



## Decarbonising Industry in the Humber



*Developing a roadmap to achieve Net Zero by 2040 and low carbon by 2030 in the UK's highest emitting industrial cluster.*

The Humber industrial cluster is a complex system of connected and interdependent industries. As the highest emitting cluster, it presents a significant opportunity to decarbonise UK industry by 2040.

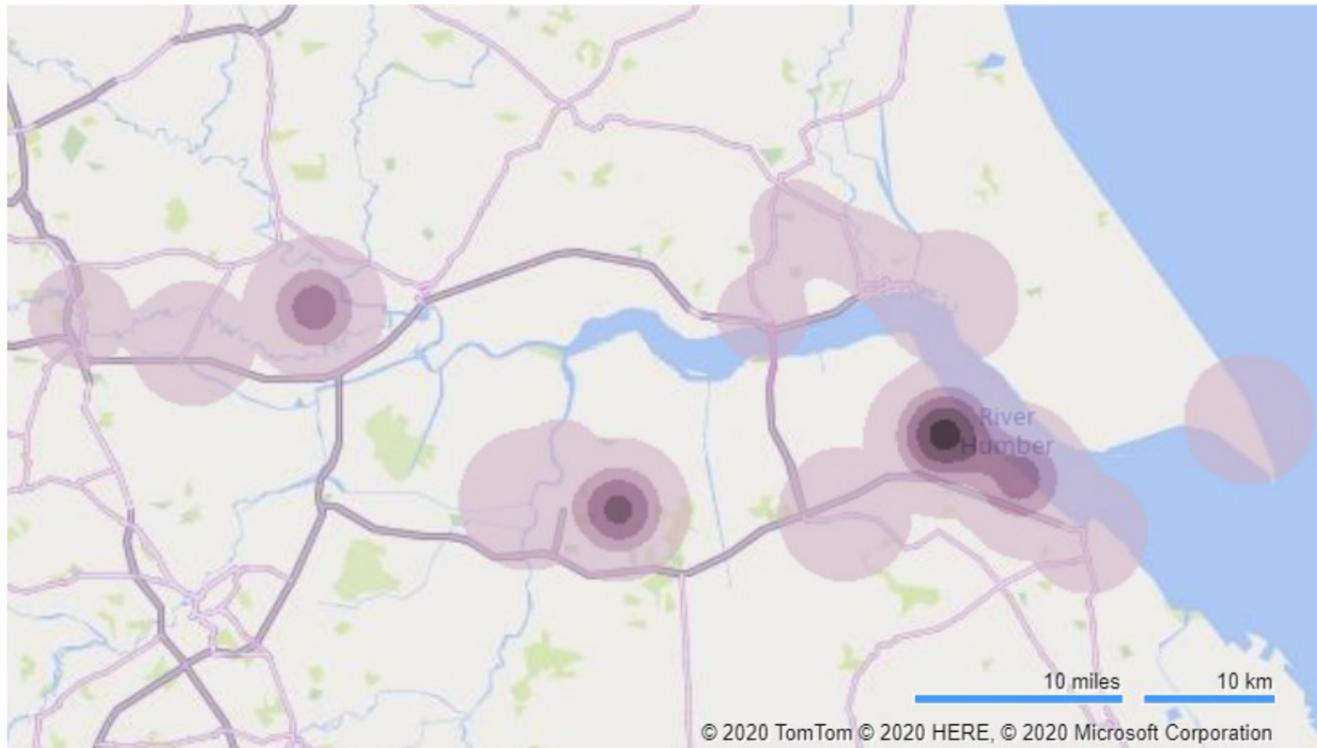
Business Modelling Associates (BMA), working collaboratively with CATCH, the Humber LEP and Humber stakeholders, have explored the modelling options available to develop the decarbonisation roadmap. Advanced analytics including systems modelling is recommended due to the complex nature of the Humber cluster, as well as future uncertainties - and a demonstration model has been developed on this basis.

