

CATCH

TECHNICAL



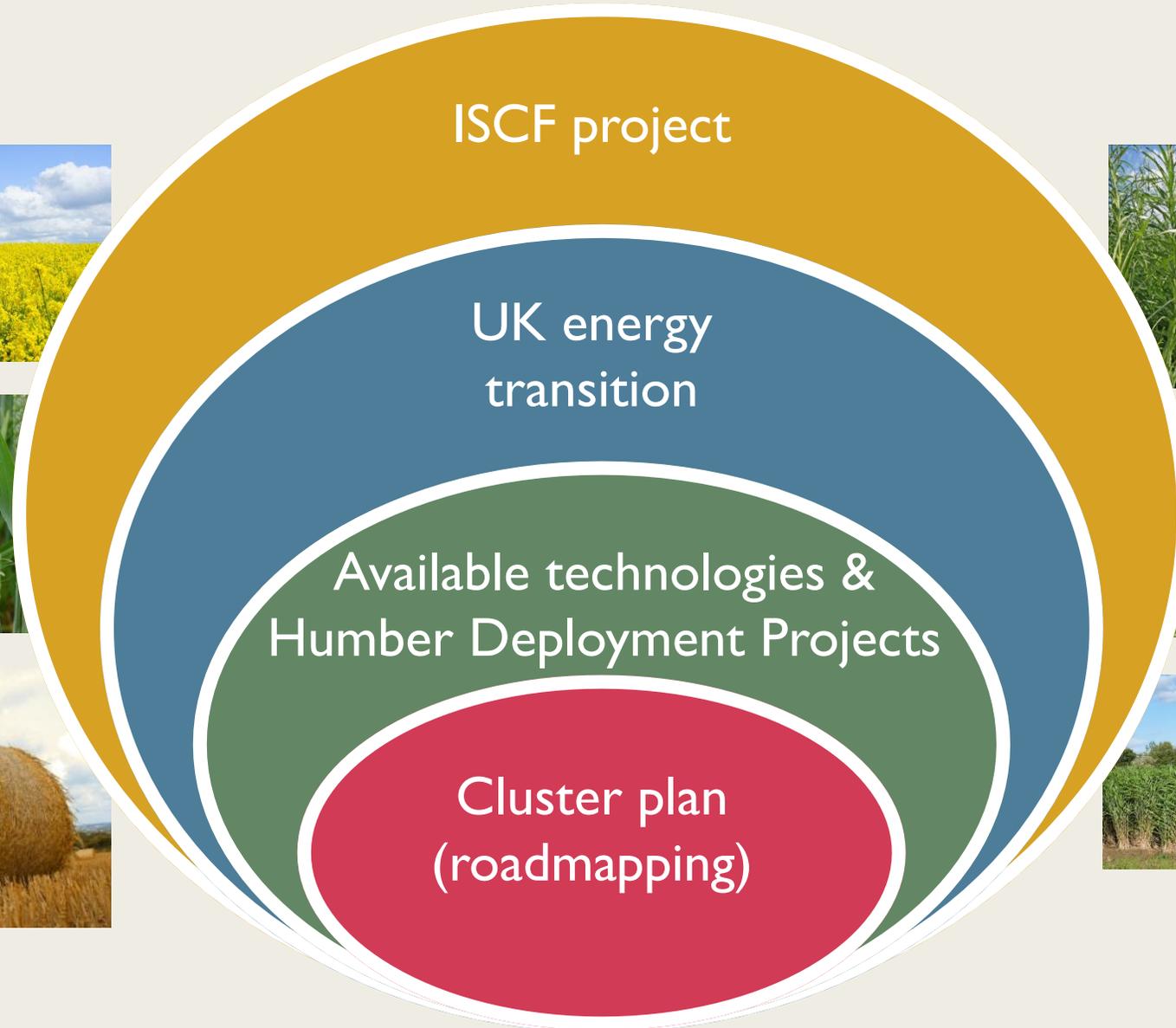
Targeting industrial net zero in the Humber region

30 July 2020

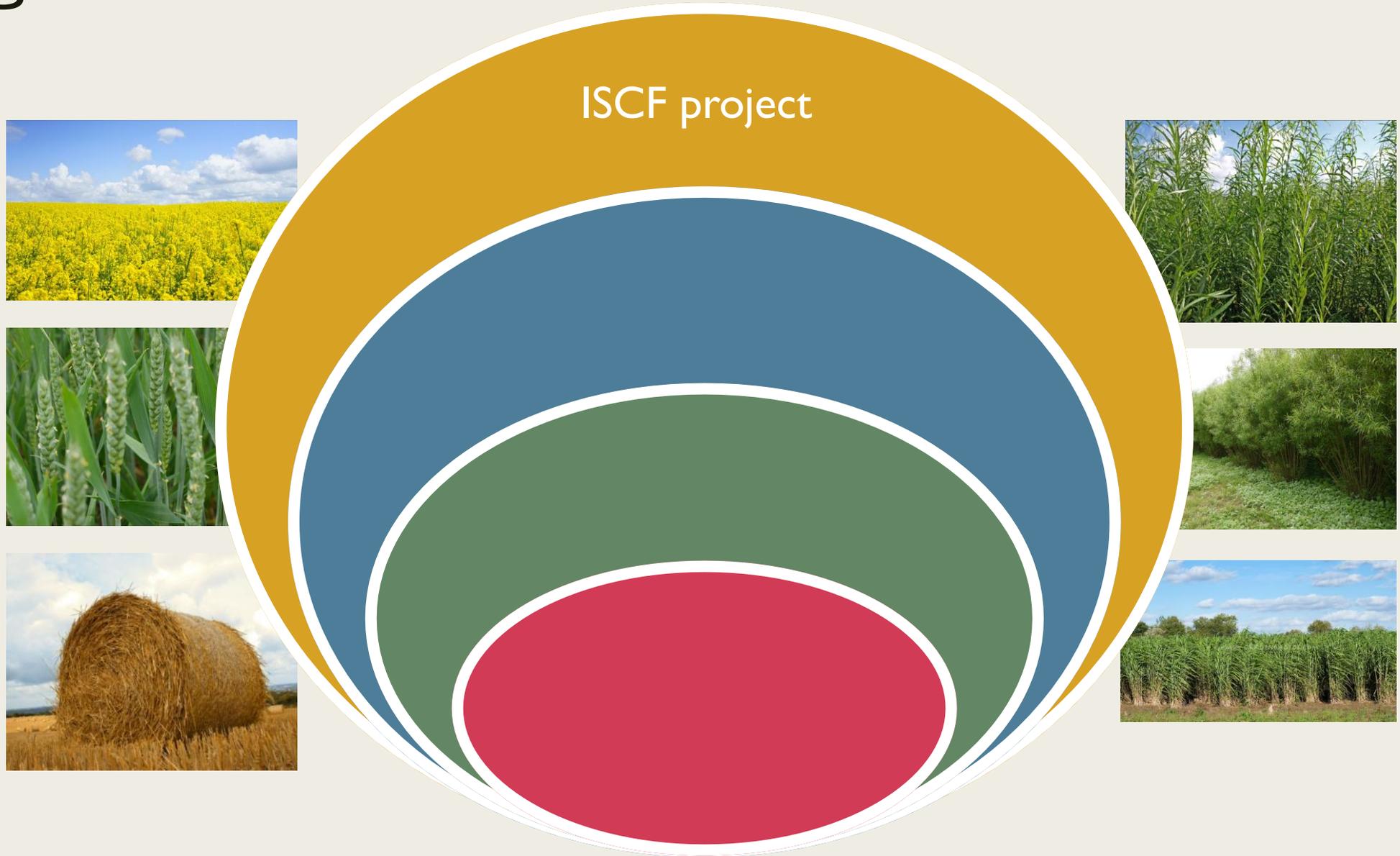
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Catch Consultants

