The economic contribution of the UK Marine Engineering and Scientific industry

A Cebr report for Maritime UK

August 2019

Cebr

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Authorship and acknowledgements

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The industry figures making up the broad Maritime sector are not always additive because some of the reports have been customised to cater for the overlap between certain industries. Simply adding together the industries would therefore produce a degree of double counting. Nonetheless, the broad Maritime report has had this double counting stripped out. Cebr believes fundamentally in the thoroughness and robustness of its approach and, as such, we stand by our own unbiased and fresh examination of the role of the Maritime sector and its constituent industries in the UK.

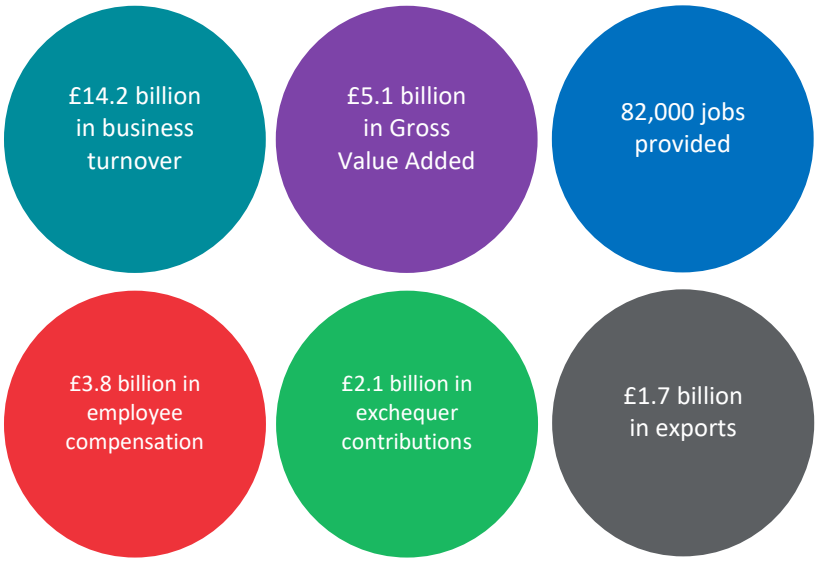
The report does not necessarily reflect the views of Maritime UK.

London, August 2019

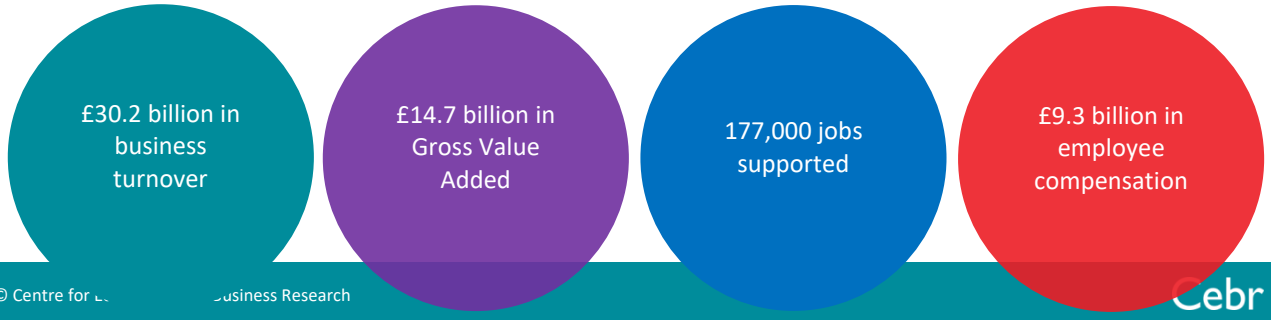
Contents

Executive Summary

- The Centre for Economics and Business Research (Cebr) has been commissioned by Maritime UK to **quantify the economic contribution of the Marine Engineering and Scientific (MES) industry to the UK economy.**
- **The MES industry consists of a variety of activities, such as, shipbuilding; marine renewable energy; marine oil and gas support; and marine scientific and technical activities.** The direct and aggregate economic contribution of these activities have been quantified, both at UK and regional level. This has been done for the years 2010 to 2017 inclusive.
- **This report forms one of ten reports which also assess the contribution of the Maritime Sector as a whole, at an industry-level, in Scotland, Wales, the Liverpool City Region and the Solent LEP region.**
- The MES industry makes a substantive direct macroeconomic contribution to the UK through business turnover, Gross Value Added (GVA), employment, the compensation of employees, tax revenue and the export of goods and services. These direct contributions are as follows:



- **Marine oil and gas support and shipbuilding are the largest constituent activities within the industry in terms of economic activity, directly contributing £2.1 billion and £1.5 billion in GVA, and directly supporting around 19,000 jobs and 29,000 jobs respectively in 2017.** Combined, this contribution equates to 70% of GVA and 58% of employment for the MES industry as a whole.
- **The average job in the MES industry generated £62,600 in GVA in 2017;** this lies below the average productivity of the UK Maritime sector of £77,400 but above the UK-wide level of £54,300.
- After quantifying the aggregate economic impacts through the industry supply chains and induced effects on expenditures, the economic footprint of the MES industry is as follows:



- **The economic activity directly contributed and more widely supported by the MES industry is spread across all regions of the UK.** In 2017, the UK regions with the largest direct contribution in terms of GVA were Scotland (£2.5 billion), the North West (£0.7 billion) and the South West (£0.5 billion). Scotland's relatively high economic contribution can be attributed to the high share of employment in marine oil and gas support and shipbuilding activities in all years considered.

1 Introduction

Cebr is pleased to present this report to Maritime UK and the Society of Maritime Industries (SMI) on the economic impact of the marine engineering and scientific (MES) industry on the UK economy**. This report forms one of ten reports on the economic contribution of the wider Maritime Sector,** which is defined as comprising the individual shipping, ports, marine engineering and scientific, leisure marine and Maritime Business Services (MBS) industries, each comprising a wide range of component activities. The other reports focus on the economic contribution of each of the other four industries at UK level, the contribution of the sector in Scotland, Wales, Liverpool City Region and the Solent LEP, and the contribution of the Maritime Sector at UK-level. **It is therefore important to consider this report as part of the wider framework set out in the ten reports, which set out the impact of the Maritime Sector both at a national and regional level.**

In this context, the MES industry is defined as encompassing a wide range of constituent activities, categorised under shipbuilding, marine renewable energy, marine oil and gas support and marine scientific and technical activities. Each activity represents a diverse range of sub-activities; for example, shipbuilding and marine scientific and technical activities are dominated by large manufacturers such as BAE Systems and QinetiQ.

Our examination spans the period from 2010 to 2017 (inclusive), with the latter being the latest year for which full data is available, and endeavours to capture the full economic 'footprint' of the MES industry. As such, our report is not confined to direct ongoing contributions to GDP and employment through the MES industry's operations and activities in the UK, but also provides assessments of the associated indirect and induced multiplier impacts.

1.1 About Maritime UK

Maritime UK is the industry body for the UK's Maritime Sector, representing companies and partner organisations in the shipping, ports, leisure marine, marine engineering and scientific and Maritime Business Services industries. It acts to promote the sector, influence government and drive growth.

1.2 Purpose of this report

This study seeks to equip Maritime UK and the Society of Maritime Industries with statistics and figures on the value of the marine engineering and scientific industry to the UK economy, within the context of the value of the wider Maritime Sector. As such, Cebr has focused on the following key economic indicators: Gross Value Added (GVA), turnover, employment, the compensation of employees, the Exchequer contribution (through tax revenues raised) and the export of goods and services. The study also seeks to identify the contribution of the marine engineering and scientific industry at regional level.

1.3 Overview of the study and methodology

Purpose of the study

This report provides a thorough and comprehensive examination of the role of the marine engineering and scientific industry in the UK and its constituent sub-regional economies. It presents a range of analyses demonstrating different aspects of the value contributed by the industry, including direct contributions to GDP and employment, indirect and induced multiplier impacts and the marine industry's contribution to the UK Exchequer through tax revenues raised.

An important task has been to develop an in-depth understanding of the MES industry. To produce a robust study, it is necessary to interrogate the available data to ensure that it captures the full range of activities that should be included in establishing the aggregate 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 industry. The key macroeconomic indicators include:

- Gross Value Added (GVA) contributions to UK and regional GDP generated by the marine engineering and scientific industry, directly and through indirect and induced multiplier impacts. **GVA is a measure of the value from production, and can be thought of as the value of what is produced, less the value of the intermediate goods and services used as inputs to produce it.** GVA is also commonly known as income from production and is distributed in three directions – to employees, to shareholders and to government. [1]
- Jobs supported by the industry, including direct, indirect and induced jobs through multiplier impacts.
- The value of the turnover of marine industry and, again, the turnover supported in the UK and regional economies through multiplier impacts.
- The value of employee compensation[2] supported by the industry, representing the total remuneration of employees operating in the industry.
- The contribution of the marine engineering and scientific industry through tax revenues raised for the Exchequer.

Mapping the UK marine engineering and scientific industry

In order to identify and quantify these economic impacts, Cebr has adhered to the following definition of the marine engineering and scientific industry as comprising the major activity groupings listed below:

- **Marine engineering and scientific (MES)**
  - Shipbuilding and marine engineering;
  - Marine renewable energy;
  - Marine oil and gas support;
  - Marine scientific and technical.

The first stage of the study has involved mapping the activities of the MES industry against the National Accounts framework, in order to establish clarity on the precise definition of the industry as it maps against the Standard Industrial Classification (SIC) framework.[3] In essence therefore, this involves taking each of the MES industry's activities, and mapping these to the most relevant Standard Industrial Classification (SIC) code in order to identify the activity's economic data.

It is clear that some of the activities of the MES industry do not map neatly onto the SIC framework. For instance, while broader financial services and activities can be identified through SIC code 64, there is no separate distinction within the national accounts framework for marine financial activities specifically.

As a result, this precludes the use of publicly-available data sources such as the Annual Business Survey (ABS) to gather data for some constituent activities of the MES industry. Cebr has therefore exclusively

[1]. GVA is linked as a measurement to GDP – both being a measure of economic output. That relationship is (GVA + Taxes on products - Subsidies on products = GDP). Because taxes and subsidies on individual product categories are only available at the whole economy level (rather than at the sectoral or regional level), GVA tends to be used for measuring things like gross regional domestic product and other measures of economic output of entities that are smaller than the whole economy.

[2] Compensation of employees is the total remuneration, in cash or in kind, payable by an employer to an employee in return for employers' social contributions, mainly consisting of employers' actual social contributions (excluding apprentices), employers' imputed social contributions (excluding apprentices) and employers' social contributions for apprentices.

[3] The United Kingdom Standard Industrial Classification of Economic Activities (SIC) is used to classify business establishments and other standard units by the type of economic activity in which they are engaged.

drawn upon a combination of publicly-available data, desk research and industry-level data to quantify the contributions made through MES industry activities.

Quantifying the direct economic impacts of the MES industry and data sources

In order to quantify the direct economic impacts of the MES industry, three different approaches have been taken which reflect the degree of alignment (or otherwise) for each marine activity against the National Accounts framework. They are as follows:

- Where MES industry activities can be assigned to a particular SIC code, Cebr have drawn upon business demography data taken from Bureau van Dijk's Financial Accounts Made Easy (FAME) database.[4] Examples of activities where this approach was viable include shipbuilding and marine offshore oil and gas support activities.
- For those activities which cannot be separately identified through the use of SIC codes, Cebr have drawn upon existing analysis from marine industry bodies including British Marine (BM) and the Society of Maritime Industries. Examples of activities where this approach was taken include the marine scientific and technical activities. However, for the estimation of some macroeconomic indicators (such as GVA for Marine Scientific and Technical activities), these sources have been combined with FAME data in order to generate estimates.
- For marine renewable energy activities, Cebr have drawn upon the 2015 Department for Business, Innovation and Skills (the former BIS; now the Department for Business, Energy and Industrial Strategy) report, "The Size and Performance of the Low Carbon Economy"[5] which covers the economic contribution of marine renewable energy activities over the years 2010 to 2013.

A more detailed description of the sources used for each MES industry activity can be found in the next section of this report.

Quantifying the aggregate economic impacts of the MES industry

After collation and interrogation, the direct economic impacts for the MES industry have then been embedded within Cebr's economic impacts models of the UK economy. For each of the four activity groups, the direct impacts are then combined with the bespoke economic multipliers to generate indirect, induced and so aggregate impacts.

These multipliers were calculated by Cebr using our input-output modelling approaches, as these activities are not 'standard' sectors reported in the ONS' input-output tables. Cebr's models establish the relationships between industries through supply chain linkages, as well as industries' linkages with government, capital investors and the rest of the world (through trade).

The models produce three types of impact for four indicators – business turnover, GVA, the compensation of employees, and employment. The three types of impact are:

- Direct impact: this is the value generated and jobs supported directly by the economic activities of the UK marine engineering and scientific industry.
- Indirect impact: this is the value generated and jobs supported in industries that supply inputs to the UK MES industry.

[4] FAME is a company financials database which provides detailed information on UK and Irish companies as taken from annual reports and other sources up to the latest available year. FAME has been used to establish the aggregated contribution of businesses in the Marine industry to the UK economy in terms of turnover, employee numbers and GVA.
[5] BIS, 2015. "The Size and Performance of the Low Carbon Economy, Report for 2010 to 2013."

- Induced impact: this is the value generated and jobs supported in the wider economy when the direct and indirect employees of the MES industry spend wages and salaries on final goods and services.

These three impacts are then combined to convey the aggregate impact associated with each activity within the MES industry in terms of GVA, employment, business turnover, and the compensation of employees.

1.4 Structure of the report

The remainder of the report is structured as follows:

- Section 3 provides an overview of how the Maritime Sector has been defined, and how the MES industry fits within this definition. Further information is also provided on how the key macroeconomic indicators have been captured or estimated;
- Section 3 outlines the direct economic impacts of the MES industry. We consider the direct impacts through GVA, employment, the compensation of employees, and contribution to the UK Exchequer through tax revenues contributed by the industry.
- Section 4 considers the multiplier impacts of the MES industry through the activities it stimulates in the local supply chain and in the wider economy when employees directly and indirectly employed by the industry spend their wages and salaries in the local and wider economy.
- Section 5 examines the direct and multiplier impacts of the MES industry at regional level, as disaggregated by the 12 former Government Office Regions (GORS).[6]
- Section 6 outlines the future potential of autonomous vessels using a case study example.