# Understanding the Humber

Over recent decades, the Humber Region has developed into a critical industrial cluster within the UK. The Humber industrial cluster:

- Has two of the UK's four oil refineries producing a third of the UK's fuel output: operated by Phillips 66 and Total - both receive steam and power from VPI Immingham.
- Has one of the UK's two integrated steelworks: British Steel.
- Has the second largest chemical cluster in the UK at Saltend - receiving power and steam from Triton Power.
- Handles a third of UK coal and biomass imports, some of which go to Drax power station.
- Receives a fifth of UK gas imports.
- Produces a sixth of UK electricity.
- Has three of the world's largest wind farms, with the largest in the world currently under construction at Dogger Bank.
- Has 20 operational onshore wind farms.
- Is a hub for offshore wind turbine manufacture and servicing.
- Has a key port and logistics hub, which contributes £2.5bn GVA to the UK economy.

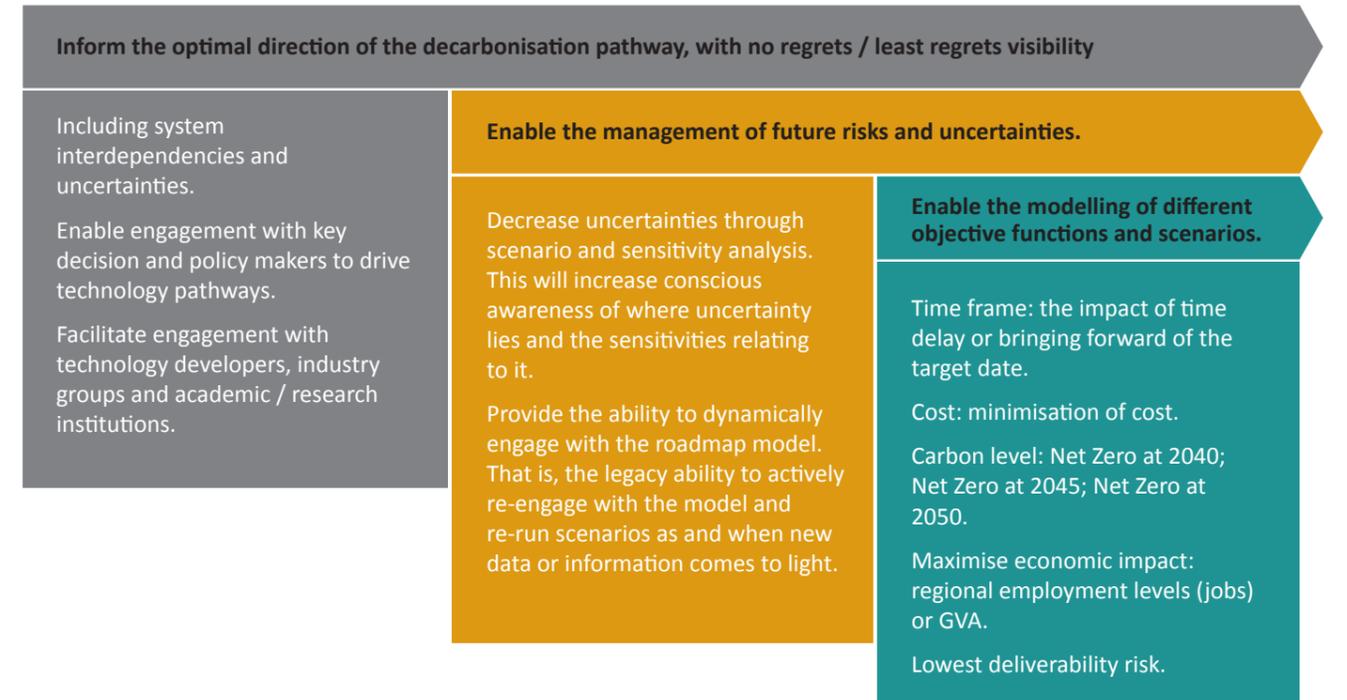
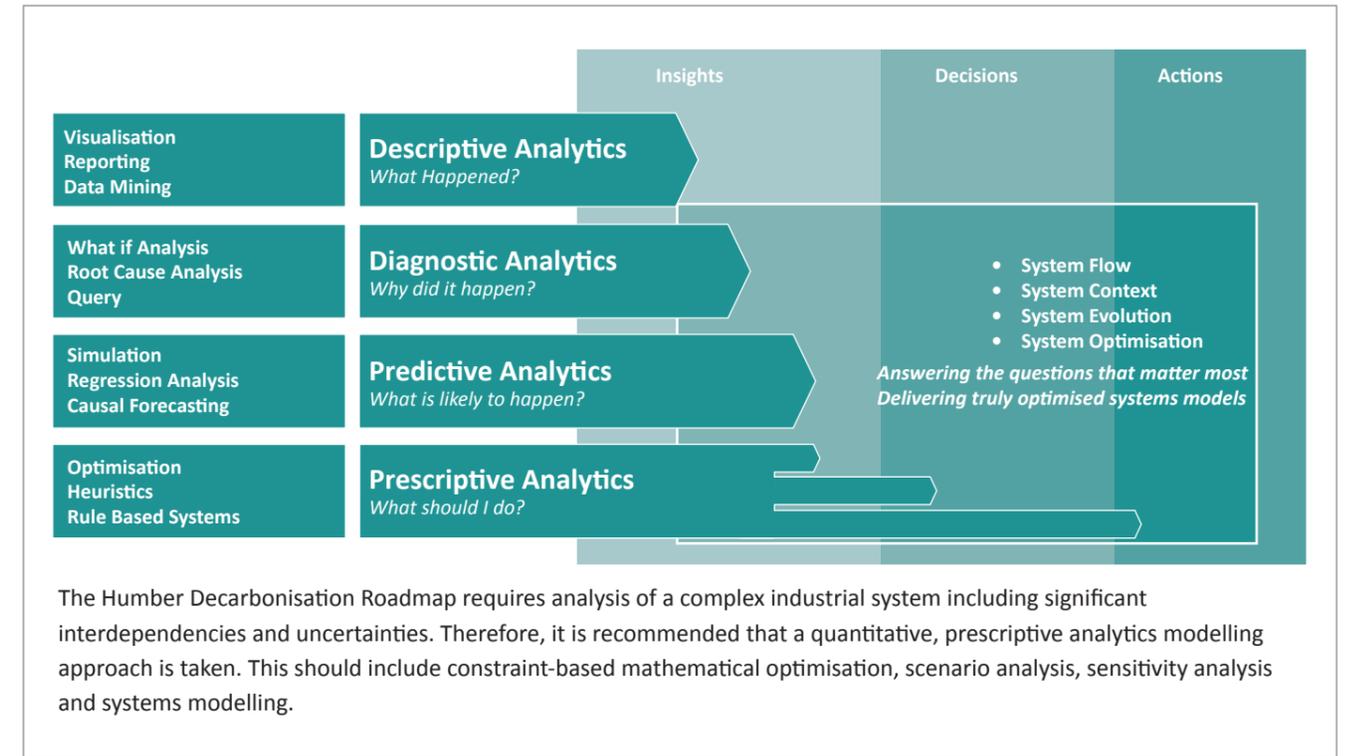
## Humber Emissions Heat Map



