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Pioneering fertiliser transition

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Italian firms aligned with UAE's goals

Italian companies are at the forefront of sustainable innovation in the energy sector, and we see a clear alignment with the UAE's sustainability goals – Page 20

COP29: RICH FAIL TO WALK THE TALK ON CLIMATE FUNDS



World leaders at COP29 in Baku, Azerbaijan

By ABDULAZIZ KHATTAK

MANAMA: At the close of the 29th United Nations Climate Change Conference (COP29) in Baku, Azerbaijan, the world's negotiators failed to meet the expectations of developing nations, leaving many disappointed over the commitment made by developed countries towards climate finance.

A long-anticipated agreement on the financial support for vulnerable nations battling the impacts of climate change fell short of the \$1.3 trillion per year target that had been called for.

Throughout the two-week conference, developing countries had urged the wealthier nations to raise \$1.3 trillion annually by 2035 to assist in combating climate change, including a substantial portion of public funds.

The target was seen as essential to help finance the necessary adaptation and mitigation measures, particularly in low-income countries most affected by climate disasters.

These nations had originally sought \$600 billion in public finance, with the remainder raised from private investments.

However, the final agreement unveiled at COP29 sets a much lower target. It includes a "core" goal of \$250 billion per year by 2035, with the hope that this will come from a mix of public and private sources.

This figure, while an improvement over the previous \$100 billion target set under the Paris Agreement, has been met with outrage by many of the poorer nations in-

involved in the talks.

Kenya's Special Envoy for Climate Change, Ali Mohamed, who also chairs the African Group of Negotiators, expressed his disappointment, calling the proposed figure "totally unacceptable."

He warned that such a small amount of funding would lead to catastrophic consequences, stating: "\$250 billion will lead to unacceptable loss of life in Africa and around the world, and imperils the future of our world."

African negotiators were particularly vocal in their criticism, with Alpha Kaloga, a finance negotiator for the African Group, condemning the deal as "a joke" in a post on social media.

Kaloga was not alone in his frustration. The Alliance of Small Island States (AOSIS), representing nations highly vulnerable to climate change, also condemned the deal, describing it as a "shoddy placebo goal".

In a statement, AOSIS added: "We appeal to the moral conscience of those who proclaim to be our partners to stand with us."

Bolivian negotiator Diego Pacheco, speaking on behalf of several emerging economies, dismissed the proposed finance goal, labelling it "not serious" and pointing out its lack of alignment with the principles of the Paris Agreement.

The new financial goal, which replaces the previous \$100 billion annual target, forms part of a broader ambition to raise, at least, \$1.3 trillion a year from all public and private sources by 2035. However,

many are sceptical about whether such a target can be met in time to avert the worst effects of climate change.

While the conference did achieve some progress, including a reaffirmation of a commitment to scale up climate finance, the agreement fell far short of the bold steps that many had hoped for.

Developed nations were urged to increase their financial contributions, but as it stands, the agreement only sets a non-binding target to "triple finance" to developing countries, increasing from the previous \$100 billion to \$300 billion annually by 2035.

The goal of \$1.3 trillion is seen as a more aspirational figure, calling on a wide range of financial actors, including both public and private sources, to contribute.

Despite the criticism, the agreement reached at COP29 is seen as a vital stepping stone, according to Simon Stiell, the Executive Secretary of UN Climate Change.

He described the new finance goal as "an insurance policy for humanity" amid worsening climate impacts.

However, he cautioned that promises must be kept to ensure the success of the deal.

"It only works if premiums are paid in full, and on time. Promises must be kept, to protect billions of lives," Stiell said.

As the world looks toward the next climate conference in 2025, the challenge of securing adequate financing for climate action is far from over.

Arab Group stood by fossil fuel at summit



EVEN before the final declaration in Baku, the 22-member Arab Group had made it clear it won't accept any text at COP29 that pushed for transitioning away from fossil fuel, media reports said.

This was in stark contrast to what was announced in the Dubai meeting (COP28) last year that ended with a call to transition away from fossil fuel.

"The Arab Group will not accept any text that targets any specific sectors, including fossil fuel," Albara Tawfiq, a Saudi official speaking on behalf of the Arab Group, said during the discussions in Baku and as reported The Arab Weekly.

This reluctance to abandon fossil fuels is not limited to the group. The Organisation of Petroleum Exporting Countries (Opec) has consistently pushed back against the notion that the Paris Agreement mandates a shift away from fossil fuels.

OPEC Secretary General Haitham Al Ghais, during his address at COP29, reiterated that the agreement's primary focus is on reducing emissions, not selecting specific energy sources. He called fossil fuel a "gift of God", and highlighted the need for a balanced approach, stressing the importance of leveraging all available energy sources and technologies to meet global energy demands.

The controversy surrounding the future of fossil fuels also finds support from Azerbaijan's President Ilham Aliyev, the host of this year's summit.

He criticised Western nations, particularly the US and the EU, for their "double standards" on fossil fuels.

Aliyev argued that oil and gas are essential for global markets and that countries should not be vilified for providing these resources.

In contrast, the UAE continued to advocate for the transition away from fossil fuels.

A UAE spokesperson emphasised the importance of honouring the resolution reached last year at COP28, which called for a global shift to cleaner energy, the Guardian reported.

"As a Cop decision, it is by definition unanimous. All parties must honour what they agreed. They must now focus on implementation by providing the means to take it forward with a robust NCQG (new collective quantified goal on climate finance). We urge all parties to focus on this outcome," he said.

The conflicting perspectives at COP29 highlight the complex and often contentious debate over the future of energy.



KEY CLIMATE ACHIEVEMENTS AMID GLOBAL CHALLENGES

COP29 makes strides on carbon markets, transparency, and adaptation, though climate funding, the centrepiece of agreements that deliver progress across all climate pillars, remains a major hurdle

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By ABDULAZIZ KHATTAK

THE 29th United Nations Climate Change Conference (COP29), held in Baku, Azerbaijan, concluded with significant advancements despite challenges in securing desired climate funding.

While the outcome was not perfect, the complexity of the negotiations was evident, with no country achieving all of its objectives. The conference highlighted the difficult balancing act of addressing the diverse needs and priorities of nations, leaving a considerable amount of work to be done as global efforts to tackle climate change continue to unfold.

Hosted from November 11 to 22, 2024, and presided over by Azerbaijan's Minister of Ecology and Natural Resources, Mukhtar Bahadur Babayev, COP29 brought together world leaders, civil society, businesses, and various stakeholders to address pressing climate issues, achieving milestones on carbon markets, transparency, gender equality, and youth involvement.

Although climate finance remained a key point of contention, the conference made notable strides in other areas.

Simon Stiell, Executive Secretary of the UNFCCC, acknowledged that while the outcome was not perfect, the progress made was substantial.

"No country got everything they wanted, and we leave Baku with a mountain of work still to do," he said, underscoring the complexity of the negotiations.

One of the conference's most significant achievements was the establishment of the Baku Finance Goal (BFG), a new framework committing developed countries to mobilise \$1.3 trillion annually in climate finance for developing nations.

This includes a target of at least \$300 billion per year by 2035. While this was a step forward, developing nations continue to push for further commitments and timely financial assistance.

• **Progress on carbon markets:** COP29 marked the end of a decade-long negotiation on carbon markets, particularly under Article 6 of the Paris Agreement.

This breakthrough ensures that country-to-country trading (Article 6.2) and carbon credit mechanisms (Article 6.4) are now operational, opening the door to the possibility of financial flows from compliant carbon markets reaching \$1 trillion annually by 2050.

This development is crucial for driving global emission reductions and ensuring that carbon trading mechanisms contribute meaningfully to climate goals.

• **Transparency and reporting gains:** Transparency was another key area of progress at COP29, as several countries took steps to improve climate reporting. Thirteen Parties, including Andorra, Azerbaijan, the European Union, and Japan, submitted their Biennial Transparency Reports (BTRs), which are vital for building a stronger evidence base for climate policies. These reports will help track progress and highlight financing needs, fostering greater accountability in climate action.

• **Loss and Damage Fund:** One of the most anticipated developments at COP29 was the operationalisation of the Loss and Damage Fund. This fund, first agreed



The closing plenary at COP29

upon at COP27, aims to provide financial assistance to countries most affected by climate change, such as small island states and African nations. With over \$730 million pledged to date, the fund is set to begin financing projects in 2025, marking a significant milestone in addressing the inequities caused by climate impacts.

No country got everything they wanted, and we leave Baku with a mountain of work still to do

*-Simon Stiell,
Executive Secretary,
UNFCCC*

• **Focus on adaptation and vulnerable nations:** Adaptation efforts took centre stage at COP29, especially regarding Least Developed Countries (LDCs). A new support programme for National Adaptation Plans (NAPs) was announced, reflecting the urgency of adapting to the impacts of climate change.

The High-Level Dialogue on NAPs, which involved ministers from LDCs, small island developing states, and international donors, emphasised innovative financing and technical support to expedite adaptation efforts. The Baku Adaptation Road Map and the launch of the UAE Framework further reinforced the global commitment to adaptation.

The conference also addressed the growing need for transformational adaptation to ensure that vulnerable communities can effectively respond to climate impacts.

• **Inclusion of indigenous and local**

communities: COP29 also took significant steps to elevate the voices of Indigenous Peoples and local communities in climate action. The adoption of the Baku Workplan and the renewal of the Local Communities and Indigenous Peoples Platform (LCIPP) mandate underscored the critical role these groups play in addressing the climate crisis. The decision further highlighted the need for inclusive climate strategies that empower local leadership in sustainable practices.

• **Gender equality and youth involvement:** Gender and youth issues were high on the agenda at COP29. A key decision was made to extend the Lima Work Programme on Gender and Climate Change for another ten years, advancing gender mainstreaming and ensuring that gender equality remains a central pillar of climate action. Furthermore, a new gender action plan will be developed for adoption at COP30.

The conference also saw the active participation of youth and children, with more than 55,000 attendees, including young climate activists. For the first time, dedicated spaces were created for children in the Youth-led Climate Forum. The youngest participant, just ten years old, took on a significant role as a speaker, underscoring the importance of intergenerational collaboration in the fight against climate change.

LOOKING AHEAD

While COP29 achieved significant progress on several fronts, the journey towards comprehensive climate action continues. The conference's successes in carbon markets, transparency, gender equality, and adaptation provide a solid foundation for future negotiations. However, much work remains to be done, particularly in securing the necessary climate finance and ensuring that vulnerable communities receive the support they urgently need.

As world leaders return to their respective nations, the outcomes of COP29 will continue to shape the global climate agenda, with the next opportunity for nations to further their commitments coming at COP30.

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Carbon markets deal ray of hope amidst complexities

A landmark deal was reached by leaders at COP29 on carbon credit trading, establishing new rules for how countries can trade emissions reductions and create funding opportunities to combat climate change.

