Mesh-AI

# The Race to Net Zero: How AI, Data & Digital Twins Will Reimagine The Energy Industry

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# Introduction

**The energy industry is at a crossroads.** Climate change is no longer a distant threat but a stark reality, and **the race to achieve Net Zero emissions is on.** People, governments and society across the world are calling for a rapid transition to a sustainable energy system, which means decarbonising our economy and ensuring that the energy we consume is clean, reliable, and affordable.

Fortunately, emerging technologies such as **Artificial Intelligence (AI), Machine Learning (ML) and advanced data & analytics are presenting new opportunities for the energy industry** to transform and achieve its sustainability goals. Unified, AI, ML and data-driven solutions can help industry to optimise energy systems, improve efficiency, and reduce greenhouse gas emissions.

Ultimately, the race to Net Zero is not just a challenge for the energy industry, but for all of us. It requires collective effort and commitment from governments, businesses, and individuals to make the necessary changes and drive a more sustainable future. However, the adoption of AI, ML & advanced analytics to help solve these problems is a sophisticated undertaking for energy & utilities suppliers, those involved in transition networks, as well as oil & gas operators.

**Mesh-AI has a proven track record in enabling organisations** to answer their Net Zero challenges and we will explain some of the HOW over the course of this e-Book.

Chapter 1

# The Energy Industry Landscape

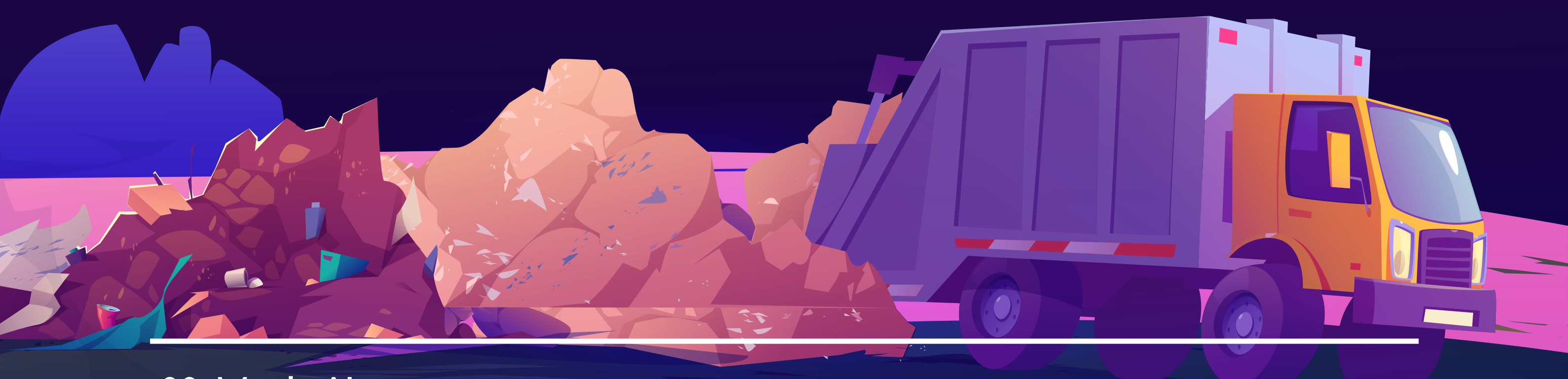
The energy industry is a vital component of our global economy, powering industries, homes, and transportation. However, this sector is also responsible for a significant portion of global greenhouse gas emissions, which contribute to climate change. As such, the energy industry has a critical role to play in achieving a Net Zero carbon future.

# Why is Net Zero Important?

The concept of Net Zero refers to achieving a balance between the amount of greenhouse gas emissions produced and the amount removed from the atmosphere. This balance can be achieved by reducing emissions and investing in carbon removal technologies.

The need for Net Zero emissions has become increasingly urgent due to the impact of climate change on our planet. Rising global temperatures are causing more frequent and severe natural disasters, including droughts, floods, and wildfires. These events have significant economic, social, and environmental costs, including damage to infrastructure, loss of life, and displacement of communities.

Achieving Net Zero emissions will require a significant shift in the way we produce and consume energy. This shift is not just important for the health of our planet but also presents significant economic opportunities for businesses that are willing to embrace the transition to a sustainable energy system.



# Government initiatives

Governments around the world are taking action to accelerate the transition to a Net Zero carbon future. The Paris Agreement, signed in 2015, committed countries to limit global warming to well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 degrees Celsius.

