Industry, innovation and infrastructure

Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

This document contains comments gathered during publication of the initial research. Not all the inputs and comments received are included here. Some chapter leads worked informally, in person or offline with their own networks, colleagues or UKSSD network and partners. In some cases, the chapter lead revisited the research considering comments, if so the amendments are below. In other cases, they took the feedback on board as they finalised their summary chapter.

Key to RAG ratings

GREEN: Global or proposed UK target has been met, exceed or close to being met

AMBER: Some progress or aspect of the targets met

RED: Off target, poor progress, not addressed in existing policies

Prepared by
Target: 9.1 Develop quality, reliable, sustainable and resilient infrastructure, including regional and trans-border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all

<table>
<thead>
<tr>
<th>Indicator</th>
<th>9.1.1 Proportion of the rural population who live within 2 km of an all-season road</th>
</tr>
</thead>
</table>
| Applicable UK policy / legislation | 2017 Industrial Strategy  
Construction 2025: industrial strategy for construction  
Business and Energy Department Single Departmental Plan |
| National SDG target | 50% Reduction in greenhouse gas emissions in the built environment by 2025 |
Reduction in greenhouse gas emission in the built environment (newly proposed indicator) |

Comment: See comment above – should we be going beyond just GHG emissions (CEEQUAL for example would include other aspects such as flood risk, biodiversity, etc). Target could be 25% of all new build infrastructure projects built to CEEQUAL ‘Excellent’ or equivalent

Comment: Really important to add other indicators here than just original so agreed more is needed. Not sure greenhouse gas emissions on its own is broad enough to be ‘sustainable’. Recommend inclusion of additional indicator as proportion of projects using rating schemes (CEEQUAL or equivalent) may give a broader sustainability indicator whilst promoting use of CEEQUAL as a standard.

Looking at the target wording do we also need to include ways to measure the ‘quality, reliability and resilience of the infrastructure’ which is broader than just road links and should ensure public transport is also an indicator?? (eg performance indicators from rail industry, % population served by local bus routes/services, etc)

Comment: No reference to wellbeing in the indicators – although this will I guess be picked up by SDG#3 – by providing good infrastructure will have a beneficial impact.
**Baseline status / performance**
The Green Construction Board has developed the Low Carbon Routemap for the Built Environment to serve as a visual tool enabling stakeholders to understand the policies, actions and key decision points required to achieve the UK Government target of 80% reduction in greenhouse gas emissions in the built environment vs 1990 levels by 2050. The Routemap also sets out actions, together with key performance indicators that can be used to deliver and measure progress in meeting the 2050 target.

On total greenhouse gas emissions (kt of CO₂ equivalent), it is falling over time.

<table>
<thead>
<tr>
<th>Year</th>
<th>Emissions (kt CO₂)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>839,587</td>
</tr>
<tr>
<td>1990</td>
<td>777,244</td>
</tr>
<tr>
<td>2010</td>
<td>609,587</td>
</tr>
</tbody>
</table>

**CO₂ emissions (metric tons per capita)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Emissions (metric tons per capita)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>11.7</td>
</tr>
<tr>
<td>1990</td>
<td>9.7</td>
</tr>
<tr>
<td>2010</td>
<td>7.8</td>
</tr>
</tbody>
</table>

The Greenhouse Gas (GHG) in 2015 were 495.7 Mt CO₂e. This is accounting for the 7 GHGs which are covered by the Kyoto Protocol. Carbon dioxide (CO₂) is the most potent out of the seven GHGs which are analysed, it accounts for 81% of the total UK GHGs in 2015. This is a 3.8% reduction when compared to the 2014 emissions of 525.1 Mt CO₂e. The total emissions from 2015 are estimated to have decreased by 38.0% from the 1990 benchmark.

**Comment:** Yes we need to ensure GHG emissions are falling but don’t forget other aspects – circular economy/waste, flood risk, social inclusion, biodiversity etc.

**Other relevant UK indicator/s**
Supported by £170 million of government investment over three years through the Industrial Strategy Challenge Fund, and £250m of match funding from industry

The Climate Change Act 2008 committed the UK to reducing GHGs by a minimum of 80% below the 1990 baseline by 2050 with an interim target of 34% by 2020. If the above estimations are correct, the interim target has therefore already been met. To enable this progress, the Carbon Budget was created which set legally-binding limits on the GHG emissions for the UK every 5 years. In 2014, it was confirmed that the first carbon budget was met with a saving of 36 Mt CO₂e.

When looking at the UK emissions against the Kyoto Protocol target the UK met its first commitment period (2008–2012) targets. The target was to reduce emissions by 12.5% below the base year levels over the first commitment period of 5 years, this was surpassed and a 23% reduction was achieved. By 2020 for the second commitment period, a reduction target of 20% from the base year levels.

**Assessment of current state**
**RAG RATING:** Amber

Difficult to give a confident assessment as the reduction specific to the built environment is quite new and driven by the Construction 2025 strategy. If the decarbonisation of the built environment remains consistent to the that of the UK greenhouse gas emissions trends then it is likely to be able to achieve this indicator. The challenge will be in ensuring that sufficient levels of investment are made in the infrastructure sector whilst ensuring that the greenhouse gas emissions are falling.

**Comment:** I do think we need to be measuring the right things here as indicated above but would agree that plans are in place so without a crystal ball it’s difficult to rate this anything else than amber.

**Notes/ Disaggregation**
N/A

**Coherence issues & synergies**
N/A

**Local to International Dimensions**
The UK target for a 50% reduction by 2025 and an 80% reduction by 2050 aligns with the European Union carbon reduction plan.
**UKSSD — Measuring up Appendix: Sustainable Development Goal 9**

**Trends**
The potential business opportunities from low carbon construction are huge and they will drive future markets to 2025 and well beyond. The global green and sustainable building industry is forecast to grow at an annual rate of 22.8% between now and 2017 because of increasing low carbon regulatory requirements and greater social demand for greener products.