The deal finalised the much-debated rules for Article 6 of the Paris Agreement. However, the agreement has left many experts questioning whether the rules are robust enough to ensure the carbon market operates with the necessary transparency and accountability.

The Article 6 rules adopted at COP29 are intended to lay the groundwork for a global carbon market, helping to accelerate emissions reductions, especially in developing countries.

The framework is designed to facilitate trade between countries and companies, where emissions cuts made in one country can be purchased and used by another to meet their climate targets. This approach is expected to unlock billions of dollars in capital for climate action.

But the complex nature of the negotiations raised significant concerns. One of the key challenges lies in the lack of accountability for countries that fail to comply with carbon credit agreements.

The rules stipulate that inconsistencies in carbon credit transactions must be addressed, but there are no clear penalties or deadlines for action, leaving room for non-compliance.

Moreover, the lack of oversight could lead to the trading of substandard carbon credits, undermining the credibility of the market.

TRANSPARENCY: A STEP FORWARD, BUT NOT ENOUGH

While the agreement includes some improvements in transparency, such as requiring countries to publish information when they approve carbon credits, critics argue that it does not go far enough.

Jonathan Crook, Policy Lead on global carbon markets, pointed out that crucial information about trade deals such as risks of reversal or uncertainties in quantification may not be made public until long after the credits have been used, potentially years down the line.

"The package does not shine enough light on an already opaque system," Crook said, stressing the continued risks in carbon trading despite modest improvements.

The complexity of the new system, particularly under Article 6.2, means that developing countries will not be required to create their own carbon credit registries.

Instead, an alternative system will be set up, but questions remain about how quickly and effectively it will be implemented. The deal also touched on Article 6.4, which governs the use of



COP29 lays the groundwork for a global carbon market

carbon credits from emission reduction projects.

The COP29 outcome was seen as a breakthrough in the establishment of a global carbon market, but some aspects of the decision raised alarm bells.

In particular, the refusal to impose additional checks on old Clean Development Mechanism (CDM) projects under the Kyoto Protocol means that these credits could continue to be issued with limited scrutiny. This raises concerns about the quality of credits coming from such projects.

Federica Dossi, a policy expert on global carbon markets, stressed that it is now up to the Article 6.4 Supervisory Body to ensure that the carbon credits issued under this mechanism are of higher integrity than the credits generated by older CDM projects.

"Much lies in the hands of the Supervisory Body now," Dossi remarked. She added that if the body fails to take stronger action, it could result in a low-trust market where carbon credit prices fall and interest dwindles, ultimately rendering the entire system ineffective.

THE ROAD AHEAD

Despite these challenges, some remain hopeful that the deal reached at COP29 will pave the way for more robust climate finance and market-based solutions to carbon emissions.

Sebastien Cross, co-founder of the carbon ratings agency BeZero Carbon, noted that the deal lays a stronger foundation for the carbon market.

"With proper implementation, Article 6 will unlock billions in capital flows, a large part of which will go toward developing nations," he said, emphasising that the framework could still provide significant benefits if executed correctly.

In the years ahead, it will be critical to monitor the implementation of the rules and the functioning of carbon credit systems, particularly as the market expands and the pressure to meet climate targets intensifies.

As the world faces the mounting challenge of addressing climate change, the integrity of the carbon credit market will be a key factor in determining its effectiveness in driving global emissions reductions.

First Biennial Transparency Reports a milestone

COP29 has marked a significant milestone in global climate transparency with the first submissions of Biennial Transparency Reports (BTRs) under the Paris Agreement. As the 31 December 2024 deadline for BTR submissions approaches, UN Climate Change and the COP29 Presidency have hosted a series of high-level events to celebrate early adopters of the Enhanced Transparency Framework (ETF), which is vital for enhancing climate action and accountability.

The celebrations began on 12 November with the High-Level #Together4Transparency Opening Event. During the event, UN Climate Change Executive Secretary Simon Stiell and Azerbaijan's Deputy Minister of Ecology and Natural Resources Umayra Taghiyeva acknowledged Guyana, Panama, and Spain for their prompt submissions.

"Transparency enables stronger climate action," Stiell said. "Each Biennial Transparency Report represents a milestone, capturing the strides made and charting the path ahead." In recognition of their leadership, representatives from these countries were presented with certificates celebrating their commitment to transparency in climate action.

Another key moment came during the High-Level Ministerial Roundtable on 18 November, where additional early submissions were celebrated, including from Andorra, Germany, Japan, Kazakhstan, the Maldives, the Netherlands, Singapore, and Türkiye. These submissions



Ministerial roundtable on global climate transparency at COP29

were seen as vital for building political momentum towards more transparent global climate action.

Inger Andersen, UN Under-Secretary-General and Executive Director of the United Nations

Environment Programme, emphasised the value of BTRs in supporting investment and ensuring predictable outcomes: "BTRs provide high-quality, consistent climate data, offering predictability for investment. When data is

measured regularly and shared openly, countries are more likely to meet and exceed their commitments."

Germany's State Secretary Jennifer Morgan also highlighted the importance of transparency in fostering international cooperation: "Trust is at the heart of reaching agreement in any negotiation. That's why transparency in climate negotiations is so important."

Prime Minister Philip Davis of the Bahamas echoed these sentiments, stating, "Transparency is the thread that unites us all."

The discussions also focused on the Baku Transparency Platform (BTP), an initiative by the COP29 Presidency to enhance participation in the ETF and provide greater support, particularly for developing nations. The platform aims to streamline transparency processes and increase the effectiveness of climate data sharing across nations.

Azerbaijan and the European Union submitted their BTRs during the latter days of COP29, and further submissions are expected in the coming weeks. After submission, the reports will undergo technical expert reviews and be discussed during the Facilitative Multilateral Consideration of Progress, providing countries with an opportunity to share successes and challenges.

These reports are set to play a crucial role in shaping international climate action, offering the evidence needed to guide future efforts in the global fight against climate change.

Sulzer Chemtech advances CC, efficiency technologies

Sulzer Chemtech leads in mass transfer solutions to reduce CO₂ emissions, improve energy efficiency, and drive innovation in sustainable energy solutions across various industrial sectors, Dr Rafic Traboulssi tells **OGN**

SULZER Chemtech's mass transfer and process technologies are used in various carbon capture (CC) and energy efficiency process solutions to help the industry reduce CO₂ emissions.

The company, a division of Sulzer a Swiss technology corporate based in Switzerland, is a world leader in the design and supply of mass transfer technologies for separation processes such as distillation and absorption.

"These processes are at the heart of industrial plants across oil and gas processing, oil refining, manufacturing of petrochemicals, chemicals, specialty chemicals, and pharmaceuticals," Dr Rafic Traboulssi, Director – Strategic Business Development, Sulzer Chemtech Middle, tells *OGN* energy magazine.

In 2019 Sulzer acquired GTC Technologies, a process technology licensor, to extend its capabilities to support customers with licensed technologies targeted at aromatics extraction, process intensification, such as Dividing Wall Distillation Columns (DWCs), and technology for pushing thermal efficiency of fired heaters to above 95 per cent, as well as process technologies for manufacturing renewable fuels such as sustainable aviation fuel (SAF) and renewable diesel (RD).

With industrial countries committing to net-zero carbon policies, carbon capture has gained increased attention.

Several process technology solutions have been developed that are specialised in different applications depending on the source of the CO₂ stream (for example, pre/post combustion) or low/high CO₂ concentrations.

These process solutions utilise technologies like absorption (solvent-based process), adsorption, membrane technologies, mineralisation, and others.

The captured CO₂, as a source of carbon, has the potential to be used as a raw material in the manufacturing of fuels, carbonates, polymers, fertilisers, and chemicals, or as a recovery agent in techniques such as enhanced oil recovery or enhanced coal bed methane recovery (ECBM), depleted oil gas fields, and deep saline aquifers.

Sulzer Chemtech offers several technologies for carbon capture.

• **Sulzer Mellapak™ CC:** The main challenge in removing CO₂ from large volume flue gas streams with CO₂ concentration of typically 3.5 – 14 vol per cent - such as for in post-combustion flue gas - using solvent-based approaches is the requirement for large absorber columns.

Hence, this renders the specific pressure drop an important cost factor specifically for the operation of such absorption columns.

Structured packing offers an excellent solution in terms of both reducing the column's dimensions (capex) and providing a low pressure drop (opex) over the absorber.

The correct choice of gas and liquid distributors is also critical in the economic operation in such large-scale industrial applications.

With deep understanding of the fundamentals of mass transfer and reaction kinetics in CO₂ chemisorption, Sulzer has developed the Mellapak™ CC structured packing family to address various challenges in a broad range of carbon capture applications, including post-combustion flue gas at atmospheric pressure and process streams at high pressures.

Mellapak™ CC, which is specifically suited for carbon capture using solvent-based absorption processes offers optimum mass transfer performance at the lowest possible specific pressure drop.

It reduces pressure drop by up to 60 per cent compared with conventional structured packings used in post-combustion CO₂ capture.

In high pressure applications like fertiliser plants, Mellapak™ CC offers significant improvement in both efficiency and capacity compared to commonly used random packings which yield up to 20 per cent reduction in energy consumption.

Due to its technical benefits Mellapak™ CC is now the industry-leading choice for CO₂ absorber columns proven in some of the largest carbon capture projects in the world, and most recently in the GCC region.

• **Dividing Wall Column (DWC) distillation technology:** This technology enables more energy efficient solution by integrating two or more distillation columns into one and thus lead to reduced energy consumption but also lower equipment costs as well as to a lowered plant footprint, ultimately leading to lower conversion costs whilst improving the carbon footprint of a process.

Sulzer offers licensed DWC technology for various processes including naphtha splitters, Food Grade Hexane (FGH) production, and LPG recovery.

For instance, the GT-LPG Max™ column is a top dividing wall column which enables achieving 99 per cent propane recovery without the use of external refrigeration.

• **Heater 95+ Technology:** Sulzer Heater 95+ technology offers further opportunities towards decarbonisation of industrial plants by improving fired heater thermal efficiency to above 95 per cent.

The patented process solution not only reduces CO₂ but also, SO_x, and NO_x emissions can be applied in grassroots plant but also be implemented as revamp in existing plants.

In traditional fired heaters, the heat efficiency is limited due to the sulfuric acid's dew point and related corrosion and fouling.

As a result, the maximum efficiency is capped at 89-92 per cent even with various materials of APH.



Dr Rafic Traboulssi

Typically, in oil refineries, fired heaters are designed to operate at above 150 deg C flue gas temperature. In practice, those units often operate at 180–200 deg C, which results in thermal efficiencies of only 89–92 per cent.