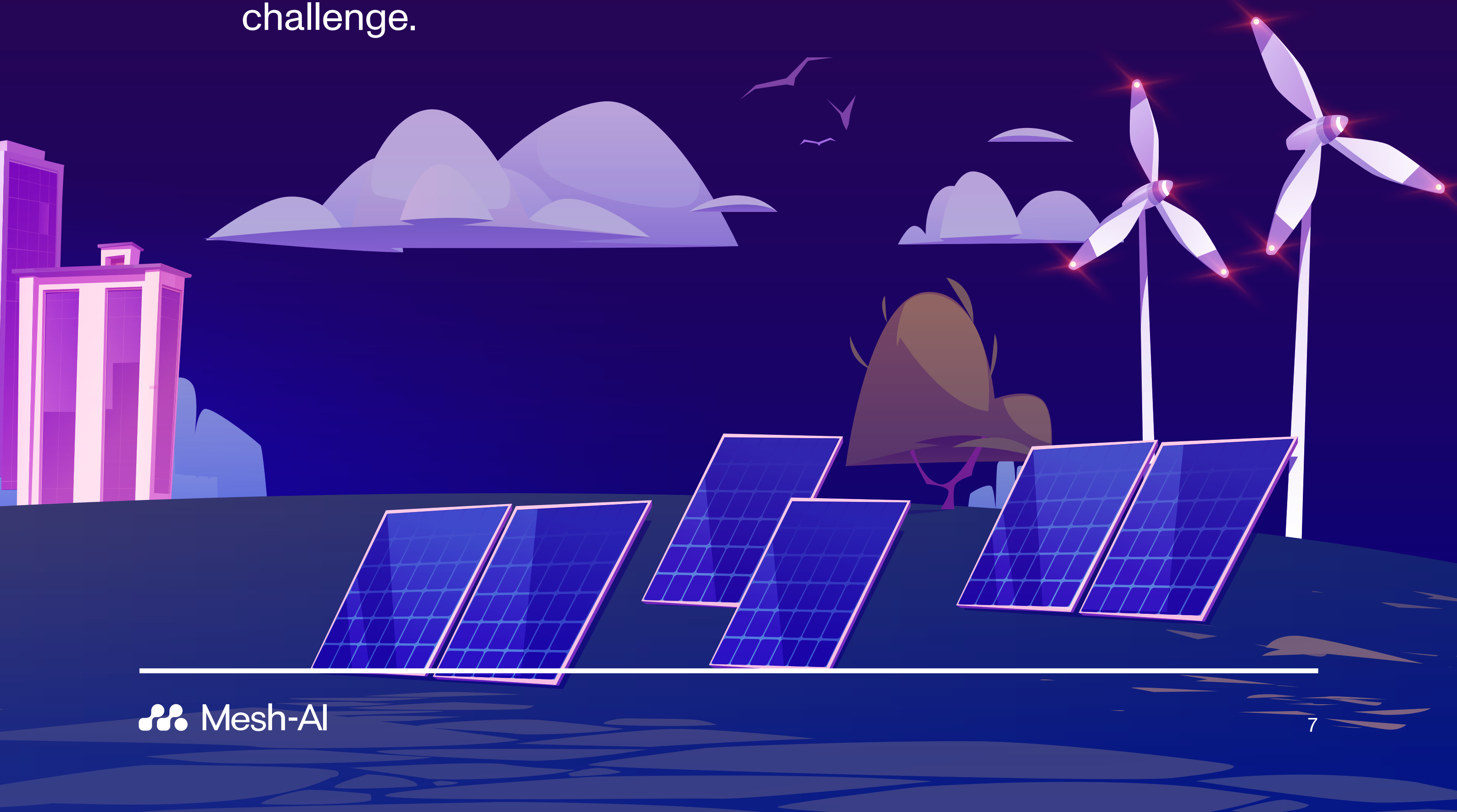
To achieve these goals, governments are implementing policies and regulations to encourage the adoption of renewable energy and the reduction of greenhouse gas emissions. Given the volume and variety of data being captured across industry, not just the energy & utilities sector, we can't rely on just human intuition and manual effort to analyse these insights and take corrective action. Renewable energy sources play a massive role in enabling the transition to Net Zero.

# The Role of Renewables

One of the most significant ways to reduce greenhouse gas emissions in the energy industry is to shift away from fossil fuels and towards renewable energy sources. Renewable energy includes technologies such as solar, wind, hydro, geothermal, and bioenergy, which are all sources of power that can be replenished naturally.

Renewable energy is becoming increasingly cost-competitive with fossil fuels, and in many parts of the world, it is now the cheapest source of electricity. As a result, the use of renewables has been growing rapidly in recent years, and this trend is expected to continue.

However, the World will not make the switch to renewables overnight. As such, organisations need to optimise how they operate existing assets, maintain them, prevent accelerated asset depreciation and ensure they protect against greenhouse gas emissions leakage. An integrated data, ML & AI strategy can help organisations with this challenge.



Chapter 2

# How AI & Data are an Enabler to Net Zero

Artificial intelligence and data analytics are transforming the way the energy industry operates. These technologies are being used to optimise energy systems, improve efficiency, and reduce greenhouse gas emissions. In this chapter, we will explore some of the ways in which **AI and data are enabling the transition to a Net Zero carbon future.**

# Introduces operational effectiveness

AI and data analytics enable the energy industry to achieve operational effectiveness by optimising energy production and distribution. For example, AI can be used to forecast energy demand and adjust production accordingly, which reduces waste and improves efficiency. Additionally, **AI can help to manage the variability of renewable energy sources such as solar and wind power,** ensuring that the energy grid remains stable and reliable. This is becoming increasingly possible with the advent of the Internet of Things (IoT), sensors and data streaming platforms.

# Protect against asset depreciation

Energy assets such as turbines, transformers, and pipelines are subject to wear and tear over time, leading to asset depreciation. **AI and analytics can be used to detect and prevent asset depreciation, ensuring that assets remain in good condition and operate efficiently.** For example, predictive maintenance systems can use real-time data from sensors to detect potential faults before they occur, allowing for preventative maintenance to be carried out before more significant problems arise. This can reduce downtime, extend the life of assets and reduce costs.

Furthermore, **drones can be used to take pictures & recordings of assets to leverage computer vision** and identify corrosion across assets. This is much cheaper and environmentally friendly than performing the same task in a helicopter as an example.

# Maintaining Assets in a Proactive Manner

AI and data analytics can also enable the energy industry to maintain assets in a proactive manner. For example, **AI can be used to monitor the condition of assets and predict their remaining useful life, allowing for proactive replacement or refurbishment.** This can reduce the risk of failures, improve safety, and reduce maintenance costs. Indeed, depreciated assets are more likely to emit harmful emissions and as such, being able to proactively maintain assets can help to reduce greenhouse gas emissions.

