Space Based Solar Power as a Contributor to Net Zero

Annex C: Economic Assessment Detailed Methodology and Data Tables

FNC 004456-51624R Issue 1.0

Prepared for Department for Business Energy and Industrial Strategy (BEIS)

SYSTEMS AND ENGINEERING TECHNOLOGY

DOCUMENT INFORMATION

Project :	Space Based Solar Power as a Contributor to Net Zero
Report Title :	Annex C: Economic Assessment Detailed Methodology and Data Tables
Client :	Department for Business Energy and Industrial Strategy (BEIS)
Client Ref. :	
Classification :	COMMERCIAL IN CONFIDENCE

Report No. :	FNC 004456-51624R		
Issue No. :	1.0	**Compiled By :**	Doug Godden
Date :	23-Apr-2021	**Verified By :**	Michael Hall
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ANNEX C

Detailed approach to the economic assessment and associated Data Table Outputs

This Annex provides information regarding the approach to estimating the economic footprint of the Space Based Solar Power Feasibility study: Phase 2: Economic Feasibility, as performed by Oxford Economics.

A.1 APPROACH TO ESTIMATING THE ECONOMIC FOOTPRINT OF SBSP

Oxford Economics estimated the UK 'economic footprint' of the project, for each of the three cost scenarios for each of the six phases. By this we mean the sum of three 'demand-side' channels of economic impact, namely:

- The direct impact, concerned with employment in the 'first round' of suppliers to the solar panel project, and the associated contribution to national GDP and tax revenues.
- The indirect impact, capturing activity supported in the remainder of the UK-based supply chain, as a result of the direct suppliers' procurement of raw materials, other goods, energy supplies, and services, in the course of their project-related production activities.
- The induced impact, capturing activity in the rest of the economy supported by the wage-funded spending of individuals working in all parts of the supply chain.

All of the monetary values in the analysis are presented on a 2018 net present value basis. The effect of general price inflation has been stripped out and, in addition, a real discount rate of 3.5% per annum has been applied. This means that the same monetary amount, in inflation-adjusted terms, has a lower value attached to it, the further into the future that it occurs.

As explained in the main results write-up, this analysis does not capture the entire economic benefit of, or economic rationale for, the project. In particular, no attempt is made to assess the potential private return (or loss) to the project's investors or sponsors, nor the potential 'consumer surplus' for the final users of the innovative technology, nor other potential 'spillover returns' to unconnected UK businesses and the wider UK economy. And of course the project is likely to provide a substantial net benefit to the environment, compared with electricity generated in more traditional ways.

On the other hand, there is one sense in which the main set of results will over- rather than under-estimate the economic benefit. They reflect the gross demand-side impact, after allowing for leakage due to imports but before allowing for the alternative uses to which the labour and other resources might be put, in the absence of the solar panel project. (That is, the main set of results does not allow for 'displacement' or 'substitution' effects.) This reflects the difficulty and uncertainty involved in defining the alternative scenario, in which the resources are put to their 'second best' use.

However, a separate section of the analysis does address the question of possible net (or 'additional') benefits, by drawing on the extent to which individuals involved in work on the project's development will typically be engaged in industries of a high-productivity nature.

The estimation process for each phase was as follows.

Step 1: Deriving the output of direct UK suppliers from gross project spending

Frazer-Nash provided estimates of project expenditure in each phase, broken down by the type of asset, equipment or service purchased. The costs were supplied on a constant 2018 price basis, to strip out the effects of general price inflation, and the annual discount rate of 3.5% was then applied.

The cost of land purchases was deducted from these total projected outlays, and the remaining expenditure on produced goods and services was allocated to various industries of supplier, based on the classification of businesses found in the Annual Business Survey (ABS) published by the ONS.[1] Estimated direct imports were then deducted, based on the following stylised assumptions agreed between Frazer-Nash and Oxford Economics:

[1] ONS. 2019. 'Annual Business Survey - 2018 Provisional Results; Standard Extracts.' (At the time of writing, the ABS results for 2019 had yet to be published.)

- Two-thirds of the value of electronic and optical equipment purchased was assumed to be imported, in line with the recent share of imports in all such equipment purchased by UK-based users.
- Half of the value of spacecraft machinery was assumed to be imported, in line with the recent pattern for aerospace equipment (mainly aircraft and parts) purchased by UK-based entities.
- One third of the value of space transport services was assumed to be imported, in line with the recent share of UK air transport services accounted for by imports (i.e. provided by operators based overseas).
- All construction work, and all provision of other services (engineering consultancy, R&D, insurance, and quantity surveying), was assumed to be provided by UK domestic suppliers. The solar electricity generation itself would also take place in the UK.

UK taxes on the products supplied were also deducted at this stage. However, taxes of this type were assumed to be confined to insurance premium tax only, with the project sponsor able to recover VAT, and no other excise duties or 'green' levies, etc, being applicable because of the nature of the products supplied in this 'first round' of transactions.

The remaining value, i.e. the net-of-tax revenues of each of the UK-based industries directly supplying goods and services to the project, equates to the output of those UK suppliers.

Step 2: Splitting direct suppliers' output between GDP and procurement

The output of each of these supplying industries was then split between the businesses' own contribution to UK GDP (technically its gross value added or GVA), and its procurement of goods and services from third parties (technically its intermediate consumption), based on ratios for recent years in the ABS.[2] Because of the volatility of these ratios from one year to the next, for industries at this low level of aggregation, averages were taken across the latest five years. The ratios for electricity production were adjusted to be relevant to solar energy production specifically, by excluding supplies of oil, coal and other energy products. All of these ratios were then assumed to be constant throughout the time horizon of the entire project (i.e. 2022-2066).

The GDP of these businesses forms the direct GDP of the solar panel project, for the purposes of this study.

Step 3: Estimating direct employment from direct GDP

All businesses directly supplying the project were assumed to be registered businesses, with all of the work carried out by employees. GDP-per-job ratios were taken by combining data from the latest ABS and ONS Business Register Employment Survey (BRES), and growing those forward to 2020 with the help of more up-to-date ONS low-level GDP data, and ONS labour market statistics. These productivity measures were then rebased to 2018 prices, and projected forward over the project time horizon, in line with the GDP and employment forecasts for the corresponding (broader) UK industries in the Oxford Economics' Global Industry and Global Economics models. They were then further adjusted to reflect the 2018 net present value measure for GDP.

Direct employment for each industry was then derived by combining the estimates for each industry's direct GDP with these estimates for GDP per job, as averaged over the years covered by the phase concerned.

2 Gross value added is the contribution that each firm, institution or sector makes to GDP. But unlike the 'headline' GDP measure used for national economies, it is measured net of taxes on products such as VAT and excise duties. It is easiest thought of as the value of a firm's output, minus the cost of bought-in inputs of goods and services used up in the production of that output.

Step 4: Splitting direct GDP into its components

The direct GDP of each industry of supplier was split into various components, in order to estimate the direct tax impacts, as well as the spending power of the businesses' employees. Here, GDP was split between the wage bill, employers' social contributions, taxes on production (mainly business rates), and the remaining gross operating surplus (covering the firms' capital costs and net profits), based on average shares for each respective industry over the latest five years in the ABS.

Capital depreciation was then estimated, based on the share of capital depreciation in total output for the nearest corresponding industry in the ONS input-output table.[3] The net corporate surplus or deficit of the industry in recent years, as a proportion of GDP, was then worked out as the difference between the gross operating surplus and capital depreciation. However, as this is a forward-looking study, it is assumed that losses cannot be sustained continually over the project time horizon. For a few industries where that was not the case on the basis of the recent ABS results, the future GDP component shares, and future GDP-per-job ratios, were adjusted to ensure that the gross operating surplus was sufficient to cover expected capital depreciation at the very least.

Employers' national insurance contributions (NICs) were estimated as part of the tax calculations (see step 5 below), and then carved out of employers' total social contributions. The residual here was assumed to be employers' contributions to employees' non-state pension arrangements, and these assumed GDP shares were checked, to ensure that they were non-negative and reasonable.

Step 5: Estimating direct tax impacts

For each industry of supplier, average wages were calculated by combining the wage bill component of GDP with the number of employees. Employees' income tax, employees' NICS, and employers' NICs were calculated from there by applying the assumed UK tax and NICs structure to these average wage levels.

For these purposes, the UK system for income tax and NICs set to prevail in 2025-26, as proposed in the March 2021 Budget, was assumed to apply in real terms throughout the lifetime of the project, on average for each phase. The proposed thresholds in money-terms were adjusted to 2018 prices for the purposes of the study calculations.

The direct tax impact estimate was then completed by adding in the following taxes:

- Taxes on production (mainly business rates), taken straight from the GDP components estimates (at step 4).
- Corporation tax, charged at the proposed future main rate of 25% on the net corporate surplus (as worked out at step 4).
- Taxes on products purchased (such as fuel duty), as carved out of these businesses' estimated procurement spending (see step 7 below).
- Taxes on products supplied (as estimated at step 1).

Step 6: Estimating the spending power of the direct businesses' employees

The spending power of the direct businesses' employees was assumed to be equal to their take-home pay, calculated as wages net of income tax and employee NIC payments.

Step 7: Deriving indirect GDP from the direct suppliers' procurement

The direct suppliers' procurement spending was broken down into broad product and services types, based on the breakdown of purchases by industry in the ABS, averaged over a five-year period. These categories

[3] ONS. 2019. 'United Kingdom Input-Output Analytical Tables, 2015.' (This table was used as the 64-industry table now available for 2016 does not capture the refined level of industry detail required for this study.)

were then split into more refined product groups, using the 105-industry breakdown found in the most detailed set of the ONS UK 'input-output' tables. Each type of product purchased, by each of the industries in the direct channel, was then split between UK taxes on products, imports (including overseas taxes but net of UK taxes), and net-of-tax domestic supplies, based on ratios in the ONS input-output tables, using a combination of the respective tables for combined use at purchasers' prices, domestic use at net-of-tax ('basic') prices, and imports.

Purchases from domestic suppliers, by industry of supplier, were then summed up over all of the purchasing industries, to arrive at a vector for purchases by the direct suppliers to the project, from the 'second round' of UK-based suppliers. This was then combined with ratios in a specially-adapted UK input-output table, to arrive at the total value of output of the remaining UK supply chain (i.e. starting with the 'second round' of suppliers, but excluding the direct suppliers to the project).

The adapted UK input-output table was based on the latest 105-industry ONS domestic input-output table, but updated to 2020 in line with the latest GDP data. The sub-components of GDP and intermediate consumption by industry were split out, including self-employed income in this case, which was split out from the gross operating surplus. Figures for GDP per job, wages per employee job, and self-employed income per self-employed job, were then added in, and the shares of each industry's output accounted for by the various types of tax—on the same basis as for the direct impacts—were embedded into the model.

The GDP of the entire supply chain could then be worked out, using the share of GDP in each industry's output. The resulting indirect GDP figure was, as expected, a little lower than the value of the initial output of the 'second round' of suppliers, with import content and taxes on products in the supply chain accounting for the remainder.

Step 8: Deriving indirect employment from indirect GDP

The GDP-to-jobs ratios, estimated for the 2020-based model described in step 7, were rebased to 2018 prices and grown forward in line with Oxford Economics projections for broader industries, as was done for the industries in the direct channel. Indirect employment was worked out by combining those productivity ratios with the indirect GDP estimates, for each industry.

Step 9: Splitting indirect GDP into its components

Indirect GDP was split into its components, including self-employed income in this case, using the ratios from the model described at step 7.

Step 10: Estimating indirect tax impacts

The share of each industry's output accounted for by each of the following taxes was embedded in the supply chain model built at step 7:

- Employers' NICs.
- Employees' income tax and NICs.
- Self-employed income tax and NICs.
- Taxes on production.
- Corporation tax.
- Taxes on products purchased.

The indirect tax impact is simply the sum of these taxes. Taxes on products supplied by these businesses, to the project's direct suppliers, are already counted in the direct tax impact (step 5), so are excluded here.

Step 11: Deriving induced GDP from the direct and indirect impacts

Induced output is effectively worked out in two stages. First, induced output supported by the spending of employees and self-employed workers in the second and subsequent 'rounds' of the supply chain is derived from the procurement spending of the direct suppliers, using the model described at step 7. For these purposes, workers' spending power (wages and self-employed income net of income tax and NICs), by industry of employment, and household spending by type of product purchased, were also built into the model.

Spending by the direct project employees, as calculated at step 6, was then fed into the model, to arrive at the additional induced output supported by those individuals' spending. This was added to the estimate for induced output supported by workers in the indirect channel, to arrive at total induced output. In all cases, the induced output calculations allow for UK taxes on household spending, and imports of UK consumer goods and services, using ratios derived from the ONS input-output tables.

The GDP-to-output ratios for each industry were then applied to induced output by industry, to arrive at induced GDP.

Step 12: Deriving induced employment from induced GDP

Induced employment was derived from induced GDP by applying the same set of GDP-per-job ratios used in the calculation of indirect employment.

Step 13: Estimating induced tax impacts

Induced tax impacts were derived from induced output in the same way that the indirect tax impacts were derived from indirect output. However, taxes on products levied on the consumer spending of employees (such as VAT and excise duties) were then added. This value was worked out by taking the share of workers' spending power in direct, indirect, and induced GDP, and multiplying it by the tax-to-household spending ratio implicit in the input-output based model. These taxes will include UK taxes on imports of consumer goods and services, as well as those levied on purchases of UK-produced goods and services.

Step 14: Summing to the total economic footprint

The total GDP, employment and tax footprints are simply the sum of the separate direct, indirect, and induced impacts.

INDUSTRY CLASSIFICATION USED IN THE TABLES AND CHARTS

The table below clarifies the industry classification used in the tables and charts.

