Supergen Offshore Renewable Energy

What is the value of innovative offshore renewable energy deployment to the UK economy?

A Supergen Offshore Renewable Energy Hub Policy Paper prepared by the **Policy and Innovation Group** at the University of Edinburgh

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The Policy and Innovation Research Group is part of the Institute for Energy Systems (IES), which is one of the six research institutes within the School of Engineering at the University of Edinburgh.The group combines expertise on technologies, energy system organisations and institutions, and the wider policy and regulatory context for energy. They apply a range of quantitative and qualitative research tools and methods including innovation systems, energy system modelling and scenarios, and transitions management. This leads to preparation of strategy and investment roadmaps for organisations' funding, public and private investment and government departments.

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Supergen Offshore Renewable Energy Hub

The Supergen ORE Hub is a £9 Million Engineering and Physical Sciences Research Council (EPSRC) funded programme which brings together academia, industry, policy makers and the general public to support and accelerate the development of offshore wind, wave and tidal technology for the benefit of society.

The Hub is led by the University of Plymouth, and includes Co-Directors from the Universities of Aberdeen, Edinburgh, Exeter, Hull, Manchester, Oxford, Southampton, Strathclyde, and Warwick.

The Supergen ORE Hub is one of three Supergen Hubs and two Supergen Network+ created by the EPSRC to deliver strategic and coordinated research on Sustainable Power Generation and supply.
https://www.supergen-ore.net/

Designed by Martin Budd Design Consultant
Cover image: Climate Warming Stripes:
https://www.climate-lab-book.ac.uk/warming-stripes/

Acknowledgments

This report has been made possible thanks to input from:
Adam Thirkill, Energy Systems Catapult
Uwe Remme, International Energy Agency
Grant Allan, University of Strathclyde

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1 EXECUTIVE SUMMARY

This study quantifies the potential economic benefit, in gross value added (GVA) terms, that the UK stands to gain through the deployment of innovative offshore renewable energy (ORE) technologies (wave, tidal stream and floating offshore wind) in domestic and international waters. The economic implications of increased and targeted innovation across the supply chain have also been quantified. GVA is the metric used in this study, in lieu of an alternative which may account for wider social impacts, because it is the generally accepted economic performance metric employed by governments and policymakers.

This work is founded on deployment scenarios, where cost, performance and systemic conditions are defined by the 2030 levelised cost of energy (LCOE) targets in the Strategic Energy Technology Plans (SET Plans) for wave, tidal stream, and floating offshore wind (FOW) technologies. Deployment modelling obtained from the Energy Systems Catapult (ESC) and the International Energy Agency (IEA) form a basis for an input-output (IO) analytical model. The time series of the installed capacity are coupled with deployment costs, leakage rates, and GVA effects to obtain GVA results associated to the different project phases and components.

Results are presented across multiple levels of local content ambition, to assess the impact on this economic benefit of increasing local content in specific areas of the UK supply chain, for example through targeted investment by the UK government. A **High Ambition supply chain scenario** assumes more ambitious levels of spend for domestic and international deployments retained by the UK supply chain. Conversely, a **Low Ambition supply chain scenario** assumes less ambitious retention levels of UK content.

Results from this work can be summarised as:

- Global deployments of wave, tidal stream, and floating offshore wind technologies produce **a total of £24.6bn to £79.6bn in GVA to the UK economy**, dependent on supply chain assumptions.
- Of this total figure, domestic deployments result in £16.4bn to £41.4bn in GVA for the UK economy. Within this obtained GVA range, a 152% increase in GVA can be observed, due to more ambitious retention assumptions reflecting a stronger UK supply chain.
- UK content in international deployments therefore generates £8.2bn to £38.2bn in GVA for the UK economy. Within this obtained GVA range, a 221% increase in GVA can be observed from global deployments, due to more ambitious retention assumptions reflecting a stronger UK supply chain.
- Translating this per MW of deployment, **domestic ORE deployments result in GVA per MW** values which range from £258k/MW to £745k/MW, dependent on technology and retention assumptions. International ORE deployments result in values of £35k/MW to £179k/MW.
- Lifetime OPEX is the cost centre that contributes the most to the incurred GVA for all technologies and scenarios. In terms of the CAPEX-related GVA, the balance of plant supply generates the highest CAPEX-related GVA for FOW, and the generating device results in the highest CAPEX-related GVA for wave and tidal.

This economic benefit to the UK economy is only achievable if focused investment in ORE technologies enables a reduction in LCOE in line with the SET Plan targets. This results from performance improvements and cost reduction both through innovative step-changes in research and development and through learning from continued successive deployments. This focused investment would also have to result in sufficient domestic supply chain development to achieve the levels of spend retention assumed in this work.

2 INTRODUCTION

Eunice and the Northern Lights - Nova Innovation

Introduction

Offshore Renewable Energy (ORE) technologies will play a key role in meeting long term decarbonisation targets, both in the UK and globally. These technologies can provide a range of benefits in terms of reduced reliance on importing fossil fuels, emissions reduction, and socioeconomic benefits such as Gross Value Added (GVA) and jobs creation.

This study quantifies the potential socioeconomic benefit offered to the UK economy in terms of GVA of the development, deployment, and maintenance of ORE technologies until 2050, both in the UK and globally. Deployment trajectories for wave, tidal stream and floating offshore wind have been modelled based on the assumption of meeting Strategic Energy Technology Plan (SET Plan) cost targets for each of these technologies by 2030. Input-output analysis is then used to convert the capital and operational expenditures associated with these deployments to GVA.

The proportion of the total spend associated with the domestic and international deployment retained in the UK is dependent on the relative strength of the UK supply chain. The sensitivity of the GVA results to assumed retained spend is highlighted through scenario analysis. Results are presented both in terms of total GVA and as GVA per MW of deployed capacity to quantify the potential value of investing in each MW of ORE to the UK economy.

Offshore Renewable Energy Technologies

This analysis focuses on the potential future deployment and resultant economic benefits of three offshore renewable technologies: floating offshore wind, tidal stream, and wave energy. These technologies are of particular interest as they still require significant levels of innovation and cost reduction to become commercially mature. They also still have a wide potential scope for the UK to lead the way in terms of technology and supply chain development in the future.

The first full scale arrays of floating offshore wind have been deployed at the Hywind and Kincardine sites in the UK, and other demonstration projects are in construction [1]. The first full scale arrays for tidal stream have also been deployed in the UK, at the Meygen and Bluemull Sound sites [2]. Wave technology is at a more nascent stage of development, with a number of single device demonstration projects ongoing, at partial scale and full scale. For example, the oscillating water column (OWC) Mutriku Wave Power plant in the Basque country [3] and the Mocean attenuator device at the European Marine Energy Centre in Orkney, UK [4].

The European Technology and Innovation Platforms for Wind and for Ocean Energy have produced Strategic Research and Innovation Agendas (SRIAs), which include further information about the challenges and opportunities associated with floating wind, wave and tidal deployment today [5, 6].

Mocean Blue X wave energy prototype. (Credit: Colin Keldie)

Orbital Marine Power O2 tidal turbine (Credit: Orbital Marine Power)

Future cost targets have now been established for these ORE technologies through the Strategic Energy Technology Implementation Plans (SET Plans) for Offshore Wind Energy [7] and Ocean Energy [8]. The SET Plans aim is to lead the clean energy transition in Europe. Coordinated by the SET Plan Working Groups, the SET Plans outline a structured approach that aids the progression of renewable energy technologies to commercialisation.

