CAN AI HELP THE O&G INDUSTRY FOR A SUSTAINABLE FUTURE?

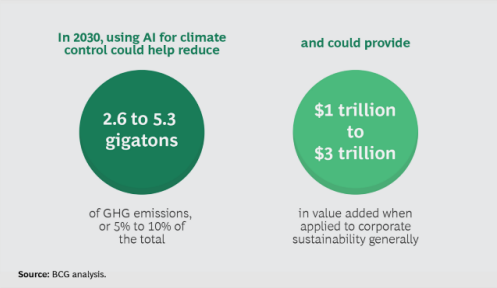

Figure 1: How the use of AI could reduce GHG emissions and increase value

In recent times, owing to its increasing rise in popularity, Artificial Intelligence ("**AI**") is being used by a multitude of companies for different purposes, one of them involving sustainable development. The use of AI by companies with heavy carbon emissions not only makes their activities more environmentally-friendly but the overall process further helps in achieving the Sustainable Development Goals ("**SDGs**") as introduced by the United Nations ("**UN**") in 2015. This is because AI can maximise efficiency, reduce expenses and lessen carbon pollution, which would contribute to cleaner energy.[1] This can be better illustrated in Figure 1 which depicts that by 2030, AI could substantially reduce carbon emissions to 2.6 gigatons and generate a return of $3 trillion.

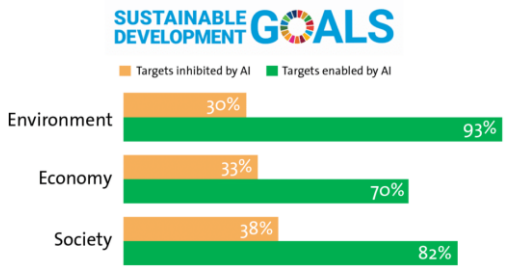

Figure 2: Targets inhibited and enabled by AI as released by the United Nations

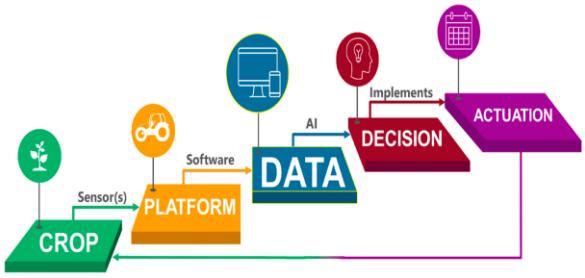

Figure 3: An illustrative example of how AI is used in agriculture

As shown in Figure 2, AI can support the achievement of 93% targets with an inhibition of 30% towards the environment. To give an **example** of how AI can be used as an indispensable requirement for the environment, an AI-supported mechanism can observe the environment by assembling a tremendous amount of data about crops and production. This, in turn, could give important insights into increasing the efficacy of the entire process. For instance, AI may be developed to identify patterns to use less energy and water to grow crops, thereby enhancing agricultural sustainability. Sharing this data collected across various stages in the whole supply chain allows for much larger data sets to be processed, which could provide more comprehensive insights. While AI systems are used to automate processes and identify patterns across various

[1] https://www.forbes.com/sites/glenngow/2020/08/21/environmental-sustainability-and-ai/?sh=638d33e07db3

amounts of microclimatic data (such as humidity and temperature), in practice, it will involve huge financial costs in training such AI systems. This can be better understood from the flowchart given in Figure 3.

In addition, a supply chain involves several processes, which can be simplified with the use of AI. If the correct measures are not taken, the Oil and Gas ("**O&G**") industry may be unfavorable to the environment, owing to leakages and uncontrolled carbon emissions. This would go opposite to the goals of SDGs which, *inter alia*, involve protecting the climate and promoting renewable energy. This article aims to focus on AI in the supply chain, particularly in the oil sector through quantitative data and graphs. It shall also capture the existing AI adopted by the major tech players to safeguard the environment and be in alignment with SDGs.

