Physics and the Economy: Measuring the value of physics-based industries in Northern Ireland

A Cebr report for the Institute of Physics

November 2021

Authorship and acknowledgements

This report has been produced by Cebr, an independent economics and business research consultancy established in 1992. The views expressed herein are those of the authors only and are based upon independent research by them.

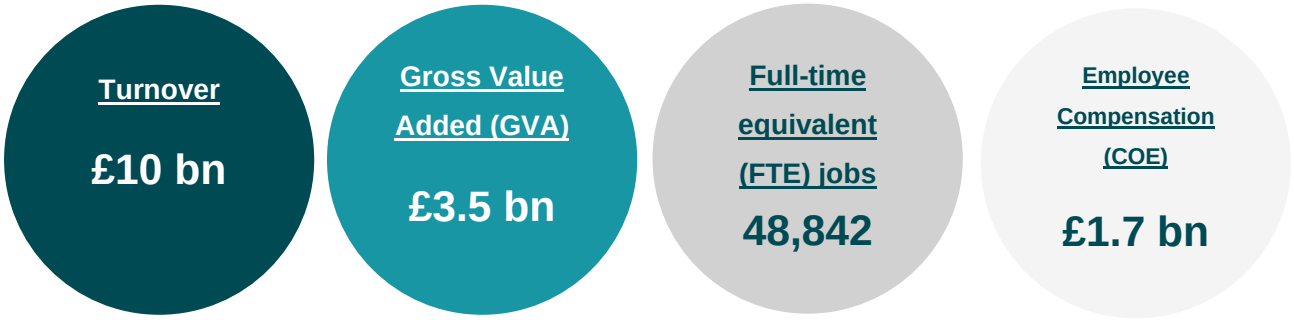
The report does not necessarily reflect the views of Institute of Physics.

London, November 2021

Contents

Headline findings

- This is a report by the Centre for Economics and Business Research (Cebr), on behalf of the Institute of Physics, detailing the **economic contribution of physics-based industries (PBIs) in Northern Ireland (NI), to the Northern Irish economy.**
- In the graphic below, we present the economic impact of the PBIs in NI in 2019, although our analysis also covers trends over the nine preceding years.
- In 2019, it is estimated that in NI, the PBIs directly contributed to the Northern Irish economy:



- Total GVA contributed by the PBIs in 2019 (£3.5 billion) represented 7.3% of total GDP in Northern Ireland.
- With respect to GVA, in 2019, the biggest PBI sub-sector was Physics Manufacturing, which contributed £1.6 billion in 2019, followed by Energy Production, Transmission & Distribution (£0.67 billion), Physics Science & Technology (£0.51 billion) and Telecoms (£0.4 billion).
- There were 5,285 PBI enterprises operating in Northern Ireland in 2019, which accounted for 7.1% of all enterprises in the nation. More than 90% of these are classified as micro enterprises with fewer than nine employees - a common trend across the UK economy (where 92% are micro enterprises). The number of enterprises increased by more than 70% in the period 2010-2019.
- The Physics Science & Technology sub-sector had the greatest number of enterprises among the PBI sector, with 2,555 enterprises in Northern Ireland (48% of all PBI firms in the region) in 2019.
- Throughout the decade, the turnover of PBIs increased by 59.5%, from £6.3 billion to £10.1 billion. The highest absolute growth was experienced by the Energy Production, Transmission & Distribution sector, whose turnover increased from £1.2 billion to £3.1 billion, an increase of 158.9%.
- The Defence sub-sector experienced a decline in turnover of 15.6% across the period, from £173 million to £146 million. This was consistent with wider trends for the sub-sector across the UK.

- Employment broadly increased over the period 2010-2019, with 48,842 FTE employees in Northern Ireland's PBIs in 2019. This represents 6.8% of total FTE employment nationally in Northern Ireland.
- Over the period, growth in labour productivity was much higher in the PBIs (21.3%) than across the whole nation (4.5%). In 2010, PBI productivity was approximately £2,500 below the national average (less than £60,000 per FTE worker), but by 2019 PBI productivity was more than £6,000 above the national average, reaching almost £72,000.

1. Introduction

This report by the Centre for Economics and Business Research (Cebr) on behalf of the Institute of Physics (IOP), considers the contribution and importance of physics-based industries (PBIs) to the Northern Irish economy, an analysis that spans the period 2010 to 2019. This report forms part of a series of six reports, which quantify the impact of the PBIs on the UK and Irish economies.

1.1 Background and general purpose of the study

According to the IOP's definition, PBIs are those where either:

- Ongoing research and development (R&D) in the industry consistently makes use of physics knowledge (and the R&D activity can be expected to significantly affect the fortunes of businesses within the industry)

Or

- The underlying technology supporting the industry requires significant physics knowledge for continued operation.

In other words, PBIs can be thought of as those industries in which the industrial and technical activities associated with the industry require physics knowledge.

This research provides up-to-date insights on the size and performance of the UK and Irish PBI sector, presenting a range of analyses which demonstrate different aspects of the economic value brought by the PBIs. The intention of this is to empower the IOP with a thorough and comprehensive knowledge and evidence base, such that they can support and advocate for the sector across the UK and Ireland.

An important task has been to develop an in-depth understanding of PBIs. To produce a robust study, it is necessary to analyse the available data to ensure that it captures the full range of activities that should be included in establishing the total economic 'footprint' of the industry. Following the collation of the necessary data capturing these activities, the values of key economic indicators were established to demonstrate the impact of the sector. The key macroeconomic indicators include:

- GVA[1] contributions to Northern Ireland and constituent regional GDP generated by the PBIs
- Full-time equivalent (FTE) jobs supported by the sector[2]

1 GVA, or gross value added, is a measure of the value of production in the national accounts. Conceptually it can be considered the value of what is produced, less the value of intermediate goods and services used to produce it. GVA is distributed in three directions – to employees, to shareholders and to government. It is often used as the proxy for the contribution of a sector or industry to GDP: strictly this relationship is GVA + Taxes on products - Subsidies on products = GDP.

2 The calculation of full-time equivalent (FTE) is an employee's scheduled hours divided by the employer's hours for a full-time workweek. When an employer has a 40-hour workweek, employees who are scheduled to work 40 hours per week are 1.0 FTEs. Employees scheduled to work 20 hours per week are 0.5 FTEs. We considered all part-time workers to work 20 hours per week. Lastly, we subtracted the number of employees from the number of employment in order to get the number of self-employed individuals.

- The value of the turnover of the PBIs
- The value of employee compensation[3] generated by PBIs, representing the total remuneration of employees operating in the sector
- The productivity of the PBIs
- The number of PBI businesses operating in Northern Ireland.

In addition to the core modelling and analysis, we also undertake a range of comparisons to contextualise the findings, including:

- How the economic indicators vary over the period 2010-2019
- How the economic indicators vary across different categories or groupings of the PBIs
- How the economic indicators for the PBIs vary between the UK nations
- How the indicators for the PBIs compare with other important sectors of the Northern Irish economy.

Mapping Northern Irish PBIs

Here, we set out how PBIs have been defined for the purposes of the study. The PBIs consist of over 120 four and five-digit SIC codes, in which ongoing R&D in the industry consistently makes use of physics knowledge, or the underlying technology supporting the industry requires significant physics knowledge for continued operation. The full list of SIC codes used within this study can be found in Appendix I**: SIC-based definition of PBIs and sectoral alignment**.

For the purpose of this report, these SIC codes are then aggregated into 11 sub-sectors.[4] These are:

- Oil & Gas Extraction
- Physics Manufacturing
- Physics Machine Services
- Energy Production, Transmission & Distribution
- Physics Waste & Recovery
- Physics Machine Sales
- Medical Equipment Sales
- Space Transport & Air Transport Services
- Telecoms
- Physics Science & Technology
- Defence

3 Compensation of employees (COE) or employee compensation, is the total remuneration, in cash or in kind, payable by an employer to an employee in return for work done by the latter. This consists of wages paid to employees; employers' actual social contributions (excluding apprentices); employers' imputed social contributions (excluding apprentices); and employers' social contributions for apprentices.

4 In order to visualise the data better, and avoid some volatility, we aggregated several of these smaller sub-sectors into an 'Other' category. 'Other' consists of: Oil & Gas Extraction; Physics Machine Services; Physics Waste & Recovery; Physics Machine Sales; Medical Equipment Sales; Space Transport and Air Transport Services; and Defence

1.2 Earlier research

The IOP previously commissioned Cebr in 2016 to produce studies focused on measuring the impact of the PBIs to the UK and to the Irish economies.

In this suite of six reports, we go beyond the 2016 research to present a range of new materials, including assessment of:

- How the full range of economic indicators for the PBIs vary across the UK nations and English regions, as well as the Republic of Ireland
- How the economic indicators for the PBIs vary between the UK and Ireland and other comparable countries
- How the indicators for the PBIs compare with other important sectors in the UK and Ireland (such as Construction or Transportation & Storage), and how they are broken down by the UK's constituent nations and regions.

In addition, the definition of the PBIs has been updated since the 2016 research; therefore, figures between reports in the two series are not directly comparable.

This report focuses on Northern Ireland specifically.

2. Enterprises in the Northern Irish PBIs

This section provides an assessment of the importance of PBIs to Northern Ireland in terms of turnover and business demographics, over the period 2010-2019.

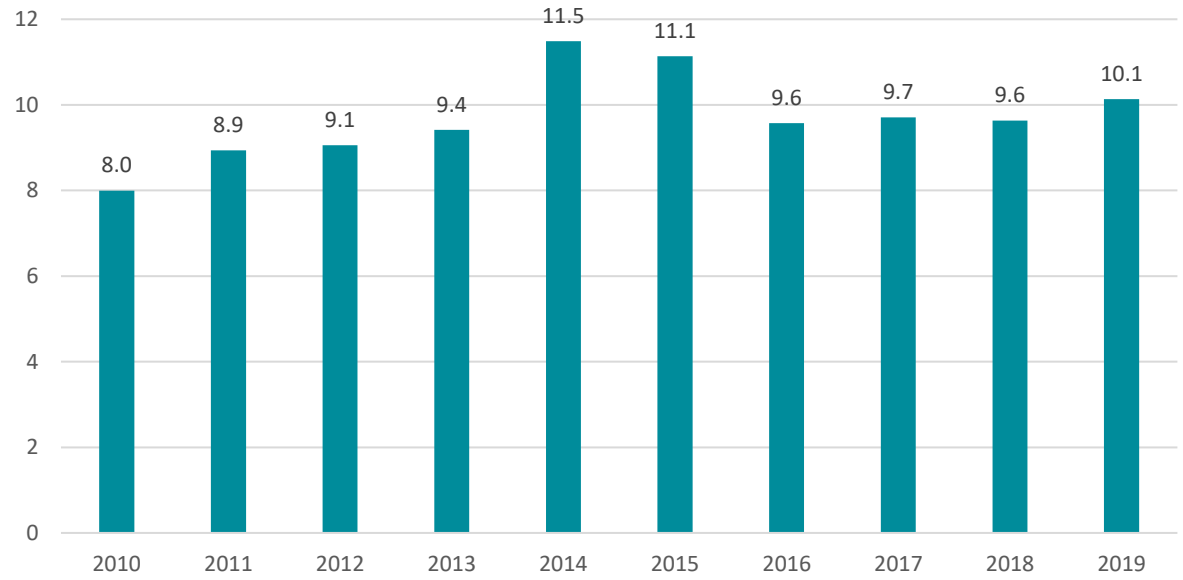
2.1 Turnover

We firstly present the contribution of PBIs to the Northern Irish economy in terms of the turnover generated by those industries. Figure 1 shows that Northern Ireland's physics-based economic activities generated £10.1 billion in turnover during 2019, an increase of 26.8% from £8 billion in 2010. The nation's contribution to the UK turnover remained stable, at 1.6%, with a peak of 2.0% in 2014 and 2015.

In 2014, the total turnover generated by PBIs increased significantly, but this period of growth was followed by a decline in turnover. There was a period of contraction between 2014 and 2017, driven by turnover decline in the Physics Manufacturing, Energy Production, Transmission & Distribution and Defence sub-sectors over these years. In all other years, turnover increased and never fell below the 2010 value (£8 billion).

The PBI sector in Northern Ireland had an average yearly turnover increase of 3.1%, which is 0.7% higher than the average UK-wide PBI sector yearly turnover rise of 2.4%. This difference is largely driven by growth in Northern Ireland's Physics Manufacturing sub-sector, which increased by almost 29.9%, compared to 27.4% in the UK. Furthermore, it can be explained by significant turnover declines in the Oil & Gas Extraction sub-sector, which constitutes a much larger share of total turnover in Scotland (and therefore also the UK), than in Northern Ireland.