The Humber industrial cluster is on the east coast of the UK. There are six industries in scope for decarbonisation under the Industry Strategy Challenge Fund (ISCF) decarbonisation programme: refineries, steel & iron, chemicals, glass, paper and cement. These industries and the associated power they require are currently producing over 20 million tonnes of carbon emissions per year, presenting a significant opportunity to reach net zero in the Humber and assist in the decarbonisation of UK industry by 2040.

# Modelling Requirements

*Data creates the opportunity; systems modelling delivers the value.*



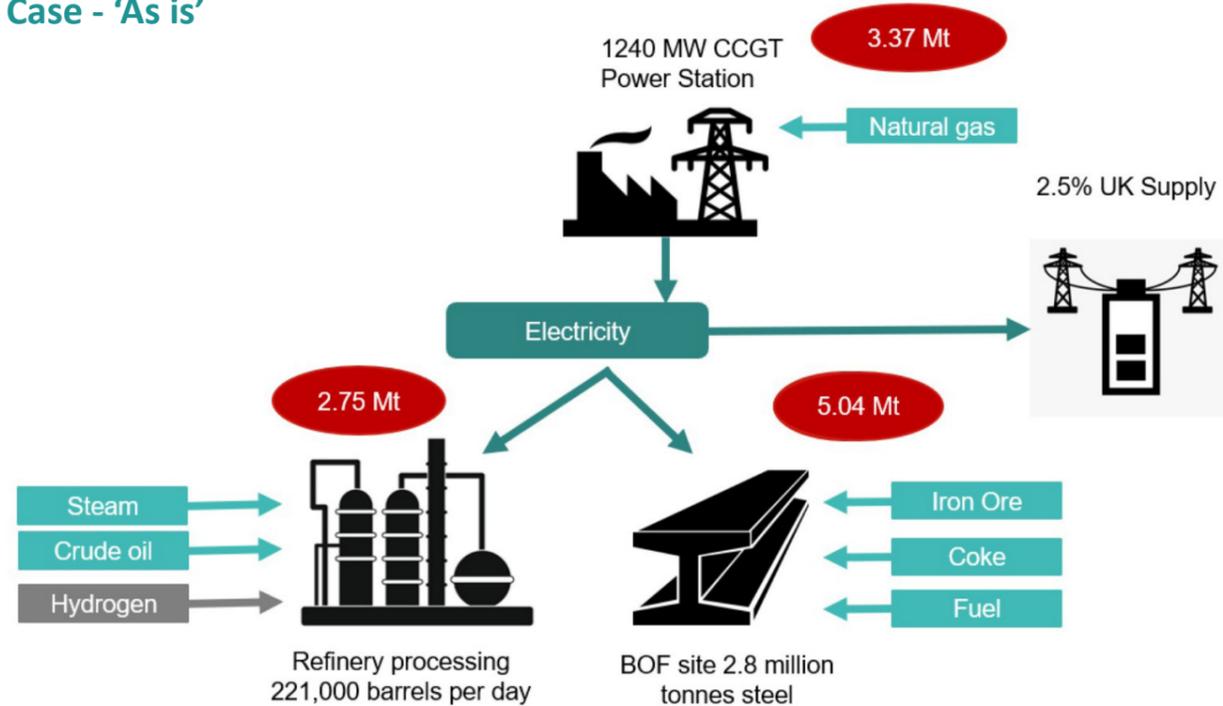
*Successful realisation of the net zero target will be underpinned by high levels of engagement with industrial, technology and infrastructure stakeholders in the process of Roadmap Strategy creation.*

## Demonstration Model

In addition to the requirements of the Humber Decarbonisation Roadmap Phase 1 project, BMA developed a demonstration model to illustrate to stakeholders the future capability and functionality of a Phase 2 model. The model centres around a sub-section of Humber industries, demonstrating the greatest amount of functionality possible using order of magnitude data.

The aim of the demonstrator was therefore not to provide any answers or conclusions about the decarbonisation pathway itself, which is the objective of the Phase 2 project. The demonstrator's aim was to illustrate how a model could be used in Phase 2. For example, what questions could be asked or how scenarios and constraints could be framed and used. Example dashboards were also created to demonstrate the different levels of granularity, visuals and interactivity there could be for different users, roles and stakeholders.

### Case - 'As is'



### Demonstration Model: Base Case

The oil refinery and steel sectors and associated power and steam requirements were chosen for the demonstration model as these are key emitters in the Humber, with steel manufacture accounting for around half of all direct regional industry emissions (excluding power generator emissions).

Decarbonisation technology was also selected to be reflective of that currently being explored within the Humber's deployment projects, namely blue and green hydrogen, CCS, BECCS and efficiency improvements. A lower technology readiness level (TRL) technology was also included: DACCS.