# Detect and Prevent Leakages into the Environment

The energy industry is also responsible for preventing leakages into the environment, which can cause pollution and contribute to climate change. **AI and data analytics can be used to detect and prevent leakages in real-time, minimising the impact on the environment.** For example, AI can be used to monitor the emissions from assets and detect anomalies that could indicate a potential leak. This can allow for rapid response and prevent damage to the environment.

# Intelligent Workforce & Resource Planning

The ongoing **maintenance of assets is a costly and time consuming effort for energy originators and distributors.** Whilst this is equally challenging for organisations operating in upstream gas. The co-ordination and distribution of engineers to perform maintenance tasks is also a logistical challenge that often results in untimely delivery and repeat engineering as a by-product of poor data quality.

By uplifting the quality of data in their asset management systems, energy & utilities organisations can **use machine learning to optimise their workforce distribution and allocate engineers to maintenance jobs,** with the right materials and job specifications. In addition, AI can be used to provide recommendations on other maintenance jobs that can be grouped together in order to maximise outage windows.

By reducing the amount of repeat callouts for their engineering fleets, **organisations can limit emissions from non-electrified vehicles.** Whilst, proactive bundling of maintenance tasks ensures ongoing proactive maintenance.

# Residential & Commercial Energy Sectors

The cost of living challenges faced across the world have exacerbated the need for households and businesses to explore and identify ways to optimise their energy use. By leveraging data & AI to monitor consumption; weather and occupancy patterns, **residential & commercial energy providers can provide customers with recommendation services on how energy can be conserved in near real-time.** In addition, this could be further advanced to make recommendations on how best to reduce energy use and switch to cost efficient tariffs that are 100% renewable. This can reduce our wider dependency on fossil fuels and thus lower greenhouse gas emissions.

# Carbon Capture & Storage

**AI can be used to optimise the capture and storage of carbon dioxide emissions.** By analysing data on the performance of carbon capture and storage systems, AI can identify areas where improvements can be made. This can include optimising the placement of capture and storage systems to maximise efficiency, and identifying ways to reduce the operating costs for these systems.

# Digital Supply Chain

Fundamental weaknesses in traditional supply chain management have been brutally exposed by serial crises and novel pressures that are turning up the heat on businesses. The Covid-19 pandemic. The war in Ukraine. The cost of living crisis. Rising interest rates. Pressures to reduce carbon emissions. Complex regulatory requirements. These pressures are disrupting all aspects of the supply chain, pushing up the cost of raw materials and forcing companies to find new partners because existing partners cannot fulfill the demand.

**The only way to tie your entire supply chain together is by putting high-quality, trustworthy, and highly-available data at the heart of your organisation's operation.** Traditional data paradigms treat data like a technical liability. But it must instead be handled like the mission-critical resource that it is. Approaches like data mesh flip traditional data paradigms on their heads, democratising your data and making it available on a domain basis in the form of data products.

Once your organisation's data has been democratised, you can start applying AI to critical parts of your supply chain to drive novel insights, predictions and business decisions. Examples include; predictive modelling, risk analysis and mitigation, automated supply chain optimisation.

**Your organisation can even combine predictive modelling with third party data in order to anticipate risks to your supply chain based on political or meteorological events** (say) in different countries and adjust your procurement accordingly. In addition, given the rich vein of data captured at each stage of the supply chain process, your organisation can be increasingly informed about its ESG performance and apply machine learning models to provide recommendations around optimising asset performance to further control your ESG metrics and key performance indicators.

Chapter 3

# How do we bring this to life?

In the previous chapter, we explored how AI, ML and data can be used to transform the energy industry and enable the transition to Net Zero emissions. In this chapter, we will discuss some of the practical steps that can be taken to bring this vision to life.

## Creating a Democratised and Accessible Data Operating Model, Based on Data Mesh Principles

To fully realise the potential of AI and data in the energy industry, **a democratised and accessible data operating model is essential**. We believe this model should be based on data mesh principles, which aims to create a self-serve data ecosystem where data is easily discoverable, accessible, and understandable for all stakeholders.

This requires a fundamental shift in the way data is managed and governed, from a centralised and hierarchical approach to a more decentralised and collaborative model.

To create a data mesh-based operating model, the following steps should be taken:

## Step 1
## Define Data Domains:

Identify the key areas of the business that generate or consume data, and group them into logical data domains. For example, an oil and gas company may define data domains for exploration, production, refining, and distribution. Once these domains are identified **it's critical to identify key data sources and assign ownership to Data Owners**.

## Step 2
## Create Data Domain Teams:

For each data domain, create a cross-functional domain team that **includes business stakeholders, data engineers, data scientists, and data analysts.** These teams should be empowered to manage and govern their own data domains.

## Step 3
## Implement self-service tools:

Provide self-service tools that **allow domain teams to easily discover, access, and analyse data within their domains.** This includes things like a data platform, data catalogue, metadata management framework, machine learning platform and a data quality framework.

## Step 4
## Build Strategic Data Products:

**Define the purpose and need for a set of strategic data products that are aligned to your data domains.** For instance, Asset, Customer, Regulation and design the data models that allow you to expose the most valuable data-sets to the organisation in a uniform and standardised way.

# Step 5
# Data Product Lifecycle:

Establish a repeatable lifecycle and operating model around your data products to **ensure they are fed, watered and maintained** in the same way that you would maintain the lifecycle of a software product.

