Assessment of the expected economic impact of the Future Combat Air System programme (2025-2070)

October 2024

pwc

Disclaimer and impartiality statement

PwC was commissioned by BAE Systems to undertake an independent assessment of the Future Combat Air System (FCAS) programme.

The inputs and data used in this report have been provided by Future Combat Air System (FCAS) industry partners. The analysis represents PwC's impartial and objective assessment of the impact of the programme's activity. Conclusions have been driven by the evidence available and have not been subject to any influence from the industry partners.

The analysis is therefore based on what has been agreed with the FCAS industry partners as the appropriate assumptions at the point of writing. Given the nature of the programme, these assumptions are subject to potentially significant change as the programme evolves.

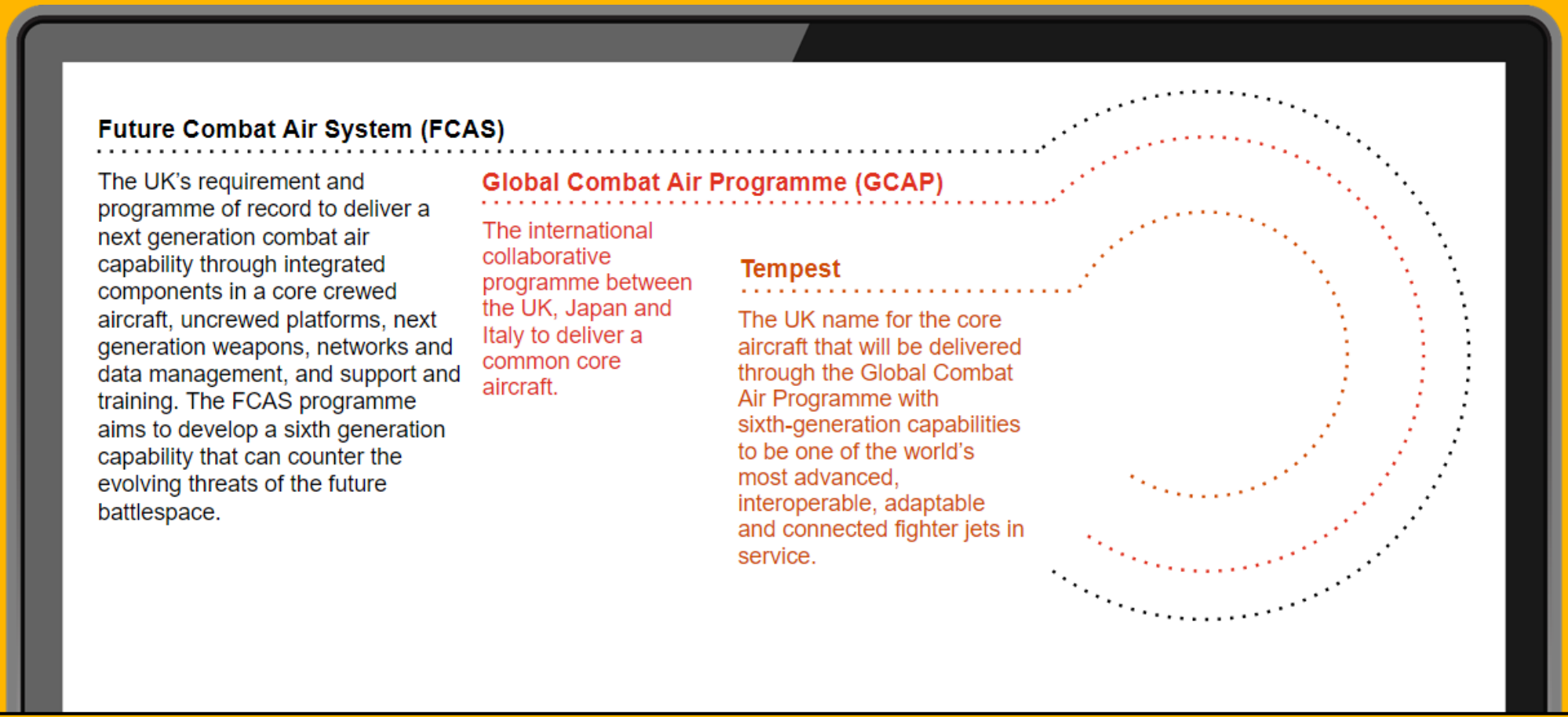
The analysis in this report primarily considers the core crewed aircraft to be developed through the Global Combat Air Programme (GCAP), as well as associated support, training, and enhancements.

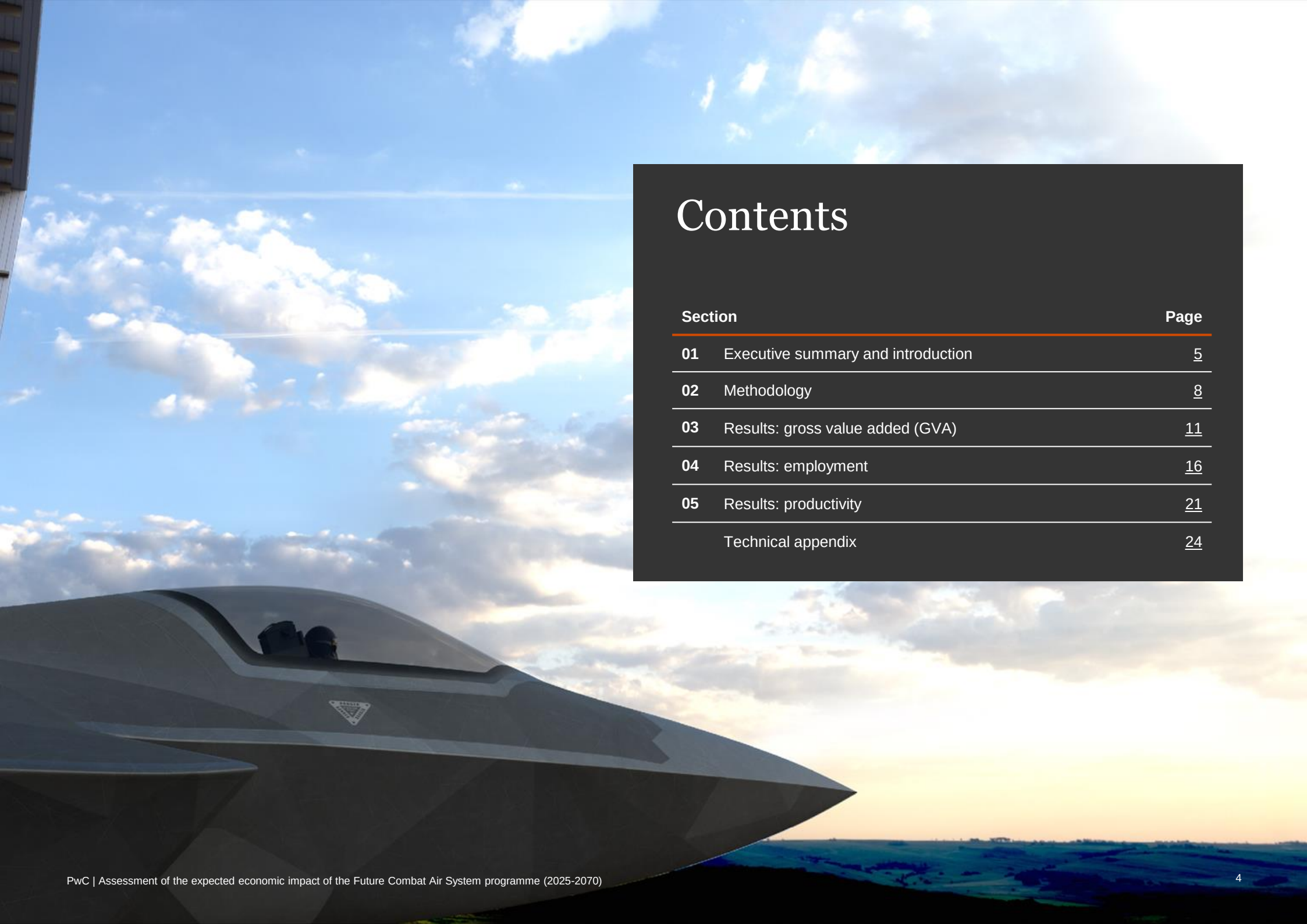
Wider FCAS system elements including uncrewed platforms, next-generation weapons, and networks and data management are not currently included in this analysis, as the concept and assessment phase for these elements is ongoing.