These cost targets are:

- €90/MWh for floating offshore wind by 2030,
- €100/MWh for tidal stream by 2030, and
- €150/MWh for wave energy by 2030.

9.5MW Floating Offshore Wind Turbine at Kindardine offshore wind farm (Credit: Principle Power)

Exploring socioeconomic benefits through GVA

This work can be described as a Socioeconomic Cost of Energy (SCOE) study, as it quantifies the socioeconomic benefits associated with ORE deployments. For this SCOE analysis, GVA is employed as the metric calculating the external economic effects of the deployment of offshore renewable energy devices at grid scale. GVA is an economic performance metric employed by governments to measure the impact of an activity on a particular economy.

This work builds on existing studies which have produced deployment scenario and GVA results for offshore renewables in the UK [9] - [10]. Some studies use assumptions for future ORE deployments informed by industry stakeholders and roadmaps [9], [11], [12], whilst some more recent work has involved the use of energy systems models to inform future ORE deployment [10]. The cumulative UK deployment of wave and tidal from these studies ranges from 1.6 GW [9] to 37.7 GW [10].

These studies all use the Input-Output (IO) method to derive GVA effects from IO tables. The study from Allan et al [13] also compared both IO and Computable General Equilibrium (CGE) methods to calculate GVA, finding that IO could slightly overstate the economic impacts during the expenditure period compared with the CGE methods.

The present work builds on the methodologies used by these previous studies, using UK IO tables to calculate GVA effects and using energy system models to produce UK deployment scenarios from 2030 to 2050 for wave, tidal stream, and floating offshore wind technologies. The following sections outline the GVA calculation methodology and input assumptions, the UK and global deployment results, the total GVA results, and further analysis and discussion of the supply chain implications associated with the GVA outputs.

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3 METHODOLOGY AND INPUT ASSUMPTIONS

Source: Wave Energy Scotland

GVA Calculation Methodology

In this study, the economic benefits to the UK associated with the domestic and international deployment of wave, tidal stream, and floating offshore wind until 2050 are explored in terms of Gross Value Added (GVA). The GVA calculation methodology is structured in four stages as illustrated in Figure 1:

1. Deployment scenarios based on the SET Plan targets were designed and modelled by the ESME modelling team at the Energy Systems Catapult (ESC) and the TIMES modelling team at the International Energy Agency (IEA).
2. Capital expenditure (CAPEX) and operational expenditure (OPEX) values were derived from the SET Plan targets from 2030 to 2050 and applied per MW to the deployment modelling outputs. The CAPEX values were split across individual technical cost centres[1] for emerging ORE technologies. Different breakdowns were employed to reflect not only the different technological requirements, but also their varying stages of development [14].
3. GVA effects were obtained through the Leontief inverse of Input Output (IO) tables from the Office for National Statistics (ONS), adapted to Industry-by-Industry (IxI) format by the Fraser of Allander Institute[2]. These effects enabled the calculation of type II GVA benefit associated with the expenditure required for each technology.
4. The impact on the GVA results of the level of local content (UK supply chain) servicing the domestic (and export) markets was assessed through the application of variable retention rates across technical cost centres [15]. Two retention scenarios were investigated, referred to here as High Ambition (high retention of spend) and Low Ambition (low retention of spend).

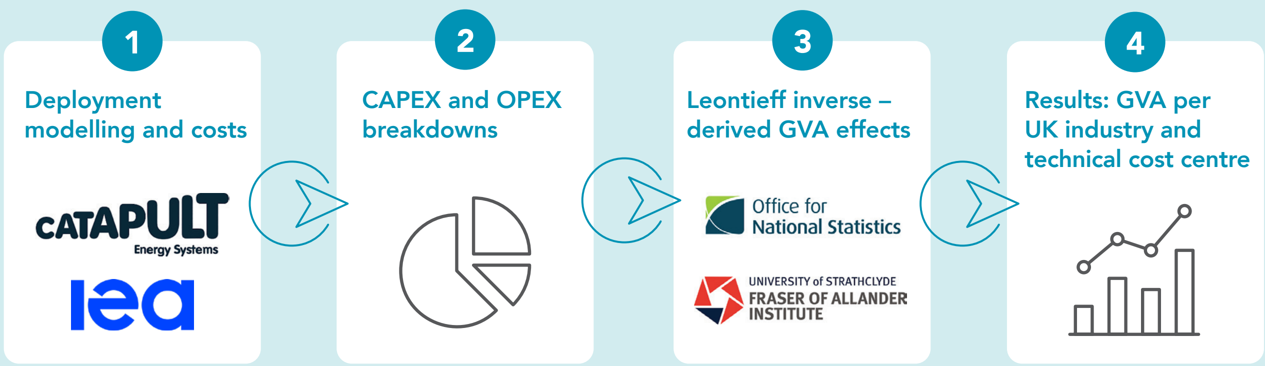

Figure 1 - Overview of GVA methodology

The inputs and assumptions required for the GVA calculation over these four stages are detailed in the following sections in terms of UK and global deployment modelling, cost breakdown assumptions and expenditure retention assumptions.

[1] Technical cost centres are technology specific, and broadly encompass costs associated with project development, the generating device, balance of plant, installation and contingency.

[2] https://fraserofallander.org/research/economic-databases-and-accounts/

UK Deployment Modelling

The deployment presented in this study is founded on the Energy Systems Catapult's 96% Further Ambition (FA96) scenario, modelled using the Energy Systems Modelling Environment (ESME) tool. ESME is a whole systems modelling tool, used to create scenarios for the future GB energy system using a least cost optimisation algorithm, subject to system constraints such as annual energy demand and greenhouse gas emissions. The FA96 scenario is aligned, in terms of 2050 greenhouse gas (GHG) emissions, to the Committee on Climate Change (CCC)'s Further Ambition position defined in the Net Zero report and used in the ESC's Innovating to Net Zero analysis [16] [17] [18]. As such, the energy mix is highly electrified and decarbonised.

A dedicated ESME run has been performed for this work with the following assumptions:

- The respective SET Plan cost targets for 2030 have been input to ESME for wave (€150/MWh), tidal stream (€100/MWh) and floating offshore wind (€90/MWh).
- Annual OPEX for 2030 is assumed to be 4% (wave), 4.5% (tidal steam) and 1.5% (floating offshore wind) of CAPEX respectively.
- Capacity factors for 2030 are assumed to be 33% (wave), 39% (tidal steam) and 53% (floating offshore wind).
- Cost reductions and performance improvements beyond 2030 for tidal stream and wave power are in line with those used in the JRC TIMES modelling [19].
- Cost reductions and performance improvements for floating offshore wind use standard ESME assumptions post-2030.
- Cost and performance inputs for all other electricity generation technologies are also based on the standard ESME cost assumptions.

Global Deployment Modelling

Global ORE deployment, which the UK export market serves, is based on the IEA Energy Technology Perspectives (ETP) Sustainable Development Scenario (SDS), informed by the IEA global TIMES model [20]. The SDS is one of four scenarios depicting possible energy futures that may be achieved through a range of policy mechanisms at various levels of ambition. The SDS has historically been presented as part of the regular ETP research package alongside the less ambitious Current Policies and Stated Policies scenarios. The assumptions on which the SDS is based are as follows:

- The net zero carbon emissions target would be attained globally by 2070.
- The major changes that would be required to reach the key energy-related goals of the United Nations Sustainable Development Agenda are achieved. These include emissions reductions in line with the Paris Agreement, as well as rapid deployment of renewable technologies, universal access to fit-for-purpose energy and dramatic increase in air quality [20].
- The costs achieved at a global scale align with the SET Plan targets. In other words, any export results pertain to the achievement of the SET Plan targets only.