Chapter 4

# What are the data domains in the industry?

The energy industry is a **vast** and **complex field**, with many different **data domains** that are essential for efficient and effective operation. Here are some examples of the data domains in three major sectors of the industry: **water utilities, oil & gas and energy & utilities.**

## What are data domains?

Data domains are **logical groupings of data**. They are all about **ownership, governance and responsibility**. In respect of good governance, data domains refer to a specific area of responsibility within an organisation for managing data assets.

Establishing data domains and assigning ownership to data, is a key requirement for organisations to control their critical data assets whilst unlocking opportunity for ML, AI and advanced analytics to tackle net zero objectives.

## What is Domain Driven Design?

Domain-Driven Design (DDD) refers to the concept of **assigning responsibility for specific parts of a system to specific teams or individuals within an organisation.** In the context of DDD, these parts are known as domains or subdomains, which are distinct areas of the business that can be modelled and understood separately.

DDD can support establishing clear lines of ownership for data and their associated systems. Whilst enabling teams to be focussed on specific sections of a system or data-set without becoming overwhelmed with increasing complexity and scale. This offsets the risk of conflicts between teams around who owns what and **enables opportunities to accelerate the delivery of change and innovation opportunities for AI & ML driven solutions.**

Sample Data Domains -
### Water Utilities:

- Customer
- Consumption
- Billing • Asset
- Quality Control
- Asset Maintenance
- Regulatory Compliance
- Workforce Management
- Environmental
- Operations & Performance

Sample Data Domains -
### Oil & Gas:

- Studies • Projects
- Design • Facilities
- Operations
- Performance Management
- Field Monitoring
- Well Monitoring
- Resevoir • Cyber
- Regulatory Compliance
- Supply Chain

Sample Data Domains -
### Energy & Utilities:

- Network • Assets
- Maintenance
- Market Operations
- Regulatory Compliance
- Customer
- Connections
- Environmental
- Planning
- Workforce
- Investments & Finance • Cyber

Chapter 5

# Implementing Data Mesh & Federated Data Governance

Federated data governance is essential to ensure data privacy, security, and compliance while enabling collaboration and innovation at speed. It involves the decentralisation of data governance, allowing domain teams to manage and govern their own data while adhering to standard policies and principles.

## To implement federated data governance, based on data mesh principles, the following steps should be taken:

**01.** **Define data governance policies:**
Develop policies that define data ownership, security, privacy, and compliance requirements.

**02.** **Implement a data catalogue:**
Establish a data catalogue that provides a centralised view of all data domains, and enables domain teams to easily discover and access data.

**03. Implement standard interfaces:**
Define standard interfaces for data exchange between different domains, ensuring that data is clean, consistent, and adheres to data governance policies.

**04. Establish data quality and monitoring processes:**
Establish processes to ensure data quality and monitor data usage, to ensure that data remains accurate, complete and up-to-date.

# Generating Machine Learning Opportunities

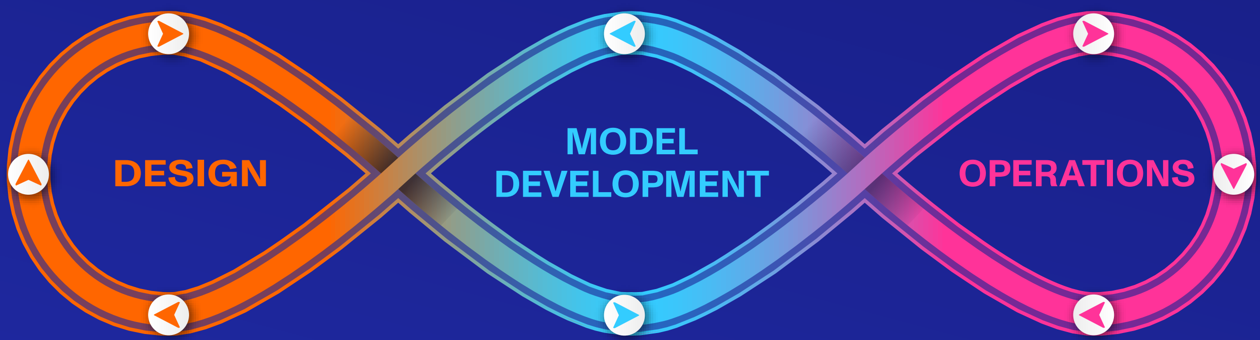
Machine learning is a key enabler of Net Zero capabilities, allowing energy & utilities organisations to **optimise their operations, reduce greenhouse gas emissions and improve business performance.** However, it's important to consider factors such as data quality and accessibility. As well as the value, feasibility and usability of any such machine learning intervention to offset the challenges afforded by Net Zero.

We believe MLOps is a key enabler to support these needs. Whilst it is still a young and evolving concept, MLOps or ML Ops is a set of practices that aims to deploy and maintain machine learning models in production reliably and efficiently. The word is a compound of "machine learning" and the continuous development practice of DevOps in the software field. At its core, **MLOps is the standardization and alignment of machine learning lifecycle management practices.**

By applying an MLOps approach, **organisations can take a business problem, identify how data & machine learning can address it and execute a series of complex, interrelated tasks in a transparent and governed way. With the intention of deploying it in production, in order to turn business challenges into measurable outcomes.**

It is rapidly becoming an essential part of successful data science, ML & AI projects across the enterprise. As a concept, approach and framework it enables business and technology leaders to demonstrate that there are guardrails in place to govern their development and deployment of ML & AI.

# MLOps Lifecycle




**DESIGN**

01 Requirements Engineering

02 ML Use-Cases Priorization

03 Data Availability Check

**MODEL DEVELOPMENT**

01 Data Engineering

02 HL Model Engineering

03 Model Testing & Validation

**OPERATIONS**

01 HL Model Deployment

02 CI/CD Pipelines

03 Monitoring & Triggering

As an example, both the energy & utilities and oil & gas sectors are built on a constantly evolving tectonic plate that is responsible for servicing the world's energy demands. With trillions of kilowatts of energy being transmitted each day, and millions of barrels of oil being produced week by week even a minor distortion of system performance can result in systemic risks to critical national infrastructure and beyond.

