ACCELERATING DECARBONIZATION
IN OIL AND GAS COMPANIES WITH **DIGITAL-TWIN** TECHNOLOGY

DECARBONIZATION GOES DIGITAL

Digital-transformation technologies can play an important role in enabling the oil and gas sector to become more sustainable, secure, and transparent, while meeting the ever-increasing global demand for energy

The global energy system plays a crucial role in driving economic growth, development, and societal progress. However, it also poses significant challenges, including energy security, affordability, and sustainability.

Achieving these objectives requires a concerted effort from all stakeholders, including governments, businesses, and individuals. As leading suppliers to the energy sector, Amazon Web Services (AWS) and Capgemini are committed to addressing these challenges and promoting a more secure, affordable, and sustainable global energy system.

SUSTAINABILITY PRIORITIES FOR OIL AND GAS COMPANIES

One of the biggest challenges facing the energy sector is to reduce greenhouse-gas emissions and mitigate the impact of climate change, while continuing to meet the growing demand for energy. Oil and gas (O&G) companies are crucial players in this effort, because they account for a significant portion of global carbon emissions.

Profit and sustainability must work in tandem. In practice, this means a focus on optimizing hydrocarbon production while decarbonizing and reducing emissions.

To achieve sustainability and viability in the oil and gas sector, companies must adopt a multifaceted approach that balances environmental, social, and economic concerns. Digital transformation plays a crucial role in delivering on this aim.

Digital transformation can help achieve decarbonization by enabling better monitoring and management of energy use

For example, remote sensing technology, data analytics, and workflow automation can help optimize oil and gas production by providing real-time data on environmental and operational conditions. This can help companies better monitor and manage their operations to cut costs and increase efficiency while reducing waste, so they can lower their carbon footprint.

Digital-transformation technologies such as artificial intelligence, machine learning, and automation can further help to optimize production processes and reduce emissions.

Companies must also embrace sustainability practices that go beyond environmental concerns. For instance, they can work to enhance their social credibility to operate by engaging with local communities, promoting diversity and inclusion.

The United Nations identified 17 Sustainable Development Goals (SDGs) that are essential for creating a sustainable future for the planet. In the oil and gas industry, there are several key SDGs that are especially relevant, in particular decarbonization, inclusion, and collaboration.

One way that digital transformation can help achieve decarbonization is by enabling better monitoring and management of energy use. By using sensors, analytics, and other digital tools, companies can gain a better understanding of their energy consumption and identify opportunities for reducing their carbon footprint.

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>
> *Robert Bekkering*
> Global Senior Partner Development Manager, Capgemini Energy/Utilities & Life Sciences, AWS

Inclusion refers to the need to create a more equitable and just society. In the energy/oil and gas industry, this means ensuring that all stakeholders, including communities, workers, and suppliers, are included in decision-making processes and benefit from the industry's activities. Digital transformation can help achieve inclusion by providing greater transparency and engagement.

Collaboration is especially important because it involves many different stakeholders, including governments, regulators, suppliers, and customers. Digital transformation can help facilitate collaboration by enabling better communication and data sharing.

Seventy to 90 percent of the greenhouse emissions any oil and gas operator produces comes from the oil and gas field production activities.

Oil and gas companies have the inherent task of maintaining and/or increasing production of their oil and gas fields, so combining this with reducing emissions presents inevitable challenges from both a planning and a field-operations perspective (see box, below).

These challenges can be addressed by using the open cascade field digital-twins solution from AWS and Capgemini.

This solution uses an open and flexible architecture developed by AWS and Capgemini Open Cascade to build a field-level digital twin specifically customized to support asset teams with the information needed to run their operation and optimize production, while developing solid steps to decarbonization.

A field-level digital twin brings together the best AWS technology and Capgemini's Open Cascade to manage oil and gas field operations in a holistic way, responding to the very particular characteristics of each field and type of operation.

The integrated architecture enables data flows from the field, wells, and surface infrastructure as well as information and insights from the engineering asset-management teams to work together to manage the field in a holistic way through the field-level digital twin for informed decision-making.

"Capgemini leverages AWS cloud to help our clients maximize production of the resilient hydrocarbon assets while decarbonizing their operations," says Lidia Ramirez Garcia Cano, Principal, Transformation Subject Matter Expert for Energy, Oil, and Gas at Capgemini.

