DNV

WHEN TRUST MATTERS

# ACTIONABLE PLANS TO REDUCE OIL AND GAS EMISSIONS

Exploring opportunities and challenges for the oil and gas industry in a carbon neutral society

REPORT

# Pressure is mounting on the oil and gas industry

## World carbon emissions will remain stubbornly high until the mid-2030s, according to DNV's Energy Transition Outlook 2020[1], our independent forecast of developments in the world energy mix to 2050.

Without greater efforts to decarbonize, the world will miss the 2°C limit for global warming under the Paris Agreement. Spurred on by the need to realize targets set under the Paris Agreement, Europe is leading the way in adopting net-zero carbon emissions targets, already followed by China and others.

The proliferation of net-zero policies is increasing pressure on the oil and gas industry to show emissions cuts in the short term, but also to prepare to deeply decarbonize in the coming years.

**Preparing for an energy system that does not accept the release of carbon emissions**
In the shorter term, the oil and gas industry is focusing on reducing emissions from production and distribution. The industry will later be measured on emissions from the full oil and gas value chain, including combustion (so-called scope 3 emissions). We forecast that hydrogen and carbon capture and storage (CCS) will be a catalyst for deep decarbonization after 2035, removing carbon from natural gas – before or after combustion – to reach hard-to-abate sectors.

Total emissions across the oil and gas value chain – from exploration and production through to end use – will have dropped by a third by 2050, according to our forecasts. The industry will need to decarbonize even more deeply than this to achieve international emissions targets.

**Developing an actionable plan to reduce emissions**
At the policy level, governments, oil and gas companies, and other stakeholders are making long-term commitments to reduce emissions, but this ambition needs to translate into effective, actionable plans.

This paper narrows in on a systematic approach for the oil and gas industry to assess and select the most cost-effective measures to reduce emissions, based on an evaluation of the cost and climate reduction potential of each measure. Reflecting the focus of the industry, it addresses the measures available in the shorter term to reduce emissions from production and distribution, and shares examples from recent projects.

This paper should be read as a follow up to DNV's Oil and Gas Energy Transition Outlook 2020, which provides the wider context and discussion on decarbonizing the oil and gas industry.

1. DNV GL. Energy Transition Outlook 2020, Oil and Gas Report

# Developing an actionable plan

## The measures that can most cost-effectively reduce greenhouse gas (GHG) emissions will vary depending on where an operator is in the oil and gas value chain, with operations differing greatly in terms of their nature, regional context and field specific aspects.

To identify the measures that are most cost-effective, we propose that operators should apply a systematic approach based on the philosophy behind technology qualification: to set targets; screen, assess and select measures; plan and execute implementation; and document process and achieved emission reductions.

### Qualification of a plan to reduce emissions

Technology qualification is a systematic process that aims to provide evidence that a technology will function within specified operational limits with an acceptable level of confidence (DNV, 2019).[2] The process and principles of technology qualification are today widely deployed within the oil and gas industry to manage and reduce risks associated with adoption of new technology or technology components. It is, however, also deployed beyond technology, for instance to qualify sites and projects for geological storage of $CO_2$ (DNV, 2009).[3]

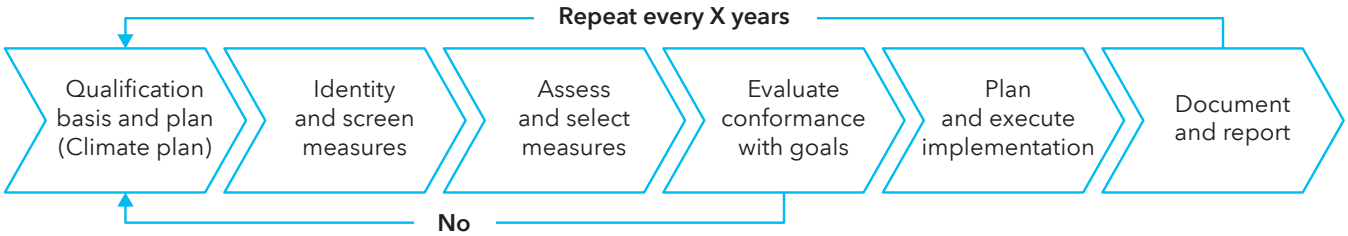
**Qualification basis and plan**

In their qualification basis and plan, operators should state their GHG emission baseline and GHG emission reduction targets for the relevant time-periods considered in the climate plan.