The analysis uses data that were available from the FCAS industry partners based on the activity they anticipated under the programme as was envisaged at the time of writing, although the scope may vary as the programme evolves. Assumptions made around work share within the GCAP or between key subcontractors may change over time, or there may be a different balance of activity between the industry partners or with other potential suppliers

The analysis presented in this report is based on data that do not include any exports, which could be significant based on previous internationally collaborative programmes. However, in the event that there are significant export sales, this would result in increased production and a greater degree of economic activity and employment in the combat air sector.

Programme definitions





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Executive summary and introduction

Overview of this report

Overview

The UK's Future Combat Air System (FCAS) programme was launched in 2018. Innovation sits at the heart of the programme, which builds on existing capabilities through advanced technology development.

FCAS is developing capability for the next generation of air warfare capability for the Royal Air Force (RAF). The analysis in this report considers the potential economic impact of the FCAS programme in the UK from 2025 to 2070. This period includes development, production, entry into service, operational support, and continued evolution of the programme.

The report also examines the short-term economic impact of the programme, from 2025 to 2035. This period has been chosen because 2035 is the expected In-Service Date (ISD) and captures both the design stage and manufacture stages.

What is the FCAS programme?

FCAS is a Ministry of Defence (MOD) programme with the aim of providing the UK with cutting-edge combat air capability, comprised of a core aircraft platform (Tempest), alongside other elements within a wider ecosystem. As an example of planned innovation, the core aircraft platform will be integrated with information systems to optimise live and virtual training. The FCAS programme will aim to integrate crewed and uncrewed aircraft with offboard information technology. This will enable data centric warfare, which itself is intended to form part of a multi-domain approach. The analysis in this report considers the development of a UK-led international FCAS programme.

How is FCAS linked to GCAP?

The Global Combat Air Programme, launched in December 2022, is a tri-national collaborative programme between the UK, Italy and Japan to deliver a crewed aircraft, that will be at the heart of the UK's Future Combat Air System. This aircraft will be called 'Tempest' in the UK.

Scope of this report

This report is an update to PwC's previous analysis[1], which examined the economic impact of the Tempest Programme, and was published in 2021.

The analysis for this report uses input-output modelling to estimate the economic impacts of the FCAS programme. The economic impact is presented as both a contribution to Gross Value Added (GVA) and Full-Time Equivalent (FTE) jobs. The analysis presented here is on a gross basis, i.e., it is not adjusted for factors like displacement.

This report does not capture the impact of potential exports for the FCAS programme. Under FCAS, the potential for exports is significant, given the scale of previous combat air systems, such as the Typhoon programme, which has seen over 680 orders across nine countries to date.[2] Any significant degree of exports could increase the GVA and employment impacts.

The analysis in this report primarily considers the core crewed aircraft (Tempest), as well as associated support, training, and enhancements. Wider FCAS system elements, including uncrewed platforms, next-generation weapons, and networks and data management, are not currently included as the assessment phase is still ongoing.

The next section outlines the approach to estimating the economic impact for the FCAS programme. A technical appendix has been included to provide further detail on the methodologies and assumptions used.

[1] – PwC (2021) Assessment of the expected economic impact of the Tempest programme (2021-2050), link.

[2] – Eurofighter Typhoon: The programme, link.

FCAS is estimated to increase GVA and employment across the UK, resulting in highly-productive jobs

2025 – 2035 impact

£16 billion*

Estimated GVA contribution from FCAS in the UK over the period 2025-2035.

£9bn	£4bn	£3bn
Direct	Indirect	Induced

16,400*

Estimated total jobs per year from FCAS in the UK over the period 2025-2035.

6,280	5,717	4,387
Direct	Indirect	Induced

£130,000

Estimated direct GVA per direct job for FCAS over the period 2025-2035.

Of the total GVA 2025-2035 88% is expected to be outside London and the South East, along with 86% of jobs.

2025 – 2070 impact

£37 billion*

Estimated GVA contribution from FCAS in the UK over the period 2025-2070.

£19bn	£10bn	£7bn
Direct	Indirect	Induced

13,300*

Estimated total jobs per year from FCAS in the UK over the period 2025-2070.

3,593	6,211	3,486
Direct	Indirect	Induced

£118,000

Estimated direct GVA per direct job for FCAS over the period 2025-2070.

Of the total GVA 2025-2070, 86% is expected to be outside London and the South East, along with 82% of jobs.

*This analysis does not capture the potential for exports, which could be significant - based on previous internationally collaborative programmes. Please note that figures are independently rounded so may not sum to the total.

2

Methodology

Overview of this report

In this report, the economic impact of the FCAS programme is assessed using three key metrics:

Gross value added (GVA)

A measure of the economic contribution of a company, industry, or sector. GVA is similar to GDP, but without an adjustment to include taxes on products and exclude subsidies on products.

This measure is used in order to avoid potential double-counting, as it only includes the 'value added' at each stage of production. It is used to communicate the total value created at industry level, including wages, profits, and other contributions that bring value within the production process.

Employment

The number of people who work for a sector, who have a contract of employment and receive compensation in the form of salaries. This is the number of full-time equivalent (FTE) jobs supported by FCAS, both directly through employing workers in the sector, and more broadly in the economy.

Productivity

Productivity is measured by direct GVA per direct employee, which is comparable over time and across industries, as a proxy measure for the skill level of employees. In other terms it is the value created per worker.

It is recognised that the FCAS programme involves numerous partners in the UK, which could have a geographically dispersed impact on the UK economy. This report endeavours to capture estimates of this impact across all regions in the UK and utilises the International Territorial Level 1 (ITL1) breakdown of the UK, which splits the country into 12 regions.[3]

[3] – Office for National Statistics, International geographies, link.

An input-output model was built to estimate the direct, indirect, and induced impact of the industry

Type I multiplier

Type I multipliers estimate the impact on the **supply chain** as a result of the change in direct contribution. Type I multipliers are the **ratio of direct and indirect effects to direct effects.**

Type II multiplier

Type II multipliers capture the **direct, indirect and also induced** effects resulting from a change in direct contribution.

