership Roadmap."

The decarbonisation roadmap will include:

- Hydrogen: Explore options for replacing natural gas with hydrogen and hydrogen-blended fuels for combustion in EGA's GE turbines.
- CCUS: Explore the potential to integrate this technology into EGA's power plants and implement the necessary changes required to the auxiliary and balance of plant systems.

Achieving sustainable operations in capital-intensive industries

Digital technologies will take centrestage on the path to net-zero. However, attaining a balance between sustainability and business objectives is a considerable challenge, Antonio Pietri, President and CEO, Aspen Technology, tells *OGN*

IN recent months, firstly at COP26 in Glasgow and then at Adipec in Abu Dhabi, capital intensive industries reiterated calls to increase efforts to improve sustainability and reach carbon-zero targets.

In the run up to 2030, with the culmination of the EU's climate target plan, this upcoming deadline is just one of many drivers coming together to act as a catalyst for change and increasing the urgent need for technology that enables sustainability and environmentally-efficient operations.

An additional thrust is a soaring demand for energy as we emerge from the impacts of the pandemic, also underscoring the need for more sustainable solutions.

And, while over the years investors have differentiated their portfolios by offering ESG-conscious funds, these funds now represent a growing proportion of the investment funds in the marketplace – accounting for $51B of new money from investors in 2020. That ability to access finance is pressuring companies further to embrace ESG to implement and meet sustainability targets.

An increasing number of oil and gas companies are seen adopting net zero carbon emission targets. Chemical companies are establishing thermal emission targets and are additionally making commitments around plastic waste, an initiative rapidly becoming a priority for governments and regulators.

Simultaneously, employees and customers expect organisations across these industries to run clean and efficient businesses.

The latest generation of workers and customers are demanding greater accountability around sustainability.

Organisations know that if they want to protect their brand reputation and attract and engage workers, they must build cleaner, safer and greener businesses.

The result of all these combined factors is that companies in capital-intensive industries are facing a dual challenge – meeting the growing demand for resources and higher standards of living from a growing population while also addressing sustainability goals. And to succeed they will require new levels of operational excellence.

ARC Advisory Group's recent report, 'The Sustainability Future for Energy and Chemicals' revealed that 90 per cent of global energy and chemical companies have sustainability initiatives in place.

And while definitive action may still be needed, at least, by some of these businesses, but for all of them sustainability either is, or can be, a driver of digital transformation.

DIGITAL SOLUTIONS KEY ENABLER FOR SUSTAINABILITY GOALS

Whereas in the past, investment in digital was often justified based on its potential to deliver enhanced profitability, today, this kind of funding is just as commonly signed off based on its ability to deliver a reduction in CO_2 emissions. It hits the bottom line, just from a different angle.

Digitalisation is a crucial enabler for companies to meet both business and sustainability objectives.

In the ARC survey, 75 per cent of respondents said they believed digital transformation was either extremely important or very important for achieving sustainability goals.

The International Energy Agency (IEA) found that digital solutions can help boost energy efficiency as much as 30 per cent for industrial operations.

In Europe, the Technology Platform for Sustainable Chemistry has highlighted digitalisation as a key tool to meet sustainability objectives in the chemicals sector.

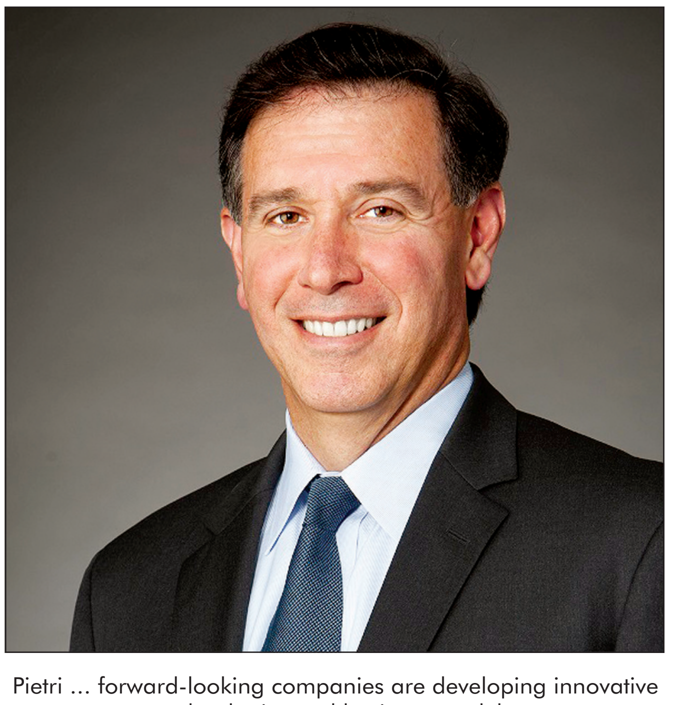
The new generation of digital solutions deployed across the capital-intensive industries provides the visibility, analysis and insight required to address the challenges inherent in the achievement of sustainability targets.

Success begins by harnessing the vast volumes of data available from operations – leveraging new technologies, like artificial intelligence (AI) – to control operations and empower operators to make the decisions that will help attain their core objectives of customer satisfaction, sustainability, and profit.

To achieve energy efficiency, operators must focus on cutting the environmental footprint from resources consumed by their own business activities.

That might encompass everything from reducing the use of non-renewable resources, like water for feedstocks or energy generation, through to cutting down their carbon footprint, or lessening environmental emissions generated by business operations.

Digital technologies can help reduce environmental impact



Pietri ... forward-looking companies are developing innovative technologies and business models

Many digital solutions have concentrated on efficiency gains for production processes, and technology projects frequently target reductions in energy use, yield improvement and lower emissions. Critically too, many solutions make it possible to track progress on sustainability goals.

For example, the latest process simulation technology monitors and optimises CO_2 and other pollutant emissions; while the same tools, combined with other technologies like enterprise visualisation tools and planning solutions, provides the basis for emissions reporting for chemical plants, refineries, and other energy assets.

PUTTING TECHNOLOGY IN PLACE

Integrated technological solutions can form the core of strategic sustainability initiatives.

Sophisticated models and workflows enable companies to do everything from cutting water and energy usage to reducing or avoiding emissions.

Indeed, the use of AI will be instrumental in driving energy efficiency and achieving sustainable operations across the capital-intensive industries.

Embedding AI in process models, for instance, helps companies develop more efficient production options that utilise less energy and resources.

REDUCING ENVIRONMENTAL IMPACT

Digital solutions can also provide guidance on environmental impact throughout project planning and operating processes, and even give insight into maintenance activities to help avoid equipment breakdowns – and the emissions and dangerous conditions that come with them.

Digital technologies can also be used to reduce environmental impact when processes do not run as planned, by providing insight and avoidance measures.

AI gives companies advance warning of potential breakdowns, so they can avoid dangerous conditions, and minimise maintenance costs. For complex processes, multivariate analytics can identify those process variables that are critical to reduce off-spec production and lower waste.