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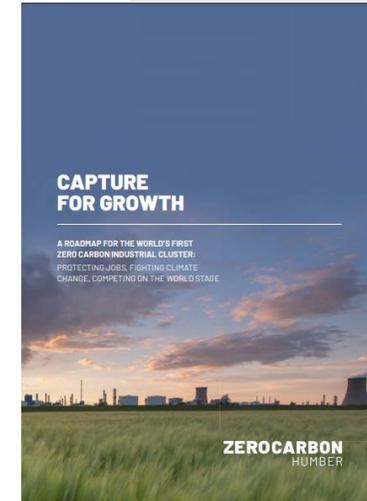
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4 BEIS Grand Challenges, 5 Missions

- Artificial intelligence and data – use AI to transform medical research
- Meeting the needs of an aging society
- Clean growth
 - *Halving energy use in buildings*
 - *Establish the world's first net-zero carbon industrial cluster by 2040 and at least 1 low-carbon cluster by 2030*
- Future of mobility – zero emissions vehicles

Six energy intensive industry clusters in the UK



Net zero?

- Net zero means that the UK's total greenhouse gas (GHG) emissions would be equal to or less than the emissions the UK removed from the environment. This can be achieved by a combination of emission reduction and emission removal.
 - 100% vs 1990
- Applied to a region (Humber) and a sector (industry):
 - *How to consider embedded carbon in construction and indirect effects of construction*
 - *How to consider imports of fuels (e.g. low carbon H2, high carbon H2) – risk of offshoring?*
 - *Who claims negative emissions if imported H2 made from BECCS is made out of region?*

<https://www.ons.gov.uk/economy/environmentalaccounts/articles/netzeroandthedifferentofficialmeasuresoftheuksgreenhousegasemissions/2019-07-24>

Industrial Strategy Challenge Fund (ISCF)

- £170M fund, matched with up to £261M from industry = £431M
- Deploy new low carbon technologies and accelerate cost effective and deep industrial decarbonisation
 - *Support delivery of achieving one low-C cluster by 2030*
 - *First net zero cluster by 2040*
 - *Covering energy intensive industries*
 - Iron/steel, refining, chemicals etc
- Boost competitiveness of industrial regions
 - *Drive inward investment*
 - *Create and protect jobs*

ISCF fund has three strands



IDRIC (Heriot Watt led) - Sustainable industrial clusters knowledge creation and sharing function, including the creation of a joint industry/government/academic-led research programme



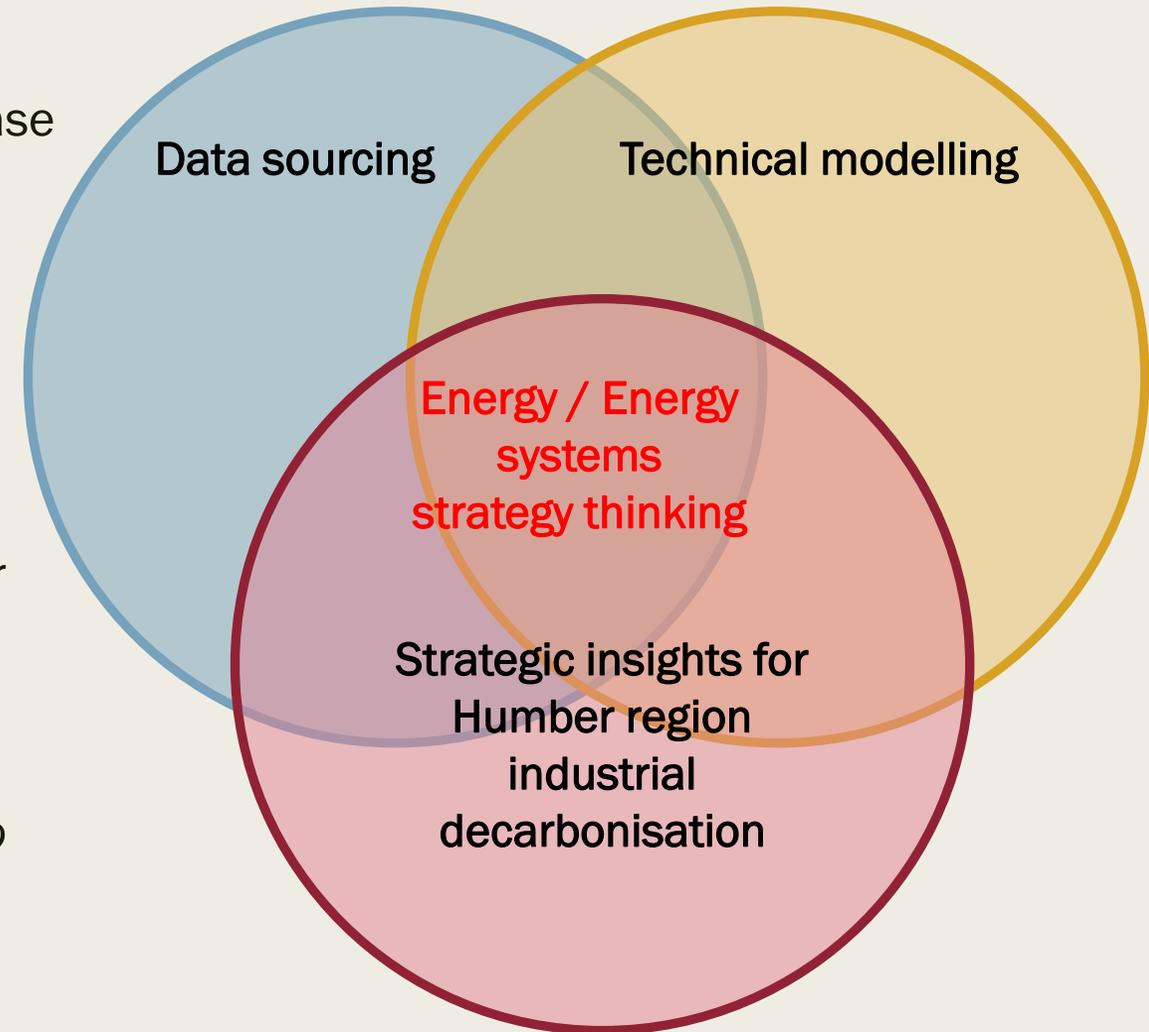
Deployment projects - Detailed designs and demonstration of industry-scale technologies and shared infrastructure for the cost-effective deep decarbonisation of at least one industrial clusters