Operators should also state underlying assumptions, for instance pertaining to the operational boundaries applied to estimate GHG emissions, and regarding permissible emission reduction measures within the context of their climate plan. Finally, they should state the role or title of the person in their company with accountability for the climate plan.

The qualification plan should describe the subsequent steps in the qualification process. This includes the timeline, key resources, and decision points. The qualification plan should also describe the criteria the operator would apply to initial screening of possible emission reduction measures, and any constraints that would apply to the selection of preferred measures. The latter may be based on a maximum cost per unit of carbon dioxide equivalent ($CO_2$e)-emissions abated, or a constraint on the total budget for emission abatement.

2. DNV GL. (2019, September). DNVGL-RP-A203, Recommended practice - Technology qualification.
3. DNV. (2009). $CO_2$QUALSTORE - Guideline for selection and qualification of sites and projects for geological storage of $CO_2$.



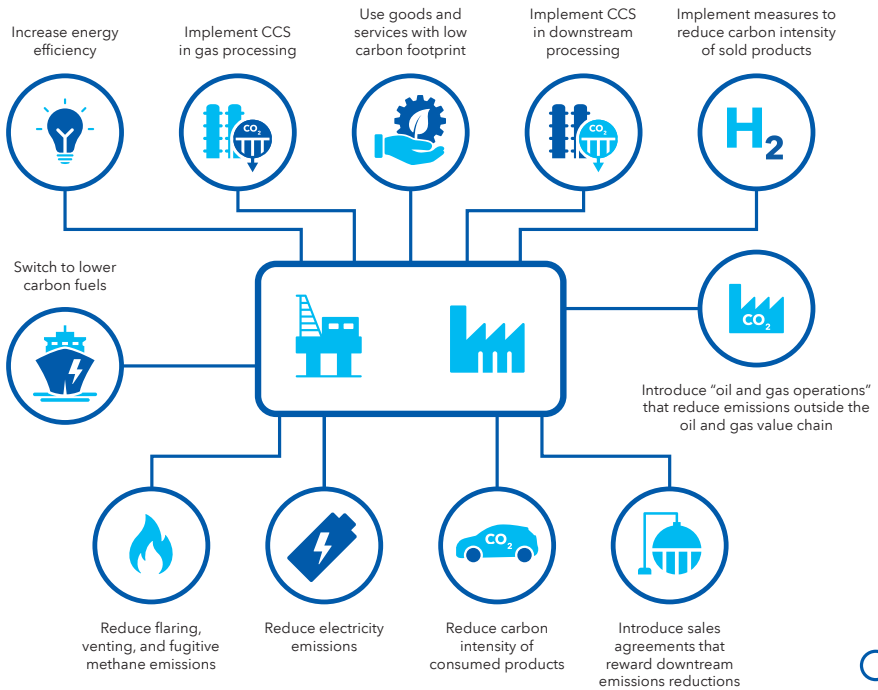

**Generic steps in process to assess and implement climate plans.**

DNV has identified the following 11 levers with potential to reduce the total carbon footprint of the oil and gas industry:

1. Reduce gas flaring, gas venting and fugitive methane emissions
2. Implement energy efficiency measures in exploration and production (E&P) or downstream processing
3. Implement carbon capture and storage (CCS) in gas processing
4. Reduce emission intensity of electricity consumed for E&P
5. Switch to fuels with lower carbon intensity for E&P
6. Use goods and services with low carbon footprint
7. Implement CCS in downstream processing (oil or natural gas used as feedstock)
8. Introduce sales agreements that reward downstream emission reductions
9. Implement measures to reduce carbon intensity of sold products
10. Use measures implemented after point of sale to reduce carbon intensity of consumed products
11. Introduce "oil and gas operations" that reduce emissions outside the oil and gas value chain.