DRIVING EFFICIENCY & INNOVATION

The desire to make significant strides toward sustainability targets is also driving many companies to fundamentally change their energy sources and shift product portfolios.

This transition is taking time and requires substantial investment in new technologies. However, the potential payoff is significant.

Digital technologies are enabling companies to more quickly develop solutions to solve the challenges of the circular economy, where materials are re-used after initial application so fewer resources are used overall.

The solutions focus primarily on emissions associated with energy use, such as CO2 and NOx, in addition to a move toward the use of alternative energy sources.

MARCH TOWARDS DECARBONISATION

We are seeing a growing focus across the industry towards 'decarbonisation', or the reduction of the carbon footprint of a process or energy source.

These efforts target a reduction in carbon emissions associated with a process, for instance, using a lower-carbon fuel like natural gas instead of coal, or substituting wind or solar energy or renewable biomass for a fossil fuel.

Digital solutions aid these efforts by modelling and comparing alternative processes for various metrics, such as cost, emissions of CO_2 and other greenhouse gases for the energy delivery.

McKinsey's research on Europe's net-zero pathway suggests that this type of mature climate technologies could deliver as much as 60 per cent of the emissions abatement needed to stabilise the climate by 2050.

There are many strategic and technological challenges to be overcome before this becomes a reality.

Many forward-looking companies have already begun this process, investing to build new capabilities, and developing innovative technologies and business models to achieve new targets.

Achieving the fragile balance of sustainability goals equally considering people, planet and profit is a considerable challenge, but one that must be addressed to be competitive in the capital-intensive markets of tomorrow.

Digital technologies will take centre stage during this transition, enabling the capabilities that will separate the winners from the losers.

CCS is an essential tool in the fight against climate change

The global CCS industry must grow exponentially by 2050 to achieve the Paris Agreement targets. This means building 70-100 facilities a year at a total investment between $655 billion and $1,280 billion, says a report by Global CCS Institute

THE carbon capture and storage project pipeline is growing more robustly than ever. From 75 million tonnes a year (Mtpa) at the end of 2020, the capacity of projects in development grew to 111 Mtpa in September 2021 – a 48 per cent increase.

A recent report, 'The Global Status of CCS: 2021', by Global CCS Institute, says the CCS project pipeline mirrors climate ambition, growing steadily since the 2015 Paris Agreement.

Civil society's calls for governments and the private sector to align their policies and practices with climate stabilisation have grown in number and volume, especially since the Intergovernmental Panel on Climate Change's (IPCC's) special report in 2018.

Four pathways show how global anthropogenic emissions must change through this century to achieve a 1.5 deg C climate outcome. All require a rapid decrease in emissions to net zero by 2060.

The IPCC also estimated that 5-10 gigatonnes (Gt) of carbon dioxide (CO_2) must be removed from the atmosphere each year in the second half of this century to:

• Offset residual emissions that are very difficult to avoid, such as those from agriculture and air travel.

• Reduce the total load of greenhouse gases in the atmosphere to below the carbon budget for 1.5 deg C of global warming.

The International Energy Agency (IEA) reports that, by late April 2021, 44 countries and the EU had announced net zero emissions targets. These commitments cover approximately 70 per cent of global CO_2 emissions.

The Climate Ambition Alliance, which brings together countries, regions, cities, businesses and investors to work towards achieving net zero emissions by 2050, has almost 4,000 participants, including over 2,300 companies and 700 cities.

The leaders of these organisations have pledged to reach net zero emissions by mid-century.

It is no coincidence that recent growth in net zero commitments has been accompanied by an unprecedented spike in CCS activity.

When organisations consider adopting net zero, they commonly do an analysis where they catalogue emissions, identify mitigation options for each, and then rank them for cost and efficacy. CCS often emerges as an essential part of the lowest cost pathway to net zero.

There is an increasing recognition by governments of CCS's critical role. It now appears in 24 of 291 long-term Low Emissions and Development Strategies (LEDS) submitted under Article 4 of the Paris Agreement, as national governments decide how they'll deliver their abatement commitments.

CCS is one of many climate mitigating technologies – commercially available and absolutely necessary to achieve a stable climate.

ECONOMIC & SOCIAL VALUE OF CCS

Emissions-intense industries often develop in clusters due to the availability of feedstocks; access to infrastructure, such as ports and rail; the presence of a skilled workforce; and a critical mass of specialist suppliers of engineering and other goods and services.

Many local communities rely upon a cluster like this for a large proportion of their employment and local economy. They would suffer severe economic and social dislocation if their emissions intense industries were shut down.

CCS can help transform high emissions-intensity industries to near-zero emissions industries – continuing support for economic prosperity, but also helping achieve climate imperatives.

Put simply, CCS protects jobs in industries and communities.

It is one of the reasons why networks centred on existing industrial precincts are emerging as a preferred model for CCS development.

CCS also creates new high value jobs. CCS facilities begin as large engineering and construction projects that take years to plan, design, construct and commission. They require a significant development and construction workforce.

At its peak, the Boundary Dam CCS facility in Canada employed a construction workforce of 1,700. Similarly, up to 2,000 people helped build the Alberta Carbon Trunk Line. Ongoing jobs are then created to run and maintain the CCS facilities.

The global CCS industry must grow by more than a factor of 100 by the year 2050, to achieve the Paris Agreement climate targets.

This means building 70 to 100 facilities a year, up to 100,000 construction jobs and ongoing jobs for 30,000 to 40,000 operators and maintainers. Between $655 billion and $1,280 billion in capital investment is needed until 2050.

The size of the global CCS industry could approach that of the world natural gas industry within a few decades creating a significant engine of growth, alongside renewable energy, in the new low emissions economy.

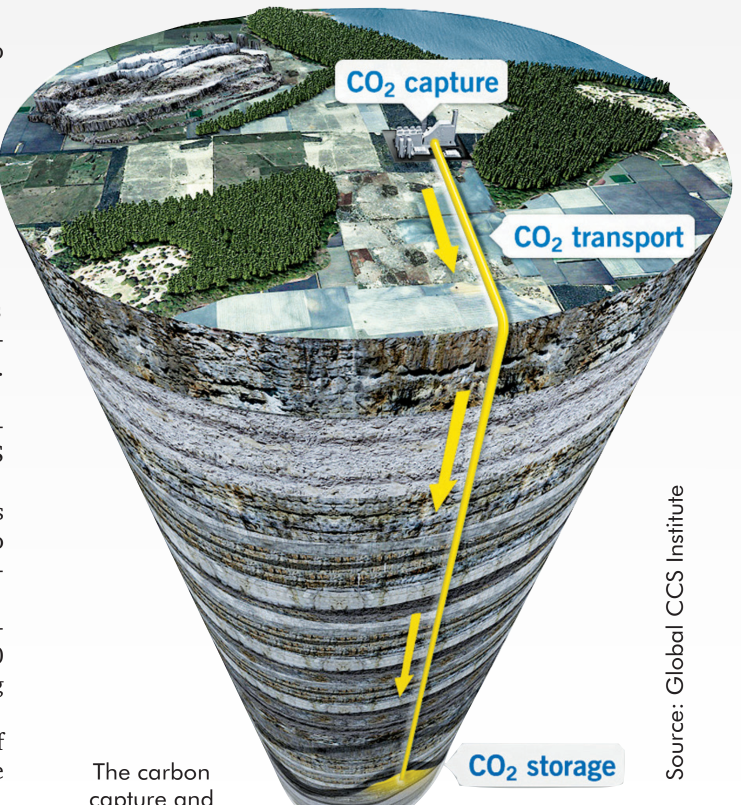
Despite unprecedented growth in the CCS project pipeline for the last 12 months, there remains a massive gap between today's CCS fleet and what is required to reduce global anthropogenic emissions to net zero.