Sulzer's 95+ Fired Heater technology enables operating the fired heater at a much lower temperatures, as low as 100 deg C, and thus enhances the thermal efficiency to above 95 per cent by eliminating the sulfur-induced corrosion problems in traditional heaters.

Some of the applications include reforming heaters, CDU/VDU heaters, cyclene column heaters, coker heaters, hydrotreating heaters, and some chemical heaters.

• **Renewable process technologies:** Sulzer is at the forefront of innovation in process technologies for renewable feedstocks. From oleo-chemicals to biofuels (SAF and RD), biochemicals, and biopolymers, the company is committed to sustainable solutions.

Sulzer continues driving advancements in plastic recycling and battery materials for a low-carbon future.

Our offering covers fully customisable separation technologies, mass transfer solutions, and polymerisation expertise for businesses keen on developing or producing sustainable materials.

• **VoltaSplit™ Technology:** VoltaSplit™ is the latest technology announcement by Sulzer for electrified distillation. VoltaSplit™ exemplifies Sulzer's dedication to innovation.

This technology marks a major advancement in Sulzer's efforts to reduce the energy consumption and CO₂ emissions from industrial plants, particularly distillation plants.

Traditionally the steam to heat distillation units is generated using fossil fuels. With VoltaSplit™, the energy consumption can be reduced significantly by introducing heat pump technology using electricity as energy source.

VoltaSplit™ uses vapour recompression to achieve this remarkable efficiency. By recompressing distillation column overhead vapours, the steam can be used as heating medium in the column's reboiler.

This almost eliminates the need for cooling water for and heat as utilities. These savings lead often lead to payback periods of less than two years for the implementation of the technology, all while saving significantly reducing CO₂ emissions.

VoltaSplit™ is versatile and thus can be adapted to a wide range of industrial processes. For applications where direct vapour recompression is not feasible, VoltaSplit™ can be adapted using indirect vapour recompression (heat-pump systems).

This flexibility ensures that VoltaSplit™ can meet the specific needs of various industries, including chemicals, biofuels, and pharmaceuticals.

The control system for the compressor and distillation column can be optimised to maximise efficiency and ensure stable operations.

This fine-tuning enhances the performance of distillation units, allowing them to deliver reliable and consistent results across different process conditions.



Sulzer's Mellapak™ CC

A comprehensive policy approach, including incentives and stronger regulatory frameworks, is essential to overcome challenges and accelerate CCS deployment, says a global report

CCS makes notable progress but frameworks still lacking

By ABDULAZIZ KHATTAK

THE global shift towards decarbonisation has gained significant momentum over the past few years, with carbon capture and storage (CCS) technology increasingly recognised as a vital tool for achieving net-zero emissions.

As part of this growing recognition, countries are taking proactive steps to establish and enhance the policies, regulations, and fiscal mechanisms needed to deploy CCS at a large scale, says a report on 'CCS Policy, Legal and Regulatory Review' by the Global CCS Institute.

This includes introducing carbon pricing mechanisms, emissions trading systems (ETs), and offering direct funding and fiscal incentives to accelerate the development of CCS projects.

Over the past two years, there has been a marked acceleration in efforts to support CCS worldwide. Key trends include growing fiscal incentives, increased regulatory certainty, enhanced regional and international collaboration, and a heightened focus on carbon dioxide removal (CDR).

The report provides an overview of the progress and challenges facing CCS governance regimes, highlighting global and regional trends in policy, legal, and regulatory developments.

This includes a deep dive into four key regions: the Americas, Europe, Asia-Pacific (APAC), and the Middle East and Africa, all of which have seen varying degrees of activity and development in CCS deployment over the past two decades.

REGIONAL HIGHLIGHTS

• **Americas:** North America has emerged as one of the most mature regions in terms of CCS development, with the US and Canada leading the charge.

In the US, CCS policies have been significantly strengthened in recent years, with notable improvements in fiscal incentives such as tax credits and direct funding.

For instance, the US government has allocated billions of dollars to expand CCS infrastructure, and the ongoing commitment to the Carbon Management Challenge (CMC) further underscores the country's focus on using CCS to meet its net-zero targets.

As of 2024, the US federal government is working on finalising regulatory frameworks for offshore storage and CO₂ pipeline transportation, while also releasing joint policy statements aimed at enhancing voluntary carbon markets.

At the state level, US states have begun to take more proactive roles in implementing federal CCS policies. Numerous state-specific laws have been passed to facilitate the deployment of CCS, addressing aspects such as CO₂ transport, storage, pore space ownership, and liability.

In Canada, similar support exists, with the federal government introducing Carbon Contracts for Difference (CCfDs) and establishing an Investment Tax Credit (ITC) in 2024.

These measures complement an increase in the national carbon tax. Brazil is also emerging as a regional leader in South America, having passed the Fuels of the Future Bill, which establishes obligations for operators of geological storage sites and creates a momentum for CCS development across the continent.

Trinidad and Tobago has made history as the first country to receive funding for CCS projects from the Green Climate Fund (GCF).

• **Asia-Pacific (APAC) and India:** In the Asia-Pacific region, countries are beginning to recognise CCS as essential for meeting ambitious decarbonisation goals.



CCS facilities help reduce greenhouse gas emissions

Southwest Asia and Australia, in particular, are considered prime candidates for CO₂ storage in geological formations, given their significant capacity and cost-effectiveness for CO₂ storage.

As a result, private sector companies have started forming alliances to develop cross-border CCS value chains, involving countries like Australia, Japan, South Korea, and Malaysia.

Cross-border CCS projects face unique challenges, particularly due to international treaties like the London Protocol, which governs offshore CO₂ storage.

While countries such as South Korea, Japan, and Australia are signatories to the Protocol, non-contracting parties like Malaysia and India are still working towards a clear framework for international collaboration.

Issues such as liability allocation, verification requirements, and the operation of emissions trading schemes must be addressed to ensure the successful deployment of CCS across borders.

Despite significant progress in countries like Australia and Indonesia, other APAC nations such as Malaysia, India, and China face significant gaps in regulatory frameworks.

These gaps are most apparent in areas like post-closure liability, pore space ownership, site selection, and long-term monitoring.

Financial incentives to support CCS investment are also underdeveloped, with unclear tax incentives and inconsistent eligibility criteria for CCS credits under emissions trading schemes.

• **Europe:** The European Union (EU) has long been a leader in the push for decarbonisation, and CCS has been a key element of its climate strategy since 2009.

The EU's commitment to reducing greenhouse gas emissions by 40% by 2030, followed by its target to reach net-zero by 2050, has provided a strong foundation for CCS policy development.

In 2024, the EU launched the Industrial Carbon Management (ICM) Strategy, setting a target of capturing and storing or utilising 450 million tonnes of CO₂ per year by 2050.

However, many countries in the region still lack comprehensive CCS legal and regulatory

frameworks. This ambition has led to greater collaboration across European countries, with increasing bilateral agreements for the transportation and storage of CO₂ across borders.

In the UK, a vision for a competitive carbon capture, utilisation, and storage (CCUS) market was unveiled in December 2023, aiming for the capture of 20-30 million tonnes of CO₂ per year by 2030.

However, unresolved issues such as the integration of bioenergy with CCS (BECCS) and direct air carbon capture and storage (DACCS) remain, as well as uncertainty over the inclusion of CDR in the EU Emissions Trading System (EU ETS).

Despite the progress, challenges persist within the EU, including unresolved aspects of bioenergy with CCS and the future role of CDR in the EU ETS.

The European Commission is expected to address these issues in forthcoming legislative proposals, as well as supporting the development of a regulatory framework for CO₂ transport and storage across borders.

• **Middle East and Africa:** In the Middle East and Africa, while CCS projects have been contemplated for decades, progress in policy and regulatory frameworks has been slow.

However, recent developments suggest that the region is starting to accelerate its efforts.

The UAE's state-owned energy company, ADNOC, has been a pioneer in CCS, launching a CO₂ injection well for sequestration in Abu Dhabi's carbonate saline aquifer.

This builds on ADNOC's existing carbon capture facility, which captures up to 800,000 tonnes of CO₂ annually.

South Africa has also demonstrated an interest in CCS, with the World Bank initiating a capacity-building programme back in 2009.

Over recent years, the urgency of global decarbonisation has led to greater momentum in the region, with 12 out of 32 countries in the Middle East and Africa incorporating CCS or CCUS in their decarbonisation policies.

However, many countries in the region still lack comprehensive CCS legal and regulatory

frameworks.

Oman is one of the few countries in the Middle East working towards establishing a CCS-specific framework, while other countries rely on existing oil and gas legislation or concession agreements to govern CCS activities.

Challenges also remain regarding cross-border CO₂ transportation, as only a limited number of Middle Eastern and African countries are signatories to the London Protocol.

CONCLUSION

In conclusion, while there has been significant progress in carbon capture and storage (CCS), several challenges remain. The key obstacles include:

- The slow development of legal and regulatory frameworks in many regions outside the US, Canada, the EEA, Australia, and the UK. Although some Southeast Asian and Middle Eastern countries are exploring CCS frameworks, this often lacks urgency, causing delays.
- The lengthy permitting processes for storage facilities, with the International Energy Agency (IEA) noting it can take up to 10 years to establish operational facilities. To meet 2050 climate targets, permitting timelines must be shortened, but without compromising thorough reviews.
- The management of long-term stewardship and liability for CO₂ storage. Clarity on the responsibilities after the operator's lifespan is vital to mitigate risks and attract private investment. There is no universal model for this, though some jurisdictions allow liability transfer to competent authorities.
- The commercial viability of CCS, as most projects rely on government support. Regulatory certainty, stable revenue streams, and innovative business models could improve commercial feasibility, but high upfront capital costs remain a barrier.

A comprehensive policy approach, including incentives and stronger regulatory frameworks, is essential to overcome these challenges and accelerate CCS deployment.

MEA renewable energy growth drives demand for grid flexibility

As renewable energy capacity grows, the region will require significant upgrades to existing energy infrastructure to ensure reliability, stability, and resilience in the face of new energy needs

By ABDULAZIZ KHATTAK

As the global shift towards renewable energy accelerates, many regions are rethinking their electrical grid infrastructures.

This transition from centralised to decentralised grid systems presents a range of new challenges, particularly in maintaining grid flexibility as renewable energy sources are integrated into existing networks.

This transformation is taking shape across the world, with countries in North America and Europe set to double their renewable energy capacity by 2028.

The Middle East and Africa (MEA) region is also embracing a renewable energy revolution, with rapid growth and ambitious goals, says a report by Power Technology Research, a market research consultancy focusing on areas within power technology and industrial automation.

But with these advances come significant challenges, notably in grid stability and energy supply management.

GROWTH OF RENEWABLE ENERGY IN MEA

According to the International Energy Agency (IEA), renewable energy generation in the MEA region surged by 20 per cent in 2023, with projections indicating a further 23 per cent increase in 2024.