Direct

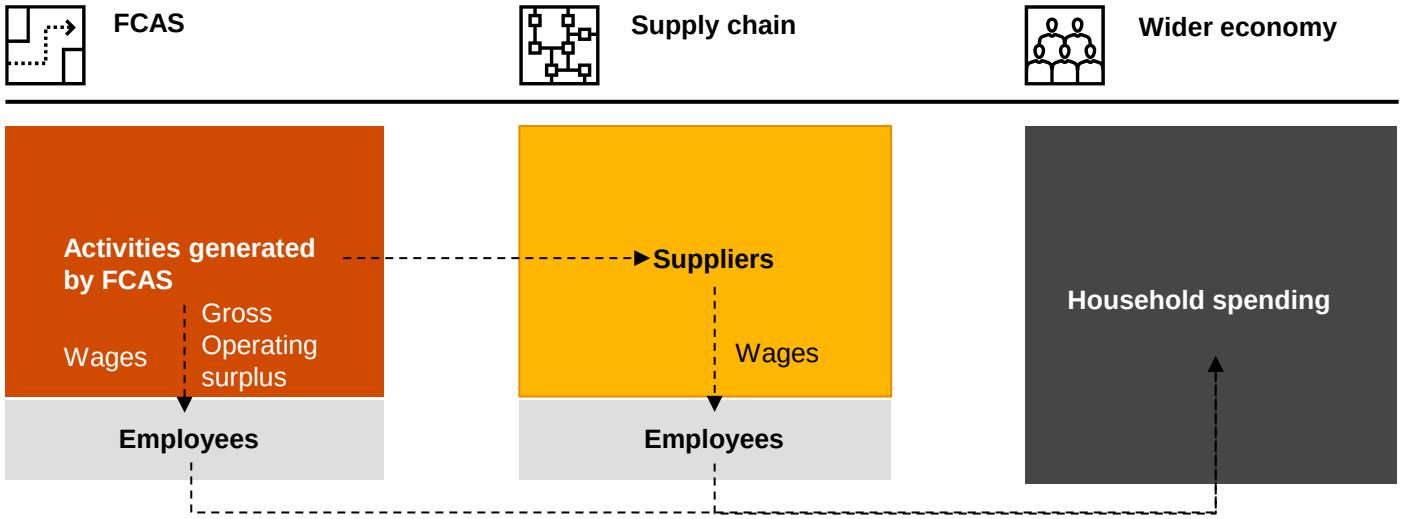
The direct contribution results from FCAS operations: it includes the **people employed directly and the expenditure of industry partners.** This includes expenditures such as wages, purchases, rentals, marketing, IT services and use of professional activities.

Indirect

The indirect contribution is generated in the industry's **supply chain** through the procurement of inputs by industry partners. It measures the increased output and employment created from demand for goods and services from **suppliers down the supply chain.**

Induced

The induced contribution is generated through the **spending by employees from their earnings**. It includes both employees directly hired from the partners and others who operate within the supply chain. It measures **output and employment generated from demand and spending** by employees.



3

Gross value added (GVA)

FCAS is estimated to contribute £16bn of GVA across the UK between 2025 and 2035

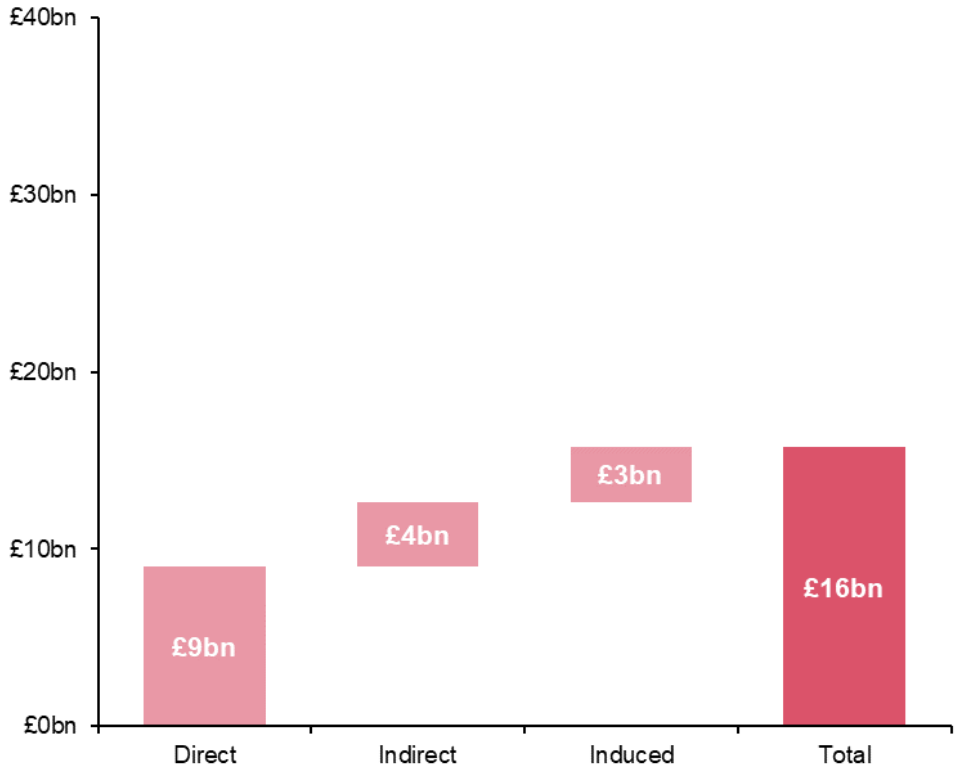
In the period of 2025 to 2035, it is estimated that the FCAS programme could contribute up to £16 billion to the UK economy.

For every £1 of the partners' direct economic activity under FCAS, the analysis indicates that a further £0.78 could be supported elsewhere in the economy.

The total estimated GVA contribution of £16 billion is made up of a direct contribution from the four industry partners of £9 billion (57% of the impact). £4 billion of economic activity is estimated to be generated through the supply chain (23% of the impact) with the remaining £3 billion coming from employees' spending (20% of the impact).

This analysis does not capture the potential for exports, which could be significant - based on previous internationally collaborative programmes.

GVA contribution (between 2025 and 2035, discounted)



Please note that figures are independently rounded so may not sum to the total.