In recognition of this tremendous opportunity, the Green Construction Board has developed a high level route map which identifies the work required for the built environment to meet the 80% carbon reduction target by 2050.21

**Actions needed**
Following the Government own Clean Growth Strategy and the Grand Challenge posed within the industrial strategy would ensure that this indicator could be met. The real challenge will be ensuring that these strategies are followed and delivered in their entirety by the infrastructure sector.

**Indicator**
**9.1.2 Passenger and freight volumes, by mode of transport**

**Applicable UK policy / legislation**
National Infrastructure and Construction Pipeline 2017
2017 Industrial Strategy

**National SDG target**
£300 billion by 2020/21

**UK commensurable indicator**
23 billion National Productivity Investment Fund.
Total investment in social and economic infrastructure (newly proposed indicator)

**Baseline status / performance**
Since 1997 infrastructure investment has remained between £2 and £4 billion per annum. Full details can be found here - [http://www.bbc.co.uk/news/business-25201064](http://www.bbc.co.uk/news/business-25201064) (note - unable to find source data on the ONS website)

**Other relevant UK indicator/s**
N/A

**Assessment of current state**
RAG Rating: Amber/Green

The ambitious pipeline of infrastructure projects represents a significant government investment in social and economic infrastructure. It is difficult to say that extent to which this can be deemed a success but it is clear that there is significant appetite from the government to invest heavily in UK infrastructure.

Comment: Green sounds right - assuming the commitments are implemented in practice and within the timelines

Comment: This probably should be amber - not green. We have this ambitious pipeline to rectify a poor starting point as noted above. Also, there are problems with the financing of these pipeline projects - the new PFI being discredited and political uncertainty reducing appetite for private sector to invest. Also loss of links to EIB will not help since major investor. The pipeline also doesn't account for local level infrastructure which has its own problems getting off the ground. So gap potentially between plans and realisation. There's also no real understanding of whether or not this infrastructure is sustainable in the long-term and future-proofed.
Notes/ Disaggregation

Coherence issues & synergies
Around half of the pipeline to 2020/21 is made up of public funding, including more than three quarters of transport spending. Most of the investment in the energy and utilities sectors is made up of private funding. Around 7% of the pipeline to 2020/21 is funded by a combination of public and private money. For example, the Environment Agency’s £2.3 billion six-year flood defence programme to 2021 is based on a partnership funding model, which encourages private investment.

Comment: There is also a need to ensure that the infrastructure itself is sustainable environmentally (see previous comment) and also socially - eg by being designed wherever possible to promote ‘inclusive growth’ (eg apprenticeships/supply chain spend in low income areas)- so links to SDGs 7,8,12, 11, 13.

Local to International Dimensions
The pipeline contains projects and programmes distributed across the UK but the majority of the value of the pipeline relates to spending in England. This is because most infrastructure spending in Northern Ireland, Scotland and Wales is the responsibility of each devolved administration, and therefore is not included in this pipeline.

The split between the responsibility of the UK government and each of the devolved administrations for infrastructure policy and funding varies according to the distinct devolution settlement in place, as set out in the National Infrastructure Delivery Plan. Each devolved administration produces its own infrastructure plan setting out spending in economic infrastructure:

- The Northern Ireland Executive published an Investment Delivery Plan for Roads and Regional Strategic Transport Network Plan
- The Scottish Government published an Infrastructure Investment Plan with a Project Pipeline
- The Welsh Government published an Infrastructure Investment Plan with a Project Pipeline

Infrastructure can help to unlock the economic potential of regions, supporting growth and strengthening productivity by providing greater connectivity within and between regions. While infrastructure projects can support the local economies in which they are physically located,

they can also benefit other regions through the creation of supply chain jobs. For example, more than 60% of suppliers for Crossrail are currently based outside of London.

Around 40% of the value of projects in the pipeline to 2020/21 has been allocated to individual English regions. The remaining 60% cannot accurately be allocated to an individual region because it relates to schemes that cover multiple regions or programmes that will be spread across the whole country (such as HS2 or the rollout of smart meters). It is therefore very difficult to offer a meaningful regional breakdown of infrastructure investment.

Comment: Surely this is a UK wide target and so the devolved administrations would need to contribute towards the overall target?? Bit confused from the text as to whether NI and Wales are contributing or not.
Trends

The pipeline combines projects and programmes across housing, and economic (for example, transport, energy, digital communications) and social (for example, education, justice) infrastructure. In total, the pipeline includes 15 sectors.

The three sectors with the highest level of investment to 2020/21 are transport (£92 billion), energy (£79 billion) – of which nearly half is made up of electricity generation – and utility networks (£59 billion). Together, these three sectors make up more than three quarters of the total value of the pipeline to 2020/21.

Of the £92 billion of transport investment in the pipeline to 2020/21, more than £20 billion will be invested in roads and nearly £15 billion in high speed rail. Autumn Statement 2016 set out an additional £2.6 billion of transport spending, including £127 million to build a new expressway from Oxford to Cambridge and to accelerate the construction of East-West rail.

Whereas electricity and gas transmission, as well as the rollout of smart meters, were included in the energy sector in the March 2016 infrastructure pipeline, they are now included in the nearly £60 billion investment in the utilities sector because these schemes are associated with the regulated utilities programmes.

Of the £71 billion in the pipeline in the remaining 12 sectors, there is currently £47 billion of investment in social infrastructure, defence and housing to 2020/21, including more than £20 billion in education and £3 billion of projects and programmes in health, from the £24 billion announced at Spending Review 2015.

Actions needed

The proposals set out in the National Infrastructure and Construction Pipeline are ambitious. The actions required to make this happen are for continued government investment and for the private sector to realise the opportunities of investing in these sectors.