[6] These are: Scotland, Wales, Northern Ireland, the East of England, the East Midlands, London, the North East, the North West, the South East, the South West, the West Midlands, and Yorkshire and the Humber.

2 The Maritime Sector and the marine engineering and scientific industry

Here we set out how the wider Maritime Sector has been defined for the purposes of the study. On a holistic level, the wider sector can be disaggregated into the shipping, ports, marine engineering and scientific (MES), leisure marine and maritime business services industries, which in themselves are formed of numerous individual and distinct activities, of which the MES industry is the focus of this report.

2.1 The definition of the Maritime Sector and its constituent industries

Maritime UK have provided a list of activities which fall under the auspices of the Maritime Sector; Cebr has subsequently undertaken a mapping exercise using this list to identify how each of these four industries aligns with the national accounts. For most Maritime Sector activities, a corresponding Standard Industrial Classification (SIC) code exists which enables the identification and quantification of the direct economic impacts using publicly-available data sources. A minority of activities do not map neatly against the SIC framework, necessitating the use of industry or local-level data for quantification purposes.

- **Shipping industry**
  - International passenger transport (cruise and ferry);
  - Domestic and inland waterway passenger transport;
  - International freight transport (bulk, container, gas and tanker);
  - Domestic & inland waterway freight transport;
  - Other shipping activity.
- **Ports industry**
  - Warehousing and storage;
  - Port activities and management;
  - Stevedores, cargo and passenger handling;
  - Border agency, HMRC and public sector employees operating in ports.
- **Leisure marine industry**
  - Recreational marine activities, marine finance and legal activities and general marine services;
  - Boatbuilding (marine leisure vessels);
- **Marine engineering and scientific industry**
  - Shipbuilding;
  - Marine renewable energy;
  - Marine support activities for offshore oil and gas, engineering and mining;
  - Marine science and academic activities, including government vessels and technical consulting;
- **Maritime Business Services industry**
  - Shipbroking services;
  - Maritime Insurance services;
  - Maritime Financial services;
  - Maritime Legal services;
  - Ship Surveying and Classification activities;
  - Maritime Education (including Maritime university courses and cadetships);
  - Maritime Consultancy; and
  - Maritime Accountancy.

In this report we focus solely on the MES industry. The remainder of this section focuses on how the direct economic impacts of the constituent activities have been measured, in light of difficulties in establishing how aspects of the industry map against the National Accounts framework.

2.2 Quantifying the direct economic impacts of the marine engineering and scientific industry

Quantifying the direct economic impacts for the MES industry

Table 1 below shows how activities for the MES industry have been identified, and the data sources used to capture and quantify the associated economic activity.

Table 1: Mapping the activities of the MES industry

INDUSTRY	ACTIVITY	MAPPING	SOURCE(S)
Marine Engineering & Scientific Industry	Shipbuilding and marine engineering	Identified in the National Accounts framework through SIC code 3011 ("Building of ships and floating structures") and 3315 ("Repair and maintenance of ships and boats")	ABS, BRES, FAME, Cebr Analysis
	Marine renewable energy	Marine renewable energy activities do not map neatly across the SIC framework. Cebr have therefore drawn upon the BIS report, "The size and performance of the UK-low carbon economy" BIS report (2013) to derive employment, turnover and GVA estimates.	BIS, Cebr Analysis
	Marine support activities for offshore oil and gas, engineering and mining	Identified in the National Accounts framework through SIC code 91, "Support activities for petroleum and natural gas extraction".	FAME, Cebr Analysis
	Marine scientific and technical	Marine Scientific and Technical activities do not map neatly across the SIC framework, as they are typically bundled together with other activities within the Manufacturing and "Other Scientific and Professional" sectors. Cebr have therefore drawn upon the Society of Maritime Industries (SMI) "Annual Review of UK Marine Scientific Industries" reports to gather data.	SMI, Cebr Analysis

Source: Maritime UK, Cebr analysis

2.3 Quantifying the direct economic impacts of the industry at regional level

In this final subsection we set out the approach taken to disaggregate the direct and aggregate economic impacts at regional level. For some activities, the approach taken to disaggregate the direct economic impacts of the MES industry has involved combining the direct economic impacts at UK-level with publicly-available statistics which can be disaggregated at regional level. However, for some activities this approach is precluded as they cannot be separately identified within the National Accounts framework.

Shipbuilding

As shipbuilding activities are explicitly identified within the National Accounts framework (under SIC code 3011, as described in Table 1 above), macroeconomic data for shipbuilding activities as sourced from the FAME database have then been combined with publicly-available data sources capturing shipbuilding activity at regional-level.

Alongside FAME, the major source of employment was the Business Register and Employment Survey (BRES)[7], as accessed through NOMIS. BRES employment data associated with the 3012 SIC code were gathered and an implied regional breakdown estimated after interpolating for some missing information. Shipbuilding employment in Northern Ireland has been estimated using a combination of BRES and the ABS, the latter providing the proportion of employment in Northern Ireland across the broader industrial sector categories. Table 2 below shows the implied regional breakdown of employment in Shipbuilding activities from 2010 to 2017 using the approach described above.

Table 2: The regional breakdown of UK employment in shipbuilding activities, 2010 to 2017

Share of Aggregate Employment	2010	2011	2012	2013	2014	2015	2016	2017
England	68.9%	68.8%	67.6%	67.5%	65.1%	69.9%	68.0%	68.1%
Scotland	26.5%	26.0%	28.0%	27.5%	30.6%	25.3%	26.5%	27.3%
Wales	1.5%	1.7%	1.2%	1.4%	0.7%	1.3%	1.8%	1.0%
Northern Ireland	3.1%	3.5%	3.3%	3.6%	3.7%	3.5%	3.7%	3.6%
East of England	3.1%	1.3%	1.0%	2.1%	1.3%	1.9%	2.2%	1.6%
East Midlands	0.4%	0.7%	0.9%	0.7%	0.9%	0.2%	0.3%	0.6%
London	0.1%	0.1%	0.8%	0.0%	0.3%	0.2%	0.4%	0.0%
North East	4.4%	3.0%	2.3%	1.4%	1.0%	0.8%	0.8%	0.6%
North West	26.5%	26.0%	28.0%	27.5%	30.6%	37.9%	35.3%	36.4%
South East	11.0%	8.7%	10.5%	8.0%	3.9%	2.9%	2.0%	1.1%
South West	22.0%	26.0%	23.3%	27.5%	26.2%	25.3%	26.5%	27.3%
West Midlands	0.7%	0.4%	0.5%	0.2%	0.2%	0.2%	0.2%	0.1%
Yorkshire and the Humber	0.7%	2.6%	0.2%	0.2%	0.7%	0.4%	0.2%	0.5%

Source: ONS, Cebr analysis

Marine renewable energy

Marine renewable energy activities do not map neatly across the National Accounts framework, thereby preventing the use of publicly-available data sources such as BRES or ABS to generate regional-level estimates. Cebr have therefore drawn upon regional breakdown estimates published as part of the 2013 report, "The size and performance of the UK-low carbon economy". Table 3 below shows the implied regional breakdown of employment in offshore wind and marine in 2013 (including the supply chain); it is assumed that the direct employment contribution in each region follows the Aggregate employment breakdown. It is worthwhile to note that while the case study has not been updated since 2013, the results are still relevant for the updated report. However, the reader should take into consideration that the regional figures below will be slightly different for 2017 as to when the study was conducted.

[7] The Business Register and Employment Survey (BRES), produced by the ONS on an annual basis, is the official source of employee and employment estimates by detailed geography and industry within Great Britain.

Table 3: The regional breakdown of UK employment in marine renewable energy in 2013 as implied by BIS analysis

Share of Aggregate Employment	Offshore wind	Marine	Total
England	79.0%	64.5%	76.3%
Scotland	15.2%	32.3%	18.3%
Wales	2.9%	3.2%	3.0%
Northern Ireland	2.9%	0.0%	2.4%
East of England	16.5%	9.7%	15.3%
East Midlands	1.4%	3.2%	1.8%
London	16.5%	3.2%	14.1%
North East	12.2%	3.2%	10.6%
North West	7.2%	9.7%	7.6%
South East	5.7%	22.6%	8.8%
South West	8.6%	6.5%	8.2%
West Midlands	7.2%	3.2%	6.5%
Yorkshire and the Humber	3.6%	3.2%	3.5%

Note: Figures subject to rounding. Source: BIS, Cebr analysis

Marine oil and gas support activities

Marine oil and gas support activities can be separately identified within the National Accounts framework through SIC code 91, "Support activities for petroleum and natural gas extraction". Regional estimates for GVA, employment and the other key macroeconomic indicators have therefore been generated using a combination of the UK-level sources described in Table 1 and publicly-available data sources BRES and ABS. Table 4 below shows the implied regional breakdown of employment in marine oil and gas support activities using this approach; perhaps unsurprisingly, the vast majority of activity took place in Scotland in all years considered.

Table 4: The regional breakdown of UK employment in marine oil and gas support activities, 2010 to 2017

Share of Aggregate Employment	2010	2011	2012	2013	2014	2015	2016	2017
England	8.1%	12.0%	16.2%	13.7%	11.1%	7.4%	10.0%	5.4%
Scotland	91.4%	87.5%	83.4%	85.8%	88.5%	91.9%	89.2%	94.3%
Wales	0.5%	0.5%	0.4%	0.5%	0.4%	0.7%	0.8%	0.3%
Northern Ireland	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
East of England	1.9%	2.2%	2.6%	2.1%	1.6%	2.0%	1.8%	1.2%
East Midlands	1.4%	1.5%	1.8%	1.2%	1.0%	1.5%	0.8%	0.8%
London	1.0%	1.5%	2.6%	1.4%	0.7%	1.0%	1.8%	1.6%
North East	1.4%	1.7%	0.7%	0.2%	0.2%	0.1%	0.1%	0.1%
North West	0.5%	0.2%	0.1%	0.0%	0.3%	0.2%	0.2%	0.3%
South East	0.4%	2.4%	5.5%	6.0%	3.6%	0.5%	0.5%	0.7%
South West	0.5%	1.0%	1.8%	0.8%	0.8%	0.7%	0.5%	0.0%
West Midlands	0.1%	0.1%	0.1%	0.0%	0.1%	0.1%	0.0%	0.1%
Yorkshire and the Humber	1.0%	1.5%	1.1%	1.9%	2.8%	1.3%	4.2%	0.8%

Source: ONS, Cebr analysis

Marine scientific and technical activities

The Society of Maritime Industries' Annual Review of UK Marine Scientific Industries reports focus on economic activity at a UK level; therefore in drawing upon company annual reports published at UK-level, using the FAME database would not be appropriate to disaggregate activity at regional level. Cebr have therefore estimated the regional breakdown of turnover, GVA, employment and the compensation of employees based on regional employment data for the "Other professional, scientific and technical activities" industry grouping (SIC 74909).

The main source of data for regional employment was BRES. BRES employment data associated with the 74909 SIC code were gathered and an implied regional breakdown estimated after interpolating for some missing information. Once again, employment in Northern Ireland has been estimated using a combination of BRES and ABS data, the latter providing the proportion of employment in Northern Ireland across the broader industrial sector categories.

Table 5: The regional breakdown of UK employment in marine scientific and technical activities, 2010 to 2017

EMPLOYMENT	2010	2011	2012	2013	2014	2015	2016	2017
England	89.5%	91.0%	90.7%	90.0%	89.1%	89.4%	91.0%	91.1%
Scotland	7.5%	5.1%	7.4%	5.9%	8.2%	7.3%	5.5%	5.9%
Wales	2.3%	3.4%	1.3%	3.3%	2.0%	2.6%	2.8%	2.4%
Northern Ireland	0.6%	0.6%	0.6%	0.8%	0.7%	0.7%	0.7%	0.7%
East of England	15.0%	8.4%	8.9%	7.3%	8.2%	8.8%	12.0%	7.1%
East Midlands	5.6%	4.2%	7.4%	5.1%	8.2%	8.8%	6.5%	8.3%
London	22.5%	30.3%	22.3%	27.8%	25.9%	22.0%	27.7%	24.8%
North East	1.9%	4.2%	3.0%	2.2%	3.1%	1.5%	3.2%	2.4%
North West	8.4%	8.4%	13.4%	13.2%	12.3%	8.8%	9.2%	10.6%
South East	13.1%	11.8%	14.9%	11.7%	13.7%	14.7%	12.0%	14.2%
South West	13.1%	11.8%	10.4%	10.2%	8.2%	8.8%	7.4%	10.6%
West Midlands	3.3%	4.2%	5.9%	5.1%	5.5%	10.3%	5.5%	4.7%
Yorkshire and the Humber	6.6%	7.6%	4.5%	7.3%	4.1%	5.9%	7.4%	8.3%

Other adjustments for regional economic activity

Other adjustments have been made to the regional disaggregation of the key macroeconomic indicators which represent the direct economic impacts of the MES industry, in order to reflect differences in economic performance across the regions. These are as follows:

- To account for regional differences in productivity (GVA per employee), the breakdown of GVA has been adjusted using the ONS GVA per employee by region statistics.[8]
- To account for regional differences in wages and salaries, estimated wages and salaries paid to employees in the MES industry have been adjusted using differentials taken from ASHE.[9]

[8] ONS, 2017. Subregional Productivity: Labour Productivity (GVA per hour worked and GVA per filled job) indices by UK NUTS2, NUTS3 subregions and City regions.
[9] Ibid.

- To account for regional variation in the ratio of compensation of employees to GVA in different sectors, the compensation of employees for the industry have been adjusted using regional differentials implied by the closest industry, as sourced from the Annual Business Survey.

The results of this analysis are shown in the final section of this report. The next sections in this report set out the direct and aggregate economic impacts of the MES industry in the UK.