Sectors in 'impact' charts	Sectors in 'impact' tables	Direct suppliers' industries	Description with standard industrial classification (SIC 2007) codes
Machinery	Computers and electronic equipment		Computers and electronic equipment (C26).
		Electronic and optical equipment	- Electronic components (C26.11).
			- Communications equipment (C26.309).
			- Optical precision instruments (C26.701).
	Aircraft and spacecraft machinery		Aircraft and spacecraft machinery (30.3).
		Spacecraft machinery	- Spacecraft machinery (part of C30.3).
	Other machinery		Other machinery manufacture (C27-30 ex 30.3).
	Machinery repair		Machinery installation and repair (C33).
Other goods	Other non-energy goods		Manufacturing, other than of machinery and energy products (C10-18, 20-25, 31-32). Agriculture (A).
Energy	Electricity production and supply		Electricity production and supply (D35.1).
		Solar electricity	- Solar electricity production (part of D35.11).
	Other energy, mining and utilities		Mining and oil extraction (B). Refined petroleum and coke (C19). Energy supply other than electricity (D ex 35.1). Water and waste services (E).
Construction	Construction		Construction (F).
		Construction	- Construction of commercial buildings (F41.201).
			- Construction for electricity and telecoms (F42.22).
Air and space	Air and space transport services		Air and space transport services (H51).
		Space transport services	- Space transport services (H51.22).
Technical	Technical and scientific services		Architectural and engineering services, and technical testing (M71). Scientific R&D (M72).
		Engineering design	- 'Other' engineering activities (M71.129).
		Scientific R&D	- R&D for non-biological sciences including engineering (M72.19).
Business and finance	Information and communication		Publishing, filming, TV and radio activities, telecommunications, computer services (J).
	Finance and real estate		Finance and insurance (K). Property rental and other real estate services (L).[1]
		Insurance	- Non-life insurance (K65.12).
	Other business services		Accountancy, management consultancy, advertising, design, and other professional services (M69-70, 73-75). Equipment rental, employment agencies, cleaning and security, office support, and other business support services (N).
		Quantity surveying	- Quantity surveying activities (M74.902).

Distribution and other	Other distribution and transport		Wholesale and retail distribution, and motor trades (G). Transport services other than by air (H ex 51).
	Catering, community & personal services		Catering and hotels (I). Arts, recreation, culture, other personal services, and households as employers (R-T). Public administration, education, training, health, and care services (N-P).[1] [4]

[4] Indirect and induced impacts only relate to privately-funded rather than taxpayer-funded services. Nor do they include any imputed owner-occupied rent.

A.1.1 THE ESTIMATED 'ECONOMIC FOOTPRINT' OF THE PROJECT

This part of the analysis sets out the estimated 'economic footprint' in the UK of developing, building and operating the space-based solar panel. By this we mean the employment, value-added contribution to GDP, and tax revenues supported by the required spending on the project, amongst the direct UK-based suppliers to the scheme, and through the major knock-on demand-side effects of their activity for other parts of the UK economy.

More precisely, the estimates capture three 'channels' of impact:

- The **'direct'** effects relate to employment in the direct UK-based suppliers to the project—including the operators of the electricity generation scheme itself once the project is up and running—and the contribution to GDP and tax revenues associated with that work.
- The **'indirect'** impacts relate to activity in the remainder of the UK-based business supply chain, as a result of the direct suppliers' purchases of inputs of goods and services from third party enterprises.
- The **'induced'** economic contributions capture the activity supported in the wider UK economy, as a result of the wage-funded household expenditure of workers in the project's entire supply chain.

A.1.2 LIMITATIONS OF 'ECONOMIC FOOTPRINT' ANALYSIS IN THIS CASE

It should be noted that, while these estimates capture an important dimension of the project's potential economic benefits, they do not fully encapsulate the economic case or rationale for investing in the innovative technology concerned. In particular:

- The 'direct' impact reflects the value of the work undertaken by a 'first round' of suppliers to the project, and does not necessarily equate to the ultimate market value of the solar energy provided. The cost of developing, constructing and then running the operation is taken as the starting point, with these costs allowing for a 'normal' level of gross profit (before depreciation) for the suppliers and operators, as well as the cost of labour, other inputs, and taxes. But no account is taken of any additional commercial profit—or loss—that could ultimately arise for those with an equity stake in the project.
- Nor is any attempt made here to assess the potential 'spillover benefits' of the project, for other UK businesses or the UK economy more generally, nor to assess the value of the 'consumer surplus' that the final users of the technology might be able to enjoy.
- Jobs in the supply chain are broken down by industry, to show how they are, by and large, of a high-productivity, high-wage nature, thereby supporting the development of the UK's skills base, compared with an alternative scenario in which the same workers are employed in 'average' occupations. But no assessment is made here of the wider benefits to the economy's supply-side that could arise as a result of this kind of knowledge-based supply chain being fostered.

Nor does the analysis capture the potential benefit of the project to the UK and global environment, as a result of its contribution to the replacement of fossil fuel-based electricity with electricity generated by renewable means.

On the other hand, there is one sense in which the main set of results will over- rather than under-estimate the economic benefit. They reflect the gross demand-side impact, after allowing for leakage due to imports but before allowing for the alternative uses to which the labour and other resources might be put, in the absence of the solar panel project. (That is, the main set of results does not allow for 'displacement' or 'substitution' effects.)

However, section 2.9 further below does address the question of possible net (or 'additional') benefits, by drawing on the extent to which individuals working in the project's development and CAPEX phases will typically be engaged in industries of a high-productivity nature.

A.1.3 PROJECT PHASES AND COST SCENARIOS

As described elsewhere in this report, the project is split into four distinct development phases (phases 1-4 in the charts), followed by a construction phase (CAPEX) and then, an operational phase running for 23 years (OPEX). Three cost scenarios are also considered, namely the high-cost (P90) assumption, central (P50) assumption, and low-cost (P10) assumption.

Separate economic impact assessments have been made for each of the six phases, and for each of the cost scenarios. The results described below mainly focus on the central cost scenario. Results for the high-cost and low-cost scenarios are however included in the full results tables at the end of this report.

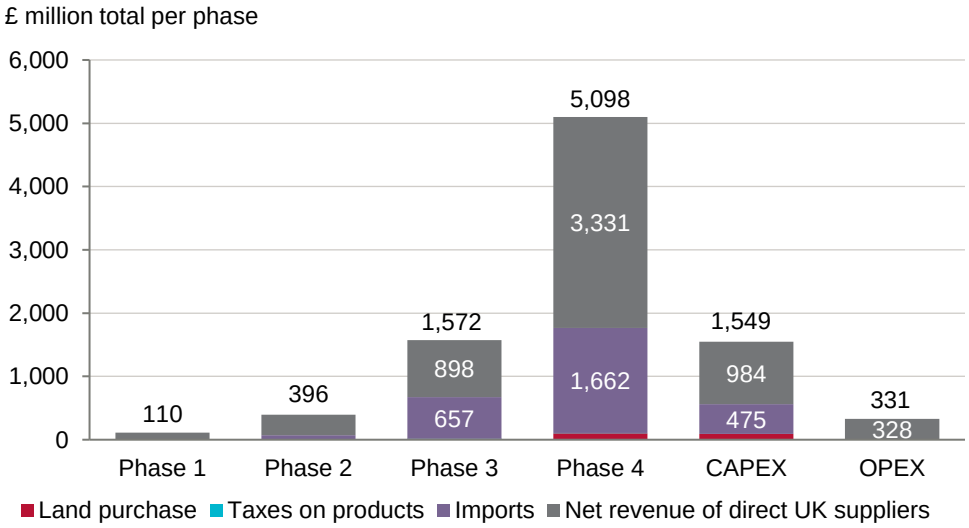
A.1.4 CENTRAL ESTIMATES OF SPENDING AND UK-BASED PRODUCTION

The starting point for the estimates is provided by total spending in each phase of the project. To work out the economic impacts, that spending is first split between land purchases, direct imports of goods and services, taxes on products supplied, and the net-of-tax value of revenues received by the UK-based suppliers. These values are shown in Fig. 1, for the central scenario.[5]

As the chart shows, the major part of spending on the project takes place in development phase 4 (2036-39), with spending in phase 3 (2032-35) and in the construction phase (2039-40) also quite significant. The subsequent, ongoing cost of running the operation is quite modest in comparison with the initial development and building cost, while spending in the early phases of development is also expected to be relatively low.

Most spending benefits UK suppliers, although some imports will be needed, given the constraints on UK productive capacity. (These relate to manufactured equipment and space transport services. All other services, and construction work, are assumed to be provided domestically.)

Fig. 1. Gross spending on the project by economic category



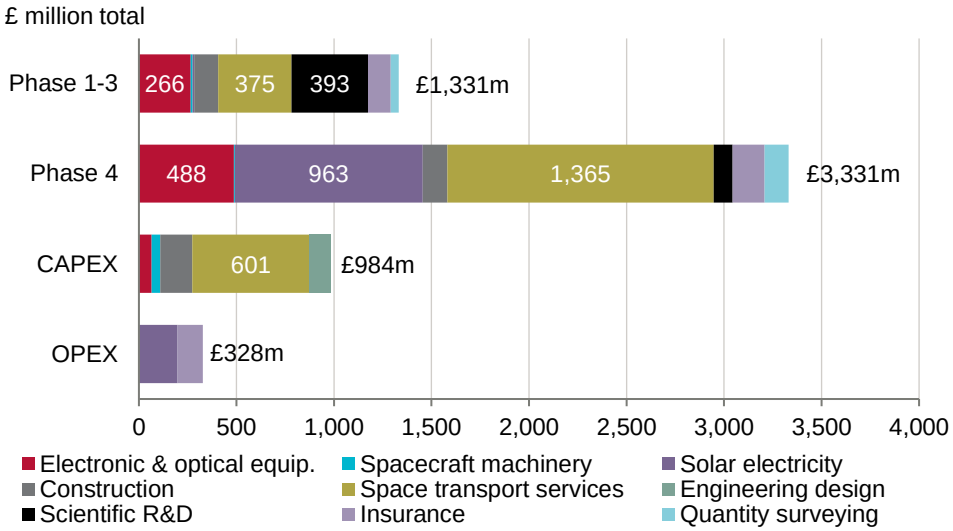
Source: Oxford Economics

Looking at the net-of-tax turnover by industry of UK supplier, space transport services dominate the construction phase—which includes the cost of the solar panel launch—and are also significant in the phase 4 of the development programme (see Fig. 2). Purchases of electronic and optical equipment, relating to the satellite, reflector and rectenna, as well as telecommunications, are also important throughout the development phases, while scientific R&D is significant early on. Solar electricity production is, not surprisingly, the most important activity in the operational phase, but is also a key feature of development phase 4.

Construction of buildings and utility structures, spacecraft machinery, engineering design work, quantity surveying activities, and insurance provision, account for the remaining UK supplies.

[5] All monetary amounts presented in this analysis are 2018 net present values.

Fig. 2. UK suppliers' output by industry



Source: Oxford Economics

A.1.5 CENTRAL ESTIMATES OF THE OVERALL UK ECONOMIC IMPACTS

This section sets out the overall UK-wide economic impacts, while details of those effects by industry and type of tax are described further below. The impact of the final development phase is described first, as that phase is the most important in terms of the scale of expenditure. That first section is also used to set out, in basic terms, how the estimates are derived, and how they should be interpreted. The same methodology is used for each of the prior and subsequent phases.

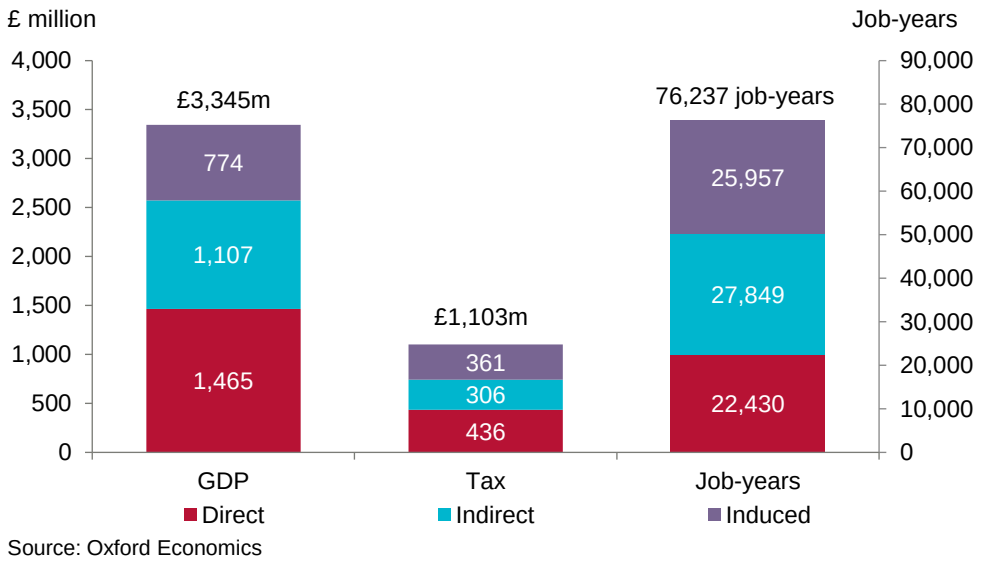
A.1.5.1 The final development phase (2039-42)

As set out earlier, the net-of-tax value of UK supplies to the project will total £3.3 billion over the four years of development phase 4, based on the central cost assumption. Of that amount, we estimate that almost £1.9 billion will be used by those suppliers to purchase raw materials, components, energy supplies, and other inputs of goods and services from third party businesses. That estimate is based on the ratio of inputs to outputs in recent years, for businesses in the same industries as these suppliers.