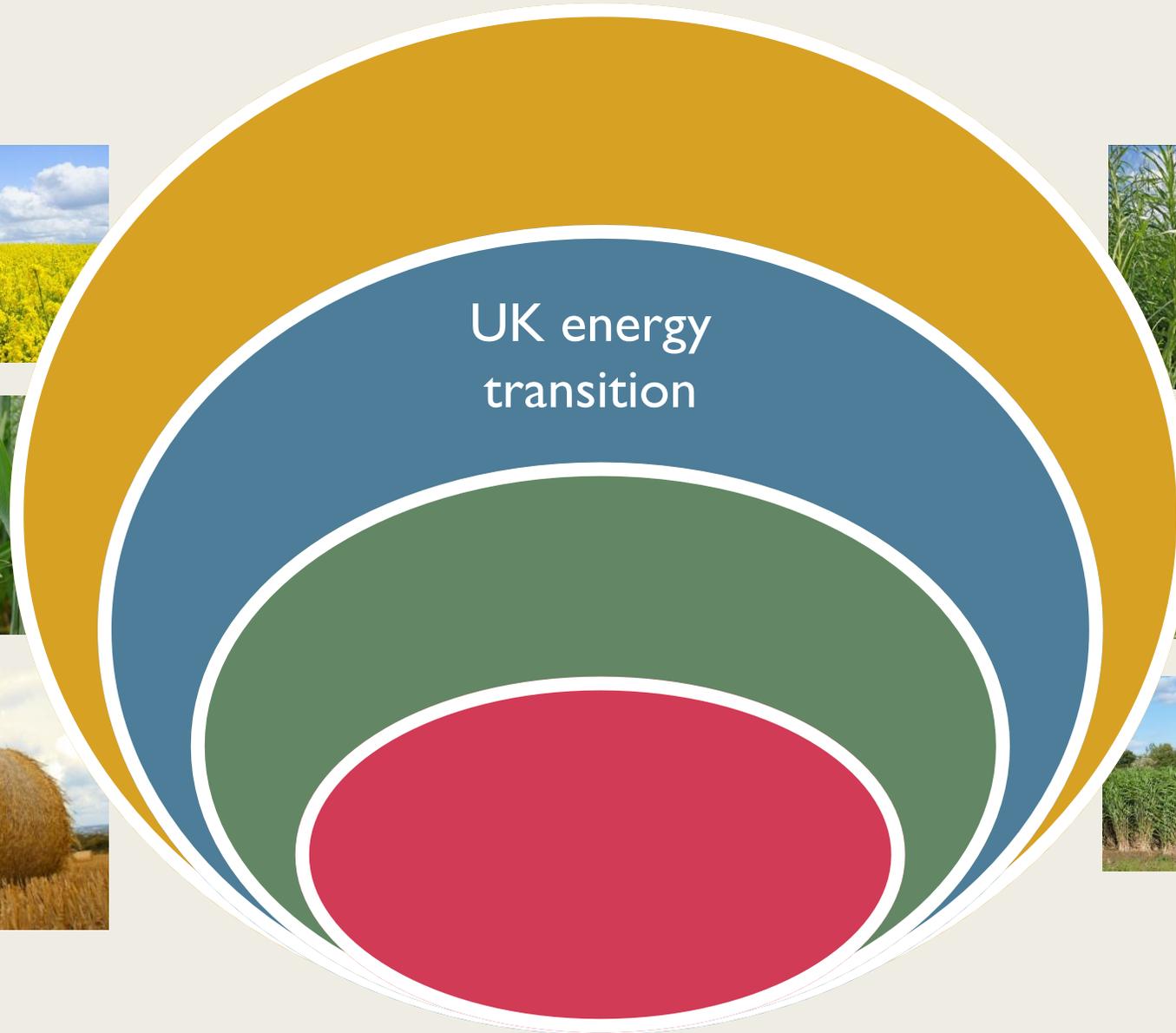
Cluster Plans (roadmaps) and feasibility studies for net zero industrial cluster

Humber Cluster Plan (HIDR, now HCP)

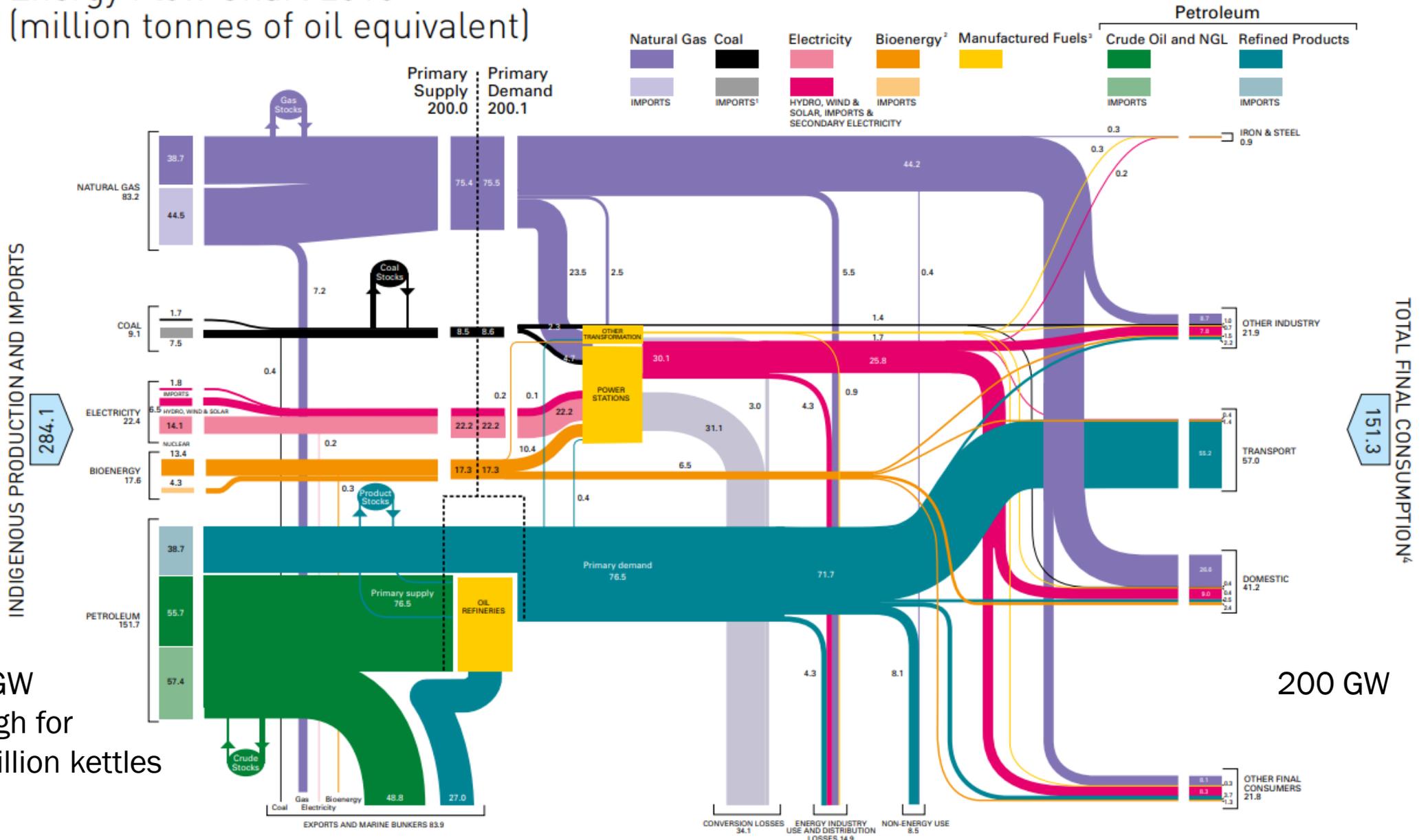
- Phase 1 is now complete – developing the methodology for an accelerated start to a Phase 2
 - *Baseline emissions data*
 - *Modelling scope and capabilities*
 - Prescriptive analytics
 - *Data sourcing/identification*
- Completion of Phase 1 permits entry to the Phase 2 competition for funding to deliver our Cluster Plan (Roadmap)
 - *Starts January 2021*
 - *Completion 31 March 2023*
 - *Identify optimal secure, low cost route to achieving a zero carbon Humber energy intensive industrial sector by 2040.*



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Energy Flow Chart 2018 (million tonnes of oil equivalent)



377 GW
Enough for
65 million kettles

FOOTNOTES:

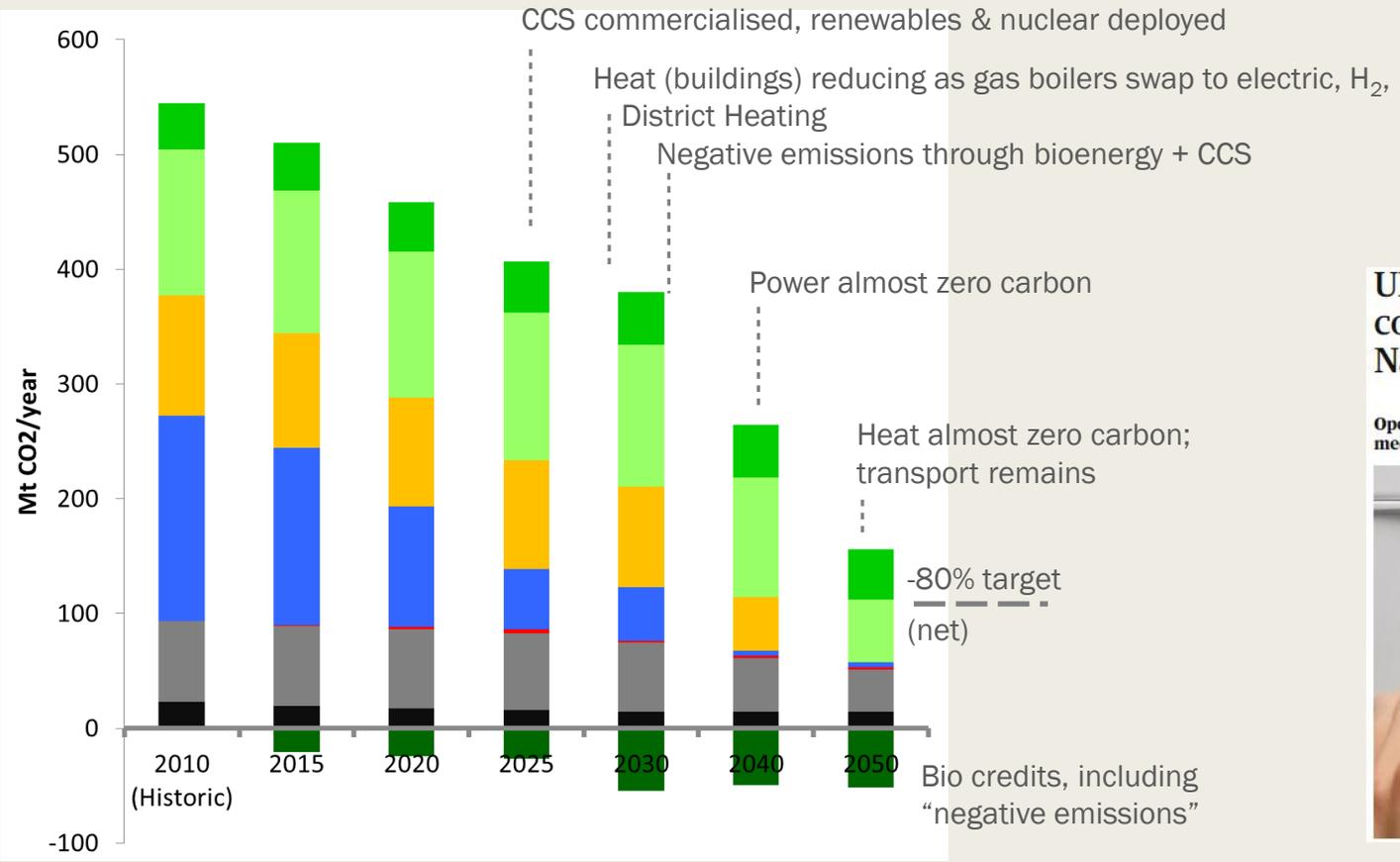
1. Coal imports and exports include manufactured fuels.
2. Bioenergy is renewable energy made from material of recent biological origin derived from plant or animal matter.
3. Includes heat sold.
4. Includes non-energy use.

This flowchart has been produced using the style of balance and figures in the 2019 Digest of UK Energy Statistics, Table 1.1. (gross calorific values basis)

A route to meeting - 80% CO₂ for the UK

Power now, heat next, transport gradual – cost optimal

- Intl Aviation & Shipping
- Transport Sector
- Buildings Sector
- Power Sector
- Other conversion
- Industry Sector
- Other CO₂
- Biogenic credits



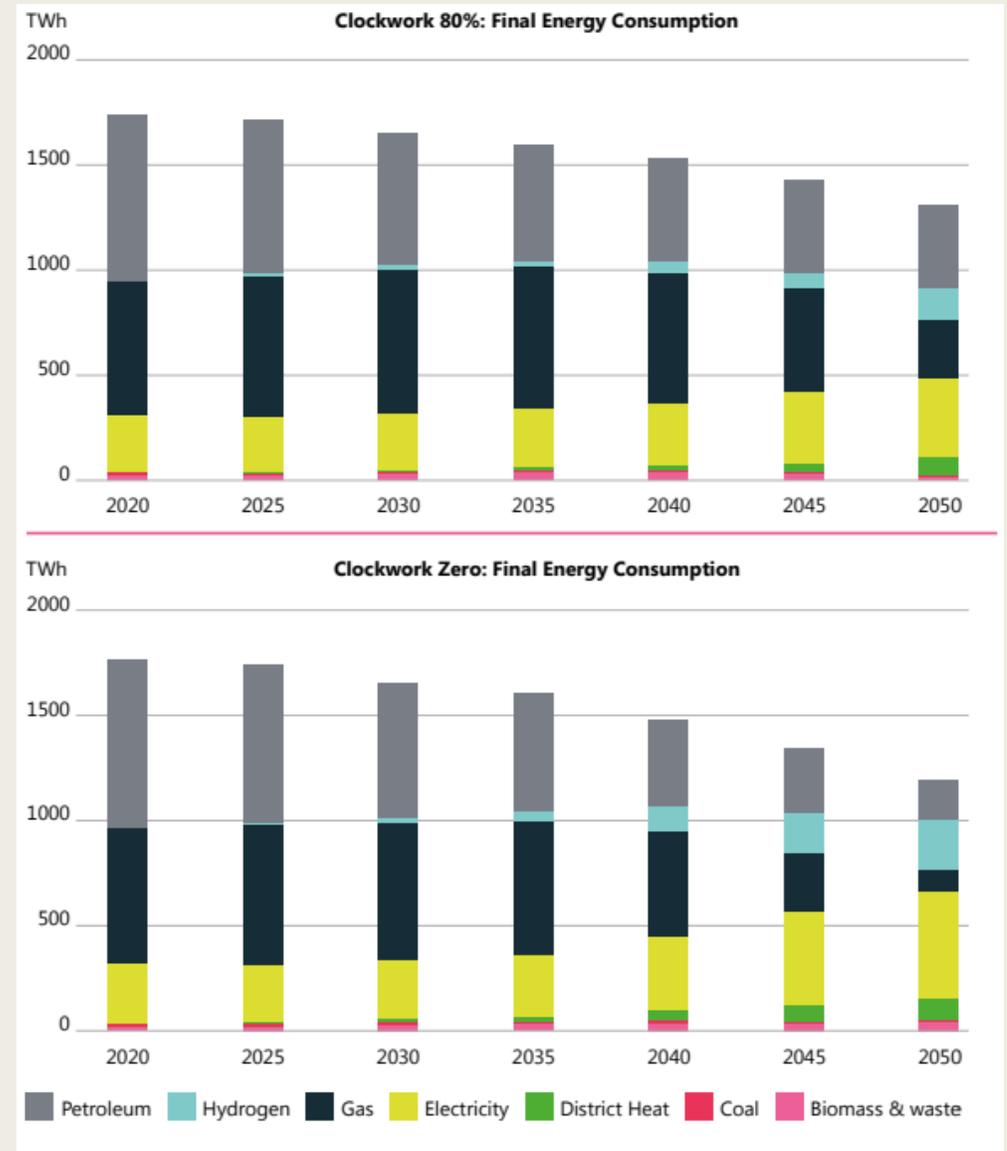
UK electricity grid's carbon emissions could turn negative by 2033, says National Grid