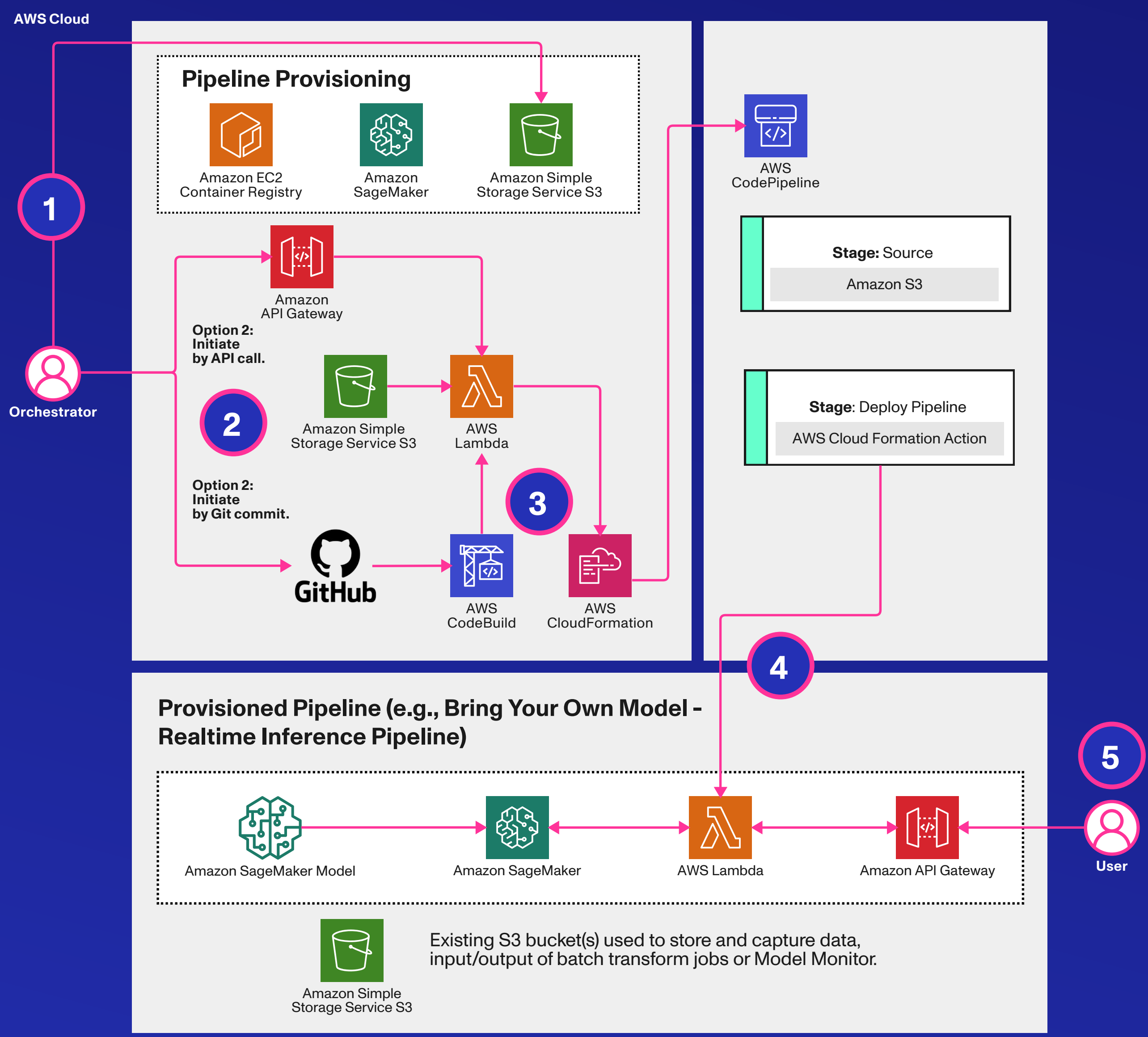
Alternatively, a poorly configured model operating in production could ultimately cause significant disruption to operational systems that power deep sea drilling platforms.

As such, an audit trail of events explaining the following evidence points can be critical to control and govern risk. **This is why MLOps can be useful in enabling organisations to provide transparency around:**

01. Why was the model developed?
02. What was the hypothesis of its impact and intent?
03. How was the model developed?
04. Who created it?
05. What components were used to build it?
06. Which data was used to create and train the model?
07. Where are the testing reports and what did they tell us?
08. How and where was that data accessed from?
09. What was the state of the data?
10. When did all of these events take place?
11. Who approved its deployment into production?
12. Did the model perform as expected in production?

AWS have created a reference architecture and accelerator for building a lightweight MLOps framework on on their platform. See below:

# AWS MLOps Orchestrator



# AWS Architecture System Flows

1. The Orchestrator (solution owner or DevOps engineer) **launches the solution in the AWS account** and selects the desired options (for example, using Amazon SageMaker model registry, or providing an existing Amazon S3 bucket).

2. **The Orchestrator uploads the required assets for the target pipeline** (for example, model artifact, training data, or custom algorithm zip fi le) **into the Amazon S3 assets bucket.** If using Amazon SageMaker model registry, the Orchestrator (or an automated pipeline) must register the ML model with the model registry.

3a. **The solution provisions a single account AWS Code Pipeline** by either sending an API call to the Amazon API Gateway or by committing the mlops- config.json file to the Git repository.