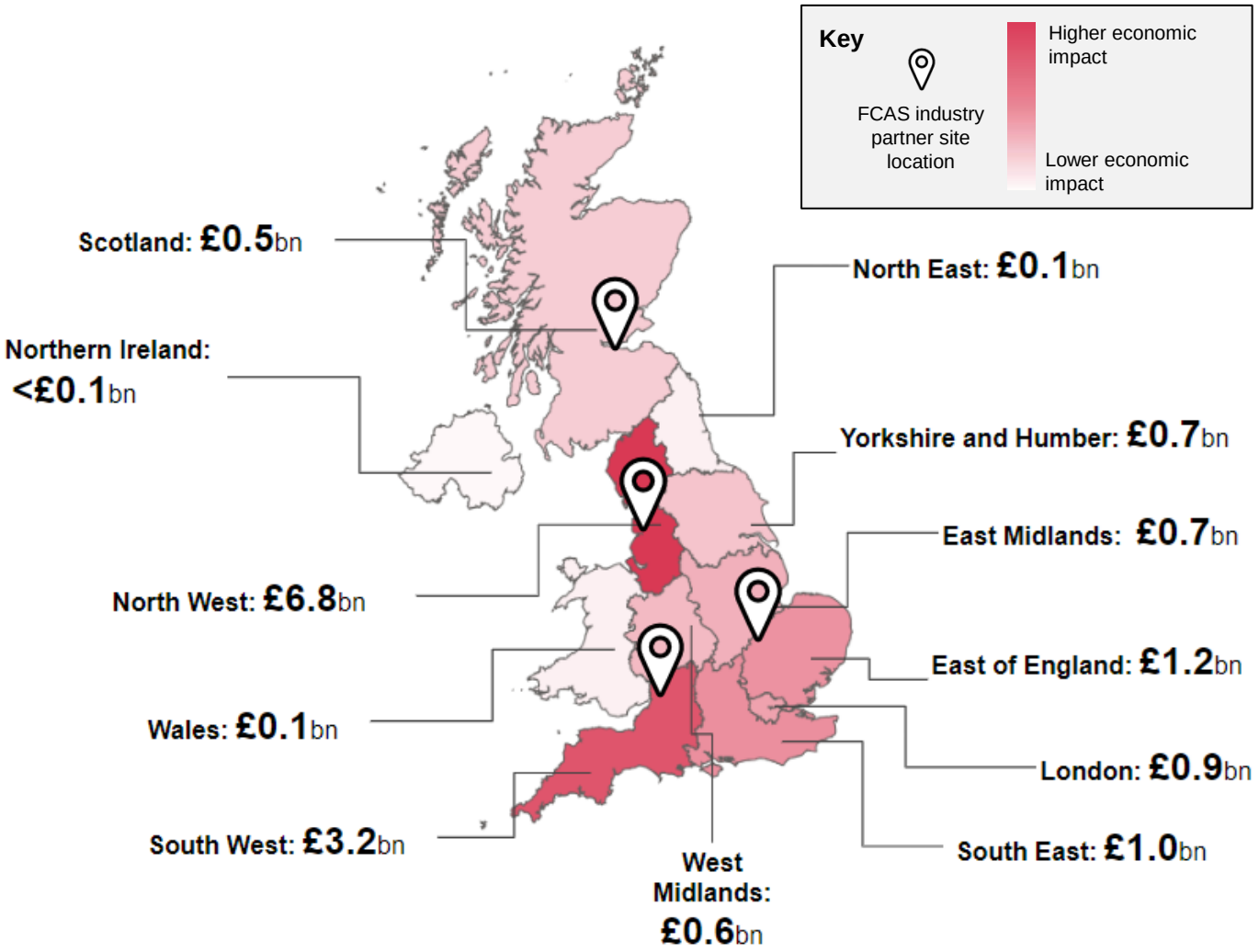
FCAS is estimated to contribute £16bn of total GVA to the UK between 2025 and 2035

Given the geographical spread of activity, FCAS is anticipated to have significant impacts on a number of regions in the UK. A large part of defence manufacturing activity takes place in the North West and the South West of England. Indeed these two regions account for the largest GVA impact between 2025 and 2035, at £6.8 billion and £3.2 billion respectively.

FCAS is estimated to create economic activity in all regions. 88% of this impact is felt outside of London and the South East of England. This can support government objectives to drive economic growth across the country.

This analysis does not capture the potential for exports, which could be significant - based on previous internationally collaborative programmes.

Total regional GVA (between 2025 and 2035, discounted)



Please note that figures are independently rounded so may not sum to the total.

FCAS is estimated to contribute £37bn of GVA across the UK between 2025 and 2070

In the period of 2025 to 2070, it is estimated that the FCAS programme could contribute up to £37 billion to the UK economy.

For every £1 of the partners' direct economic activity under FCAS, the analysis indicates that a further £0.90 could be supported elsewhere in the economy.

The total estimated GVA contribution of £37 billion is made up of a direct contribution from the four industry partners of £19 billion, which is around half of the impact (53%). £10 billion of economic activity is estimated to be generated through the supply chain (28% of the impact) with the remaining £7 billion coming from employees' spending (19% of the impact).

This analysis does not capture the potential for exports, which could be significant - based on previous internationally collaborative programmes.

GVA contribution (between 2025 and 2070, discounted)

Please note that figures are independently rounded so may not sum to the total.

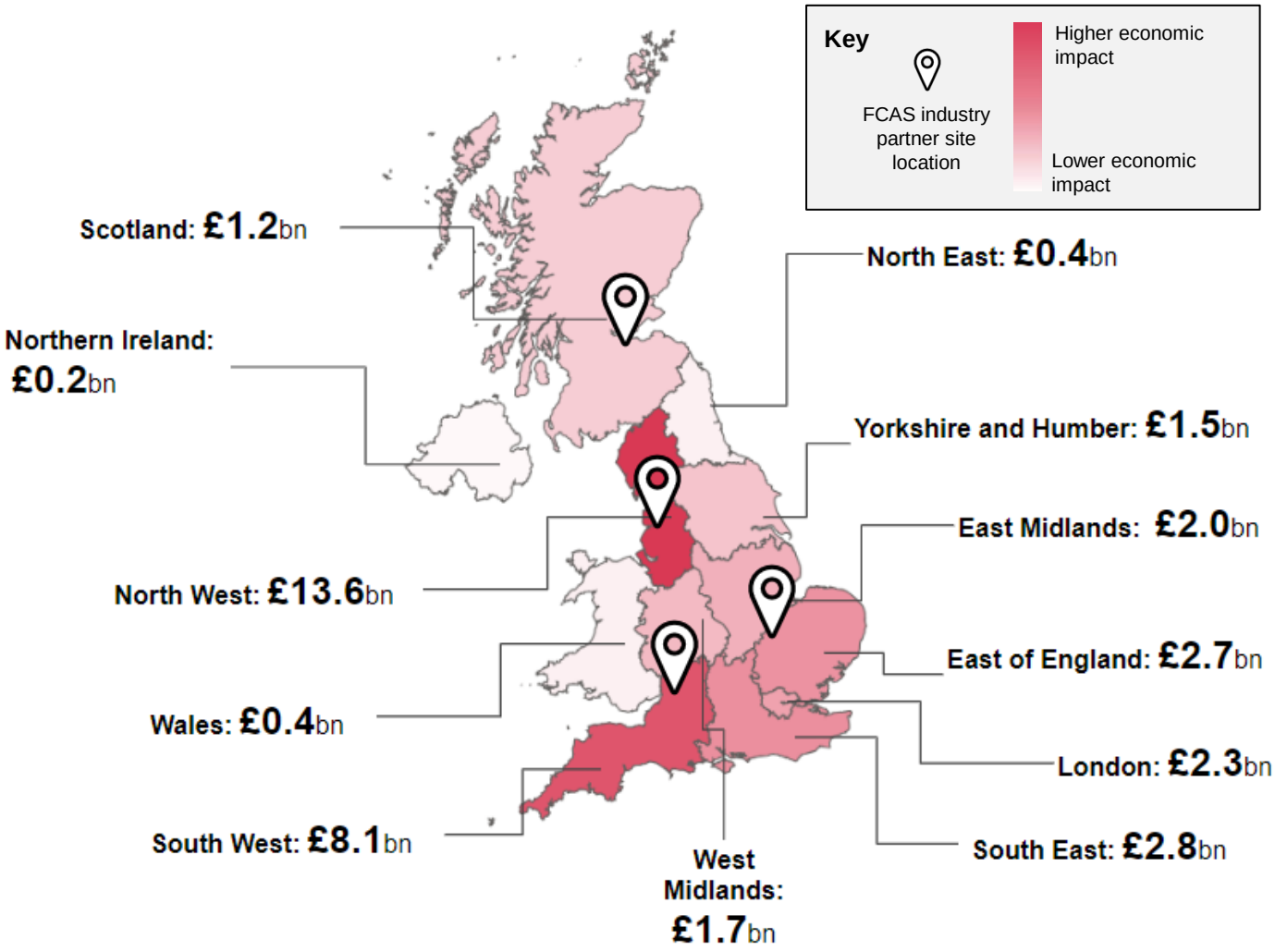
FCAS is estimated to contribute £37bn of total GVA to the UK between 2025 and 2070

Given the geographical spread of activity, FCAS is anticipated to have significant impacts on a number of regions in the UK. A large part of defence manufacturing activity takes place in the North West and the South West of England. Indeed, these two regions account for the largest GVA impact between 2025 and 2070, at £13.6 billion and £8.1 billion respectively.

