

CIRCULAR ECONOMY

A rounded approach

Oil and gas companies have the leverage and expertise to deploy their organisational capabilities to integrate circular economy principles on the road to net zero. University College London's Daisy de Selliers and Catalina Spataru report.*

The circular economy (CE) is increasingly coming to the fore on both national and global agendas, driven by climate change concerns, zero waste ambitions and technological innovations. Oil and gas companies have the potential to contribute by developing business models that generate growth in a net zero future, including a shift towards renewable energy, reducing the extraction of natural resources, implementing resource recovery measures and emissions reduction technologies, and extending the useful life of products and assets.

This will require the development of new operating models upstream and downstream, that are transformative, systemic and functional.

Movement towards renewable energy

Several oil and gas companies have already embarked on this process, including Total, Shell, Repsol and Eni, engaging in the renewable energy business by developing plants producing low carbon energy and acquiring companies active in this segment. Total, for example, has been investing in wind and solar projects through subsidiaries including Total Quadran. Shell has been building wind farms through joint ventures with electric utilities and owns interests in solar asset developers in the US and Germany. Meanwhile, Repsol has added renewable energy projects to its portfolio recently, creating a joint venture in Chile in 2019 to operate and build solar and wind assets.

Traditional oil and gas companies have also been exploring alternatives to fossil fuels in the transport sector by investing in electric mobility, hydrogen and biofuels. Total and Shell, for example, have participated in the roll-out of hydrogen stations through the H2 Mobility Germany joint venture; Shell has acquired providers of electric vehicle (EV) charging points such as

NewMotion in Europe and Greenlots in the US; and Repsol has acquired the EV charging network Ibil in Spain.

Bioenergy represents another opportunity for oil and gas companies given the synergies between the biofuel and fossil fuel value chain. This includes the conversion of hydrocarbon refineries into biorefineries. Total started up the La Mède biorefinery in France in 2019 with a capacity of 500,000 t/y of hydrotreated vegetable oils (HVO) to use as an alternative to conventional diesel. The French major also launched a research programme to use oleaginous waste and algae for biofuel production without the need for arable land.

Meanwhile, Repsol uses commercial biofuels produced from industrial and domestic waste and plans to double its production of HVO biofuels to 600,000 t/y by 2030. It is also developing a project in Spain for a plant that generates gas from urban waste through a pyrolysis process. This consists of heating waste at high temperatures without oxygen until it is transformed into gas. The plant is expected to reuse up to 100,000 tonnes of waste.

Italy's Eni has developed proprietary waste-to-fuel technology for the transformation of organic municipal solid waste into bio-oil with recovery of water contained in the wet waste. A process of hydrothermal liquefaction transforms the organic waste into bio-oil, which can be used for maritime transport or contribute to biofuel production. The company started a pilot plant in Italy, which demonstrated the feasibility of applying the technology on an industrial scale. It has also entered a joint venture to develop industrial plants in the country.

Shell has a facility in the US producing renewable natural gas from organic waste through anaerobic digestion. It also completed in 2017 the construction of a demonstration

plant in India that turns waste feedstock, such as agricultural and municipal waste, into transport fuel with the aim of demonstrating the technology for possible scaling up and commercialisation.

Circularity in plastics

Addressing the issue of end-of-life plastics also presents opportunities for oil and gas companies. Industrial value chains for plastics recycling can be developed in synergy with refining and petrochemical activities.

In the field of plastic recycling, Total is conducting research in the three channels of mechanical, chemical and organic recycling. The company markets 15 grades of polymers containing up to 50% recycled materials and has a target of producing 30% of its polymers portfolio from recycled materials by 2030.

Repsol produces polyethylene and polypropylene from chemical recycled oil from plastic waste not suitable for mechanical recycling. It has been testing this type of oil at its industrial complex in Spain since 2015. The company marketed its first recycled plastic materials in 2019, which are commercially available to customers in Europe. Repsol has set the goal of achieving 20% recycled content in all its polyolefins by 2030.

Eni launched in 2019 its first range of polyethylene and polystyrene made from mechanically recycled plastics. Its chemical company Versalis developed the materials in its research laboratories and uses urban post-consumer plastic, primarily packaging. Eni (Versalis)



has joined the Circular Plastics Alliance launched by the European Union to bring 10mn tonnes of recycled plastics to market by 2025. It has committed to increasing the production capacity of mechanically recycled plastics and to develop a new chemical recycling technology to transform mixed plastic waste into raw material to manufacture new virgin polymers.