Global floating offshore wind deployment was obtained by segmenting the proportion of total offshore wind occupied by floating (as opposed to fixed) technology, with floating offshore wind assumed to be 16% of total offshore wind installed capacity.

Global wave and tidal deployment was obtained by segmenting the proportion of total ocean energy generation assuming a ratio of 40%:60% between tidal stream and wave.

Cost breakdown assumptions

The total spend for each year is allocated across the wave, tidal stream and floating offshore wind technical cost centre breakdowns, based on the proportional costs from a BVG Associates and Ocean Power Innovation Network (OPIN) value chain study for Scottish Enterprise [14]. The proportional CAPEX breakdown for each of the generation technologies can be seen in Figure 2 and Table 1. The proportional spend varies considerably between these cost centres for each of the generation technologies.

The cost centres are also assigned to economic sectors of the UK economy (those of the Leontief matrices) in order for relevant GVA effects to be identified. Table 1 also shows the Standard Industrial Classification (SIC) codes allocated to each cost centre.

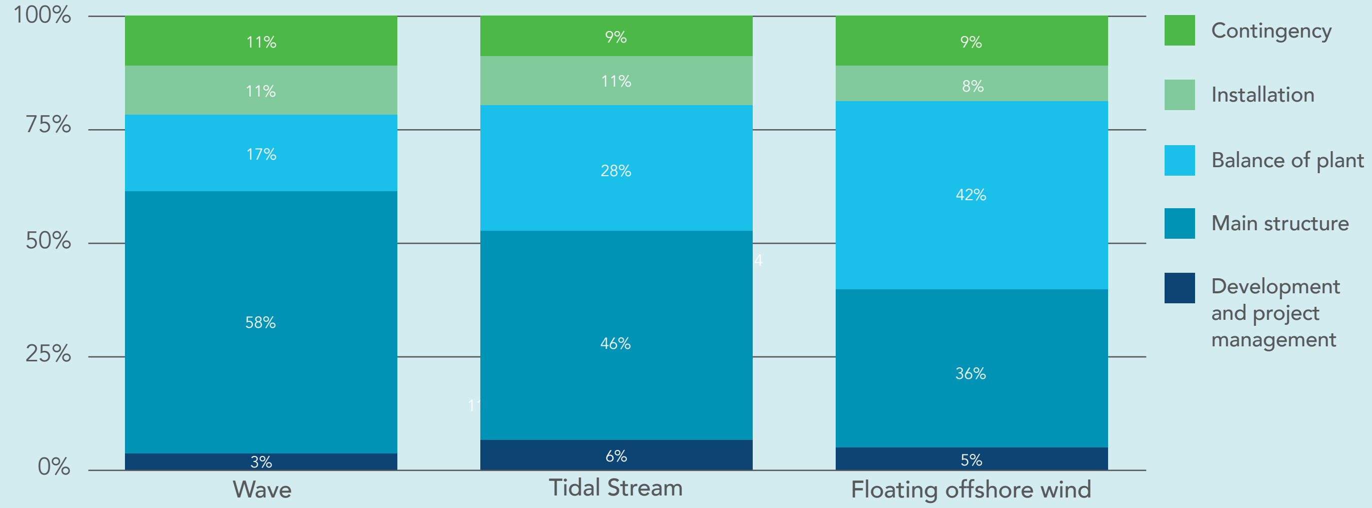

Figure 2 – Proportional capital expenditure breakdown for each of the ORE technologies.

COST CENTRE CATEGORY	PROPORTION OF CAPEX			SIC CODES ALLOCATED
	Wave	Tidal Stream	Floating offshore wind	
Development and project management	3%	6%	5%	M69_70
Main structure (generating device)	58%	46%	36%	C25, C26, C27
Balance of plant (moorings, foundations, electrical cables)	17%	28%	42%	C25, C33
Installation (including structure and balance of plant)	11%	11%	8%	H50 M69_M70
Contingency	11%	9%	9%	K65

Table 1 – Capital expenditure breakdown and SIC code allocation for each of the ORE technologies.

Supply chain retention assumptions

To account for imports and competition in the export market, leakage rates were applied across each technology's technical cost centres. Analysis was carried out to assess the impact on the GVA results of increasing local content within specific areas of the UK supply chain servicing domestic deployments, for instance through the application of targeted investment. This was carried out by increasing the spend retention where there would be opportunity to develop the supply chain. The results of this sensitivity are presented here as two scenarios, a **'Low Ambition'** scenario representing lower retention of UK content in the domestic and international supply chains and a **'High Ambition'** scenario representing higher retention of UK content in domestic and international supply chains.

The supply chain retention assumptions used for the two scenarios have been aggregated to the high-level cost categories in Table 2. Floating offshore wind retention figures were adapted from the study *Macroeconomic benefits of floating offshore wind in the UK* by OREC and Crown Estate Scotland [12]. The 'Market Follower' supply chain retention values in this report define the retention applied in the **'Low Ambition'** scenario presented here. The 'Maximum Potential' supply chain retention values in the report define the retention in the **High Ambition** scenario.

For wave and tidal technologies, the **Low Ambition** retention values have been adapted from Allan et al (2014) [9]. **The High Ambition** retention values are based on expert assumptions and consultation during this analysis.

COST CENTRE CATEGORY	RETENTION - WAVE & TIDAL		RETENTION - FLOATING OFFSHORE WIND	
	Low Ambition	High Ambition	Low Ambition	High Ambition
Development and project management	57%	85%	39%	80%
Generating device	41%	85%	10%	40%
Balance of plant	42%	70%	17%	45%
Installation	43%	85%	19%	75%
Contingency	50%	75%	20%	75%
O&M	50%	90%	38%	85%

Table 2 - Supply chain retention rates applied to domestic content for high ambition and low ambition scenarios, based on figures from [9] and [12], as well as internal assumptions.

Supply chain retention values were assumed across the supply chain servicing exports of all technologies across all scenarios for international deployments. These are presented in Table 3 below. In contrast to the variable retention rates by subsystem for the domestic market, a flat rate was applied to exports because an assessment of the UK's relative strength, on the global market and at subsystem level, is out-with the scope of this study. As with the domestic market, however, lower and higher retention rates have been applied for the high and low ambition scenarios, respectively, to assess the potential opportunity offered to the UK through increasing local content of exports.

TECHNOLOGY	Low Ambition	High Ambition
Tidal stream	5%	25%
Wave	5%	25%
Floating Offshore Wind	3%	10%

Table 3 – Supply chain retention applied to international deployment across all scenarios

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4 DEPLOYMENT OF INNOVATIVE ORE TECHNOLOGIES TO 2050

Magallanes Renovables ATIR installation. (Credit: Colin Keldie)

UK future deployment

UK deployed generation capacities resultant from the ESME modelling are shown in Figure 3 between 2030-2050. By 2050, 6GW of wave, 6GW of tidal stream and 45 GW of floating offshore wind have been deployed as part of the wider UK energy mix. As such, the ESME model produces a total of 57 GW installed capacity of innovative ORE technologies by 2050, based on the cost assumption that the SET Plan targets are met by 2030.