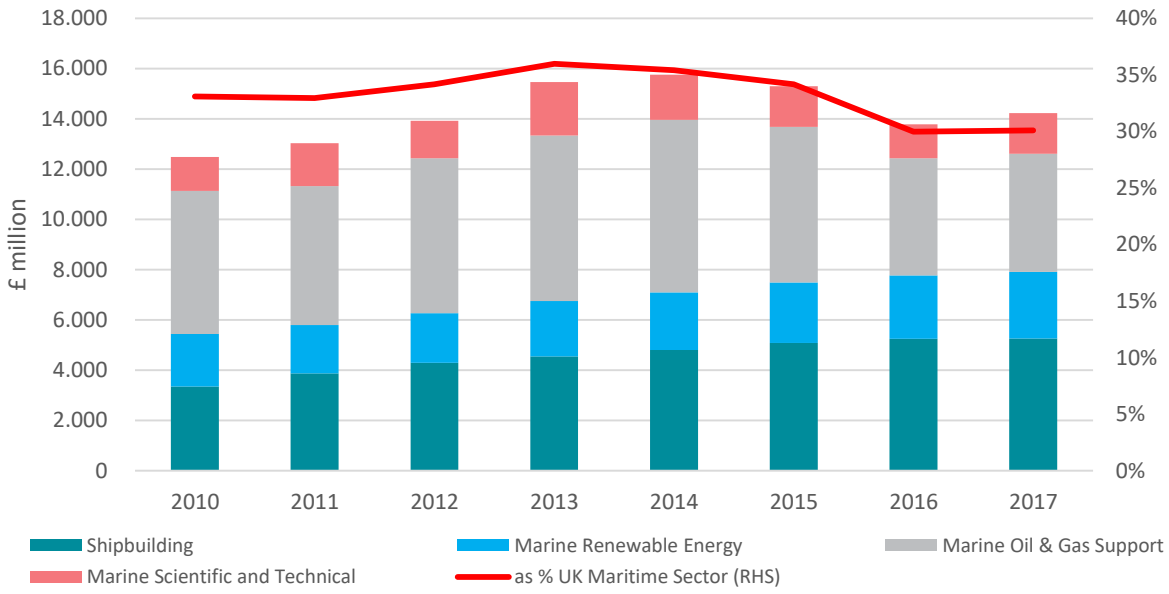
3 The direct economic impact of the marine engineering and scientific industry in the UK

The direct contribution of the MES industry is measured in terms of the following key macroeconomic indicators: turnover, GVA, employment, the compensation of employees, the Exchequer contribution through tax revenues raised, and exports.

3.1 The direct economic impact through turnover

Figure 1 below shows the breakdown of business turnover generated by the MES industry and its constituent activities between 2010 and 2017. Overall, the industry is estimated to have contributed £14.2 billion in business turnover in 2017, an increase of 3.3% from 2016. The turnover peaked in 2014 at £15.7 billion. The overall increase since 2010 can be attributed to persistent turnover growth experienced among shipbuilding and marine renewable energy activities.

Figure 1: The estimated turnover of the MES industry, and expressed as a share of the Maritime Sector's total turnover, 2010 to 2017, £ million



Source: BM, SMII, FAME, ONS, Cebr analysis

Shipbuilding activities generated the largest share of business turnover, with £5.3 billion (37%) of turnover in 2017; marine oil and gas support and marine renewable energy activities were the next largest contributors with £4.6 billion and £2.6 billion respectively. Overall, turnover from the MES industry represented 30.1% of the Maritime Sector total in 2017.

Notably, marine renewable energy turnover has grown 27% over the period 2010 to 2017. This is significant given the Maritime 2050 strategy report placing a significant emphasis on the wider Maritime Sector reducing carbon emissions by 50% by 2050.[10]

Despite increases in business turnover directly generated by the MES industry, profitability (as measured using the ratio of gross profits to turnover) is estimated to have remained broadly stable since 2010. Table 5 shows trends in profitability across each industry activity. The overall profitability of the industry remains

[10] Department for Transport. (2019). 'Maritime 2050'.

just below the Maritime Sector average; for every £1 in turnover generated by the MES industry in 2017, an estimated 15 pence was generated in gross profit. This compares to 20 pence across the entire Maritime Sector in the same year.

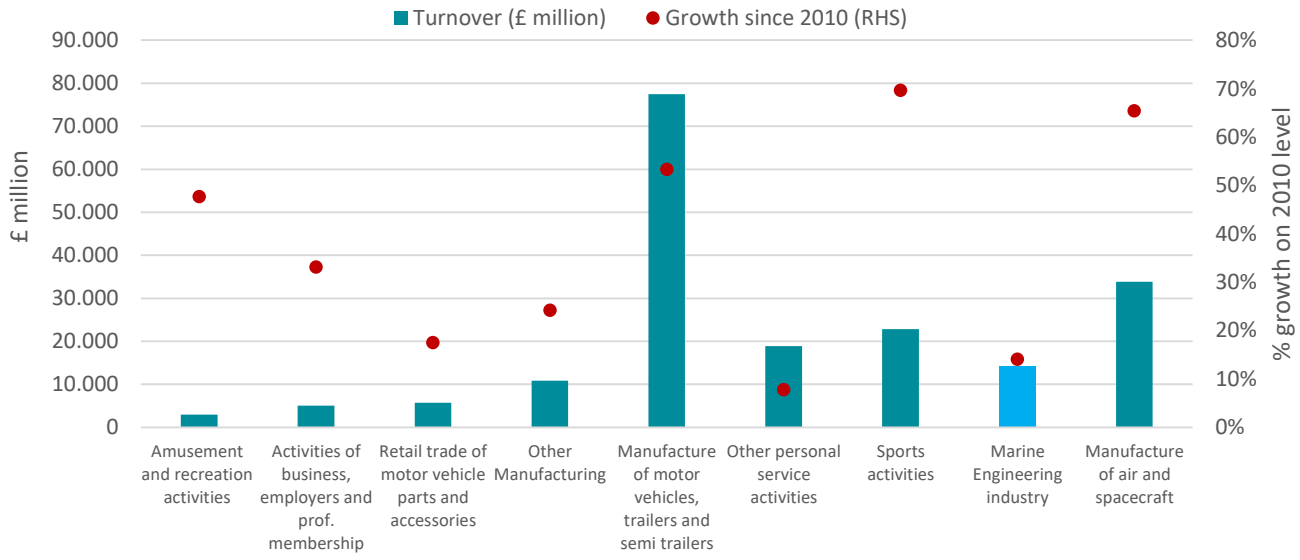
Table 6: Estimated profitability (gross profit ratio) of the MES industry and its constituent activities, 2010 to 2017

Profitability	2010	2011	2012	2013	2014	2015	2016	2017
UK Maritime Sector	17%	17%	19%	20%	22%	20%	21%	20%
UK Marine engineering industry	**16%**	**16%**	**17%**	**19%**	**20%**	**16%**	**14%**	**15%**
Shipbuilding	8%	7%	7%	7%	8%	6%	4%	5%
Marine renewable energy	5%	5%	11%	13%	14%	14%	15%	15%
Marine oil & gas support	18%	16%	17%	19%	20%	15%	15%	12%
Marine scientific and technical	32%	31%	32%	31%	30%	29%	24%	34%

Source: BM, SMI, FAME, ONS, Cebr analysis

To place this direct contribution in context, Figure 2 below compares the turnover of the MES industry against that of comparable industries and activities; nominal turnover growth against the 2010 level is also shown for each industry activity. Turnover data for the comparable industries has been sourced from the ABS.

Figure 2: The estimated turnover of the MES industry against comparable industries in 2017, and growth against the 2010 level



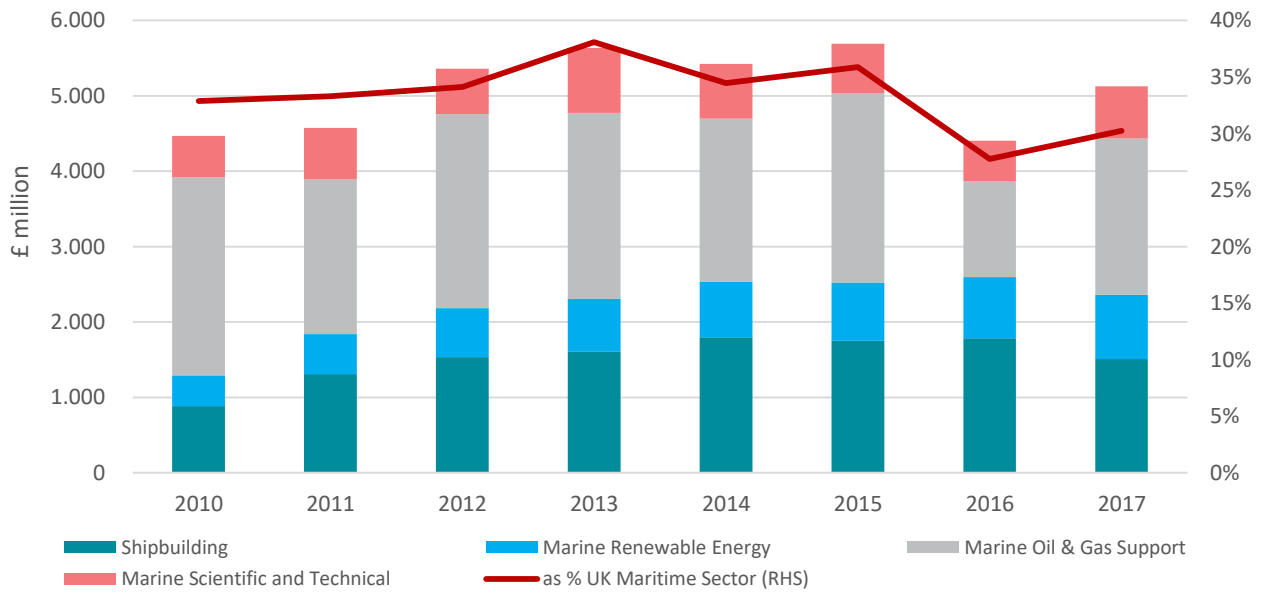
Source: BM, SMI, FAME, ONS, Cebr analysis

In 2017, turnover from the MES industry was £14.2 billion and stood higher than other manufacturing (£10.8 billion), retail trade of motor vehicles (£5.6 billion), activities of businesses, employers and professional membership organisations (£5.0 billion), and amusement and recreation activities (£2.9 billion). However, it lay behind turnover from the manufacture of motor vehicles (£77.4 billion), manufacture of air and spacecraft (£33.8 billion), sports activities (£22.8 billion) and other personal service activities (£18.8 billion).

3.2 The direct economic impact through GVA

Figure 3 below shows this direct impact, disaggregated by industry activities in the years 2010 to 2017, as well as the MES industry's share of the GVA directly generated by the Maritime Sector. GVA is a measure of the value from production, and can be thought of as the value of what is produced, less the value of the intermediate goods and services used as inputs to produce it.

Figure 3: The direct contribution of the MES industry through GVA, and the industry's share of the Maritime Sector's total direct contribution through GVA, 2010 to 2017, £ million



Source: BM, SMI, FAME, ONS, Cebr analysis

It is estimated that the MES industry directly contributed a total of £5.1 billion in GVA in 2017, rising from £4.4 billion in 2010. Marine oil and gas support and shipbuilding activities contributed 70% of GVA of the entire MES industry in 2017. Marine oil and gas support has consistently been the highest contributor to GVA from 2010 to 2017 (with the exception of 2016 where shipbuilding activities contributed the highest share to GVA).

Total GVA for the MES industry fell by 22% from 2015 to 2016, largely caused by a dramatic decrease in GVA for the marine oil and gas support industry, where GVA fell by over 50%. The fall in GVA for marine oil and gas can most likely be linked to the global decline of the price of crude oil. From June 2014 to February 2016, the price of crude oil fell by 67%[11]. A similar trend can be noted in the UK gas prices which more than halved between November 2014 and April 2016[12]. However, GVA for marine oil and gas recovered in 2017 increasing by 63% over the course of one year which follows the trend of rising oil and gas prices. In contrast, GVA for marine renewable energy has more than doubled from 2010 to 2017 reaching a high of £0.8 billion in 2017. This is encouraging as one of Maritime UK's key strategies is to invest in more renewable energy and to significantly reduce carbon emissions by 2050[13]. Overall, the MES industry was responsible for 30% of the total GVA directly contributed by the UK Maritime Sector in 2017.

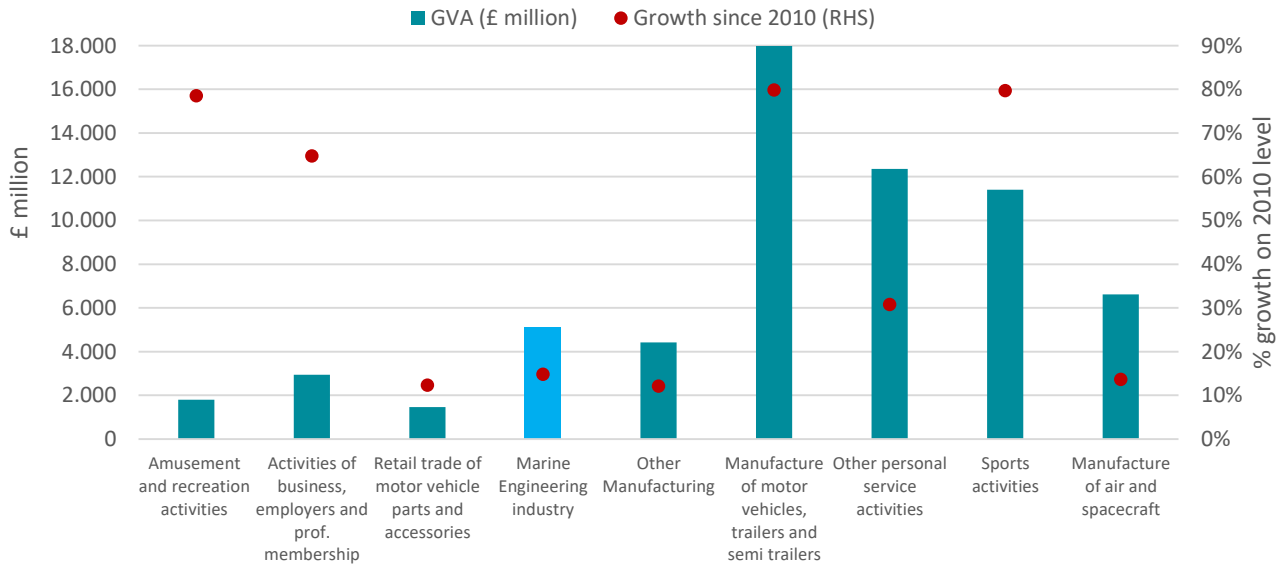
[11] Macrotrends (2019). 'Crude Oil Prices – 70 year historical chart'

[12] ERCE (2019) 'Gas Spot Price'

[13] Department for Transport. (2019). 'Maritime 2050'.