Comment: Part of the reason for lack of investment is because of the risk/return assessment including political uncertainty with current models eg PFI2 (and Labour’s proposed abolition of this approach). Some other countries seem to have more innovative approaches to brokering and creating multi-stakeholder deals which work for all parties. A simple action suggested is for the UK government to learn from international good practice and innovate to better enable cross-sector partnerships to realise investment aims

Target: 9.2 Promote inclusive and sustainable industrialization and, by 2030, significantly raise industry’s share of employment and gross domestic product, in line with national circumstances, and double its share in least developed countries

Indicator 9.2.1 Manufacturing value added as a proportion of GDP and per capita

<table>
<thead>
<tr>
<th>Applicable UK policy / legislation</th>
</tr>
</thead>
<tbody>
<tr>
<td>*National Infrastructure and Construction Pipeline 2017</td>
</tr>
<tr>
<td>*Catapult Centres</td>
</tr>
<tr>
<td>*The Advanced Manufacturing Supply Chain Initiative</td>
</tr>
<tr>
<td>*The Manufacturing Advisory Service</td>
</tr>
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<td>*The Regional Growth Fund</td>
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<table>
<thead>
<tr>
<th>National SDG target</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>UK commensurable indicator</th>
</tr>
</thead>
</table>

Comment: ONS NRP reports on the UK manufacturing value per capita or as percentage of GDP, disaggregated by manufacturing category, using population estimates, GDP low level aggregates and GDP
Baseline status / performance

“The manufacturing industry... in 2013, accounted for 10% or £150.7 billion of national economic output.”(full details over time available on page 4).

In recent years, the relative share of manufacturing in the UK economy has declined more rapidly than in other developed economies while the service sector has grown at a faster rate. This growth of the service sector in the UK is consistent with growth in other developed economies including France and the US. This 'deindustrialisation' has also applied to UK manufacturing employment, with numbers reducing at a faster rate than in other developed economies, from close to nine million people in 1966 to below three million in 2011.

Comment:

ONS NRP reports for 2016: £2600m manufacturing value per capita in UK / 2016: UK’s manufacturing value in 2016 was 9.16% of GDP

Comment:

Industry 4.0 is the future, and the UK is far behind Germany and some other countries (I will post some figures to show that).

This research should start with a review to analyse the academic and industrial progress in topics related to the fourth industrial revolution in a systematic manner, to provide insights into the past, present and future of this topic.

This goal should discuss three Necessary Integration Features of industry 4.0 in the UK:

1. Horizontal Integration: integration of the various IT systems used in the different stages of the manufacturing and business planning processes within a company (e.g. inbound logistics, production, outbound logistics, marketing) and between several different companies (value networks).

2. Vertical Integration: integration of the various IT systems at the different hierarchical levels (e.g. actuator and sensor level, manufacturing and execution level, production management level, and corporate planning levels) to deliver an end-to-end solution.

3. 3End-to-End Digital Integration: integration throughout the engineering process so that the digital and real worlds are integrated across a product’s entire value chain and across different companies, while also incorporating customer requirements.

To achieve the above, there are Eight Priority Areas for Action:

1. Standardisation and Reference Architecture: development of a single set of common standards to support collaboration and of a reference architecture to provide a technical description of these standards.

2. Managing Complex Systems: development of appropriate planning (for systems to be built) and explanatory models (for existing systems) to provide a basis for managing complex products and manufacturing systems.

3. Delivering a Comprehensive Broadband Infrastructure: development of a reliable, comprehensive and high-quality communication network to expand the broadband Internet infrastructure on a massive scale.

4. Safety and Security: to ensure that production facilities and products themselves do not pose a danger either to people or to the environment. Meanwhile, protect the data that they contain against misuse and unauthorised access.

5. Work Organisation and Design: implementation of a socio-technical approach for work organisation and design to offer workers the opportunity to enjoy greater responsibility and enhance their personal development.

6. Training and Continuing Professional Development (CPD): realisation of appropriate training strategies and organisation of work in a way that fosters learning, enabling lifelong learning and workplace-based CPD.


8. Resource Productivity and Efficiency: to deliver gains in resource productivity and efficiency. The calculation of the trade-offs between the additional resources that will be needed in smart factories and the potential generated savings.
**Other relevant UK indicator/s**

“Almost 70% of Research & Development investment is in the manufacturing sector, and goods produced in the sector account for 44% of all UK exports.”

<table>
<thead>
<tr>
<th>Assessment of current state</th>
<th>RAG Rating: Amber</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK manufacturing performance has been weak relative to international competitors in some key areas:</td>
<td></td>
</tr>
<tr>
<td>Expenditure on manufacturing R&amp;D has been low, especially with regard to new products.</td>
<td></td>
</tr>
<tr>
<td>The level of investment in capital equipment has been relatively low for many decades.</td>
<td></td>
</tr>
<tr>
<td>The UK’s share of global manufacturing exports has fallen from 7.2% in 1980 to 2.9% in 2012</td>
<td></td>
</tr>
<tr>
<td>The future of manufacturing: A new era of opportunity and challenge for the UK</td>
<td></td>
</tr>
<tr>
<td>New sources of revenue and of value creation will transform manufacturing business models over time. They will draw on new sources of knowledge and closer, long term relationships with customers. Future sources of revenue for manufacturers will include:</td>
<td></td>
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<tr>
<td>Increasingly extensive packaging of services with products;</td>
<td></td>
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<tr>
<td>New sources of information on how products are used, drawing on embedded sensors and open data;</td>
<td></td>
</tr>
<tr>
<td>Becoming a ‘factoryless goods producer’, capturing value by selling technological knowledge and leaving production to others;</td>
<td></td>
</tr>
<tr>
<td>Becoming a ‘remanufacturer’ with end of life products remanufactured and returned to original specifications or better;</td>
<td></td>
</tr>
<tr>
<td>Targeting ‘collaborative consumption’, where no one customer owns a product outright.</td>
<td></td>
</tr>
<tr>
<td>Creating value from new forms of (competitive) strategic alliance within and across sectors; and</td>
<td></td>
</tr>
<tr>
<td>Exploiting new technologies more rapidly through greater operational capability coupled to entrepreneurial insight.</td>
<td></td>
</tr>
</tbody>
</table>