Limiting global warming to 2 deg C requires installed CCS capacity to increase from around 40 Mtpa today to over 5,600 Mtpa by 2050.

The figure may appear daunting but investing around $1 trillion over almost 30 years is well within the capacity of the private sector.

As proof, in 2018, the sector invested approximately $1.85 trillion in just the energy sector.

In addition to enormous financial resources, the private sector has the expertise and experience to develop projects.



The carbon capture and storage process

More private investors now want CCS in their portfolios. There is increased interest in CCS as part of a broad suite of technologies and strategies that can help achieve net zero emissions solutions at the lowest possible risk and cost. Without CCS, net zero is practically impossible.

Furthermore, rapid growth of supporting infrastructure is required by 2030 to bring more projects into the development pipeline and get them operating by 2050.

Faster rates of CCS facility development demand additional CO_2 transport and storage facilities.

North America's CO_2 transport pipeline network is estimated to need to grow from around 8,000 km today to 43,000 km by 2050. This scale is definitely achievable, being only slightly larger than Australia's natural gas transmission network, which has over 39,000 km of pipelines.

A CCS network requires geological storage for CO_2. Identifying and characterising a storage resource requires tens to hundreds of millions of investment dollars. All funds are at risk as there is no guarantee of success.

GLOBAL CCS FACILITIES UPDATE & TRENDS

There are 135 commercial CCS facilities in the pipeline in the Global CCS Institute's database. In the first nine months of 2021, 71 projects were added.

The US again leads the global league table, hosting 36 of the added facilities. Other leading countries are Belgium with four, the Netherlands with five and the UK, eight.

The large increase in commercial CCS facilities in H1 2021, has led to project pipeline capacity levels not seen since 2011 – 149.3 Mtpa. The project pipeline capacity annual average growth rate since 2017 has been 30 per cent.

Most growth so far in 2021 was in early development (25.9 Mtpa) and advanced development projects (9.0 Mtpa).

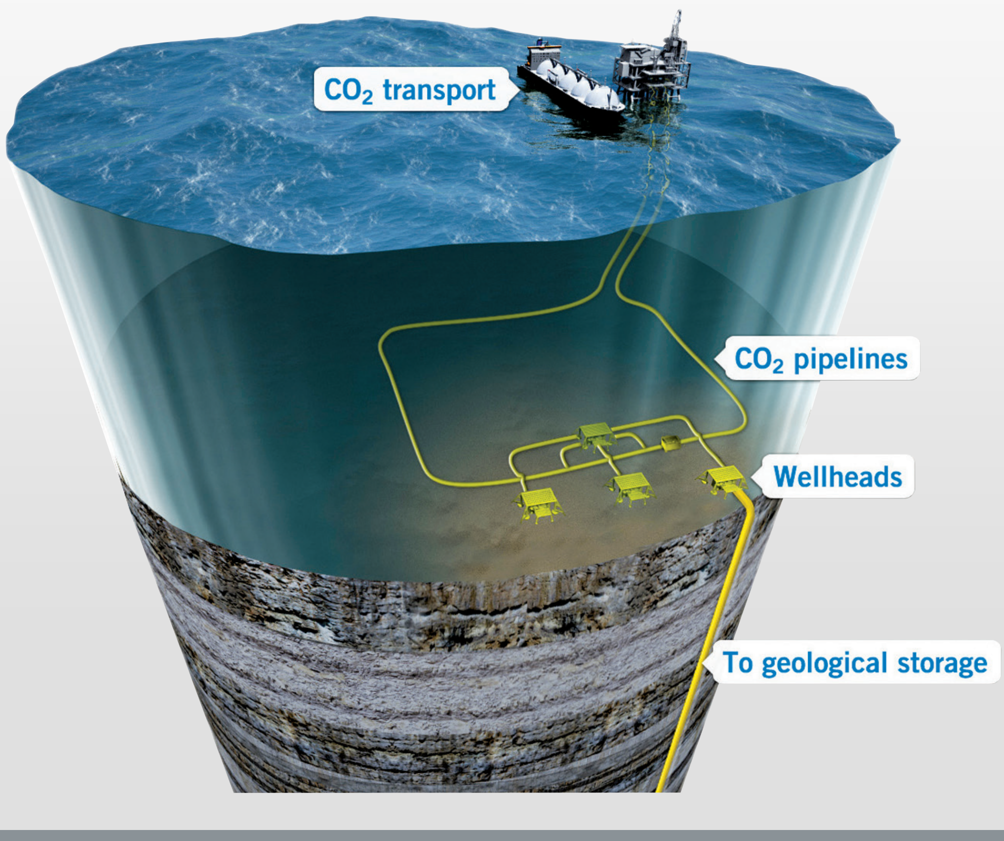
As new projects are announced and developed, the range in the scale of facilities is becoming broader.

Individual capture plants are larger, with facilities like Shell's Rotterdam hydrogen project developing in the megatonne range.

At the same time, networks like the US's Summit Carbon Solutions are making smaller capture viable; their smallest capture plant has a capacity of just 90,000 tonnes a year. Capacities this small would be difficult to justify without supporting network infrastructure.

The recently approved Norcem Brevik project, part of the Langskip network in Norway, has CCS expanding into a new sector – cement manufacturing.

As a significant global emitter with limited decarbonisation options, the cement sector's use of CCS is an essential step towards net zero.



Offshore transport and storage of CO_2

The Norcem project is expected to provide valuable CCS learning and insights.

THE RISE OF CCS NETWORKS

Historically, CCS projects tended to be vertically integrated, with a capture plant having its own dedicated downstream transport system.

This favoured large-scale projects, where economies of scale made downstream costs reasonable.

Recently, there has been a trend toward projects sharing CO_2 transport and storage infrastructure: pipelines, shipping, port facilities, and storage wells.

These CCS networks mean smaller projects can also benefit from economies of scale.