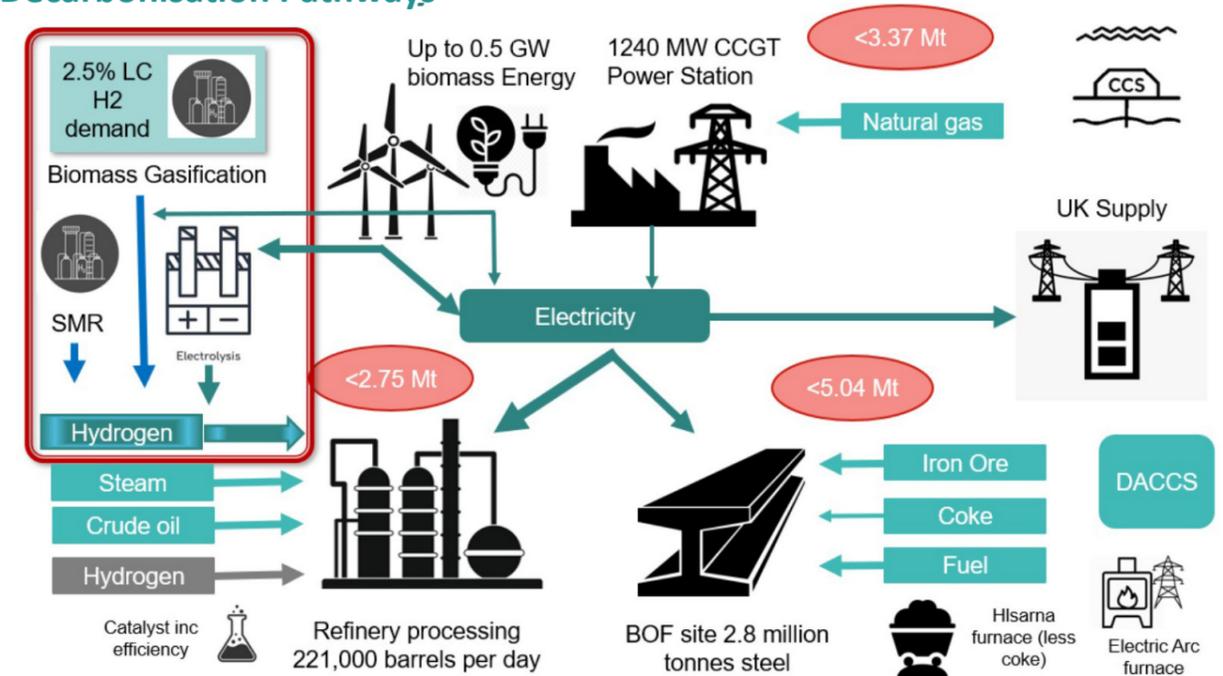


*"It is a really exciting opportunity for us in this region. It gives opportunity to re-focus on the green agenda right round the Humber Bank and is a great opportunity to drive forward."*  
David Talbot, CATCH Chief Executive

In the Base Case of the model, which shows the current state, it was assumed there was a 1200MW combined cycle gas turbine (CCGT) power station supplying the following:

- An oil refinery with electrical power and steam in order to process c. 220,000 barrels of crude oil each day. This also uses hydrogen for a process known as hydrocracking, where heavier compounds in crude oil are broken into lighter, shorter chain compounds which are more readily usable, such as petrol.
- A steel manufacturing plant with electricity to manufacture c. 2.8 million tonnes of steel per year by turning coal into coke then iron and finally into steel using processes which are intensive in their requirements for both heat and energy.
- The national electricity grid with 2.5% of the UK's electricity requirements.

### Decarbonisation Pathways



### Demonstration Model: Decarbonisation Pathways

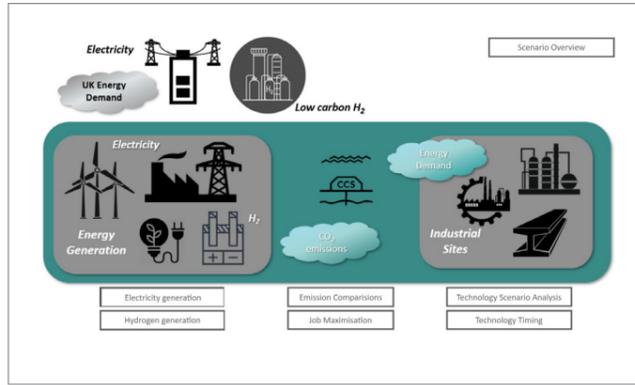
An array of decarbonisation options were built into the model so it could determine the best decarbonisation pathway:

- An increased efficiency in the catalyst used in oil refinery processes.
- Alternatives to steel blast furnaces, such as electric arc furnaces.
- Bioenergy or direct air capture and carbon capture and storage (CCS).
- Electricity supplied by wind turbines instead of CCGT.
- Blue or green hydrogen available for industrial processes and power generation.

The model calculates the best decarbonisation pathway based on the scenario (objective function) and constraints. This is essentially the question(s) the model user wants to find the answers to. This could be, for example: how do I minimise cost whilst meeting net zero at 2040? Or, how do I maximise regional employment or economic growth whilst meeting net zero?