These provide a good basis for possible measures in the short term, but operators should identify and screen the best measures for them on an individual basis.

**I WANT TO REDUCE EMISSIONS FROM OIL AND GAS PRODUCTION AND DISTRIBUTION**




**BUT WHICH LEVERS ARE BEST FOR MY PROJECT?**

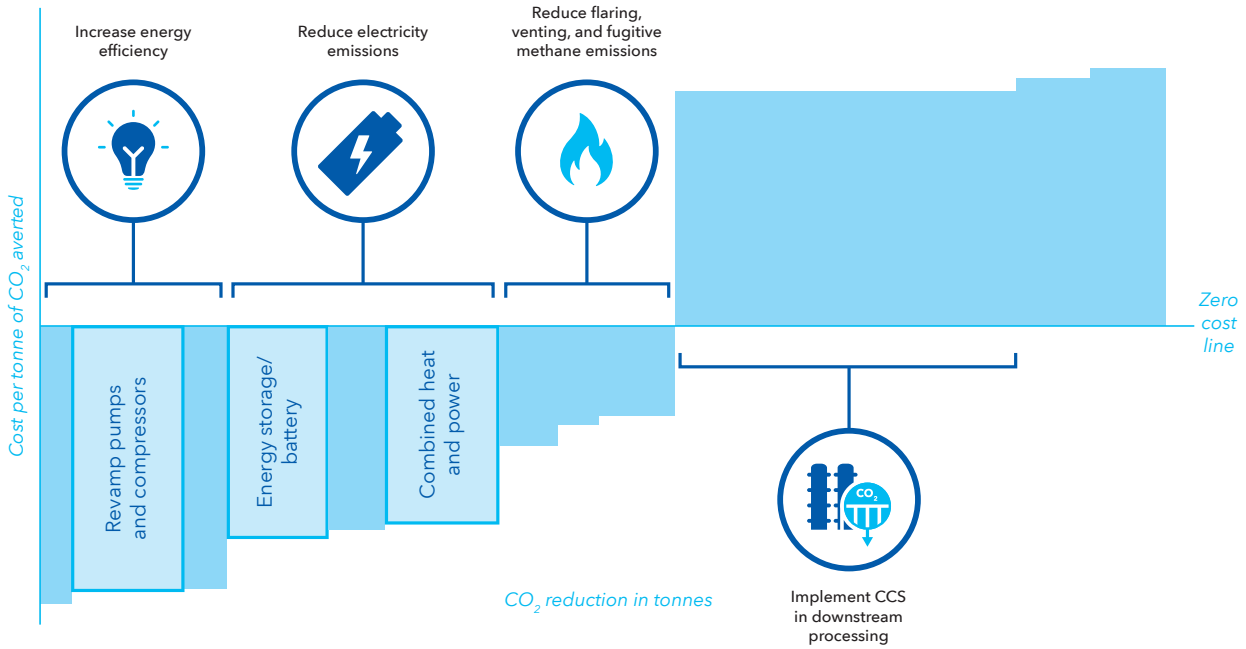
**Identify and screen measures**
The starting point for this step may be an operator's pre-existing database of possible emission reduction measures. The operator can then identify relevant measures by applying the screening criteria. Alternatively, operators can screen measures through a combination of literature search and workshops, where they apply the screening criteria as part of the measure-identification process. The outcome from this process is a set of measures that operators can potentially apply to meet the targets set in the climate plan, and in the qualification basis.

**Assess and select measures**
To assess and select measures that can achieve the emission reduction targets most cost-effectively, operators need to evaluate the cost and climate reduction potential of each measure. DNV advocates the use of marginal abatement cost curve (MACC) for this purpose, for each target in the qualification basis. The MACC approach provides a systematic and transparent method for prioritising and selecting $CO_2$ reduction measures and energy improvement opportunities. It turns complex assessments into visual and intuitive results, and at the same time providing a good basis for discussing and refining key input to the process.