The Porthos network in Rotterdam entered advanced development early in 2021. A shared pipeline will transport liquid CO_2 from four new blue hydrogen projects – Air Products, Air Liquide, ExxonMobil and Shell – under development in the Port of Rotterdam region, to storage about 20 km offshore, beneath the North Sea. The Netherlands Government committed €2.1 billion ($2.38 billion) in grants to these four projects in support of this network.

Also in Rotterdam, TotalEnergies and Shell have partnered to develop the Aramis CCS Network; a world-scale network with a proposed capacity in excess of 20 Mtpa.

The project in early development proposes storage in the Rotliegendes Sandstones Formation beneath the North Sea at 3–4km depth.

Transport modes will be mixed: a combination of liquefied CO_2 transported by barges, gas-phase CO_2 by onshore pipelines, and dense-phase CO_2 by offshore pipeline.

It is expected to receive CO_2 from a range of hard-to-abate sectors such as waste to energy (WtE), steel, chemicals, oil refineries and cement.

When the Norcem Brevik cement plant in Norway was funded by the Norwegian government in late 2020, the Langskip CCS network also took a step forward.

Norcem Brevik will capture and liquefy 400,000 tonnes of CO_2 a year which will be transported by ship to the Naturgasspark-en, then offloaded and pumped via pipeline to offshore storage beneath the North Sea.

The other capture project in this network – the Fortum Oslo Varme waste-to-energy capture project is in advanced development and also expected to capture and liquefy 400,000 tonnes of CO_2 a year.

Langskip CCS network has been designed for an initial 1.5 Mtpa of storage (in one well) with plans for 5 Mtpa (multiple wells) in phase two.

Summit Carbon Solutions network, under development, is emerging as the world largest negative emissions network, with planned CO_2 capture capacity of 7.9 million tonnes a year.

Supporting 31 separate bioethanol plants, it leverages the twin economies of low-cost capture (corn fermentation CO_2 is high purity) and aggregation of CO_2 streams, reducing transport and storage costs.

In recent years, the UK has seen considerable development over multiple regions. These include the Humber Zero network and the nearby Zero Carbon Humber and net zero Teesside networks – the latter two recently combining as the East Coast Cluster.

All are based in areas with heavy industry – including oil refineries, power stations and natural gas processing plants – with reasonable proximity to offshore storage.

CCS IN THE GCC REGION

The significance of the GCC region in the context of CCS deployment is often overlooked, both in terms of current scale and short-term prospects.

Three facilities in the UAE and Saudi Arabia already account for 10 per cent of global CO_2 captured each year, about 3.7 Mtpa. Europe accounts for just four per cent.

The GCC region is poised for a significant take-off in CCS activity over the next decade.

Onshore transport can be done through gas-phase CO_2 pipelines

If efforts to deploy CCS intensify as trends suggest, CO_2 capture might reach 60 Mtpa by 2035 across the GCC region.

In late 2020, the leaders of the G20 endorsed the concept of the 'circular carbon economy' developed by Saudi Arabia's King Abdullah Petroleum Studies and Research Center, which recognises and values all forms of CO_2 mitigation.

The concentration of CO2 emission sources in the GCC region is also conducive to CCS.

More of 2025's estimated CO_2 emissions will come from power generation, rather than oil and gas operations, in four of five countries.

As well as reducing the number of CCS facilities needed to decarbonise industry, the geographical concentration of major emitters along the Gulf coast could support the building of CO2 infrastructure networks, reducing overall costs and providing incentives for new CCS projects.

CCS project activity is spread across Qatar, Saudi Arabia and the UAE (more specifically in Abu Dhabi). Around 3.7 Mtpa of CO_2 is captured at three CCS facilities:

- Qatar Gas captures 2.1 Mtpa of CO_2 from the Ras Laffan gas liquefaction plant.
- Saudi Aramco captures 0.8 Mtpa of CO_2 at its Hawiyah Naturals Gas Liquids plant. The CO_2 is used to demonstrate the viability of EOR at the Uthmaniyah oil field.
- In Phase I (of at least three phases) of Adnoc's Al Reyadah project, 0.8 Mtpa of CO_2 is captured at the Emirates Steel plant in Abu Dhabi.

Both the Ras Laffan and Al Reyadah projects are already developing expansion plans:

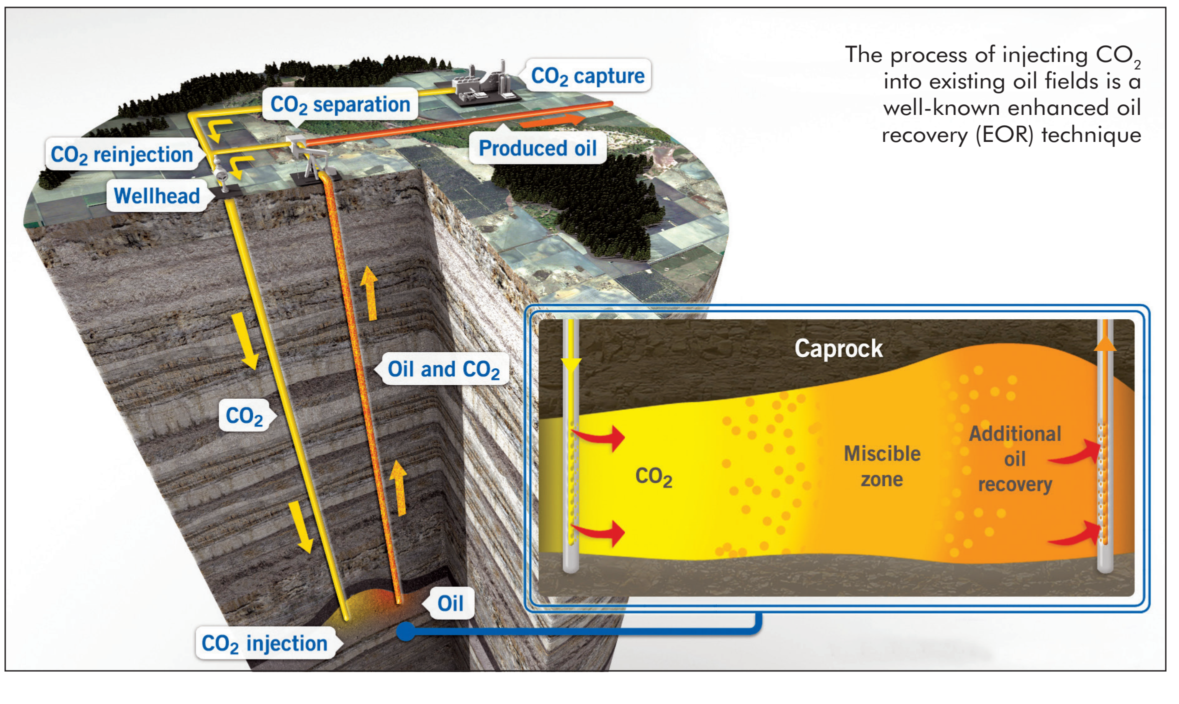
- Qatar Gas expects to expand its capture rate to 5 Mtpa by 2025.
- Adnoc estimates that Phase II of Al Reyadah could see capture of another 2.3 Mtpa of CO_2 by 2025 and Phase III could add a further 2 Mtpa of CO_2 from the Habshan and Bab gas processing facility by 2030.