3b. Depending on the pipeline type, **the orchestrator AWS Lambda function packages the target AWS CloudFormation template and its parameters / configurations** using the body of the API call or the mlops- confi g.json fi le, and uses it as the source stage for the AWS CodePipeline instance.

4. The DeployPipeline stage takes the packaged Cloud Formation template and its parameters / configurations and **deploys the target pipeline into the same account.**

5. After the target pipeline is provisioned, users can access its functionalities. An Amazon Simple Notification Service **(Amazon SNS) notification is sent to the email provided in the solution's launch parameters.**

Chapter 6

# Creating a Digital Twin: Predictive Maintenance, IoT, Sensors, Intelligent Planning

When combining machine learning with a data mesh approach and by building strategic data products organisations start to have the ingredients to build a digital twin of the business. **This is where the Net Zero magic happens!**

**What is a digital twin?** A digital twin is a virtual replica of a physical asset or system, which can be used to simulate and optimise performance. Across the energy & utilities industry, digital twins can be used to improve operational efficiency, reduce downtime, and minimise greenhouse gas emissions.

# What types of Digital Twin Exist?

There is a wide breadth of use cases for digital twins. Each requires different services, technologies, and data needed to enable them. Typically, the energy sector can make use of 4 types of digital twin. **These are:**

## Type 1 • Descriptive:

These types of digital twins focus on the engineering design and the visual representation of the physical system. **These are usually a 2D engineering diagram** (such as a process or P&ID diagram), a building information model (BIM), or a complex high-fidelity 3D/AR/VR model. They can be used for pre-site analysis and readying field engineers to understand the schematic of pipes, electrical flows and other assets to ensure that jobs can be adequately planned ahead of time.

## Type 2 • Informative:

**These types of digital twins introduce IoT sensor and maintenance data from the physical system** and display it to users in a context-relevant manner, such as a dashboard or a 3D contextual visualisation (e.g. its state). This builds on the Descriptive Digital Twin and provides the end user with an ability to understand the condition of an asset and can include simple analytics to trigger alarms when performance and condition thresholds are on the cusp of, or have exceeded acceptable risk tolerances.

## Type 3 • Predictive:

This incarnation of a digital twin **enables organisations to make predictions of unmeasured quantities** (e.g., virtual sensors, machine learning based anomaly detection), as well as using predictive models to understand future states of an asset under continued operations. For instance, this may include the ingestion of weather data, manufacturing warranties and computer vision to determine and forecast where the future behaviour is the same as past behaviour. These models can either be based on scientific first principles, purely data-driven (e.g., using AI/ML), or a hybrid of the two.

## Type 4 • Dynamic Digital Twin:

The Dynamic Digital Twin brings together Descriptive, Informative and Predictive Digital Twin capabilities. The Dynamic Digital Twin **focuses on updatable models to drive actionable insights at an individual asset of component level.** The key distinction between Dynamic and Predictive Digital Twins is that the AI/ML models that power the Dynamic Digital Twin are self healing and capable of updating themselves based on the data being generated from the physical environment (e.g., sensors, scans, video etc).

# What Capabilities Do You Need to Build a Digital Twin?

**Data acquisition:**
The ability to collect data from the physical system, sensors and other sources, and to integrate this data into the digital twin.

**Modelling and simulation:**
The ability to create a mathematical model of the physical system and to simulate its behaviour using this model.

**Analytics:**
The ability to analyse data from the digital twin to gain insights into system performance, identify patterns and predict future behaviour. More often than not this will include the adoption and implementation of graph database capabilities.

**Visualisation:**
The ability to represent the digital twin and its behaviour in a visual format, allowing stakeholders to easily understand its performance and to identify opportunities for improvement.

**Integration with other systems:**
The ability to integrate the digital twin with other systems, such as enterprise resource planning (ERP), customer relationship management (CRM) and Internet of Things (IoT) platforms. Or leverage architectures that enable you to surface, expose and democratise data using a data product oriented approach.

**Security:**
The ability to ensure the security and privacy of data and models in the digital twin, and to prevent unauthorised access and manipulation.

**Scalability:**
The ability to scale the digital twin to meet the growing demands of the physical system, and to accommodate new data sources and simulation requirements

**Continuous improvement:**
The ability to continuously update and refine the digital twin based on new data, insights and feedback from stakeholders.

**Querying Engine:**
Deploying the use of a query engine that allows users to interact with the data and analytics generated by the digital twin in a consumer friendly way.

# The Digital Twin - Data Driven Businesses

In the case of a utility provider, **a digital twin can be used to create a virtual model of the entire utility network.** For instance the power grid, the water supply network, and gas pipelines.

The digital twin would include real-time data about the physical systems, such as energy consumption, pipeline pressure, and water flow rates. By analysing this data, the operator/provider can optimise the performance of the network, identify potential faults or issues, and make more informed decisions about maintenance and upgrades.

**The digital twin can also be used to simulate different scenarios,** such as sudden increases in demand for electricity due to extreme weather conditions. This would allow the utility provider to predict potential problems and adjust the network in real-time to prevent outages and ensure a reliable supply of energy.

By integrating the digital twin with other capabilities such as machine learning and artificial intelligence, **the utility provider can create an intelligent connected system that can make autonomous decisions based on real-time data.** For example, the system could automatically reroute power to prevent outages. Or in the case of the residential energy supply market adjust energy prices based on demand and a customer's bespoke needs. This will become particularly useful with the onset of 30-minute settlements across the energy sector.