Operator says UK can tap carbon capture and renewables to help meet UK's targets

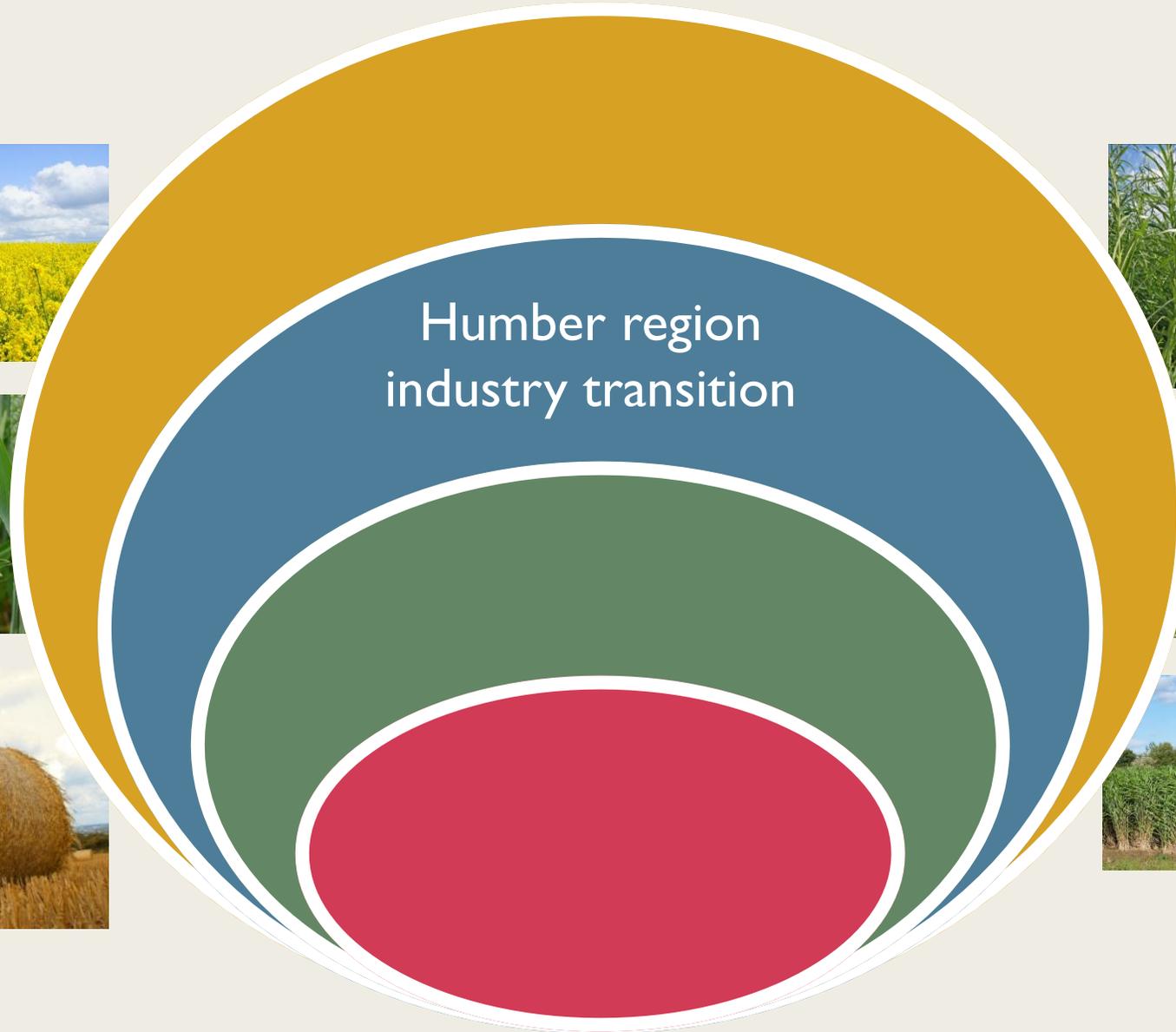


Meeting net zero in 2050

- To meet 80% decarbonisation, fossil fuels still made up 50% of final energy demand (30% petroleum, 20% gas). Electricity made up 30%, heat networks 5%, hydrogen at 10% and biomass 5%.
- More profound changes are needed to meet net zero.
 - *Wherever possible, delivery of final energy by fossil fuels is substituted out.*
 - Share of fossil fuels drops to 25%.
 - *~ three quarters of energy mix provided by electricity (43%), hydrogen (20%) & district heat (10%).*
 - *Negative emissions needed to counter residual emissions, especially from aviation.*
 - *Most of remaining fossil fuel used in industry and aviation*
 - *Greater intermittent power use so greater requirement for system balancing (power storage etc)*



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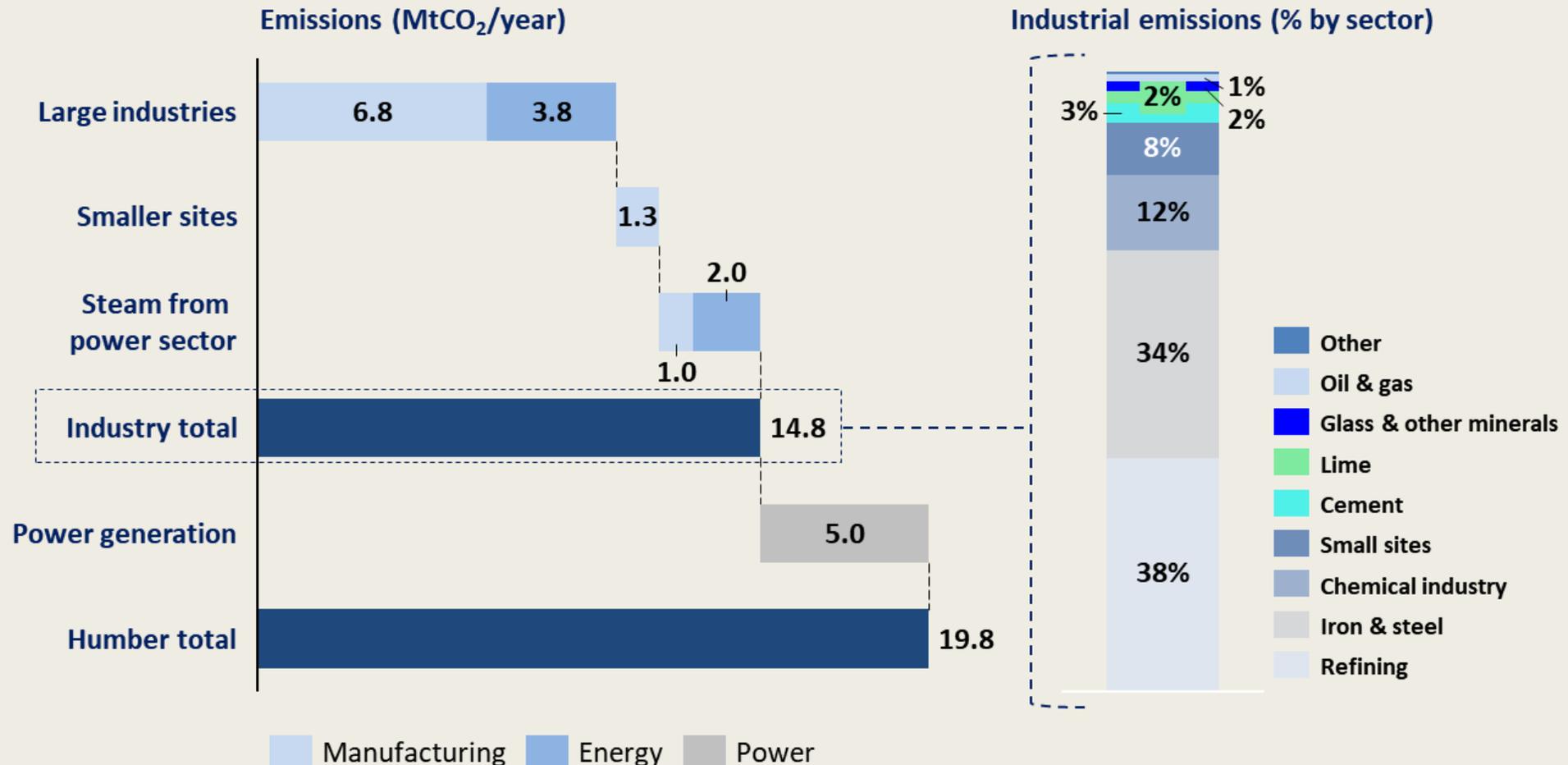
Industry is challenging to decarbonise