Even without further CCS activity, these projects could raise overall regional CO_2 capture to almost 10 Mtpa by 2030.

There are two regional CO_2 utilisation facilities where permanence of storage is not assured:

- Saudi Basic Industries Corporation (SABIC) captures 0.5 Mtpa of CO_2 at its Jubail ethylene facility for use in methanol and urea production.
- Qatar Fuel Additive Company captures 0.2 Mtpa of CO_2 at its methanol refinery.

It is widely anticipated that planned new coal generation plants in Oman and the UAE be built with CCS to complement NDC ambitions. This could add another 5–10 Mtpa to the regional CO_2 capture rate, taking it to 15–20 Mtpa even before any heavy industry CCS plans are added.



The process of injecting CO_2 into existing oil fields is a well-known enhanced oil recovery (EOR) technique

Both blue and green hydrogen are essential in the future net-zero emissions economy. Therefore, faster growth is needed over the next three decades to support achievement of net zero emissions targets, says a report by Global CCS Institute

Blue hydrogen projects rise, but still more needed for net-zero

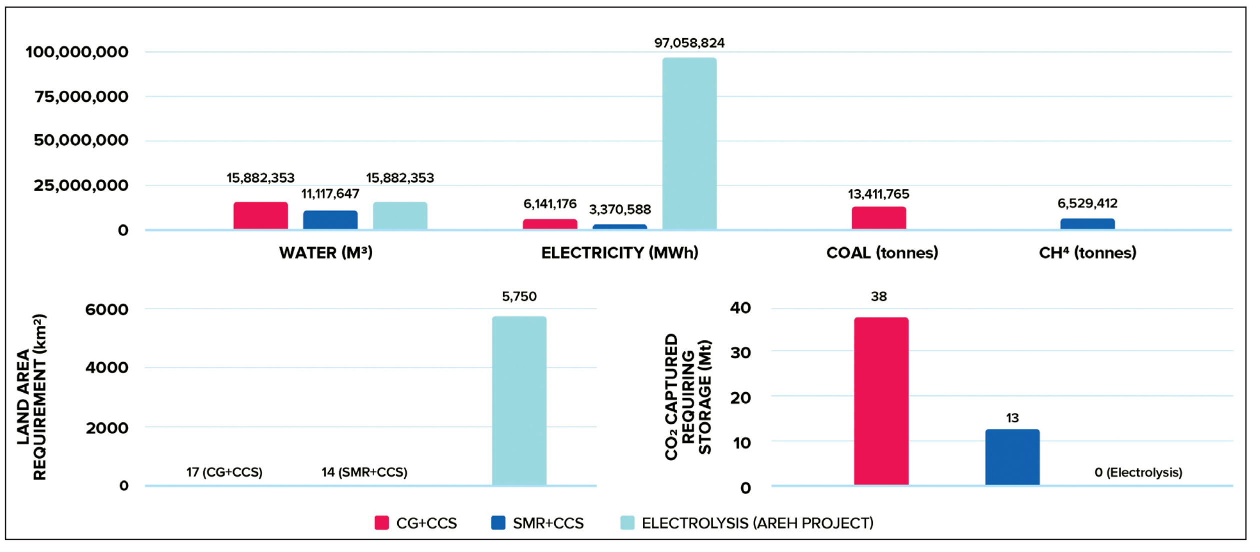


Fig 1... Resources required for the production of 1.76 Mt OF H2 from coal or gas with CCS and electrolysis powered by renewable electricity

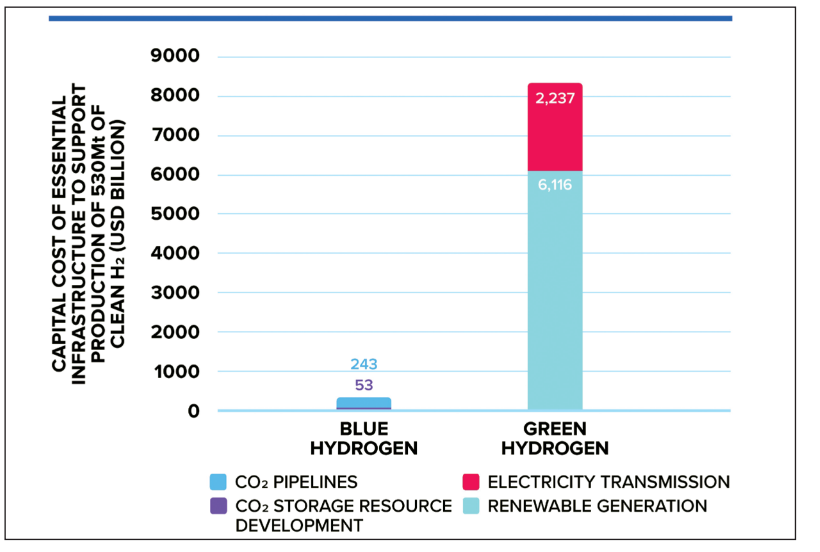


Fig 2 ... Capital cost of essential infrastructure to support production of 530 Mt of blue hydrogen or green hydrogen

FOSSIL fuels, such as natural gas and coal, can be converted to produce hydrogen, and the use of carbon capture, utilisation, and storage (CCUS) can reduce the carbon footprint of these processes.

Clean hydrogen can be produced in three ways: from fossil fuels with CCS (blue hydrogen); from biomass; and from electrolysers powered by renewable electricity (green hydrogen) or nuclear power.

This diversity of potential supply sources is an important reason why hydrogen is such a promising energy carrier.

According to the 'The Global Status of CCS: 2021' report by Global CCS Institute, hydrogen could deliver multi gigatonnes (Gt) of abatement annually, when used in various industries, transport and stationary energy.

The global Hydrogen Council estimates that hydrogen demand could exceed 500 Mt by 2050, delivering up to 6 Gt a year of abatement.

Achieving 6 Gtpa of abatement, requires that demand for, and supply of, clean hydrogen increase. Two factors critical to realising this opportunity, are scale and cost:

• Production scale must rise from approximately 1 Mtpa in 2020 to over 500 Mtpa by 2050.
• Production costs must be low enough to compete with fossil fuels – taking into account the current policy environment – to stimulate demand.

SCALING UP PRODUCTION OF CLEAN HYDROGEN

Blue hydrogen is very well positioned for rapid scale-up, having been produced in commercial quantities (hundreds to over 1,000 tonnes every day in each facility) since 1982.