**Notes/ Disaggregation**

- Manufacturing value added per capita (2016) £m: 2600
- Percentage GDP (2016) %: 9.16
- [https://www.ons.gov.uk/economy/grossdomesticproductgdp/datasets/ukgdpolowlevelaggregates](https://www.ons.gov.uk/economy/grossdomesticproductgdp/datasets/ukgdpolowlevelaggregates)
- [https://www.ons.gov.uk/economy/grossdomesticproductgdp/timeseries/abmi/pn2](https://www.ons.gov.uk/economy/grossdomesticproductgdp/timeseries/abmi/pn2)

**Coherence issues & synergies**

Almost 70% of Research & Development investment is in the manufacturing sector however, the output for the sector has been declining particularly during the 2008/09 recession and once again in 2012 with only a slow increase in recent years.

Comment: Investment and grants made available for Innovative technologies will ensure UK is at the global leading edge in manufacturing best practice

Also investment in manufacturing skills – (eg apprenticeships) is key to ensuring we have the talent to perform
### Local to International Dimensions

The UK has been a major recipient of inward FDI for manufacturing and remains in a good position to attract an above-average share of FDI coming into Europe. However, FDI flows into Europe, as a proportion of total available FDI, are likely to reduce due to competition from BRIC, other emerging economies, and BREXIT.

Onshoring (or ‘reshoring’) is a recent trend typically involving the repatriation of production from low cost locations; investment in onshore production to enhance capability; and sourcing of components from onshore, rather than from overseas. Some underlying trends suggest it will become increasingly possible for the UK to compete with lower cost locations, on quality, delivery speed and customisation.

If current trends continue, the foreign-owned manufacturing sector within the UK will account for a larger share of output (by 2020), GVA and employment (by 2015) than the UK-owned sector. The presence of multi-national corporations (MNCs) will continue to help improve the performance of the UK’s largest firms, but the detail of the effects depends on the investment and production strategies of MNCs.

### Trends

This target should be achievable however, unsure as to whether this is so relevant to the UK as the country is now diversifying in its industries and becoming a more service providing economy. Yet, as above it does still contribute greatly to the current economy.

### Actions needed

Given the pace of change in technological developments and international competition, the UK needs to strengthen the extended system that identifies and supports new technologies and their applications. The UK’s High Value Manufacturing (HVM) Catapult Centre, established in 2011, has a key role in the near term, and is an example of a step that the Government has taken to develop a more systemic approach across research, innovation and industrial policy.

### Indicator

| 9.2.2 Manufacturing employment as a proportion of total employment |

### Applicable UK policy / legislation

* National Infrastructure and Construction Pipeline 2017  
* Catapult Centres  
* The Advanced Manufacturing Supply Chain Initiative  
* The Manufacturing Advisory Service  
* The Regional Growth Fund

Comment: This is a classic ‘lagging’ indicator. Would be good to introduce a leading indicator such as skills investment/number of apprenticeships etc.

### National SDG target

None

Comment: Surely we need some sort of target so we know what to aim for and when we have got there??

### UK commensurable indicator

Increased percentage of employment in the manufacturing sector

Comment: ONS NRP reports manufacturing employment as a percentage of total employment in the UK

### Baseline status / performance

Manufacturing industry employs around 2.6 million people in the UK. Full table on page 6 of report.

Regionally there are also significant differences. The highest proportion of manufacturing jobs are in the East Midlands which accounts for 12% compared to only 2% in London.

The manufacturing sector makes significant contributions to the economy, accounting for over 10% of the UK’s gross value. It accounts for more than half of the UK’s exports (53%) and around 3 quarters of business research and development (72%).

Comment: Since 2010 and 2016 proportion of manufacturing employment in the UK stayed steady, between 9 and 10% of total employment.

### Other relevant UK indicator/s

Manufacturers are increasingly using this wider value chain to generate new and additional revenue, with production playing a central role in allowing other value creating activities to occur. For example, 39% of UK manufacturers with more than 100 employees derived value from services related to their products in 2011, compared with 24% in 2007. This typically involves supporting or complementing products, and offering outcome or availability based contracts for products. Not all manufacturing firms report service revenue separately, and there is no requirement for them to do so.

### Assessment of current state

<table>
<thead>
<tr>
<th>RAG Rating: Amber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current economy is moving toward a service providing economy. However, manufacturing has been increasing gradually as a proportion of the UK economy with businesses bringing their manufacturing back to the UK however, this goal may be less relative for the UK development.</td>
</tr>
</tbody>
</table>

Comment: I appreciate this is a political minefield but my gut feeling is that manufacturing has dropped significantly over time (The UK’s share of global manufacturing exports has fallen from 7.2% in 1980 to 2.9% in 2012) and although small gains have been made not sure this still feels like an amber. That’s why a clear target would be helpful.

### Notes/ Disaggregation

Manufacturing employment as a percentage of total employment (2016): 9.44

- Male: 13.4
- Female: 4.96

https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/datasets/employmentbyindustryemp13

Comment: See note above re-target – is 9.44 good?? Is it on track for the target we need – how does it compare to our competitors (France, Germany etc) – where do we want to be?!

### Coherence issues & synergies

In assessing the role of manufacturing, it is important to go beyond its direct share of GVA and employment. Evidence shows a more complex picture, emphasising that manufacturing is and must continue to be an essential part of the UK economy, with diverse benefits including:

* Absolute value: The contribution of manufacturing to UK GDP (£139 billion in 2012) is still significant and has been increasing over the long term.

* Exports: Manufacturing businesses are more likely to engage in exporting. UK exports of goods produced by the manufacturing sector totalled £256 billion in 2012, accounting for around 53% of all UK exports. In 2010, 60% of manufacturing businesses with ten or more employees exported products and services compared to 26% of non-manufacturers.