DECARBONIZATION challenges for field development planning and operation: Part 1

Field development planning

The objective here is to define the location of the reserves and how to reach and extract them. Issues include:

1. Petrotechnical challenges such as high uncertainties and risk associated to the reservoir and basin with field characteristics such as low porosity, tight formations, aquifers and water management, or natural fractures

2. Basic concerns such as conventional versus unconventional, reserves estimation, financial models

3. Different multidisciplinary physics models such as drilling, completions, geosciences, production, and reserves management that over time have been built, stored, and used in siloed specialized software products, databases, and teams

4. Manual workflows to increase production such as well testing, well integrity, artificial lift equipment optimization, and fluid-injection simulations

5. Extreme need every day for quick operative decisions that typically have a high impact on economic value and risks, affecting personnel, financial, geological, and reservoir operations.

The first software functionality implemented focuses on well-by-well management and automating workflows such as well test and well integrity. The focus then moves to risk management, and finally capabilities to stream data from sensors and telemetry in the well and the well head, to optimize equipment including notifications, alarms, and predictive failure. The objective in the future is to be able to update reservoir models with production data, customized and tailored to the specific needs of the field, reservoir, and its technology, based on the specific challenges they are facing.

To start the journey, AWS and Capgemini will perform a digital maturity assessment of the oil and gas field to understand the level of automation in existing workflows, covering areas such as status of SCADA systems; sensors on the wellheads and bottom whole conditions; virtual fluid metering, whether using cloud infrastructure or on premises; plus databases and use of third-party software platforms. This allows operators to anticipate issues and take proactive steps to prevent them before they occur, which can reduce downtime, increase efficiency, and therefore reduce emissions.

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DECARBONIZATION challenges for field development planning and operations: Part 2

Field operation

Technology challenges depend on the type of operation.

1. **Conventional reservoirs, onshore fields operations:** With mature/brown fields with more than 15 years of operation and production, with old oilfield technology and lack of basic infrastructure, assets may not support the required new instrumentation and automation. Assets should have enough hydrocarbon production life to warrant the cost of retrofitting infrastructure with well as site controls and automation.

2. **Conventional reservoirs, offshore fields operations:** Normally these are mature fields but can include initial phases of production; typically, these are high hydrocarbon volume fields with considerable infrastructure for the initial capital expenditure. Digital technology maturity is highly correlated with the field lifecycle stage and the geography located, and with important instrumentation and equipment installed on the surface systems, subsea wellheads and downhole, with relative isolation from support groups on land (such as the asset-management office) and poor connectivity. This causes a time lag to get real-time data on the onshore support centres.

3. **Unconventional reservoirs, onshore fields operations:** The operations are like a factory doing drilling, completions, and fracking at scale, and require precise, on-time, and sufficient amounts of materials, equipment, and personnel. These often experience supply-chain challenges and are driven more by production than physics models. Newer technology and sensors, optic fiber, telemetry, valves, flowmeters, chokes, and digital oilfield infrastructure can be applied economically.
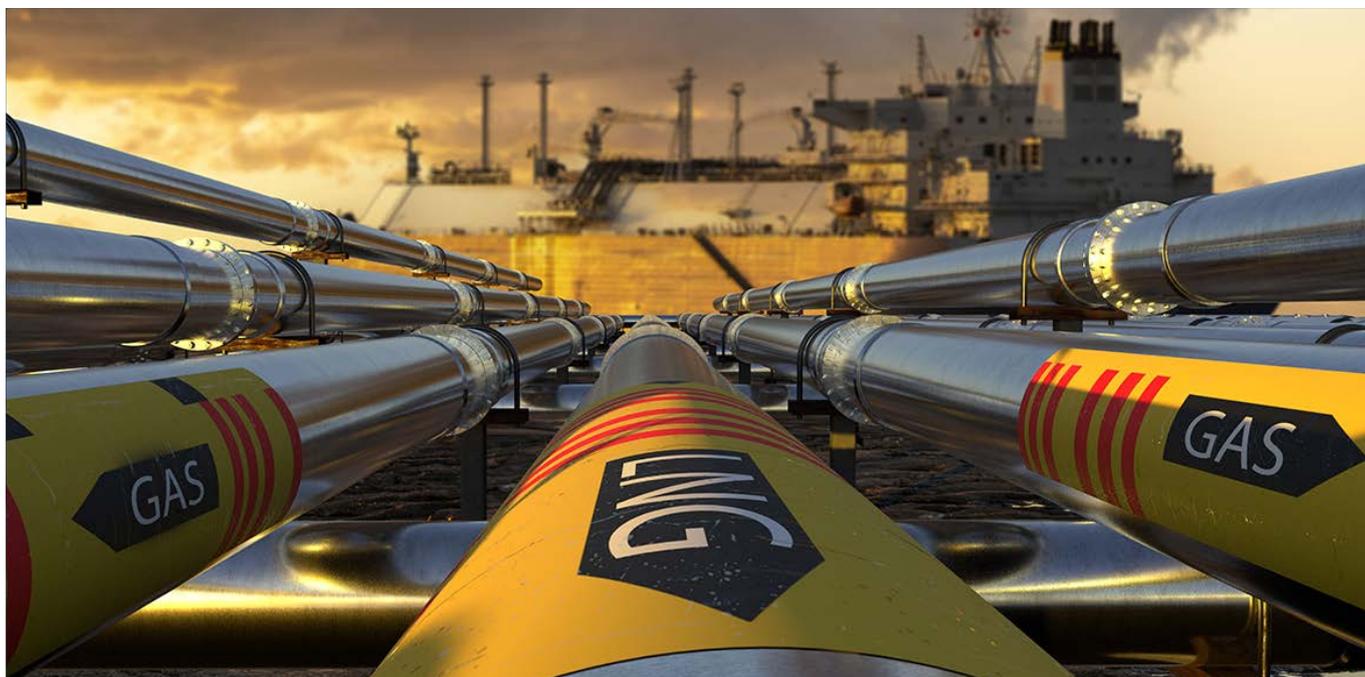
One of the key features of Open Cascade is its ability to optimize production for clean hydrocarbons. The platform uses advanced modelling and simulation tools to optimize production while minimizing greenhouse-gas emissions and other environmental impacts.

