

Industrial decarbonisation

March 2020, Rebecca Bell, SCCS Policy & Research Officer

1 Introduction

The Infrastructure Commission for Scotland's key findings report, *A blueprint for Scotland*¹, is the output of their first year of hearing evidence and engaging with stakeholders on Scotland's infrastructure needs over the next 30 years.

The report makes 23 recommendations to the Scottish Government, including that it should “develop and publish a new infrastructure assessment framework and methodology that will enable system wide infrastructure investment decisions to be prioritised on the basis of their contribution to inclusive net-zero carbon economy outcomes.”

The report considers infrastructure in a number of sectors: energy, digital, transport, housing, natural infrastructure, waste management and public services; with two key policy objectives of net zero carbon and inclusive economic growth. Despite the clear impact of industry on both these objectives, the report fails to consider the need for decarbonisation of industry, and the infrastructure associated with that. **Scottish Carbon Capture & Storage (SCCS) considers this to be a serious oversight, which could have detrimental impacts on future infrastructure deployment.**

2 Rationale for including infrastructure for industrial decarbonisation

Greenhouse gas emissions from industry will need to be reduced to near-zero if Scotland and the UK are to meet their net-zero targets.² Since high-emitting industries are a major employer in Scotland³ and provide essential materials for economic growth, this decarbonisation must not simply be achieved by closing down industry, and therefore options for decarbonisation must be considered in any infrastructure assessment.

2.1 Scale of the problem

Emissions from industry account for around 20% of Scotland's greenhouse gas emissions: this is comparable to emissions from transport (~30%) and residential (i.e. heat: ~15%).⁴

¹ <https://infrastructurecommission.scot/page/key-findings-report>

² Committee on Climate Change (2019) *Net Zero – The UK's contribution to stopping global warming*. Available at: <https://www.theccc.org.uk/publication/net-zero-the-uks-contribution-to-stopping-global-warming/>

³ “The GVA of Scottish manufacturing, of which the EII (energy-intensive industries) form the core, totalled £12.7bn in 2016 while employment totalled 179,300”. Scottish Government (2019) *Decarbonising Scotland's industrial sectors and sites: discussion paper*. Available at <https://www.gov.scot/publications/decarbonising-scotlands-industrial-sectors-sites-paper-discussion-scottish-energy-intensive-industries/pages/2/>

⁴ Scottish greenhouse gas emissions 2017, Table B1: <https://www.gov.scot/publications/scottish-greenhouse-gas-emissions-2017/pages/3/>

Both heat and transport are drawn out by the Commission as “key priorities for Scotland in reaching net zero carbon.” From the scale of the emissions, it is clear that decarbonising industry should be given parity with decarbonising heat and transport.

2.2 Industrial emissions are not just about heat

The Commission recommends addressing “heating for domestic, commercial and public buildings, as well as all surface-based transportation.” It could be argued that this implicitly includes the heat used in industrial processes, although the word “buildings” rather implies that this recommendation is in relation to space heating, rather than industrial process heating.

Fossil fuel consumption for industrial heat has some similar issues to space heating (e.g. whether the primary source should be electricity, hydrogen or biomass) but has its own unique issues. These include the need for raising large quantities of high-pressure steam, very high temperatures for direct firing, and the integral role that fossil fuels and the re-use of combustible off-gases play in some industrial processes.

In addition to emissions from industrial heat, carbon dioxide (CO₂) is emitted by certain industries as an integral part of the process, and this would not be changed by switching fuel.

2.3 The options for decarbonising industry are not the same as for decarbonising heat and transport

Although there are overlaps, fuel switching to low-carbon hydrogen, renewable electricity or biomass may be options in some cases. But in others, particularly where there are process emissions, the current available options for decarbonisation are either deploying carbon capture and storage (CCS) or closing down the operation.

“Our understanding of what is possible in industry has significantly strengthened through deeper evidence and analysis. We can now identify ways to reduce emissions close to zero for the vast majority of industrial processes and activities. In many cases these involve similar changes to those in the rest of the economy: efficiency, electrification, application of CCS and switching heat sources to low-carbon hydrogen.” *Committee on Climate Change, 2019*

2.4 If it isn’t mentioned, it might not be dealt with

Through the first year’s evidence-gathering,

stakeholders have successfully – and rightly – made the case to the Commission that

Scotland’s natural assets should be included in its definition of infrastructure.

“The Scottish Government’s definition of infrastructure includes both economic and social infrastructure that covers transport, energy, telecoms, water, waste, flood defences, housing, education, health, justice and culture. During the work of the Commission it has also become evident to us that Scotland’s natural assets should also be incorporated in this definition of infrastructure.” *Infrastructure Commission for Scotland, 2020*

The rationale for this, presumably, is that if a type or function of infrastructure is not explicitly covered in the definition and in the report, it risks being omitted from the National Infrastructure Assessment, resulting in sub-optimal outcomes.

