Transitioning Industrial Clusters towards Net Zero

Initiative Introduction

August 2022
Industrial Clusters: The Net-Zero Challenge

With industry responsible for 30% of total global CO2 emissions, and more than ½ of these emissions occurring in industrial clusters, industrial clusters will be a critical player in accelerating the path to net zero.

Industrial clusters are geographic areas where **co-located companies, representing either a single or multiple industries, provide opportunities for scale, sharing of risk/resources, aggregation and optimization of demand.**

- Industry composition
- Geography
- Existing infrastructure
- Energy costs and policy

Source: Accenture’s **2021 Net Zero Industrial Clusters Report**
Initiative’s Signatory Clusters

Today the eight signatory clusters of the initiative represent 344 million metric tonnes CO₂, 1.1 million jobs protected and created, and $182 billion contributed to the global GDP.
## Initiative impact

With greater than 10,000 industrial clusters globally, a subset of ~100 clusters would represent emissions larger than most countries.

<table>
<thead>
<tr>
<th>#</th>
<th>Country</th>
<th>Emissions (Million Metric Tonnes)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>China</td>
<td>12055</td>
</tr>
<tr>
<td>2</td>
<td>United States</td>
<td>5771</td>
</tr>
<tr>
<td>3</td>
<td>India</td>
<td>3363</td>
</tr>
<tr>
<td>4</td>
<td>Indonesia</td>
<td>1959</td>
</tr>
<tr>
<td>5</td>
<td>Russia</td>
<td>1924</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>24</td>
<td>Italy</td>
<td>376</td>
</tr>
<tr>
<td>25</td>
<td>Nigeria</td>
<td>354</td>
</tr>
<tr>
<td>26</td>
<td>France</td>
<td>352</td>
</tr>
<tr>
<td>27</td>
<td>Egypt</td>
<td>351</td>
</tr>
<tr>
<td>28</td>
<td>Iraq</td>
<td>321</td>
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### 100 Cluster's Impact

- **1600 MT** of CO₂
  - 5% of total Global CO₂ Emissions
  - 15% of Global CO₂ Industrial Emissions

- **$2.5 Trillion**
  - Total GDP Contribution

- **17.8 Million**
  - Direct Jobs

*Source: Accenture Strategy Analysis, Climate Watch Data*
The need for an integrated approach to establish a net-zero cluster

A holistic and collective approach is required to optimize emissions solutions and create an integrated energy system that maximizes system value outcomes across the cluster.

**SYSTEMIC EFFICIENCY AND CIRCULARITY**
- Increase circularity within a cluster through cross-entity waste utilization
- Integrate processes within a cluster to share energy and material streams
- Provide cost-effective system benefits outside the cluster

**DIRECT ELECTRIFICATION AND RENEWABLE HEAT**
- Electrify low-to-medium temperature and pressure processes
- Generate low-cost, renewable electricity and heat onsite (e.g. rooftop solar, biomass, CSP)
- Pursue shared infrastructure (e.g. microgrid, storage, flexibility)

**HYDROGEN**
- Leverage electricity and heat from nearby zero carbon sources (wind, solar, nuclear, biomass)
- Produce low-to-zero carbon hydrogen from the most economical source (e.g. blue, green)
- Use produced H₂ as an alternative fuel for hard-to-electrify industrial processes, building heating, and transport

**CARBON CAPTURE, UTILISATION AND STORAGE (CCUS)**
- Capture carbon from energy and hydrogen production
- Use captured carbon for industrial and manufacturing processes
- Store carbon underground where feasible

Source: Accenture’s 2021 Net Zero Industrial Clusters Report
The Approach

While every industrial cluster will be different depending on its make-up, the market where it operates, the technology it employs, a standardized approach is possible to accelerate the transition of the cluster to net zero.

**Partnerships**
How to build trust between competing companies both on supply and demand side?

**Policy**
Have enabling policies been developed to accelerate net zero industrial clusters?

**Financing**
What innovative options exist for financing?

**Technology**
While the initiative is technology neutral, there is a logical pathway to consider which applies to all clusters.
## Initiative Operating Structure & Key Value Drivers for Participants