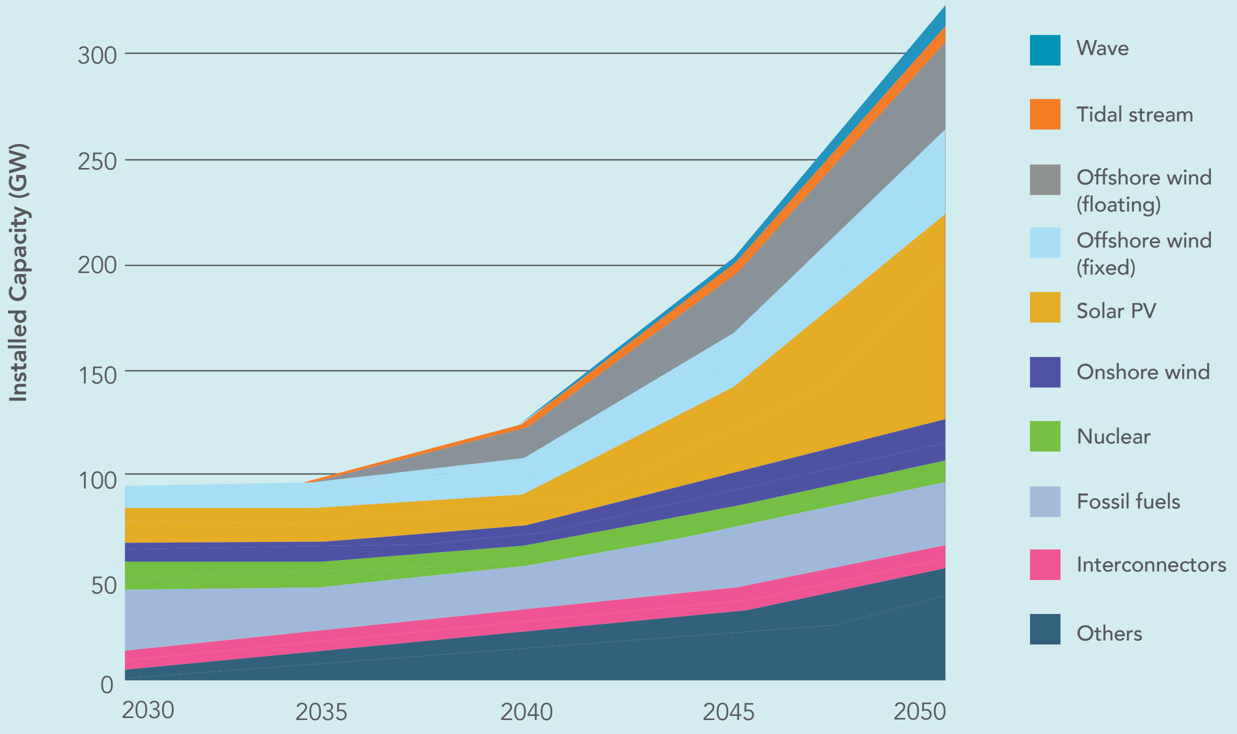

Figure 3 – UK deployed capacity from ESME modelling based on SET Plan cost targets for wave, tidal stream and floating offshore wind.

Global ORE deployment

International deployments of ORE technologies derived from IEA TIMES modelling are 71GW for tidal stream, 109GW for wave and 51GW for floating offshore wind by 2050, illustrated alongside the UK deployments of these technologies in Figure 4. The total global deployed capacity of innovative offshore renewables of 288GW is thus made up of 115GW of wave energy, 77GW of tidal stream and 96GW of floating offshore wind.

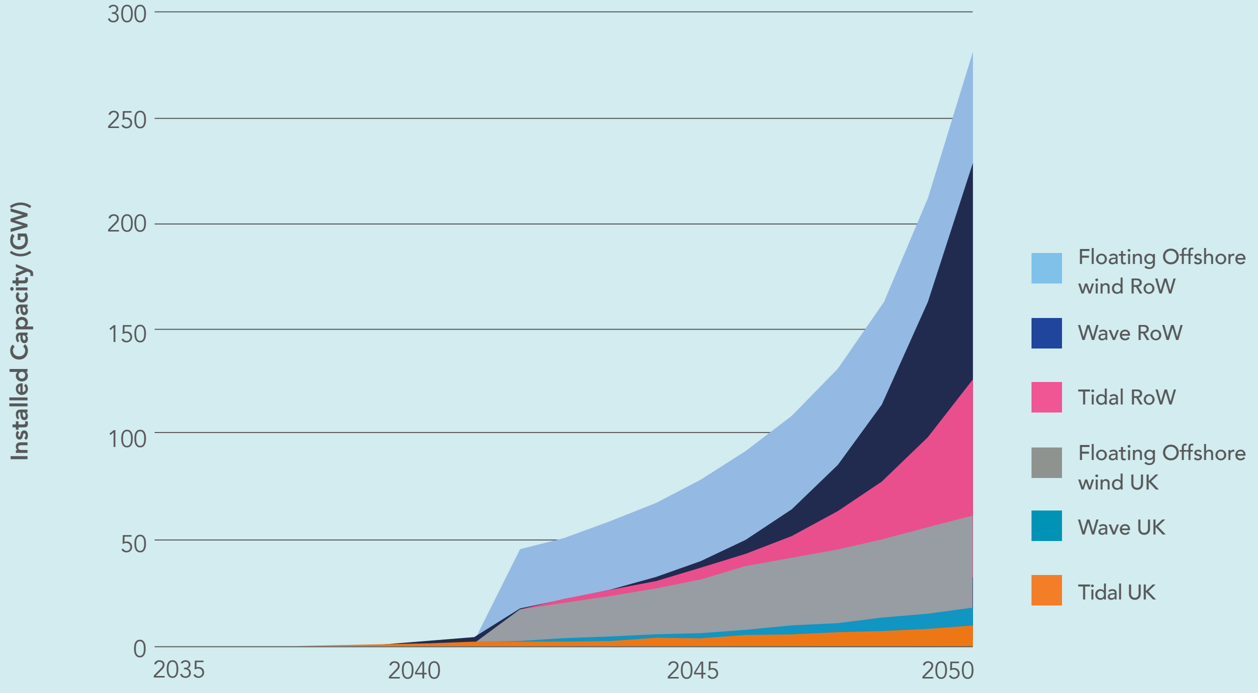

Figure 4 – Deployment trajectories for wave, tidal stream and floating offshore wind to 2050, derived from ESME and IEA modelling.

5 GVA BENEFIT RESULTS

Mocean nacelle welding – Wave Energy Scotland

What is the total GVA benefit associated with innovative ORE deployment to 2050?

Results for the GVA associated with the ORE deployment scenarios range from £16.4bn to £41.4bn in GVA generated for the UK economy from domestic deployments. Exports servicing international (non-UK) deployments generate between £8.2bn to £38.2bn in GVA for the UK economy.