It is hard to see where industrial decarbonisation is even implied in the Scottish Government's definition of infrastructure which sets the framework for the Commission's work. Since CO₂ is a waste product that causes environmental harm, it could be considered to be covered under waste, although it is clear from the Waste Management chapter of the key findings report that the definition of waste here only covers solid waste.

If infrastructure to enable industrial decarbonisation is not explicitly included in the Commission's recommendations, then it risks being omitted from future assessments.

2.5 Importance of swift action on industrial emissions

The Committee on Climate Change (CCC) has said that, in order to reach net-zero emissions, industry must be largely decarbonised.⁵ The two measures it proposes for achieving that are CCS and low-carbon heat. The CCC found that both of these will be required and are not alternatives to each other:

- *"Reaching net-zero GHG emissions requires extensive changes across the economy, with complete switchovers of several parts of the UK capital stock to low-carbon technologies and development of new industries for carbon capture and storage and low-carbon hydrogen production. Major infrastructure decisions need to be made in the near future and quickly implemented."*
- *"CCS, low-carbon hydrogen and electrification must be fully deployed in industry alongside efficiency."*
- *"A significant low-carbon hydrogen economy will be needed to help tackle the challenges of industry, peak power, peak heating, heavy goods vehicles, and shipping emissions. CCS will have a larger role, including in industry and at scale in combination with biomass."*⁶

"Existing ambitions must be delivered in full, **challenges that have so far been out of scope must now be confronted**. The UK must make firm plans for housing and domestic heat; for **industrial emissions; carbon capture and storage**; road transport; agriculture; aviation and shipping." *Committee on Climate Change, 2019*

3 Specific issues for CCS

3.1 CO₂ transport and storage infrastructure does not exist yet – but it will

CCS infrastructure – or more accurately, infrastructure to transport and store CO₂ – does not exist yet in Scotland. This means that it will be easy to ignore without a prompt from the Commission.

However, the CCC has been clear that CCS is a necessity not an option for reaching net zero – so, although the scale of deployment is up for debate, the need for it is not. **We recommend that the Commission makes clear to Government that this is infrastructure that must be included in an Infrastructure Needs Assessment.**

⁵ Committee on Climate Change (2019)

⁶ All quotes from Committee on Climate Change (2019)

3.2 CCS infrastructure supports decarbonisation elsewhere in the economy

By providing a takeaway service for the CO₂ off-gas, CCS infrastructure allows low-carbon hydrogen to be produced in bulk from methane. This would provide a reliable supply of hydrogen for use in heat and transport. Although hydrogen is one of many options for eliminating these dispersed emissions (including electrification, demand management and behaviour change) it seems likely that a mix of approaches will be most appropriate. It is important to ensure that decisions taken now do not shut off options for the future.

CO₂ transport and storage infrastructure enables greenhouse gas removals – negative emissions – where CO₂ is captured and stored from biogenic sources, such as biomass power plant, biogas and biomethane production and use, and fermentation for alcoholic beverages. This means that net zero emissions can be achieved by offsetting the residual emissions that cannot be eliminated elsewhere in the economy.

3.3 CCS infrastructure supports multiple objectives

CCS infrastructure is about managing a waste product, but in doing that it opens up opportunities for inclusive economic growth.

- Scotland's uniquely abundant and well-characterised storage resource means that CO₂ storage services can be sold to other countries, that have high emissions but no ability to store their CO₂.
- Industries will be able to continue production without emitting CO₂, retaining jobs where they might otherwise be lost as production moves overseas. This also has the benefit of reducing the carbon footprint associated with goods consumed in Scotland.
- In a low-carbon world, high-emitting industries could be drawn to locate in areas where a CO₂-takeaway service is available, bringing more jobs to Scotland.
- Early action on CCS in Scotland means that an indigenous supply chain and skills base can be augmented and scaled up, and these skill and products can also be exported.

“With appropriate policy and support there could be an industrial boost to the UK from being one of the early movers in some key sectors (e.g. specialised supporting services like finance and engineering for low-carbon technologies, carbon capture and storage), with potential benefits for exports, productivity and employment.” *Committee on Climate Change, 2019*

3.4 Timeliness

In its 2017 Clean Growth Strategy⁷, the UK Government renewed its commitment to deploying CCS (and CO₂ utilisation) in the UK. Since then, a number of policy documents and consultations have been published to address existing barriers and move deployment forwards⁸.

⁷ <https://www.gov.uk/government/publications/clean-growth-strategy>

⁸ <https://www.gov.uk/guidance/uk-carbon-capture-and-storage-government-funding-and-support>

Three significant funding streams have been launched to support industrial decarbonisation projects: the £800 million CCS Infrastructure Fund⁹, the £315 million Industrial Energy Transformation Fund¹⁰ and the £170 million Industrial Strategy Challenge Fund Industrial Decarbonisation Challenge¹¹. These are UK-wide funds, and Scotland is not guaranteed to benefit from them – a robust infrastructure assessment would help strengthen the case for these funds supporting projects in Scotland.