* Innovation: Manufacturers are more likely to innovate. In 2010, 26% of manufacturing businesses with ten or more employees carried out process innovation compared to less than 14% for non-manufacturers, and 44% undertook product innovation (less than 26% for non-manufacturers).
Local to International Dimensions

In recent years, the relative share of manufacturing in the UK economy has declined more rapidly than in other developed economies while the service sector has grown at a faster rate. This growth of the service sector in the UK is consistent with growth in other developed economies including France and the US. This ‘deindustrialisation’ has also applied to UK manufacturing employment, with numbers reducing.

Comment: This statement is potentially contradicting the point above about the positives of manufacturing.

Trends

This target should be achievable however, unsure as to whether this is so relevant to the UK as the country is now diversifying in its industries and becoming a more service providing economy. Yet, as above it does still contribute greatly to the current economy.

Comment: Not sure I’m clear what the ‘target’ is – maybe use the word ‘goal’ or ‘objective’

Comment: ONS NRP reports a downward trend in the percentage of manufacturing employment between 2000 and 2016, from 14.8% of total employment to 9.44%.

Actions needed

Future approaches to policy depend strongly on recognising that manufacturing is part of an extended system, which requires a response from Government that cuts across policy departments. This requires a ‘systems based’ approach that takes full account of the linkage between science, technology, innovation and industrial policies. The result is the need for more integrated coordination by government across policy domains and Government departments, that makes it easier to anticipate the potential unintended consequences of policies, and to identify where intervention would achieve the greatest impact. Such an approach should help to avoid the adoption of selective policies based on narrow objectives that might inadvertently hold back sustainable growth, and which are more a feature of the current approach which devolves policy-making to different government departments with different roles and agendas.

Comment: The industrial strategy is a good practical starting point. These actions are quite generic/process-oriented and part of this will also need to include sectoral strategies as well as an element of focus with respect to emerging tech particularly.

Target: 9.3 Increase the access of small-scale industrial and other enterprises, in particular in developing countries, to financial services, including affordable credit, and their integration into value chains and markets

<table>
<thead>
<tr>
<th>Indicator</th>
<th>9.3.1 Proportion of small-scale industries in total industry value added</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applicable UK policy / legislation</td>
<td>Innovate UK - Small Business Research Initiative (SBRI)</td>
</tr>
<tr>
<td>National SDG target</td>
<td>None</td>
</tr>
<tr>
<td>UK commensurable indicator</td>
<td>Percentage increase in the annual turnover from small-scale industries over medium to large industries and businesses.</td>
</tr>
<tr>
<td>Baseline status / performance</td>
<td>“There were a record 5.4 million private sector businesses at the start of 2015. This is an increase of 146,000 since 2014 and 1.9 million more since 2000. 76% of businesses did not employ anyone aside from the owner.” Small businesses accounted for 99.3% of all private sector businesses at the start of 2015 and 99.9% were small or medium-sized (SMEs). “just under a fifth of all SMEs were operating in Construction, compared to less than 1% in the Mining, Quarrying and Utilities sector” Full information about the breakdown on Page 12 of this report: <a href="https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/467443/bpe_2015_statistical_release.pdf">https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/467443/bpe_2015_statistical_release.pdf</a></td>
</tr>
</tbody>
</table>
UKSSD — Measuring up Appendix: Sustainable Development Goal 9

Assessment of current state

RAG Rating: Amber

Current state of UK business has sustained growth in the total business population, with an increase of over 55% since 2000 and 3% since 2014. However, the majority of this increase has been due to non-employing businesses which accounted for 90%.

Notes/ Disaggregation

Question of comparability between small industry and small businesses:

ONS give extensive disaggregation on the type of industry in terms of value added but the data does not speak to size of industry/business.

https://www.ons.gov.uk/economy/grossdomesticproductgdp/datasets/gdpolowlevelaggregates

Coherence issues & synergies

Local to International Dimensions

The US also has a Small Business Innovation Research Program (SBIR), which currently lets $2 billion of contracts annually. Since its inception the programme has worked with over 15,000 firms, developed more than $21 billion worth of research, and over 45,000 patents.

Trends

Achievable - small-scale industries and businesses are increasing however, as mentioned above the percentage of people employed in each of these needs to increase in order for the value added to increase too.

Actions needed

Immediate priorities should be to scale up funding for the HVM Catapult Centre, to promote much stronger involvement of small and medium enterprises in the member centres, and to enhance the role it plays in connecting academic expertise to industry. Longer term, there is potential for the Centre to support international collaboration between manufacturers, for example by establishing a presence in key emerging economies.

Target: 9.4 By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities

<table>
<thead>
<tr>
<th>Indicator</th>
<th>9.4.1 CO2 emission per unit of value added</th>
</tr>
</thead>
</table>
| Applicable UK policy / legislation | *The Climate Change Act  
*The Clean Growth Strategy  
*2017 Industrial Strategy |

National SDG target

None

UK commensurable indicator

*Carbon budgets  
*20% of total energy consumption from renewable energy and increase in energy efficiency by 2020.  
*At least 27% of total energy consumption from renewable energy and increase in energy efficiency by 2027.

Comment: Not sure I quite understand the measure – eg for a £1 billion investment project would the indictor require a calculation of carbon emissions (all scopes?) involved in its construction (and then operation??). Use of Science-based targets to link to agreed carbon goals of 80% by 2050. Again focus is on decarbonisation without other aspects of ‘sustainability’ being addressed (eg resource efficiency). Again need an SDG target which links to the agreed policy carbon targets so can assess whether its successful or not.