The remaining amount, of over £1.4 billion, covers the businesses' labour costs, capital costs, and net profits, and represents their direct contribution to UK GDP.[6,7] More precisely, the direct GDP impact is estimated at £1,465 million, as shown in the bottom left segment of Fig. 3.

[6] All references to GDP in this section relate to the 'basic price' measure, excluding taxes on products such as excise duties and some 'green' levies. This is technically known as 'gross value added' or 'GVA'. As well as labour costs, capital costs and net profits, GVA also includes taxes on production other than on products (mainly business rates).

[7] Monetary values here are set out in terms of the total amount per phase. The equivalent average annual values can be found in the detailed results tables.



Source: Oxford Economics

Fig. 3. The UK economic footprint in development phase 4 (2039-42)

But the full contribution of these suppliers to the UK GDP does not end there. Those businesses' own purchases of supplies from third parties (the £1.9 billion) are expected to stimulate £1,107 million of 'indirect' GDP along the rest of the UK supply chain. The 'missing' £0.8 billion here reflects imports by these suppliers (£0.45 billion), further import content in their UK-sourced supplies (£0.22 billion), taxes on products purchased by these businesses (£0.06 billion) and taxes on transactions levied further along the supply chain (£0.03 billion). Again, these ratios are based on the pattern of spending in recent years for UK enterprises in the same industries as the project's suppliers.

In addition, a significant part of the direct and indirect GDP is used to pay wages to the firms' employees, and these in turn fund household expenditure, supporting further activity at retail, leisure and other outlets, and along their supply chains. The UK GDP supported in this way is referred to as the induced GDP contribution of the project, and is put at £774 million over the four years of phase 4 (on the central cost scenario).[8]

The total GDP footprint of this phase of the project, which is the sum of the direct, indirect and induced GDP impacts, is therefore £3,345 million. This means that, for every £1 of GDP generated at the direct suppliers to the project, in this phase, a further £1.30 of GDP is supported elsewhere in the UK economy as a result of supply chain linkages and wage-funded spending effects. Or put another way, as the total GDP contribution is 2.3 times the direct GDP contribution alone, the "GDP multiplier" in this case is 2.3.

As Fig. 3 also shows, these GDP impacts are associated with an employment contribution of over 76,000 job-years, equivalent to 19,000 jobs held throughout the four-year phase.[9] For the purposes of this study, we have assumed that all of the direct suppliers to the project are registered businesses, and that all of the workers concerned are employees. However, employment in the indirect and induced channels is assumed to include some self-employed jobs, in line with recent labour market shares for each relevant industry. Here, the indirect and induced jobs contributions are each greater than the direct jobs contribution, in sharp contrast to the pattern for the GDP impact, where the proportion accounted for by the direct channel is much higher. This reflects the fact that GDP per job at the direct suppliers to the project is, on average, much higher than the average across all sectors of the UK economy. By contrast, businesses further along the

[8] The induced impact includes the effect of spending by self-employed workers out of their project-related earnings, as well as the impact of the wage-funded spending of employees. It also takes into account further 'rounds' of expenditure by workers in the consumer-facing supply chain.

[9] A "job-year" is one job held for one year, or the equivalent. So ten jobs each held for four years would be counted as 40 job-years, while 80 jobs each held for six months would also count as 40 job-years. All employment metrics in this section are set out in job-year terms, as that concept sits neatly alongside the GDP metrics, which relate to the phase totals. Figures for the average number of jobs held throughout each phase are included in the results tables, alongside the average annual GDP estimates shown there.

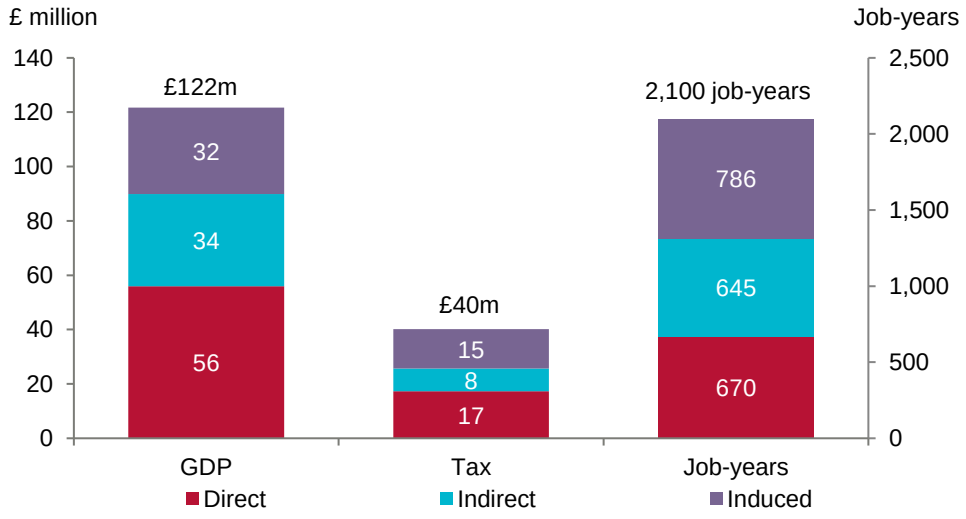
supply chain to the project, and firms in the consumer-facing induced channel, are more representative of the economy as a whole.
As a result, the "employment multiplier" is 3.4, with every job in the businesses directly supplying the project effectively supporting 2.4 jobs in other industries, as a result of the various knock-on impacts on the demand for UK-produced goods and services.

The economic footprint analysis also includes an assessment of tax payments supported by the project. These include all taxes on work and business in each of the direct, indirect, and induced channels, namely income tax and NICs paid by employees and the self-employed, plus employers' NICs, corporation tax, taxes on products purchased (such as excise duties), and other taxes on production (such as business rates).
In addition, taxes on employee spending (such as VAT) are counted in the induced tax impact, while taxes on products directly supplied to the project are added into the direct tax impact.[10]
As Fig. 3 shows, the total tax impact in phase 4 is put at £1,103 million. This is equivalent to 22% of the £5.1 billion initial project spending, in this phase, and demonstrates the extent to which any government grants in support of the project would be partially 'self-funding', even before the project generated revenue streams of its own. As the chart also shows, the direct tax impact would amount to £436 million, with the indirect and induced channels contributing £306 million and £361 million, respectively.

A.1.5.2 The earlier development phases (2022-38)

Spending in phases 1-3 is more modest than in the fourth and final phase of the development work (even on the net present value basis used here), and the overall economic impacts are summarised in Fig. 4, Fig. 5, and Fig. 6, respectively. It can be seen that, for example, the total number of job-years supported builds from 2,100 in five-year phase 1, to over 7,300 in five-year phase 2, and then to over 20,000 in four-year phase 3. As in the case of phase 4, the employment multiplier is higher in each case than the GDP multiplier, reflecting relatively high labour productivity (as measured by GDP per job) in the direct channel businesses.

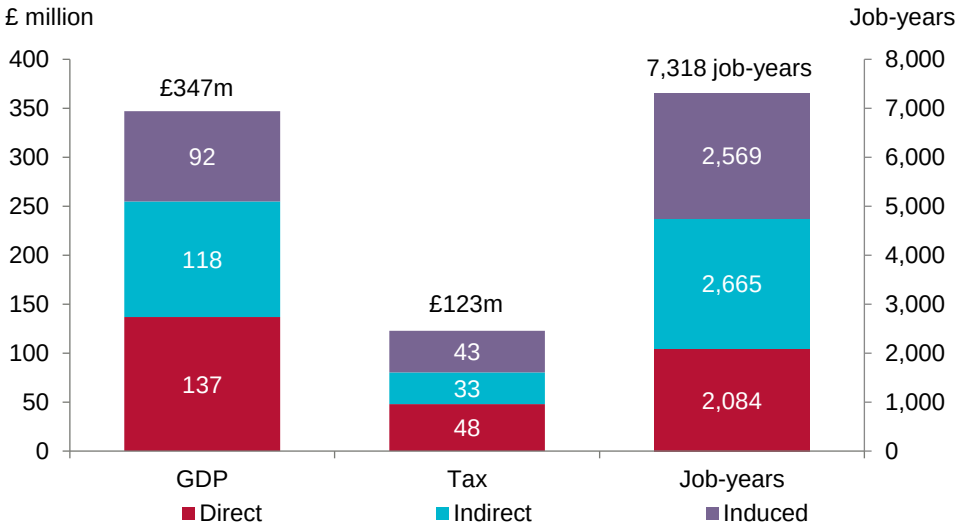
Fig. 4. The UK economic footprint in development phase 1 (2022-26)



Source: Oxford Economics

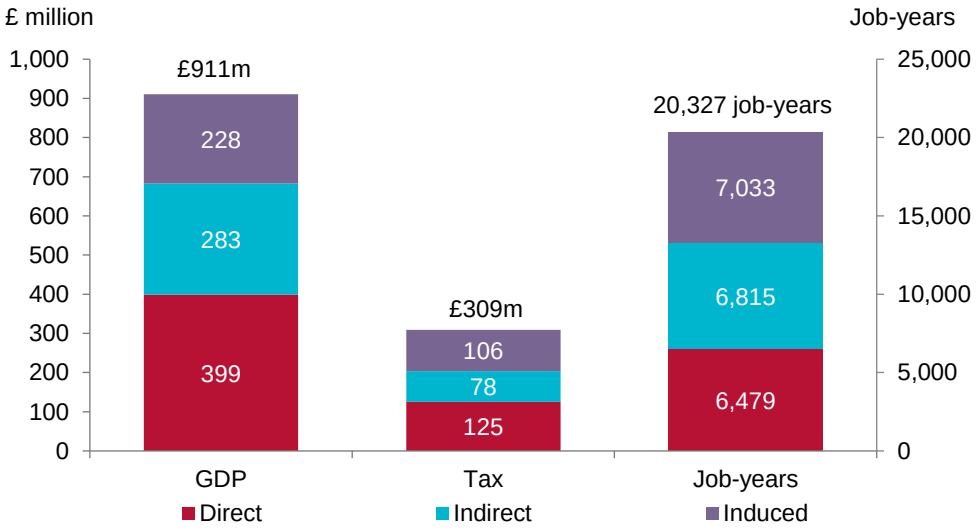
[10] The taxes on products supplied here are assumed to be limited to insurance premium tax. More generally, the taxes on products counted include UK taxes on imports as well as those on domestic supplies, but exclude recoverable VAT in the case of business-to-business transactions.

Fig. 5. The UK economic footprint in development phase 2 (2027-31)



Source: Oxford Economics

Fig. 6. The UK economic footprint in development phase 3 (2032-35)



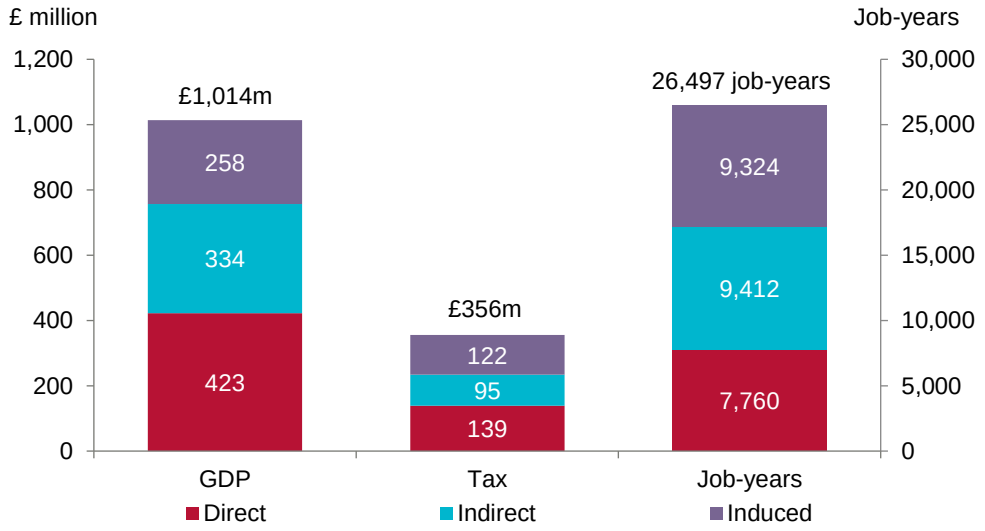
Source: Oxford Economics

1.1.1 The construction phase (2039-40)

The construction phase is planned to last for two years, culminating in the launch of the solar panel into space. The first year of this phase (2039) coincides with the final year of development phase 4. Some £1.5 billion is expected to be spent during this time—in 2018 net present value terms—and the resulting economic footprint across the UK is shown in Fig. 7.

Here, the direct GDP impact is £423 million, with the total GDP impact put at £1,014 million, making the GDP multiplier 2.4. The direct employment impact is 7,760 in terms of job-years, with almost 26,500 job-years supported in total, so that the jobs multiplier is 3.4. And the total tax impact works out at £356 million, equivalent to 23% of the initial gross cash outlay for this phase.