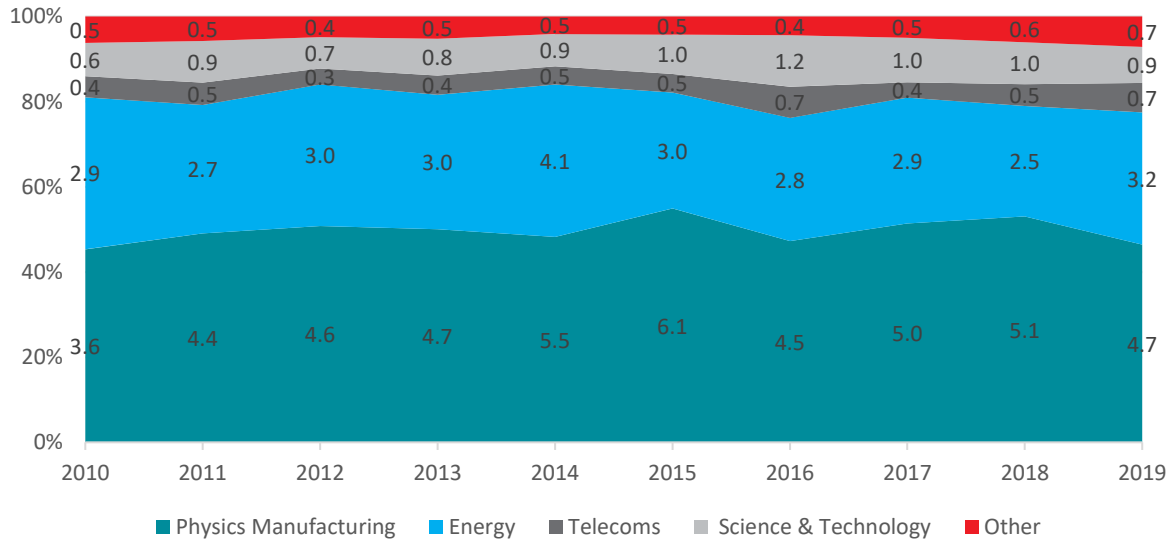
Figure 1: Turnover in PBIs in Northern Ireland, £ billions, 2010-2019



Source: ABS, Cebr analysis

Figure 2 presents a breakdown of the turnover generated by Northern Irish PBIs by sub-sector.[5] Their share remained reasonably constant during 2010-2019. Those PBIs that are engaged in manufacturing occupied the largest share, averaging 49.6% across the period, followed by those engaged in energy activities, accounting for approximately 30.9%. This share was much higher than in the UK overall, where the sub-sector provided 17.3% of the PBI turnover on average.[6] In the 'Other' sector (i.e. all those listed in Section 1.2 not explicitly covered in the graph), the share of Northern Irish PBI-related turnover fluctuated between 4.1% and 7.1%, because the turnover rates of Defence, Physics Machine Sales and Physics Waste & Removals sectors were volatile over this period.

Figure 2: Turnover in the different sub-sectors of the PBIs in Northern Ireland, % of PBI total (LHS axis) and monetary value (£ billions), 2010-2019



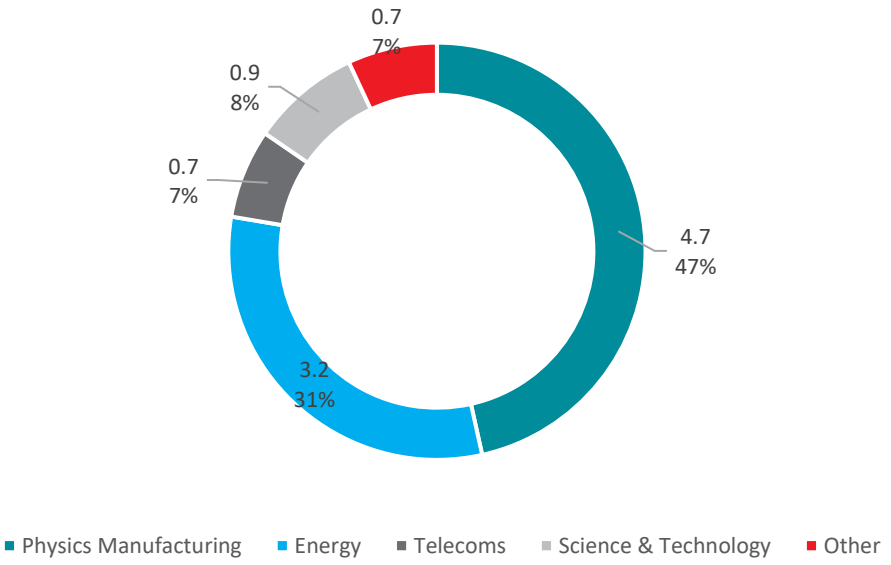
Source: ABS, Cebr analysis

Figure 3 below visualises the breakdown of turnover in 2019.

5 See Table 10 in Appendix II: Supplementary figures and tables for a full breakdown of the contribution to total turnover by Northern Irish PBIs, disaggregated by all industries.

6 The single-year spike in turnover in the Energy sub-sector in 2014 is interesting and has several causes within our modelling. Firstly, turnover in the largest industry within this, SIC 35.13 (the distribution of electricity), across the UK increased slightly. Within this industry, employment per the BRES dataset (which is used primarily to distribute impacts at a national/regional level) in the largest nation, England, decreases slightly, suggesting the activity attributable to other nations increases. While we do not have BRES data for Northern Ireland, regional ABS data for Northern Ireland for the wider SIC 35, suggests turnover increases in the broader industry group (albeit not to the same extent as modelled here). The compounding impact of these is a relatively significant single-year spike in turnover, although as this is modelled rather than hard data, it is difficult to be fully confident in the exact magnitude of this.

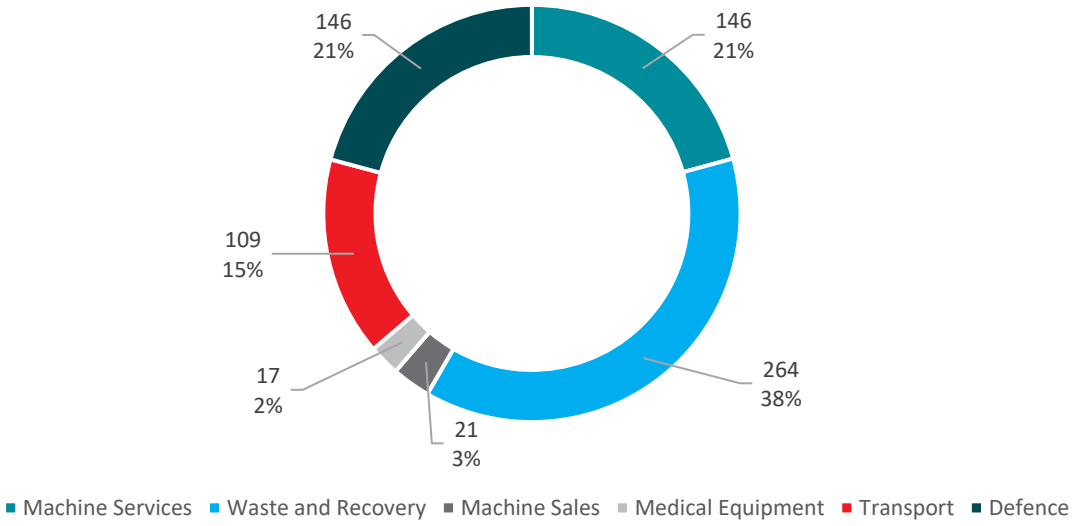
Figure 3: Turnover in the different categories of PBIs in Northern Ireland, £ billions, 2019



Source: ABS, Cebr analysis

Figure 4 below shows the full breakdown of the industries included within the 'Other' category.

Figure 4: Breakdown by turnover of industries included within 'Other', £ millions, 2019



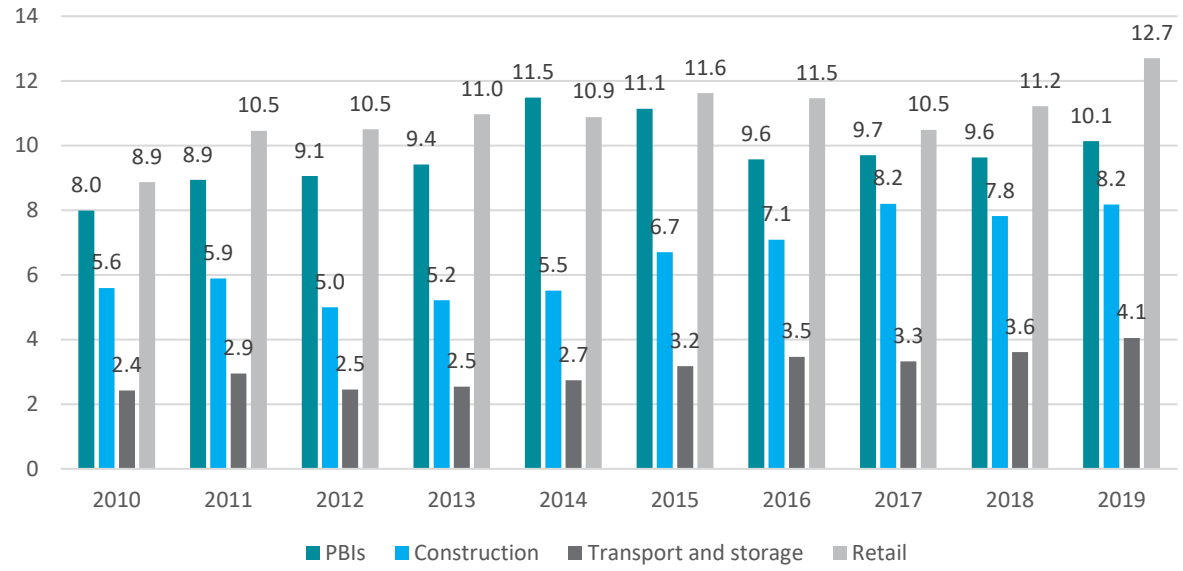
Source: ABS, Cebr analysis

Industry comparison

Figure 5 compares the turnover generated by the Northern Irish PBI sector with a selection of sectors across 2010 to 2019. The turnover of the PBIs has been compared to the turnover of three other significant sectors of the Northern Irish economy: Construction (SIC F),

Transportation & Storage (SIC H), and Retail (SIC 47).[7] The turnover generated by PBI enterprises is more than double the values of Transport & Storage over the decade. However, Retail has the highest absolute growth amongst all the sectors, and Transport & Storage has the highest growth rate of 66.8% over the period. Northern Ireland is the only UK nation where the PBI turnover does not outweigh the comparators vastly. This can be accounted for by the fact that the relative economic contribution of the PBIs in Northern Ireland is slightly lower than for the other UK nations, discussed further in Section 3.1.

Figure 5: Turnover comparison for selected sectors of the Northern Irish economy, £ billions, 2010-2019



Source: ABS, Cebr analysis

When compared to the UK as a whole, the Northern Irish PBI sector is a smaller contributor in relative terms to the NI economy than these three other sectors, and this is constant during the 2010-2019 period. The ratio of turnover generated in Northern Ireland by PBIs to the sum of the three other sectors is 0.46 on average during the period, compared to 0.76 for the UK as a whole. This means that for every £1 these three sectors produce combined, the PBIs produce £0.46 in Northern Ireland, compared to £0.76 across the UK.

2.2 Business demography

Business count[8]

The PBIs experienced a steady upward trend in terms of the number of enterprises operating in relevant fields between the period 2010-2019. In 2010, there had been an estimated 3,755 businesses counted, which increased to 5,285 by 2019. This accounted for 7.1% of all enterprises in Northern Ireland, which is much smaller than the UK average of 12.9%. This also made up 1.5% of all PBI enterprises in the UK, which is broadly consistent with the other

7 These sectors are selected for comparison, as three of the larger SIC sections which do not already have significant overlap with the PBIs.

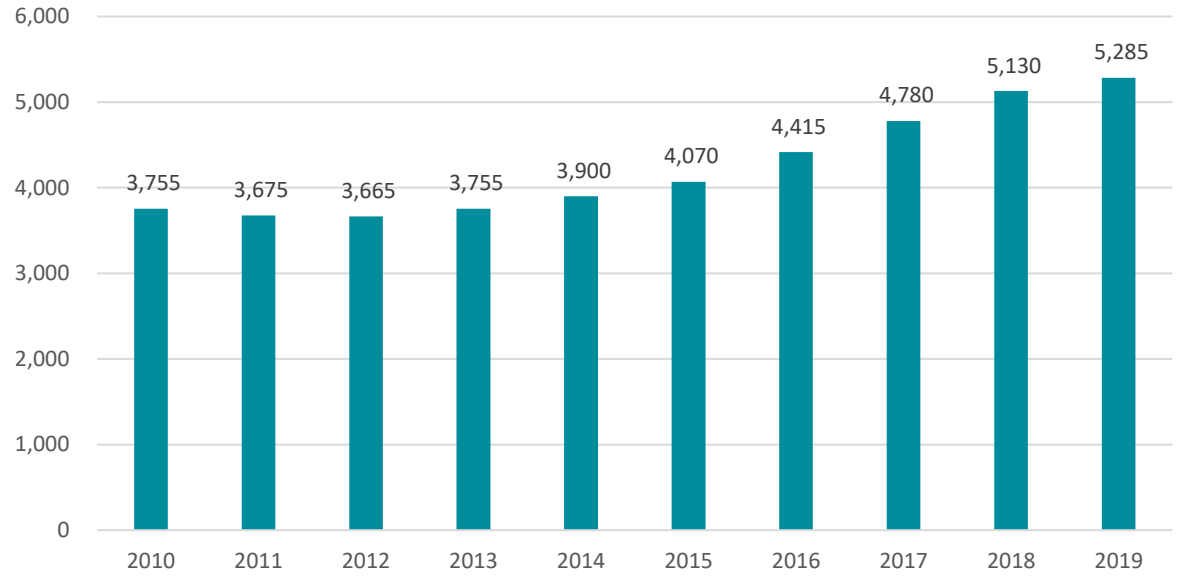
8 Due to a lack of data, we didn't include the Defence sector in the business demography analysis. SIC 84.22 Is dominated by a few very large companies, therefore omitting it doesn't alter the data on a significant level.

metrics analysed in the report. The greatest change was seen in 2015, when the number increased from 4,070 to 4,415 (8.4% increase).

Prior to 2013, growth in the number of enterprises was relatively low, but it accelerated by the middle of the decade. The period of 2015 to 2019 witnessed much stronger growth, due to the number of Physics Science & Technology enterprises increasing significantly, with the largest increase happening in 2016, of 8.4% from 2015.