Comment: ONS NRP reports kilotonnes of CO2 per GBP in the UK, using Atmospheric Emissions: Greenhouse Gas Emissions: By Economic Sector and Gas, United Kingdom and UK GDP(O) low level aggregates
## Baseline status / performance

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Greenhouse Gas Emissions (kt of CO2 equivalent)</th>
<th>CO2 Emissions (metric tons per capita)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>839587</td>
<td>11.7</td>
</tr>
<tr>
<td>1990</td>
<td>777244</td>
<td>9.7</td>
</tr>
<tr>
<td>2010</td>
<td>609587</td>
<td>7.8</td>
</tr>
</tbody>
</table>

On total greenhouse gas emissions (kt of CO2 equivalent), it is falling over time. The Greenhouse Gas (GHG) in 2015 were 495.7MtCO2e. This is accounting for the 7 GHGs which are covered by the Kyoto Protocol. Carbon dioxide (CO2) is the most potent out of the seven GHGs which are analysed, it accounts for 81% of the total UK GHGs in 2015. This is a 3.8% reduction when compared to the 2014 emissions of 525.1MtCO2e. The total emissions from 2015 are estimated to have decreased by 38.0% from the 1990 benchmark.

## Other relevant UK indicator/s

- Range of measurements here. For example, the total greenhouse gas emissions (kt of CO2 equivalent) for the UK over time can be found here: [http://data.worldbank.org/indicator/EN.ATM.GHGT.KT.CE?locations=GB](http://data.worldbank.org/indicator/EN.ATM.GHGT.KT.CE?locations=GB)

The Climate Change Act 2008 committed the UK to reducing GHGs by a minimum of 80% below the 1990 baseline by 2050 with an interim target of 34% by 2020. If the above estimations are correct, the interim target has therefore already been met. To enable this progress, the Carbon Budget was created which set legally-binding limits on the GHG emissions for the UK every 5 years. In 2014, it was confirmed that the first carbon budget was met with a saving of 36 MtCO2e.

When looking at the UK emissions against the Kyoto Protocol target the UK met its first commitment period (2008-2012) targets. The target was to reduce emissions by 12.5% below the base year levels over the first commitment period of 5 years, this was surpassed and a 23% reduction was achieved. By 2020 for the second commitment period, a reduction target of 20% from the base year levels. Are these targets therefore ambitious enough?
Assessment of current state

**RAG Rating: Amber – performance is good but needs more action. Amended during review.**

In order for the UK to meet its fourth and fifth carbon budgets a significant increase in the rate of decarbonisation is required. This is where innovation and making our current sectors more efficient and less carbon intensive. Our current sectors currently make the figure below. The UK’s energy efficiency sector currently turns over £20.3 billion which employs 144,000 people. The potential for energy efficiency through investment in cost-effective energy efficient technologies in buildings and industry would save a further £6 billion. 13% of the UK emissions come from homes, increasing the 22% when electricity use is added. Energy consumption in homes has fallen by 17% since 1990 due to greater levels of insulation however, to meet the 2032 pathway for the fifth carbon budget home emissions are required to further reduce by a fifth to an estimated 58MtCO₂e. This will enable 2.5 million fuel poor homes in England to improve to a minimum energy efficiency rating of C by 2030. Full decarbonisation in the method that we heat our homes will be required to meet the 2050 targets. A greater emphasis on innovation and a shift to renewable energy is key.

The Clean Growth Strategy set out 4 main opportunities for carbon reduction across industries by 2050, with the largest opportunity being Carbon Capture, Usage and Storage (CCUS). CCUS will have a vital role in decarbonising many industries where the use of fossil fuels are still being used. CCUS also enables further decarbonisation of the current situation. Currently the CCUS market is valued at £100 billion which is largely untapped, with a potential opportunity for the UK to take control of £5-9 billion per year by 2030. The main reason behind this untapped market is due to the cost associated with the technology which has largely remained unchanged since 2007. Research and development (R&D) is still required enormously within this sector in addition to the £130 million already invested to date. £100 million from the BEIS Energy Innovation Programme will go to supporting the continued R&D of CCUS.

The second opportunity is by fuel switching, this would be undertaken by fuelling industries with alternative low carbon fuels such as hydrogen. However, this is currently seen as being too expensive and inefficient with the current technology. £20 million for research within demonstration projects for industries will be available from 2018 onwards.

The third opportunity is around the topic of unlocking business energy efficiency with the aim of improving energy efficiency by at least 20% by 2030. The CRC Energy Efficiency Scheme will continue through to 2030 whilst reinforcing the changes in rates stated in the Climate Change Levy from 2019. Innovative technologies such as industrial heat recovery will be received a £18 million fund to encourage the continued development ensuring that any additional heat produced throughout the manufacturing processes is recovered and used.

And finally, the remaining opportunity would be to transform manufacturing and heavy industries. This will be majorly done by undertaking the 3 opportunities listed above. The continued use of carbon pricing would be highly beneficial here to ensure that a clear price continues to incentivise industrial emission reductions.
Notes/ Disaggregation

Focusing on the CO2 per unit of value added (GEVA approach) need to then focus on industries, sectors and businesses. This is where the same rates cannot be added to all the sectors as this overlooks the great differences between industry sectors regarding the range of potential mitigation and cost implications. However, this approach does not take into account the company performance and its influence on decarbonisation as a uniform trajectory is then applied. Furthermore, this method does not ensure that the trajectories of carbon emissions remain within the carbon budget.

Which is why a Sectoral Decarbonisation Approach (SDA) influenced by global targets is the way in which decarbonisation at a rate quick enough to not exceed the 2°C maximum is most likely to be achieved. A study undertaken by Krabbe et al., (2015) Translating the sectoral emission pathways into sectoral intensity pathways (intensity pathway = emission pathway/ activity projections) can be undertaken using a physical indication such as tonnes of cement produces or monetary indicators in the form of value added. The SDA follows a decarbonisation pathway which is in line with the IPCC’s RCP 2.6 scenario which indicates an 80% chance of limiting the average temperature increase reaching 2°C as well as allocating a respective global carbon budget for every year up to 2050 to individual sectors and sub-sectors. The method which was deemed the most effective is by relating the energy required and the amount of physical indicator as your emissions indicator and potential mitigation possibilities. However, the limitation with this methodology is that it can only be used with sectors which only have one main product such as timber, steel or cement etc. On the other hand, 76% of the total carbon budget within the median IPCC RCP 2.6 scenario is consumed by sectoral physical indicators such as these. The way in which this methodology would apply to heterogeneous industries is that the value-added indicator would be more applicable by assuming that the sector activity would grow in parallel to the GDP growth to create its intensity pathway. Once the sectoral intensity pathways are developed whether that is using the a monetary or product, individual business intensity pathways can then be established enabling specific company targets to be set. These targets should be set at interim periods to ensure that the targets are not set too far into the future resulting in the targets becoming unrelated to present.