- Chemical feedstocks themselves emit CO₂, e.g. limestone
 - *~45% of industrial emissions*
- Highly integrated processes – some make their own “internal” fuels from their chemical feedstocks e.g. steel, refining
 - *Replacing refinery fuel gas with hydrogen requires an abated use for fuel gas*
- Requirement for high temperature heat (~35% of industrial emissions) – could potentially use electric furnaces or hydrogen
 - *Steel ~1200 °C, limestone calcination ~1400 °C*
- Industrial facilities have long lifetimes. Design changes would require costly redesigns, retrofits and/or rebuilds.
- The need to maintain business competitiveness.

Humber energy intensive industry sector

Over 70% of industrial emissions from 2 sectors

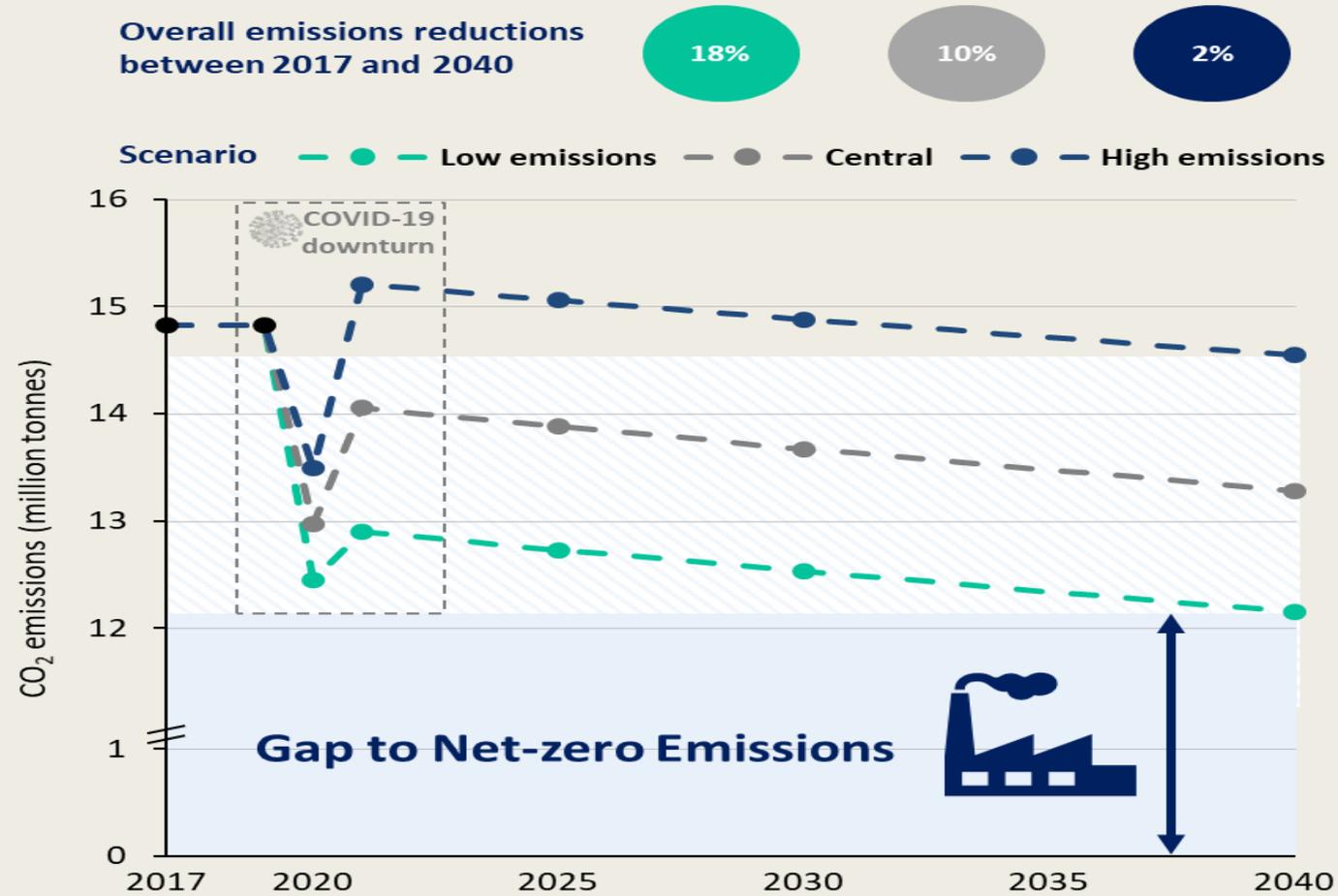
50% emissions from internal fuels. CCUS crucial



Doing nothing would likely lead only to a slight drop in emissions by 2040.