The UK Government has set out a policy objective to level up the UK economy. The aim is to spread the creation of opportunities throughout the UK. FCAS is estimated to create economic activity in all regions. 85% of this impact is felt outside of London and the South East of England.

This analysis does not capture the potential for exports, which could be significant - based on previous internationally collaborative programmes.

Total regional GVA (between 2025 and 2070, discounted)



Please note that figures are independently rounded so may not sum to the total.

4

Employment

FCAS could support 16,400 jobs on average per year between 2025 and 2035

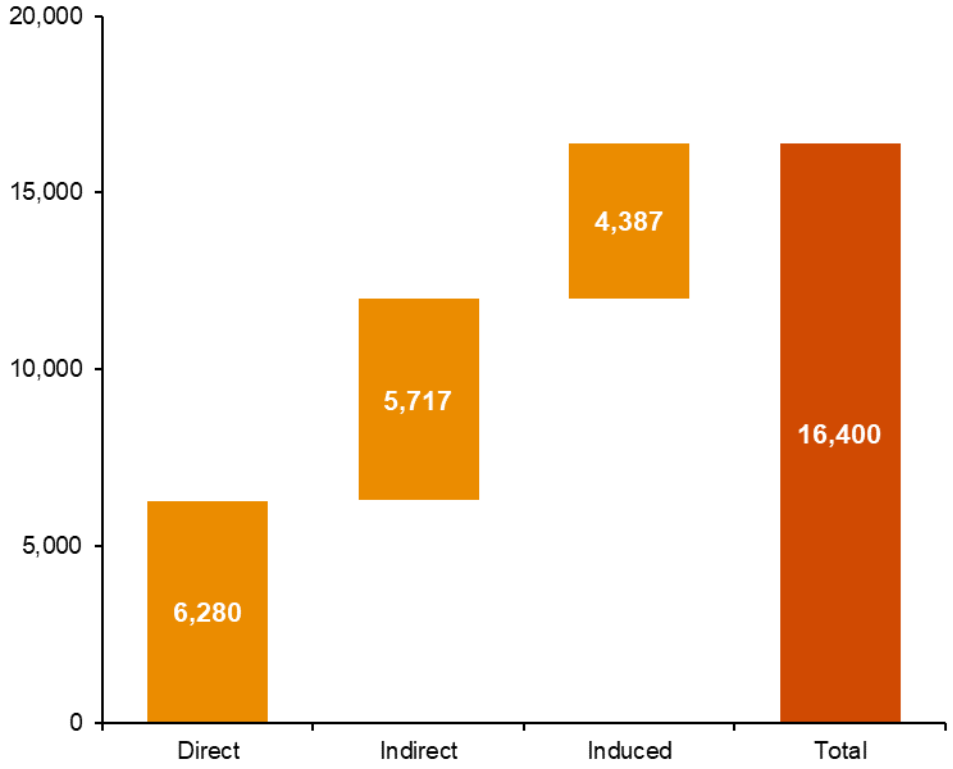
The analysis indicates that the FCAS programme could support an annual average of 16,400 FTE jobs between 2025 and 2035, which is the expected In-Service Date (ISD).This period captures both the design stage and manufacture stages.

Direct contribution accounts for 38% of the impact (6,280 jobs) with 35% driven by the supply chain (5,717 jobs) and the remaining 27%, as a result of employees spending their wages (4,387 jobs).

Direct and induced impacts are larger during this period, which is explained by the larger workforce required in the design stage. Indirect impacts are slightly smaller on average during this period as a result of the lower supply chain spending, with average annual spending on the supply chain around £50m lower in this period compared to 2025 to 2070.

This analysis does not capture the potential for exports, which could be significant - based on previous internationally collaborative programmes.

Employment contribution (between 2025 and 2035)



Please note that figures are independently rounded so may not sum to the total.

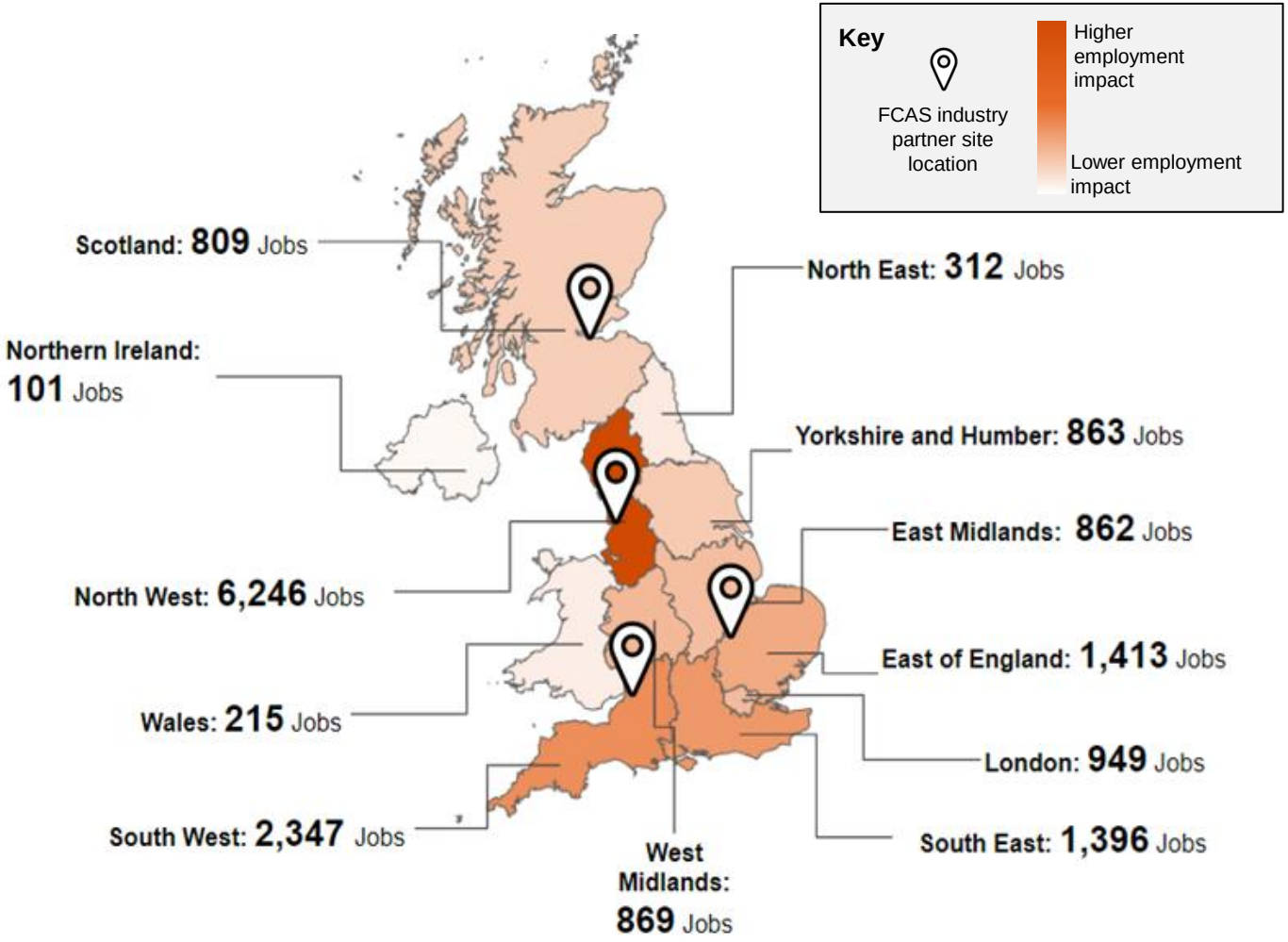
FCAS could support 16,400 total jobs on average each year in the UK between 2025 and 2035

On a regional basis, the analysis indicates that the North West could be the largest beneficiary, with almost 6,250 FTE jobs per year. The second most jobs supported are located in the South West, with almost 2,350 FTE jobs supported annually.