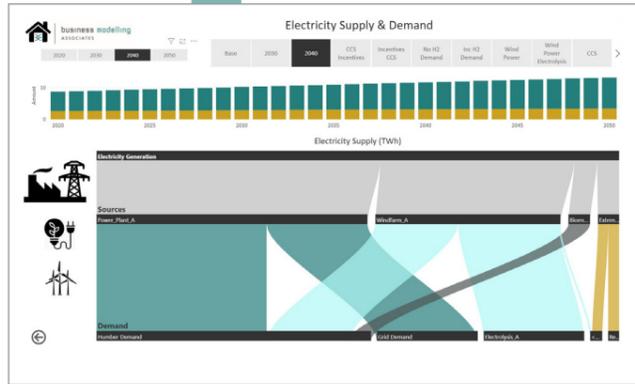
There is much uncertainty around the future of energy, decarbonisation technology and integration of sectors and systems to deliver net zero targets. Uncertainty can be modelled and tested by using different scenarios and performing sensitivity analysis and stress testing within the model.

# Developing the Pathway to Net Zero



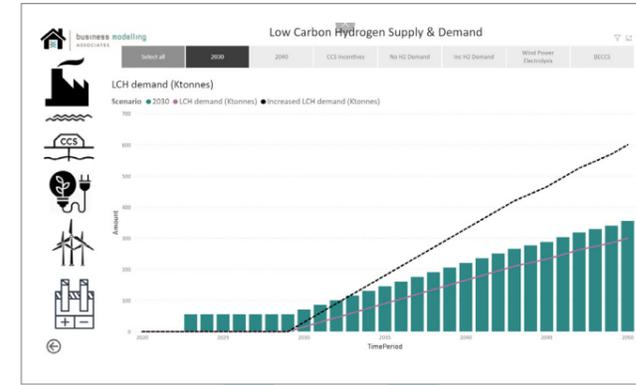
## Demo Model Home page

Format and layout adapted to the client, providing easy access to key scenarios, results and dashboards.



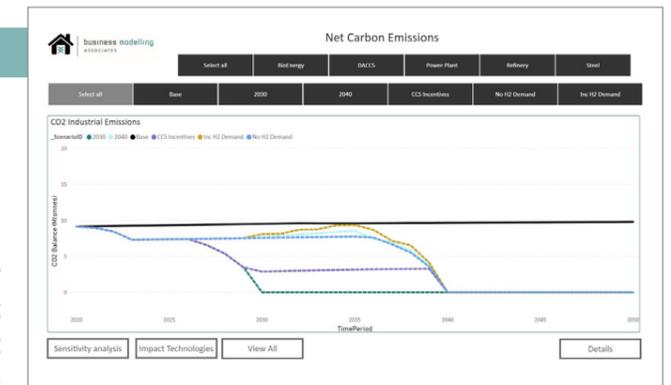
## Electricity Supply & Demand

Forecast of electricity demand forecasts, matched to the best sources of supply - based on scenario inputs and constraints.



## Hydrogen Supply & Demand

Forecast of hydrogen demand forecasts, matched to the best sources of supply - based on scenario inputs and constraints.

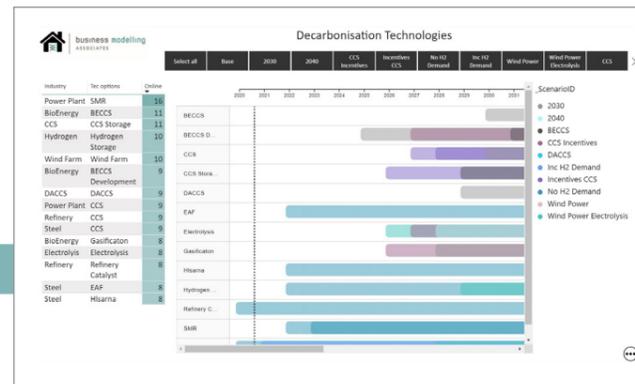


## Emission Reduction

Comparison of emission reductions for different scenarios. Provides visibility of which combinations of technology options are required to achieve net zero, as well as allowing a deeper dive into individual tech scenarios - enabling clearer visibility of potential blockers / enablers

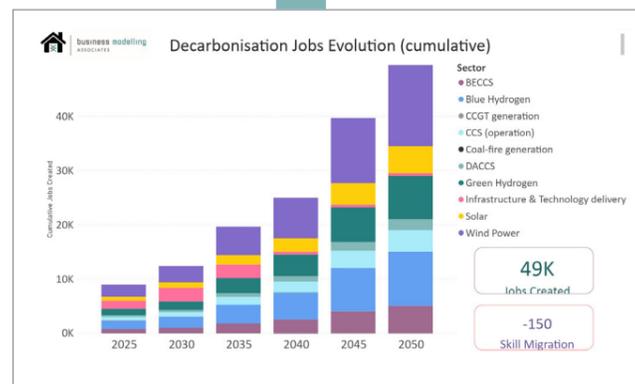
## Technology Scenario Analysis

Scenario analysis showing the frequency and timing of technology requirements - enabling support of no regrets, least regrets decision making and visibility of technology and infrastructure lead times.