This produces a total of £24.6bn to £79.6bn in GVA to the UK economy from global deployment of innovative ORE technologies, dependent on supply chain assumptions. The GVA figures are broken down by generation technology, deployment location, and ambition scenario in Figure 5

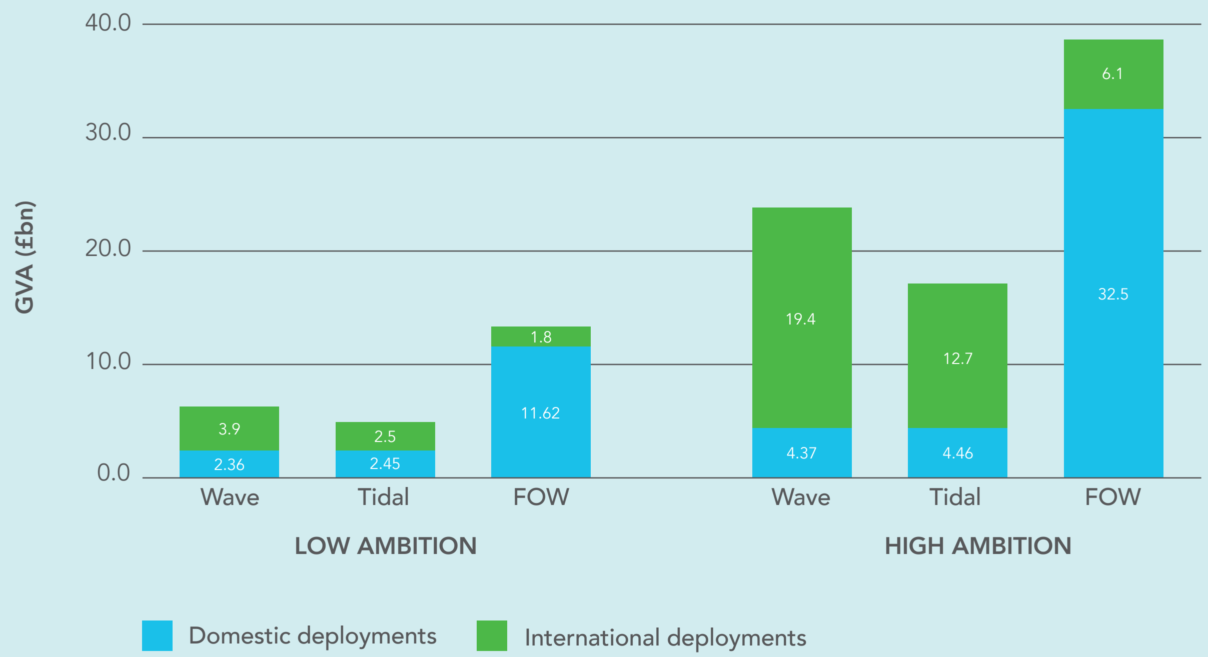

Figure 5 – Discounted GVA results (in £bn) for domestic and global deployments of offshore renewables between 2030-2050.

What is the total GVA benefit associated with domestic deployments?

The discounted GVA results for domestic (UK) deployments are presented in Figure 6 and Table 4 below. The Low Ambition scenario generates £16.4bn in GVA for the UK economy and the High Ambition scenario generates £41.4bn in GVA for the UK economy. The majority of this domestic GVA comes from floating offshore wind, due to the significantly higher deployment levels.

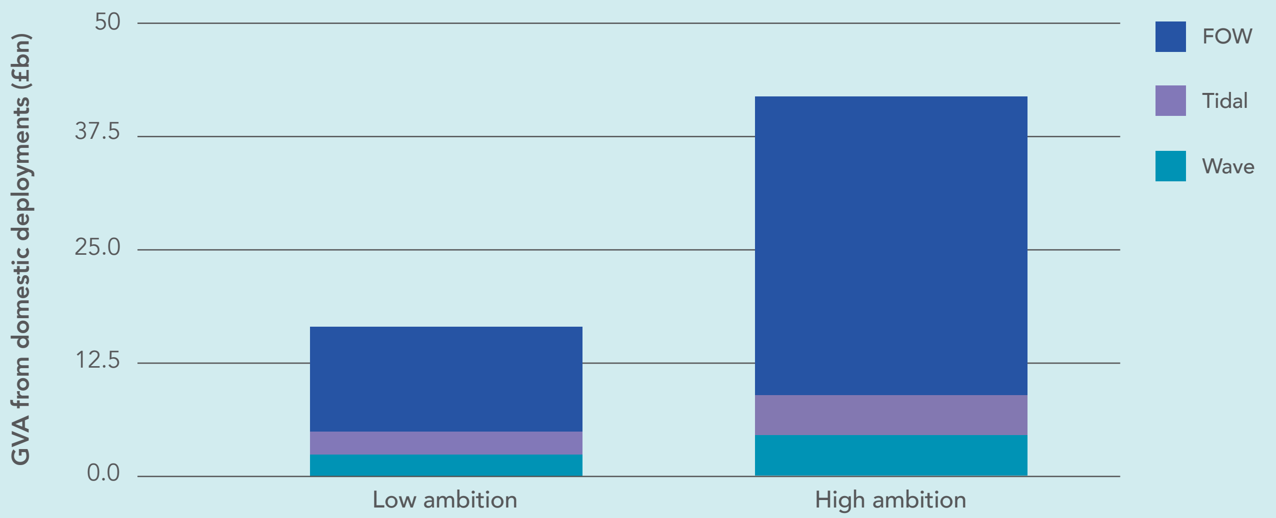

Figure 6 – GVA associated with domestic deployments when SET Plan targets are achieved, for both ambition scenarios.

		GVA (£bn)	
Technology	2050 UK Deployment	Low Ambition	High Ambition
Wave	6 GW	£2.36 bn	£4.38 bn
Tidal stream	6 GW	£2.45 bn	£4.47 bn
Floating Offshore Wind	45 GW	£11.62 bn	£32.53 bn

Table 4 - GVA associated with domestic deployments when SET Plan targets are achieved, for both ambition scenarios.

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What is the total GVA benefit associated with international deployments?

The discounted GVA benefit to the UK from exports to international (non-UK) deployments are presented in Figure 7 and Table 5 below. The Low Ambition scenario generates **£8.2bn in GVA for the UK economy** due to international deployments and the High Ambition scenario generates **£38.2bn in GVA for the UK economy.** The majority of this GVA from exports comes from wave energy deployment, due to the significantly higher deployment of wave energy globally from the IEA modelling.

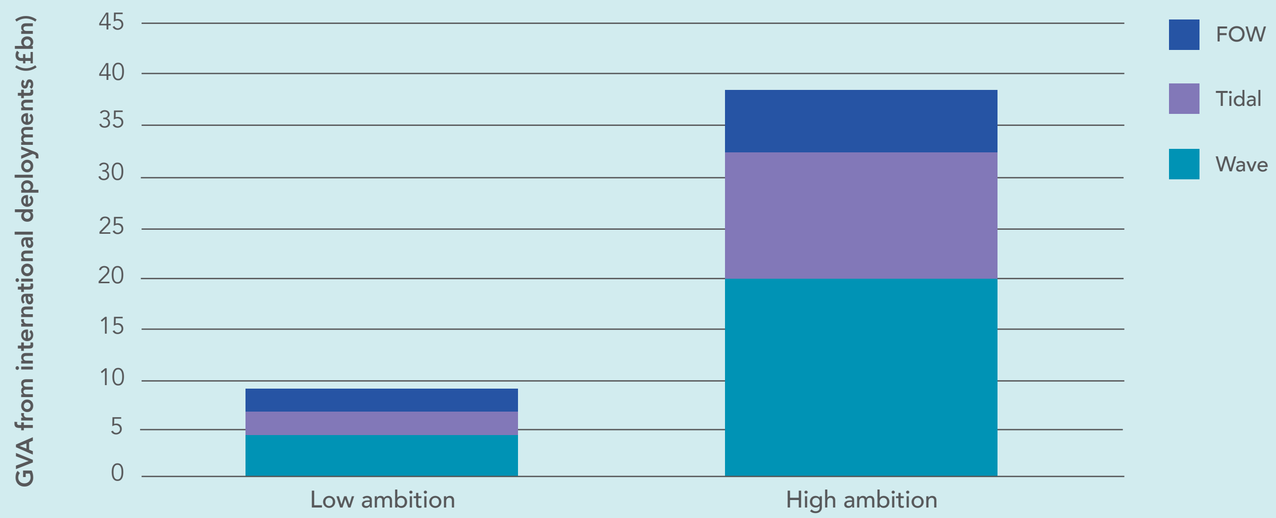

Figure 7 – GVA associated with international deployments when SET Plan targets are achieved, for both ambition scenarios.