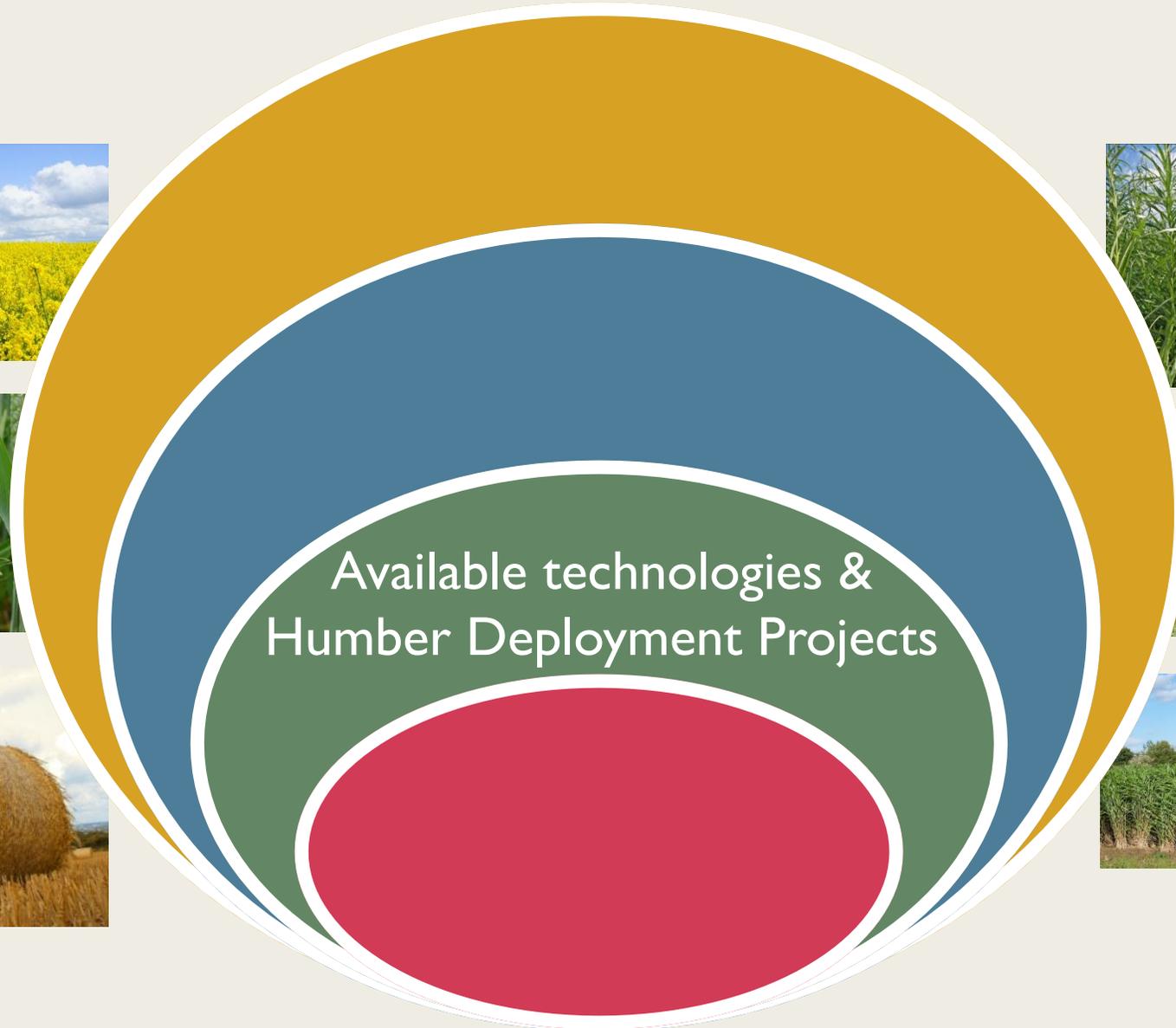
Deep decarbonisation needed.

All technologies crucial but especially CCS, hydrogen, BECCS



Emissions reductions were computed for the years indicated with circular markers.
Dashed lines indicate interpolation between these years rather than decarbonisation paths.

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Available technologies &
Humber Deployment Projects

Demand side measures

Reduce demand for primary resources & emissions through optimisation, re-using, recycling

Energy efficiency

Adapt production equipment to lower energy use per unit volume

CCS (CCU)

Capture CO₂ emitted and store (CCS) or use (CCU)

Direct air capture and BECCS

Capture CO₂ from the air or via biomass to provide a negative emission credit

Hydrogen as a fuel or feedstock

Replace feedstock or fuel with low or negative carbon hydrogen.

Biomass as a fuel or feedstock

Replace feedstock or fuel with sustainably produced biomass e.g. to produce an ultra-clean syngas for acetic acid manufacture.

Electrification

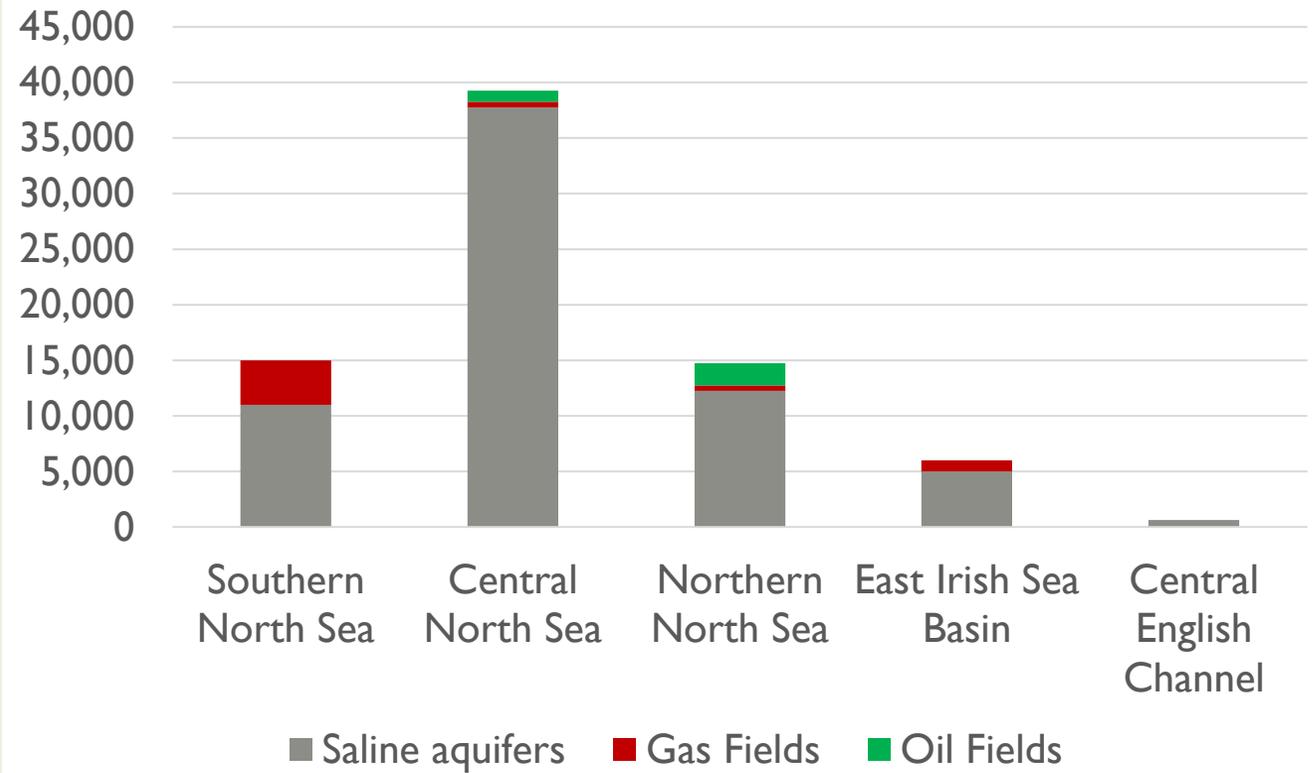
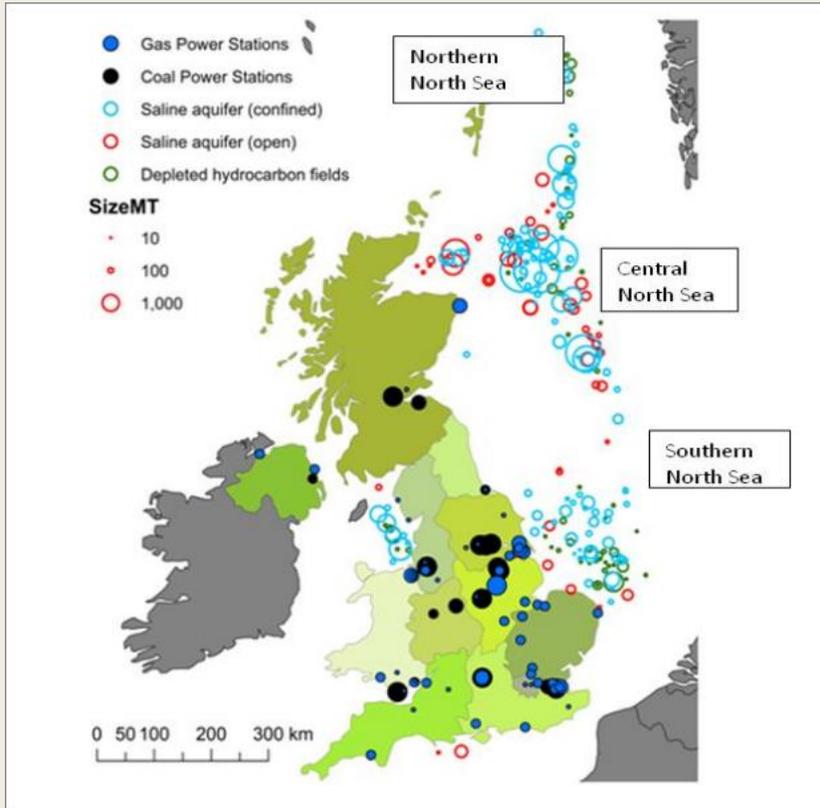
Replace fossil fuel for heating, mobile plant and motor drives with renewable electricity