Interestingly, the growth in enterprise numbers over the second half of the decade is not reflected (yet) in increasing economic performance; for example, average business turnover actually declined slightly over the same period, from £2.1 million to £1.9 million. As a potential explanation, this growth in enterprises in the Physics Science & Technology sub-sector is primarily driven by increased numbers of micro enterprises. As will be seen further in this section, the significant majority (94.7% in 2019) of Physics Science & Technology enterprises are micro enterprises, employing nine or fewer people. Whilst the growth in small businesses has not yet been reflected in increasing economic performance, this could be promising for future growth (withstanding the impacts of the Covid-19 pandemic), if these businesses are able to grow in the future.

Figure 6: Number of physics-based businesses in Northern Ireland, 2010-2019

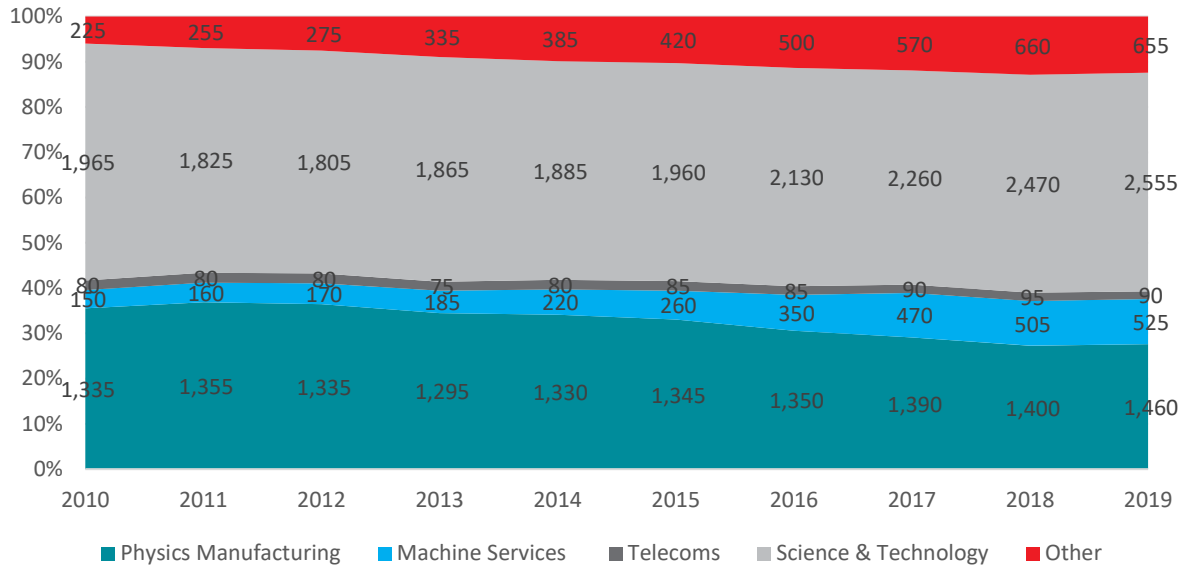


Source: Nomis, Cebr analysis

Figure 7[9] below shows the composition of the number of PBI enterprises in Northern Ireland from 2010 to 2019. It is clear that the Physics Science & Technology sub-sector heavily dominated the sector. On average, this sub-sector contributed 48.9% of all physics-related enterprises, and this ratio peaked in 2010 with 52.3%. This is a UK-wide phenomenon, as this sub-sector is heavily micro-oriented.

9 Here we included the Energy sector in the 'Other' category, as it had few enterprises present.

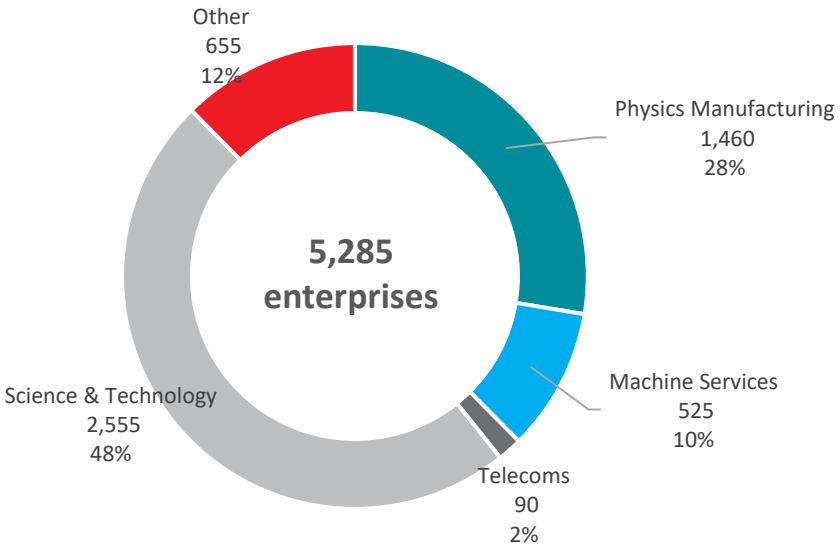
Figure 7: Number of enterprises in selected PBIs in Northern Ireland, % of PBI total (LHS axis) and value (quantity), 2010-2019



Source: Nomis, Cebr analysis

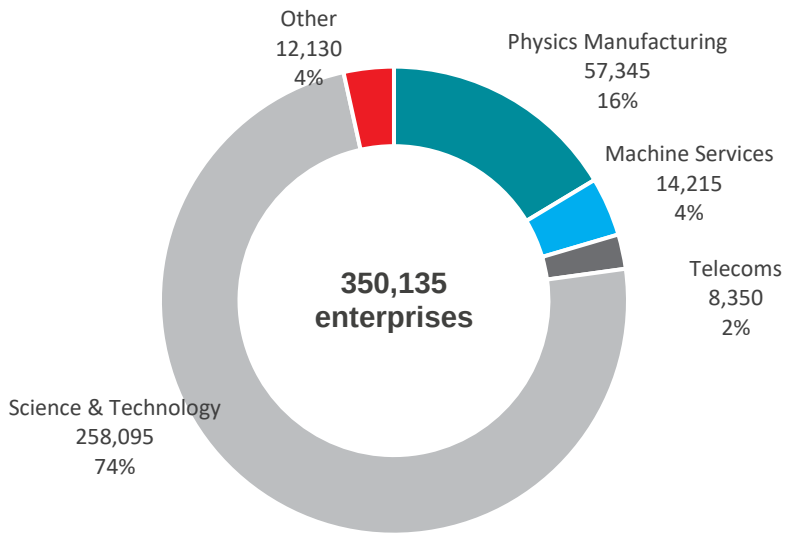
Figure 8 visualises the division of the sub-sectors for 2019 in Northern Ireland, while Figure 9 visualises the division of the sectors for 2019 across the whole of the UK, and for both, Physics Science & Technology is the dominant sub-sector across the decade. In 2019, however, this industry was underrepresented in Northern Ireland compared to the rest of the UK (48% compared to 74%), while the share of Machine Services enterprises in Northern Ireland was higher than in the UK (10% compared to 4%). The biggest sub-sector in terms of turnover and GVA, Physics Manufacturing, accounted for 27.6% of enterprises in Northern Ireland in 2019, which declined from 35.5% over the period.

Figure 8: Division of enterprises in PBIs in Northern Ireland, 2019



Source: Nomis, Cebr analysis

Figure 9: Division of enterprises across all UK PBIs, 2019

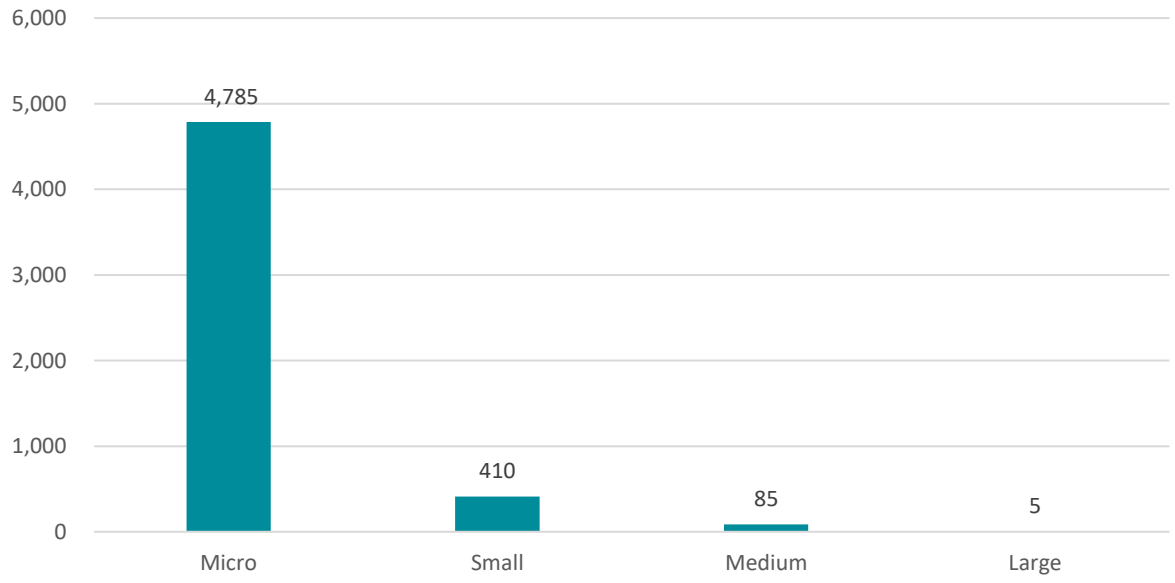


Source: Nomis, Cebr analysis

Size of businesses

Micro companies are considered as enterprises which employ a maximum of nine people. In 2019, PBIs in Northern Ireland were dominated by these micro enterprises, where 90.5% (4,785) of all PBIs fell into this category, which is similar to the other UK nations. This also broadly aligns with the UK shares of PBI enterprise sizes, as 92.0% were micro, 6.6% were small, and 1.4% were medium or large. Figure 10 shows the composition of micro (0-9 employees), small (10-49), medium (50-249) and large (250+) enterprises in Northern Ireland for 2019.

Figure 10: Number of businesses in PBIs, distinguished between size, 2019



Source: Nomis, Cebr analysis

Table 1 presents a division of enterprises in Northern Ireland for selected PBIs, distinguished by size for 2019. In the Medical Equipment Sales sub-sector (included within 'Other' in the table), 100% of businesses within Northern Ireland were considered micro enterprises in 2019. The Space Transport & Air Transport Services sub-sector (also included in 'Other') had the smallest proportion of micro enterprises, at 50%. In Northern Ireland, 230 out of 410 (56%) small enterprises were found in the Physics Science & Technology sub-sector. In 2019, there were 85 'medium' sized enterprises in Northern Irish PBIs, of which the Physics Manufacturing sub-sector accounted for the greatest share (64%). Physics Manufacturing was the only sub-sector to have 'large' PBI enterprises in Northern Ireland in 2019.[10]

Table 1: Division of businesses in Northern Ireland for selected PBIs, distinguished between size, 2019

Sub-sector	Micro	Small	Medium	Large
Physics Manufacturing	1,170	230	55	5
Physics Machine Services	505	15	5	0
Telecoms	85	5	0	0
Physics Science & Technology	2,420	120	15	0
Other	605	40	10	0
Total	**4,785**	**410**	**85**	**5**

Source: ONS, Cebr analysis

The trend of enterprises in the Physics Manufacturing sub-sector being relatively larger explains why this sub-sector consistently generates the most turnover within the PBIs, despite having fewer enterprises than the Science and Technology sub-sector. This can perhaps be explained by the strong economies of scale associated with manufacturing, where there are inherently competitive advantages associated with being a larger firm, with more scalable operations, relative to Physics Science & Technology enterprises.

10 The data is retrieved from Nomis/ONS, with data rounded to the nearest five. There is a possibility of one or two businesses rounded to zero, from some of the other sectors.

3. Economic contribution of the PBIs to Northern Irish economy

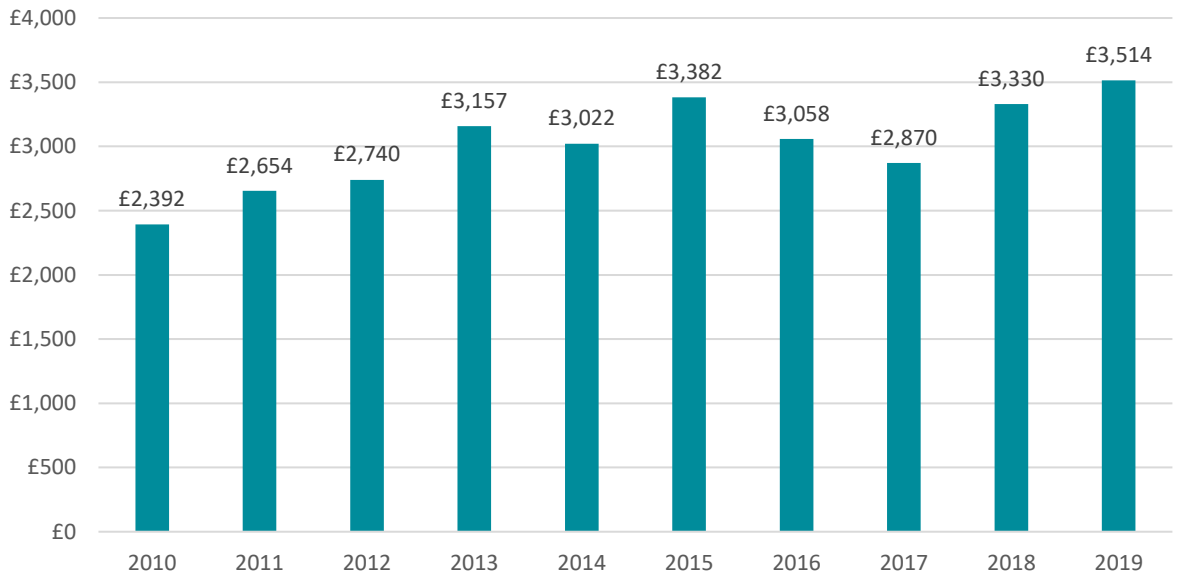
This section provides an assessment of the economic contribution of PBIs to Northern Ireland in terms of employment, GVA and COE over the period 2010-2019.