		GVA (£bn)	
Technology	2050 International Deployment	Low Ambition	High Ambition
Wave	109 GW	£3.89 bn	£19.42 bn
Tidal stream	71 GW	£2.54 bn	£12.70 bn
Floating Offshore Wind	51 GW	£1.80 bn	£6.13 bn

Table 5 - GVA associated with international deployments when SET Plan targets are achieved, for both ambition scenarios.

What is a Megawatt of ORE deployment worth to the UK economy?

The value of a MW of installed capacity to the UK economy depends on the proportion of spend retained within the supply chain. The difference in GVA per MW generated across the High and Low Ambition supply chain scenarios accentuates the role of local content in maximising the economic benefit to the UK economy. Figure 8 illustrates the GVA per MW associated with each technology across the two levels of ambition, broken down by domestic and international deployment. It can be seen that the economic benefit for a MW varies considerably between technologies, ambition scenarios and deployment location. **Domestic ORE deployments results in GVA per MW values which range from £258k/MW - £745k/MW, dependent on technology and ambition scenario.** The maximum GVA per MW occurs for floating offshore wind within the High Ambition Scenario at £723k/MW.

The total GVA generated per MW of wave energy technology deployed domestically ranges from £394k per MW to £730k per MW for the Low Ambition and High Ambition scenarios, respectively. Similarly, the domestic supply chain servicing exports for wave energy technology deployment generates between £36k per MW and £178k per MW.

The total GVA generated per MW of tidal stream technology deployed domestically ranges from £409k per MW to £745k per MW for Low Ambition and High Ambition, respectively. Similarly, domestic supply chain servicing exports for tidal stream technology deployment generates between £35k per MW and £179k per MW.

The total GVA generated per MW of floating wind energy technology deployed domestically ranges from £258k per MW and £723k per MW for Low Ambition and High Ambition, respectively. Similarly, domestic supply chain servicing exports for floating wind energy technology deployment generates between £35k per MW and £120k per MW.

It is interesting to note that the GVA per MW is highest for tidal stream in both of the scenarios. The GVA per MW for floating offshore wind is consistently the lowest of the three technologies across both of these scenarios. It should be noted that the GVA per MW is dependent on many factors including the total spend per MW, deployment rate and timescales, technology cost breakdowns and associated GVA multipliers from the IO analysis, as well as retention rates.

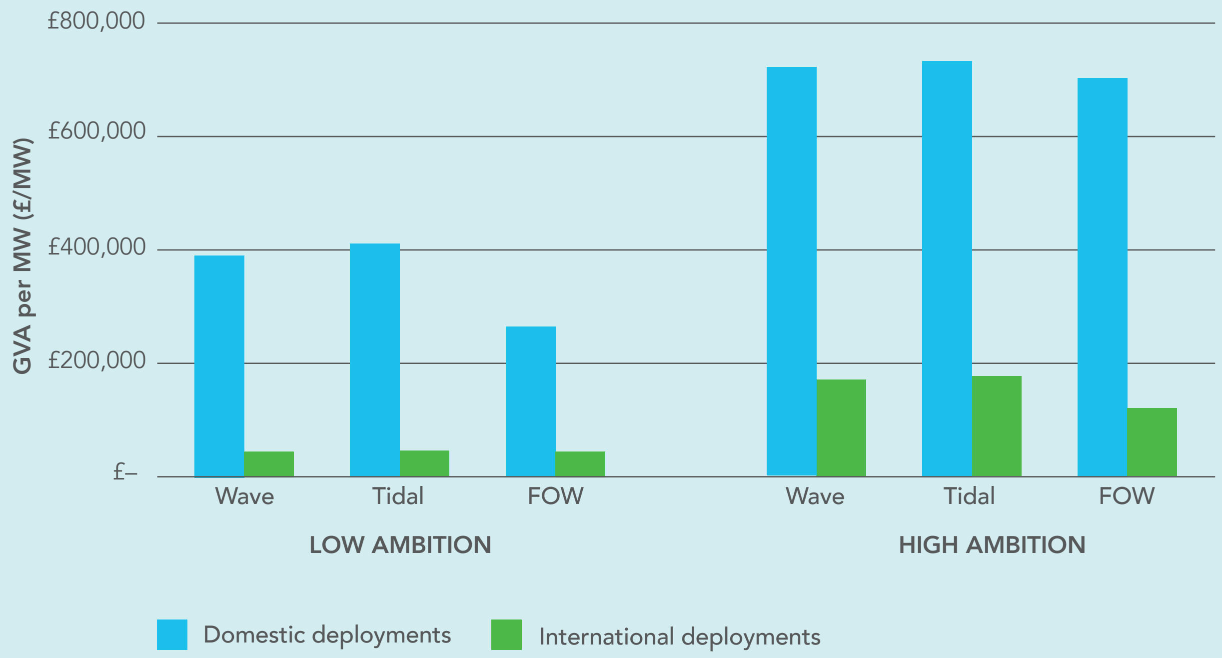

Figure 8 – Breakdown of GVA per MW for domestic and international deployments for each scenario.

6 SUPPLY CHAIN IMPLICATIONS

Artemis Intelligent Power's Quantor PTO and test rig - Wave Energy Scotland

Which parts of the supply chain provide the highest GVA?

The percentage share of total GVA per technical cost centre is shown for each of the technologies and scenarios for UK domestic deployments in Figure 9. It can be seen for all technologies and scenarios that **the lifetime OPEX cost centre contributes the most to the incurred discounted GVA.** In terms of the CAPEX-related GVA, **the balance of plant supply generates the highest CAPEX-related GVA for FOW,** and **the generating device results in the highest CAPEX-related GVA for wave and tidal.** The GVA from balance of plant for FOW is particularly high as this cost centre includes the floater, foundations and moorings, which form a large proportion of the total FOW system CAPEX.