Over the next five years, renewable capacity in this region is expected to triple, driven largely by a select few countries, including Saudi Arabia, the UAE, Morocco, and Egypt, which are expected to account for over 90 per cent of the region's growth.

These nations are setting ambitious targets to shift their energy mixes towards more sustainable sources.

For instance, Saudi Arabia is diversifying its energy portfolio, targeting 50 per cent renewables in its energy generation mix by 2030, alongside the introduction of nuclear power.

Similarly, the UAE aims for 12 per cent renewable energy by 2026, rising to 30 per cent by 2030, with considerable investments in solar energy projects, especially in Abu Dhabi.

Egypt, already a regional leader in renewable energy, plans to achieve 42 per cent renewables in its energy mix by 2030, five years ahead of its original target.

Meanwhile, Jordan aims to reach a 30 per cent renewable energy share by 2030, up from around 27 per cent currently, and South Africa has set its sights on 41 per cent renewable energy by the same year, despite challenges related to outdated infrastructure and slower growth in its renewable energy sector.

As these countries ramp up renewable energy capacity, their growing energy demands driven by economic expansion will require significant upgrades to existing energy infrastructure to ensure reliability, stability, and resilience in the face of new energy needs.

CHALLENGES TO GRID STABILITY & FLEXIBILITY

The integration of large-scale renewable energy sources brings with it several challenges. The most pressing of these is the need to maintain grid stability and flexibility.

With renewables like solar and wind power dependent on environmental factors, the supply of electricity can fluctuate significantly, causing issues with voltage stability, curtailment, and balancing supply and demand.

• **Interconnecting grids for renewables:** One of the most significant challenges for the MEA region lies in the development of robust grid interconnections.

Renewable energy resources are often located in remote areas, far from population centres and existing grid infrastructure.

For instance, solar power plants in the deserts of Saudi Arabia or wind farms along the Mediterranean coast of Egypt require extensive transmission lines to bring this energy to urban areas.

Cross-border transmission lines will be key in ensuring that renewable energy can be shared efficiently between countries.

• **Voltage stability:** The adoption of renewable energy introduces volatility to grid operations, especially in regions relying on solar power, which generates electricity during daylight hours but is often out of sync with peak demand.

Traditional power plants, such as gas and coal-fired plants, offer grid stabilisation through the inertia provided by their rotating machinery. However, as renewable energy grows, these traditional stabilisers are less available, making it essential to develop new technologies for stabilising voltage and preventing blackouts.

• **Energy balance dilemma:** The intermittent nature of renew-



The adoption of renewable energy introduces volatility to grid operations

able energy sources exacerbates the challenge of balancing supply and demand.

During periods of high renewable generation, such as midday when solar power output is at its peak, there may be excess electricity, leading to curtailment.

Conversely, at times of low renewable generation, such as during the night or cloudy weather, conventional sources may be needed to meet peak demand, which could compromise the environmental goals of the region.

SOLUTIONS TO ENHANCE GRID FLEXIBILITY

To address these challenges, the MEA region is increasingly investing in new energy technologies that can enhance grid flexibility, enable smoother integration of renewable energy, and ensure reliable electricity delivery.

Key solutions include:

• **High-voltage direct current (HVDC):** HVDC technology allows for efficient long-distance power transmission, which is particularly crucial in regions with geographically dispersed renewable resources.

By using direct current (DC) instead of alternating current (AC), HVDC reduces transmission losses and enhances grid stability.

Two primary types of HVDC converters Line Commutated Converters (LCC) and Voltage Source Converters (VSC) are being deployed across the MEA region.

Notable projects include Hitachi Energy's contract for a 3-GW HVDC system in Saudi Arabia's NEOM city, which will integrate renewable energy and energy storage.

Similarly, Adnoc has implemented subsea HVDC systems to reduce offshore carbon emissions by over 30 per cent, replacing conventional gas turbine generators with sustainable power sources.

• **Battery energy storage systems (BESS):** As intermittent renewable energy sources can cause supply-demand imbalances, BESS plays a crucial role in smoothing these fluctuations.

BESS can store excess renewable energy when supply outstrips demand and release it when required.

Several major storage projects are underway in the MEA region. For example, Emirates Water and Electricity Company (EWEC) plans a 400-MW BESS project to enhance grid flexibility.

Saudi Arabia has also committed to large-scale energy storage systems, including a 1.2-GWh facility at the Red Sea project.

Egypt has joined the energy storage race with a collaboration between Scatec and the Egyptian Electricity Holding Company, developing Egypt's first solar-plus-storage facility.

• **Flexible alternating current transmission systems**

(FACTS): FACTS technologies, such as Static Var Compensators (SVC) and Static Synchronous Compensators (STATCOM), are designed to improve the reliability and stability of transmission networks.

These systems use power electronics to regulate voltage and manage transmission flows, which is particularly important when integrating large amounts of renewable energy.

The MEA region is already seeing investments in FACTS technology, with General Electric (GE) and Alfanar installing a Hybrid STATCOM for the Saudi Electricity Company (SEC) in Tabuk, and Hitachi Energy deploying a STATCOM in Egypt to enhance power quality and transmission network capabilities.

THE PATH AHEAD: POLICY & INVESTMENT CHALLENGES

Despite the technological advances, the successful transition to a renewable energy future in the MEA region will require comprehensive policy support and investments.

Governments must create favourable conditions for the development of grid flexibility technologies, including clear policies and regulations for energy storage systems, as well as incentives for private sector investment.

Countries in the MEA region that are heavily reliant on conventional energy sources, such as South Africa and Egypt, may face additional challenges due to aging infrastructure and a slower pace of renewable energy adoption.

These nations may need government funding and international support to ensure a smooth transition to a low-carbon future.

Moreover, addressing power quality standards and establishing a coherent policy framework for grid modernisation and renewable energy integration will be crucial for ensuring that renewable energy technologies can be effectively deployed across the region.

CONCLUSION

The Middle East and Africa are experiencing a surge in renewable energy capacity, driven by ambitious targets and substantial investments.

However, as renewable energy becomes a larger share of the energy mix, maintaining grid flexibility and stability is essential for ensuring reliable electricity supply.

The adoption of technologies such as HVDC, BESS, and FACTS will play a key role in overcoming the challenges of decentralised energy systems, allowing the MEA region to harness the full potential of renewable energy. With continued investments, supportive policies, and regional cooperation, the MEA can build a sustainable energy future that benefits both the environment and the economy.

Pioneering sustainable fertiliser transition

Stamicarbon is developing new technologies to address global food demand by enhancing agricultural productivity and reducing environmental impact, focusing on fossil-free feedstock alternatives in the nitrogen fertiliser industry, Deepak Shetty tells **OGN**

THE production of nitrogen fertilisers with a lower carbon footprint is high on the agenda due to the global efforts to reduce greenhouse gas (GHG) emissions and the industry's aim to decrease dependence on fossil fuels.

Green ammonia, produced using renewable energy sources, is currently seen as one of the most promising pathways to provide a sustainable energy carrier or fuel for a wide range of industries.

"When integrated with cutting-edge fertiliser technology, it presents a viable solution to address the increasing food supply demand while safeguarding the planet for future generations," Deepak Shetty, Nikolay Ketov, Stamicarbon (MAIRE), The Netherlands, tells *OGN* energy magazine.

In regions abundant in renewable energy resources and equipped with a robust fertiliser infrastructure, investing in a green fertiliser complex can be more than just a step toward sustainability.

It can serve as a catalyst for economic growth, supporting the development of new skills and expertise critical for the emerging green economy.

This approach not only addresses immediate environmental and economic challenges but also lays the groundwork for a resilient, future-proof industrial landscape.

A STRATEGIC OPPORTUNITY FOR THE GULF REGION

Currently, global ammonia production depends on fossil fuels, leading to substantial greenhouse gas emissions.

Nonetheless, there is a viable way to direct the industry towards sustainability. The most promising path, as seen by the industry leaders and regulators in most of the world, involves green hydrogen and, down the line, green ammonia.

Both can be produced using renewable energy sources such as wind, solar, geothermal, or hydroelectric power.

This process involves splitting water into hydrogen and oxygen, resulting in a carbon-free feedstock.

This production path that utilises proven and readily available technology is increasingly recognised as one of the most practical routes for transitioning to carbon-free solutions.

Overcoming the key hurdles in decarbonising the ammonia and fertiliser industry requires addressing several critical factors, including economics, infrastructure, and the availability and storage of renewable energy.

The Gulf region stands out as uniquely positioned to tackle these challenges effectively. With its abundant solar energy resources, strong policy support, advanced infrastructure, and established proficiency in chemical processes, the Gulf region has the potential to emerge as a global hub for low-carbon fertiliser production.

For example, the UAE, Saudi Arabia, and Oman have the lowest levelised cost of electricity (LCOE) for solar photovoltaic (PV), between \$19 and \$26 per Mwh, thanks to a capacity factor of more than 35-40 per cent.

Additionally, onshore wind LCOE is also among the cheapest in Saudi Arabia, ranging between \$20 and \$25 per Mwh.

Moreover, the region's strategic location, connecting major markets in Asia, Africa, and Europe, enhances its potential to build a sustainable and efficient fertiliser supply chain.

By leveraging these advantages, the Gulf region can not only transition beyond fossil fuels but also establish itself as a pioneer in shaping the future of the industry.

Starting early in the shift toward green ammonia and fertiliser production offers significant benefits. By acting now, the key players in the industry aim



Figure 2 ... 3D drawing of NX Stami Green Ammonia

to build expertise and cultivate a skilled workforce capable of managing and innovating in low-carbon production methods.

Conventional fertiliser majors are seeking opportunities to complement their established conventional projects with low-carbon hydrogen and ammonia production projects in the Gulf region.

Early adoption also enables the gradual modernisation of existing infrastructure, allowing facilities to align with new sustainability standards without causing major disruptions.

This phased approach spreads investment costs over time while ensuring infrastructure and supply chains can adapt to evolving environmental regulations and market demands.

Shipping fertiliser from the Gulf region to Europe is efficient due to the relatively low logistical costs associated with bulk fertiliser transport.

Further, the European market presents a significant opportunity, especially with the impending enforcement of the Carbon Border Adjustment Mechanism (CBAM) in 2026, which will include carbon taxes on fertilisers.

By taking proactive steps today, the Gulf region can secure a competitive position in the global market, ensuring long-term growth and sustainability.

START SMALL, THINK BIG

While the idea of immediately embarking on a global-scale green transition is appealing, it is not yet possible due to numerous bottlenecks.

The limited availability and high cost of renewable electricity, coupled with a shortage of immediately available electrolyzers, make large-scale implementation challenging.