3.1 Gross value added (GVA)

We now focus on the economic contribution of the PBIs to the Northern Irish economy in terms of their GVA contributions to GDP. We present our estimates of the Northern Irish PBIs' GVA contributions to GDP in Figure 11. The latest data suggests a £3.5 billion GVA contribution in 2019. Regarding the share of Northern Irish GDP attributable to PBIs, we estimate that this sector accounts for approximately 7.3% of output, compared to 10.6% on average across the UK. Northern Ireland's share of the overall PBI GVA in the UK slightly increased over the period, from 1.3% to 1.5%.

The weakest year in terms of growth was 2016, when GVA reduced by 9.5% compared to the year before. The causes of this 2016 decline are drops in COE for the Physics Manufacturing sub-sector (£258 million decline). Physics Manufacturing also displays a GVA drop of £424 million in 2016, however it recovered to a large extent in 2018, increasing by £311 million from 2017.

Figure 11: GVA in PBIs in Northern Ireland, £ millions, 2010-2019

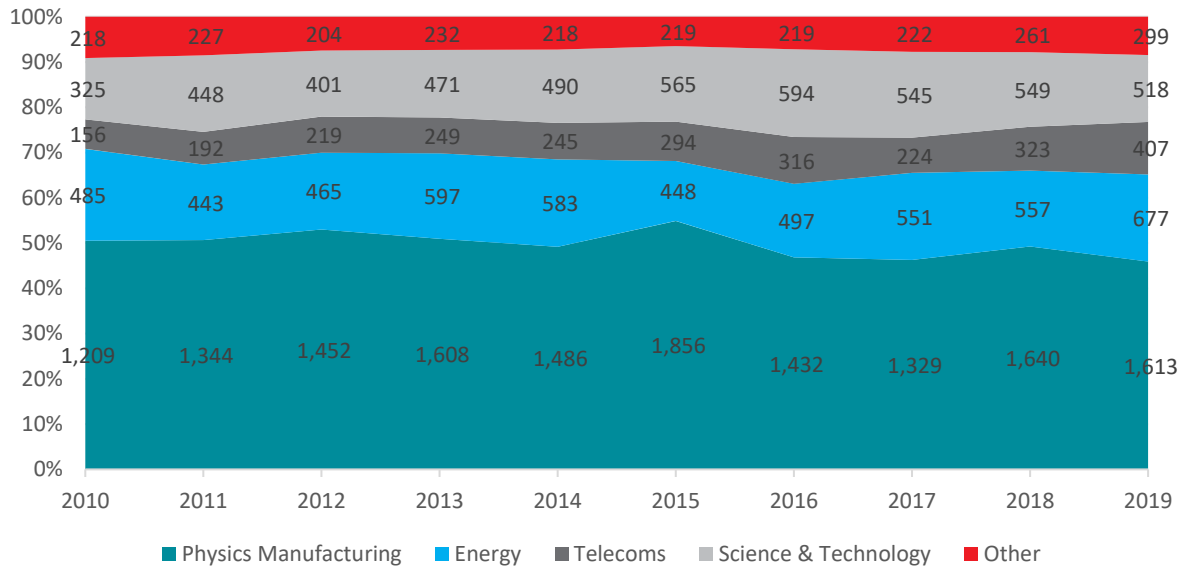


Source: ABS, Cebr analysis

Annual nominal growth of PBIs in Northern Ireland averaged 4.7% between 2010 and 2019, but was strongest in 2018, at 15.9%. This growth rate is very strong, relative to the wider growth of the PBIs across the UK (2.1% annually over the same period). Therefore, while the share of national GVA contributed by the PBIs in Northern Ireland is lower than the other UK nations, the PBIs in Northern Ireland have been 'catching up' over the decade. The greatest contributor to this was the strong growth in the Physics Manufacturing sub-sector in Northern Ireland. The GVA generated by this sub-sector grew by 33.4% over the period, compared to 18.0% on average across the UK.

Physics Manufacturing accounted for the largest share of Northern Irish PBIs' GVA contribution, as illustrated in Figure 12, contributing on average 49.6% of Northern Ireland's annual physics-based GVA over the period 2010-2019. The next largest contributor is the Energy Production, Transmission & Distribution sub-sector, which also contributes a significant share of Northern Irish PBIs (approximately 17.6% of the total PBI sector). For a detailed breakdown of the industry GVA contributions, please see Table 13 in Appendix II: Supplementary figures and tables.

Figure 12: GVA in selected PBIs in Northern Ireland, % of PBI total (LHS axis) and monetary value (£ millions), 2010-2019



Source: ABS, Cebr analysis

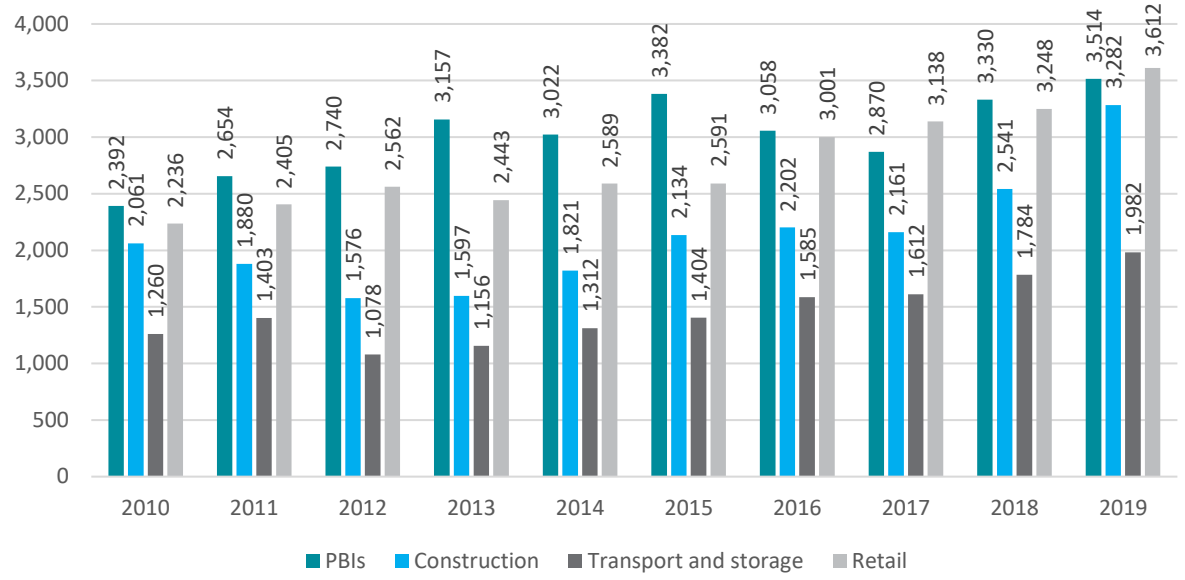
We note the significantly smaller range in the GVA contributions of these categories of PBIs than was observed for turnover. Using figures taken for 2019, this is driven by a relatively high rate of GVA generated per pound of turnover in the small (relative to Physics Manufacturing) Physics Science & Technology industry (£0.60), compared to the overall average of £0.35 of GVA generated per pound of turnover. This sub-sector has the highest GVA contribution per pound of turnover.

Industry Comparison

In line with the previous comparisons between the PBI sector and other major sectors in Northern Ireland regarding turnover, PBIs' contribution to annual GVA has been high and close to the Retail and Construction sectors (see Figure 13). In 2019, the PBI sector contributed £3.5 billion in GVA to the Northern Irish economy, close to the £3.6 billion contributed from Retail, the £3.2 billion from Construction, and the £1.9 billion from Transport & Storage.

In terms of the rate of GVA contributed per pound of turnover, PBIs did not perform as well as some of the other comparators. The average rate of GVA contributed per pound of turnover was £0.31 over 2010 to 2019 for PBIs. This was higher than in Retail (£0.25), however both the Construction and Transport & Storage sectors display higher rates of GVA per pound of turnover than PBIs, averaging £0.33 and £0.47 across the period, respectively.

Figure 13 : GVA in selected Northern Ireland sectors, 2010-19, £ millions



Source: ABS, Cebr analysis

3.2 Employment

Cebr's estimates suggest that FTE employment in the PBIs in the UK topped more than 2.7 million in 2019 and amounted to a 10% share of total UK employment. For Northern Ireland specifically, an estimated 48,842 FTEs were employed in 2019, accounting for a 6.8% share of total employment in Northern Ireland.

Compared to the rest of the UK and the other three home nations, the PBIs in Northern Ireland supported a relatively low share of total employment: in both Scotland and Wales the PBIs generated 9.8% of total FTE employment. Employment growth in Northern Irish PBIs averaged 2.7% annually between 2010 and 2019, increasing from 40,335 in 2010, to 48,842 in 2019.

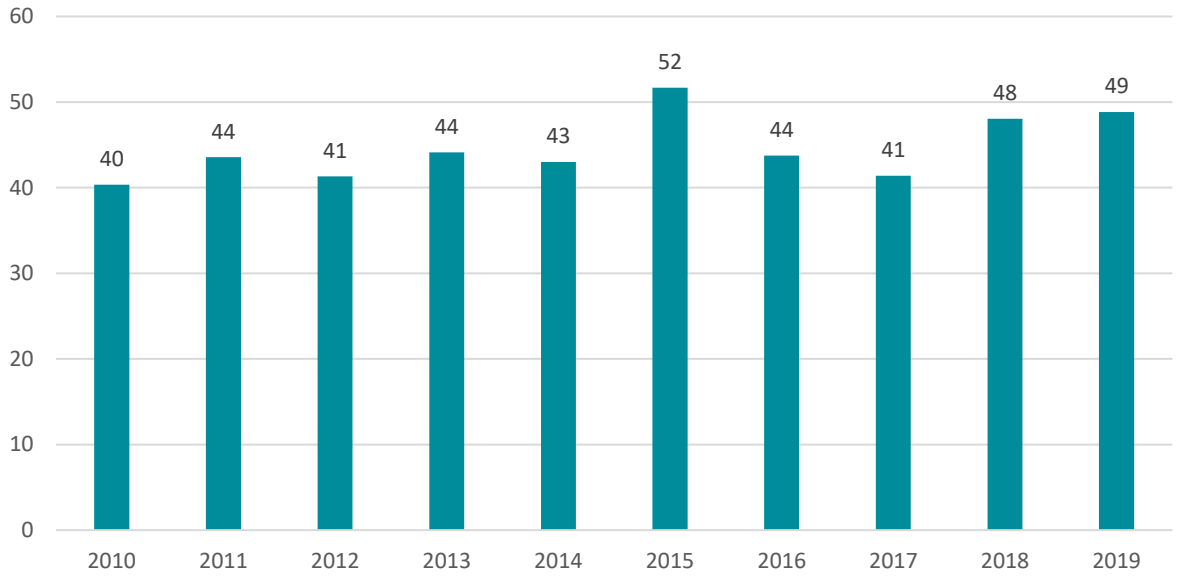
Just as we have seen with turnover and GVA, Northern Ireland's share of UK PBI employment also increase very slightly, from 1.7% in 2010 to 1.8% in 2019. Relative to the UK average PBI employment growth of 13.2%, Northern Ireland outperformed this at 21.1%.

Employment growth in Northern Irish PBIs fluctuated over the period 2010 to 2017 and increased across 2018 and 2019, with an average year-on-year growth rate of 2.7% between 2010 and 2019. The highest peak was in 2015 at 51,600 FTE jobs The cause of the following diminishing trend is predominantly declining employment in the Physics Manufacturing and Telecoms sub-sectors, which showed net decreases of approximately 9,300 and 734 respectively between 2015 and 2017.[11]

11 The decrease in the Physics Manufacturing sub-sector in 2016 was largely attributable to SIC 30 (Manufacture of other transport equipment). Regional ABS data for Northern Ireland showed that this sector dropped its turnover and GVA value to 0 from 2016 onwards, from £1.2bn of turnover and £354 million of GVA respectively in 2015. Per ABS data, activity in SIC 30 in Northern Ireland never recovered. Driven by this, our modelling suggests 5,500 FTE jobs were lost. If this had been a one-time drop which then recovered back to a similar value as before, we would have assumed the average of the years before and after. However, since here many years had a missing value, while we do slightly question the underlying data, there was not sufficient justificiation to significantly adjust trends driven by this.