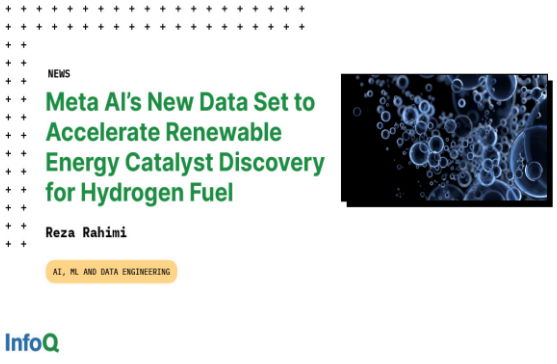

Figure 4: Goals of Meta AI to prevent climate change

To understand how AI is being used, it becomes important to capture what the big-league companies are pursuing to promote environmental sustainability. Facebook has unveiled the Open Catalyst Project to combat rising temperatures through AI.[2] As a measure to address climate change, the goal of the Open Catalyst is to find low-cost electrocatalysts that can drive the chemical processes required to transform excess solar and wind energy into alternative fuels which are easier to store and affordable.[3] This aligns with the second core target of SDG 7 which mentions '*increasing the share of renewable energy in the global energy mix, substantially*'. Renewable energy sources, including solar, wind, geothermal, hydropower and biofuels, have contributed to more than half of all the new power production capacity.[4] In certain cases, this energy can give off-grid or microgrid energy access at a lower cost and promote better health and environmental results vis-à-vis the typical solid fuel use, which is environmentally unsustainable. Deep predictive skills and intelligent grid systems may further be used by AI to control the demand and supply of renewable energy.[5]

Similarly, in addition to investing in green energy projects, Google has introduced several machine learning algorithms to reduce the amount of energy emitted by their various data centres by 40%.[2] This creates a sustainable model for other businesses to use Google's cloud services and lower their energy consumption as well. [6] Overall, these environment-friendly decisions undertaken by major companies contribute towards

[2] https://kooshaj.medium.com/top-5-companies-using-ai-to-combat-climate-change-7f18fb8615e9
[3] https://ai.facebook.com/research/impact/open-catalyst/?utm_source=twitter&utm_medium=organic_social&utm_campaign=impact&utm_content=open-catalyst_people
[4] https://www.ipieca.org/resources/awareness-briefing/mapping-the-oil-and-gas-industry-to-the-sustainable-development-goals-an-atlas/
[5] Refer to 1.
[6] Refer to 5.

achieving SDGs, which provide for "*ensuring access to affordable, reliable, sustainable, and modern energy for all*".[7]

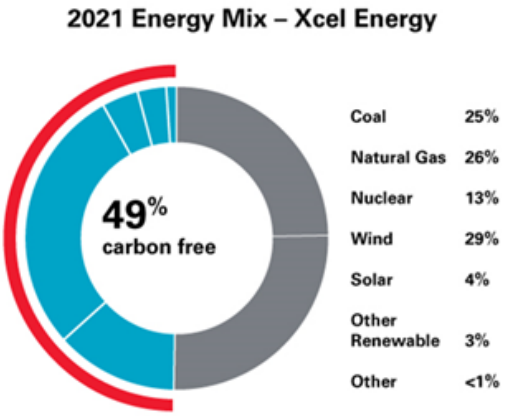

Figure 5: Anticipated energy consumption patterns by Xcel Energy to reduce carbon imprints

AI can optimise energy output as well as better predict and respond to the changing conditions and demand. As shown in Figure 5, to illustrate this principle, Xcel Energy, a coal-burning and nitrous oxide-emitting utility company, uses AI to anticipate energy consumption patterns better and acclimatise its operating systems.[8] As a result, renewable energy output can be improved, and non-renewable sources are finally replaced. Such ventures meet the third target of SDG7, which involves doubling the global rate of improvement in energy efficiency.[9]