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<tbody>
<tr>
<td>• Whom do we need to partner with to achieve net zero?</td>
<td>• What industrial policies do we need to support the transition?</td>
<td>• How do we develop the long-term decarbonization funding strategy?</td>
<td>• How might we engage with pioneering technology initiatives?</td>
<td>• How should the cluster’s story be communicated to maximize stakeholder buy-in?</td>
<td>• How can we build momentum and strengthen the coalition of ambitious clusters?</td>
</tr>
<tr>
<td>• What is our vision and joint goal?</td>
<td>• How do we apply diverse policy structures from all regions?</td>
<td>• How might we maximize funding from all mechanisms available?</td>
<td>• How might we identify technology requirements for the initiative?</td>
<td>• How can we disseminate learnings and knowledge?</td>
<td>• How can we exchange knowledge and learn from others?</td>
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<td>• What partnership agreement and governance needs to be in place?</td>
<td>• How do we work with national and local governments to fulfill our vision?</td>
<td>• How do we secure support from the regulatory agencies and collaborate on the funding applications?</td>
<td>• How can a holistic evaluation (e.g., system value approach) be leveraged when considering anchor projects?</td>
<td>• How can we showcase our leadership to encourage and support other clusters?</td>
<td>• How might we collaborate between clusters?</td>
</tr>
<tr>
<td>• What are the resources that each partner is willing to commit?</td>
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### Key questions to address...

- Joint vision and GHG reduction goal development
- Partnership facilitation including alignment on cornerstones towards a collaboration agreement/MoU
- Potential partners identification across industries and regions

### ...with initiative support and resources

- Analyses by geography
- Facilitated collaboration and public-private roundtables with key governments and civil society organizations
- Potential partners identification across industries and regions
United Kingdom
Hynet and Zero Carbon Humber
Case Studies
UK Industrial Cluster Profile
While industry faces several challenges on the path to net zero, there are also sizeable social and economic opportunities from investments in low-carbon technologies through industrial clusters.

**Challenge**
- ~25% The industrial sector accounted for 25% of total final energy consumption in 2017
- ~36 MtCO₂ Emissions from six identified industrial clusters, representing 10% of UK CO₂ emissions
- 2/3 by 2035 A 2/3 reduction in GHG emissions from 1990 levels is required by 2035 to stay on track for Net Zero and meet carbon budgets

**Opportunity**
- 1.5m jobs 1.5 millions jobs secured through the development of the UK’s industrial clusters
- 15% Of current UK CO₂ emissions could be captured a year by 2050 in Humber, equivalent to 53 MtCO₂ via CO₂ capture, blue hydrogen, BECCS, transport & storage projects.
- £320bn Annual exports and services provided by the UK’s industrial clusters
- £2.9-4.2bn Of potential savings per year by 2050 through avoided CO₂ penalties for firms in the Humber region using carbon capture and storage

Sources: IEA, Industrial Clusters BEIS, Decarbonisation Strategy BEIS, Energy White Paper, Element Energy (1, 2), Zero Carbon Humber
HOW DID THE UK DEVELOP ITS INDUSTRIAL CLUSTERS?

BRYONY LIVESEY
UK Government ambitions for CCUS

- **£1bn investment through CCS Infrastructure Fund**
- **CCUS deployment at HyNet Cluster by mid 2020s**
- **CCUS deployment at North East Cluster by mid 2020s**
- **2 further clusters by 2030**
- **3 Business models being defined for Power CCUS, Transport & Storage, and Industrial Carbon Capture**

**Net Zero Strategy ambition to capture 20 – 30Mt of CO₂ by 2030**

**Investing in carbon capture usage and storage could potentially deliver…**

| Support for around 50,000 jobs by 2030³ | Up to £1.0bn of public investment by 2025 | Savings of around 40MtCO₂e between 2023 and 2032, or 9% of 2018 UK emissions |

Source: Will Lochhead, BEIS Deputy Director, Industrial Carbon Capture and Hydrogen Business Models

The Energy Security Strategy set a 10GW ambition by 2030.

The Net Zero Hydrogen Fund provides CAPEX/DEVEX support with £240m.

£100m for electrolytic H2 projects for 2023 through H2 Business Model.

12,000 jobs in the UK hydrogen industry by 2030, based on 10GW target.

20GW of potential hydrogen projects identified in the UK pipeline (through to 2037).

66% of UK hydrogen companies already exporting to growing int. market.

£12bn capital available from UK Infrastructure Bank with H2 as priority.
World Economic Forum - Transitioning Industrial Clusters Towards Net Zero

ZERO STARTS HERE

ZERO CARBON HUMBER

EAST CO₂AST CLUSTER
- Cluster COD October 2026
- 17 Primary Emitter projects
- 24.5 million tonnes CO\textsubscript{2} stored by 2030
- 20Mtpa CO\textsubscript{2} injection rate by 2030
- 25,000 jobs per year to 2050 (avg)
- £2bn GVA per year across the cluster
Drax
The largest decarbonisation project in Europe will convert the existing power station to bioenergy with carbon capture (BECCS) producing negative emissions.