The next task for operators is to select the preferred measures that can be implemented within budget constraints with available or accessible resources. This also requires an evaluation of the technical feasibility of implementing the respective measures under applicable circumstances and regional context.

**MACC approach to reducing emissions**
A MAC (Marginal Abatement Cost) curve shows the cost of reducing the next unit of emission. Each relevant measure is indicated by a $CO_2$ reduction potential (width on the horizontal axis) and a cost per tons of $CO_2$ avoided (height on the vertical axis), and is ranked according to their cost-efficiency.

**WHICH LEVERS AND SUPPORTING MEASURES SHOULD I ASSESS?**




Each assessment is unique, with the cost and emissions reduction potential of the levers differing for each company and project

**WHICH WILL GIVE ME THE MOST EMISSIONS REDUCTIONS FOR LEAST COST?**

The method calculates the cost efficiency of combined measures and assumes that the most cost-efficient measure is implemented before the other measure are applied. The MACC (Marginal Abatement Cost Curve) can be related to a single asset, a limited collection of assets, or all the assets in a region for example.[4,5]

The reduction effect of an abatement measure is the estimated volume of $CO_2$ emissions averted. The reduction effect will depend on the characteristics of the installations it is being applied to (e.g. size, age, previously implemented measures).

The cost per tonnes of $CO_2$ averted is calculated by dividing the sum of monetary costs and benefits from the abatement measure by the accumulated emission reduction potential achieved over the lifetime of the measure or the remaining lifetime of the asset, whichever is the shortest.

The cost of implementing a measure includes both initial costs (e.g. engineering, construction and installation costs) and operational costs (e.g. maintenance, training, lost revenue). The benefit from the measure includes fuel cost savings, increased revenue and other savings (i.e. carbon taxes and fees, maintenance). Both costs and benefits are expressed in terms of net present value.

**Evaluate conformance with goals**

This step should determine an operator's cumulative emission reductions from their full portfolio of selected measures, and allow them to compare the results with their emission reduction targets.

If the measures do not meet emission reduction targets, then operators must restart the qualification process, and should consider whether any of the following criteria or constraints can be relaxed:

- Emission reduction targets
- Screening criteria
- Constraints on selection of measures.

Operators should then relax one or more of these criteria so that they can meet emission reduction targets.

**Plan and execute implementation**

Operators should design their implementation plan to allow timely and cost-effective implementation of the selected measures within applicable constraints relating to time, budget and resources. The plan should include an evaluation of possible upsets or delays, and operators should allocate necessary contingencies and redundancies to keep risk at an acceptable level. In general, the cost of contingencies and redundancies should not be disproportionate to the level of risk reduction achieved. Note that the risk reduction benefit may not be cost, but could be in terms of reputation, time, health and safety, or other factors.

**Document and report**

In accordance with the Greenhouse Gas Protocol standards, reporting of corporate GHG emissions should be relevant, complete, consistent, transparent and accurate.[6,7] There is currently no common industry methodology for how to document and report on emissions. Issues around equitable sharing of GHG emissions in joint projects or assets with mixed ownership is a particular issue. DNV will continue to work towards common industry standards on defining, measuring, and reporting on emissions, and on developing guidance and principles on this issue.

4. DNV GL, Reduced Environmental Footprint at. Høvik, Norway: DNV GL Oil and Gas Position Paper, 2016.
5. DNV GL, Pathways to a low carbon oil & gas industry - abatement potentials for offshore assets, 2017.
6. Greenhouse Gas Protocol. (2004, March). A Corporate Accounting and Reporting Standard - Revised edition.
7. Greenhouse Gas Protocol. (2013). Corporate Value Chain (Scope 3) Accounting and Reporting Standard

# Actionable plans, in action

DNV has assisted customers to improve energy efficiency and reduce emissions, using the process set out above.
We provide three recent examples, based on real projects.