Fig. 7. The UK economic footprint in the construction phase (2039-40)

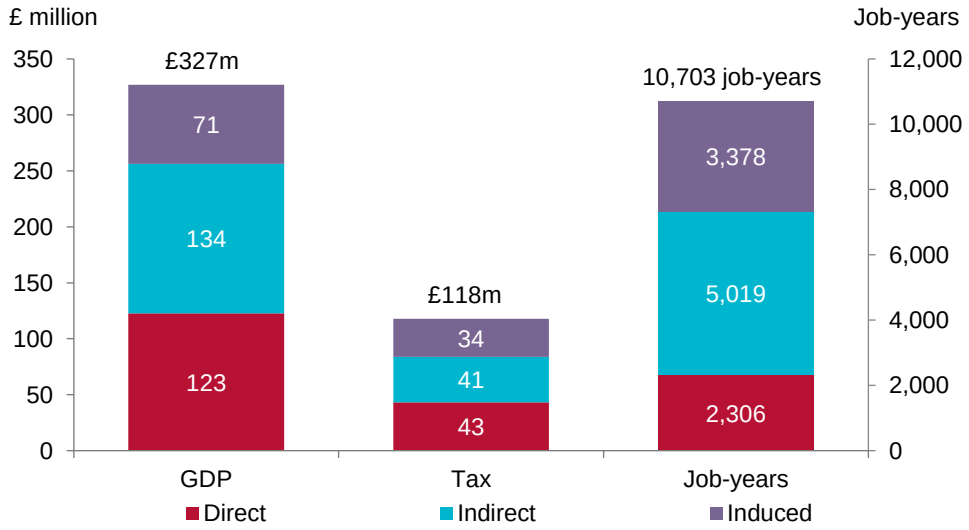


Source: Oxford Economics

A.1.5.3 The operational phase (2044-66)

In the operational phase, the direct running costs are essentially limited to the operation of the ground-based electricity production, and the insurance provision necessary for a project of this type. The direct GDP impact of £123 million (see Fig. 8), over the 23-year operational period, allows for a 'normal' gross profit, in line with electricity generation more generally. But it does not include any scheme-specific return on top of that, of the kind that might be expected to cover the cost of developing the innovative technology, and to compensate for the risks involved.

Fig. 8. The UK economic footprint in the operational phase (2044-66)



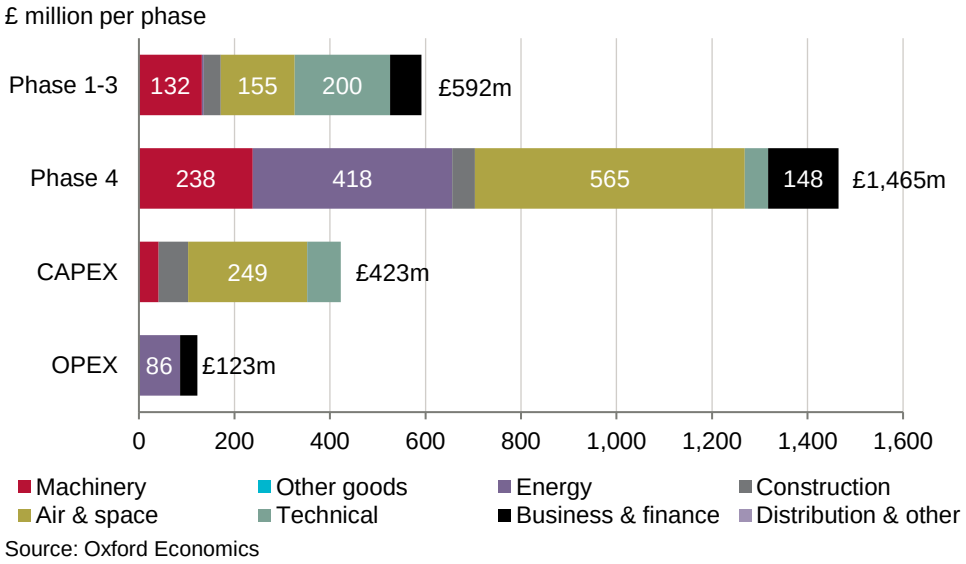
Source: Oxford Economics

In this phase, the total GDP contribution is put at £327 million, so that the GDP multiplier is a little higher than in the development and CAPEX phases, at 2.7. It is estimated that the operation would directly employ an average of 100 staff throughout the 23-year period, taking the direct employment contribution to some 2,300 in job-year terms. The total employment impact, however, would be significantly higher, at 10,700 job-years, putting the employment multiplier at 4.6—with every job in the electricity-generating operation (and in the associated insurance providers) supporting a further 3.6 jobs elsewhere in the UK economy.
The direct tax impact here is estimated to be £43 million, and the total tax contribution, £118 million.

A.1.6 GDP AND JOBS IMPACTS BY INDUSTRIAL SECTOR

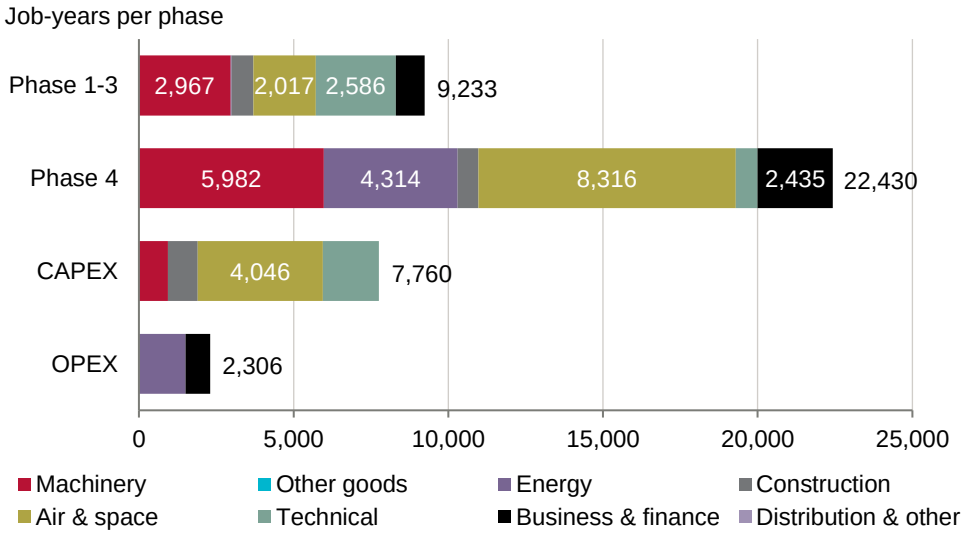
The GDP and jobs impacts illustrated above can be broken down by UK industry of supplier, and the pattern here varies considerably by the phase of the project and channel of impact.[11]
Starting with the **direct impact**, the activity is focused on a comparatively small group of industries, but with significant variation in the pattern over time. This is shown in Fig. 9 for GDP and Fig. 10 for employment.
It can be seen that the early phases of project development work mainly support activity in the machinery manufacturing, space transport services, and technical services sectors (reflecting scientific research and development here). Machinery manufacturing and space transport services remain important in the final development phase, when the significance of energy supply (solar electricity production here) and business and finance activities (insurance and quantity surveying in this case) is stepped up.

Fig. 9. Direct GDP impacts by industry grouping and phase



Source: Oxford Economics

Fig. 10. Direct jobs impacts by industry grouping and phase

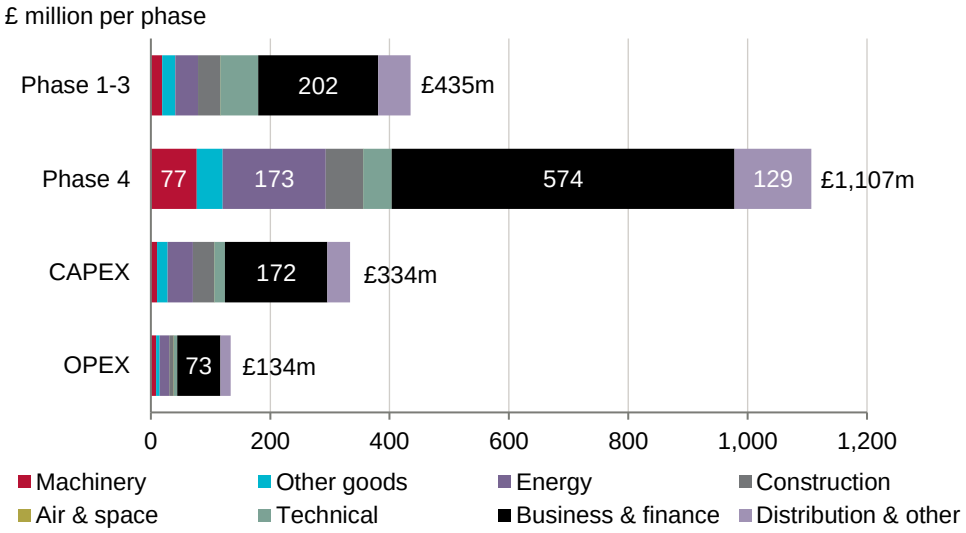


Source: Oxford Economics

[11] A precise description of the industry groups used in this section, including SIC codes, can be found in the methodology section of this report. Results at a more granular level are set out in the tables.

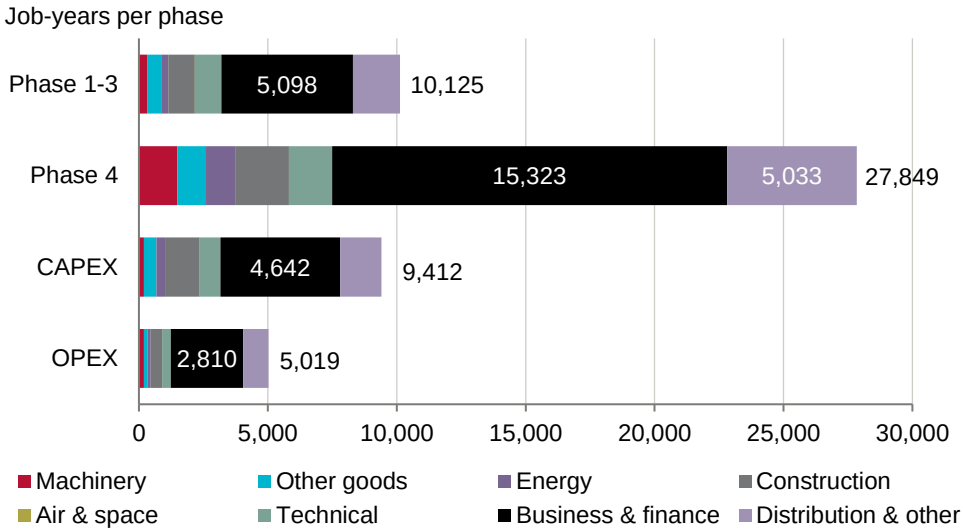
The CAPEX phase is dominated by space transport services surrounding the space lift exercise, with the remaining activity in the machinery manufacturing, construction, and technical services fields, while the OPEX phase involves energy production and insurance services only. (In the CAPEX phase, engineering design work replaces R&D within the 'technical' sector.)
The by-industry pattern in the **indirect channel** is illustrated in Fig. 11 and Fig. 12. In this case, the business and financial services category dominates. This covers a range of professional services (such as accountancy, management consultancy, and advertising), business support services (such as equipment rental, employment agencies, and office administrative support), financial services, real estate services, telecommunications, and computer services.

Fig. 11. Indirect GDP impacts by industry grouping and phase



Source: Oxford Economics

Fig. 12. Indirect jobs impacts by industry grouping and phase

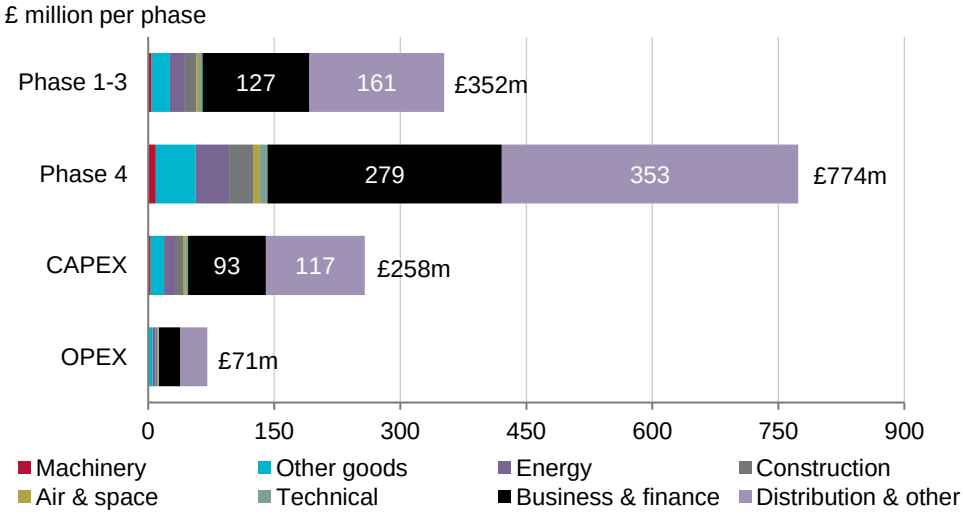


Source: Oxford Economics

The 'energy' grouping is also fairly important for indirect GDP in phase 4. This captures the general energy, water and waste services used by businesses throughout the supply chain, and also includes oil extraction and petroleum refining activities feeding into these firms' energy and road fuel use. But no oil extraction or coal mining is required as a direct consequence of the electricity-generating activity of the project itself. Energy-related jobs in the indirect channel are less significant than energy-related GDP, due to the high capital-intensity of those sectors. But the opposite pattern can be seen in the more labour-intensive 'distribution and other' category. In this instance, this mainly reflects wholesale distribution activity, and the

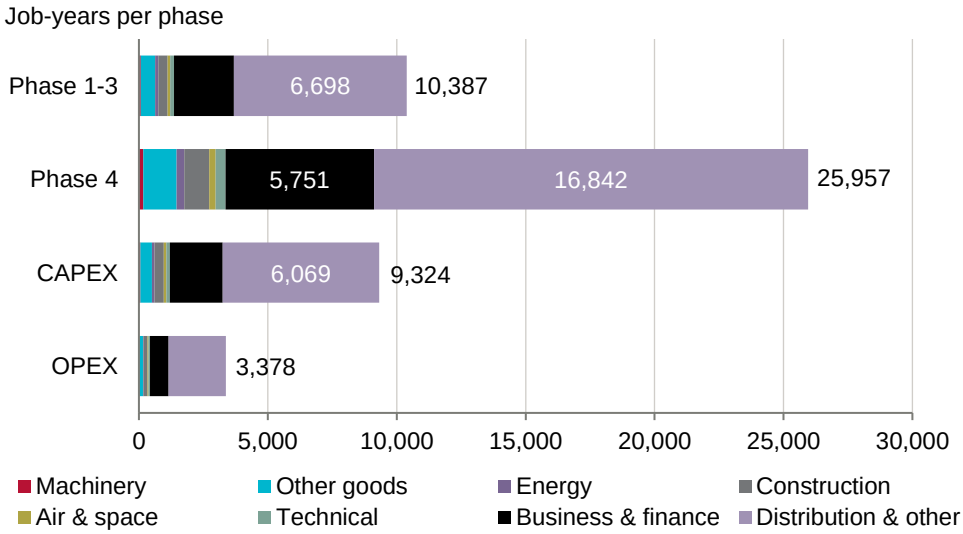
associated use of freight transport services, in the business supply chain. Training activities also contribute here.
The **induced impacts** on different industrial sectors reflect household spending patterns (see Fig. 13 and Fig. 14).