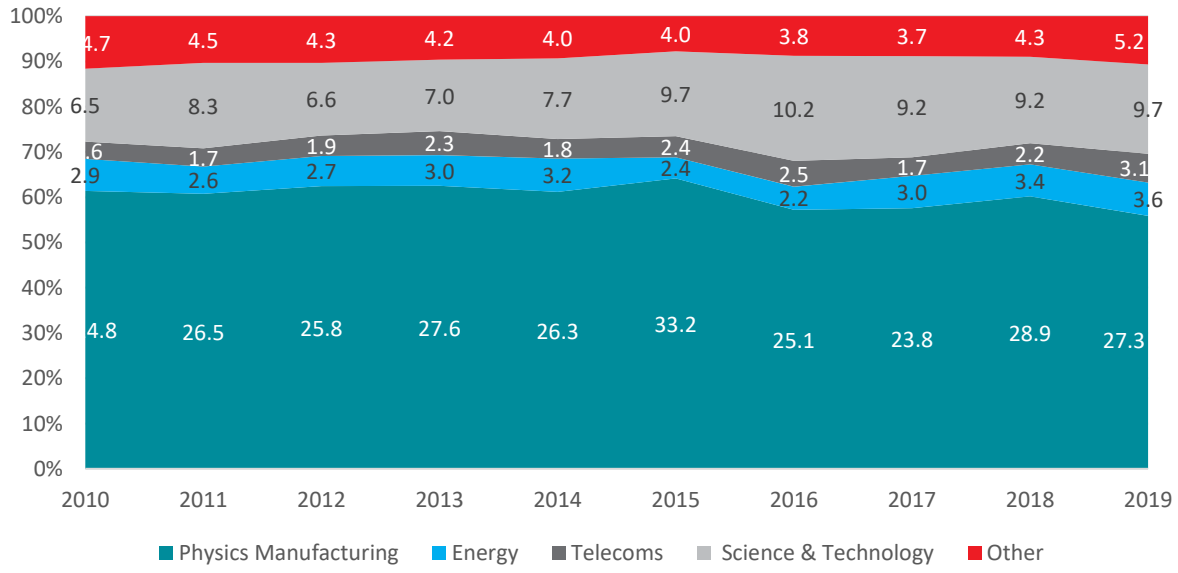
Large shares of employment in the physics-based industries are accounted for by Physics Manufacturing activities and Physics Science & Technology (55.9% and 19.8% recorded in 2019, respectively).

Figure 14: Physics-based employment in Northern Ireland, FTEs, 2010-19



Source: ABS, BRES, Cebr analysis

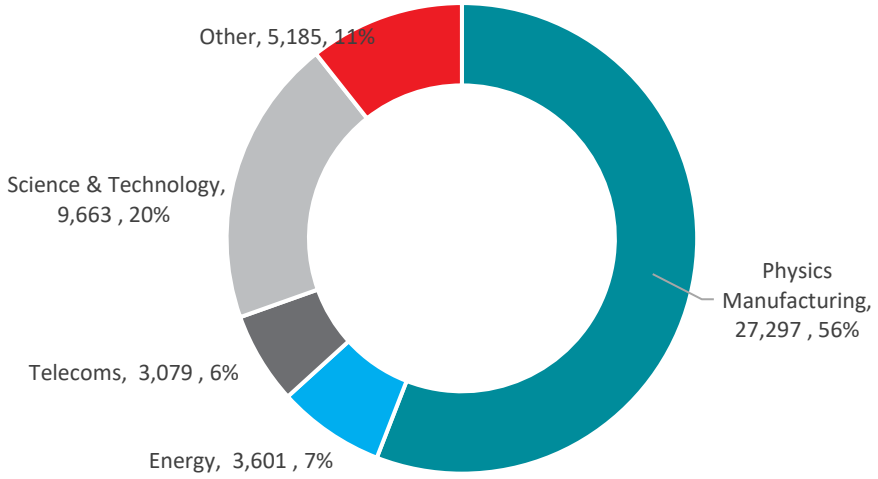
Figure 15: FTE employment in selected PBIs in Northern Ireland, % of PBI total (LHS axis) and value (thousands), 2010-2019



Source: ABS, BRES, Cebr analysis

Figure 16 shows the number and share of FTE employment across the most prominent sub-sectors for Northern Irish PBIs in 2019. See Table 14 in Appendix II: Supplementary figures and tables for a full breakdown of FTE employment estimates for all industries.

Figure 16: FTE employment across Northern Irish PBIs, FTE jobs and %, 2019

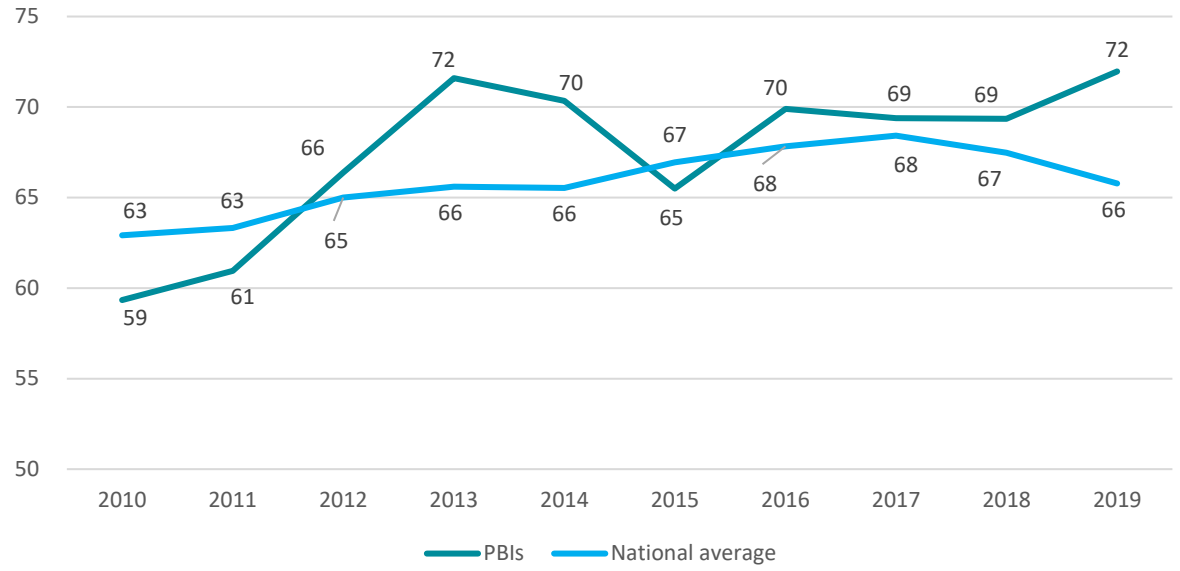


Source: BRES, Cebr analysis

Labour Productivity

Labour productivity is defined as annual GVA over the number of full-time equivalent workers in the same year, or output per worker per year. For the Northern Irish PBIs, Figure 17 shows the evolution of this metric over the period. It is a fluctuating trend, but over the whole 2010 to 2019 period, labour productivity increased by 21.3% from £59,340 to £71,966 There was a temporary spike in 2013 with labour productivity at £71,598 of GVA per worker. Compared to the productivity in Northern Ireland as a whole, where in 2010 PBIs were more than £2,500 below the national average, by 2019 the sector was above it by more than £6,000. The growth in labour productivity was much higher in the PBI sector (21.3%) than across the whole nation (4.5%).

Figure 17: Overall labour productivity for PBIs in Northern Ireland, compared to the national average, £ thousands, 2010-2019



Source: ABS, BRES, Annual Population Survey, Cebr analysis

Table 2 presents a comparison between the share of total FTE employment in Northern Irish PBIs for each sub-sector and the share of the total GVA that is contributed by that respective sub-sector. In 2019, we find that these shares are broadly proportional, except for four industries: Physics Manufacturing, Energy Production, Transmission & Distribution, Telecoms, and Physics Science & Technology. The Physics Manufacturing and Physics Science & Technology sub-sectors' employment shares were more pronounced than their GVA contributions, while in the Energy Production, Transmission & Distribution and Telecoms sub-sectors, contributions to the total GVA generated by Northern Irish PBIs were greater than their respective shares of FTE employment. This suggests that labour productivity – defined as GVA per FTE employee – is higher in the Energy Production, Transmission & Distribution and Telecoms sub-sectors than in the Physics Manufacturing and Physics Science & Technology industries.

Table 2: Comparison between the shares of GVA and FTE employment by Northern Irish PBIs, 2019

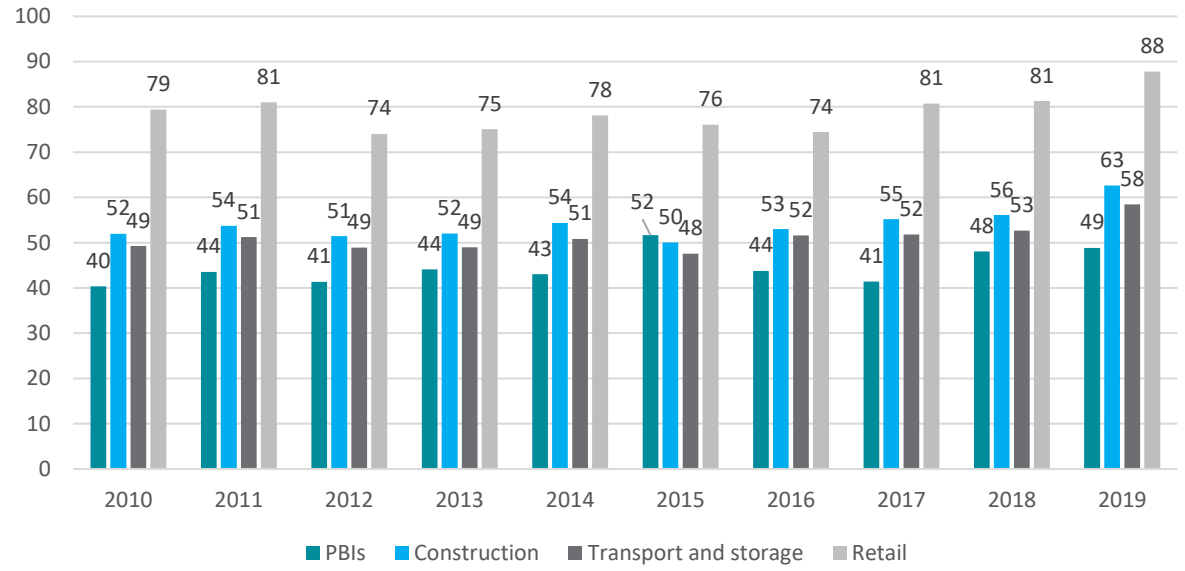
Sub-sector	Share of 2019 GVA	Share of 2019 employment
Oil & Gas Extraction	0.0%	0.0%
Physics Manufacturing	45.7%	55.9%
Physics Machine Services	1.7%	2.5%
Energy Production, Transmission & Distribution	19.2%	7.4%
Physics Waste & Recovery	1.5%	1.8%
Physics Machine Sales	0.3%	0.3%
Medical Equipment Sales	0.3%	0.5%
Space Transport & Air Transport Services	2.3%	1.5%
Telecoms	11.5%	6.3%
Physics Science & Technology	14.7%	19.8%
Defence	2.4%	4.0%

Source: ABS, BRES, Cebr analysis

Industry Comparison

When comparing the turnover and GVA contributions of the Northern Irish PBI sector with other sectors of the Northern Irish economy, Retail is the sector with the greatest share of employment, whilst the PBI sector accounts for the smallest share. Despite this, the relative trend of turnover and GVA suggests a higher level of labour productivity of the PBIs. For a similar share of Northern Irish employment, the PBIs generate a greater GVA contribution than the respective other sectors.

Figure 18: FTE employment comparison for selected sectors of the Northern Irish economy, thousands, 2010-2019



Source: ABS, BRES, Cebr analysis

In 2019, the PBI sector generated similar turnover and GVA than the Retail sector, but the Retail sector had 1.8 times more FTEs than PBI. Therefore, labour productivity (GVA per FTE) in the PBIs was much higher than the Retail sector, as illustrated by Table 3.

On average over the period, GVA per FTE was £67,470 in the PBIs, compared to £34,476 in Retail, £39,048 in Construction, and £28,353 in Transport & Storage.

Table 3: Comparison between GVA per FTE for selected sectors of the Northern Irish economy, £, 2010 - 2019

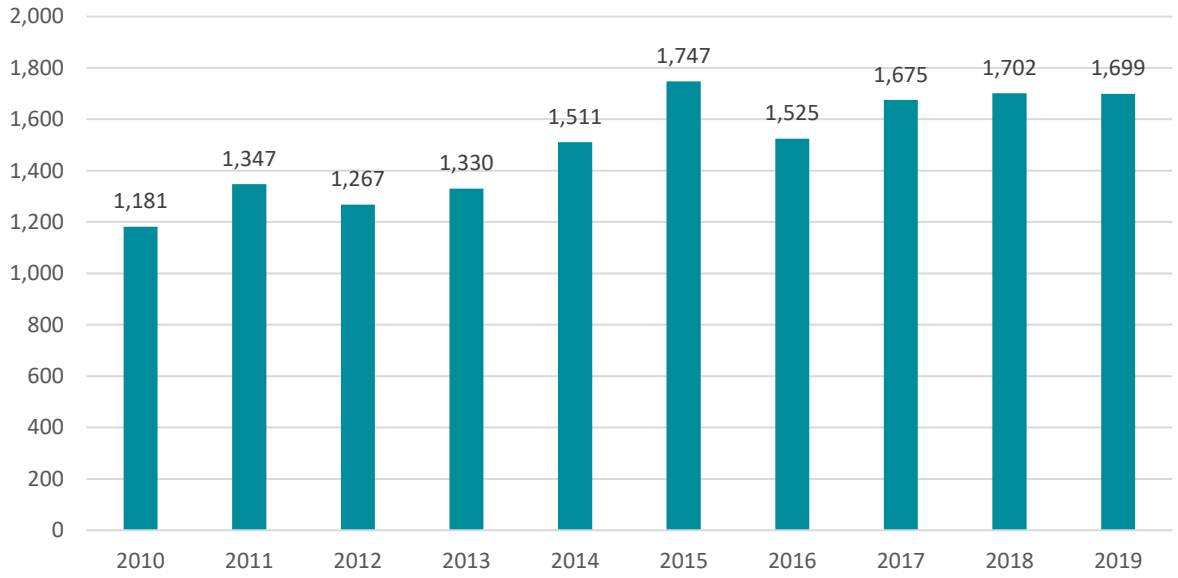
Year	PBIs	Construction	Transport & Storage	Retail
2010	59,340	39,660	25,570	28,173
2011	60,946	34,999	27,373	29,694
2012	66,382	30,613	22,026	32,547
2013	71,598	30,689	23,602	30,613
2014	70,334	33,493	25,801	31,342
2015	65,491	42,658	29,531	34,059
2016	69,897	41,546	30,709	38,386
2017	69,389	39,124	31,129	38,861
2018	69,356	45,300	33,864	39,958
2019	71,966	52,393	33,925	41,131

Source: ABS, BRES, Cebr analysis

3.3 Compensation of employees (COE)

Total employee compensation across Northern Irish PBIs was £1.7 billion in 2019. This COE value meant a 1.5% share of the total UK COE for PBIs, which is a 0.1 percentage point increase compared to 2010. Figure 19 presents the evolution of COE for Northern Irish PBIs over the period, with a peak in 2015 at £1.75 billion.