Aldbrough
SSE Thermal & Equinor's proposal for one of the UK's largest low-carbon hydrogen storage facilities.

H2H Saltend
Equinor's new low-carbon hydrogen production facility to fuel-switch the chemicals park, and new ammonia production facility for export opportunities. Hydrogen off-taker Triton Power CHP will provide decarbonised heat and power from upgraded Mitsubishi Power's gas turbines to users on the PX site and potentially beyond.

Easington
Easington offers one of the potential locations to pump CO₂ from onshore infrastructure and export for safe and permanent storage in a North Sea aquifer via a subsea pipeline.

Deep-water ports
ABP's Humber ports provide deep-water facilities for international shipping of CO₂, green hydrogen and ammonia.

Keadby
SSE Thermal & Equinor's proposals for a new CCS-equipped power station and the world's first major 100% hydrogen-fired power station, at the existing Keadby power generation site.

Uniper's Humber Hub
Development of a hydrogen hub at its Killingholme site, with both blue and green hydrogen production.

British Steel
Ambitious plans across a range of technologies considering electrification, CCS and hydrogen to support carbon reduction and clean growth.
ECONOMIC BENEFITS OF THE EAST COAST CLUSTER – THE HEADLINES

- **25,000+** Jobs up to 2050 (average per annum)
- ~ **41,000** Jobs peak in 2026
- **Construction:**
  - **9,400** direct jobs/yr
  - **12,300** indirect jobs/yr
- **Operations:**
  - **2,200** direct jobs/yr
  - **13,300** indirect jobs/yr
- **25,000 additional induced jobs/yr**
- **£2bn +** Average GVA up to 2050
TELL US ABOUT THE TECHNOLOGY APPROACH OF THE CLUSTER AND HOW THIS UNLOCKS FUTURE PROJECTS?

OONAGH O’GRADY
Knowledge Dissemination

- **183** Partner Led Knowledge Dissemination Events detailed since Nov 2020.

- Increased Focus with KM Champions in place.

- Proactively identifying future opportunities allows for engagement and support from other partners to deliver maximum value.

**Podcasts & COP26**

**Energy Articles**

**Ministerial Visits**

**STEM events**

**Events & Presentations**
The **HyNet** Project Vision

- CO₂ transport and storage infrastructure, delivering CO₂ to safe, permanent storage in Liverpool Bay, 30km offshore.
- Facilities to capture CO₂ emissions from new & existing industry from 2025.
- Low-carbon hydrogen production plants, with CO₂ capture.
- A hydrogen distribution network, delivering hydrogen to industrial consumers.
- Hydrogen buffer storage in underground salt caverns.
HyNet CO₂ Transportation & Storage Network - Eni

Field capacity of 190 MT of CO₂ storage
Initial design rate capacity - 4.5MT/Y expanding to 10MT/Y.
Utilising depleted gas reservoirs

Excellent unit cost for the project
Competitive Time to Market
(First UK CCUS project - 2025)
Easy implementation using existing assets

Location
Adjacent to large industrial and population centres. Access to existing CO₂ emitters and supportive of a future regional hydrogen hub

Low Risk
Multiple fields (redundancy) and proven subsurface knowledge

Low Cost
Re-utilisation of existing infrastructure

Time to Market
Very competitive lead time to start up

Flexibility
Low initial cost and expansion will be demand-driven
HOW DID THE CLUSTER APPROACH HELP TO INCREASE THE NUMBER OF OFFTAKERS?

NICOLO AGGOGERI
HyNet Cluster: Key messages

- 19 MOU’s signed with Prime Emitters
- > 25 MOUs signed with hydrogen customers
- Led by regional demand

- Tracked 1 in Oct 2021
- FID by 2023
- Start-up in 2025
- First stage capacity 4.5MTPA
- 10MTPA capacity from 2030

- Up to 50% of the UK CCUS target by 2030
- 40% of the new UK low carbon hydrogen target by 2030
- 25% of regional emissions abated

- + 2.8B£ of GVA by 2030
- + 6B£ of GVA by 2050
- Delivers 6000 jobs/year for the first 10 years
- Protects 350,000 jobs in Hard to Abate Sectors
Thank you
Additional Resources

- Transitioning Industrial Clusters towards Net Zero Landing Page
- Achieving net-zero future with industrial clusters Report
- COP26 Video: Transitioning Industrial Clusters towards Net Zero
- COP26 Video: Signatory Cluster Vision (4 Videos)
- System Value Framework Overview & Analyses by Market