Following Figure 2, Figure 4 below compares GVA trends in the MES industry against those of comparable activities. In terms of the direct GVA contribution in 2017, the MES industry was larger than amusement and recreation activities, activities of business, employers and professional membership organisations, retail trade of motor vehicles, and other manufacturing. Nominal GVA growth between 2010 and 2017 for the MES industry was 15%.

Figure 4: The estimated GVA of the MES industry against comparable industries in 2017, and growth against the 2010 level

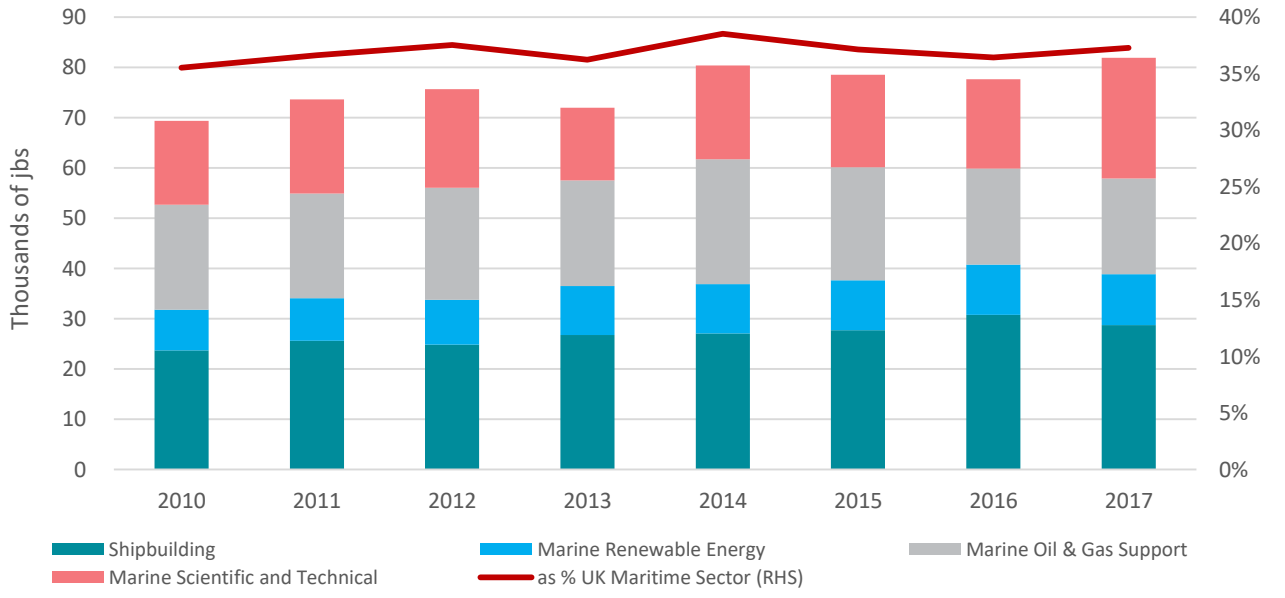


Source: BM, SMI, FAME, ONS, Cebr analysis

3.3 The direct economic impact through employment

In addition to its contribution through GVA, the MES industry also directly supports a significant number of jobs. Figure 5 below highlights the direct contribution of the MES industry to UK employment, again disaggregated by industry activity.

Figure 5: The direct contribution of UK MES through employment, and the industry's share of the Maritime Sector's direct contribution through employment, 2010 to 2017



Source: BM, SMI, FAME, ONS, Cebr analysis

It is estimated that the MES industry directly supported 82,000 jobs in 2017, an increase from 69,000 jobs in 2010. The MES industry's share of the employment directly supported by the Maritime Sector remained broadly constant over this period, on average around 37% of the Maritime Sector total. Shipbuilding activities made the largest direct contribution through employment within the industry – 29,000 jobs, or 35% of employment in 2017. After this, marine scientific and technical activities directly contributed 24,000 jobs 2017.

Employment within shipbuilding activities has the possibility of expanding further in the next few years as investments are made into the development and building of autonomous vessels. The development of new technologies is one of the key focuses of the Maritime UK 2050 report,[14] with the aim of retaining the UK's position as a global leader in maritime technologies and comparative advantage of skills and outputs.

Table 7 below shows the estimated productivity of each MES sub-industry activity across the years 2010 to 2017, and compared against the average productivity level of the Maritime Sector and the UK as a whole. Productivity here is defined as GVA per job; we observe that productivity across the MES industry is considerably in excess of the UK average but below that of the wider Maritime Sector in all years (with the exception of 2013)

Table 7: Productivity (GVA per job) in the MES industry and constituent activities, the Maritime Sector and UK economy, 2010 to 2017

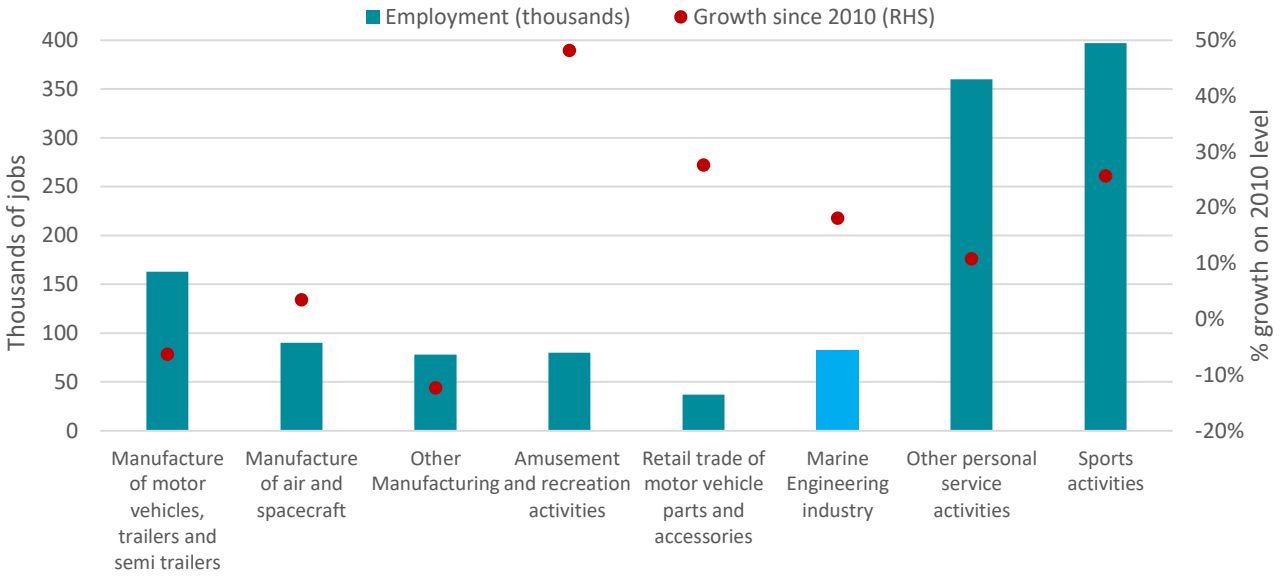
GVA per employee	2010	2011	2012	2013	2014	2015	2016	2017
UK economy	£46,215	£47,176	£48,355	£49,691	£50,877	£51,619	£53,013	£54,330
UK Maritime sector	£69,760	£68,554	£78,170	£74,721	£75,599	£75,209	£74,609	£77,358
UK Marine industry	£64,370	£62,117	£70,822	£78,267	£67,440	£72,459	£56,692	£62,602
Shipbuilding	£37,201	£51,097	£61,654	£60,185	£66,333	£63,125	£58,034	£52,543
Marine Renewable Energy	£51,075	£62,433	£73,097	£72,165	£74,961	£77,864	£77,864	£77,864
Marine Oil & Gas Support	£125,500	£98,757	£115,416	£117,009	£87,223	£111,887	£66,642	£108,979
Marine Scientific and Technical	£32,789	£36,354	£30,732	£59,445	£38,848	£35,525	£30,076	£28,842

Source: BM, SMI, FAME, ONS, Cebr analysis

[14] Department for Transport. (2019). 'Maritime 2050 Navigating the Future'.

Figure 6 below compares the direct contribution that the MES industry made through UK employment in 2017 against comparable industries and activities.

Figure 6: The estimated employment of the MES industry against comparable industries in 2017, and growth against 2010 level



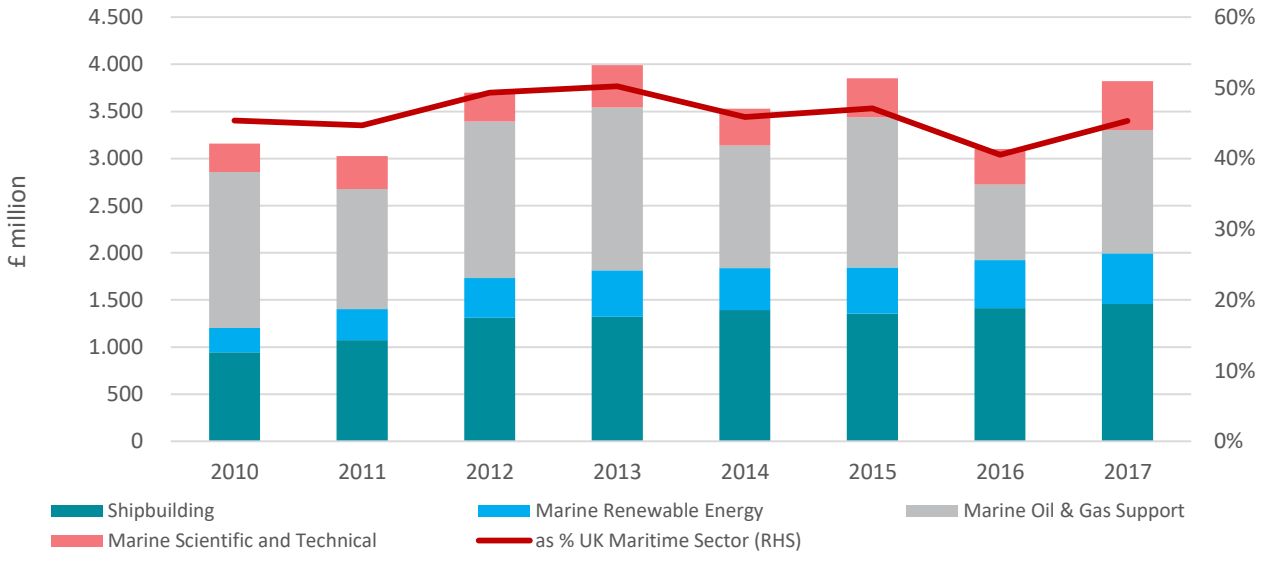
Source: BM, SMI, FAME, ONS, Cebr analysis

Employment in the MES industry in 2017 was 18% higher than in 2010. In terms of direct employment contribution in 2017, the MES industry employed more people than other manufacturing, amusement and recreation activities, retail trade of motor vehicle parts and accessories, and activities of business, employers and professional membership organisations.

3.4 The direct economic impact through the compensation of employees

Figure 7 below illustrates the compensation of employees which is directly supported by the MES industry, disaggregated by activity. It also illustrates the proportion of all direct employee compensation in the Maritime Sector which is directly supported by the industry.

Figure 7: The direct contribution of the MES industry through the compensation of employees, 2010 to 2017, £ million



Source: BM, SMI, FAME, ONS, Cebr analysis

It is estimated that the MES industry directly contributed just over £3.8 billion through the compensation of employees in 2017; this total has increased by around £650 million since 2010. Marine oil and gas support and shipbuilding activities contributed 72% to the direct impact of compensation of employees. Overall, the total value of compensation of employees directly supported across the Maritime Sector from the MES industry is estimated to have remained relatively stable from 2010 to 2017 at around 45% (peaking in 2013 at 50%).

3.5 The direct contribution to the UK Exchequer

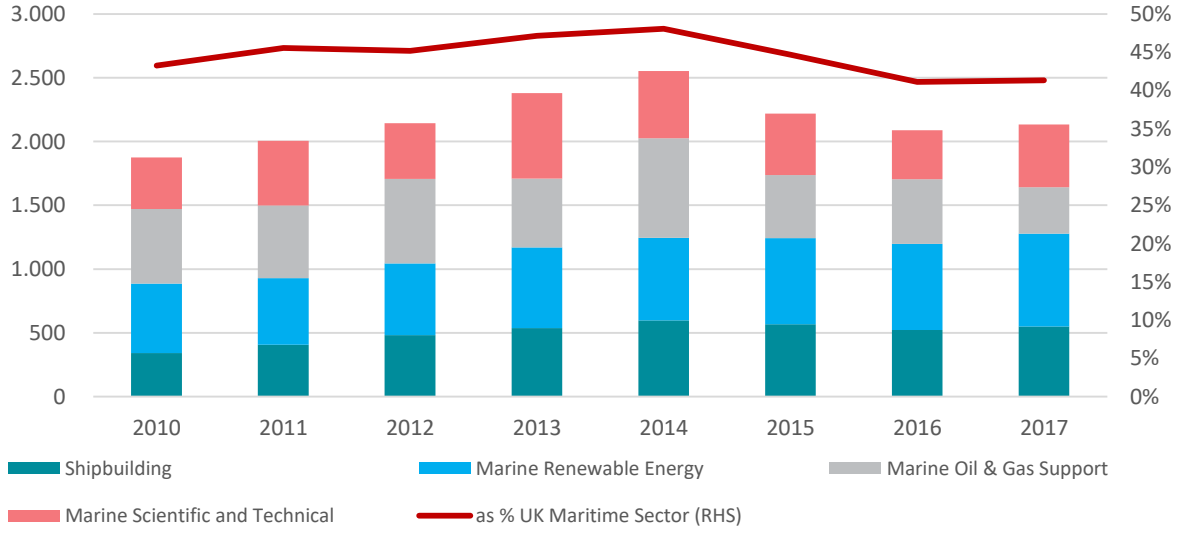
This section discusses the contribution of the marine engineering and scientific industry to the UK Exchequer. For each activity within this industry, Cebr have calculated the contributions in terms of:

- Income Tax;
- National Insurance Contributions (NICs) – from both employees and employers;
- VAT;
- Corporation Tax;
- National Non-Domestic Rates (Business Rates).