### Improving energy efficiency for an FPSO (Customer A)

Customer A had been granted funds from a government to improve the energy efficiency of their FPSO, having already operated the FPSO for eight years. In cooperation with the authorities, the operator set a goal to reduce the power consumption of the FPSO by 11%.

The operator performed a mapping exercise to establish a baseline for current energy use and associated emissions. To identify measures for reducing energy use, the operator and DNV subject matter experts discussed all processes and subprocesses onboard the FPSO, and identified relevant measures for each of them. The operator involved personnel from many units, including operations, maintenance, process, rotating equipment, electrical and HSEQ. In total, eight people from the operator were actively involved in the four-month project. Using the MACC methodology, the team assessed the measures with regard to cost efficiency, putting forward the measures that achieved the goals at lowest cost for implementation. The results showed that 8% of the power consumption could be cut in a profitable manner, in which money is saved over the lifetime of the FPSO. The remaining energy savings could be achieved at low cost.

The operator established an implementation plan based on planned maintenance and shutdowns for the FPSO. In addition, the team developed a plan for monitoring the effect of the implemented measures and to document their effect for the authorities, which was part of the prerequisites for the funding.

**CUSTOMER A: I WANT TO IMPROVE THE ENERGY EFFICIENCY OF MY FPSO**

**ASSESSED LEVERS**

Increase energy efficiency

Reduce electricity emissions

Switch to lower carbon fuels

**SELECTED LEVERS**

Increase energy efficiency (100%)

Each assessment is unique, with the cost, emissions reduction potential, and other factors considered differing for each company and project

**BUT WHICH MEASURES SHOULD I IMPLEMENT FOR MY PROJECT?**

### Achieving net zero operations (Customer B)

Customer B had set targets for achieving net-zero emissions from their production facilities, including two FPSOs, by 2030. They planned to achieve the targets through emissions cuts as well as carbon offsets. As part of the five-month project, the project team selected measures and developed an implementation plan.

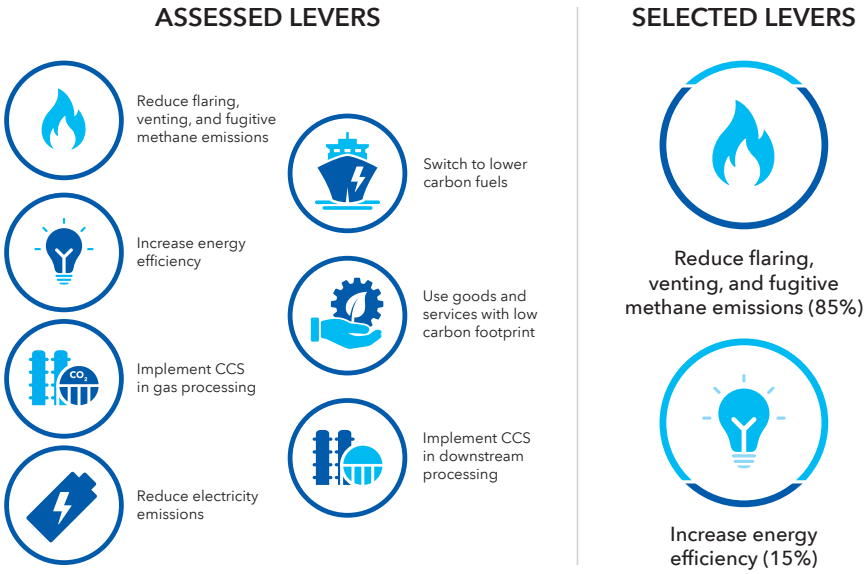
The operator had established a baseline for its operations, which formed the basis to identify a list of measures. The measures were then screened, with criteria including the potential to reduce $CO_2$ emissions, cost, maturity and timing.

After screening, the team assessed the selected measures based on cost-efficiency and reduction potential using DNV's MACC tool. This was followed by a risk rating to assess the safety and environmental impact of the measures. Based on the assessments, the operator selected the measures it would include in its plans to reduce emissions.

The team then established an implementation plan, containing a schedule as well as the effect on emissions in relation to the baseline. By calculating the gap between the actual emissions and the net zero goal, they were able to assess the size of carbon offsets required.