It is expected that 86% of the direct, indirect and induced jobs would be created outside London and the South East. This can support government objectives to drive economic growth across the country.

This analysis does not capture the potential for exports, which could be significant - based on previous internationally collaborative programmes.

Total regional jobs per year (between 2025 and 2035)



Please note that figures are independently rounded so may not sum to the total.

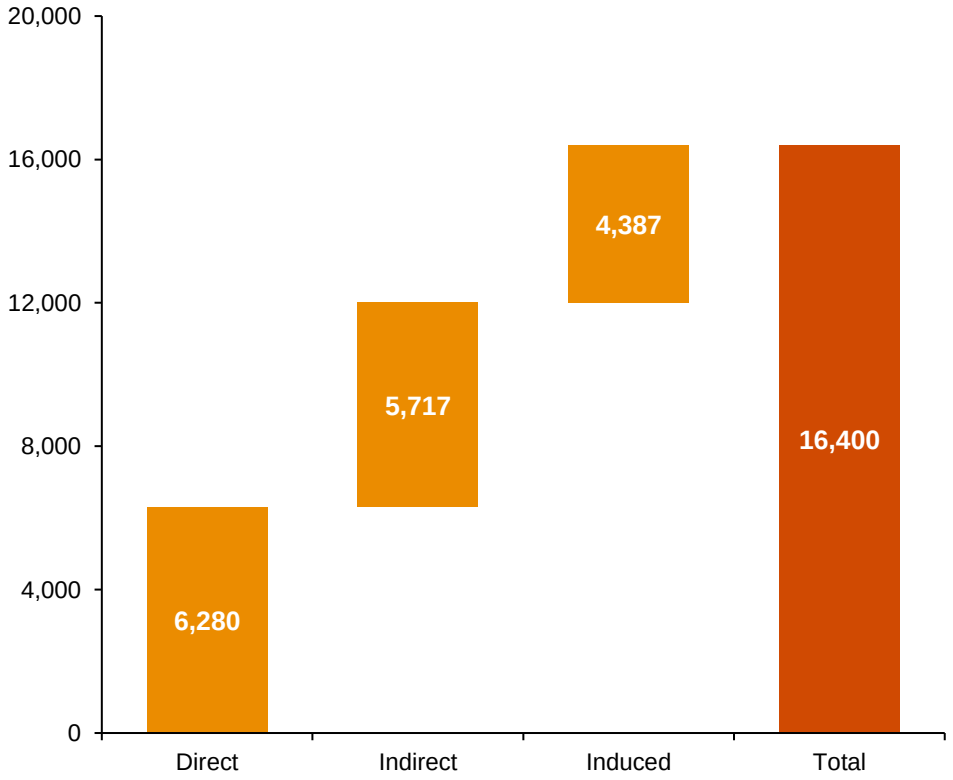
FCAS could support 13,327 jobs on average per year between 2025 and 2070

The analysis indicates that the FCAS programme could support an annual average of 13,300 FTE jobs between 2025 and 2070. This is lower than the average over the initial manufacturing period, which may be more labour intensive. But exports or manufacture of other elements of the system could support a higher level of employment for a longer period.

The largest share of jobs is supported through the supply chain, standing at 47% of the impact (6,200 FTE jobs). This is consistent with the nature of specialist skills required by the industry, such that there are complex supply chains. The Defence and Security Industrial Strategy (DSIS) emphasises the importance of strengthening supply chains and FCAS could contribute to this objective.

This analysis does not capture the potential for exports, which could be significant - based on previous internationally collaborative programmes.

Employment contribution (between 2025 and 2070)



Please note that figures are independently rounded so may not sum to the total.

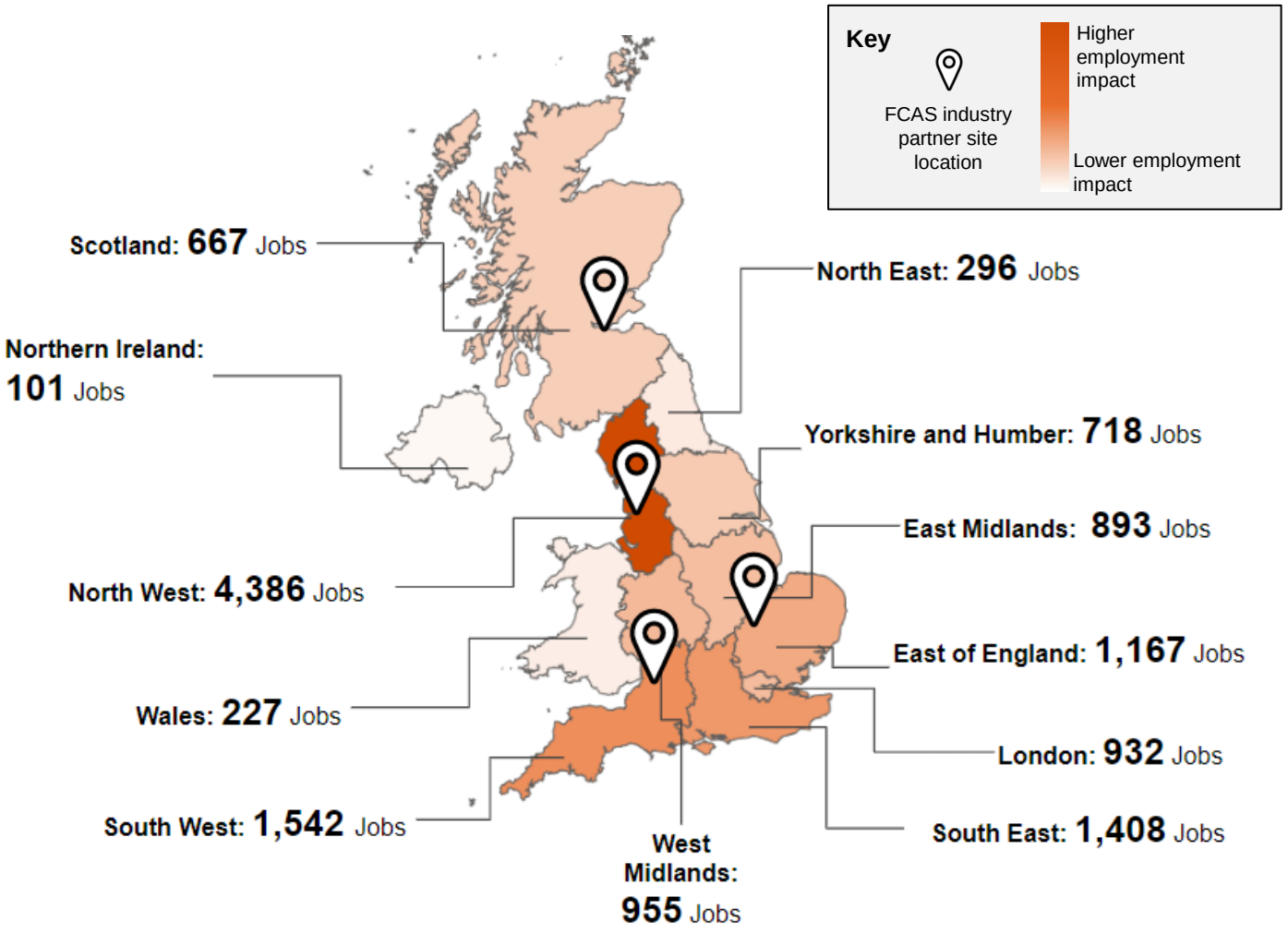
FCAS could support 13,327 total jobs on average each year in the UK between 2025 and 2070