For the personal taxes listed above, Income Tax and NICs revenues have been calculated by applying tax rates to the estimated wages and salaries paid to employees operating in each industry activity; rates and thresholds have been sourced from HMRC for the years 2010 to 2017. Wages and salaries for employees have been sourced from the Annual Survey for Hours and Earnings (ASHE)[15]. For the business taxes listed above, Corporation Tax revenues have been estimated by applying HMRC estimates for Average Effective Tax Rates (AETRs) to the estimated Gross Profit of each industry activity. Business Rates have been estimated using the average level of Business Rates paid as a proportion of GVA, drawing upon the ONS Annual Business Survey (ABS).

Figure 8 below depicts the direct contribution of the MES industry to the UK Exchequer across 2010-2017, both in absolute levels (left side) and as a percentage of the overall Maritime Sector.

Figure 8: The direct contribution of the MES to the UK Exchequer, 2010 to 2017, £ million



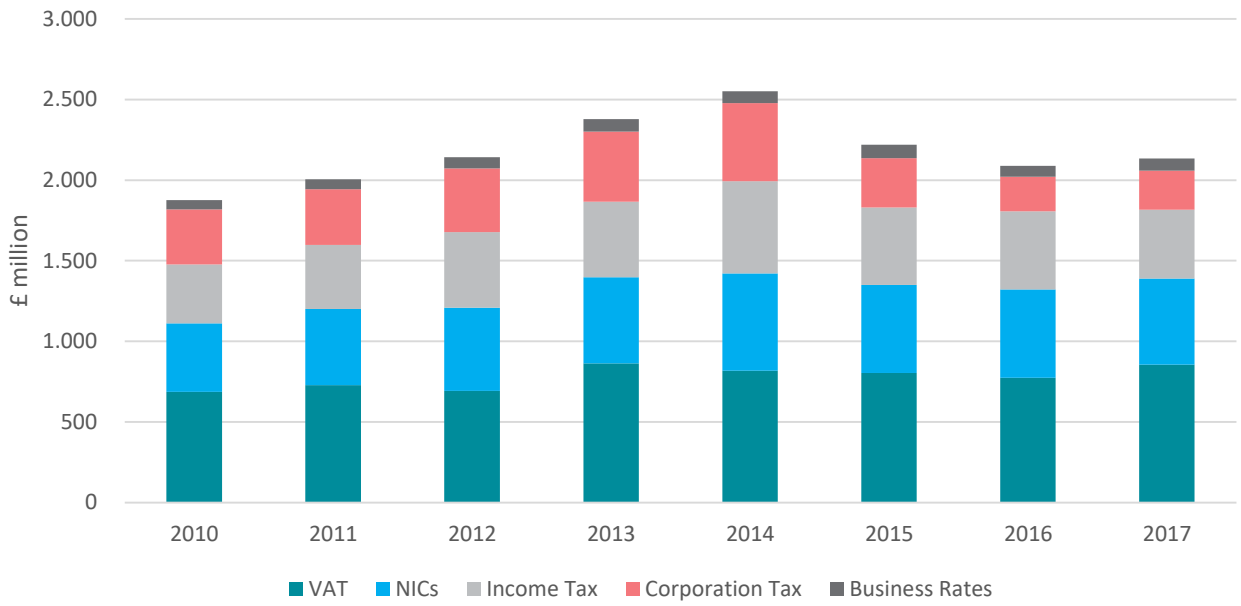
Source: BM, HMRC, SMI, FAME, ONS, Cebr analysis

[15] The Annual Survey of Hours and Earnings (ASHE) provides data on the levels, distribution and make-up of earnings and hours worked for UK employees by sex and full-time or part-time status in all industries and occupations.

The MES industry directly contributed £2.1 billion in tax revenues in 2017; this corresponds to approximately 41% of the total Maritime Sector tax contribution. In aggregate, the MES industry's direct Exchequer contribution grew by 14%, from £1.9 billion in 2010 to £2.1 billion in 2017. Marine Renewable Energy contributed the most to this direct impact, generating £730 million in tax revenues (34% of the direct contribution).

Figure 9 disaggregates the Exchequer contribution of the MES industry by tax head. VAT forms the largest component of Exchequer contributions from the industry, averaging 36% of total tax receipts from the industry from 2010 to 2017. After VAT, the industry is estimated to have contributed £960 million in Income Tax and National Insurance Contributions in 2017.

Figure 9: The direct contribution of the MES industry to the UK Exchequer by tax head, 2010 to 2017, £ million



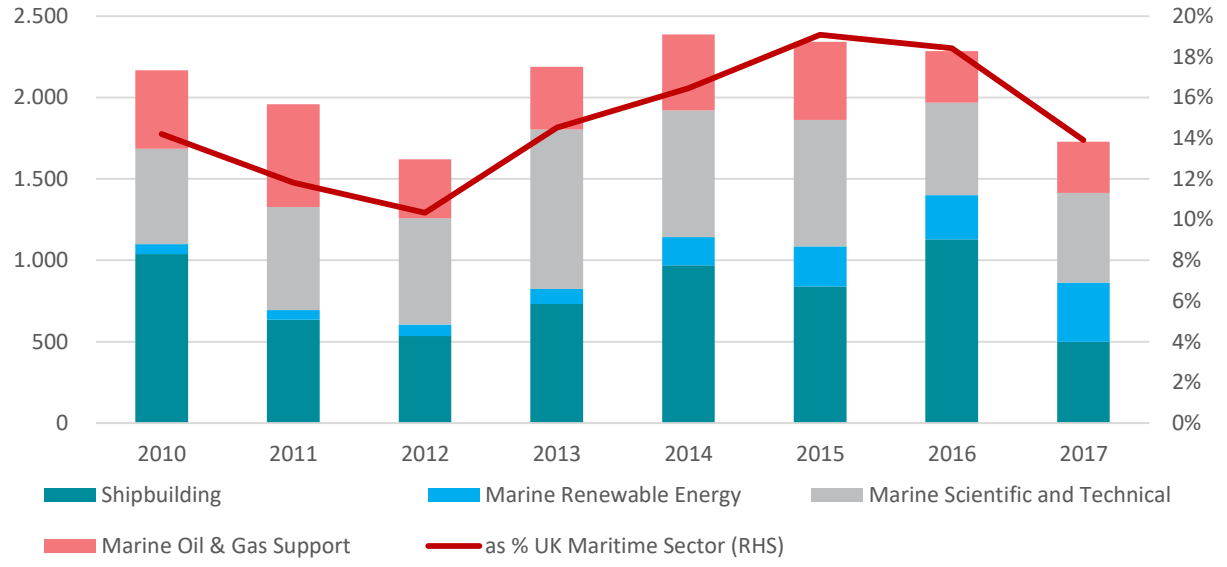
Source: BM, HMRC, SMI, FAME, ONS, Cebr analysis

3.6 The direct contribution to the UK's export of goods and services

Exports for the activities of the MES industry have been estimated by assuming that the level of exports for an industry activity is the same as that of the wider sector within which it sits. For example, exports from marine renewable energy expressed as a proportion of turnover from this activity is assumed to be the same as that of the wider Energy Sector. Specifically, exports of goods and services across each industry activity have been estimated using the ratio of goods and services exports to wider industry turnover as sourced from the ONS Supply Use Tables.

Figure 10 below shows trends in exports of goods and services from the MES industry between 2010 and 2017, and exports expressed as a share of total Maritime Sector exports across the same period.

Figure 10: Exports of goods and services from the MES industry, 2010-2017, £ million

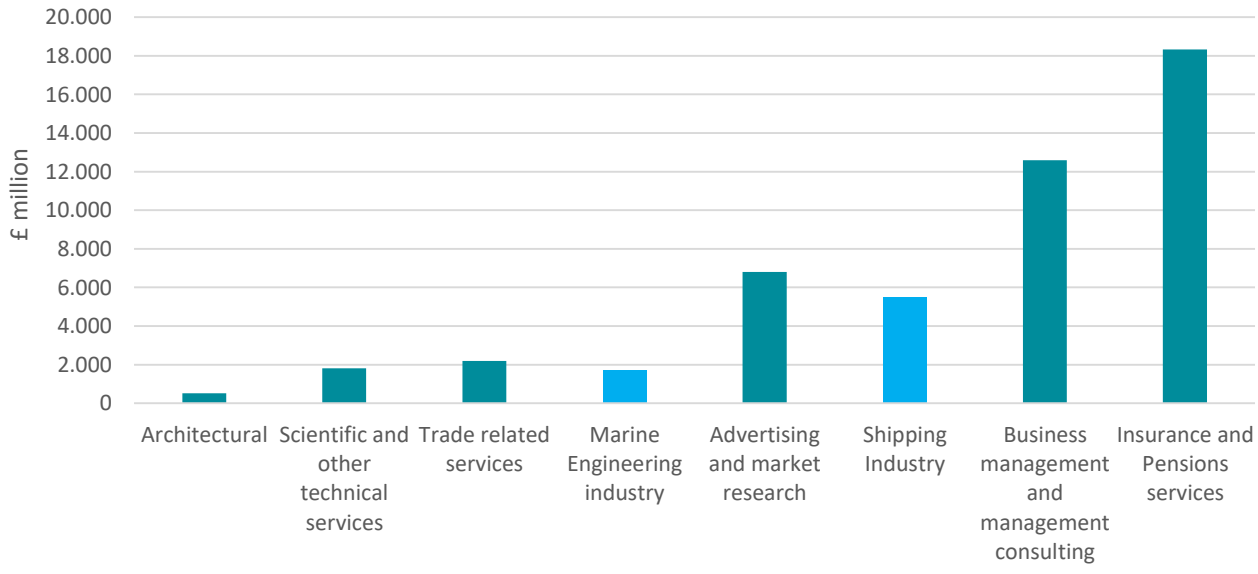


Source: BM, SMI, FAME, ONS, Cebr analysis

The MES industry exported goods and services valued at £1.7 billion in 2017. Marine scientific and technical followed by shipbuilding contributed the most of the MES industry's exported goods, £550 million and £500 million respectively. Growth in MES exports have been varied from 2010-2017. On average, the proportion of industry exports supported by the MES industry has remained around 15%.

Figure 11 below compares exports from the MES industry against exports of goods and services from other comparable activities in 2017, as taken from the Pink Book. The MES industry is estimated to have exported £1.7 billion of goods and services in 2017; this compares to £5.4 billion from the shipping industry and £6.8 billion from the entire advertising and market research industry. The MES industry exports exceeded that of trade-related services (£2.2 billion), scientific and other technical services (£1.8 billion) and architectural services (£0.5 billion).

Figure 11: Exports of goods and services from the MES industry in 2017 against those from comparable activities, £ million



Source: ONS, Cebr analysis

4 The aggregate economic impact of the marine engineering and scientific industry in the UK

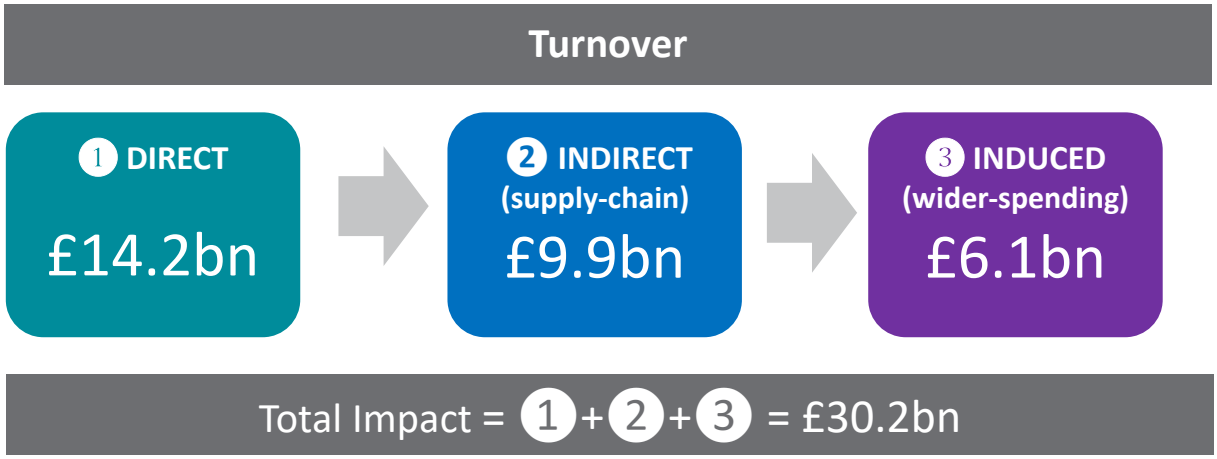
The aggregate economic impacts of the MES industry, take into account the indirect (or supply chain) and induced (employee spending) impacts that arise from the activities of firms within this industry.

4.1 The aggregate economic impacts through turnover

Figure 12 below illustrates the multiplier impacts of the MES industry within the UK. The MES industry directly contributed £14.2 billion in turnover in 2017, where £9.9 billion worth of turnover is stimulated in the supply chains and £6.1 billion worth of turnover in the wider economy when direct and indirect employees spend their earnings.

Alternatively, this can be interpreted as for every £1 of turnover initially generated by the MES, the UK economy as a whole experiences a stimulus in turnover of £2.12.

Figure 12: Turnover multiplier impacts of the UK MES industry, 2017



Source: BM, SMI, FAME, ONS, Cebr analysis

Table 8 shows the estimated aggregate turnover impacts from the individual industry activities when taken in isolation. Shipbuilding had the largest direct turnover impact in 2017 at £5.2 billion followed by marine oil and gas support at £4.6 billion. Similarly, shipbuilding contributed to the largest aggregate turnover impact at £12.6 billion equivalent to 42% of the total MES industry.

Table 8: Domestic turnover impact of the MES industry, 2017, £ million

Turnover in 2017	Direct Impact	Indirect Impact	Induced Impact	Total Impact
TOTAL	**14,239**	**9,861**	**6,111**	**30,212**
Shipbuilding	5,269	4,642	2,778	12,689
Marine renewable energy	2,652	1,856	1,197	5,705
Marine oil & gas support	4,688	2,565	1,397	8,650
Marine scientific	1,630	798	740	3,168

Source: BM, SMI, FAME, ONS, Cebr analysis

Table 9 below presents in each year the direct contribution to turnover from the MES industry, alongside our estimate of the composite turnover multiplier that applies to the entire industry. We observe that both

the turnover multiplier and direct impact are higher in 2017 than in 2010, and thus so too is the total turnover impact.