"The umbrella of an integrated asset management digital twin includes decarbonization, as we know this is one of the main strategic objectives companies embrace in their journey to net zero and sustainable operations," says Capgemini's Ramirez Garcia Cano.

"One of the most important KPIs is the monitoring and reduction of kilograms of CO_2 emitted per barrel of oil equivalent produced – deep correlated with the integration of reservoir conditions while producing, as well as operational and production efficiencies. Due to the multivariable complex system, there is no "one solution fits all." Each reservoir, field, operation, and company will face different challenges to achieve these objectives, hence our flexible and integrated architecture. The same happens with reducing flaring intensity, methane management and,

for unconventionals, water and spill management."

A FOUNDATION FOR SUSTAINABLE TRANSFORMATION

To achieve sustainability objectives, it's crucial to ensure that all stakeholders are included in the decision-making process. This can involve developing close partnerships with clients to gain insight into their specific needs and preferences and involving clients in the co-creation of sustainable solutions.

AWS and Capgemini Open Cascade can help to sustainably optimize production of hydro-carbons, remove the complexity of operating an oil field by managing it holistically, while supporting strategic decarbonization objectives.

"AWS and Capgemini provide the foundation that energy companies require to transform complex business and operational systems to accelerate the transition to a more sustainable energy future," says Robert Bekkering, Global Senior Partner Development Manager, Capgemini Energy/Utilities & Life Sciences, AWS.

"AWS has the broadest and deepest cloud platform and industry solutions that energy companies require to revamp legacy operations to be less carbon-intensive and accelerate the development of new renewable energy businesses and business models."

Through the use of sustainable production optimization solutions, oil and gas companies will increase efficiency, reduce costs, and minimize environmental impact.

About AWS

Since 2006, Amazon Web Services has been the world's most comprehensive and broadly adopted cloud. AWS has been continually expanding its services to support virtually any workload, and it now has more than 200 fully featured services for compute, storage, databases, networking, analytics, machine learning and artificial intelligence (AI), Internet of Things (IoT), mobile, security, hybrid, virtual and augmented reality (VR and AR), media, and application development, deployment, and management from 99 Availability Zones within 31 geographic regions, with announced plans for 15 more Availability Zones and five more AWS Regions in Canada, Israel, Malaysia, New Zealand, and Thailand. Millions of customers—including the fastest-growing startups, largest enterprises, and leading government agencies—trust AWS to power their infrastructure, become more agile, and lower costs.

For more information, please contact:

Lidia Ramirez Garcia Cano, Principal, Transformation Subject Matter Expert for Energy, Oil, and Gas

lidia.cano@capgemini.com

About Capgemini

Capgemini is a global leader in partnering with companies to transform and manage their business by harnessing the power of technology. The Group is guided every day by its purpose of unleashing human energy through technology for an inclusive and sustainable future. It is a responsible and diverse organization of 360,000 team members in more than 50 countries. With its strong 55-year heritage and deep industry expertise, Capgemini is trusted by its clients to address the entire breadth of their business needs, from strategy and design to operations, fueled by the fast evolving and innovative world of cloud, data, AI, connectivity, software, digital engineering, and platforms. The Group reported in 2022 global revenues of €22 billion (about $23 billion USD at 2022 average rate).

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