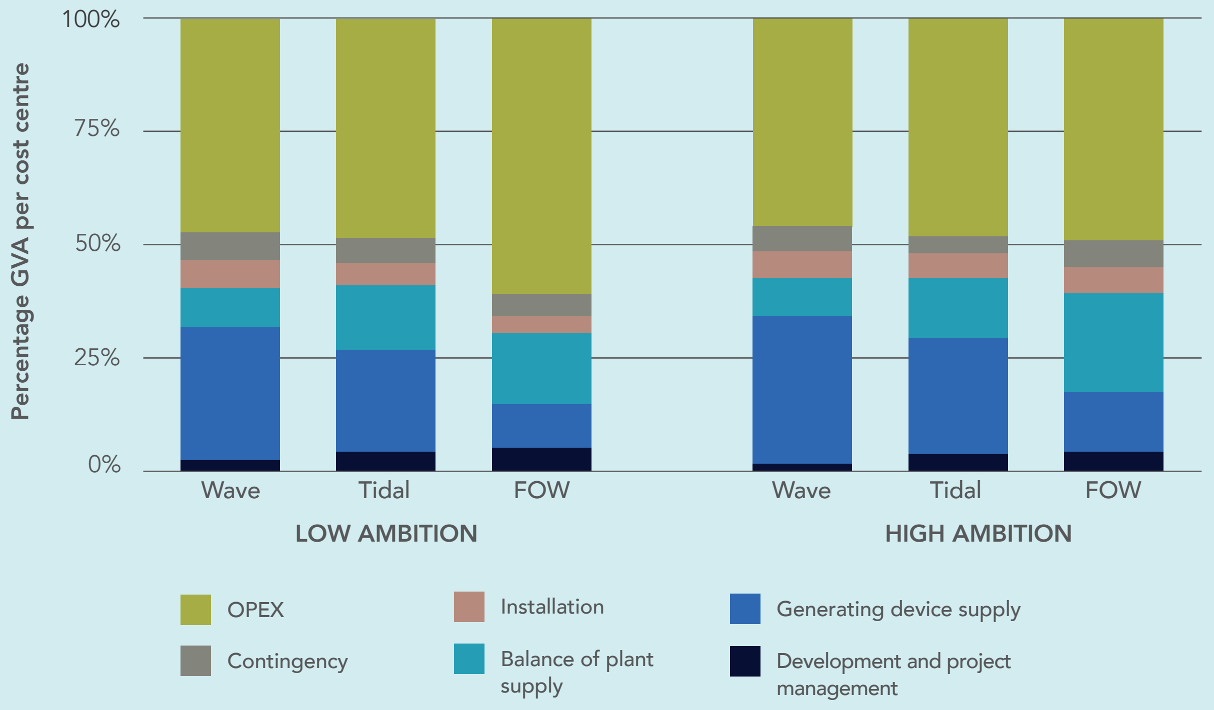

Figure 9 – Proportional breakdown of total GVA per cost centre, for domestic deployments.

Figure 10 shows the GVA incurred per MW of domestic deployment, which again highlights **the high proportion of GVA coming from OPEX.** The GVA per MW due to OPEX ranges from £157k/MW for FOW OPEX in the Low Ambition scenario to **£355k/MW for tidal stream OPEX** in the High Ambition scenario.

The highest CAPEX-related GVA per MW is £240k/MW for the wave energy device in the High Ambition Scenario, f**ollowed by £190k/MW for the tidal stream device** in the High Ambition Scenario.

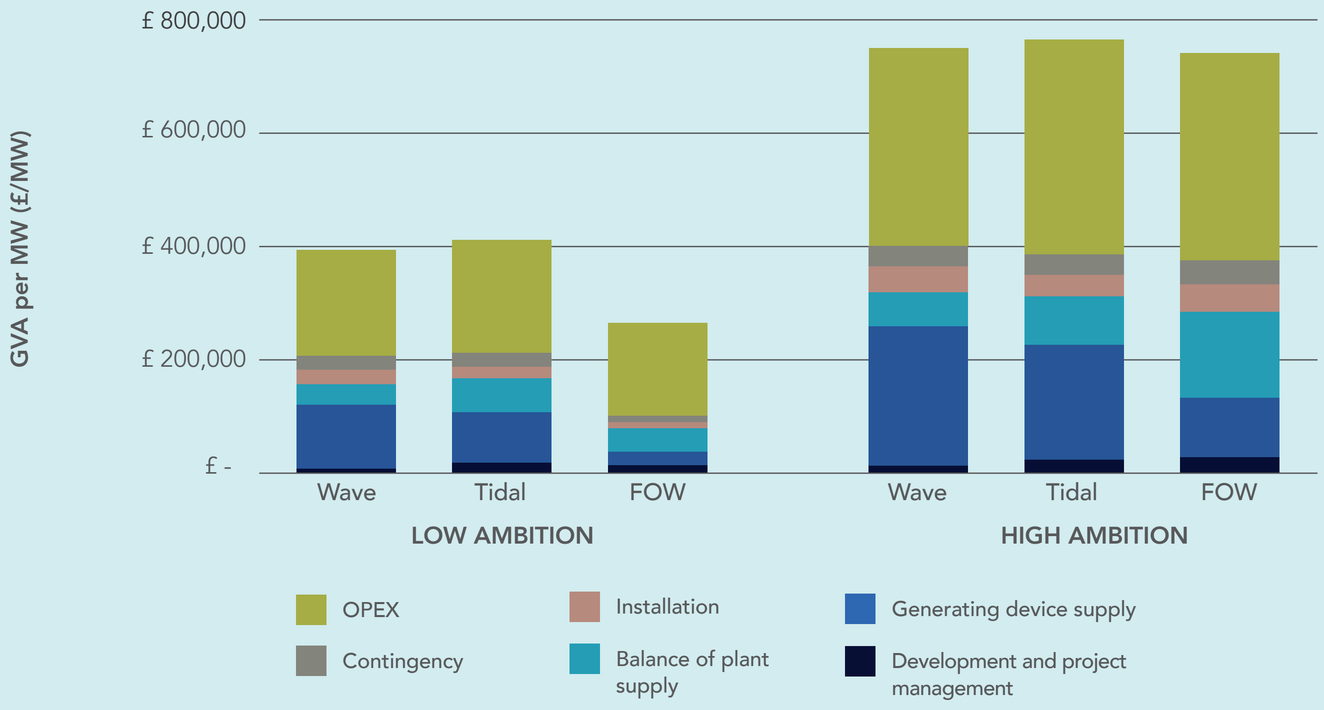

Figure 10 – GVA per MW for each cost centre, for domestic deployments.

WHAT IS THE VALUE OF INNOVATIVE ORE DEPLOYMENT TO THE UK ECONOMY?

What are the opportunities associated with a stronger UK supply chain?

The High Ambition scenario sees increased local content in the supply chain (and subsequently higher retention of total spend) relative to the Low Ambition scenario. A comparison between these scenarios provides insight as to the scale of the opportunity if the UK supply chain were strengthened by focused investment in these developing technologies. The difference in GVA benefit between these scenarios for wave, tidal stream and floating offshore wind deployments across the supply chain ambition scenarios is shown disaggregated by technical cost centre in Figure 11, Figure 12 and Table 6.

The High Ambition scenario generates £41.4bn in GVA for the UK economy from domestic deployments of wave, tidal stream and FOW. This comprises of £21.5bn of which would be spent on CAPEX in the construction year (year 0), and £19.9bn of which would be spent on OPEX over the remaining (20-year) lifetime of the deployments. The low ambition scenario generates £16.4bn in GVA for the UK economy from domestic deployments of wave, tidal stream and FOW. This comprises of £7.1bn of which would be spent on CAPEX in year 0, and £9.4bn of which would be spent on OPEX over the remaining lifetime of the deployments.