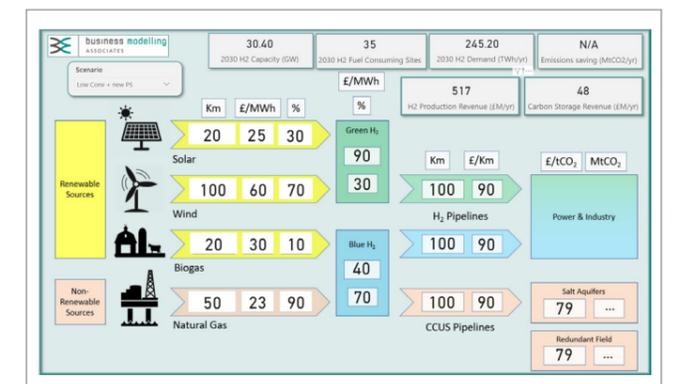
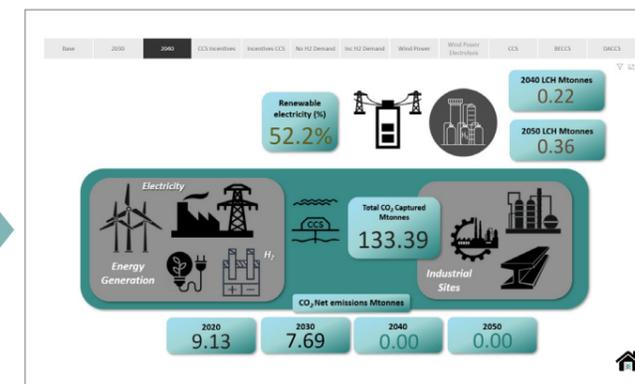


## Job & Skills Evolution

Provides visibility of jobs evolution in industry and technology sectors, enabling job mobility and skills planning.



## Scenario Summary & Executive KPI dashboards



For other companies or sectors considering developing a roadmap to Net Zero, the basis will be the same. The detail of the model and dashboard visualisation will depend on specific business processes, required business transformation and the nature of the system being modelled.

Developing a Decarbonisation Roadmap to achieve Net Zero in the Humber industrial cluster by 2040 ...

## Collaborative Working



Business Modelling Associates (BMA) is a leading business analytics and solutions development firm operating in the UK, Europe and Africa.

We design solutions that help clients systemically and holistically model their end-to-end operations and the context in which they operate. Our Advanced Digital Business Twin platform enables clients to analyse complex what-if scenarios and explore how potential changes affect service, costs, investor returns, sustainability, decarbonisation and risk.

We pride ourselves in a partnering approach defined as flexible, collaborative and engaging.

Fundamentally, BMA helps customers by giving them the tools to visualise, analyse and optimise their key decisions.



CATCH is an industry led partnership supporting the process, energy, engineering and renewable industries in Yorkshire and Humber.

Created in 1999 to support the development of the £6 billion Humber chemical and chemistry using sectors, CATCH now boasts members and partners drawn from across the process engineering, energy, engineering and renewable sectors, their associated supply chains, regional and national government agencies and local authorities, including all four Humber local authorities.

CATCH's approach to industry training is unique. Not only do they have world class facilities, but they work in partnership with multiple training providers including local further education colleges and private organisations who are recognised as leaders in their field.