However, beginning with medium- or small-scale sustainable ammonia production provides a feasible starting point for reducing the environmental footprint of fertiliser facilities.

Stamicarbon, the nitrogen technology licensor of NEXTCHEM (MAIRE Group), offers a proven solution to the low-carbon ammonia challenge with its high-pressure NX STAMI Green Ammonia technology.

Applicable for capacities ranging from 50 to 500 metric tonnes per day (MTPD), this technology is optimised for operations reliant on green feedstock.

Designed to address the intermittent nature of renewable energy sources, NX STAMI Green Ammonia incorporates a high-pressure ammonia synthesis loop operating at approximately 300 bar (Figure 1).

This design ensures efficient production while

accommodating the variability inherent in renewable energy supply.

The ammonia converter used in the NX STAMI Green Ammonia process is a single-bed axial-flow converter with a tubular design.

The feed is pre-heated using the exothermic ammonia synthesis reaction on the catalyst side to a temperature required for adequate catalytic activity. The start-up heater is integrated into the ammonia converter to ensure optimal heat integration during start-up.

Due to the high pressure, the reactor and catalyst volume can be reduced compared to larger-scale technologies.

An electrically-driven multi-service reciprocating compressor is responsible for compressing the make-up gas, recompressing the recycle stream containing the unconverted gas, managing the refrigeration loop, and, if necessary, conditioning the process stream to meet the required specifications.

The high pressure of the synthesis loop allows for single-stage ammonia condensation using cooling water.

This eliminates the need for a dedicated refrigerating compressor, thus minimising equipment count, leading to about 25-30 per cent capex savings, essential to offset the lack of economies of scale. Depending on the capacity, the plant uses about 25-250 MW of power, and its footprint is about 15 x 30 m for smaller scales and 50 x 50 m for larger scales (see Figure 2).

INTEGRATION OF TECHNOLOGIES IN A GREEN FERTILISER COMPLEX

The NX STAMI Green Ammonia technology of-

fers a competitive solution and can be applied in combination with Stamicarbon's nitric acid, available in mono-pressure and dual-pressure designs, and urea technologies to produce green nitrate fertilisers.

In combination with the use of recycled or recovered CO₂, it reduces the carbon intensity of urea fertiliser production.

This complex might include a urea solution plant, an ammonium nitrate solution plant, and a UAN mixing plant.

NX STAMI Nitrates portfolio offers a set of technologies with optimal energy recovery and reliable operation, and due to the efficient tail gas treatment system, greenhouse gas emissions are minimal.

Having a portfolio of proprietary technologies, Stamicarbon can improve the integration between plants and consequently optimise different technologies to make the complex more attractive from an economic point of view.

Stamicarbon is also ready to apply its green ammonia and fertiliser technologies to other industries, such as steelmaking, to help make them more sustainable.

CONCLUSION

The rising global food demand presents a critical challenge for the nitrogen fertilisers industry: How to meet the growing demand while simultaneously reducing environmental impact.

In response to these challenges, we are developing new technologies to shift towards more productive agriculture and the adoption of fossil-free feedstock alternatives.

Major players in the fertiliser industry worldwide are already taking significant steps towards this goal. The move towards sustainable practices in the fertiliser industry is not just a response to environmental concerns but also a strategic adaptation to the changing demands of global agriculture.

The green fertiliser market is emerging gradually, driven by the shift to zero-carbon hydrogen in products such as Ammonium Nitrate or CAN (calcium ammonium nitrate).

Stamicarbon's technology package offers a competitive option for local production of a high-value product with significant potential in a carbon-free economy.

A green fertiliser plant under a single licensor can streamline the integration of processes to reduce emissions, simplify maintenance, and, ultimately, maximise efficiency. This integrated approach is essential for succeeding in the challenging journey towards sustainable fertiliser production, ensuring that the industry can meet the dual demands of increasing productivity and environmental stewardship.

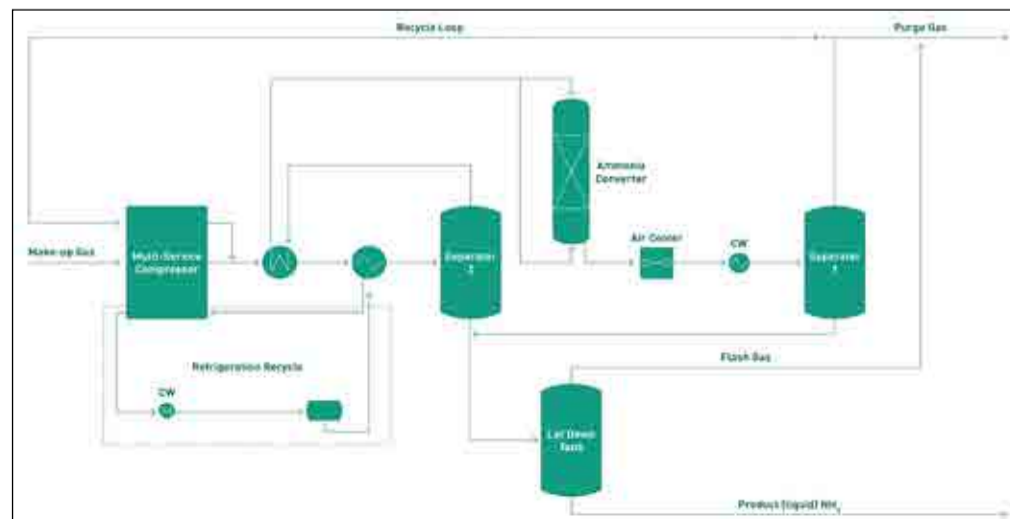


Figure 1 ... The NX Stami Green Ammonia process diagram

Through strategic investments, innovative technologies, and a focus on green infrastructure, the Kingdom is building a future that is both economically diversified and environmentally sustainable, says a report

KSA sets benchmark for sustainability in Mideast

By ABDULAZIZ KHATTAK

IN recent years, Saudi Arabia has rapidly emerged as a key player in the global sustainability movement, leveraging its vast economic resources to lead the Middle East in renewable energy and green technologies.

A white paper prepared by Horizon Group, Switzerland, and commissioned by Agility, says the Kingdom is not only seeking to mitigate the effects of climate change through a series of ambitious national initiatives, but also aiming to transform its entire economic landscape, diversifying away from its traditional reliance on oil and gas.

The government's Vision 2030, paired with the Saudi Green Initiative (SGI), is set to guide the country through a profound ecological and economic transformation.

VISION FOR A SUSTAINABLE FUTURE

Saudi Arabia's push towards sustainability is driven by the understanding that the Kingdom's economic future is at risk from the impacts of climate change.

By 2050, projections suggest that the country could face severe environmental challenges, including more frequent agricultural droughts, prolonged heatwaves, and substantial damage to its GDP.

To address these issues, Saudi Arabia has set in motion a comprehensive green agenda that focuses on clean energy, infrastructure, and environmental preservation.

The government's commitment to sustainability is evident in the measurable progress it has made. As of 2024, the Kingdom is on track to achieve many of the targets outlined in Vision 2030. Key performance indicators show that 87 per cent of its 1,064 initiatives are completed or on track, and more than half of the goals related to environmental sustainability have exceeded their targets.

Over 49 million trees have been planted, while 2.8 gigawatts (GW) of renewable energy have been integrated into the national grid, powering over 500,000 homes.

The Saudi Green Initiative (SGI), launched in 2021, plays a pivotal role in these efforts, with a goal to increase the country's reliance on renewable energy to 50 per cent by 2030.

As part of this ambitious plan, the Kingdom has connected 2.8 GW of renewable energy to its national grid and rehabilitated vast areas of degraded land. By 2030, the aim is to plant over

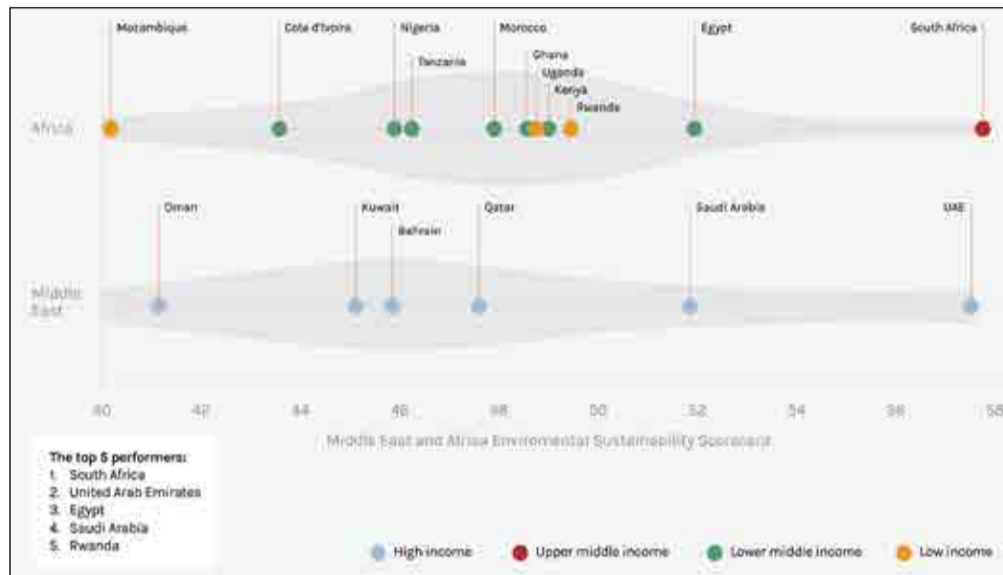


Figure 1 ... MEA Environmental Sustainability Scorecard 2023 results

600 million trees and restore more than 8 million hectares of land.

Meanwhile, the economic diversification towards non-oil activities reached

an all-time high in 2023 SR1,889 billion (\$510 billion) contributing to 50 per cent of the nation's GDP. Driven by Vision 2030, this showcases the Kingdom's commitment to reducing reliance on fossil fuel revenues.

GREEN INVESTMENT & INNOVATION

One of the most significant drivers of Saudi Arabia's sustainability efforts is its focus on green investment and innovation.

A key indicator is the Middle East and Africa Environmental Sustainability Scorecard (MEA ESS), a comprehensive dataset that captures public and private sector sustainability actions.

Saudi Arabia emerged among the top performers (Figure 1), with its performance reflecting both strengths and areas for improvement (Figure 2).

The country's Public Investment Fund (PIF) has been a cornerstone in this transformation, channelling funds into clean technology, renewable energy, and sustainable infrastructure.

The PIF's green bonds, which raised \$8.5 billion in 2023, are used to finance projects that align with Saudi Arabia's environmental goals.

Additionally, the PIF is a founding member of the One Planet Sovereign Wealth Fund Network, a global coalition that seeks to accelerate the transition to a low-carbon economy.