AI and Sustainability: Possible challenges to the O&G industry

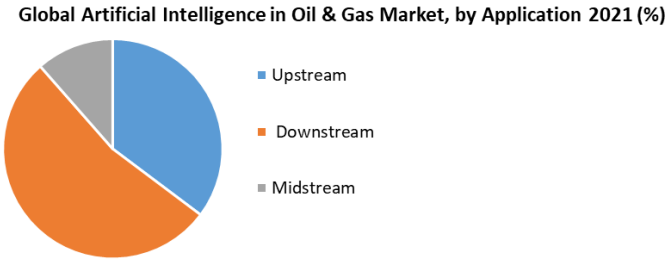

Figure 6: AI application percentage in the O&G industry[10]

The oil and gas supply chain is a complicated operation that includes multiple decision-making processes. It involves the procurement of crude, buying costs, transportation to the refinery, refining activities, gantry operations, and the retail sale of the final products. Regarding how AI can be incorporated, as far as the oil and gas industry is concerned, AI is used to evaluate historical and real-time data, conduct analytics, plan production, manage the supply chain, and employ resources to enhance monetary and environmental returns. AI serves several roles along the oil and gas value chain, each involving a supply chain component.[11] As given in the above Figure 6, AI is being extensively used in all sectors of the O&G industry. To explain this further, the entire supply chain can be divided into upstream, midstream and downstream processes as shown in the Figure 7 below.

[7] https://www.seforall.org/sustainable-development-goal-7-sdg7
[8] https://earth.org/data_visualization/ai-can-it-help-achieve-environmental-sustainable/
[9] Target 7.3, SDG.
[10] https://www.kbvresearch.com/ai-in-oil-and-gas-market/
[11] https://www.futurebridge.com/industry/perspectives-energy/artificial-intelligence-in-supply-chain-management-in-oil-and-gas/?print=pdf

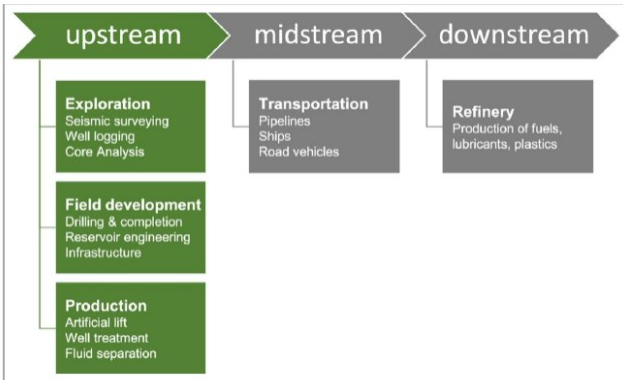

Figure 7: Supply chain of the oil and gas industry[12]

Figure 8: Upstream sector in the O&G industry

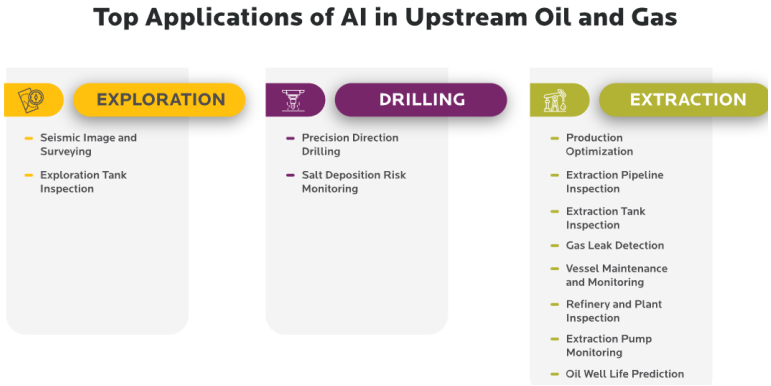

Figure 9: Use of AI in the Upstream sector

With an exhaustive list of the use of AI in the upstream sector in Figure 9, AI could assist the operations team in coordinating with the warehouse to ensure critical parts' availability. Machine Learning ("**ML**") models have been used in exploration to automate data collection, transmission, and analysis for tasks such as seismic surveys, well logging, and core analysis, lowering costs, reducing errors, and increasing efficiencies.[13] Enhancing energy efficiency in both operations and production falls under SDG7.[14] AI is also being used by upstream oil firms to optimise CO2 storage for increased oil recovery.[15] Several oil and gas companies have set net-zero emission goals for themselves. The best method, as highlighted in the McKinsey report, to cope with climate change is to use artificial intelligence apps to measure carbon emissions and develop remedies.[16] For instance, ExxonMobil revealed its carbon goal, to reduce the intensity of its operating upstream greenhouse gas emissions by 15% to 20% over the next five years,