Fig. 13. Induced GDP impacts by industry grouping and phase



Source: Oxford Economics

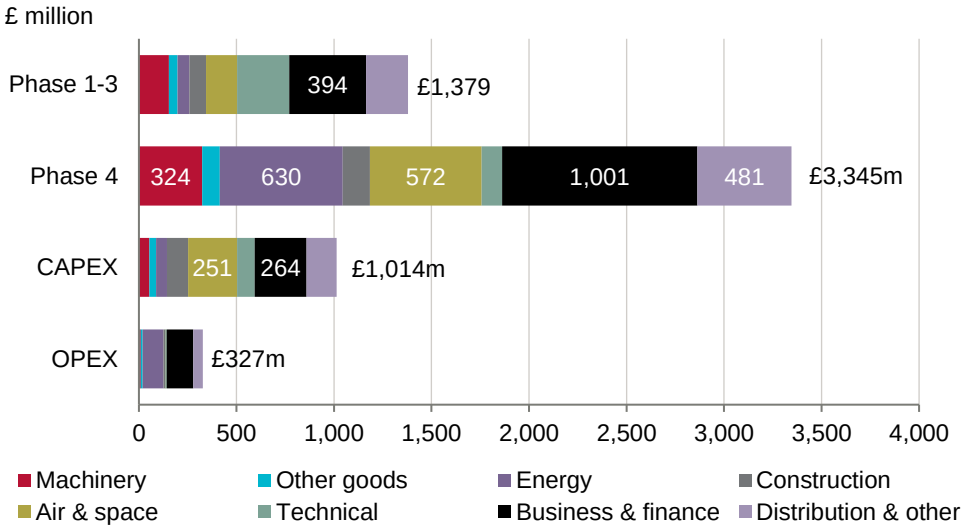
Fig. 14. Induced jobs impacts by industry grouping and phase



Source: Oxford Economics

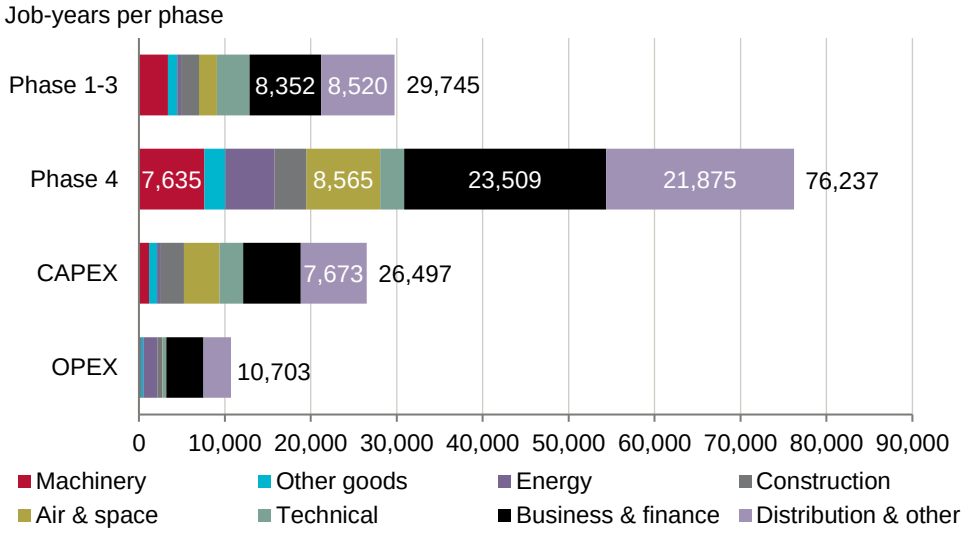
Here, 'distribution and other' services are most important, including retail sale, passenger transport, hotels and catering, private healthcare and education, and miscellaneous personal services (such as hairdressing). The 'business and finance' services here will include some genuine business activity, as the induced impact includes business-to-business transactions further along the consumer-facing supply chain. But it also captures some activities, such as property rental, telecommunications, and travel reservation services, counted in the 'business' category but also used directly by households.
The share of jobs accounted for by the 'distribution and other' grouping is even greater than that sector's share of GDP, due to the labour-intensive nature of, for example, retail distribution, catering, and miscellaneous personal services.
Taking all three channels of impact together, 0 and Fig. 16 show how the **total GDP and jobs impacts** break down on an industry-by-industry basis.

Fig. 15. Total GDP footprint by industry grouping and phase



Source: Oxford Economics

Fig. 16. Total jobs footprint by industry grouping and phase



Source: Oxford Economics

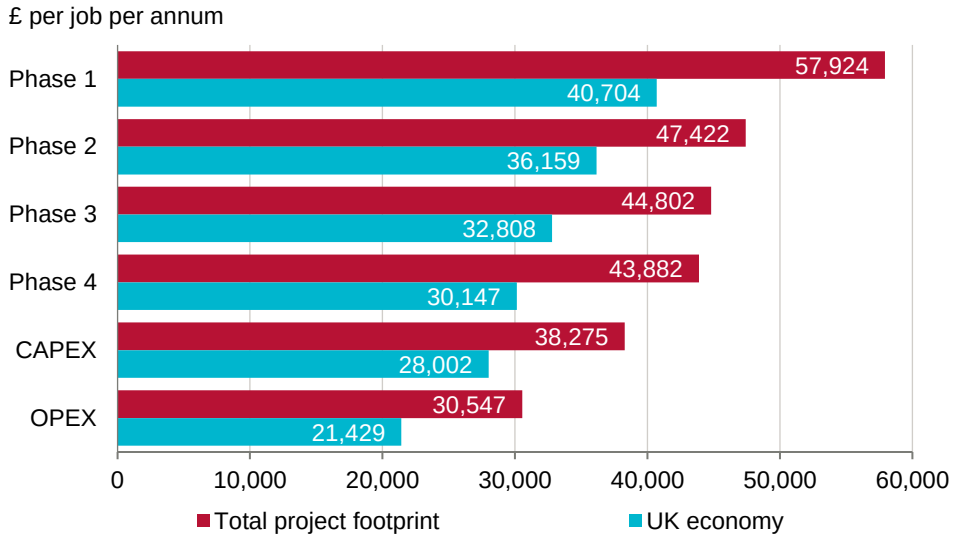
The role of the direct suppliers can be seen in the contributions of the machinery manufacturing, energy-related activity, and air and space travel services sectors. But the knock-on demand-side multiplier effects mean that the project will support a much wider range of economic activity in total.

A.1.7 CONSEQUENCES FOR RELATIVE LABOUR PRODUCTIVITY

The nature of the work involved means that the labour productivity of activity supported by the project, measured in terms of GDP per job per annum, should be significantly above the average prevailing across the UK economy as a whole.[12] The comparison for the total economic footprint is set out in Fig. 17.

[12] Average UK productivity in this analysis is based on GDP excluding imputed owner-occupied rent.

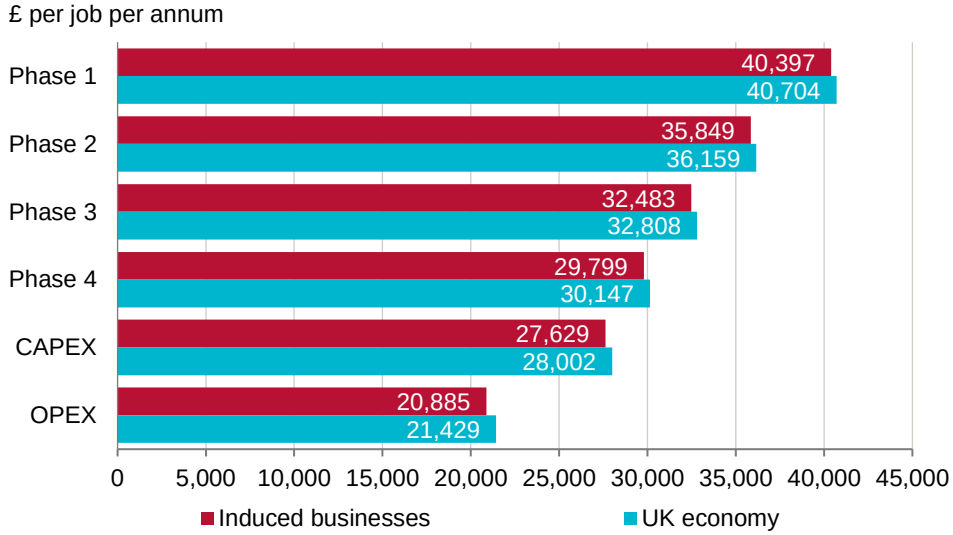
Fig. 17. Productivity of all work supported by the project



Source: Oxford Economics

The out-performance illustrated in Fig. 17 is, however, tempered by the inclusion of the induced channel (Fig. 18), which is heavily influenced by the pattern of activity across the UK economy as a whole.

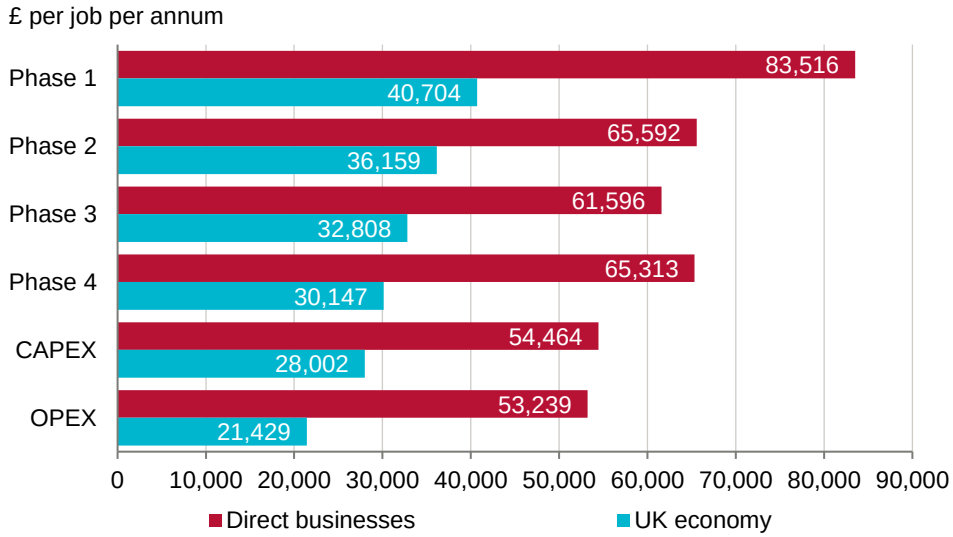
Fig. 18. Productivity in the project's induced channel



Source: Oxford Economics

By contrast, labour productivity amongst the direct businesses is substantially above the UK average (Fig. 19). In the OPEX phase, this is heavily influenced by the GDP of the solar power generation activity itself, which is assumed to follow the pattern for recent electricity production more generally, in terms of labour costs per job, and the 'normal' gross operating surplus per job. And this in turn largely reflects the capital-intensive nature of that wider sector today.

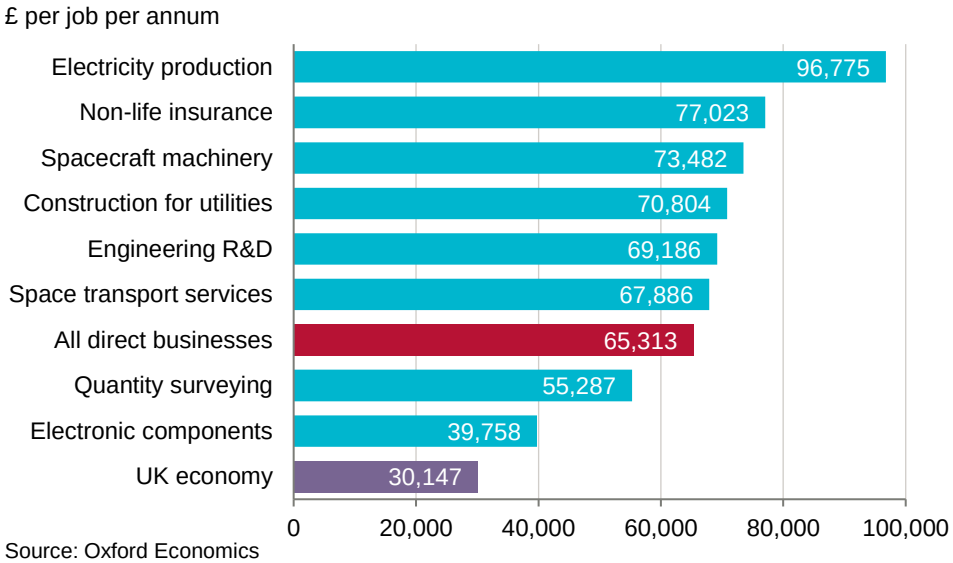
Fig. 19. Productivity in the project's direct channel



Source: Oxford Economics

But in the development and construction phases, the outperformance of direct businesses, in terms of GDP per job relative to the UK average, can only be explained—at least in part—by the skill and knowledge requirements of the work. Here, average GDP per job for direct businesses, by narrow sector of industry, is shown in Fig. 20 for phase 4, and in Fig. 21 for the construction phase.