Saudi Arabia is also making strides in green technology innovation. Companies like Aramco have committed millions of dollars to developing energy transition solutions, while over half of Saudi companies are planning to introduce green technologies in their operations.

These efforts are not limited to the domestic market. Saudi investors are playing a leading role in global climate tech investments, with estimates showing that 75 per cent of the capital coming from the Middle East to climate tech startups globally originates from Saudi Arabia.

THE HYDROGEN REVOLUTION

Saudi Arabia's ambition extends to becoming a global leader in hydrogen energy. The country is poised to dominate the hydrogen market by 2030, with plans to produce 2.9 million tonnes of hydrogen annually by the end of the decade and 4 million tonnes by 2035.

This commitment is supported by the development of NEOM, a futuristic city in the northwest of the country that will house the world's largest green hydrogen plant.

With an investment of \$8.4 billion, this project is expected to be a key component of Saudi Arabia's transition to a sustainable energy future.

Hydrogen production is part of the Kingdom's broader strategy to reduce its dependence on fossil fuels.

The country is already exporting clean ammonia, a hydrogen derivative, to international markets such as Japan and Europe, and it has agreements in place to develop green hydrogen solutions in partnership with South Korea.

SUSTAINABLE INFRASTRUCTURE & MEGA PROJECTS

At the heart of Saudi Arabia's sustainability plans is a series of mega infrastructure projects designed to reshape the country's urban and economic landscape.

The NEOM city project, for example, is envisioned as a fully sustainable urban development powered entirely by renewable energy.

Meanwhile, the Red Sea Project aims to create a high-end tourism destination that balances environmental conservation with luxury experiences. This includes the world's first zero-carbon 5G network, which has been deployed at the Six Senses Southern Dunes resort on the Red Sea.

Transport infrastructure is another area where sustainability is being prioritised. The Riyadh Metro project, worth \$23 billion, will see the construction of 176 km of metro lines, with driverless trains expected to carry up to 400,000 people daily.

Similarly, the Makkah Public Transport Programme will cater to millions of pilgrims visiting the holy city, with an 180-km network of metro stations.

These projects are part of a broader \$1 trillion infrastructure development plan that is set to lay the groundwork for a sustainable economy in the coming decades.

GOVERNANCE & REPORTING

For sustainability to be truly transformative, strong governance and transparent reporting mechanisms are essential.

Saudi Arabia has made significant strides in this area, scoring higher than the regional average in both government regulations and corporate governance related to sustainability.

The Kingdom's Greenhouse Gas Crediting and Offsetting Mechanism (GCOM) provides incentives for domestic businesses to reduce emissions, helping the country meet its net-zero by 2060 target.

Corporate governance is also evolving, with many businesses increasingly incorporating environmental, social, and governance (ESG) practices into their strategies.

Notable companies, such as Saudi Aramco, now publish annual reports detailing their environmental impact, carbon emissions, and water usage, reflecting a broader trend of corporate responsibility in Saudi Arabia.

ENERGY TRANSITION & CIRCULAR ECONOMY

Saudi Arabia's energy transition is one of the most significant aspects of its green agenda. The Kingdom has set an ambitious target of reducing carbon emissions by 278 million tonnes per year by 2030.

Efforts to improve energy efficiency are already bearing fruit, with a marked increase in renewable energy adoption.

The Sudair Solar Plant, with its 3.3 million solar panels, is set to power 185,000 homes, while the country is exploring large-scale renewable projects in wind and solar energy.

The Kingdom's efforts also extend to circularity and waste management. Saudi Arabia aims to divert 90 per cent of its waste from landfills by 2040 through recycling, composting, and waste-to-energy projects.

The Circular Carbon Economy National Programme is central to this effort, helping to promote responsible resource use and waste management across the country.

ENVIRONMENTAL ECOSYSTEMS & BIODIVERSITY

Saudi Arabia's environmental preservation efforts are a crucial component of its broader sustainability strategy.

The country has committed to protecting 24.6 per cent of its land, including 18.1 per cent of its terrestrial areas and 6.5 per cent of its marine environments.

In December 2024, Saudi Arabia will host the 16th session of the Conference of the Parties (COP16) to the United Nations Convention to Combat Desertification.

This high-profile event will bring together global leaders to discuss land degradation and sustainable solutions, further cementing Saudi Arabia's role as a sustainability leader in the region.

CONCLUSION

With its continued progress, the Kingdom may well exceed its ambitious Vision 2030 targets and redefine what it means to be a sustainable economy in the 21st century.

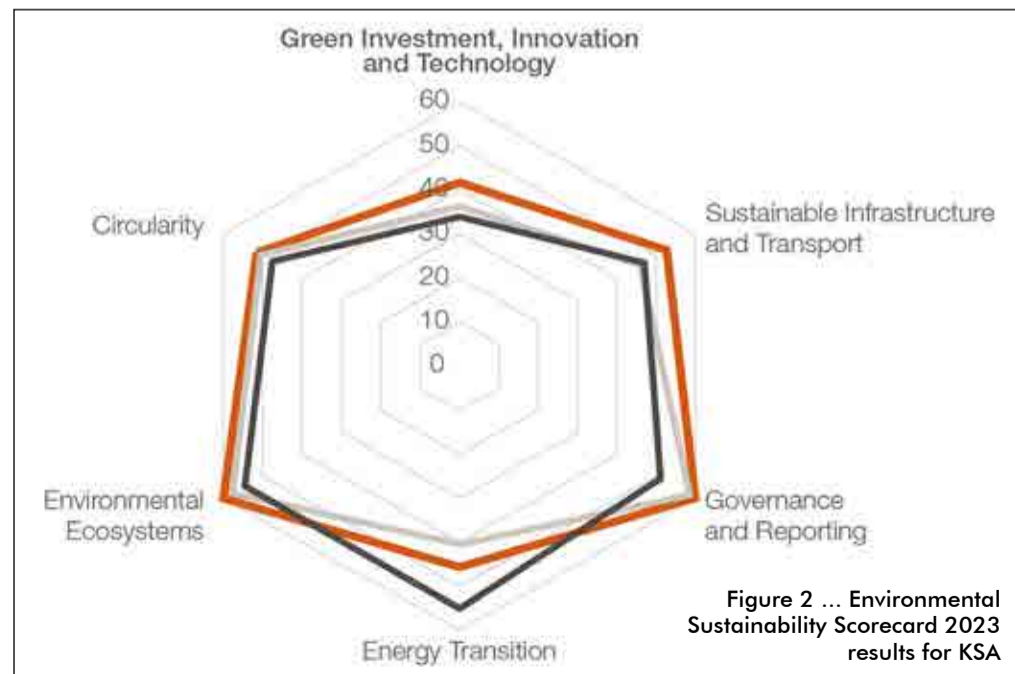


Figure 2 ... Environmental Sustainability Scorecard 2023 results for KSA

A new chapter in the GCC for gas analytical market

The joint venture combines Kanoo Energy's in-depth regional knowledge with Adage Automation's technological expertise to make significant contributions to the gas analytics sector



Official launch of AKIC in Jubail ... marking a new era in gas analytics



Key leaders from Kanoo Energy and Adage Automation at AKIC's cutting-edge facility, driving innovation in gas analytics

THE latest joint venture by Kanoo Energy, part of the Yusuf Bin Ahmed Kanoo Group (YBAK) in Saudi Arabia, represents a significant milestone for gas analytics capabilities in the GCC region and aligns strategically with the country's Made in Saudi Program.

Adage Kanoo Industrial Company (AKIC) was established in collaboration with Adage Automation, India, a leader in integrated gas analytical solutions and officially launched on November 12, 2024 in Jubail, Saudi Arabia.

AKIC's state-of-the-art factory is equipped with a training centre, and a repair and calibration lab, and supports KSA's push for local manufacturing initiatives in accordance with the In-Kingdom Total Value Add (iktva) requirements.

In addition to bolstering domestic production, the company will also export equipment to other regions thus introducing Saudi-made products to a wider global audience.

The joint venture will allow the two companies to combine and leverage their unique capabilities to make significant contribution to driving the gas analytics sector forward.

By combining Kanoo Energy's in-depth regional knowledge with Adage Automation's technological expertise in the gas analytics domain, the new venture will offer tailored solutions for industries, such as oil and gas, petrochemicals and utilities, with a strategic effort to address the unique demands of the region.

The venture aims to deliver value-added ser-



AKIC's state-of-the-art factory in Jubail ... driving local manufacturing and innovation

vices to major stakeholders, including Saudi Aramco and SABIC, through local operations and enhance operational efficiency through skilled experts and on-the-ground support.

The integration of advanced gas analytics with digitalisation and data analytics enables industries to adopt robust and scalable solutions, improving operational performance and ensuring compliance with environmental standards.

Commenting on the partnership, Ali Abdulla

Kanoo, President of Kanoo Industrial and Energy, said: "With this collaboration with Adage, we've found the right partner who shares our vision and ideals. With other partners also coming on board, we're creating a great amalgam for a transformative future."

Meanwhile, Dr Abhijit Chatterjee, Co-founder and Managing Director of Adage Automation, said: "This is a red-letter day for us as we inaugurate our newly established company in the Kingdom of Saudi Arabia in partnership

with Kanoo."

On his part, Manoj Tripathy, CEO of Kanoo Industrial & Energy, said: "It is indeed a great day for Kanoo and another milestone in our strategy mapping. Five years ago, we set out to transform trading-focused activities to bring more value-added solutions and expand local manufacturing capabilities within the Kingdom. We look forward to contributing to the region's growth through this new venture."



Midland methane leaks dubbed 'super emitters'

The detection of more than 50 methane leaks in the region underscores the environmental challenges that come with large-scale production, says Momentick

MIDLAND, Texas, located at the heart of the Permian Basin, is known as one of the most prolific oil and gas-producing regions in the US.

With a history of production stretching back to the 1940s, the area has contributed significantly to the country's energy independence and economic growth.

In 2020, the Midland Basin accounted for approximately 15 per cent of US crude oil production and 6 per cent of dry natural gas production.

However, this success has also brought challenges, most notably the release of methane gas a potent greenhouse gas into the atmosphere.