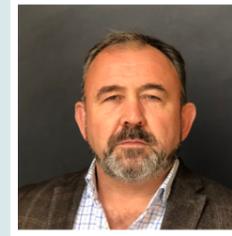


**Kate Hedges**  
CATCH Project Lead

*Working with BMA on the Humber Roadmap project has really opened our eyes to the added value that a systems modelling approach can bring to complex problems with a range of data inputs and uncertainties.*

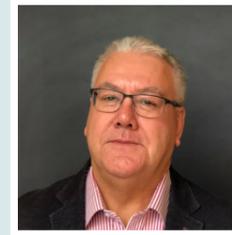
*Our vision for the Humber Cluster Plan is the development of a robust systems model, supported by accurate data, that can respond rapidly to changes. Such as new industrial emitters joining the system, changes in incentives for carbon capture and the pace of technology improvements. This approach will enable the Humber region to demonstrate how far we can decarbonise by 2030 and the transformation pathways to achieve net zero by 2040. These will provide clear visibility of the realisable benefits for the region, including jobs creation and economic growth.*

## BMA Team & Experience



**Rod Stout**  
Co-founder & Chairman

A proud product of Yorkshire, Rod moved to South Africa in 1989 with Manro Management Consultants to establish an operation in Johannesburg. In 1993 Rod co-founded and was Managing Director of The Logistics Bureau, South Africa's first specialist Supply Chain consulting & analytics company. Rod has subsequently established and grown a number of successful Analytics Innovations firms, including co-founding Business Modelling Associates in 2009.



**Mark Penny**  
Chief Operating Officer

Mark is a business and change leader with over 35 years' experience in Utilities. As a Yorkshire Water Main Board Director, he worked collaboratively and inclusively to deliver business wide asset and people change resulting in significant regulatory outperformance and customer service improvement. As COO, Mark has been instrumental in establishing the BMA operation in the UK utility sector over the last six years.



**Dr Craig Mauelshagen**  
Head of Research – Risk Analytics

Craig has worked for seven years in the areas of risk analytics, risk governance and risk culture. Clients include central and local Government, Energy (Electricity and Gas) and Water utilities. He has a PhD on risk governance from Cranfield University. He has led on design, delivery and implementation of energy system solutions for Utility clients including Northern Gas Networks and National Grid (UK). Through this work he has engaged with both BEIS and Ofgem on behalf of clients.



**Keri Bunnell**  
Head of Energy Systems & Sustainability

Keri has over 13 years of combined engineering, asset management and consulting experience. She is a Chartered Engineer and a Member of the Institute of Asset Management. Her experience in the gas industry includes asset strategy and risk quantification, as well as regulatory business planning. Keri moved back into consulting to work directly with clients across their business to implement and embed analytics software. Keri was Project Lead for the Humber Project.



**Cambell Plant**  
Technical Lead

Cambell is a senior consultant at BMA who has been technical lead on a number of our energy utility projects. She has been instrumental in developing our integrated hydraulic and investment optimisation solution, and our linear asset system resilience solution. Cambell has been the Technical Lead on the Humber Decarbonisation Project, providing expertise, insight and leading model configuration.

# BMA Sustainable Energy Solutions

- Determine the best pathways to net zero.
- Apply whole systems approaches.
- Model complexity and uncertainty, simplifying understanding for users.
- Support sustainable growth and building back better.
- Support collaborative, multi-stakeholder development, operation, accessibility & visibility.



Through our whole range of solutions and ways of working across the business, BMA supports the following UN SDGs:



**Affordable and Clean Energy**



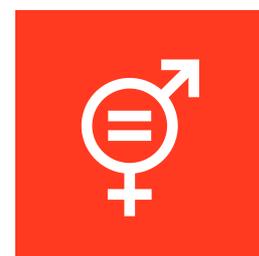
**Climate Action**



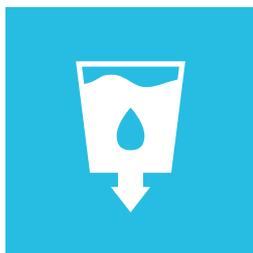
**Decent Work and Economic Growth**



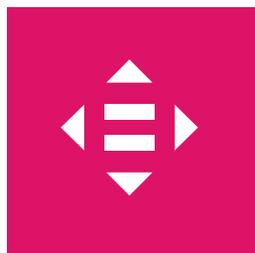
**Industry, Innovation and Infrastructure**



**Gender Equality**



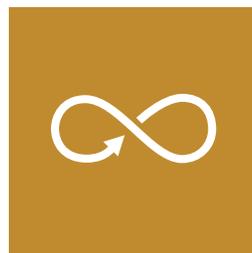
**Clean water and Sanitisation**



**Reduced Inequalities**



**Sustainable Cities and Communities**



**Responsible Consumption and Production**

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