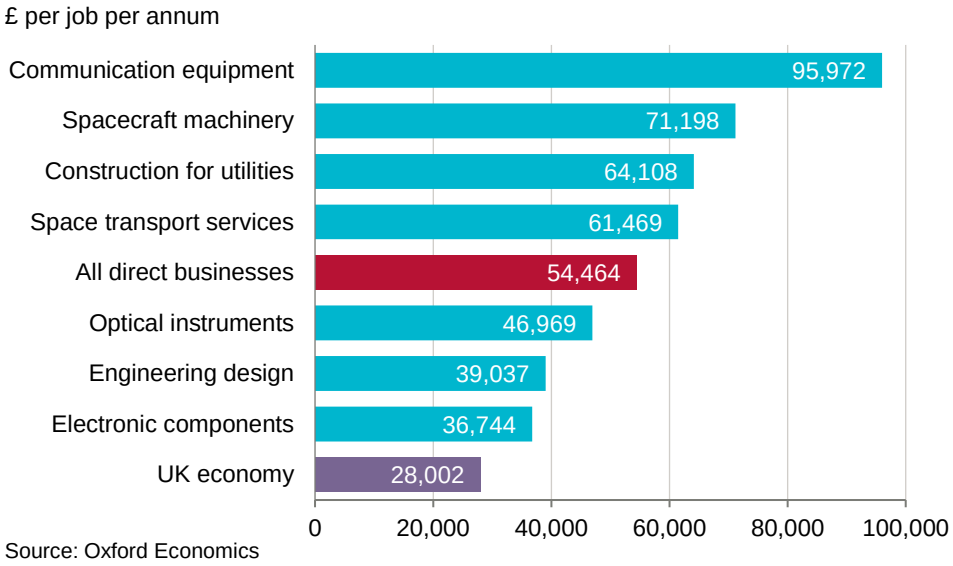
Fig. 20. Productivity of direct businesses in development phase 4



Source: Oxford Economics

While productivity in the development phase is boosted by the inclusion of electricity production and insurance services, a range of manufacturing, construction, and non-financial services activities are also involved—all of them also having a labour productivity ratio above the national average. In the construction phase, all of the activity directly supported takes place in manufacturing, construction, and non-financial services, and in each of these cases, too, productivity is above the UK-wide mean.

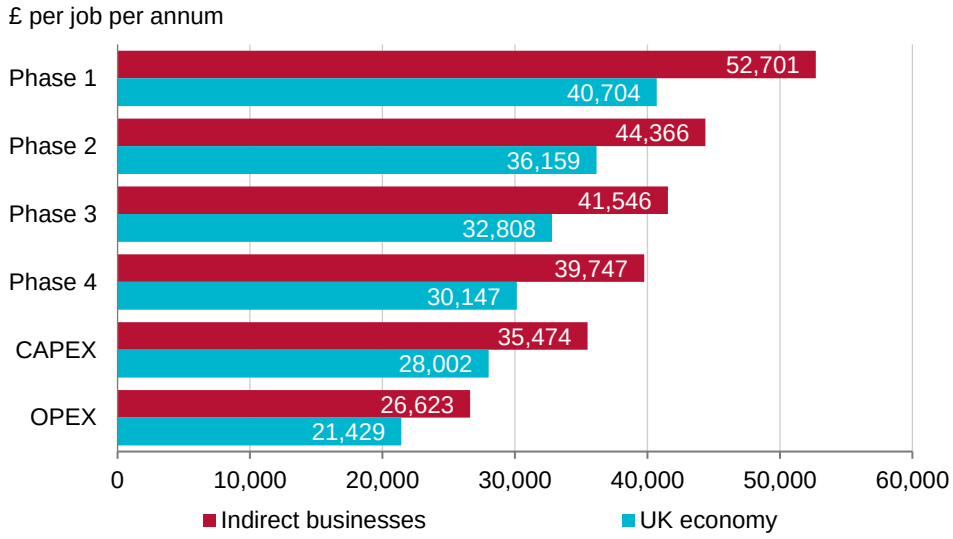
Fig. 21. Productivity of direct businesses in the construction phase



Source: Oxford Economics

Furthermore, average productivity in the indirect channel—covering the second and subsequent rounds of UK-based suppliers to the project—is also expected to be somewhat above the national mean (Fig. 22), reflecting the mix of jobs involved in those often closely-related activities.

Fig. 22. Productivity in the project's indirect channel

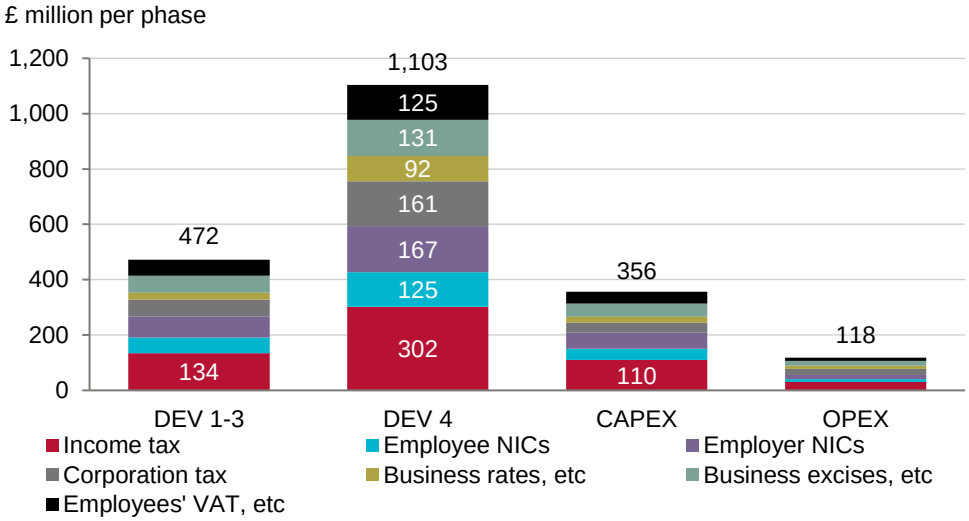


Source: Oxford Economics

A.1.8 TAX IMPACT ANALYSIS

The total tax footprint by phase is set out in Fig. 23, with this again relating to the central scenario. In the chart, income tax takes into account payments by employees and the self-employed in relation to their project-derived work. 'Employee NICs' also includes self-employed NICs, 'business rates etc' includes other taxes on production such as vehicle duties, 'business excises' covers all unrecoverable taxes on products in the business supply chains, and 'employees' VAT, etc' covers all taxes on products relating to the household spending of employees and the self-employed.

Fig. 23. Total tax footprint by type of tax and phase



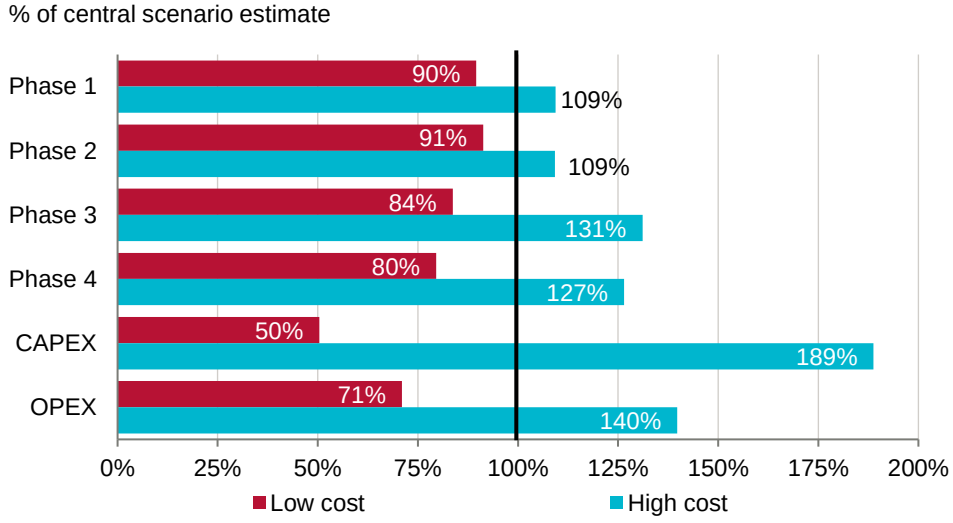
Source: Oxford Economics

In very broad terms, income tax and NICs paid by workers account for 39-42% of all taxes in the development and CAPEX phases, employer NICs for 15-16%, other business taxes for 30-35%, and VAT and other taxes on workers' spending for the remaining 11-12%. In the OPEX phase, where the total tax take is more modest, business taxes other than employer NICs account for a higher share, at 43%, with workers' income tax and NICs at 34%, employer NICs at 13%, and taxes on workers' spending at 10%.

A.1.9 ALTERNATIVE HIGH-COST AND LOW-COST SCENARIOS

Detailed estimates for the alternative high-cost and low-cost scenarios are set out in the results tables at the end of this report. To give a broad indication of the variation in outcomes, the estimated total GDP impacts for the first two phases of the development work are equivalent to 90-91% of the central estimates, in the case of the low cost scenarios, and 109% in the case of the high scenarios (see Fig. 24). The range around the central outcome is, however, significantly greater in each of the later phases, as shown.

Fig. 24. Alternative total GDP impacts relative to the central scenario



Source: Oxford Economics

A.1.10 POSSIBLE NET 'ADDITIONAL' BENEFITS

The results set out in sections 2.4-2.8 above are on a 'gross' basis, allowing for 'leakage' due to imports but not for the displacement of labour and other resources which would otherwise be used elsewhere in the UK economy. A full estimation of the net rather than gross benefits would require the alternative use of those

resources to be modelled, in turn requiring a range of assumptions to be made about detailed features of the future UK economy—and industrial landscape—which are in fact highly uncertain.[13]
However, it is possible to make a few observations on the extent to which the net benefit will or will not fall short of the gross amounts estimated. There are two important general principles here:

- Where the economy concerned is clearly operating below 'full capacity', with a large number of unemployed or under-employed individuals willing and able to work more, then the amount of activity displaced by a new investment project will be very limited, provided that the timeframe concerned is relatively short. But where the economy is operating close to 'full capacity', the net benefit, after allowing for displacement, will be clearly lower than the gross value.

- However, in the first of these cases, if the timeframe considered is a long one, then a significant share of the calculated gross benefit could still reflect displacement, because of the likelihood that alternative work will become available as the economy moves back towards 'full capacity' over time, even in the absence of the project (due to market forces and/or suitable macroeconomic policy interventions).

As the timeframe involved in the present case is very long, then a sizeable proportion of the gross benefit will almost inevitably be accounted for by displacement. More specifically, it may be fairly reasonable to assume that:

- The electricity generation, and associated spending and activity, in the OPEX phase, will essentially displace a similar amount of other electricity-related activity, albeit quite possibly in a slightly different (and perhaps less 'green') range of supplying industries.14
- Work in the induced channel will essentially displace other consumer-facing activity of a similar nature, to the extent that it is any different at all to the consumer-related activity that would otherwise take place.15
- The remaining workers, in the direct and indirect businesses in the development and CAPEX phases, would almost certainly be employed in alternative roles in the absence of the project, so that the overall net employment impact in terms of headcount would be negligible.

However, as set out in section 2.6 above, work in the supplying (i.e. direct and indirect) businesses, in the development and CAPEX phases, is of a high-productivity nature. And there is no guarantee that these workers' roles, in the alternative 'no project' scenario, would require them to develop and use the same high level of knowledge and skills that they would need to contribute to the development of the innovative space-based solar panel.
The project can, therefore, be expected to generate a positive net benefit in terms of extra GDP for each worker in the supply chain—in addition to the likely consumer, R&D 'spillover', and environmental benefits, and the possible return to the project's investors or sponsors. And that additional net GDP will have additional net tax revenues associated with it.
To give an indication of the possible size of the additional GDP benefit, Fig. 25 splits the total gross GDP impact into three segments:

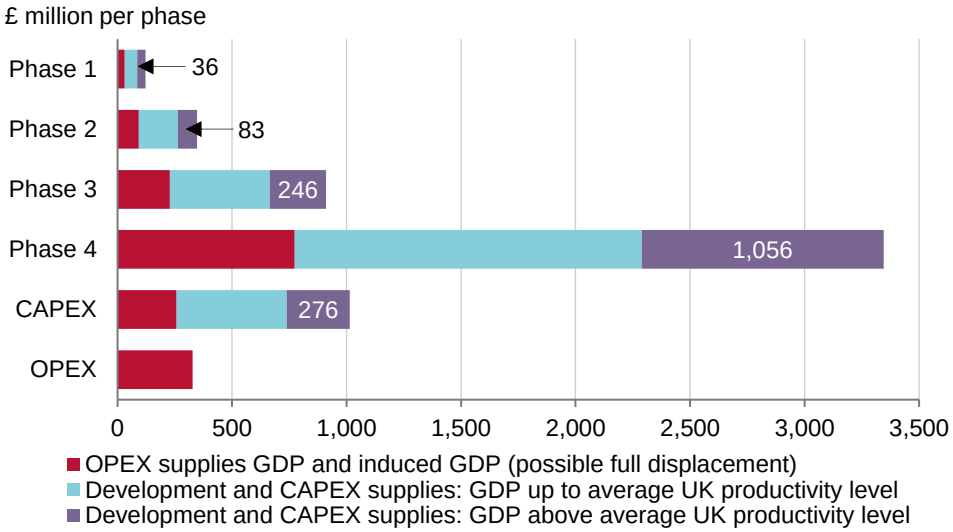
- Direct and indirect GDP ('supplies') in the OPEX phase, and all induced GDP, where displacement is likely to account for most or even all of the gross impact.

