METHANE

Mitigating methane emissions

Prediction, in addition to detection, is required to help cut greenhouse gas emissions and meet net zero targets, writes IBM's *Mark D Hall*.

Reduction of methane emissions is expected to have the greatest immediate positive impact the oil and gas industry can have on climate change.[1] New approaches and technologies are becoming available; however, preventing emissions as they arise requires not just detection but prediction.

Methane detection and monitoring needs to be integrated into a corporation's larger energy management and sustainability programmes, including operational workflows to model, predict, recommend and optimise emissions in near-real time. This can be done at the level of a single asset, an entire region, business unit, or indeed the whole enterprise.

A business imperative

Environmental sustainability, while remaining a corporate social responsibility (CSR) issue, has become a business imperative tied to a company's licence to operate and, therefore, investor confidence in long-term viability. Environmental strategy choices, as a subset of a broader sustainability agenda, increasingly define a company's prospects in today's competitive marketplace.

Many major oil and gas companies have announced plans and committed to a portfolio of initiatives to decrease their greenhouse gas (GHG) emissions intensity by 2050 or earlier. Uncertainty in carbon markets, as well as more stringent environmental regulations linked to financial risks, drive the need for new ways of monitoring, controlling and reporting emissions.

Technology innovations such as artificial intelligence (AI), 5G, the Internet of Things (IoT), cloud, blockchain and others, will accelerate this progress and enable a transformation in how flaring, methane leaks, energy usage, and other types of GHG output can be reduced. This transformation follows a phased approach – manage, model, predict and assist, and optimise – each of which is explained in more detail below.

Phase 1: Manage

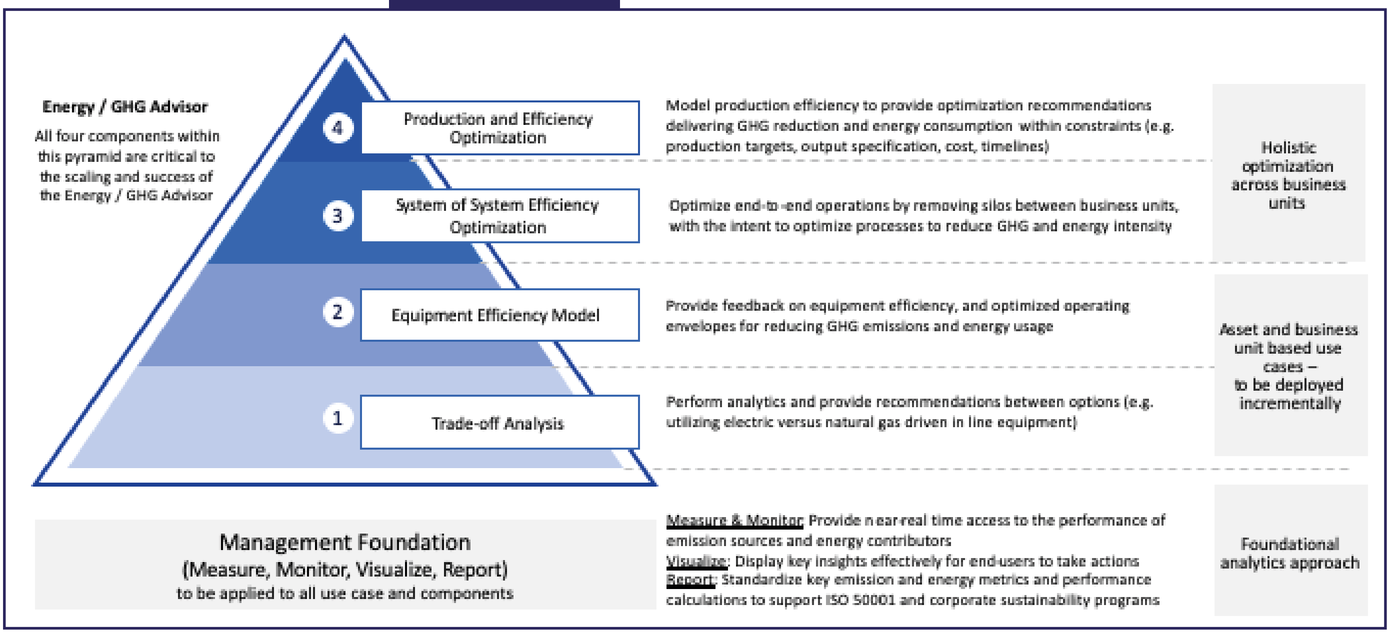
The *manage phase* is typically based on *ISO 50001:2018, Energy Management Systems* and related standards and is a strategic tool that helps organisations put in place an energy management system to use energy efficiently and effectively. The guidelines set out an energy management framework for establishing policies, processes, procedures and specific energy tasks to meet a company's energy objectives. They are also designed to help improve energy performance.