In comparison, the world's largest electrolysis hydrogen production facility, powered by wind or solar energy at Fukushima, Japan, can produce around 2.4 tonnes a day of green hydrogen.

There are currently seven commercial facilities producing blue hydrogen. Their total combined production capacity is 1.3 to 1.5 Mtpa, depending on assumed availability.

To rapidly scale up clean hydrogen production, certain resources are essential. The best clean hydrogen production method in a specific location is determined by available land, water, electricity, coal, gas and pore space for CO2 storage:

• Clean hydrogen using electrolysers, or coal or gas with CCS, requires similar amounts of water – around 6 kg/kgH2 for gas plus CCS and 9 kg/kgH2 for coal plus CCS or electrolysis.
• Electrolysis has extremely high electricity demands of 55 kWh/kgH2 compared to 1.91 kWh/kgH2 for gas plus CCS and 3.48 kWh/kgH2 for coal plus CCS, including electricity to produce the gas or coal.
• Renewable hydrogen requires sufficient land to host the wind and/or solar photovoltaic (PV) generation capacity.
• Fossil hydrogen with CCS requires land for CO_2 pipelines and injection infrastructure. It also needs coal or gas, and pore space for the geological storage of CO_2.

The Asian Renewable Energy Hub (AREH) project in Australia's remote north-west which, if constructed, will be the world's largest green hydrogen project, plans to produce 10 Mtpa of ammonia.

This requires approximately 1.76 Mtpa of hydrogen, produced by the electrolysis of water and powered by a combined 23 GW of solar PV and wind capacity located on 5,750 sq km of land

Figure 1 compares resource requirements for renewable hydrogen based on the AREH project, to the same quantity of hydrogen produced from gas or coal with CCS.

Compared to renewable hydrogen, blue hydrogen production requires modest amounts of land and electricity. For example, producing 1.76 Mt of hydrogen (equivalent to one AREH project) via steam methane reformation (SMR) with CCS would require around 14 sq km of land, assuming a 500 km CO_2 pipeline in a 20 m wide corridor, 2 sq km for the plant, and four CO_2 injection wells situated over a 2 sq km area.

Production of blue hydrogen also requires access to coal or gas and pore space for the geological storage of CO_2. Both the coal and gas industries are mature with well-established supply chains, so accessing coal or gas to support blue hydrogen production in any location would be routine.

Global resources for geological storage of CO_2 are also more than sufficient for CCS to play its full role in hydrogen production; storage for CCS is ample under any climate mitigation scenario for all applications in all industries.

To illustrate, in an extreme hypothetical case where all 530 Mt of clean hydrogen produced in 2050 is blue hydrogen, annual CO_2 storage requirements would be just 7.6 billion tonnes. This compares to a global storage capacity measured in thousands of billions of tonnes.

COST OF PRODUCTION OF CLEAN HYDROGEN

Production costs for clean hydrogen are not just affected by capital requirements. The price of natural gas affects blue hydrogen costs and the quality of the renewable energy resource (which impacts electricity price and capacity of electrolysers) affects green.

Overall, hydrogen produced from coal or gas with CCS is the lowest cost clean hydrogen. It is expected to remain so, except in regions with access to the best renewable resources and lowest-priced renewable electricity.

In addition to the direct capital and operational costs associated with hydrogen production shown in Figure 2, capital is required for essential off-site infrastructure that supports production:

• For green hydrogen, supporting infrastructure includes constructing renewable electricity generation capacity and where necessary, associated transmission lines.
• For blue hydrogen, supporting infrastructure includes CO2 pipelines and the development of geological storage resources.

The capital cost of essential supporting infrastructure is estimated in Figure 2 for two extreme scenarios – producing 530 Mt of blue or green hydrogen (the potential 2050 demand estimated by the Hydrogen Council).

Supporting 530 Mt of green hydrogen would cost over $8,000 billion, compared to approximately $300 billion for blue hydrogen. This covers pipelines, electricity generation and distribution.

There are many assumptions built into these cost estimates. While not definitive, they illustrate that the essential infrastructure required to support production of climate-relevant quantities of green hydrogen could cost 20 or 30 times more than the infrastructure required to support production of the same quantity of clean hydrogen using fossil fuels with CCS.

NEW INVESTMENT

The opportunity for clean hydrogen to offer a decarbonised alternative in industry, stationary energy and transport has supported a wave of new project announcements.

As of September 30, 2021, the Global CCS Institute's CO2RE Database included 18, either producing blue hydrogen for sale to third parties or for use in production of ammonia, fertiliser and electricity.

The total capacity is uncertain, but considering information in the public domain, it is likely to exceed two million tonnes of hydrogen each year.

There are certainly more blue hydrogen facilities in development than those listed. They will be added as they become sufficiently advanced and defined.

However, even with this recent increase in project activity, clean hydrogen production capacity must speed up.

Faster growth is needed over the next three decades to support achievement of net zero emissions targets. Both blue and green hydrogen are essential in the net zero emissions economy of the future.

FACILITY	COUNTRY	COMMENCEMENT
Wabash Valley Resources Hydrogen Plant	US	2022
Air Liquide Refinery Rotterdam	Netherlands	2024
Project Pouakai Hydrogen Production	New Zealand	2024
Shell Refinery Rotterdam	Netherlands	2024
ExxonMobil Benelux Refinery	Netherlands	2024
Air Products Refinery Rotterdam	Netherlands	2024
Acorn Hydrogen	UK	2025
Clean Energy Systems Carbon Negative Energy Plant - Central Valley	US	2025
Preem Refinery	Sweden	2025
Barents Blue Clean Ammonia with CCS	Norway	2025
Northern Gas Network H21	UK	2026
Ravenna Hub - ENI Hydrogen	Italy	2026
Hydrogen to Humber Saltend	UK	2026–2027
Net Zero Teesside - BP H2Teesside	UK	2027
Humber Zero - Phillips 66 Humber Refinery	UK	2028

Blue hydrogen production facilities in development as of June 2021

Unified operations can deliver efficiency gains to O&G firms

By unifying business ops into a single interface, O&G companies can improve their efficiency, agility and reliability, in turn raising profitability, Rashesh Mody, Senior Vice President, Monitoring and Control Business Unit, AVEVA, tells *OGN*

A unified operations centre allows companies to see new value opportunities. Right, Mody.

THE oil and gas industry is no stranger to uncertainty, but the events of 2020 highlighted the importance of agility and adaptability more than ever.

Covid-19 brought many disruptions, from the sudden need for remote working through to the oil price crash.

Many of last year's challenges helped reveal areas of low digital maturity, including the industry's reliance on engineers out in the field and the fact that their work was often reactive, rather than pre-emptive.

This has led to an acceleration of digital transformation projects as organisations look to secure business continuity and improve automation.