Table 9: Direct and total turnover impact of the MES industry, 2010 to 2017, £ million

	Direct Impact	Composite Turnover multiplier	Total turnover impacts
2010	12,484	2.06	25,699
2011	13,038	2.07	26,997
2012	13,926	2.07	28,867
2013	15,464	2.07	31,982
2014	15,767	2.07	32,678
2015	15,297	2.09	31,988
2016	13,781	2.13	29,290
2017	14,239	2.12	30,212

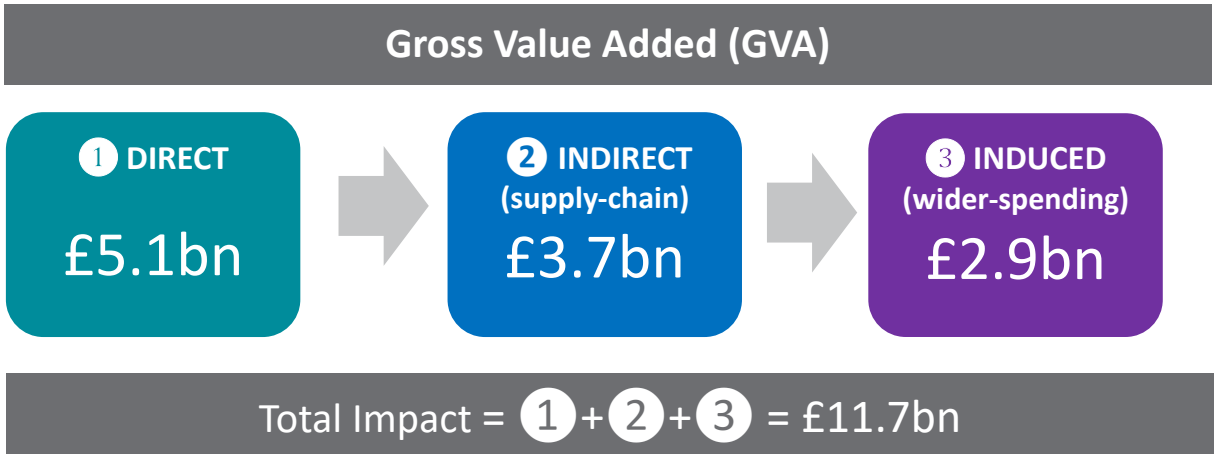
Source: BM, SMI, FAME, ONS, Cebr analysis

4.2 The aggregate economic impacts through GVA

Figure 13 below illustrates the GVA multipliers for the MES industry within the UK. The MES industry directly contributed £5.1 billion towards UK GDP in 2017; once the indirect and induced economic channels are taken into consideration the MES industry contributed £11.7 billion.

Therefore, after combining each industry activity, for every additional £1 of GVA initially contributed by the MES industry, the UK economy as a whole sees a stimulus in GVA of £2.29.

Figure 13: GVA multiplier impacts of the UK MES industry, 2017



Source: BM, SMI, FAME, ONS, Cebr analysis

Table 10 below shows the estimated aggregate GVA impacts from MES industry activities when taken in isolation. Shipbuilding had the largest aggregate GVA impact at £4.3 billion in 2017, followed by marine oil and gas support (£3.6 billion) and marine renewable energy (£2.2 billion).

Table 10: GVA impact of the MES industry disaggregated by activity, 2017, £ million

GVA in 2017	Direct Impact	Indirect Impact	Induced Impact	Total Impact
TOTAL	**5,128**	**3,307**	**2,442**	**11,727**
Shipbuilding	1,511	1,558	1,219	4,288
Marine renewable energy	852	786	638	2,276
Marine oil & gas support	2,073	963	585	3,621
Marine scientific	692	398	452	1,542

Source: BM, SMI, FAME, ONS, Cebr analysis

Table 11 below presents the direct contribution to GVA alongside our estimate of the composite GVA multiplier that applies to the entire industry, an estimated 2.29 in 2017. The aggregate GVA impact from the MES industry increased from £9.4 billion in 2010 to £11.7 billion in 2017.

Table 11: Direct and aggregate GVA impact of the MES industry, 2010 to 2017, £ million

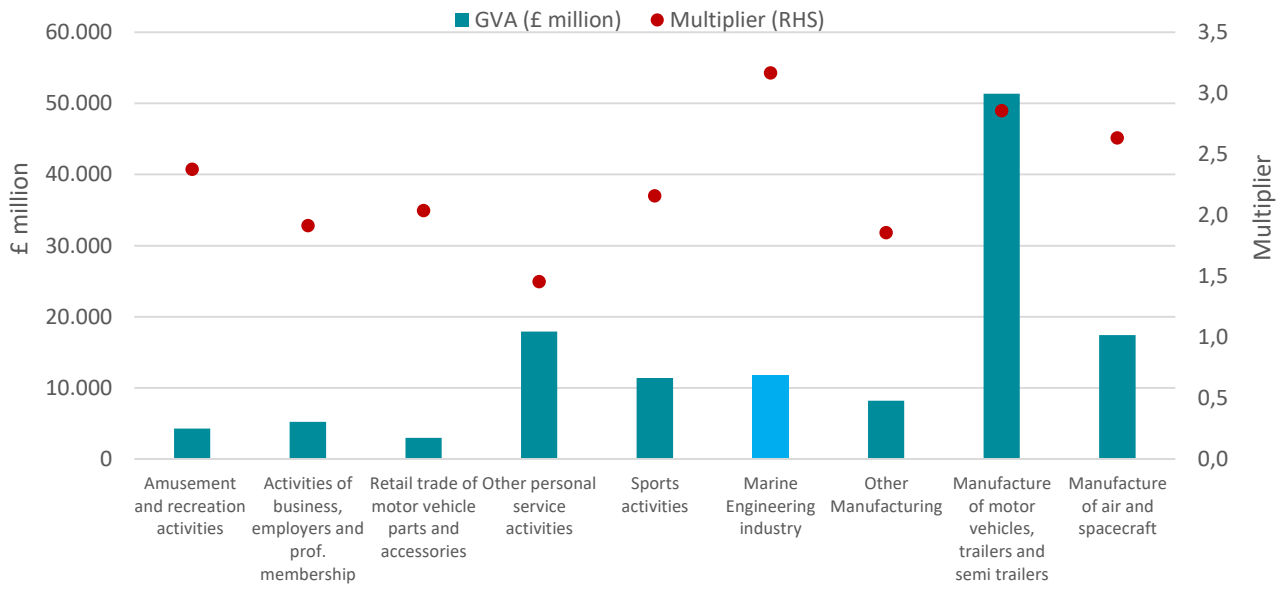
	Direct Impact	Composite GVA multiplier	Total GVA impacts
2010	4,467	2.11	9,409
2011	4,574	2.24	10,235
2012	5,360	2.23	11,927
2013	5,634	2.25	12,662
2014	5,424	2.30	12,466
2015	5,690	2.26	12,880
2016	4,404	2.42	10,649
2017	5,128	2.29	11,727

Source: BM, SMI, FAME, ONS, Cebr analysis

To place these results in context, Figure 14 compares the aggregate GVA impact of the MES industry in 2017 against the comparable activities identified in the previous section. In addition, the GVA multipliers associated with each activity are also presented.

The MES industry has the highest GVA multiplier compared to comparable activities. The MES industry also has the fourth highest GVA, only falling behind other personal service activities, manufacture of air and spacecraft, and manufacture of motor vehicles.

Figure 14: The aggregate GVA impact and GVA multiplier of the MES industry against comparable industries, 2017



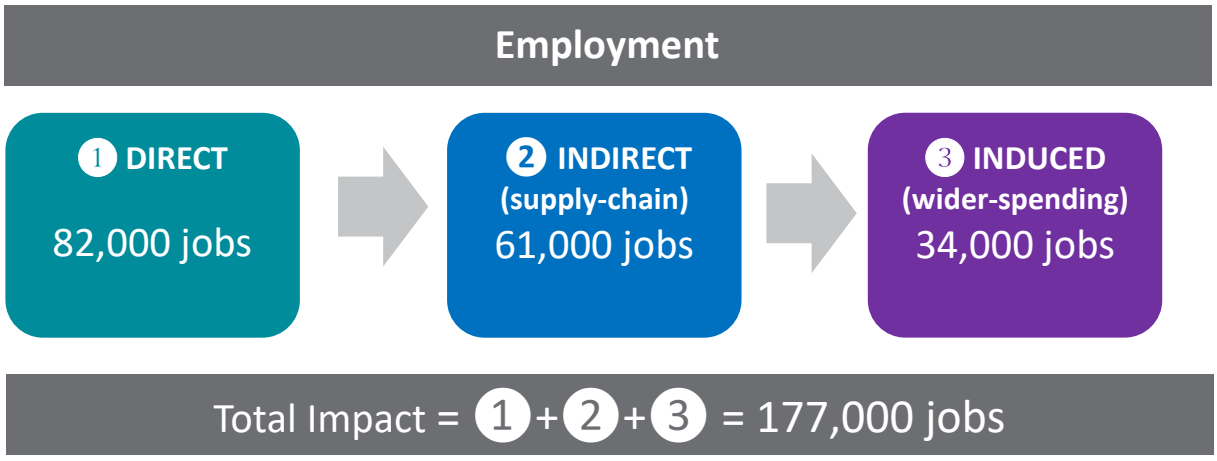
Source: BM, SMI, FAME, ONS, Cebr analysis

4.3 The aggregate economic impacts through employment

Figure 15 below illustrates the employment multipliers for the MES industry within the UK. The number of jobs directly supported by the MES industry in 2017 was 82,000, while 95,000 jobs were supported once the indirect and induced impacts of the industry are taken into account. The aggregate employment supported by the MES industry was 177,000 jobs in 2017.

On an individual level, this can be interpreted as for every one additional job initially supported by the MES industry, the UK economy experiences a stimulus of 2.15 jobs.

Figure 15: Employment multiplier impacts of the UK MES industry, 2017



Source: BM, SMI, FAME, ONS, Cebr analysis

Table 12 below shows the estimated disaggregated employment impacts from the MES industry activities, when taken in isolation. Shipbuilding has the highest aggregate impact to employment at 69,000 jobs followed by marine oil and gas support at 40,000 jobs.

Table 12: Employment impact of the MES industry, 2017, thousands of jobs

Employment in 2017	Direct Impact	Indirect Impact	Induced Impact	Total Impact
TOTAL	**82**	**61**	**34**	**177**
Shipbuilding	29	25	15	69
Marine renewable energy	10	16	5	31
Marine oil & gas support	19	13	7	40
Marine scientific	24	7	6	38

Source: BM, SMI, FAME, ONS, Cebr analysis

Table 13 shows the direct and aggregate employment impacts of the MES industry between 2010 and 2017. In line with an increasing direct contribution to UK employment between 2010 and 2017, the aggregate employment impact has also increased, from 151,000 jobs in 2010 to 177,000 jobs in 2017. The composite multiplier for the industry has remained relatively the same across the years, peaking in 2013 at 2.22.

Table 13: Direct and aggregate employment impact of the MES industry, 2010 to 2017, thousands of jobs

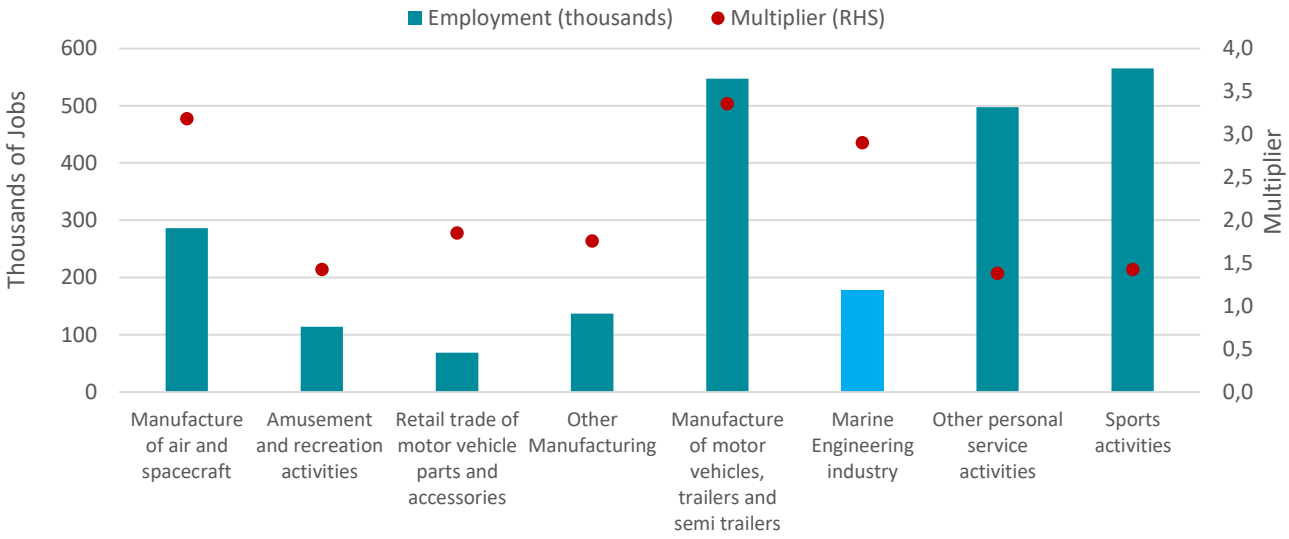
	Direct Impact	Composite Employment multiplier	Total employment impacts
2010	69	2.17	151
2011	74	2.17	159
2012	76	2.16	163
2013	72	2.22	160
2014	80	2.18	175
2015	79	2.19	172
2016	78	2.21	171
2017	82	2.15	177

Source: BM, SMI, FAME, ONS, Cebr analysis

Once again, the MES industry compares favourably against other comparable activities in terms of its aggregate employment impact, shown in Figure 16. The MES industry had an aggregate employment impact of 177,000 jobs in 2017, in comparison to 137,000 for other manufacturing and 114,000 for amusement and recreation activities.

The MES industry also has a notably higher employment multiplier compared to other comparable activities. In 2017, the MES industry had the third highest multiplier, only falling behind manufacture of motor vehicles and manufacture of air and spacecraft.