On a regional basis, the analysis indicates that the North West could be the largest beneficiary, with almost 4,400 FTE jobs per year. The second most jobs supported are located in the South West, with over 1,540 FTE jobs supported annually.

It is expected that 83% of the direct, indirect and induced jobs would be created outside London and the South East. This can support government objectives to drive economic growth across the country.

This analysis does not capture the potential for exports, which could be significant - based on previous internationally collaborative programmes.

Total regional jobs per year (between 2025 and 2070)



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5

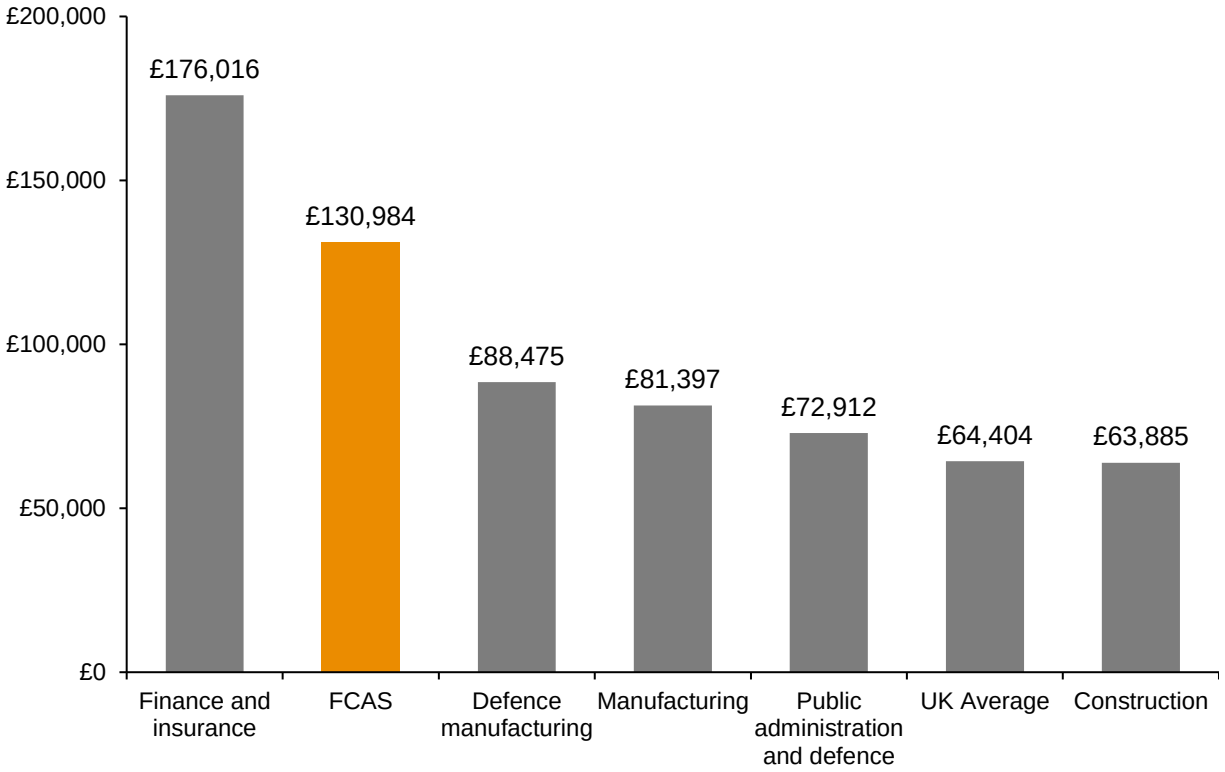
Productivity

Our analysis indicates FCAS workers could be more productive compared to similar sectors between 2025 and 2035

The analysis finds that, under FCAS, GVA per worker could be significantly higher than the UK average, with £131,000 direct GVA contributed per direct worker over the period 2025 to 2035. GVA per worker for FCAS is around 50% higher than the average for the defence sector, and is also higher than both the average of the manufacturing sector, and the average of the manufacture of other transport equipment sectors.

This analysis does not capture the potential for exports, which could be significant - based on previous internationally collaborative programmes.

Direct GVA per direct job (between 2025 and 2035)



Sources: industry partner data, output per job, Office for National Statistics, (link)

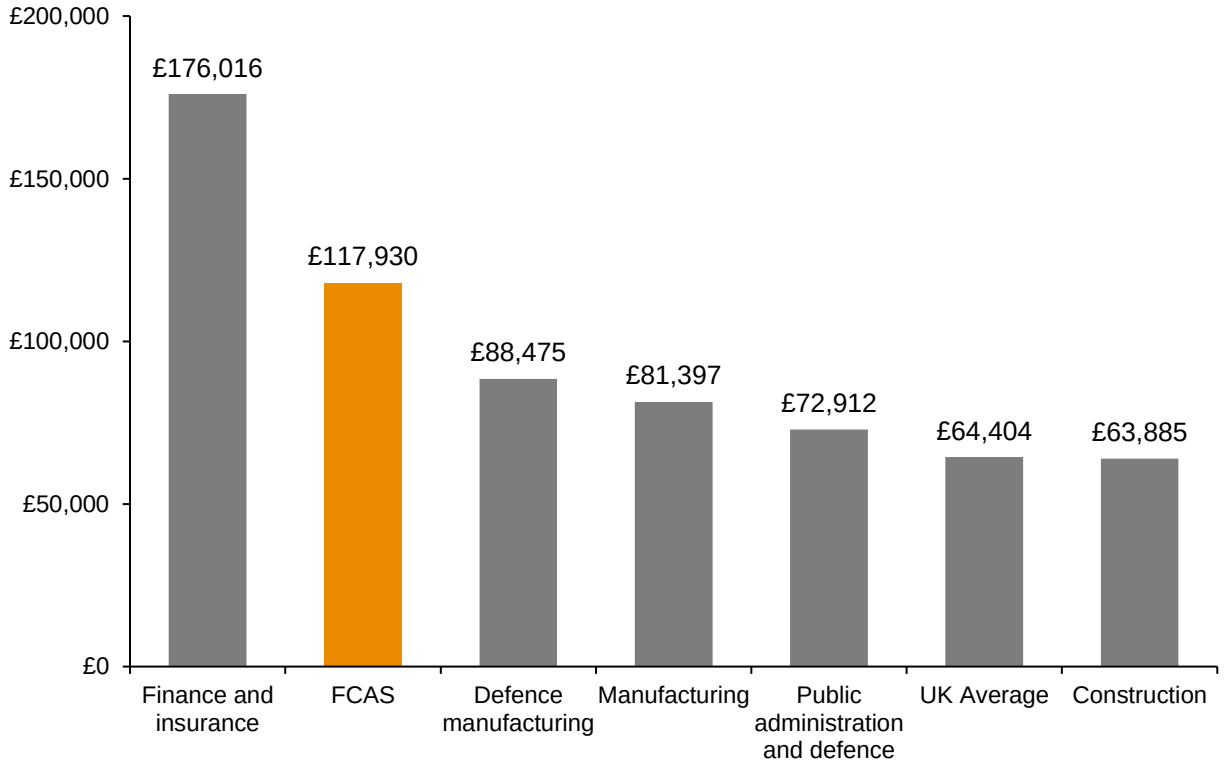
Note: Manufacture of other transport equipment is used as the comparison sector because this sector contains manufacturing of military fighting vehicles, as defined by the UK Standard Industrial Classification of Economic Activities 2007, benchmark data is from the ONS and represents output per job per sector for 2022.