PIVOTING TO A NEW ENERGY FUTURE

As the global population grows and living standards improve, energy needs are set to rise.

According to ExxonMobil's latest Outlook for Energy, global demand will rise by 20 per cent by 2040. Meanwhile, BloombergNEF's New Energy Outlook 2020 predicts demand for oil will peak in 2035, while gas will continue to rise until, at least, 2050.

At the same time society is calling for cleaner energy, and so oil and gas companies must look to supply their energy with a greater focus on environmental performance. With this in mind many are focusing on energy transition and net-zero goals.

Pivoting to this new energy future is challenging, but digitalisation has an important role to play in helping the sector make this transition.

Solutions such as remote operations centers can help to optimise efficiencies and meet environmental targets, all while ensuring competitiveness thanks to lowering costs and downtime.

ROLE OF REMOTE OPERATIONS CENTRE

A remote operations centre (ROC) helps organisations to make better informed decisions by bringing together disparate systems and providing a 360-degree view across the value chain.

Pulling together information technology (IT), operational technology (OT) and engineering technology (ET) into a converged industrial internet of things (IIoT) interface, a ROC enables organisations to create a single management environment that provides full visibility across the business.

CREATE ACTIONABLE INSIGHTS

ROCs take advantage of technologies such as artificial intelligence (AI), machine learning (ML) and cloud computing to gather, store and analyse data, which is then turned into actionable insights that drive operational efficiency and safety performance.

Operational measures such as yield, efficiency, emissions, throughput and utilisation can be calculated from the plant down to asset level, enabling meaningful comparisons of performance across multiple sites and departments, and ensuring key performance indicators (KPIs) are met.

Furthermore, reporting tools and dashboards allow users to route staff to the highest priority assets, while the overview of assets transforms reactive maintenance into predictive.

This is thanks to advanced diagnostics that enable workers to anticipate faults before they occur through the use of big data analytics.

REAL-WORLD RESULTS

Many oil and gas businesses including upstream, midstream, downstream, and retail have already made the move to ROCs.

This includes the UAE's state-owned NOC, Adnoc. Its Panorama Digital Command Centre is enabling savings of between $60-$100 million through optimised operations.

By integrating and monitoring more than 10 million tags across in excess of 120 dashboards, the unified operations centre allows the oil company to see new value opportunities for the first time – even in brownfield operations.

A CHANGING LANDSCAPE

The world still relies on oil and gas, but customer demands are changing. They expect energy that's clean, affordable and reliable.

To provide this, oil and gas companies must continue to look for efficiencies that will keep costs down, all while doing everything they can to lower emissions.

In addition, they must continue to weather uncertainties – those that they're used to in the sector, but also those new disruptions that came into being with the pandemic.

Oil and gas firms that are able to access the right information, and quickly, will weather these changeable times more favorably, and business visibility and analytics will be key to their continued success.

A ROC allows better collaboration among stakeholders and connects people, sites, systems and processes. It empowers businesses to make the most of their assets, and those that do so are most likely to lead the way in this new energy future.

First commercial-scale vessel for hydrogen transport designed

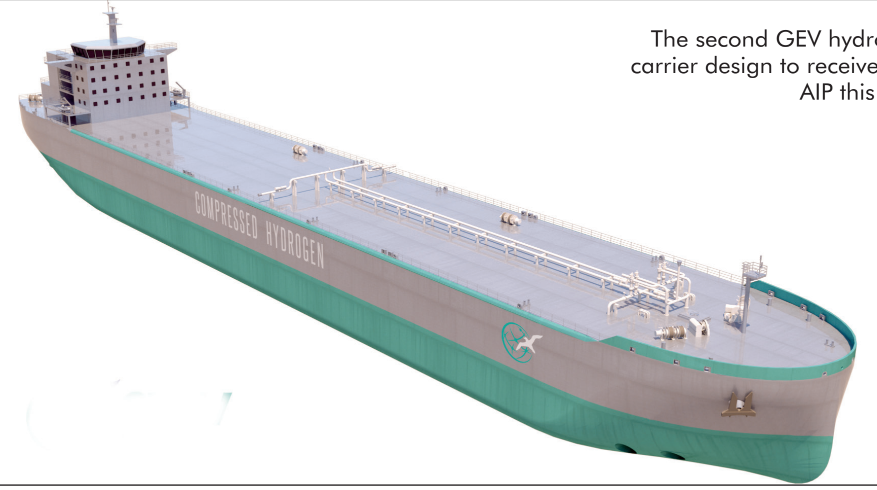
A COMPRESSED hydrogen carrier design with a 430-tonne cargo capacity by Global Energy Ventures (GEV) has received Approval in Principle (AIP) from the American Bureau of Shipping (ABS).

AIP for the Handymax vessel, which GEV intends to be the first commercial-scale vessel available for the marine transport of hydrogen, follows an ABS AIP that GEV received in July this year for a compressed hydrogen vessel with a 2,000-tonne capacity.

"Hydrogen has a significant role to play in global decarbonisation initiatives both within shipping and the wider economy. Safe and efficient transport of hydrogen at sea will be critical to the development of the infrastructure required for its wider adoption and we are proud to be able to support GEV with its innovative designs," said Georgios Plevrakis, ABS Director, Global Sustainability.

Martin Carolan, Managing Director and CEO said: "GEV is pleased to secure AIP from ABS, which is a leading classification society for gas carriers. GEV is looking forward to working with them to ensure that our compressed hydrogen ships continue to meet the highest safety standards. Marine storage and transport solutions are required for hydrogen to contribute to global decarbonisation ambitions."

GEV's Handymax design is able to enter most ports and is equipped with a dual-fuel engine powering generators coupled to two electric drive fixed pitch propellers or a dynamic positioning system.



The second GEV hydrogen carrier design to receive ABS AIP this year

The contract to export MEA Triazine to the US not only marks a milestone in the company's growth and expansion strategies, but also highlights a proactive response from the Kingdom's oil and gas industry to global market pressures

Saudi Multichem leads industry change with exports to US

SAUDI Multichem, a leading chemicals supplier in the Kingdom of Saudi Arabia, has secured a significant contract to export MEA Triazine to the US.

It is a first for the indigenous Saudi company to export MEA Triazine to the oil and gas industry in the US.

Global shortages of some commodities are putting pressure on players in oil and gas to find alternative sources for materials and products. One of these products is MEA Triazine, a H2S scavenger used extensively in removing H2S in sour oil and gas.

The contract with a major US oil and gas operator marks a significant milestone in the company's growth and expansion strategies, but also highlights a proactive response from the Kingdom's oil and gas industry to global market pressures.

Commenting on gaining market entry, General Manager Abdur Rahman Adil, says: "Saudi Multichem is poised to create opportunity out of crisis, the current global shipping crisis coupled with China's domestic power generation challenges present opportunities for Saudi Multichem to expand into global markets.