Figure 19: Physics-based COE in Northern Ireland, £ millions, 2010-19

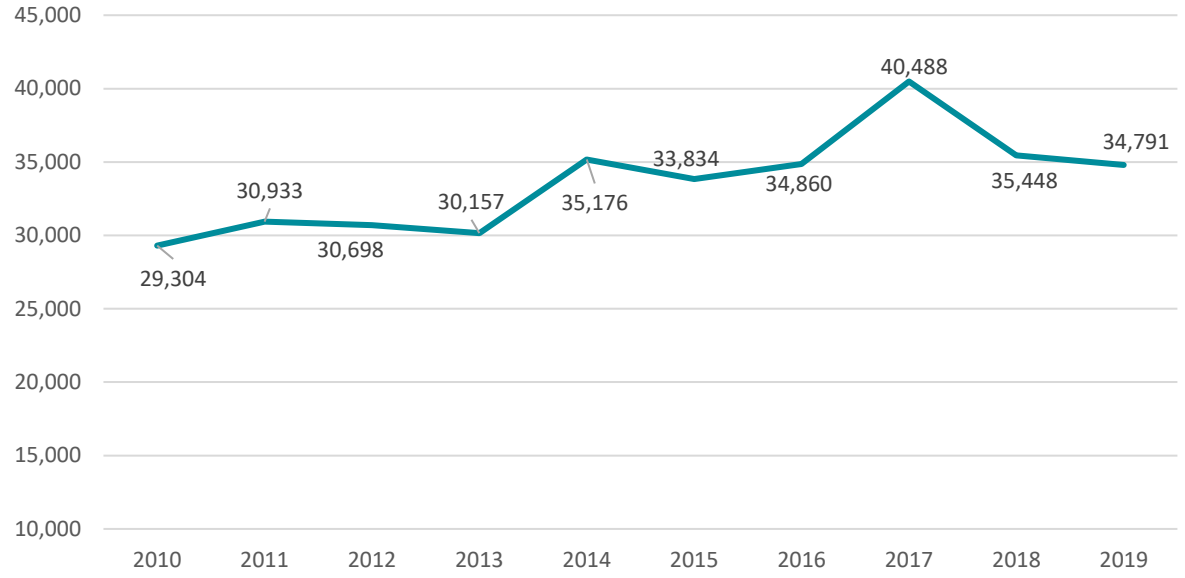


Source: ABS, BRES, Cebr analysis

Regarding the overall COE/FTE ratio for Northern Irish PBIs, there is an increasing trend over the period, rising from £29,304 in 2010 to £34,791 in 2019, with a peak in 2017 at £40,488. Over the entire period, COE/FTE increased by 18.7% in the PBIs, very similar to the 21.3% productivity growth observed. This suggests that the increased labour productivity has also been reflected by similarly increasing average wages.

In terms of sector specifics, COE/FTE in Telecoms rose (by 26.4%) significantly to £44,551 in 2019 from £35,228 in 2010, compared to COE/FTE in Physics Science & Technology, which rose by 1.98% over the same period.

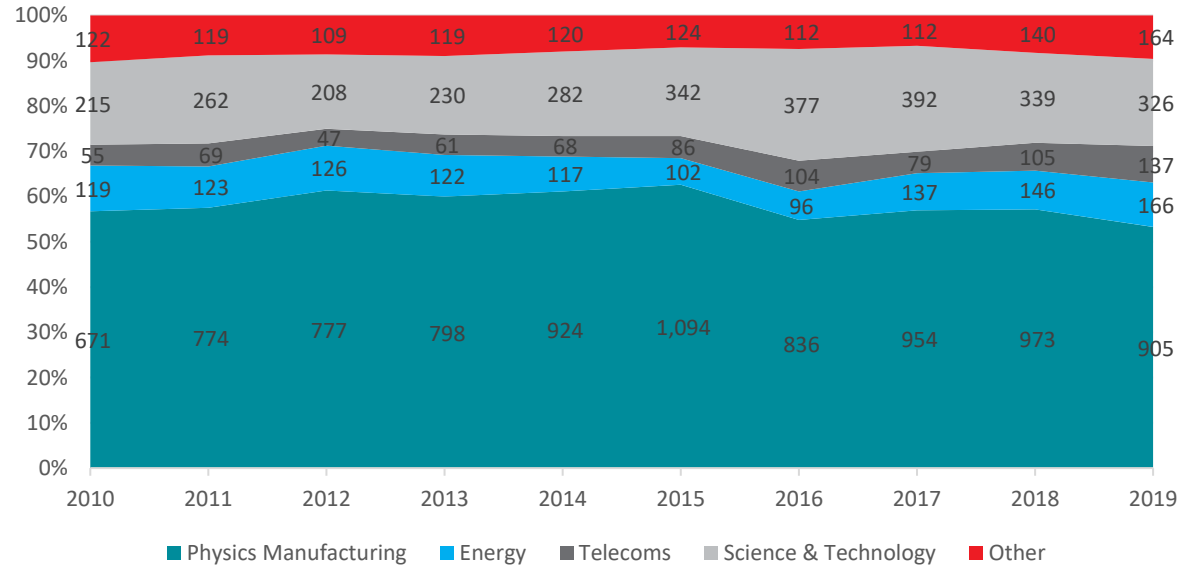
Figure 20: Average COE per FTE worker for PBIs in Northern Ireland, £, 2010 - 2019.



Source: ABS, BRES, Cebr analysis

In line with the other metrics, Physics Manufacturing accounted for the largest share of the total Northern Irish PBI COE, with 53.2% contributed by this sub-sector in 2019 (£905 million). The Physics Science & Technology sub-sector was the second largest, with a 19.1% share (£326 million), however this was down from a peak, both relatively and absolutely, in 2017 of 23.3% (£392 million). See Table 15 in Appendix II: Supplementary figures and tables for a full breakdown of COE across Northern Irish PBIs.

Figure 21: COE in selected PBIs in Northern Ireland, % of PBI total (LHS axis) and monetary value (£ millions), 2010-19



Source: ABS, BRES, Cebr analysis

Given the intuitive propensity for employment by sub-sector to drive these shares, we also present this comparison below.

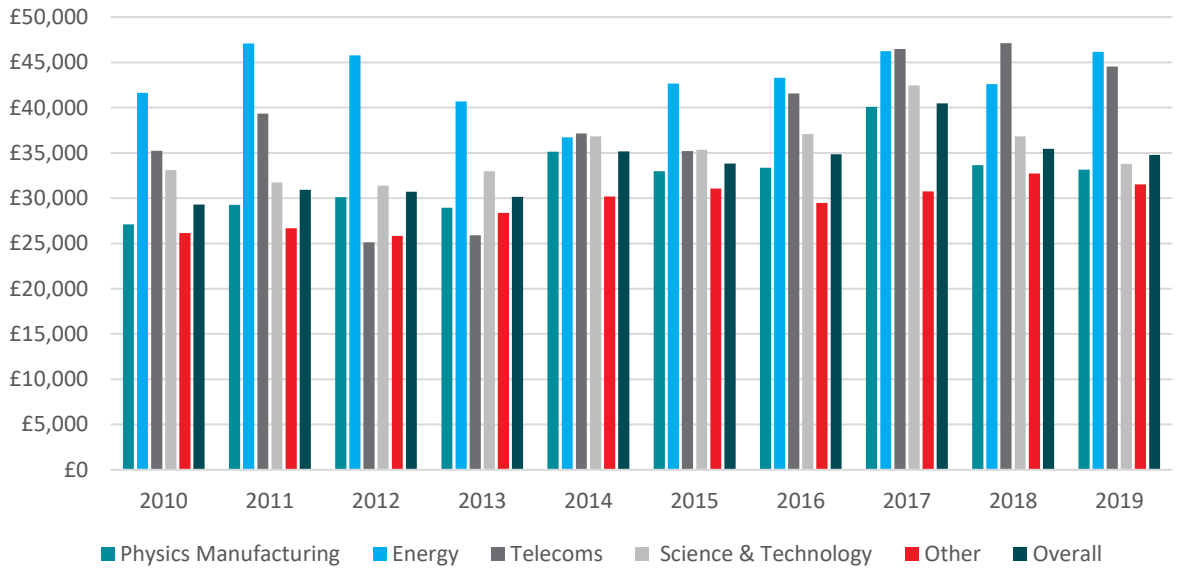
Table 4: Comparison between the shares of COE and FTE employment by Northern Irish PBIs, 2019

Sub-sector	Share of 2019 COE	Share of 2019 employment
Oil & Gas Extraction	0.1%	0.03%
Physics Manufacturing	53.3%	55.9%
Physics Machine Services	1.9%	2.5%
Energy Production, Transmission & Distribution	9.8%	7.4%
Physics Waste & Recovery	2.4%	1.8%
Physics Machine Sales	0.2%	0.3%
Medical Equipment Sales	0.2%	0.5%
Space Transport & Air Transport Services	1.4%	1.5%
Telecoms	8.1%	6.3%
Physics Science & Technology	19.2%	19.8%
Defence	3.5%	4.0%

Source: ABS, BRES, Cebr analysis

The average compensation per FTE worker increased overall across the PBIs. The Telecoms sub-sector particularly saw significant growth, 26.5% overall, or 2.6% on average. Out of the highlighted sub-sectors, the Energy Production, Transmission & Distribution and the Telecoms sub-sectors had the largest average COE: more than £44,000 in 2019 for both. Aggregated, the PBIs experienced 18.8% growth in terms of the ratio.

Figure 22: COE per FTE in selected Northern Irish PBI sub-sectors, 2010-2019



Source: ABS, BRES, Cebr analysis

It is notable that while within Northern Ireland's PBI sector over the period, the highest employment growth was in the Physics Science and Technology sub-sector (total employment growth over the period of 3,169 FTEs), this did not result in a significant increase in average employee compensation. Average COE/FTE in the Physics Science and Technology sub-sector grew by just 2.0% (£655) over the period, well below the average COE/FTE growth in the wider PBIs of 18.8%.

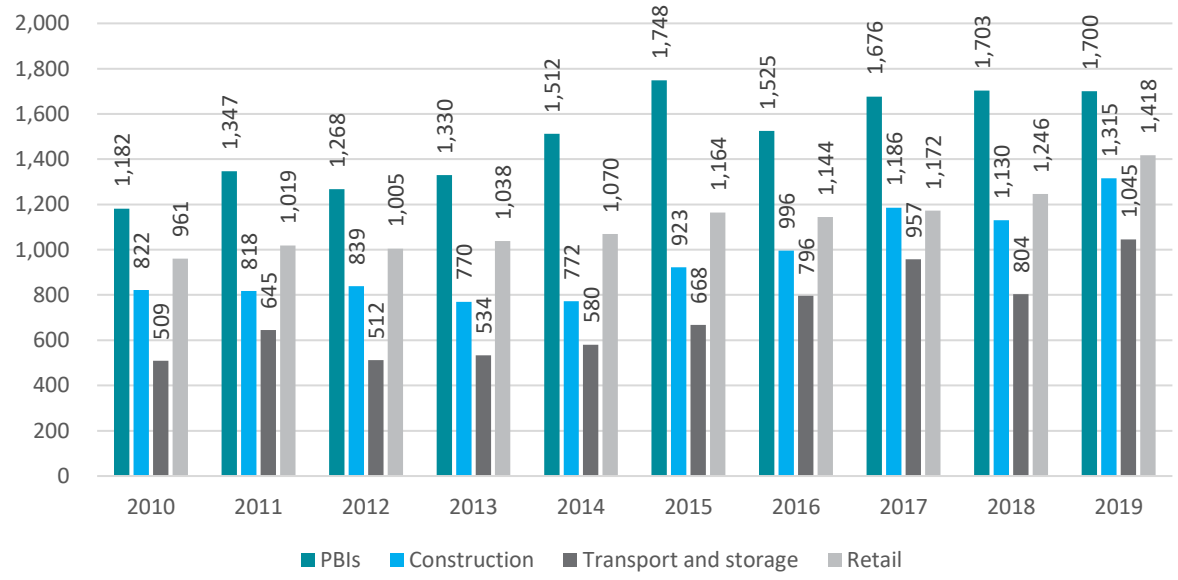
Perhaps explaining this, labour productivity in the sub-sector only increased by 2% over the decade. This could be a function of the growth in the sector in absolute terms being supported by an increased labour supply rather than an increase in capital investment (an expanded

capital base per worker typically increases labour productivity), but further research would be required to identify this with confidence.