# The Digital Twin: Future Ready for Net Zero

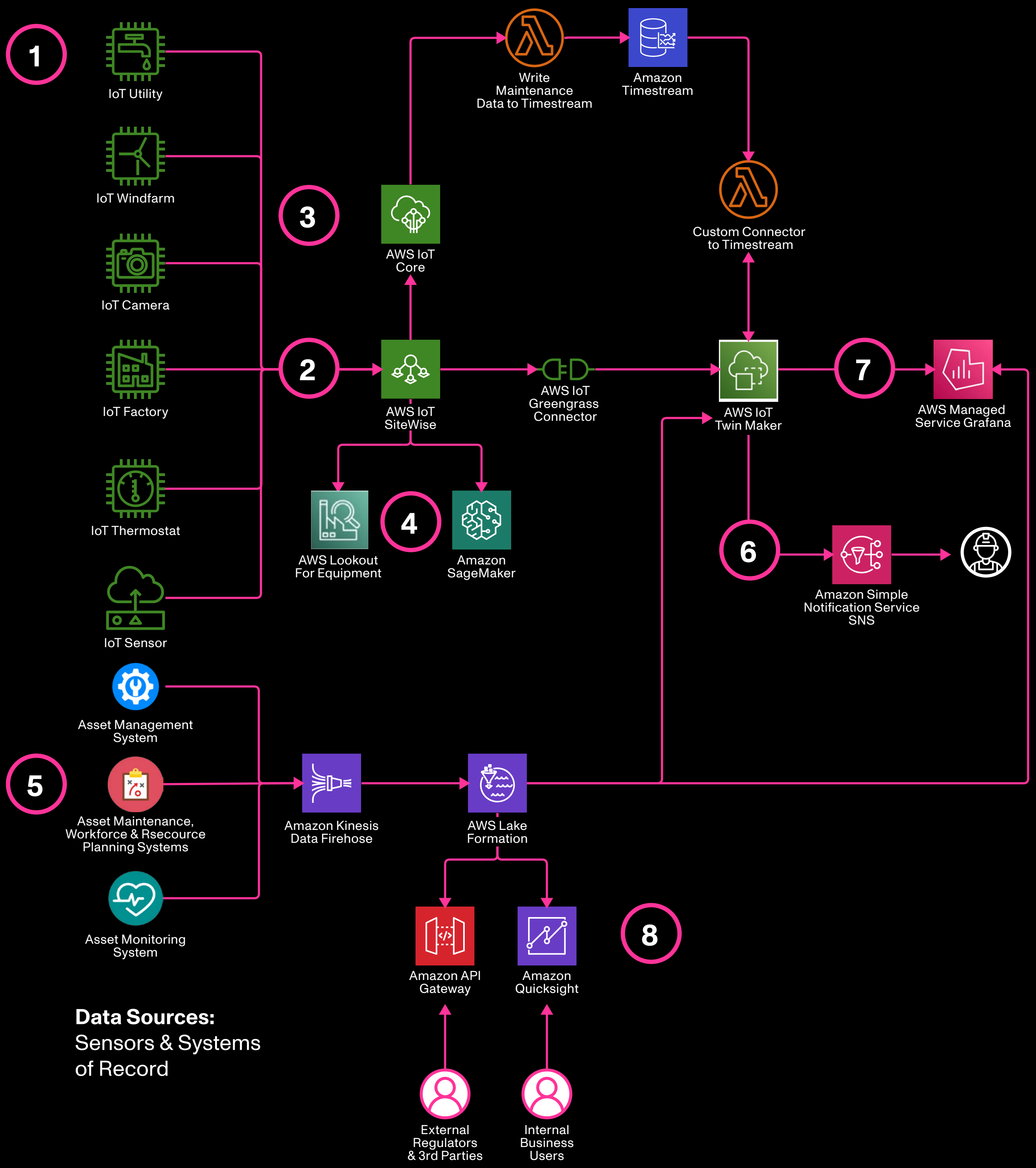
In the case of the energy & utilities sector, a digital twin can be used to create a virtual model of an oil rig or refinery. **The digital twin would include real-time data about the physical systems,** such as pressure, temperature, and flow rates. By analysing this data, organisations can optimise the performance of their assets, identify potential faults or issues, and make more informed decisions about maintenance and repairs.

The digital twin **can also be used to simulate different scenarios, such as adverse weather conditions, or seismic activities.** This would allow for more dynamic reactions to potential operational risks that could result in asset damage and result in greenhouse gas leakage, or worse, oil well blow-outs at subsea levels in the oil & gas sector.

By integrating the digital twin with other technologies such as IoT sensors and predictive analytics, energy & utilities organisations can create an optimised system that can make autonomous decisions based on real-time data. For example, the system could automatically adjust production to prevent waste and maximise efficiency or shut down equipment to prevent safety hazards.

In summary, by leveraging digital twin technology, energy organisations can **create intelligent connected systems that can optimise performance, prevent outages and shortages, improving overall efficiency and safety.** The technology allows for real-time monitoring, analysis, and control of physical systems, which can lead to more informed decision-making and ultimately, better outcomes.

# Digital Twin Architecture on AWS



# AWS Architecture High-Level System Flows

1 **AWS IoT Sensors are leveraged to provide continuous processing of asset health data** from operational systems. Consisting of data points such as temperature, weather, flow, pressure etc. This can be combined with image/video captures taken from drone technology or field engineers.

2 **IoT data is collected,** streamed and stored in AWS IoT SiteWise.

3 Upcoming maintenance data can be stored in **AWS IoT Core** and stored in **Amazon Timestream.**

4 A combination of AWS Lookout for Equipment and Sagemaker are used to **identify abnormal equipment performance.** This data is fed into AWS IoT Twin Maker to provide real- time insight into asset health. Whilst asset degradation can be surfaced via Grafana dashboards.