[13] Another option would be to scale down all of the 'gross' results by a set proportion, based on the range of ratios to be found in the Government's 'additionality' guides. However, the choice of scaling factor here would be quite arbitrary, and the example projects on which the guidance is based may well not be relevant for the present purposes. A much more nuanced approach would really be needed, allowing different scaling factors to be applied—at the very least—to the GDP and jobs impacts, and to the direct, indirect and induced impacts.
[14] However, given the Government's environmental policy commitments, it seems highly unlikely that a major part of the electricity generation displaced in the OPEX phase would be of a traditional coal- or gas-based nature.
[15] To the extent that UK consumer demand is lower at the margin, in the absence of the project, then export-related activity might well be able to take up the 'slack'.

- Direct and indirect GDP in the development and CAPEX phases, up to the amount that would be generated by the same number of jobs, but with GDP per job in line with average UK-wide productivity for the phase concerned (as calculated for the charts in section 2.6 above).
- Direct and indirect GDP in the development and CAPEX phases, in excess of this 'average' amount.

In the chart, the value highlighted for each phase relates to the amount of the direct and indirect suppliers' GDP that is above the UK average for the number of jobs involved. This is, for example, £1,056 million in phase 4, which is just under a third of the total gross GDP impact estimated for that phase. These values could be taken as an indication of the project's potential to support genuinely additional GDP in the UK supply chain.

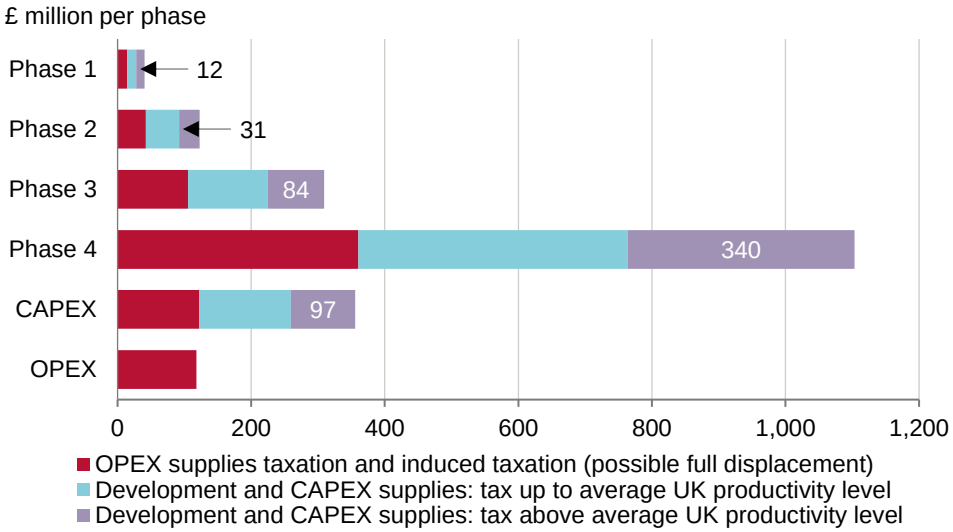
Fig. 25. Breakdown of the total gross GDP impact to inform the split between 'net benefit' and 'GDP displacement'



Source: Oxford Economics

The associated breakdown for the total gross tax impact is illustrated in Fig. 26. Here, the potentially additional tax revenues are put at £340 million for development phase 4, which is again close to a third of the estimated total gross benefit in that phase. Relative to the pattern for GDP illustrated in Fig. 25, this figure is boosted by the 'progressive' nature of employment taxation in the UK, which means that 'above productivity' work is taxed more heavily than 'average' work. But this effect is broadly offset by the role of consumer taxes in the wider UK tax system. These taxes are all allocated to the induced channel in this analysis and, therefore, all counted in the red segment in the chart.

Fig. 26. Breakdown of the total gross tax impact to inform the split between 'net benefit' and 'tax displacement'



Source: Oxford Economics

A.2 DETAILED DATA TABLES

Table 1 Overall impacts by phase and cost scenario: totals per phase

	Development phase 1 (2022-2026)			Development phase 2 (2027-2031)			Development phase 3 (2032-2035)		
	P10	P50	P90	P10	P50	P90	P10	P50	P90
GDP, £ million total for each phase									
Direct	50.1	55.9	61.2	123.2	136.7	150.9	329.5	399.1	524.6
Indirect	30.4	34.0	37.2	109.5	118.2	127.9	241.3	283.1	372.7
Induced	28.4	31.7	34.7	84.3	92.1	100.3	191.9	228.5	296.6
Total GDP impact	109.0	121.6	133.1	317.0	347.0	379.1	762.6	910.7	1,193.8
Jobs, total "job-years" for each phase									
Direct	600	670	733	1,905	2,084	2,269	5,377	6,479	8,301
Indirect	577	645	705	2,474	2,665	2,872	5,760	6,815	8,910
Induced	704	786	860	2,351	2,569	2,796	5,906	7,033	9,129
Total jobs impact	1,882	2,100	2,298	6,730	7,318	7,938	17,042	20,327	26,340
Taxes, £ million total for each phase									
Direct	15.5	17.3	18.9	43.5	47.8	52.4	104.6	125.4	162.8
Indirect	7.5	8.4	9.2	30.3	32.6	35.1	66.4	78.1	102.5
Induced	13.0	14.5	15.9	38.9	42.5	46.3	89.2	105.7	136.8
Total tax impact	36.0	40.2	44.0	112.7	123.0	133.8	260.2	309.2	402.1

	Development phase 4 (2036-2039)			Construction phase (2039-2040)			Operational phase (2044-2066)		
	P10	P50	P90	P10	P50	P90	P10	P50	P90
GDP, £ million total for each phase									
Direct	1,162.3	1,465.0	1,851.9	211.7	422.6	799.0	86.2	122.8	173.1
Indirect	890.5	1,106.9	1,394.3	168.4	333.9	637.2	95.6	133.6	185.8
Induced	608.8	773.5	986.2	131.2	257.6	478.5	50.4	70.5	98.1
Total GDP impact	2,661.6	3,345.4	4,232.4	511.3	1,014.2	1,914.7	232.2	326.9	457.0
Jobs, total "job-years" for each phase									
Direct	17,456	22,430	28,678	3,906	7,760	14,354	1,627	2,306	3,239
Indirect	22,321	27,849	35,079	4,786	9,412	17,600	3,611	5,019	6,949
Induced	20,429	25,957	33,095	4,749	9,324	17,319	2,415	3,378	4,699
Total jobs impact	60,205	76,237	96,852	13,441	26,497	49,272	7,653	10,703	14,887
Taxes, £ million total for each phase									
Direct	345.5	436.5	552.8	71.3	139.3	257.9	30.9	43.3	60.3
Indirect	246.2	306.3	385.5	48.1	94.7	179.1	29.0	40.5	56.2
Induced	284.7	360.7	459.2	62.1	121.9	226.4	24.4	34.1	47.4
Total tax impact	876.5	1,103.4	1,397.5	181.5	355.9	663.5	84.3	117.9	164.0

Table 2 Overall impacts by phase and cost scenario: annual averages

	Development phase 1 (2022-2026)			Development phase 2 (2027-2031)			Development phase 3 (2032-2035)		
	P10	P50	P90	P10	P50	P90	P10	P50	P90
GDP, £ million per annum									
Direct	10.0	11.2	12.2	24.6	27.3	30.2	82.4	99.8	131.1
Indirect	6.1	6.8	7.4	21.9	23.6	25.6	60.3	70.8	93.2
Induced	5.7	6.3	6.9	16.9	18.4	20.1	48.0	57.1	74.1
Total GDP impact	21.8	24.3	26.6	63.4	69.4	75.8	190.7	227.7	298.5
Jobs, average through-out each phase									
Direct	120	134	147	381	417	454	1,344	1,620	2,075
Indirect	115	129	141	495	533	574	1,440	1,704	2,227
Induced	141	157	172	470	514	559	1,477	1,758	2,282
Total jobs impact	376	420	460	1,346	1,464	1,588	4,261	5,082	6,585
Taxes, £ million per annum									
Direct	3.1	3.5	3.8	8.7	9.6	10.5	26.2	31.4	40.7
Indirect	1.5	1.7	1.8	6.1	6.5	7.0	16.6	19.5	25.6
Induced	2.6	2.9	3.2	7.8	8.5	9.3	22.3	26.4	34.2
Total tax impact	7.2	8.0	8.8	22.5	24.6	26.8	65.0	77.3	100.5

	Development phase 4 (2036-2039)			Construction phase (2039-2040)			Operational phase (2044-2066)		
	P10	P50	P90	P10	P50	P90	P10	P50	P90
GDP, £ million per annum									
Direct	290.6	366.2	463.0	42.3	84.5	159.8	3.7	5.3	7.5
Indirect	222.6	276.7	348.6	33.7	66.8	127.4	4.2	5.8	8.1
Induced	152.2	193.4	246.5	26.2	51.5	95.7	2.2	3.1	4.3
Total GDP impact	665.4	836.4	1,058.1	102.3	202.8	382.9	10.1	14.2	19.9
Jobs, average through-out each phase									
Direct	4,364	5,608	7,170	781	1,552	2,871	71	100	141
Indirect	5,580	6,962	8,770	957	1,882	3,520	157	218	302
Induced	5,107	6,489	8,274	950	1,865	3,464	105	147	204
Total jobs impact	15,051	19,059	24,213	2,688	5,299	9,854	333	465	647
Taxes, £ million per annum									
Direct	86.4	109.1	138.2	14.3	27.9	51.6	1.3	1.9	2.6
Indirect	61.6	76.6	96.4	9.6	18.9	35.8	1.3	1.8	2.4
Induced	71.2	90.2	114.8	12.4	24.4	45.3	1.1	1.5	2.1
Total tax impact	219.1	275.9	349.4	36.3	71.2	132.7	3.7	5.1	7.1

Table 3 Derivation of direct and indirect GDP from initial gross spending

	Development phase 1 (2022-2026)			Development phase 2 (2027-2031)			Development phase 3 (2032-2035)		
	P10	P50	P90	P10	P50	P90	P10	P50	P90
Gross spending	98.7	110.3	120.7	362.2	395.8	432.5	1,361.0	1,571.7	1,980.7
- Land purchases	0.0	0.0	0.0	1.4	1.7	1.8	12.0	14.3	15.7
- Taxes on products	0.0	0.0	0.0	0.2	0.3	0.3	2.5	2.7	2.9
- Imports	0.1	0.2	0.3	64.5	70.0	76.6	589.4	657.2	788.9
Output of 'first round' of suppliers	98.6	110.1	120.4	296.0	323.8	353.8	757.1	897.6	1,173.2
O/w: Their (direct) GDP	50.1	55.9	61.2	123.2	136.7	150.9	329.5	399.1	524.6
Their purchases	48.5	54.1	59.2	172.8	187.1	202.8	427.7	498.5	648.6
- Taxes on products	1.7	1.9	2.1	9.4	9.9	10.4	16.2	19.2	26.0
- Imports	10.2	11.4	12.5	29.0	32.1	35.5	114.5	130.7	165.0
Output of 'second round' of suppliers	36.6	40.8	44.7	134.5	145.2	156.9	297.0	348.6	457.6
- Further taxes on products	0.6	0.7	0.8	3.9	4.1	4.4	6.6	8.0	10.5
- Further import content	5.5	6.1	6.7	21.2	22.8	24.7	49.0	57.5	74.4
Supply chain (indirect) GDP	30.4	34.0	37.2	109.5	118.2	127.9	241.3	283.1	372.7

	Development phase 4 (2036-2039)			Construction phase (2039-2040)			Operational phase (2044-2066)		
	P10	P50	P90	P10	P50	P90	P10	P50	P90
Gross spending	4,052.9	5,098.2	6,455.3	814.8	1,548.7	2,933.5	235.4	331.4	463.3
- Land purchases	84.9	100.7	111.1	75.3	89.3	98.5	0.0	0.0	0.0
- Taxes on products	3.5	4.2	5.1	0.0	0.0	0.0	2.5	3.3	4.4
- Imports	1,300.7	1,661.8	2,135.8	245.0	474.9	950.7	0.0	0.0	0.0
Output of 'first round' of suppliers	2,663.9	3,331.4	4,203.3	494.6	984.5	1,884.3	232.8	328.1	458.9
O/w: Their (direct) GDP	1,162.3	1,465.0	1,851.9	211.7	422.6	799.0	86.2	122.8	173.1
Their purchases	1,501.6	1,866.4	2,351.4	282.9	561.8	1,085.3	146.6	205.3	285.8
- Taxes on products	46.2	63.0	85.4	13.5	26.4	50.1	4.8	6.5	8.8
- Imports	361.5	445.8	559.0	62.2	125.1	251.5	25.5	36.0	50.6
Output of 'second round' of suppliers	1,093.8	1,357.6	1,707.0	207.3	410.3	783.7	116.3	162.7	226.4
- Further taxes on products	25.5	31.7	39.7	5.3	10.3	18.7	3.1	4.4	6.1
- Further import content	177.9	219.0	273.0	33.5	66.1	127.9	17.6	24.7	34.5
Supply chain (indirect) GDP	890.5	1,106.9	1,394.3	168.4	333.9	637.2	95.6	133.6	185.8