Throughout the project, the operator used the outcomes from workshops and the results from assessments in its communication, to create alignment on the goals and way forward with internal and external stakeholders.

**CUSTOMER B: I WANT TO ACHIEVE NET ZERO OPERATIONS FROM MY PRODUCTION FACILITIES**




Each assessment is unique, with the cost, emissions reduction potential, and other factors considered differing for each company and project

**BUT WHICH MEASURES SHOULD I IMPLEMENT FOR MY PROJECT?**

**Ensuring cost-efficient operations and low carbon risk for an offshore development (Customer C)**

Customer C wanted to reduce $CO_2$ emissions and establish energy efficient operations for a proposed offshore development, to ensure cost efficiency and low carbon risk.

The project team developed a baseline based on the planned design of the FPSO, and established and screened a list of measures, including power from shore and offshore renewables. From the operator side, a core team of six people were involved in the four-month project, including personnel from engineering, project development and HSEQ units.

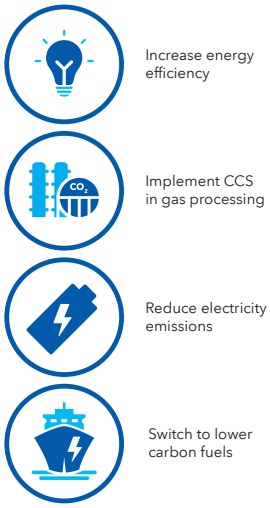
Using MACC methodology, the team then assessed the measures that had made it through the initial screening, based on their efficiency and emissions reduction potential, developing a list of prioritized measures. Up to 25 % of the emissions relative to the baseline configuration could be saved in a profitable manner – in which the money is saved over the lifetime of the installation, depending on scenarios for cost development including gas price and $CO_2$ cost.

The team further assessed the selected measures based on suitability according to a predefined scorecard, which covered weight, size, reliability, operability, lifetime expectancy, safety, environmental issues and maturity.

The customer found the approach to be structured and useful – both as input to internal decision processes and in dialog with partners and key stakeholders.

**CUSTOMER C: I WANT TO ENSURE COST-EFFICIENT OPERATIONS AND LOW CARBON RISK FOR AN OFFSHORE DEVELOPMENT**

**ASSESSED LEVERS**




**SELECTED LEVERS**

Reduce electricity emissions (100%)

Each assessment is unique, with the cost, emissions reduction potential, and other factors considered differing for each company and project

**BUT WHICH MEASURES SHOULD I IMPLEMENT FOR MY PROJECT?**

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## Publishing and updates

This report was published in December 2020.
The report was updated in March 2021 to reflect brand changes. No changes were made to the content.

## Energy Transition Outlook – Oil and Gas

This paper – Actionable plans to Reduce Oil and Gas Emissions – can be read in connection with DNV's Oil and Gas Energy Transition Outlook 2020, which provides the wider context and discussion on decarbonizing the oil and gas industry.

# ABOUT DNV

DNV is the independent expert in risk management and assurance, operating in more than 100 countries. Through its broad experience and deep expertise DNV advances safety and sustainable performance, sets industry benchmarks, and inspires and invents solutions.

Whether assessing a new ship design, optimizing the performance of a wind farm, analysing sensor data from a gas pipeline or certifying a food company's supply chain, DNV enables its customers and their stakeholders to make critical decisions with confidence.

Driven by its purpose, to safeguard life, property, and the environment, DNV helps tackle the challenges and global transformations facing its customers and the world today and is a trusted voice for many of the world's most successful and forward-thinking companies.

## In the energy industry

We provide assurance to the entire energy value chain through our advisory, monitoring, verification, and certification services. As the world's leading resource of independent energy experts and technical advisors, we help industries and governments to navigate the many complex, interrelated transitions taking place globally and regionally, in the energy industry. We are committed to realizing the goals of the Paris Agreement, and support our customers to transition faster to a deeply decarbonized energy system.



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