5 **Systems of Record can stream data, via Kinesis Firehose into an AWS Lake Formation data lake** for additional machine learning opportunities. This can consist of resource, supply chain and other 3rd party monitoring systems to provide additional insights and recommendations for proactively managing asset health. This can act as the landing and hosting point for strategic data products.

These data points can be fed into the digital twin to provide further insights and recommendations to field engineers, workforce planners and maintenance schedulers.

6 **Notifications can be sent via Text or other messaging channels** to inform engineers of asset depreciation outside of acceptable risk thresholds.

7 **Grafana can be used for visualisation of the digital twin,** as well as asset health notifications. Further data can be surfaced via strategic datasets that are streamed into the AWS Data Lake.

8 **Introduce API Gateway to provide access to third parties** so that your organisation can comply with Open Data Standards or provide secure data entry to external bodies such as regulators. Self- service analytics and report creation can be provided AWS Quicksights to internal business users.

Chapter 7

# Why the AI & Data Opportunity Matters for Net Zero

The energy & utilities sector is one of the most critical and complex sectors in the world. From exploration to production, transportation, and distribution, it is a highly complex and capital-intensive industry. **The industry faces a myriad of challenges, including high operational costs, environmental concerns, safety hazards, and complex regulatory requirements.** These challenges are further compounded by the need to transition towards Net Zero carbon emissions to mitigate the effects of climate change.

The integration of AI and data technologies in the energy and oil & gas sector has significant potential to address these challenges. Here are some specific examples of why the opportunities provided by AI and data are so important in these industries:

## 1 • Predictive Maintenance:

The energy and oil & gas industry is highly reliant on critical infrastructure, including pipelines, refineries, and power generation facilities. A single unplanned outage can result in significant financial and reputational damage. AI and data technologies can enable predictive maintenance, which **can help identify and mitigate potential problems before they occur,** reducing unplanned outages, and associated downtime costs.

## 2 • Asset Optimisation:

Optimising the use of assets such as oil rigs and refineries is a crucial aspect of running a successful oil & gas operation. Data analytics and AI tools can provide insights that help to optimise asset utilisation, **resulting in higher efficiency, lower operating costs, and reduced greenhouse gas emissions.**

## 3 • Carbon Management:

The energy and oil & gas industry is a significant contributor to greenhouse gas emissions, accounting for a significant portion of global emissions. The industry's transition to Net Zero emissions is an urgent imperative, and AI and data technologies can play a critical role in achieving this goal. **AI and data analytics can help companies track emissions,** identify high-impact areas, and develop strategies to reduce their carbon footprint.

## 4 • Safety and Risk Management:

The energy and oil & gas industry is highly regulated, and compliance with safety regulations is critical to prevent accidents, minimise damage, and avoid penalties. **AI and data technologies can provide insights that enable better safety management,** such as identifying potential safety risks and predicting the likelihood of accidents, allowing proactive measures to be taken to avoid accidents that can result in the leakage of harmful emissions into the environment.

## 5 • Supply Chain Optimisation:

The energy and oil & gas industry has complex supply chains, with multiple stakeholders, complex logistics, and long lead times. **AI and data technologies can help optimise the supply chain,** reduce lead times, and enable more efficient use of resources, ultimately reducing costs and environmental impact.

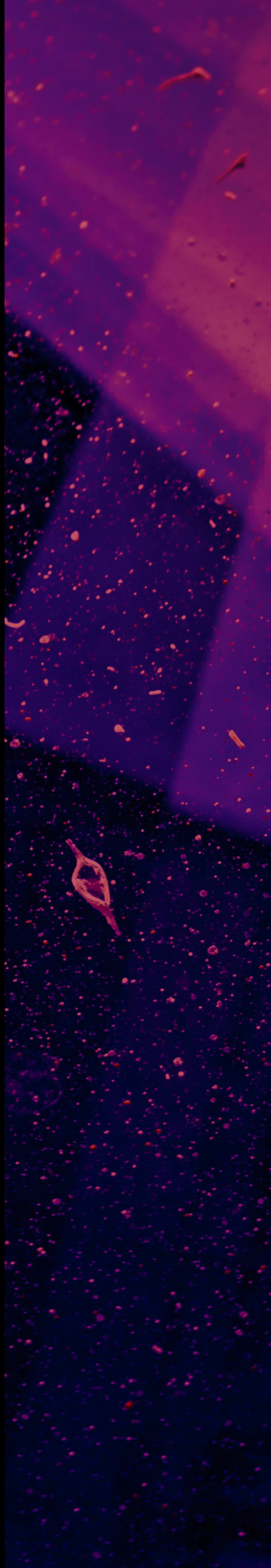
## Summary

In summary, the AI and data opportunity in the energy and oil & gas industry is immense. By leveraging data analytics, AI, and machine learning, companies in these sectors can achieve **operational efficiencies, reduce costs, manage risk and safety, optimise assets, and transition towards Net Zero carbon emissions,** ultimately contributing to a more sustainable and resilient energy future.

By harnessing their data with a data mesh approach, unlocking AI opportunities with MLOps and combining these ingredients to fuel digital twins; organisations have the constituent parts to accelerate their race to Net Zero with increased confidence and accuracy.

Mesh-AI is a transformation consultancy that exists to reimagine how enterprises operate, making data and AI their competitive advantage.

We turn enterprises into data-driven and AI enabled organisations, unleashing business growth and accelerating outcomes.



# Our Services

## Strategy & Consulting

## Product

## Data & Software Engineering

## Cloud Platforms

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