Our analysis indicates FCAS workers could be more productive compared to similar sectors between 2025 and 2070

The analysis finds that, under FCAS, GVA per worker could be significantly higher than the UK average, with £118,000 direct GVA contributed per direct worker over the period 2025 to 2070. GVA per worker for FCAS is also higher than both the average of the manufacturing sector, the average of the defence manufacturing, and the average of the manufacture of other transport equipment sectors.

This analysis does not capture the potential for exports, which could be significant - based on previous internationally collaborative programmes.

Direct GVA per direct job (between 2025 and 2070)



Sources: industry partner data, output per job, Office for National Statistics, (link)

Note: Manufacture of other transport equipment is used as the comparison sector because this sector contains manufacturing of military fighting vehicles, as defined by the UK Standard Industrial Classification of Economic Activities 2007, benchmark data is from the ONS and represents output per job per sector for 2022.

Technical appendix

How is economic contribution measured?

The economic contribution to the UK economy is estimated against two indicators:

Contributions to Gross Domestic Product (GDP): measured in terms of GVA.

Employment: expressed as average annual number of full time equivalent (FTE) jobs supported.

GVA measures the value that is added by a business or industry sector. It is measured as the difference between the value of goods and services produced and the goods and services used as an input. It can, therefore, be considered the company and sector level equivalent of GDP, and summing all sector-level GVA in an economy produces a measure that approximates that economy's GDP.

01

Direct Impact

This is the impact of a firm's own operations. Direct GVA is calculated as a sum of returns to labour and capital, while direct employment is the total number of employees for the year, in terms of FTE.

02

Indirect Impact

This is the impact on the UK economy as a result of procurement, this includes both the economic value added from immediate suppliers but also of the wider supply chain (supplier of the supplier and so on).

03

Induced Impact

This is the impact from the spending of direct employees and that of the employees linked to the supply chain.

The expenditure approach is used to calculate direct contribution to GVA, which is calculated by taking the difference between revenue and intermediate consumption. Intermediate consumption is removed to avoid double counting value added across the supply-chain.

Input-output tables were used to calculate the GVA and employment contribution of FCAS

To assess the economic contribution to the UK economy, a bespoke input-output model has been developed for this report. This was developed using the UK input-output table for 2019, published by the ONS.[4]

An input-output model is used to estimate indirect and induced contribution to the economy. Input-output modelling enables analysis of how industries interact and relate to one another, by estimating how activity by one company stimulates economic activity elsewhere in the economy. This extent to which one company's activity stimulates activity in the wider economy is known as the multiplier effect.

An input-output table provides information on what a typical business in the supplier's sector requires for producing one unit of output. It allows tracing the typical input requirements through the entire supply chain for production activities in each sector to calculate the total value of production stimulated. An input-output table also provides data on the share of revenue that constitutes profit and wages for each sector. Hence the ratio can be applied to the total production value simulated and therefore the total GVA in the supply chain by sector associated with this can be estimated.

Summary of approach to derive multipliers:

Inter-regional tables

Using regional GVA and consumption, the ONS published input-output tables were expanded into inter-regional tables that reflect trade between the regions
of the UK.

Technical matrix

The purchases per unit of output, calculated by dividing each column of the table by its output total.

Leontief inverse matrix

The industry-by-industry output multipliers, derived by taking the inverse of the identity matrix minus the technical matrix.

Multipliers

Multipliers reflect the amplified impact on the economy generated by a unit input. Industry-wide output multipliers were calculated using the Leontief inverse matrix.

These multipliers are used to calculate the supply chain and related consumer spending effects.

[4] – Office for National Statistics, UK input-output analytical tables, industry by industry, link

Our approach

To assess the potential contribution to the UK economy within this report, a bespoke model has been developed. The model is built at a regional level, as described above, and relies on UK multipliers[5] published by the Office for National Statistics (ONS).

This analysis segments the UK economy into 32 sectors, chosen to best reflect the supply chain spending of the industry partners. The UK's Standard Industrial Classification (SIC) codes are used to define these sectors, which range from manufacturing to professional services.[6]

The model relies on the following data, retrieved from the ONS:

- The UK's input-output table.
- National and regional GVA, employment and consumption data by industry.

Regional GVA and consumption are used to expand the input-output tables into an inter-regional table that reflects economic activity across all UK regions. This enables analysis of the interactions between sectors across the UK, at both a national and regional level.

Financial data are then incorporated into the model, based on data provided by the FCAS partners. This allows the estimation of impact across GVA contribution and FTE jobs supported.

This report presents the GVA impact in 2023 prices and is discounted using the social discount rate provided by the HM Treasury Green Book, which assumes a rate of 3.5% declining to 3% after 30 years.[7]

[5] - Multipliers capture how an increase in economic outputs (e.g. FTEs) impacts the wider economy.
[6] – Office for National Statistics, UK Standard Industrial Classification of Economic Activities, link
[7] – HM Treasury (2008), Intergenerational wealth transfers and social discounting: supplementary Green Book guidance, link

Type 1 and Type 2 multipliers capture different impacts of the FCAS programme

A Type 1 multiplier captures the direct and indirect impacts of an industry, and is calculated as follows:

$$\frac{\text{Direct impact + Indirect Impact}}{\text{Direct impact}}$$

A Type 2 multiplier captures the direct, indirect, and induced impacts of an industry, and is calculated as follows:

$$\frac{\text{Direct impact + Indirect Impact + Induced impact}}{\text{Direct impact}}$$

These multipliers can be interpreted as follows:

	Type 1 multiplier	Type 2 multiplier
GVA	A Type 1 GVA multiplier of 1.5 is interpreted as 'for every £1 spent by FCAS, 50p of benefit is created in the supply chain.'	A Type 2 GVA multiplier of 2.5 is interpreted as 'for every £1 spent by FCAS, £1.50 of benefit is created through the supply chain and employees spending their wages.'
Employment	A Type 1 employment multiplier of 1.7 is interpreted as 'for every job created by FCAS, 0.7 jobs are created in the supply chain.'	A Type 2 employment multiplier of 3.0 is interpreted as 'for every job created by FCAS, 2 jobs are created in the supply chain and through employees spending their wages.'

Thank you

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