Industry Comparison

Figure 23 shows the COE of the PBIs and the comparator sectors. Unsurprisingly, the trend is very similar to that seen for GVA. Despite the number of employees being lowest for the PBI sector, the COE was the highest over the period. This suggests that the average COE/employment ratio is much higher compared to the other three sectors. Furthermore, the other three sectors had a higher yearly average growth than the PBIs (1.9%): Construction (3.3%), Transport & Storage (7.3%), Retail (3.3%).

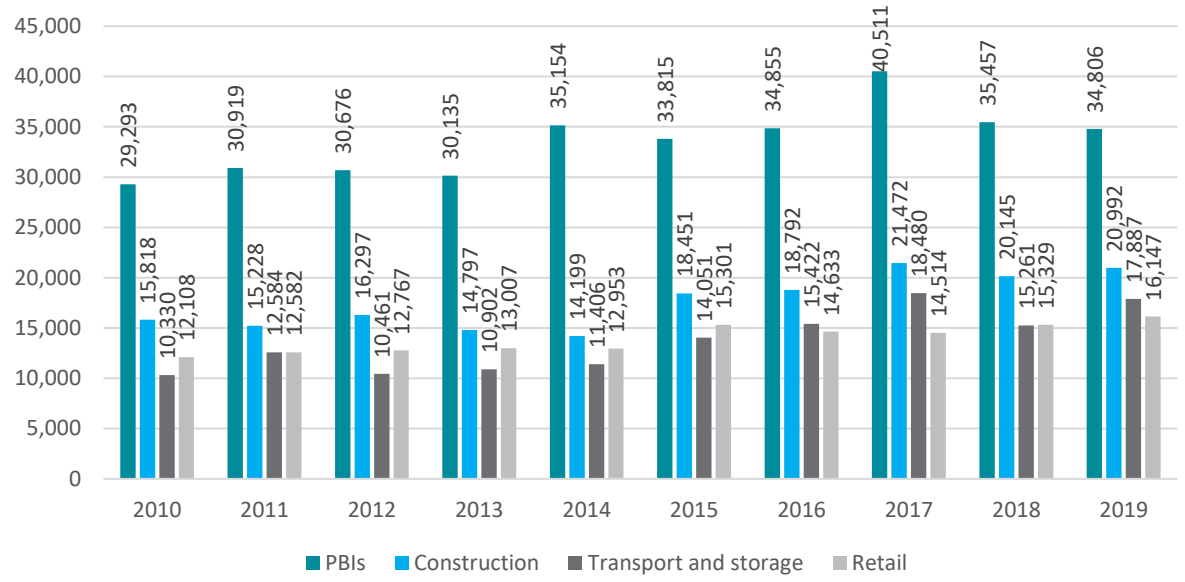
Figure 23: COE in selected Northern Irish sectors, £ millions, 2010-19



Source: ABS, Cebr analysis

As with labour productivity, the PBI sector had a higher average COE per FTE worker than the comparator sectors, with slightly more than £34,000 in 2019. Interestingly, while the Construction and the Transport sectors had very similar values for employment and different growth rates (with the Transport sector having the higher rate), Figure 24 shows that while their initial rate was almost the same, by 2019 the Construction sector had outrun the Transport sector. The Retail sector has the lowest COE of these four.

Figure 24: Compensation per FTE in selected Northern Irish sectors, 2010-2019



Source: ABS, BRES, Cebr analysis

4. National comparisons

This section provides an assessment of the importance of PBIs in Northern Ireland compared to the other UK nations in terms of turnover, GVA, employment, COE, and business demographics over the period 2010-2019.

4.1 Turnover

Table 5 provides a national breakdown of the PBIs' turnover on a yearly basis. Over the period, more than 80% of all PBI turnover was generated in England, while PBIs in Northern Ireland remained stable at around 1.6% regarding their contribution to total PBI turnover in the UK. The share of turnover by Northern Ireland peaked in 2014 and 2015 to stand at 2%. However, as identified in the regional comparison of employment, this is a broadly representative share for the country.

Over the decade, Northern Irish turnover increased by 26.9% from £8 billion to 10.1 billion, which is slightly higher than the UK average of 24.1% (from £510.6 billion to £633.7 billion).

Table 5: Turnover in UK PBIs, distinguished between nations, £ billions, 2010-2019

Nation	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
England	417.1	442.1	452.3	462.9	463.2	459.3	482.9	517.1	530.2	533.2
Scotland	65.9	70.8	58.1	64.0	62.8	59.5	60.8	58.4	60.4	63.8
Wales	19.6	23.5	23.2	25.9	25.6	30.4	26.1	30.2	26.7	26.7
Northern Ireland	**8.0**	**8.9**	**9.1**	**9.4**	**11.5**	**11.1**	**9.6**	**9.7**	**9.6**	**10.1**

Source: ABS, BRES, Cebr analysis

4.2 GVA

We now focus on the economic contribution of the PBIs to the UK national economies in terms of their GVA contributions to GDP. Northern Ireland peaked in 2015 regarding the share of UK GVA generated by PBIs (1.6%, £3.4 billion out of £210.7 billion), but this declined slightly back to its 2013 proportion (1.5%, £3.5 billion out of £229.5 billion) by 2019. The share of Northern Irish GVA contributed by PBIs was 7.4% in 2019 (out of £47.5 billion), while that of the UK average was 10.6% (out of £2,168.8 billion) in the same year.

However, while the share of GVA contributed by the PBIs to the Northern Irish economy is slightly lower than for the wider UK economy, average annual PBI GVA growth (4.7%) in Northern Ireland was higher than for the UK (2.1%). Therefore, there is evidence that the PBIs in Northern Ireland are 'catching up' to those in the UK.

In line with the concentration of PBI businesses (per Section 4.5), 80% of the GVA generated by UK PBIs is attributable to England.

Table 6: GVA in UK PBIs, distinguished between regions, £ billions, 2010-2019

Nation	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
England	153.9	164.1	166.9	176.5	181.1	176.8	181.1	187.8	190.1	190.2
Scotland	27.2	27.7	24.1	24.9	25.0	22.2	21.4	25.9	26.6	28.4
Wales	6.1	6.6	6.9	7.6	8.2	8.2	7.3	8.1	8.2	7.3
Northern Ireland	**2.4**	**2.7**	**2.7**	**3.2**	**3.0**	**3.4**	**3.1**	**2.9**	**3.3**	**3.5**

Source: ABS, BRES, Cebr analysis

4.3 Employment

As a share of total FTE employees in Northern Ireland, FTEs in Northern Irish PBIs was 6.8% in 2019 (48,000 out of 722,500), while the UK average was 10% (2,720,000 out of 27,157,200). However as with GVA, PBI employment in Northern Ireland has been increasing at a rate greater than in the UK; its share of UK PBI employment was 1.8% for 2019, which is a slight increase from its 2010 value of 1.7% (40,000 out of 2,403,000). By 2019, all nations increased their PBI-contributed employment in absolute terms, relative to 2010.

Table 7: Employment in UK PBIs, distinguished between nations, thousands, 2010-2019

Nation	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
England	2,055	2,037	1,971	1,991	2,075	2,187	2,211	2,237	2,257	2,338
Scotland	203	197	193	196	217	211	207	218	220	220
Wales	104	106	105	109	123	131	118	119	125	113
Northern Ireland	**40**	**44**	**41**	**44**	**43**	**52**	**44**	**41**	**48**	**49**

Source: ABS, BRES, Cebr analysis

4.4 COE

Northern Ireland contributed 1.5% of the total UK COE for PBIs in the UK in 2019 (£1.7 billion out of £114.3 billion), 0.1% more than in 2010 (£1.2 million out of £87 billion). As identified in Section 3.3, total COE across Northern Ireland PBIs increased by 43.9% compared to 2010, outstripping the UK average increase of 31.4% over the same period.

Table 8: COE in UK PBIs, distinguished between regions, £ billions, 2010-2019

Nation	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
England	74.2	76.5	78.5	80.6	82.5	84.5	88.8	89.9	92.5	98.2
Scotland	8.8	8.7	8.4	9.1	10.0	9.7	9.7	10.0	10.0	10.4
Wales	2.9	3.1	3.4	3.6	3.7	4.2	4.5	4.8	4.4	4.1
Northern Ireland	**1.2**	**1.3**	**1.3**	**1.3**	**1.5**	**1.7**	**1.5**	**1.7**	**1.7**	**1.7**

Source: ABS, BRES, Cebr analysis

4.5 Business demography

In terms of the number of enterprises operating in PBIs, the national disaggregation can be found below, displaying the number in Northern Ireland relative to the rest of the UK. The share of UK PBI enterprises operating in Northern Ireland was 1.5% in 2019 (5,285 out of 350,135). This aligns well with the other metrics analysed in the report. Therefore, for the given number of enterprises in PBIs, Northern Ireland had a consistent impact on a per-firm basis compared to the national average.

Table 9: Division of enterprises in UK PBIs, distinguished between regions, thousands, 2010-2019

Nation	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
England	210.1	204.6	216.2	221.5	239.8	282.7	299.4	320.1	302.9	305.4
Scotland	16.9	17.5	19.4	20.6	22.8	26.1	26.8	27.1	26.8	27.2
Wales	8.3	8.0	8.2	8.3	9.2	11.3	11.7	12.1	11.8	12.2
Northern Ireland	**3.8**	**3.7**	**3.7**	**3.8**	**3.9**	**4.1**	**4.4**	**4.8**	**5.1**	**5.3**

Source: Nomis, Cebr analysis

Appendix I: SIC-based definition of PBIs and sectoral alignment

Code	Description	Code	Description
Oil & Gas Extraction			
06.1	Extraction of crude petroleum	06.2	Extraction of natural gas
Physics Manufacturing			
13.95	Manufacture of non-wovens and articles made from non-wovens, except apparel	26.511	Manufacture of electronic instruments and appliances for measuring, testing, and navigation, except industrial process control equipment
13.96	Manufacture of other technical and industrial textiles	26.512	Manufacture of electronic industrial process control equipment
13.99	Manufacture of other textiles nec[12]	26.513	Manufacture of non-electronic instruments and appliances for measuring, testing and navigation, except industrial process control equipment
18.129	Printing (other than printing of newspapers and printing on labels and tags) nec	26.514	Manufacture of non-electronic industrial process control equipment
20.12	Manufacture of dyes and pigments	26.52	Manufacture of watches and clocks
20.13	Manufacture of other inorganic basic chemicals	26.6	Manufacture of irradiation, electromedical and electrotherapeutic equipment
20.17	Manufacture of synthetic rubber in primary forms	26.701	Manufacture of optical precision instruments
20.301	Manufacture of paints, varnishes and similar coatings, mastics and sealants	26.702	Manufacture of photographic and cinematographic equipment
20.302	Manufacture of printing ink	26.8	Manufacture of magnetic and optical media
20.51	Manufacture of explosives	27.11	Manufacture of electric motors, generators and transformers
20.59	Manufacture of other chemical products nec	27.12	Manufacture of electricity distribution and control apparatus
23.11	Manufacture of flat glass	27.2	Manufacture of batteries and accumulators
23.12	Shaping and processing of flat glass	27.31	Manufacture of fibre optic cables
23.13	Manufacture of hollow glass	27.32	Manufacture of other electronic and electric wires and cables
23.14	Manufacture of glass fibres	27.33	Manufacture of wiring devices
23.19	Manufacture and processing of other glass, including technical glassware	27.4	Manufacture of electric lighting equipment
23.2	Manufacture of refractory products	27.51	Manufacture of electric domestic appliances
23.31	Manufacture of ceramic tiles and flags	27.9	Manufacture of other electrical equipment
23.43	Manufacture of ceramic insulators and insulating fittings	28.11	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines
23.44	Manufacture of other technical ceramic products	28.21	Manufacture of ovens, furnaces and furnace burners
23.49	Manufacture of other ceramic products	28.23	Manufacture of office machinery and equipment (except computers and peripheral equipment)
24.1	Manufacture of basic iron and steel and of ferro-alloys	28.25	Manufacture of non-domestic cooling and ventilation equipment

12 'Nec' means not elsewhere classified.