"We have the capacity and knowhow to manufacture Triazine (Chemara HS-1501) for the international market and recently received orders from our strategic partners in the US for large volumes for the US market."

Established in 2001 by Mohammed Hassan Al Saidi, Saudi Multichem is a wholly owned subsidiary of Al Saidi Group, an indigenous oilfield chemical manufacturing and supply company based in Dammam, Saudi Arabia.

In the past over 20 years, Saudi Multichem has grown into a vertically integrated organisation offering oilfield chemicals and oilfield services to local and international markets.

In 2018, Saudi Multichem embarked on a transformational journey to develop its capabilities in chemical manufacturing, through the introduction of its own products using in-house R&D capability, strategic partnerships with international specialty chemical companies, and acquisitions.

In anticipation of an upswing in worldwide oil and gas production, production capacity was expanded during 2020 and into 2021 with the introduction of new state-of-the-art reactor vessels, liquid blenders.

Added to this, a multidiscipline team of international and Saudi talent gives Saudi Multichem the competency and capabilities to develop additional inhouse complex chemistries to meet more diverse local and global customer needs.

Saudi Made ... Saudi Multichem becomes first local company to export MEA Triazine to US

It was the result of these investments and ongoing global supply chain disruption events that Saudi Multichem secured the MEA Triazine export contract.

Saudi Multichem's international trajectory is further made possible by the initiatives taken by the Saudi government, which is supporting and creating greater opportunities for local manufacturers to export to the wider world and fits well with Saudi Arabia's Vision 2030 strategies.

In successfully overcoming the challenges posed by the global pandemic and other market disruptors, Saudi Multichem has built a resilient, responsive, and agile supply chain by developing strong relationships with local suppliers in the Saudi market and international suppliers across the globe.

Through the support and collaboration of industry partners SABIC and Aramco, greater in-country value is achieved leading to further internationalisation and growth is for Saudi Multichem.

The company is continuously striving to contribute to the In-Kingdom Total Value Add (IKTVA) programme, and currently has an IKTVA score in the 40s. Measures are underway to improve that further.

Sabic creates first circular polymer from ocean plastic

SABIC, a global leader in the chemical industry, and Malaysia-based plastic recycling company HHI, have announced a pioneering new collaboration to create the first certified circular polymers produced through the advanced recycling of recovered mixed and used ocean-bound plastic.

The certified circular polyolefins from ocean-bound plastic, from SABIC's Trucircle portfolio of circular solutions, will be used by its customers to announce new products over the coming months.

As well as helping to protect oceans and waterways, the ocean-bound plastic collection helps to create value for local communities by increasing demand for recycled plastic across the industry.

The material is recovered from ocean-feeding waterways and inland areas within a 50 km radius of the ocean by HHI partners predominantly in Malaysia.

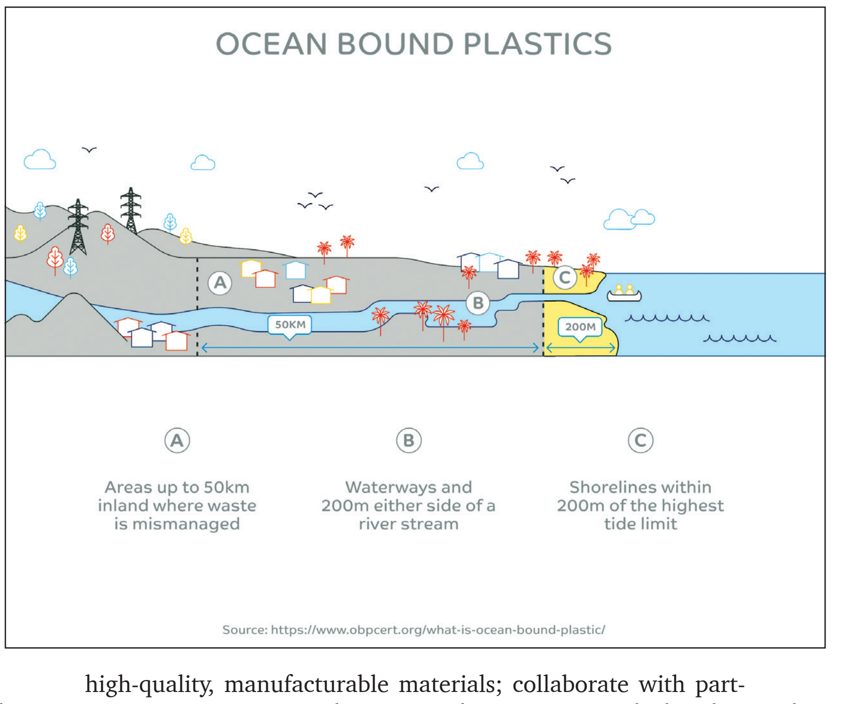
The recovered material is then sent to HHI, where it converts the used plastic into pyrolysis oil through an advanced recycling.

The pyrolysis oil is then used by SABIC in their production process as an alternative to traditional fossil materials to make new certified circular polymers.

The material has been certified under the Zero Plastic Oceans accreditation, and HHI is the first organisation to have received certification confirming the materials it recycles qualify as ocean-bound.

HHI created its own model to outline the steps required to facilitate the transition to a circular economy.

The model has five stages, which include: to collect ocean-bound plastic through its extensive network; convert them into high-quality, manufacturable materials; collaborate with partners to create new products; provide customers with the platform to champion their use of more sustainable materials; and catalyse a generation of conscientious consumers who will opt for sustainable materials.



Abdullah Al-Otaibi, General Manager, ETP & Market Solutions at SABIC, said: "We are acutely aware of the challenges we face globally to stop plastic from becoming waste. Developing an entirely circular recycling system is a huge but necessary step we need to take together and will require all players across the value chain to collaborate. That's why we're committed to developing long-term solutions and working with new partners like HHI to significantly upscale the production of more sustainable materials, including those produced using recycled ocean-bound materials, for the benefit of our customers, society and the environment."

Kian Seah, CEO at HHI, explained: "At HHI, our circular economy model helps to guide us in all of our endeavours, from business planning and collaborations with partners such as SABIC, to eco-initiatives, as we strive to protect our ocean and communities. We believe that we have the ability to work towards a cleaner future that views plastic as a valuable resource to keep within the value chain.

"We are incredibly proud of what we have achieved so far with SABIC, but also realise that we are early into our journey towards enabling a circular economy, and it is by no means a straightforward one.

"Our common spirit and passion has helped us overcome significant challenges to make this innovative process a reality and to ensure the reliability of technologies, quality of the end material and viability of the circular consumption model. We share a commitment to reshape the way we produce and recycle plastics and address environmetntal and societal challenges in a lasting, meaningful way."

Launched in 2019, SABIC's Trucircle portfolio spans mechanically recycled products, certified circular products from advanced recycling of used plastic and certified renewables products from bio-based feedstock, as well as design for recyclability and closed loop recycling initiatives.