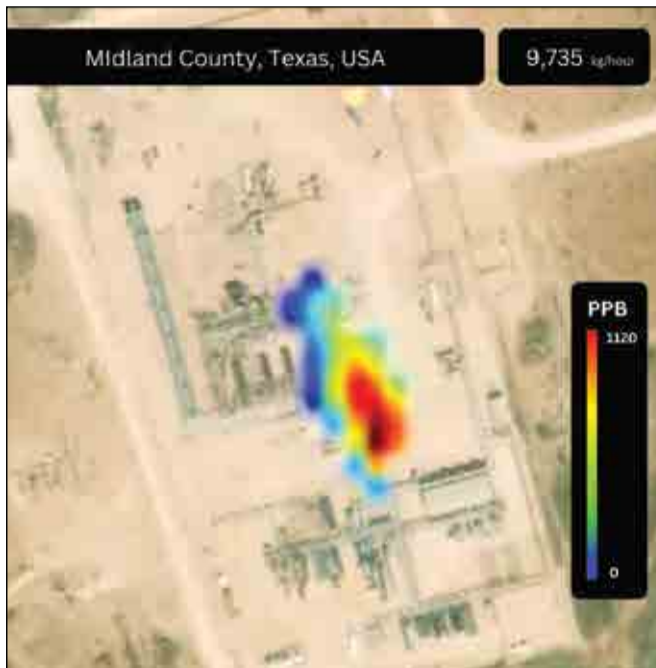
Recent discoveries of methane leaks in Midland County by Momentick, an emissions intelligence company, raise concerns about the environmental impact of the region's oil and gas activities.

Over the past four years, Momentick has detected more than 50 methane plumes across 16 unique facilities, including wells, pipelines, metering stations, and compressor stations.

The findings are alarming, as the majority of the leaks exceeded 4,500 kg per hour, with five facilities emitting more than 10,000 kg per hour.

These are classified as "Super Emitters" by the Environmental Protection Agency (EPA).

Over 20 methane emissions were detected in 2022, and 9



Leaks reaching 10,000 kg per hour have been detected

that could otherwise be captured and sold.

For Midland County, where oil and gas production is a major economic driver, balancing economic growth with environmental responsibility is a complex challenge.

The detection of methane leaks in the region emphasises the need for more stringent monitoring to ensure that emissions are minimised and the potential for economic losses is reduced.

REGULATORY & TECHNOLOGICAL SOLUTIONS

In recent years, regulators and environmental organisations have called for more robust methane monitoring and leak detection programmes in regions like Midland.

Texas, the largest oil and gas-producing state in the country, has been slower than some other states to adopt comprehensive methane regulations.

However, the growing awareness of methane's environmental and economic impact is prompting calls for change.

By improving methane monitoring and implementing stricter regulations, Texas could reduce its greenhouse gas emissions while also benefiting from the economic gains of capturing more natural gas.

Technology will play a critical role in addressing the methane challenge in Midland and other oil-producing regions.

Satellite-based methane detection tools like Momentick's have proven to be a game-changer, allowing for large-scale monitoring of vast areas with pinpoint accuracy.

This technology can help operators identify leaks more quickly and efficiently, enabling faster repairs and reducing emissions.

A PATH FORWARD FOR MIDLAND

The discovery of widespread methane leaks in Midland County is a wake-up call for the region's oil and gas industry.

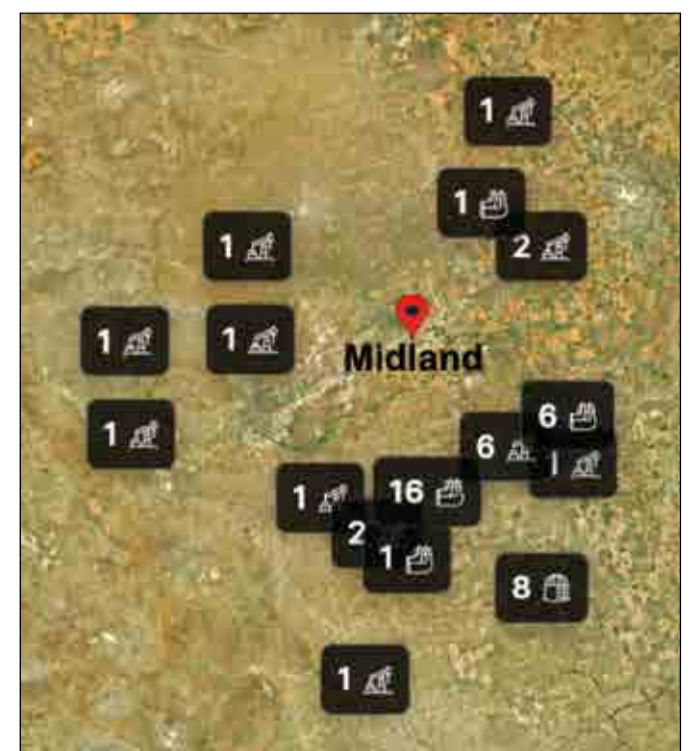
While Midland's contributions to the nation's energy supply are undeniable, investing in modern methane detection technology will allow the industry to reduce its environmental footprint while also improving its bottom line.

At a time when the global community is increasingly focused on reducing greenhouse gas emissions, addressing methane leaks in Midland and the broader Permian Basin is an essential step toward achieving climate goals.

The detection of more than 50 methane leaks in the region underscores the environmental challenges that come with large-scale production.

As the industry faces increasing pressure to reduce emissions, technological innovations such as satellite-based methane detection offer a path forward.

By embracing these tools, Midland can continue to play a vital role in the energy sector while also taking meaningful steps to reduce emissions.



Midland Texas methane emissions detected by Momentick

to date in 2024. The most recent emission was recorded on June 25, 2024.

THE METHANE CHALLENGE

Methane, the primary component of natural gas, is an invisible and odorless gas, making it difficult to detect without specialised technology.

Despite its subtle presence, methane is a major contributor to climate change. It is 84 times more effective at trapping heat in the atmosphere than carbon dioxide over a 20-year period, making it a critical target for global efforts to reduce greenhouse gas emissions.

Midland County is home to over 15,000 wells, with 75 per cent actively producing hydrocarbons.

In addition to the wells, there are miles of pipelines, compressor stations, and other facilities involved in the extraction, processing, and transportation of oil and gas.

This dense concentration of infrastructure makes it challenging for traditional leak detection and repair (LDAR) programmes to effectively monitor and address methane emissions.

Many leaks go unnoticed for extended periods, contributing to both economic losses, as methane that escapes into the atmosphere. This represents lost products for companies, alongside environmental harm.

The Permian Basin, which includes Midland, has long been a focus of concern for methane emissions, particularly as hydraulic fracturing (fracking) and other modern extraction methods have unlocked new gas-bearing formations over the past two decades.

The recent identification of more than 50 methane leaks in Midland County highlights the scale of the problem.

The emissions were detected using Momentick's satellite-based monitoring technology, which has become an increasingly valuable tool in detecting emissions.

THE ENVIRONMENTAL & ECONOMIC IMPACT

Methane emissions from the oil and gas sector are not only a climate issue but also an economic one.

Lost methane represents wasted energy

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The LIWP is specifically engineered to empower operators to safely and cost-effectively plug and abandon aging subsea wells while minimising wellhead loads and streamlining operations

Oil States launches world-first low impact workover package

OIL States, a global provider of manufactured products and services to customers in the energy, industrial and military sectors, has announced an industry-first Low Impact Workover Package (LIWP).

The innovative technology was debuted at the SPE ICoTA 30th European Well Intervention Conference, held on November 20-21 in Aberdeen, supporting the event's 'Empowering Tomorrow' theme.

Oil States brings more than four decades of engineering expertise to the international oil and gas industry and is known for supplying advanced offshore systems including drilling and completion risers, subsea connectors, subsea control packages, flexible joints as well as riser analysis.

With a deep understanding of the complexity offshore operations related to historic, fragile well systems, the LIWP is specifically engineered to empower operators to safely and cost-effectively plug and abandon aging subsea wells while minimising



Oil States' industry-first Low Impact Workover Package

wellhead loads and streamlining operations.

The fully-integrated LIWP system features a uniquely positioned FlexJoint™ connector as part of the Low Riser Package (LRP), providing a 30-40 per cent reduction in

wellhead loading compared to conventional intervention systems that rely on tethering systems.

This innovative design allows for a 15-degree emergency disconnect angle enabling direct pull and disconnect

of the Emergency Disconnect Package (EDP) during drift-off scenarios without complex, expensive connectors.

The complete LIWP system includes the EDP, LRP and workover riser interface, and arrives pre-assembled and tested as one unit with a diameter under 49.5 inches, allowing for direct deployment through the rotary table.

The LIWP eliminates time- and cost-intensive moonpool assembly and subsea tethering operations, saving 24 hours during installation and 12 hours during retrieval and as much as \$2.5 million per deployment.

"Oil States continues to pioneer innovations that promote safer and more cost-effective operations," commented Garry Stephen, Oil States' Vice-President, UK and Asia.

"The LIWP is an important solution that allows operators to meet today's P&A requirements while increasing operational efficiency and enhancing the safety of workover system deployment."

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Carbon capture tech critical to boost Mideast climate action

Carbon capture solutions could be a key factor for climate action efforts and could significantly contribute to the Middle East's decarbonisation goals and help fast-track progress, Matt Spalding tells **OGN**

By **ABDULAZIZ KHATTAK**

EARLIER this year, the UAE experienced a storm that brought an entire year's rainfall in just one day.

Large parts of the UAE were flooded, leading to widespread damage to homes, roads, buildings, cars and more.

The social and economic impact of such events is tremendous, and the unfortunate reality is that climate change may contribute to a continued rise in natural disasters both locally and globally.

Partly because of increasing carbon emissions, the Middle East is warming faster than the global average by around 0.45 deg C per decade.

The Center for Climate and Energy Solutions reported that for each degree Celsius of warming, the air's capacity for water vapour increases by 7 per cent.

For countries like the UAE, Saudi Arabia and others in the Gulf Cooperation Council (GCC), rainfall could increase by 15 to 35 per cent by the end of the century.

"Both the public and private sectors need to

act quickly to reduce carbon emissions," Matt Spalding, Vice-President and Regional General Manager MENA at Honeywell Energy and Sustainability Solutions, tells **OGN** energy magazine.

The Middle East and North Africa face unique challenges and opportunities regarding decarbonisation and the expected transition to clean energy over coming years and decades.

As a net energy exporter, the region plays a crucial role in the global energy landscape. However, it faces a pressing need to reduce emissions to avoid contributing to more catastrophic weather events.

Innovative solutions are needed to support the region – and the world – as governments and industry participants work to meet net zero targets some of them have and combat the impacts of climate change.

Carbon capture solutions could be a key factor for climate action efforts.

These technologies can significantly contribute to the Middle East's decarbonisation goals and help fast-track progress.

Carbon capture, utilisation, and storage



Matt Spalding

(CCUS) solutions help reduce carbon dioxide (CO₂) emissions from industrial processes, power plants, and other sources.

By capturing CO₂ before it enters the atmosphere, CCUS technologies can significantly help reduce greenhouse gas emissions.

CCUS solutions can play a crucial role in hard-to-abate sectors like cement and steel production, as they can reduce CO₂ emissions generated from industrial processes.

These technologies also offer cost-effective alternatives in industries where CCUS proves to be more financially efficient than other emission reduction methods or where captured carbon can serve as a valuable

input for products.