Figure 16: The aggregate employment impact and employment multiplier of the MES industry against comparable industries in 2017



Source: BM, SMI, FAME, ONS, Cebr analysis

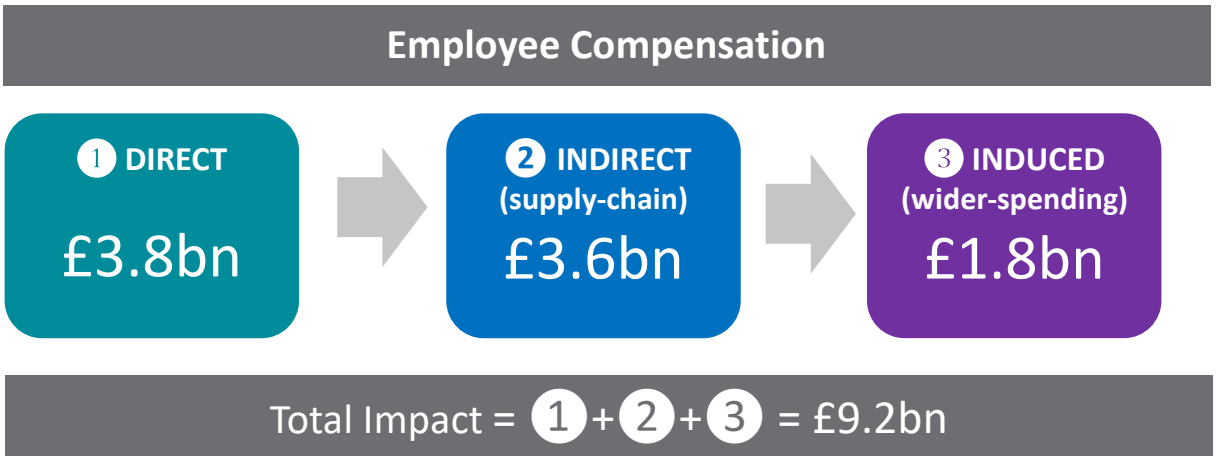
4.4 The aggregate economic impacts through the compensation of employees

Figure 17 below illustrates the direct, indirect and induced compensation of employee impacts associated with the MES industry.

The direct impact of the compensation of employees from the MES industry was £3.8 billion in 2017, whereas £3.6 billion of employee compensation is stimulated in the supply chains and £1.8 billion in the wider economy when direct and indirect employees spend their earnings. The total impact of the compensation of employees was £9.2 billion.

Alternatively this can be interpreted as follows, for the MES industry as a whole, for every £1 directly raised in the compensation of employees in 2017, a total of £2.40 in employee compensation was supported in the UK economy.

Figure 17: Aggregate contribution of the MES industry through the compensation of employees, 2017



Source: BM, SMI, FAME, ONS, Cebr analysis

Table 14 below shows the estimated aggregate impacts through the compensation of employees from MES industry activities, when taken in isolation. A total of £9.2 billion through the compensation of employees was supported by the industry in 2017, the majority of this contribution sourced from shipbuilding activities (£3.3 billion) and marine oil and gas support (£3.2 billion).

Table 14: Impact through the compensation of employees in the MES industry, 2017, £ million

Compensation of Employees in 2017	Direct Impact	Indirect Impact	Induced Impact	Total Impact
TOTAL	**3,820**	**3,573**	**1,787**	**9,180**
Shipbuilding	1,458	1,165	666	3,289
Marine renewable energy	537	954	288	1,779
Marine oil & gas support	1,306	1,212	640	3,158
Marine scientific	519	242	193	954

Source: BM, SMI, FAME, ONS, Cebr analysis

Table 15 presents the direct contribution to GVA alongside our estimate of the composite compensation of employees (COE) multiplier that applies to the entire MES industry, an estimated 2.40 in 2017. The composite multiplier for the MES industry has remained relatively constant since 2010.

However, due to growth in the MES industries, the aggregate impact through the compensation of employees has risen from £7.5 billion in 2010 to £9.2 billion in 2017.

Table 15: Direct and aggregate impacts through the compensation of employees from the MES industry, 2010 to 2017, £ million

	Direct Impact	Composite Employee Compensation multiplier	Total employee compensation impacts
2010	3,158	2.39	7,539
2011	3,026	2.39	7,235
2012	3,701	2.41	8,934
2013	3,990	2.41	9,614
2014	3,530	2.40	8,480
2015	3,853	2.41	9,295
2016	3,101	2.42	7,509
2017	3,820	2.40	9,180

Source: BM, SMI, FAME, ONS, Cebr analysis

5 The regional economic impact of the marine engineering and scientific industry

We can apportion the direct and aggregate impacts found in Sections 3 and 4 to the constituent regions in the UK.

5.1 The direct economic impact of the marine engineering and scientific industry by UK region

Business turnover and GVA

Figure 18 and 19 below show the estimated regional breakdown of business turnover and GVA directly supported by the MES industry in 2017.

Figure 18: Regional breakdown of turnover directly contributed by the MES industry, 2017, £ million

Note: Figures subject to rounding to nearest £100 million.

Source: BM, SMI, FAME, ONS, Cebr analysis

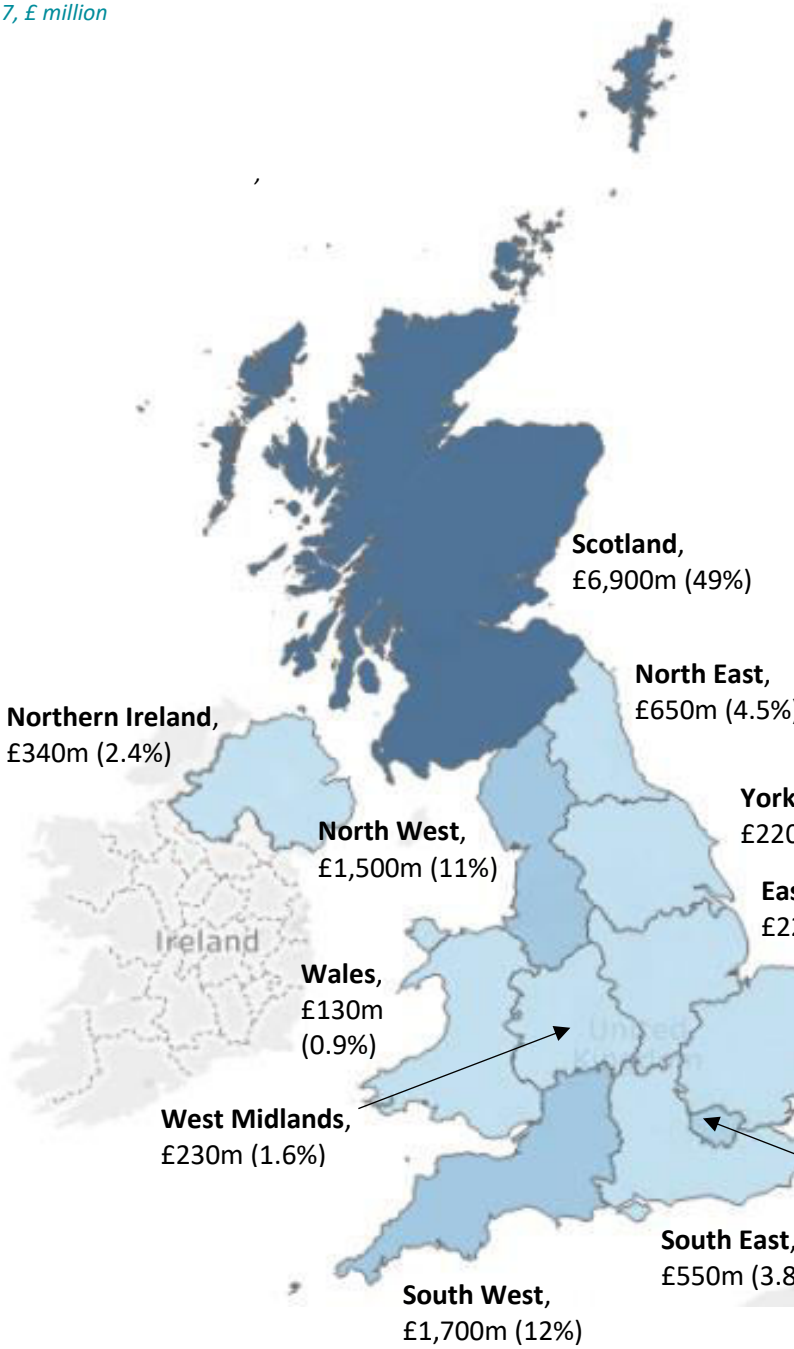
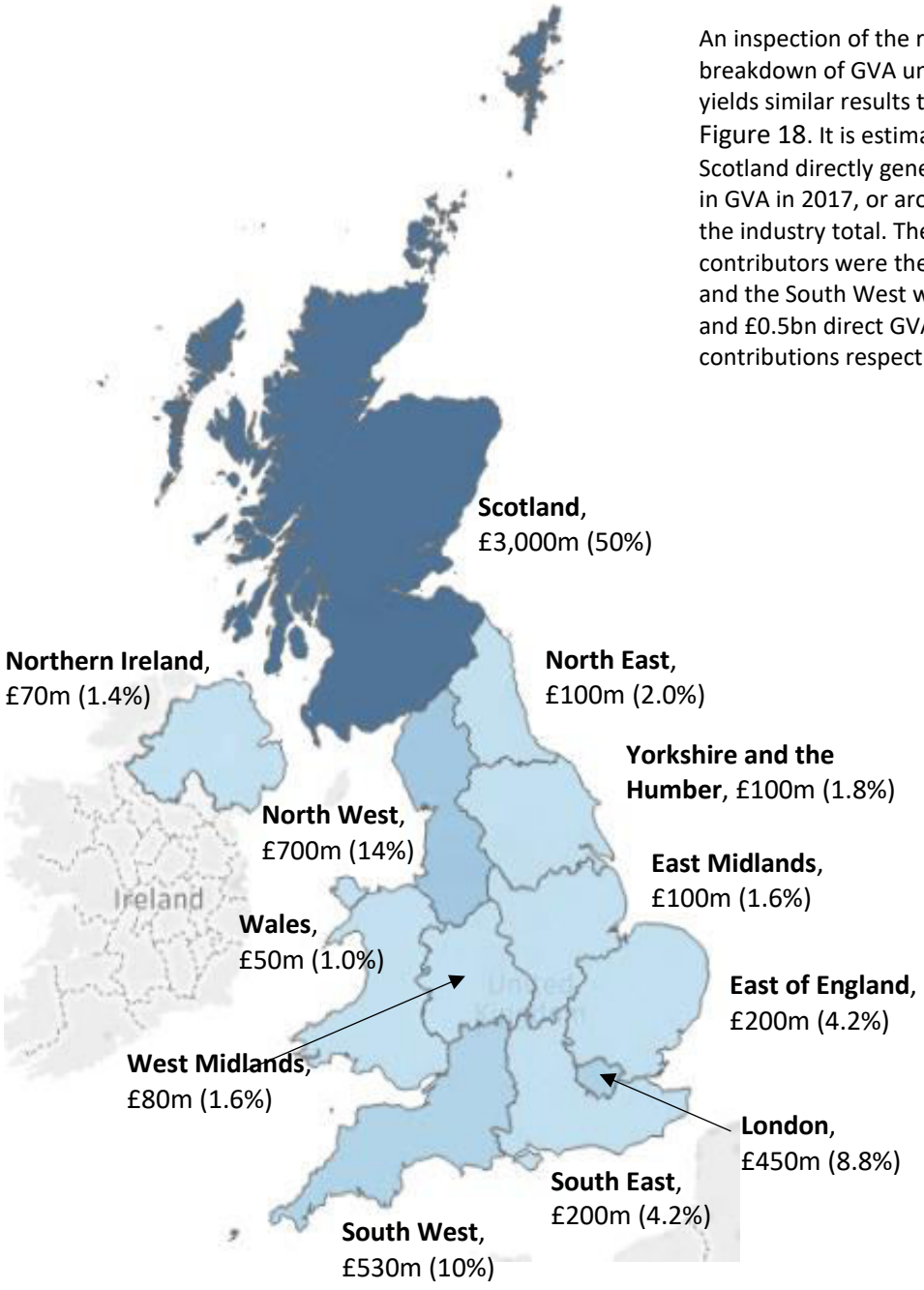


Figure 19: Regional breakdown of GVA directly contributed by the MES industry, 2017, £ million



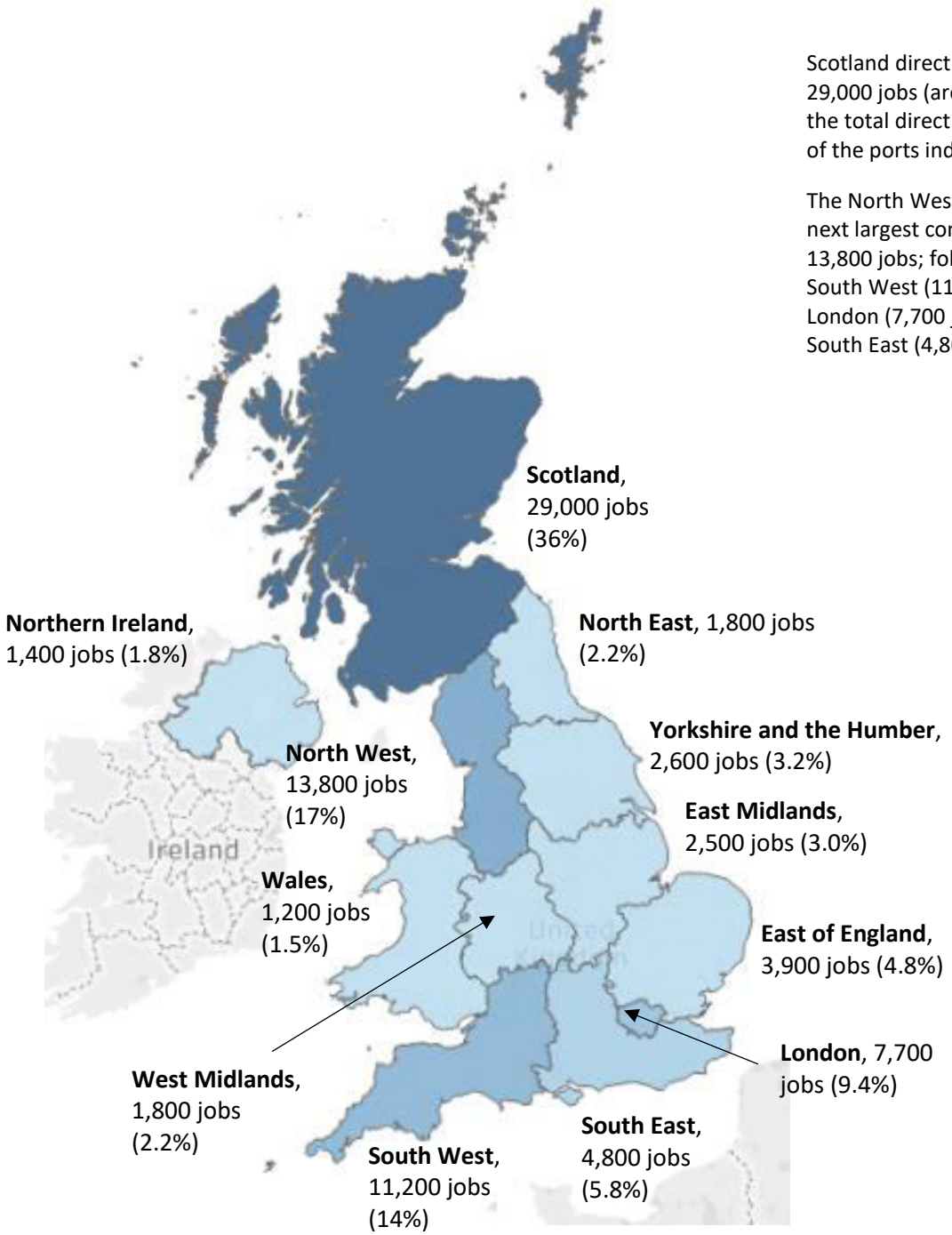
An inspection of the regional breakdown of GVA unsurprisingly yields similar results to those in Figure 18. It is estimated that Scotland directly generated £3.0bn in GVA in 2017, or around 50% of the industry total. The next largest contributors were the North West and the South West with £0.7bn and £0.5bn direct GVA contributions respectively.