ISO 50001 does not fix targets for improving energy performance. A business, regardless of its current level of energy performance, can implement the standard to establish a baseline and improve performance at its own pace. A comprehensive ISO 50001 programme requires an organisation to define its desired energy performance and work towards stated objectives through the effective measurement, monitoring, visualisation and reporting of energy and emissions targets across a wide variety of areas. These include functions such as production operations, fuel combustion, transportation, drilling operations, well services, water production and consumption, hazardous waste disposal, and grid usage.

Traditional and emerging technologies such as fixed sensors on operating equipment, smart meters, sensors mounted on rigs, satellites and drones, are becoming available to detect and capture emissions and energy consumption with varying degrees of precision and scale. These technologies need to be integrated into a data management platform as part of a sustainability platform to receive raw data from disparate sources, provide real-time data cleansing and consolidation, act as a trusted source for historical data, and also provide the basis for data analytics and in later phases – modelling, predictions and optimisations.

Figure 1: Holistic and incremental approach to optimise operations and reduce greenhouse gas emissions

Source: IBM



Phase 2: Model

To deal with the vast amounts of available data and handle the complexity of different measurements and reporting requirements, the *model phase* provides additional capabilities – to infer composition and process properties and measurements (virtual metering), identify missing and out-of-spec/invalid measurements, include additional data sources such as weather conditions (eg wind direction, humidity, temperature, etc), energy costs, maintenance activities, and production schedules, future performance, events and upset conditions based on historical performance data or thermodynamic principles.

IBM recommends a combined first principles and data analytics approach to ensure physical constraints can be met within the operational requirements (operating envelopes) while providing cognitive data insights through AI and machine learning techniques for process prediction, regression-based optimisation and scenario analysis. The latter may not be available in a traditional process model.

Data and digital technologies – especially the ability to capture data in real time with an unprecedented degree of granularity – provide new levels of insight into changes in the physical environment. The model phase can make use of process data, production plans, operating protocols, technical operating envelopes, weather, economic and maintenance data to model and simulate emissions and energy intensities in near real-time, provide alerts when potential opportunities or events are identified, and provide actionable insights that are driven by advanced analytics.

Examples of combined first principles and data analytics based prediction models include:

- Correlation and clustering analysis to identify similar historical operational states with operating modes that prioritise high performing assets.
- Combinatorial optimisation to prioritise producers to meet demand with less energy.
- Predictive machine learning/ deep learning models to project deviation from optimal efficient point.
- Explanatory models to highlight operational factors resulting in predicted inefficiencies.

The model phase has the ability to scale from modelling individual equipment and assets up to operations at the regional or corporate level.

Phase 3: Predict and assist

The *predict and assist phase* identifies emission sources and energy intensities based on similar operating conditions and advises on actions based on past experiences and the output of the combined first principles and data analytics prediction models.

Examples of prediction and actionable insights include:

- Higher utilisation of assets through 'smart' steam production modes resulting in reduced energy consumption.
- Recommendation on steam production modes to achieve minimal energy inputs while meeting production demand.
- Ability to flag predicted deviation from optimal efficiency point for rotating equipment and highlight operational factors causing predicted inefficiencies.
- Recommended minimum flow rate to achieve required recovery rate.
- Recommendations on integrated site operation to optimise heat recovery.
- Improved steam temperatures for maximum thermal efficiency.
- Optimised heat recovery per process/production asset.

Phase 4: Optimise

The *optimise phase* leverages the capabilities defined in the previous phases to provide anomaly detection, recommend set-points to optimise throughput and can deliver automated responses.

This advanced approach leverages advanced analytics capabilities to simultaneously optimise emissions, environmental performance and energy intensity in support of corporate sustainability programmes while ensuring production optimisation and meeting operational targets through:

- Improved cost savings.
- Energy efficiency and compliance.
- Co-ordinated energy programmes (energy efficiency, energy production, renewable/ alternative energy sources).
- External financial incentives (electric utility, third-party financing, tax benefits and others).
- Integrating energy management processes into business practices.
- Optimisation of energy-consuming assets.
- Improving operations and capital cost decisions.
- Reducing GHG emissions and other future environmental impacts of climate change, through the systematic management of energy.

This requires the need to capitalise on measured and inferred data, analytical and process models, and effective knowledge management to reveal new insights and underpin new solutions to existing problems.

Going digital

In order to execute on the sustainability imperative, businesses need to be 'digital'. They need to integrate analytics, AI and automation in intelligent workflows, to deliver on sustainability goals. The combination of business model transformation and a new environmental governance structure can be applied to environmental sustainability through a holistic, structured and progressive approach as shown in **Figure 1**, based on solving the problem (quantifying the impact), breaking down silos, and scaling across the enterprise to:

- Engage in industry-led initiatives and policy actions supported by financial investment.
- Reduce GHG and related emissions.
- Optimise the energy mix and allocation.
- Identify production optimisation opportunities while reducing energy consumption.
- Optimise production process settings based on energy intensity.
- Deliver on corporate sustainability targets and goals.

[1] *Methane emissions from oil and gas*, IEA, 2020.

For additional IBM recommendations on sustainability, '*The rise of the sustainable enterprise: Using digital tech to respond to the environmental imperative*' can be downloaded from **https://ibm.co/sustainable-enterprise**