24.2	Manufacture of tubes, pipes, hollow profiles and related fittings, of steel	28.41	Manufacture of metal forming machinery
24.31	Cold drawing of bars	28.49	Manufacture of other machine tools
24.32	Cold rolling of narrow strip	28.91	Manufacture of machinery for metallurgy
24.33	Cold forming or folding	28.922	Manufacture of earthmoving equipment
24.34	Cold drawing of wire	28.94	Manufacture of machinery for textile, apparel and leather production
24.41	Precious metals production	28.95	Manufacture of machinery for paper and paperboard production
24.46	Processing of nuclear fuel	28.96	Manufacture of plastics and rubber machinery
25.11	Manufacture of metal structures and parts of structures	28.99	Manufacture of other special-purpose machinery nec
25.12	Manufacture of doors and windows of metal	29.1	Manufacture of motor vehicles
25.21	Manufacture of central heating radiators and boilers	29.31	Manufacture of electrical and electronic equipment for motor vehicles
25.29	Manufacture of other tanks, reservoirs and containers of metal	29.32	Manufacture of other parts and accessories for motor vehicles
25.3	Manufacture of steam generators, except central heating hot water boilers	30.11	Building of ships and floating structures
25.4	Manufacture of weapons and ammunition	30.12	Building of pleasure and sporting boats
25.5	Forging, pressing, stamping and roll-forming of metal; powder metallurgy	30.2	Manufacture of railway locomotives and rolling stock
25.61	Treatment and coating of metals	30.3	Manufacture of air and spacecraft and related machinery
25.62	Machining	30.4	Manufacture of military fighting vehicles
26.11	Manufacture of electronic components	30.91	Manufacture of motorcycles
26.12	Manufacture of loaded electronic boards	30.92	Manufacture of bicycles and invalid carriages
26.2	Manufacture of computers and peripheral equipment	30.99	Manufacture of other transport equipment nec
26.301	Manufacture of telegraph and telephone apparatus and equipment	32.5	Manufacture of medical and dental instruments and supplies
26.309	Manufacture of communication equipment (other than telegraph and telephone apparatus and equipment)	32.99	Other manufacturing nec
26.4	Manufacture of consumer electronics	33.16	Repair and maintenance of aircraft and spacecraft
Physics Machine Services			
33.11	Repair of fabricated metal products	33.17	Repair and maintenance of other transport equipment
33.12	Repair of machinery	33.19	Repair of other equipment
33.13	Repair of electronic and optical equipment	33.2	Installation of industrial machinery and equipment
33.14	Repair of electrical equipment	33.15	Repair and maintenance of ships and boats
Energy Production, Transmission & Distribution			
35.11	Production of electricity	35.13	Distribution of electricity
35.12	Transmission of electricity	35.22	Distribution of gaseous fuels through mains
Physics Waste & Recovery			
38.12	Collection of hazardous waste	38.32	Recovery of sorted materials
38.22	Treatment and disposal of hazardous waste	39	Remediation activities and other waste management services
38.31	Dismantling of wrecks		
Physics Machine Sales			
46.14	Agents involved in the sale of machinery, industrial equipment, ships and aircraft		

Medical Equipment Sales			
47.741	Retail sale of hearing aids in specialised stores	47.749	Retail sale of medical and orthopaedic goods (other than hearing aids) nec, in specialised stores
Space Transport & Air Transport Services			
51.22	Space transport	52.23	Service activities incidental to air transportation
Telecoms			
61.1	Wired telecommunications activities	61.3	Satellite telecommunications activities
61.2	Wireless telecommunications activities	61.9	Other telecommunications activities
Physics Science & Technology			
71.121	Engineering design activities for industrial process and production	72.19	Other research and experimental development on natural sciences and engineering
71.122	Engineering related scientific and technical consulting activities	74.1	Specialised design activities
71.129	Other engineering activities (not including engineering design for industrial process and production or engineering related scientific and technical consulting activities)	74.9	Other professional, scientific and technical activities nec
71.2	Technical testing and analysis	82.99	Other business support service activities nec
72.11	Research and experimental development on biotechnology		
Defence			
84.22	Defence activities		

Appendix II: Supplementary figures and tables

Table 10: Turnover in the different sub-sectors of PBIs in Northern Ireland, £ billions, 2010-2019

Sub-sector	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Oil & Gas Extraction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Physics Manufacturing	3.63	4.38	4.61	4.71	5.54	6.12	4.53	5.00	5.12	4.71
Physics Machine Services	0.02	0.03	0.04	0.06	0.07	0.07	0.07	0.09	0.12	0.15
Energy Production, Transmission & Distribution	2.86	2.70	3.01	2.97	4.11	3.04	2.77	2.87	2.50	3.16
Physics Waste & Recovery	0.21	0.21	0.14	0.17	0.16	0.13	0.10	0.15	0.18	0.26
Physics Machine Sales	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.02	0.02
Medical Equipment Sales	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.02
Space Transport & Air Transport Services	0.06	0.09	0.09	0.09	0.08	0.10	0.10	0.08	0.10	0.11
Telecoms	0.40	0.47	0.34	0.43	0.49	0.49	0.70	0.36	0.50	0.70
Physics Science & Technology	0.62	0.88	0.67	0.81	0.87	1.03	1.16	1.01	0.95	0.86
Defence	0.17	0.16	0.13	0.14	0.14	0.13	0.11	0.12	0.14	0.15
Overall	7.99	8.93	9.06	9.41	11.49	11.14	9.58	9.71	9.63	10.13

Source: ABS, BRES, Cebr analysis

Table 11: Number of enterprises in the different sub-sectors of PBIs in Northern Ireland, 2010-2019

Sub-sector	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Oil & Gas Extraction	5	0	0	0	0	0	0	0	0	0
Physics Manufacturing	1,335	1,355	1,335	1,295	1,330	1,345	1,350	1,390	1,400	1,460
Physics Machine Services	150	160	170	185	220	260	350	470	505	525
Energy Production, Transmission & Distribution	30	40	65	120	195	220	305	355	435	440
Physics Waste & Recovery	75	80	80	95	75	85	90	100	110	105
Physics Machine Sales	75	80	85	80	75	70	65	70	70	75
Medical Equipment Sales	35	40	35	30	30	35	30	35	30	25
Space Transport & Air Transport Services	5	15	10	10	10	10	10	10	15	10
Telecoms	80	80	80	75	80	85	85	90	95	90
Physics Science & Technology	1,965	1,825	1,805	1,865	1,885	1,960	2,130	2,260	2,470	2,555
Overall	3,755	3,675	3,665	3,755	3,900	4,070	4,415	4,780	5,130	5,285

Source: Nomis, Cebr analysis

Table 12: Division of businesses in PBIs in Northern Ireland, distinguished by size, 2019

Sub-sector	Micro	Small	Medium	Large
Oil & Gas Extraction	-	-	-	-
Physics Manufacturing	1,170	230	55	5
Physics Machine Services	505	15	5	-
Energy Production, Transmission & Distribution	430	10	-	-
Physics Waste & Recovery	75	25	5	-
Physics Machine Sales	70	5	-	-
Medical Equipment Sales	25	-	-	-
Space Transport & Air Transport Services	5	-	5	-
Telecoms	85	5	-	-
Physics Science & Technology	2,420	120	15	-
Total	**4,785**	**410**	**85**	**5**

Source: Nomis, Cebr analysis

Table 13: GVA contributed by the different sub-sectors of PBIs in Northern Ireland, £ billions, 2010-2019

Sub-sector	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Oil & Gas Extraction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Physics Manufacturing	1.21	1.34	1.45	1.61	1.49	1.86	1.43	1.33	1.64	1.61
Physics Machine Services	0.01	0.02	0.02	0.03	0.03	0.03	0.04	0.04	0.05	0.06
Energy Production, Transmission & Distribution	0.48	0.44	0.46	0.60	0.58	0.45	0.50	0.55	0.56	0.68
Physics Waste & Recovery	0.06	0.06	0.04	0.05	0.04	0.04	0.04	0.04	0.05	0.05
Physics Machine Sales	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Medical Equipment Sales	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01
Space Transport & Air Transport Services	0.03	0.05	0.05	0.06	0.05	0.07	0.06	0.06	0.07	0.08
Telecoms	0.16	0.19	0.22	0.25	0.25	0.29	0.32	0.22	0.32	0.41
Physics Science & Technology	0.32	0.45	0.40	0.47	0.49	0.57	0.59	0.55	0.55	0.52
Defence	0.09	0.09	0.07	0.08	0.08	0.07	0.06	0.07	0.08	0.08
Overall	2.39	2.65	2.74	3.16	3.02	3.38	3.06	2.87	3.33	3.51

Source: ABS, BRES, Cebr analysis

Table 14: Employment in the different PBIs in Northern Ireland, thousands, 2010-2019

Sub-sector	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Oil & Gas Extraction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Physics Manufacturing	24.8	26.5	25.8	27.6	26.3	33.2	25.1	23.8	28.9	27.3
Physics Machine Services	0.3	0.3	0.5	0.5	0.6	0.6	0.8	0.7	0.9	1.2
Energy Production, Transmission & Distribution	2.9	2.6	2.7	3.0	3.2	2.4	2.2	3.0	3.4	3.6
Physics Waste & Recovery	1.1	1.0	0.8	0.9	0.7	0.8	0.6	0.6	0.7	0.9
Physics Machine Sales	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Medical Equipment Sales	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3
Space Transport & Air Transport Services	0.5	0.5	0.5	0.5	0.5	0.6	0.5	0.5	0.6	0.7
Telecoms	1.6	1.7	1.9	2.3	1.8	2.4	2.5	1.7	2.2	3.1
Physics Science & Technology	6.5	8.3	6.6	7.0	7.7	9.7	10.2	9.2	9.2	9.7
Defence	2.6	2.4	2.2	2.0	1.9	1.7	1.6	1.6	1.8	2.0
Overall	40.3	43.5	41.3	44.1	43.0	51.6	43.7	41.4	48.0	48.8

Source: BRES, Cebr analysis

Table 15: COE attributable to the different PBIs in Northern Ireland, £ millions, 2010-2019

Sub-sector	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Oil & Gas Extraction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Physics Manufacturing	0.67	0.77	0.78	0.80	0.92	1.09	0.84	0.95	0.97	0.91
Physics Machine Services	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.03	0.03
Energy Production, Transmission & Distribution	0.12	0.12	0.13	0.12	0.12	0.10	0.10	0.14	0.15	0.17
Physics Waste & Recovery	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.04
Physics Machine Sales	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Medical Equipment Sales	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Space Transport & Air Transport Services	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Telecoms	0.05	0.07	0.05	0.06	0.07	0.09	0.10	0.08	0.11	0.14
Physics Science & Technology	0.22	0.26	0.21	0.23	0.28	0.34	0.38	0.39	0.34	0.33
Defence	0.07	0.06	0.05	0.06	0.05	0.05	0.04	0.05	0.06	0.06
Overall	1.18	1.35	1.27	1.33	1.51	1.75	1.52	1.67	1.70	1.70

Source: ABS, BRES, Cebr analysis

Appendix III: Methodology

The following section lays out our methodology, broken down by our approach to the overall impacts and the national impacts. In order to estimate the impact of the PBIs in constituent UK regions, we first needed to estimate the impact of the sector across the UK as a whole. The methodology for both stages can be found in this section.

Economic impact of the PBIs in the UK as a whole

In order to provide a well-rounded summary of the PBIs in the UK, we worked with the turnover, GVA, total full-time employees and COE, as well as with the number of businesses. For these, we used the Annual Business Survey (ABS) from the Office of National Statistics (ONS), the Business Register and Employment Survey (BRES) from Nomis (the ONS's official source for labour market statistics) and the UK business counts from Nomis. Since BRES only has data on Great Britain, and thus does not include Northern Ireland, we modelled the total UK FTE employment by adjusting Great Britain's value to the yearly share of Northern Ireland FTE workers to the UK, which was derived from the annual Labour Force Survey:

$$UK\ FTE_i = GB\ FTE_i \times (1 + Share\ of\ NI\ FTE_i)$$

Where FTE_i is the number of full-time employees in year *i*.

ABS has a very granular database on economic variables at a four/five-digit SIC level, however there are some cases when some of the values were missing. When this occurs, we estimated the data we needed in order to provide a more accurate summary and not simply omit the footprint of some SICs. If an employment figure was missing, we used the average of the employment in the industry one year earlier and one year later. In cases where the turnover, GVA or COE was missing, the turnover-FTE, the GVA-FTE or the COE-FTE ratio for the previous year where we had the full data was used to extrapolate estimates for the missing year. Whenever we encountered a SIC 5-digit level industry, where ABS had no data, we used the 3- or 4-digit SIC values and the ratio of the 5- and 3-digit level BRES FTE values in order to estimate the specific data on these:

$$5\ digit\ GVA_i = 3\ digit\ GVA_i \times \frac{5\ digit\ FTE_i}{3\ digit\ FTE_i}$$

Where again GVA_i is the gross value added in year *i,* and $FTE_i$is the number of full-time employees in year *i.*

Once we had all the data, we aggregated the industries into 11 sectors. These are: Oil & Gas Extraction; Physics Manufacturing; Physics Machine Services; Energy Production, Transmission & Distribution; Physics Waste & Recovery; Physics Machine Sales; Medical Equipment Sales; Space Transport & Air Transport Services; Telecoms; Physics Science & Technology; and lastly, Defence. Appendix I shows which industries belong to which sector.

Economic impact of the PBIs in Northern Ireland

After finishing the gathering and modelling the data of the UK impacts, we were able to estimate the International Territorial Levels Level 1 (ITL1) regional values, including those for Northern Ireland.

First, we used BRES again to estimate the share of FTEs in each of the Great Britain nations and nine English ITL1 regions in a given industry. BRES does not have data on Northern Ireland but using the 2-digit level Northern Ireland turnover and Great Britain turnover, we calculate the ratio of the two. We multiply this ratio by the specific 4/5-digit level Great Britain employee number from BRES, thus getting the implied number of FTE employees. We

modelled the GVA by using the UK industrial GVA/FTE ratio, multiplying it by the regional productivity differential (from ONS) and the implied number of employees in Northern Ireland. In order to estimate the COE and turnover, we used the ABS 2-digit SIC code level regional data to find the COE-GVA and the GVA-turnover ratio in a given year. After that, we were able to estimate both from the GVA and the relevant ratio. Since we already had the overall direct impacts, we scaled back to that in order to avoid any differences between that and the regional values.

In some cases, ABS was missing one of the regional values we needed to calculate the ratios. If there was only one or two years of data missing, we averaged the earlier and later years to estimate the value of the missing year. If the lack of data was more frequent, we used the UK-level ratios to estimate the regional values. In a few cases, we had the ABS values, but they provided a great volatility in the COE-GVE ratios, for example, going from 15% in a region to 80%, or even higher. In order to control for this, we have adjusted the methodology in such cases and used the COE/GVA ratio across the UK to estimate the regional COE. For most industries, using the bespoke regional ratio is more accurate as it adjusts for regional differences in industry/firm structure, but sometimes the regional volatility is so significant that the trade-off is not worthwhile.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