Coherence issues & synergies

N/A

Local to International Dimensions

Feeds into the global goals of ensure temperatures don’t rise above the 2oS target.

Key EU targets for 2020:

• 20% cut in greenhouse gas emissions compared with 1990
• 20% of total energy consumption from renewable energy
• 20% increase in energy efficiency

Key EU targets for 2030:

• At least 40% cut in greenhouse gas emissions compared with 1990
• At least 27% of total energy consumption from renewable energy
• At least 27% increase in energy efficiency

Long-term goal: By 2050, the EU aims to cut its emissions substantially – by 80-95% compared to 1990 levels as part of the efforts required by developed countries as a group.
Trends
Achievable as current mid-term 2020 targets have been met however, as mentioned above in order for targets to be met in 2050 as well as the 5th carbon budget. 2017 was the greenest year ever in terms of how the nation’s electricity was generated. In April 2017, the UK had its first 24-hour period without using any coal power since the Industrial Revolution.

Actions needed
Implementation of carbon labels on goods therefore more educated choices can be made.

Industry specific targets to ensure efficiencies and carbon reduction targets are ambitious and specific to each industry- making them legally binding like those within the carbon budgets increases the likelihood of continued efforts.

Despite 2017 being the greenest year regarding the UK’s energy production, renewables only beat fossil fuels for only 23 days of the year. The government has focused on reducing the reliance on coal which now supplies only 7% of our energy needs, however, our reliance on gas needs to diminish in order for the UK to meet the 5th carbon budget. Greater investment needs to continue on renewable energy sources. The cost of offshore wind power fell below the price of nuclear, whilst also producing more electricity than coal on 75% of the days this year.

Target: 9.5 Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending

Indicator 9.5.1 Research and development expenditure as a proportion of GDP

Applicable UK policy / legislation
UK Industrial Strategy includes significant policy towards enhancing scientific research.

UK Research and Innovation, a single Non-Departmental Public Body that will integrate the seven Research Councils, Innovate UK, and the research and knowledge exchange functions of the Higher Education Funding Council for England

National SDG target
2.47% of GDP by 2027

UK commensurable indicator
ONS has data on research and development expenditure – see table of expenditure over time here https://www.ons.gov.uk/economy/governmentpublicsectorandtaxes/researchanddevelopmentexpenditure/timeseries/giba/gerd


Updated statistical bulletin now available (published 15 March 2018)

Comment: Some useful analysis from CaSE of the new stats also recently published: http://www.sciencecampaign.org.uk/news-media/case-comment/reflections-on-the-uk-s-r-d-funding-landscape.html

Comment: ONS NRP reports on research and development expenditure as a % of GDP

https://sustainabledevelopment-uk.github.io/9-5-1/

using UK gross domestic expenditure on research and development dataset , UK business enterprise research and development , UK gross domestic expenditure on research and development regional dataset
## Baseline status / performance

<table>
<thead>
<tr>
<th>Year</th>
<th>R&amp;D expenditure ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>£22.9bn</td>
</tr>
<tr>
<td>2010</td>
<td>£26.2bn</td>
</tr>
<tr>
<td>2014</td>
<td>£30.6bn</td>
</tr>
</tbody>
</table>

"Total R&D expenditure in the UK in 2014 represented 1.67% of Gross Domestic Product (GDP), unchanged from 2013. This was below the European Union (EU-28) provisional estimate of 2.03% of GDP, but the 11th highest of all member countries."

As of 2017 the target was upscaled to 2.47% of GDP, which would exceed the EU provisional estimate.

### Other relevant UK indicator/s
- **UK Tax Credit on R&D** - increased to 12% in the Industrial Strategy
- **Investment of £725 million in Industrial Strategy Grand Challenge Fund programmes to capture the value of innovation**

### Assessment of current state

**RAG Rating: Amber**

As it stands, although the UK is a leading country within the EU on the investment into research and development, there is still work to be done on ensuring that investment levels are consistently at a high level and recognise important nature of continued investment in this area.

Should the government maintain their commitment to 2.47% of GDP going towards research and development then this could be considered achieved.

**Notes/ Disaggregation**

- **R&D expenditure as a proportion of GDP (2015):** 1.69%
- **https://www.ons.gov.uk/economy/governmentpublicsectorandtaxes/researchanddevelopmentexpenditure/datasets/ukgrossoverallresearchanddevelopment**
- **Note:** largely unchanged from 2014

### Coherence issues & synergies

**N/A**

Comment: It would be worth noting the important role science and innovation will play in tackling a range of other SDG targets. Support for interdisciplinary and challenge-focused research is particularly important in this regard.

### Local to International Dimensions

In 2014, the South East and East of England continued to dominate R&D activity in the UK. These regions together accounted for 39% of total UK R&D expenditure (£11.9 billion).

The majority of UK R&D expenditure was carried out in England (£27.1 billion) in 2014, an increase of 5% in current prices from £25.8 billion in 2013. Wales and Scotland showed increases of 4% and 1% respectively in 2014. Northern Ireland however, showed a decrease of 14% from the 2013 estimate of £0.6 billion to £0.5 billion in 2014. This is attributable to a decrease in R&D performed in the business sector within Northern Ireland.

Comment: This is still very similar, 37% in 2016.

### Trends

Achievable in its own right. However, investment in this area will become redundant if there is not a wider strategy to improve the skills shortages that exist in these industries. Education of STEM subjects is vital.