A typical coal-fired powerplant – 650-MW capacity – could capture about 3.4 million tons of CO₂ per year using Honeywell ASCC technology, which is equivalent to removing 735,000 cars from the road each year.

The Middle East is a fertile ground for advancing CCUS technology, particularly in the areas of utilisation and storage because of its large-scale industrial developments and energy projects.

Carbon capture in these mega-projects can not only mitigate the impact of industrial CO₂ emissions but also serve as vital blueprints for other regions to learn about the positive effect that these solutions can have.

Progress is already being made: Abu Dhabi National Oil Company (Adnoc), for example, is actively developing one of the largest carbon capture and storage projects in the MENA region.

This initiative is part of Adnoc's broader carbon management strategy, aiming to connect all emission sources and sequestration sites to accelerate decarbonisation goals in the UAE.

Another example is the Al Reyadah Carbon Capture Facility in Abu Dhabi – a commercial-scale facility that can capture up to 800,000 tons of CO₂ per year from Emirates Steel's plants.

For carbon capture to succeed in the Middle East, greater collaboration is required between governments, industries, and research institutions to accelerate CCUS deployment.

To promote investment in carbon capture technologies, the public sector needs clear policies, and the private sector needs clear incentives.

Technology-driven decarbonisation, including carbon capture, is critical for the MENA region's hopes for a cleaner future.

By embracing innovation and investing in modern technologies, we can collectively reduce our carbon footprint and help establish a more sustainable energy landscape for many years to come.

Geological CO₂ storage to dominate CCUS

CCUS has been identified as one of many vital decarbonisation technologies that will be needed to meet global net-zero emissions targets.

Currently, about 75 per cent of existing CCUS projects rely on utilisation of CO₂ to achieve profitability via enhanced oil recovery (EOR).

According to IDTechEx forecasts, dedicated geological storage of carbon dioxide will outpace EOR as the leading end fate of capture CO₂ by the end of the decade.

By 2045, IDTechEx forecasts the world will be sequestering 1.6 gigatonnes per annum of CO₂ underground.

Permanently storing carbon dioxide generally has better sustainability credentials than utilising CO₂.

This is because permanently sequestering CO₂ captured from an industrial process in dedicated underground storage is a net-zero process (or even net-negative for some CO₂ sources).

In contrast, captured CO₂ returns to the atmosphere on short time scales for several CO₂ utilisation applications,

such as when a fuel synthesised from CO₂ is combusted.

Storing CO₂ is therefore better suited to meeting emission reduction targets.

Furthermore, there is simply greater potential for CO₂ storage than CO₂ utilisation.

It is estimated that the world's potential CO₂ storage capacity may exceed 15,000 gigatonnes.

To put this into perspective, global anthropogenic CO₂ emissions are currently around 40 gigatonnes per year.

This far outpaces potential utilisation markets for carbon dioxide, even when including emerging application areas such as CO₂-derived chemicals or CO₂-derived concrete products.

Many such CO₂ storage projects plan to be operational before 2030, with the Northern Lights Longship project expected before the end of 2024, but some emitters will remain without access.

In the short term, CO₂ utilisation could allow mature ready-now carbon capture technologies to be deployed as infrastructure expands.



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Collaboration between oil and gas, and geothermal industries is essential for meeting clean energy demands, with GEODE accelerating geothermal technology development to become a key component of the future energy landscape, Karine Kleinhaus tells **OGN**

GEODE bridging gap between oil & gas and geothermal

By **ABDULAZIZ KHATTAK**

As energy intensive industries look to electrify, geothermal is emerging as a pathway for supplying constant, reliable, clean energy.

Now an unusual partnership between next-generation geothermal and the oil and gas industry will help unlock the potential of the world's most abundant green energy more quickly.

Geothermal Energy from Oil and Gas Demonstrated Engineering (GEODE), a new initiative backed by the US Department of Energy (DOE), aims to leverage the technology, knowhow and infrastructure of the oil and gas industry to help scale the next-generation geothermal industry.

Spearheaded by Project InnerSpace and Society of Petroleum Engineers International, GEODE brings together more than 100 entities across both sectors to accelerate geothermal growth.

Launched with an initial \$10 million in funding and the prospect of up to \$155 million in competitive solicitations over the coming years, GEODE is set to catalyse geothermal growth, with far-reaching implications for the global energy mix.

The GEODE kickoff meeting in Houston in September highlighted the potential of this partnership.

HARNESSING OIL & GAS EXPERTISE

"The oil and gas sector has spent decades mastering the art of drilling, reservoir engineering, and managing large-scale energy projects," Karine Kleinhaus, Director of Stakeholder Engagement at Project InnerSpace, tells OGN energy magazine.

These are skills and technologies that geothermal can leverage to scale. However, adapting this know-how to the geothermal landscape requires an intricate blend of innovation, collaboration, and coordination between two industries that have historically worked in isolation.

One of the most compelling aspects of GEODE is the emphasis on the open exchange of ideas and technology between sectors.

Geothermal has faced hurdles, including directional drilling to extreme depths and managing high temperature environments.

But technologies such as advanced drilling techniques, reservoir management, and downhole tools, which were originally developed for oil and gas operations, can be adapted to enhance geothermal projects.

A collaborative effort promises to drive down costs, improve efficiency, and bring next-generation geothermal into the main-stream energy portfolio.

A CLEAR, MULTI-PHASE PLAN

The first phase of GEODE, now underway, focuses on creating a comprehensive roadmap.



The Larderello Geothermal Energy plant in Italy ... the oldest geothermal plant in the world

Through this process, key challenges and opportunities for technology transfer, geothermal workforce expansion and development, supportive policy and finance initiatives, and community engagement will be identified by a broad consortium of experts from both fields.

The goal is to fast-track geothermal development in a way that is sustainable, scalable, and commercially viable.

Another focus is on identifying real-world demonstration projects. These projects will serve in the following years as testing grounds for the crossover of oil and gas technologies into geothermal, providing critical insights for future deployments.

Additionally, GEODE plans to establish open-access databases, fostering transparency and collaboration across both industries.

TACKLING POLICY & FINANCE BARRIERS

One of geothermal's biggest challenges is attracting investment. High upfront costs and long project timelines often deter financiers.

GEODE aims to leverage the oil and gas sector's resources to draw investment into geothermal, while also identifying policy changes that would further incentivise geothermal energy projects.

By addressing both financial and regulatory hurdles, GEODE is positioning geothermal as a more attractive option for investors, policymakers, and potential customers alike.

BUILDING A WORKFORCE

As the geothermal industry expands, the need for a skilled workforce will grow. Here again, GEODE's partnership with oil and gas comes into play.

Many of the skills required for geothermal already exist in the oil and gas sector, offering a natural transition for professionals.

This cross-industry collaboration ensures that geothermal can tap into a ready-made workforce, while also growing a new workforce and providing job opportunities to a variety of communities in a rapidly evolving energy landscape.

"Our consortium brings together the best of both worlds—geothermal innovation and the oil and gas sector's operational strength," says Jamie Beard, Founder and Executive Director of Project InnerSpace.

"Together, we'll fast-track geothermal technology deployment for a greener future."

THE ROAD AHEAD: A SHARED VISION

At its core, GEODE is about creating a shared vision for the future of energy. By uniting oil and gas and geothermal professionals, the initiative is laying the groundwork for a sustainable, abundant energy future.

This effort aligns with the DOE's Enhanced Geothermal Shot™, and other DOE renewable energy initiatives and priorities.

GEODE's collaboration between oil and gas and geothermal is not just beneficial; it is essential to meet the rising demand for clean energy.

By combining strengths, these industries can accelerate the development of geothermal technology, positioning it as a critical part of the future energy mix.

Already, data centres, which are particularly energy intensive, are eyeing geothermal as a clean and reliable power source.

Just last month, Sage Geosystems, a Houston-based geothermal energy startup, announced a partnership with Meta to power data centres. We expect many more of these projects to materialise as large tech companies realise the efficacy of geothermal.

CONCLUSION

In the transition to greener energy sources, geothermal energy offers a unique solution one that is reliable, scalable, and has a minimal environmental footprint.

The collaboration between oil and gas and geothermal is not just a matter of convenience; it is a necessity if we are to meet the growing demand for clean energy.

By harnessing the strengths of both industries, GEODE can accelerate the development of geothermal technology, making it a cornerstone of our future energy landscape.

Thermal energy impacts finance, sustainability

UNLEASHING the green power of geothermal energy is a dream rapidly coming true thanks to its promise to deliver on-demand power and heat 24/7.

Yet its full potential to become a backbone of the modern economy as fossil fuel reliance is phased down is only now being scaled up.

Harnessing the earth's natural heat, geothermal energy provides a reliable and continuous power source.

Thermal energy can deliver a stable energy supply, crucial to meeting the demands of our always-on society – making it a strategic investment for green tech funds as countries strive to achieve net-zero emissions.

The geothermal industry is currently valued at approximately \$5.2 billion, but projections suggest it could grow significantly by 2040, potentially reaching around \$20 billion, driven by growing demand for renewable energy sources.

The World Bank has highlighted the potential of geothermal energy as a sustainable and reliable resource, particularly in regions with high



Klas Gustafsson

geothermal activity.

The World Bank notes geothermal energy's ability to provide baseload power and reduce

reliance on fossil fuels.

Geothermal energy is already being harnessed in the US, Indonesia, the Philippines, Iceland, and Italy with the technology also being adopted for heating, cooling, and direct-use applications beyond electricity generation.

Iceland particularly stands out as a pioneering example. The country ranks a global leader in geothermal energy utilisation, with approximately 90 per cent of its homes heated by geothermal sources.

Baseload Capital, a key player in the geothermal space, has successfully financed and developed projects in collaboration with impact-driven funds like Bluepurpose to leverage natural resources, create jobs, and position Iceland as a model for other countries seeking geothermal solutions.

One standout project is the Kopsvatn pilot power plant in Iceland, which has an installed capacity of about 600 kW of electricity and provides hot water to the local municipality heating network for heating homes, green-

houses, bathing facilities and more.

Baseload Capital also operates successful geothermal power plants in the USA, Japan and Taiwan.

Fluctuating fossil fuel prices and global government moves toward decarbonisation further bolster the economic case for thermal energy.

Funds like Blue AB are capitalising on this growing market by investing in companies focused on thermal energy, such as Baseload Capital.

"The sustainability-focused approach of geothermal energy aligns perfectly with the goals of green tech funds like ourselves," said Klas Gustafsson, Bluepurpose Portfolio Manager.

He added that as investors seek opportunities that contribute positively to the planet, thermal energy stands out as a logical choice.

"Supporting innovative geothermal projects that reduce carbon footprints and promote renewable energy sources allow us to play a key role in transiting to a sustainable future," Klas added.