Note: Figures subject to rounding to nearest £100 million. Source: BM, SMI, FAME, ONS, Cebr analysis

Employment and the Compensation of Employees

Figure 20 and 21 below shows the estimated regional breakdown of employment and the compensation of employees directly supported by the MES industry in 2017.

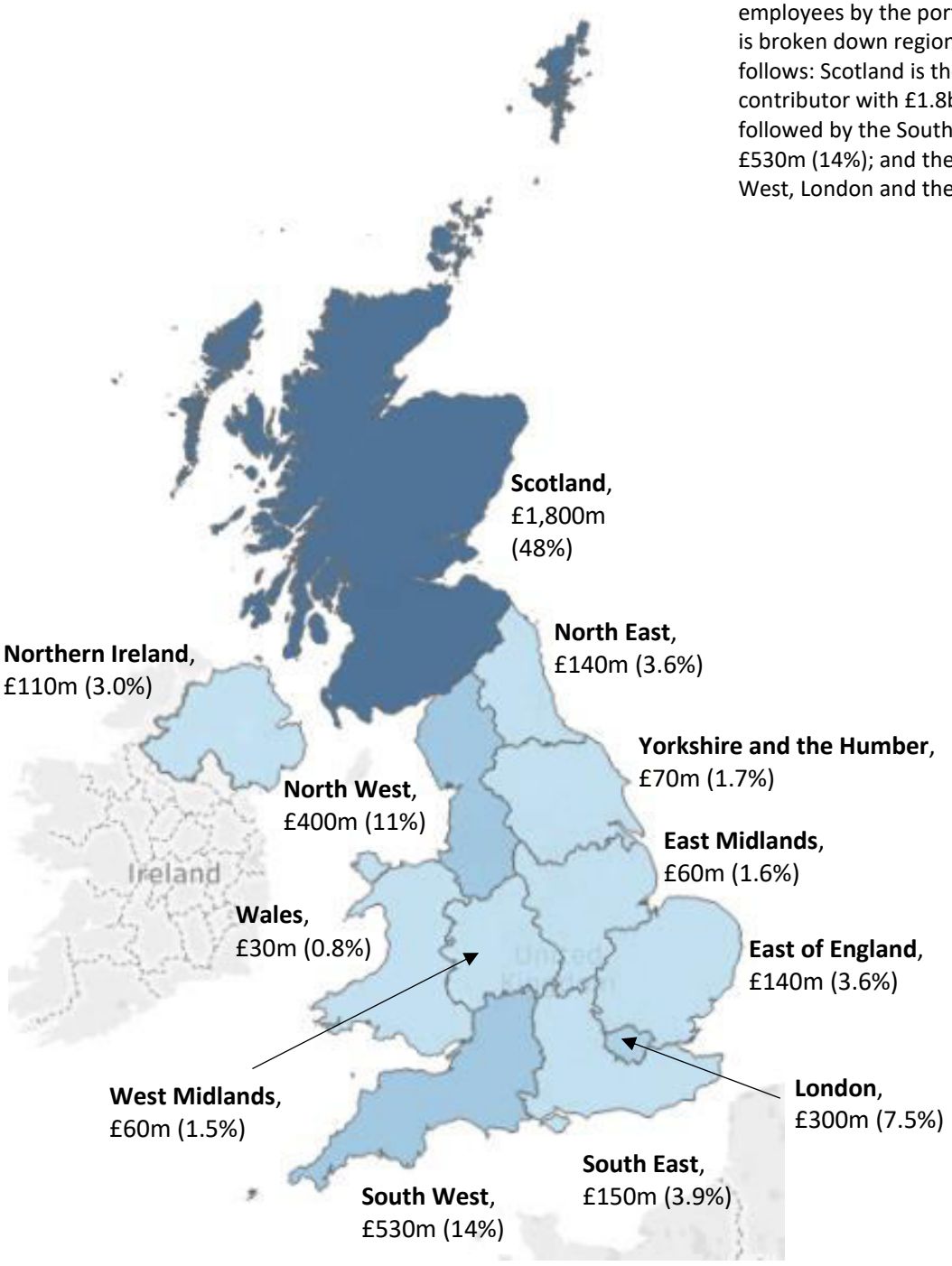
Figure 20: Regional breakdown of employment directly contributed by the MES industry, 2017, jobs



Note: Figures subject to rounding to nearest hundred jobs. Source: BM, SMI, FAME, ONS, Cebr analysis

Figure 21: Regional breakdown through the compensation of employees directly contributed by the MES industry, 2017, £ million

The direct compensation of employees by the ports industry is broken down regionally as follows: Scotland is the largest contributor with £1.8bn (48%); followed by the South West with £530m (14%); and then the North West, London and the South East.



Note: Figures subject to rounding to nearest £100 million. Source: BM, SMI, FAME, ONS, Cebr analysis

5.2 The aggregate economic impact of the industry by UK region

This final subsection examines the aggregate economic impact of the MES industry across each region for the four macroeconomic indicators covered in the previous subsection. In order to estimate the aggregate economic impact of the industry at regional level, the direct economic impacts as already estimated were combined with Cebr's regional economic impact models, within which the activities of the MES industry were separately identified and isolated.

It is important to note that the economic impact multipliers as estimated for each region are necessarily lower than the equivalent multiplier for the MES industry as a whole, reflecting the leakage of impacts when the activity of the industry in a particular region imports inputs from elsewhere in the UK outside that region.

The aggregate economic impacts for business turnover and GVA by region

Table 16 shows the breakdown of direct and aggregate economic impacts for business turnover and GVA in 2017, alongside the composite industry multiplier for each region. The region with largest aggregate impacts through turnover and GVA was Scotland, with an aggregate impact of £6.9 billion and £2.5 billion respectively. For GVA, the highest multiplier impacts are associated with the South West, East of England and North West.

Table 16: Regional breakdown of the aggregate economic impact through turnover and GVA contributed by the MES industry, 2017

	Turnover (£ million)			GVA (£ million)		
Region	Direct Impact	Industry Multiplier	Total impact	Direct Impact	Industry Multiplier	Total impact
Scotland	6,944	1.86	12,932	2,543	1.82	4,627
Wales	133	1.80	240	51	2.19	112
Northern Ireland	337	2.00	675	70	2.25	157
East of England	608	1.96	1,192	214	2.30	493
East Midlands	218	1.83	398	82	1.98	162
London	1,165	1.84	2,146	452	2.09	947
North East	647	1.95	1,264	103	2.14	221
North West	1,497	1.98	2,970	701	2.29	1,602
South East	545	1.98	1,077	214	2.28	488
South West	1,699	2.19	3,726	528	2.53	1,332
West Midlands	224	1.72	384	80	1.93	153
Yorkshire and the Humber	223	1.83	409	91	2.05	186

Source: BM, SMI, FAME, ONS, Cebr analysis

The aggregate economic impacts for employment and the compensation of employees by region

Finally, Table 17 below shows the breakdown of direct and aggregate economic impacts for employment and the compensation of employees in 2017, alongside the composite industry multiplier for each region. The region with the largest aggregate impacts through employment and the compensation of employees was Scotland, with an aggregate impact of 29,100 and £1.8 billion, respectively.

Table 17: Regional breakdown of the aggregate economic impact through employment and the compensation of employees contributed by the MES industry, 2017

	Employment (thousands of jobs)			Compensation of Employees (£ million)		
Region	Direct Impact	Industry Multiplier	Total impact	Direct Impact	Industry Multiplier	Total impact
Scotland	29.1	1.90	55.1	1,840	2.14	3,944
Wales	1.2	1.67	2.0	31	2.13	65
Northern Ireland	1.4	1.95	2.8	113	1.95	220
East of England	3.9	2.11	8.3	139	2.57	357
East Midlands	2.5	1.51	3.7	63	1.92	121
London	7.7	1.62	12.5	288	2.17	625
North East	1.8	2.01	3.7	139	2.18	302
North West	13.8	1.86	25.8	411	1.95	803
South East	4.8	1.80	8.6	148	2.30	339
South West	11.2	2.06	23.1	524	2.13	1,115
West Midlands	1.8	1.59	2.9	58	2.11	122
Yorkshire and the Humber	2.6	1.59	4.2	67	2.01	133

Source: BM, SMI, FAME, ONS, Cebr analysis

6 Case Study: Autonomous Vessels

Autonomous Vessels is a fast emerging sub-industry in the Maritime Sector with projections that it will be worth $136bn globally by 2030.[16] Its success relies on continuous investments within the marine engineering and scientific industry as well as the viability of moving into commercial shipping. Rolls-Royce have already stated that it is not a matter of 'if the technology is available', but rather how the technology can be utilised in the most cost-efficient manner.[17] The technology for automation, such as fusion sensors (sensors comprised of HD cameras, thermal imaging and LIDAR) are readily available in autonomous cars and drones.[18]

One of the crucial factors that will determine the viability and success of autonomous vessels in the case of international shipping, passenger ferries and military operations, is the vessel's safety. To have a chance of regulatory approval and commercial feasibility, the vessels need to be at least as safe as current operations.[19] However, this may not be as large an issue as it seems – autonomous vessels will benefit from reducing the amount of human error that is made. Human error currently accounts for between 75 to 95% of all insured losses from shipping.[20] Moreover, it is quite possible that unmanned vessels will be able to navigate areas that are too risky for manned vessels, creating opportunities and increasing efficiency beyond current operations.

The technology is advancing rapidly. In 2018, Rolls-Royce in partnership with Finferries completed the world's first fully autonomous ferry crossing in Finland. Although a crew were on-board, the journey between Parainen and Nauvo was completed autonomously, including the docking, using latest collision avoidance technology.[21] Similar advancements are being made in the UK from L3 ASV and AutoNaut, both leading the way for commercial use, research and military use of autonomous vessels.

L3 ASV provides autonomous vessels for commercial activities relating to Oil and Gas, Marine Science, Geophysical Surveying and Offshore Renewables. Its military operations include Marine Targets, Marine Countermeasures, Anti-Submarine Warfare and Security and Surveillance.[22] This wide scope of operations employ 83 individuals in the UK and had a turnover in 2017 of £9.78m.[23] Leading work has included operations for the National Oceanic Atmospheric Administration's Office of Coast Survey and discovery of shipwrecks in the Great Lakes of the US and Canada.[24]

In a similar vein, AutoNaut has also significantly developed autonomous vessels for commercial operations. Their speciality falls to Metocean, Water Quality Testing, Passive Acoustic Monitoring, Surveillance, Marine Surveying, Commination gateways and Marine Life Monitoring.[25] One of the key properties of AutoNaut is its use of renewable energy. It is powered by the motion of the waves and the sensory equipment through solar energy. This means it can survive weeks on end without any carbon-based fuel.[26]

[16] HWF. (2018). 'Autonomous Ships: Shipping 4.0'.
[17] Rolls-Royce. (2016). 'Autonomous Ships. The next step'.
[18] Ibid.
[19] Ibid.
[20] HWF. (2018). 'Autonomous Ships: Shipping 4.0'.
[21] Rolls-Royce. (2018). 'Rolls-Royce and Finferries demonstrate world's first Fully Autonomous Ferry.'
[22] L3HARRIS ASV. (2019). 'Redefining the way the world works at sea'.
[23] Financial Accounts from Bureau van Dijk's FAME database.
[24] L3HARRIS ASV. (2019). 'The Autonomous Boat that's redefining Coastal Hydrographic Survey'.
[25] AutoNaut. (2019). 'AutoNaut'.
[26] Ibid.

Companies like Rolls-Royce, L3 ASV and AutoNaut have illustrated their importance to the MES industry through their continual investment into this emerging area of maritime. L3 ASV was awarded, alongside nine other companies, £3 million by Innovate UK to research and develop Maritime Autonomous Systems.[27] This emphasises the view that autonomous vessels are an important emerging sub-sector to the wider Maritime Sector and to the UK as a whole.

Autonomous vessels are likely to become increasingly utilised in the future. As it stands, 95% of UK trade volume is transported via ships[28] and is not expected to decline significantly by 2050. Thus, if autonomous vessels can increase the efficiency of this trade, it will have a significant positive impact on the economy.

Moreover, a key target of the Maritime 2050 Strategy is to reduce carbon emissions by 50%.[29] AutoNaut has already shown the ability to operate for weeks on end without the need for carbon-based fuels, relying on wave movement and solar energy to power its operations. This can, in theory, be scaled up such that a larger part of the ship-based maritime sector relies more heavily on renewable energies than the heavy sulphur based fuels. This, in addition to the growth in marine renewable energies, will play a significant part in the coming years helping the wider Maritime Sector reach its sustainability goals by 2050.

[27] L3HARRIS ASV. (2015). 'ASV Wins Maritime Autonomy R&D Funding.'
[28] Department for Transport. (2019). 'Maritime 2050 Navigating the Future'.
[29] Ibid.