### Actions needed

Brexit is likely to cause a skills gap in the UK's ability to make the best of use of upward investment in science research, innovation and technological development. As it stands there is already a shortage in engineering skills, maths skills and wider scientific skills in the UK. Investment in research and development will need to be match by investment in education that will allow the country to make best use of the proposed funding in this area.
### Sustainable Development Goal 9

#### Indicator

**9.5.2 Researchers (in full-time equivalent) per million inhabitants**

| Applicable UK policy / legislation | Department for Digital, Culture, Media, and Sport Single Departmental Plan  
|-----------------------------------|-------------------------------------------------|
| **National SDG target** | Universal Service Obligation  
https://www.thinkbroadband.com/  
Proportion of the population covered by superfast broadband (newly proposed indicator)  
Comment: ONS NRP: Number of researchers in the UK has increased since 2011, from 3760 per million to 4690 per million in 2016  
ONS NRP: Researchers in the UK steadily increased between 2011 and 2016  
Comment: 9.a.1, 9.b.1 and 9.c.1 missing  
[9.a.1] ‘Total official international support (ODA plus other official flows) to infrastructure’  
ONS NRP reports Net ODA between 2010 and 2015 in the UK using DfID Statistics on International Development 2016  
[9.b.1] ‘Proportion of medium and high-tech industry value added in total value added’  
ONS NRP reports on % of total industry value added by different industries – see 9.3.1  
[9.c.1] ‘Proportion of population covered by a mobile network, by technology’  
ONS exploring data sources  
| **Baseline status / performance** | Percentage of premises covered by superfast broadband (download speed of 30Mbit/s and higher)  
2016 – 89%  
2015 – 83%  
Comment: ONS NRP: Number of researchers in the UK has increased since 2011, from 3760 per million to 4690 per million in 2016  
ONS NRP: Researchers in the UK steadily increased between 2011 and 2016  
Comment: 9.a.1, 9.b.1 and 9.c.1 missing  
[9.a.1] ‘Total official international support (ODA plus other official flows) to infrastructure’  
ONS NRP reports Net ODA between 2010 and 2015 in the UK using DfID Statistics on International Development 2016  
[9.b.1] ‘Proportion of medium and high-tech industry value added in total value added’  
ONS NRP reports on % of total industry value added by different industries – see 9.3.1  
[9.c.1] ‘Proportion of population covered by a mobile network, by technology’  
ONS exploring data sources  
| **Other relevant UK indicator/s** | N/A  
| **Assessment of current state** | RAG Rating: Amber  
Although broadband coverage is rapidly expanding, it is currently inconsistent between different regions of the UK. By 2030 universal superfast broadband should be achieved, but this is a moving target, in as much as expectations of what is acceptable broadband speed will increase  
| **Notes/ Disaggregation** | N/A  
| **Coherence issues & synergies** | N/A  
| **Local to International Dimensions** | The 95% target is not a consistent 95% across all communities in the UK, but with areas like Epson and Ewell, Tamworth, Worthing and Watford and others all pushing into the 99% superfast coverage zone these areas pull the figures up compared to the City of London (50.3%), Orkney Islands (66.8%), Western Isles (71%) and Kingston Upon Hull (71.7%) at the other end of the table.  
Comment: 9.a.1, 9.b.1 and 9.c.1 missing  
[9.a.1] ‘Total official international support (ODA plus other official flows) to infrastructure’  
ONS NRP reports Net ODA between 2010 and 2015 in the UK using DfID Statistics on International Development 2016  
[9.b.1] ‘Proportion of medium and high-tech industry value added in total value added’  
ONS NRP reports on % of total industry value added by different industries – see 9.3.1  
[9.c.1] ‘Proportion of population covered by a mobile network, by technology’  
ONS exploring data sources  
| **Trends** | Should be achievable with the right level of investment. To remain competitive, both for business and the general public, there will need to be continuing investment  
Comment: 9.a.1, 9.b.1 and 9.c.1 missing  
[9.a.1] ‘Total official international support (ODA plus other official flows) to infrastructure’  
ONS NRP reports Net ODA between 2010 and 2015 in the UK using DfID Statistics on International Development 2016  
[9.b.1] ‘Proportion of medium and high-tech industry value added in total value added’  
ONS NRP reports on % of total industry value added by different industries – see 9.3.1  
[9.c.1] ‘Proportion of population covered by a mobile network, by technology’  
ONS exploring data sources  
| **Actions needed** | The UK must continue to invest in broadband and ensuring that all communities are treated equally in the roll out. Continued investment will be required to ensure that not only do all communities have access to superfast broadband but that broadband is continuously improved to maintain competitiveness globally.  
ONS NRP: Number of researchers in the UK has increased since 2011, from 3760 per million to 4690 per million in 2016  
ONS NRP: Researchers in the UK steadily increased between 2011 and 2016  
Comment: 9.a.1, 9.b.1 and 9.c.1 missing  
[9.a.1] ‘Total official international support (ODA plus other official flows) to infrastructure’  
ONS NRP reports Net ODA between 2010 and 2015 in the UK using DfID Statistics on International Development 2016  
[9.b.1] ‘Proportion of medium and high-tech industry value added in total value added’  
ONS NRP reports on % of total industry value added by different industries – see 9.3.1  
[9.c.1] ‘Proportion of population covered by a mobile network, by technology’  
ONS exploring data sources |
9.A Facilitate sustainable and resilient infrastructure development in developing countries through enhanced financial, technological and technical support to African countries, least developed countries, landlocked developing countries and small island developing States
Outside of the scope of the research

9.B Support domestic technology development, research and innovation in developing countries, including by ensuring a conducive policy environment for, inter alia, industrial diversification and value addition to commodities
Outside of the scope of the research

9.C Significantly increase access to information and communications technology and strive to provide universal and affordable access to the Internet in least developed countries by 2020
Outside of the scope of the research