[12] https://www.researchgate.net/publication/359247638_Understanding_AI_Application_Dynamics_in_Oil_and_Gas_Supply_Chain_Management_and_Development_A_Location_Perspective

[13] Refer to 11.

[14] https://www.ipieca.org/resources/awareness-briefing/mapping-the-oil-and-gas-industry-to-the-sustainable-development-goals-an-atlas/

[15] https://www.forbes.com/sites/jimmagill/2021/03/26/oil-industry-turns-to-ai-to-help-confront-daunting-challenges/?sh=11a679ca314b

[16] https://www.mckinsey.com/industries/oil-and-gas/our-insights/the-big-choices-for-oil-and-gas-in-navigating-the-energy-transition

Figure 10: A report by PWC and Microsoft suggest the reduction of GHG emissions by 4% with the use of AI

compared to 2016.[17]This will not only address energy poverty in developing countries but also create financial incentives for efficiency.[18] According to a report prepared by PwC and Microsoft, AI technology might cut global Greenhouse Gas ("**GHG**") emissions by up to 4% in 2030.[19] Such energy-saving measures with a strong GHG element are also given under SDG13.[20]

For the midstream process, as far as transportation for distribution is concerned, AI can significantly reduce road congestion, optimize cargo transit, and provide greater autonomous driving capabilities. It can help firms estimate demand, reducing the amount of transportation required, thereby, decreasing carbon impact to a great extent.

In the downstream sector, AI models are highly preferred over traditional models as they can assist in predicting various chemical processes, which directly affects the efficiency and safety of the processing.[21] An explosion at a refinery, like Wisconsin's oil refinery, for instance, releases a huge amount of toxins in the air, causing an environmental hazard from sustainability as well as PR perspective.[22] According to research, sensors may communicate real-time field data to the AI system, which can then be coupled with past site data to predict and limit leaks.[23] The installation, which included sensors and an AI system, decreased methane leakage from wells by 74%.[24] Volumes of production grew by 20%, while operational expenses decreased by 22%.[25] Therefore, by monitoring oil flame dynamics within the refinery with cameras, the technology may be successful in forecasting the occurrence of unstable conditions, thus, averting potentially harmful scenarios and boosting safety by automating the control system.[26]

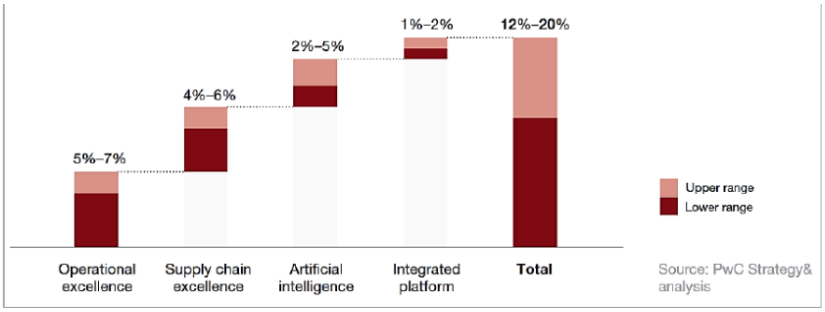

Figure 11: Efficiency increase from digitalization[27]

Under Goal 7, the worldwide challenge is to assure inexpensive, dependable, sustainable, and contemporary energy while transitioning to a global energy system with net-zero greenhouse gas GHG emissions. This will require significant investments in energy efficiency, a significant increase in renewable and lower-carbon