The recently launched Industrial Decarbonisation Research and Innovation Centre (IDRIC), based at Heriot-Watt University will work closely with six UK industrial clusters to address the challenges of industrial decarbonisation. It aims to “accelerate challenge-led research and transformative innovation that empowers UK’s research excellence and connects the research and innovation landscape.”¹²

4 Suggested text for the report

We recommend that industrial decarbonisation should be recognised as a key priority by the infrastructure Commission for Scotland and should have been treated in the same way as heat and transport in the Key Findings report.

We propose some suggested text and recommendations in the sections below.

4.1 Rationale / description

Emissions from industry account for around 20% of Scotland’s greenhouse gas emissions.¹³ This will need to be reduced to near-zero if Scotland and the UK are to meet their net-zero targets.

Industrial carbon dioxide (CO₂) emissions come from two main sources:

- Fossil fuel combustion providing heat (either directly or in the form of steam) – for example in glass manufacture
- Chemical processes that are an unavoidable part of manufacture – for example calcining limestone to make clinker accounts for around half the emissions from cement manufacturing¹⁴

The UK Government has identified Grangemouth as one of five industrial clusters with significant emissions: at 4.3 Mt CO₂, Grangemouth is the cluster with the third highest emissions, after Humberside and South Wales¹⁵.

⁹ Announced in the March 2020 budget: <https://www.gov.uk/government/publications/budget-2020-documents/budget-2020>

¹⁰ <https://www.gov.uk/guidance/industrial-energy-transformation-fund>

¹¹ https://www.ukri.org/innovation/industrial-strategy-challenge-fund/industrial-decarbonisation/?_ga=2.142168762.967632510.1582030207-1346162064.1531233721

¹² <https://idric.org/idric-explained/>

¹³ Scottish greenhouse gas emissions 2017, Table B1: <https://www.gov.scot/publications/scottish-greenhouse-gas-emissions-2017/pages/3/>

¹⁴ <https://www.carbonbrief.org/qa-why-cement-emissions-matter-for-climate-change>

¹⁵ <https://idric.org>

One option for reducing emissions from industry is fuel switching – that is, moving from fossil fuels to electricity, low-carbon hydrogen or biomass to meet a plant’s heat demand. Initial analysis by SCCS¹⁶ suggests that fuel switching may not be possible in a number of industrial applications because:

- The energy requirements are so high there is insufficient renewable generation to provide them (e.g. Grangemouth CHP is estimated to have a heat output of more than a third of the total electricity generated from all renewable sources in Scotland in 2016).
- Plant would need to be modified or re-built to accommodate alternative sources of heating.
- In some cases, off-gas from one process is currently used as fuel in another process on the same site – if this gas was displaced it would still be an emissions problem.

Fuel switching only addresses emissions associated with heat supply, not from the chemical processes themselves. Currently, carbon capture and storage (CCS) is the only option to deal with the residual CO₂ that would be emitted where fuel switching was not possible, or where process emissions still exist.

The best approach for dealing with industrial CO₂ emissions will vary from industry to industry, from plant to plant, and from process to process. However, it is inevitable that carbon capture will be required in some, if not all, cases and, therefore, the infrastructure to transport and securely store the CO₂ will be required.

The Committee on Climate Change (CCC) has made it clear that CCS is “a necessity, not an option” if the UK is to meet its net zero target. Part of the CCC’s rationale for recommending an earlier net zero target for Scotland than for the UK as a whole is that Scotland has a proportionately greater capacity for geological CO₂ storage.

In its report, the CCC states that “CO₂ infrastructure development should start as early as possible.” In Scotland, the Acorn CCS project developers have stated that they could have a full-chain CCS project running in Scotland in 2023, given the right conditions.

4.2 Recommendations

The Scottish Government’s Infrastructure Needs Assessment and Infrastructure Investment Plan should include the infrastructure needed for decarbonising industry. In scoping this assessment, the Scottish Government should consult academics with expertise in industrial fuel switching, CCS and hydrogen.

To inform its Infrastructure Needs Assessment and Infrastructure Investment Plan, the Scottish Government should carry out an assessment of the decarbonisation options for the industries that operate in Scotland and model a range of scenarios to understand the energy generation, hydrogen production, biomass resource and CO₂ takeaway infrastructure that

¹⁶ Unpublished work in progress

would be needed under each scenario. Such modelling should take into account the impact of changes in energy use elsewhere in the economy – particularly in heat and transport.

The requirement to achieve net zero should be an unequivocal priority of the land use planning system. The Scottish Government should update planning policy in NPF4 to ensure that new high-emitting industries are required to be built CCS-ready.

Scottish Carbon Capture & Storage (SCCS) is a research partnership of the British Geological Survey, Heriot-Watt University, the University of Aberdeen, the University of Edinburgh, the University of Strathclyde and the University of Glasgow with associate member the University of St Andrews. SCCS researchers are engaged in innovative applied research and joint projects with industry and government to support the development and commercialisation of carbon capture and storage as a climate change mitigation technology.

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