Other innovations

e.g. innovative processes e.g. electrochemical production process, non fossil fuel feedstock change, such as a change in cement feedstock

CCS – Humber & Teesside well placed to take advantage of low carbon electricity from wind, solar and biomass, and CCS

Millions of tonnes of potential storage in the UK Continental Shelf by region (cost and risk not appraised)



Hydrogen as a fuel or feedstock



Blue hydrogen

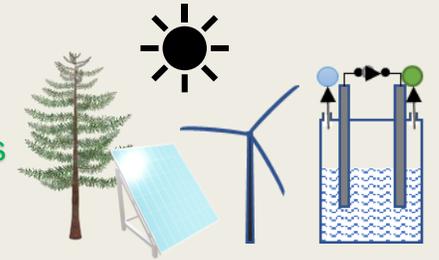


Green hydrogen



Natural gas + steam reforming
Coal + gasification
CO₂ to geological storage

Renewable electricity + electrolysis
Biomass + gasification
(with and without CCS)



Transport and storage



Zero emissions
transport



Industry



Power generation



Export

Deployment Initiatives & Projects

H2H Saltend

- *Blue hydrogen (with CCS)*
- *600MW ATR*
- *Triton at 30% H2*
- *900,000 Tonnes CO2*

Humber zero (Immingham)

- *Post combustion CCS*
- *Blue & green hydrogen for fuel switching at refineries & power plants*
- *100MW electrolyser*
- *7 MT CO2 abated*

Keadby Clean Power Hub

- *2x CCGT with post combustion CCS*

British Steel Scunthorpe

- *Investigating CCS options appropriate to sector*
- *Hydrogen (for fuel switching & within process)*
- *Re-use and recycling (e.g. using slag for road surfacing)*

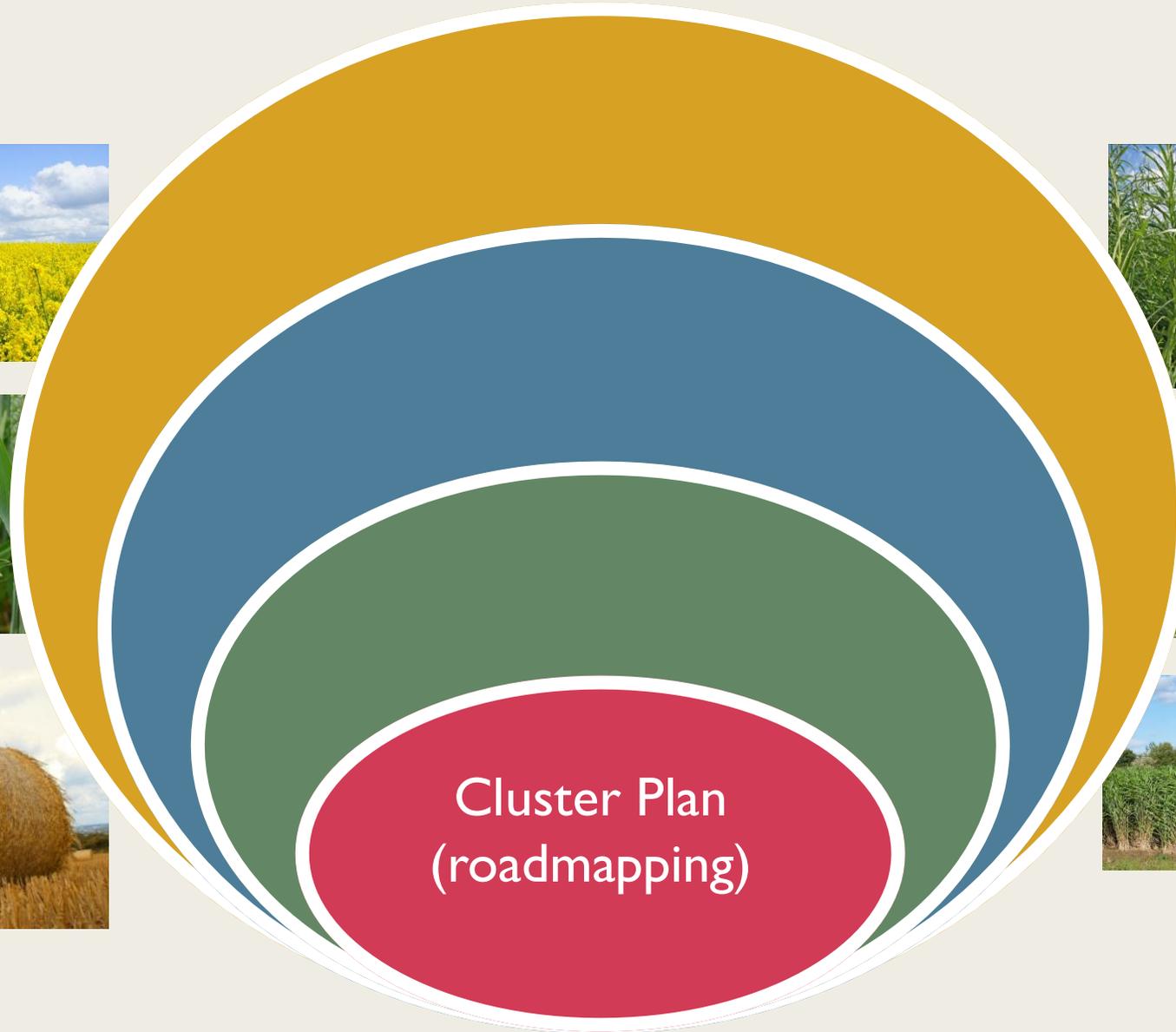
Zero Carbon Humber

- *BECCS (negative emissions) at Drax*
- *Exploring large scale hydrogen production opportunities*

Green hydrogen for Humber

- *Development of GW scale roll out of green hydrogen via electrolysis*

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Cluster Plan
(roadmapping)

Cluster Plan (Roadmapping)

- Identify optimal (secure, low cost) route to a zero carbon Humber energy intensive industrial cluster by 2040
 - *Understand uncertainties – identify resilient technologies and choices*
 - *Identify potential futures for industry in the Humber*
 - Deployment projects and others
 - *Establish value to Humber beyond 2040*
 - Jobs, inward investment, GVA
 - *Identify skills and training needs*
 - *Identify legacy potential and implement*

Climate change is an urgent issue

- Hard to decarbonise sectors just got harder
 - *Covid impact yet to play out*
 - *Must maintain momentum*
- Industrial emissions challenge
 - *CCS and fuel switching (especially hydrogen) will be crucial*
 - Continuous improvement needed
 - *Humber region is strongly placed*
- Catch and Humber LEP are working to deliver a Cluster Plan to achieve net zero in industry by 2040
- Large scale emitters working on parallel projects to demonstrate action at scale



Thank you

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