[17] Refer to 17.
[18] Refer to 14.
[19] https://www.pwc.co.uk/services/sustainability-climate-change/insights/how-ai-future-can-enable-sustainable-future.html
[20] Refer to 14.
[21] Refer to 11.
[22] https://www.offshore-technology.com/comment/ai-for-og-sustainability/
[23] Refer to 21.
[24] Refer to 21.
[25] Refer to 21.
[26] Refer to 11.
[27] Refer to 11.

energy sources, and increased deployment of carbon capture and storage (CCS), hinting towards the need for a long-term strategy. This is where AI can step in. In principle, by 2025, deploying AI in the oil and gas sector might result in capital and operational cost reductions ranging from $100 billion to $1 trillion. Figure 11 depicts this possible boost in efficiency through digitalization. As one may seek to ask how AI can be correlated with the environment, an AI model could potentially analyse data from seismic surveys, geology evaluations, and reservoirs by leveraging technologies such as machine learning, artificial neural networks, expert systems, and fuzzy logic. This technique, in return, would also lead to an increase by a factor of 10%, equating to an additional $1 trillion in the BOE (Barrel of Oil Equivalent).[28]

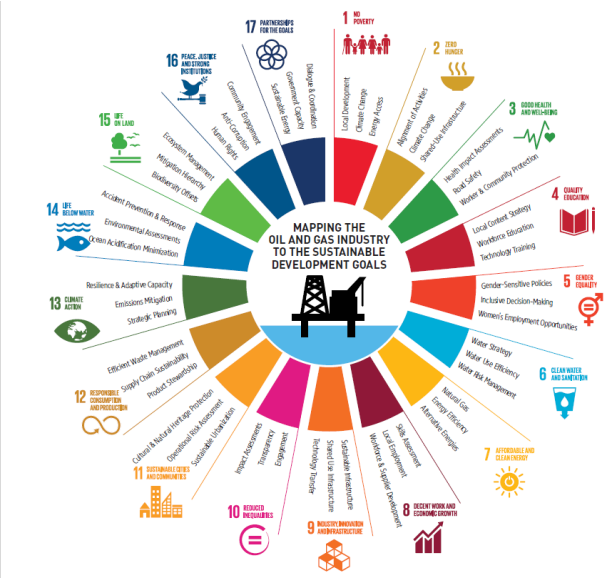

Figure 12: Mapping the Oil and Gas Industry to the SDGs

Whether it is supply chain sustainability to the use of alternative energies, Figure 12 represents how the use of AI in the O&G industry can contribute to every SDG. The major companies in the oil and gas industry are making great gains with AI by integrating it in numerous sectors, such as decreasing carbon footprint, deep-sea hydrocarbon exploration, and applying creative and sustainable energy methods to accelerate the evolution speed. Though several industries are undertaking steps to adopt AI, in order to streamline the supply chain process, there arises a rampant need to ensure that such measures are environment-friendly and cater to the SDGs. To achieve these environmental goals, oil and gas companies will need to increase operating efficiency, maximise resource use, and eventually minimise waste, all of which can be supported by AI.[29] Given the combined challenge of providing more energy (to keep up with expanding populations and demand) while generating less carbon, operational efficiency becomes crucial. This sometimes necessitates organisations to revamp processes to be more eco-efficient.[30] AI models possess the ability to ingest and analyse large datasets (as found in refineries). It can further use embedded domain knowledge and machine learning techniques to provide suggestions for improving operational efficiency.

REFERENCES FOR FURTHER READING:

[28] Refer to 11.
[29] https://www.energyconnects.com/opinion/thought-leadership/2021/november/how-ai-is-helping-oil-and-gas-companies-achieve-net-zero/
[30] Refer to 24.

1. https://www.ipieca.org/resources/awareness-briefing/mapping-the-oil-and-gas-industry-to-the-sustainable-development-goals-an-atlas/

2. https://www.offshore-technology.com/comment/ai-for-og-sustainability/#:~:text=Oil%20and%20Gas%20companies%20know,environmental%20damage%20is%20very%20low.

3. https://www.energyconnects.com/opinion/thought-leadership/2021/november/how-ai-is-helping-oil-and-gas-companies-achieve-net-zero/