Table 4 Direct GDP impacts by narrow sector of industry, central (P50) cost scenario, by phase

£ million total per phase	Phase 1	Phase 2	Phase 3	Phase 4	CAPEX	OPEX
Electronic components	0.0	13.4	115.8	237.3	25.9	0.0
Communication equipment	0.0	0.0	0.0	0.0	1.0	0.0
Optical precision instruments	0.0	0.0	0.0	0.0	2.7	0.0
Aircraft and spacecraft machinery	0.0	0.0	2.3	1.0	11.5	0.0
Electricity production	0.0	1.8	2.3	417.5	0.0	86.0
Construction of commercial buildings	0.0	18.6	0.0	0.0	0.0	0.0
Construction for electricity and telecoms	0.0	1.2	15.6	48.0	62.2	0.0
Space transport services	0.1	12.5	142.4	564.6	248.7	0.0
Engineering design	0.0	0.0	0.0	0.0	70.6	0.0
R&D for engineering	55.8	86.3	57.7	48.8	0.0	0.0
Non-life insurance	0.0	3.0	30.1	46.9	0.0	36.8
Quantity surveying activities	0.0	0.0	32.9	100.9	0.0	0.0
Total	55.9	136.7	399.1	1,465.0	422.6	122.8

Table 5 Direct jobs impacts by narrow sector of industry, central (P50) cost scenario, by phase

Total "job-years" per phase	Phase 1	Phase 2	Phase 3	Phase 4	CAPEX	OPEX
Electronic components	0	275	2,660	5,969	705	0
Communication equipment	0	0	0	0	10	0
Optical precision instruments	0	0	0	0	58	0
Aircraft and spacecraft machinery	0	0	31	13	162	0
Electricity production	0	14	21	4,314	0	1,511
Construction of commercial buildings	0	485	0	0	0	0
Construction for electricity and telecoms	0	13	197	678	970	0
Space transport services	1	144	1,872	8,316	4,046	0
Engineering design	0	0	0	0	1,809	0
R&D for engineering	669	1,123	795	705	0	0
Non-life insurance	0	30	346	609	0	795
Quantity surveying activities	0	0	558	1,826	0	0
Total	670	2,084	6,479	22,430	7,760	2,306

Table 6 GDP impacts by channel and industry group, central (P50) scenario

£ million total per phase	Development phase 1 (2024-2028)				Development phase 2 (2029-2034)			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Computers and electronic equipment	0.0	0.0	0.0	0.1	13.4	0.7	0.1	14.1
Aircraft and spacecraft machinery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Other machinery	0.0	0.2	0.2	0.4	0.0	1.2	0.7	1.9
Machinery repair	0.0	0.1	0.1	0.1	0.0	1.3	0.3	1.6
Other non-energy goods	0.0	1.2	2.0	3.1	0.0	7.6	5.7	13.3
Electricity production and supply	0.0	0.4	0.5	0.9	1.8	2.4	1.4	5.6
Other energy, mining and utilities	0.0	0.7	1.1	1.9	0.0	4.1	3.3	7.3
Construction	0.0	0.3	1.2	1.5	19.7	22.7	3.4	45.8
Air and space transport services	0.1	0.0	0.3	0.4	12.5	0.0	0.9	13.4
Technical and scientific services	55.8	15.2	0.4	71.4	86.3	25.1	1.1	112.5
Information and communication	0.0	2.4	2.0	4.4	0.0	6.5	5.8	12.3
Finance and real estate	0.0	2.2	6.1	8.3	3.0	8.0	17.6	28.6
Other business services	0.0	7.5	3.4	10.9	0.0	25.5	9.9	35.4
Other distribution and transport	0.0	2.3	7.8	10.1	0.0	9.2	22.5	31.7
Catering, community & personal	0.0	1.6	6.7	8.3	0.0	3.9	19.4	23.3
Total impact	55.9	34.0	31.7	121.6	136.7	118.2	92.1	347.0

£ million total per phase	Development phase 3 (2035-2038)				Development phase 4 (2036-2039)			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Computers and electronic equipment	115.8	5.7	0.2	121.7	237.3	12.4	0.8	250.5
Aircraft and spacecraft machinery	2.3	0.2	0.1	2.6	1.0	0.6	0.3	1.9
Other machinery	0.0	3.2	1.7	4.9	0.0	19.1	5.7	24.7
Machinery repair	0.0	6.2	0.6	6.8	0.0	45.0	2.1	47.1
Other non-energy goods	0.0	13.4	14.1	27.6	0.0	43.2	47.9	91.1
Electricity production and supply	2.3	14.0	3.5	19.9	417.5	62.5	11.8	491.9
Other energy, mining and utilities	0.0	16.4	8.1	24.5	0.0	110.5	27.5	137.9
Construction	15.6	14.9	8.5	39.1	48.0	62.4	28.8	139.2
Air and space transport services	142.4	0.0	2.3	144.7	564.6	0.0	7.9	572.5
Technical and scientific services	57.7	22.7	2.8	83.1	48.8	47.9	9.4	106.1
Information and communication	0.0	20.3	14.3	34.6	0.0	67.9	48.5	116.4
Finance and real estate	30.1	30.0	43.6	103.6	46.9	127.9	147.5	322.3
Other business services	32.9	99.0	24.5	156.4	100.9	378.7	82.8	562.4
Other distribution and transport	0.0	26.4	55.9	82.3	0.0	88.3	189.4	277.7
Catering, community & personal	0.0	10.7	48.2	58.8	0.0	40.5	163.1	203.7
Total impact	399.1	283.1	228.5	910.7	1,465.0	1,106.9	773.5	3,345.4

Table 7 GDP impacts by channel and industry group, central (P50) scenario (continued)

£ million total per phase	Construction phase (2039-2040)				Operational phase (2044-2066)			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Computers and electronic equipment	29.6	1.7	0.3	31.5	0.0	0.2	0.1	0.3
Aircraft and spacecraft machinery	11.5	0.3	0.1	11.9	0.0	0.0	0.0	0.0
Other machinery	0.0	3.7	1.9	5.6	0.0	2.4	0.5	2.9
Machinery repair	0.0	4.6	0.7	5.3	0.0	6.4	0.2	6.5
Other non-energy goods	0.0	18.0	15.9	33.9	0.0	5.5	4.4	9.8
Electricity production and supply	0.0	20.4	3.9	24.4	86.0	3.2	1.1	90.2
Other energy, mining and utilities	0.0	21.8	9.1	30.9	0.0	13.0	2.5	15.5
Construction	62.2	36.1	9.6	107.9	0.0	7.8	2.6	10.5
Air and space transport services	248.7	0.0	2.6	251.3	0.0	0.0	0.7	0.7
Technical and scientific services	70.6	17.8	3.1	91.5	0.0	5.6	0.9	6.5
Information and communication	0.0	16.1	16.2	32.3	0.0	14.6	4.4	19.0
Finance and real estate	0.0	27.3	49.1	76.4	36.8	24.3	13.5	74.5
Other business services	0.0	128.2	27.6	155.7	0.0	33.6	7.6	41.2
Other distribution and transport	0.0	25.6	63.1	88.7	0.0	11.3	17.3	28.6
Catering, community & personal	0.0	12.4	54.3	66.7	0.0	5.8	14.9	20.6
Total impact	422.6	333.9	257.6	1,014.2	122.8	133.6	70.5	326.9

Table 8 Employment impacts by channel and industry group, central (P50) scenario

Total "job-years" per phase	Development phase 1 (2022-2026)				Development phase 2 (2027-2031)			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Computers and electronic equipment	0	0	0	1	275	8	1	284
Aircraft and spacecraft machinery	0	0	0	0	0	0	0	1
Other machinery	0	3	4	7	0	22	13	35
Machinery repair	0	1	2	3	0	27	5	32
Other non-energy goods	0	23	45	68	0	181	140	321
Electricity production and supply	0	2	3	5	14	13	8	35
Other energy, mining and utilities	0	6	8	14	0	36	25	60
Construction	0	7	26	33	498	579	88	1,164
Air and space transport services	1	0	7	8	144	0	23	167
Technical and scientific services	669	176	12	857	1,123	365	38	1,526
Information and communication	0	32	24	56	0	95	74	169
Finance and real estate	0	22	45	67	30	86	144	261
Other business services	0	260	109	369	0	843	357	1,201
Other distribution and transport	0	61	233	293	0	264	758	1,022
Catering, community & personal	0	51	269	319	0	145	894	1,039
Total impact	670	645	786	2,100	2,084	2,665	2,569	7,318

Table 9 Employment impacts by channel and industry group, central (P50) scenario (continued)

Total "job-years" per phase	Development phase 3 (2032-2035)				Development phase 4 (2036-2039)			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Computers and electronic equipment	2,660	65	3	2,727	5,969	145	9	6,123
Aircraft and spacecraft machinery	31	2	1	34	13	9	4	26
Other machinery	0	60	33	93	0	367	114	481
Machinery repair	0	129	13	143	0	960	46	1,006
Other non-energy goods	0	338	366	704	0	1,117	1,295	2,412
Electricity production and supply	21	80	20	121	4,314	368	70	4,753
Other energy, mining and utilities	0	142	64	206	0	768	227	996
Construction	197	440	250	887	678	2,085	962	3,725
Air and space transport services	1,872	0	65	1,937	8,316	1	248	8,565
Technical and scientific services	795	498	105	1,399	705	1,673	390	2,768
Information and communication	0	304	196	500	0	1,076	695	1,771
Finance and real estate	346	357	390	1,093	609	1,524	1,426	3,560
Other business services	558	3,098	981	4,637	1,826	12,723	3,630	18,178
Other distribution and transport	0	829	2,056	2,885	0	3,014	7,509	10,522
Catering, community & personal	0	472	2,489	2,962	0	2,019	9,333	11,352
Total impact	6,479	6,815	7,033	20,327	22,430	27,849	25,957	76,237

Total "job-years" per phase	Construction phase (2039-2040)				Operational phase (2044-2066)			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Computers and electronic equipment	773	20	3	796	0	3	1	4
Aircraft and spacecraft machinery	162	4	1	168	0	0	0	1
Other machinery	0	72	39	111	0	49	11	60
Machinery repair	0	99	15	115	0	141	4	146
Other non-energy goods	0	478	448	927	0	147	140	287
Electricity production and supply	0	124	24	148	1,511	21	7	1,539
Other energy, mining and utilities	0	210	79	289	0	92	24	116
Construction	970	1,348	358	2,676	0	446	149	595
Air and space transport services	4,046	0	92	4,138	0	0	38	38
Technical and scientific services	1,809	810	140	2,760	0	340	51	391
Information and communication	0	266	241	507	0	274	75	349
Finance and real estate	0	357	508	865	795	404	177	1,376
Other business services	0	4,019	1,307	5,325	0	2,132	476	2,608
Other distribution and transport	0	961	2,672	3,632	0	520	929	1,449
Catering, community & personal	0	643	3,397	4,040	0	450	1,295	1,745
Total impact	7,760	9,412	9,324	26,497	2,306	5,019	3,378	10,703

Table 10 Tax impacts by channel and type of tax, central (P50) scenario

£ million total per phase	Development phase 1 (2022-2026)				Development phase 2 (2027-2031)			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Workers' income tax	6.9	2.6	2.8	12.3	15.8	10.1	8.5	34.4
Workers' NICs	2.5	1.4	1.3	5.2	5.9	5.2	3.7	14.8
Employers' NICs	3.9	1.7	1.4	7.0	9.0	5.9	4.3	19.2
Corporation tax	1.5	1.6	1.5	4.7	5.2	5.8	4.4	15.3
Business rates, etc	0.6	0.3	0.9	1.7	1.7	1.5	2.5	5.8
Taxes on business supplies	1.9	0.7	1.3	3.9	10.1	4.1	3.8	18.0
Taxes on workers' spending	-	-	5.4	5.4	-	-	15.4	15.4
Total	17.3	8.4	14.5	40.2	47.8	32.6	42.5	123.0
£ million total per phase	**Development phase 3 (2032-2035)**				**Development phase 4 (2036-2039)**			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Workers' income tax	41.7	24.0	21.9	87.7	127.4	97.8	76.8	302.0
Workers' NICs	16.6	11.2	9.3	37.1	51.0	42.1	31.7	124.7
Employers' NICs	24.4	14.2	10.8	49.4	74.8	55.0	37.3	167.2
Corporation tax	13.7	15.6	10.8	40.2	65.6	58.9	36.7	161.2
Business rates, etc	7.1	5.1	6.2	18.4	50.5	20.7	21.1	92.3
Taxes on business supplies	21.9	8.0	9.4	39.2	67.2	31.7	31.7	130.6
Taxes on workers' spending	-	-	37.2	37.2	-	-	125.5	125.5
Total	125.4	78.1	105.7	309.2	436.5	306.3	360.7	1,103.4

£ million total per phase	Construction phase (2039-2040)				Operational phase (2044-2066)			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Workers' income tax	53.8	30.2	26.4	110.3	6.8	14.9	8.2	29.9
Workers' NICs	16.7	13.1	10.6	40.3	3.0	4.9	2.9	10.7
Employers' NICs	28.2	16.5	12.6	57.4	4.2	7.4	3.6	15.2
Corporation tax	6.1	18.1	12.2	36.4	12.3	6.8	3.3	22.4
Business rates, etc	8.1	6.6	7.0	21.6	7.3	2.1	1.9	11.3
Taxes on business supplies	26.4	10.3	10.5	47.2	9.8	4.4	2.9	17.1
Taxes on workers' spending	-	-	42.6	42.6	-	-	11.3	11.3
Total	139.3	94.7	121.9	355.9	43.3	40.5	34.1	117.9

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