Meanwhile, Shell is using a liquid feedstock made from plastic waste in a chemical plant in the US. The liquid is supplied by waste management company Nexus Fuels and made from

hard-to-recycle plastic via pyrolysis. In 2020, Shell announced a supply agreement with Nexus Fuel for 60,000 tonnes of pyrolysis liquid over four years. The company has committed to using 1mn t/y in its chemical plants by 2021.

A group of chemical and consumer goods companies, including Shell and Total, founded in 2019 the Alliance to End Plastic Waste, joined in 2020 by Eni (Versalis). The objective is to develop solutions for the disposal of plastic waste in the environment, especially oceans, and promote projects for waste management and plastic recycling technologies.

Operational and decommissioning waste

The implementation of circular practices in waste management concerns all lifecycle stages from construction and operation, to decommissioning. Practices include separation of metals, reuse of platform assets and pipelines.

Sustainability reports from many oil companies include a commitment to minimise and valorise waste from operations, although data is currently too scarce for waste performance of companies to be able to make a direct comparison. Total estimates the share of waste ending up in landfill, which has fluctuated in recent years at 15% in 2019, 18% in 2018 and 13% in 2017. The company has set a target of valorising more than 50% of waste produced by sites that it operates and integrates four principles in waste management:

- Reduce waste at source by designing products and process generating minimal waste.
- Reuse products.
- Recycle residual waste.
- Recover energy from non-recycled products.

One challenge for the oil and gas industry is the decommissioning of end-of-life facilities. The CE presents opportunities for capturing economic value and reducing waste during decommissioning. It not only concerns the management of materials, but also land.

Total, for example, carries out remediation operations for end-of-life sites with the aim of reusing the site for other activities, such as solar generation or reforestation. Eni has an environmental contractor, Eni Rewind, in charge of its remediation process. It transforms areas to be remediated into new added-value projects, and carries out recovery activities in disused service stations and groundwater remediation activities following oil pipeline break-ins. This includes on-site recovery of excavated land, reforestation, groundwater treatment, restoration of natural riverbeds, asbestos removal and regeneration of existing assets.

Globally, improving material reuse requires an inventory of all materials, equipment and components. However, describing materials and getting legislative approval has proved to be a challenge. Limited data availability prevents detailed understanding of the different stages of decommissioning processes at this point in time.

Transition is underway

After a decade of discussion and research on the CE, the linear 'make-use-dispose' model of resource consumption is still deeply entrenched. Oil and gas companies face challenges in the implementation of circular business models. However, they have the leverage and expertise to deploy their organisational capabilities to integrate circular principles. Incentives behind their integration need to be strategic. Circularity can help mitigate risks from material and water supply shortages, supply chain disruptions, anticipate increasingly stringent environmental regulation, and capture and create value from product life optimisation and

waste recovery.

The role of policies and regulations is essential to facilitate a CE transition. In the European Union, Member States started taking national measures to control and manage waste in the 1970s. This led to the Waste Framework Directive and the Hazardous Waste Directive adopted in 1975, which lay the basis of the regulatory structure on waste.

However, the CE calls for a policy framework that not only focuses on waste, but also supports the transition towards broader sustainability objectives, including climate change mitigation, biodiversity preservation and resource efficiency. The European Commission adopted a Circular Economy Action Plan in 2015, focusing on ecodesign of products, exclusion of hazardous chemicals, waste prevention and environmental footprint. The plan proposes a revised legislative proposal on waste and a set of measures covering the whole cycle from production and consumption, to waste management.

For effective CE implementation in the oil and gas industry, there is a need for targets and tools to assess resource use and circularity and monitor trade-offs and synergies between circularity and decarbonisation. Assurance guidance for decommissioning programmes needs to integrate CE principles. Collaboration between micro- and macro-level stakeholders, cross-industry consortiums such as the Alliance to End Plastic Waste, and public-private partnerships can support the CE transition.

The four oil companies mentioned in this article – Total, Shell, Repsol and Eni – have started to develop solutions to support the CE, such as waste-to-fuel, plastic recycling, renewable energy and remediation measures. They face incentives and opportunities to direct their investments towards technologies and products aligned with environmental constructs and circularity principles.

The rising penetration of low carbon energy, the development of waste recovery technologies and the implementation of waste reduction measures, among others, indicate that a transition is underway. ●

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