Therefore, while the Low Ambition scenario would yield an overall economic benefit of £16.4bn to the UK economy, the High Ambition scenario would yield an overall economic benefit of £41.4bn to the UK economy. This is a **151% increase in GVA from domestic deployments due to more ambitious retention assumptions reflecting a stronger supply chain.**

As shown in Figure 7 previously, including GVA from UK content in both domestic and international deployments results in a total of £24.6bn to £79.6bn in GVA to the UK economy from global deployment of innovative ORE technologies for the Low Ambition and High Ambition scenarios, respectively. This corresponds to **a 223% increase in GVA from global deployments due to more ambitious retention assumptions reflecting a stronger supply chain.**

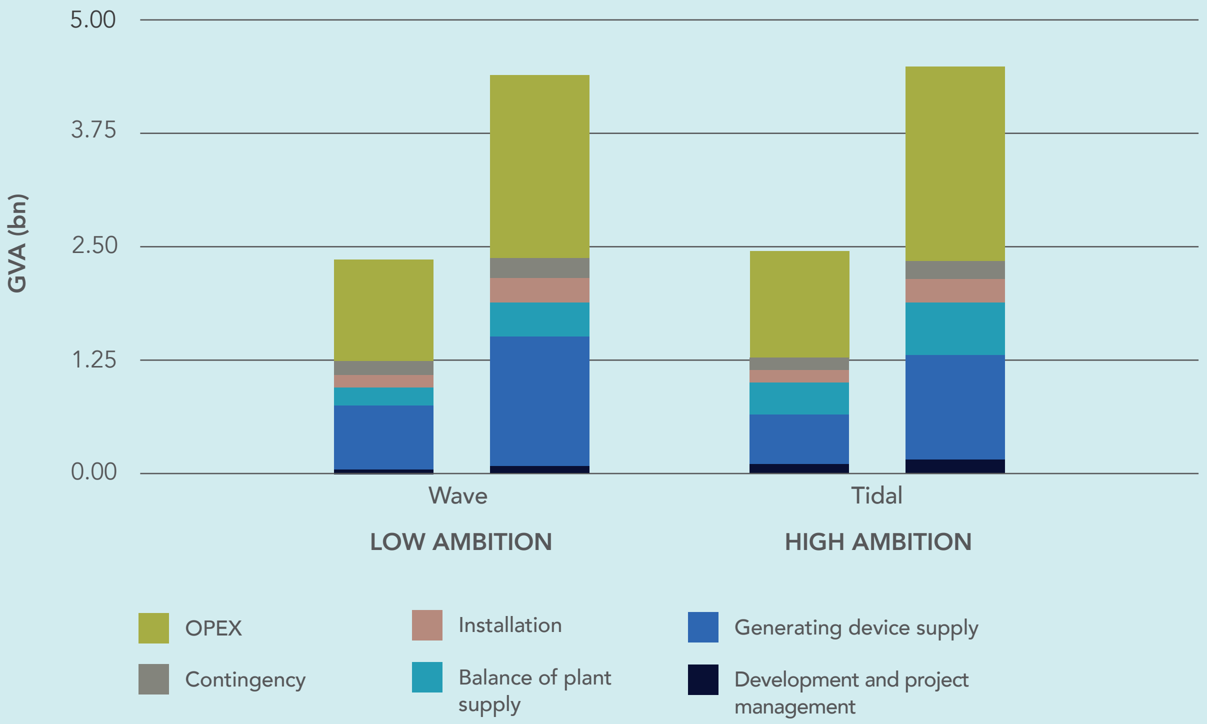

Figure 11 GVA from domestic tidal stream and wave deployments under the High Amition and Low Ambition scenarios (£bn).

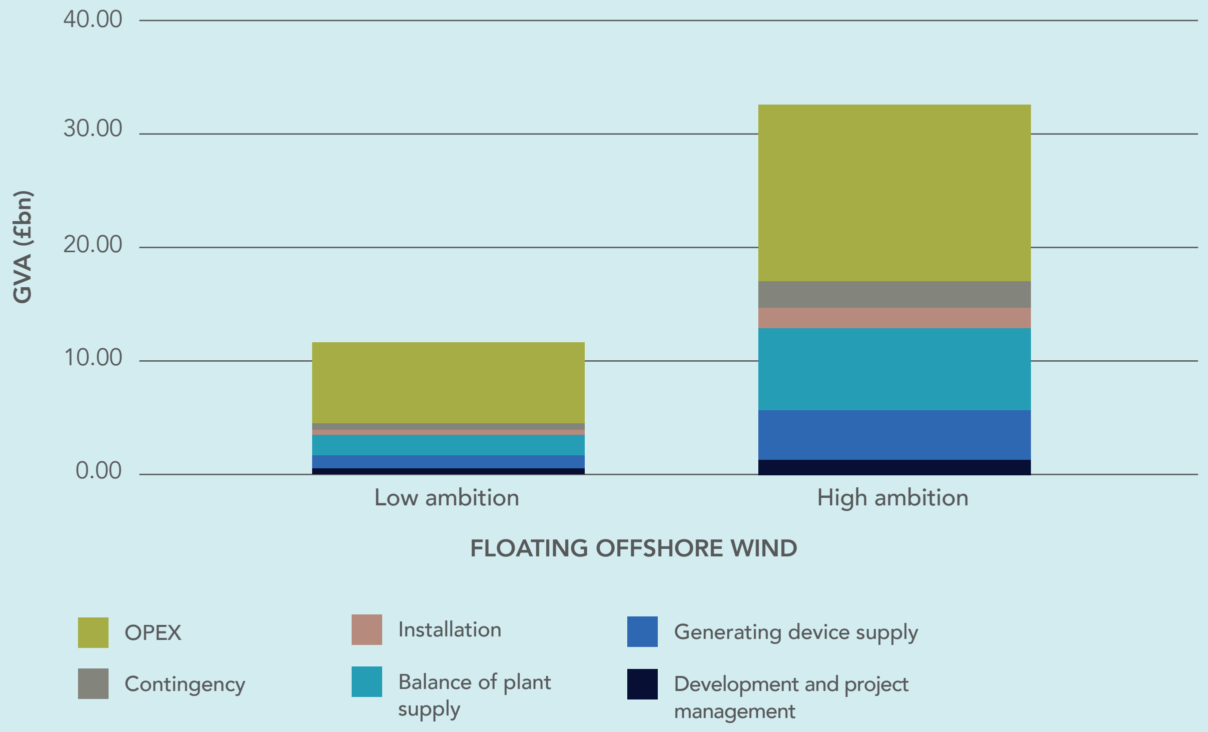

Figure 12 - GVA from domestic floating offshore wind deployments under the High and Low Ambition scenarios (£bn).

GVA (£bn)	WAVE		TIDAL		FLOATING OFFSHORE WIND	
	Low Ambition	High Ambition	Low Ambition	High Ambition	Low Ambition	High Ambition
Development and project management	0.06	0.08	0.11	0.16	0.63	1.28
Generating device supply	0.70	1.44	0.55	1.14	1.08	4.32
Balance of plant	0.20	0.34	0.35	0.58	1.81	7.18
Installation	0.15	0.29	0.13	0.26	0.50	1.90
Contingency	0.15	0.22	0.13	0.20	0.55	2.05
O&M	1.12	2.01	1.18	2.13	7.06	15.79
Total	2.38	4.38	2.45	4.47	11.63	32.52

Table 6 – GVA from domestic ORE deployments under the Low and High Ambition scenarios, split by technical cost centre (£bn)

7 KEY MESSAGES

This work has explored the potential economic benefit to the UK associated with deploying innovative ORE technologies – namely wave, tidal stream and floating offshore wind. Deployment levels from 2030-2050 have been based on UK and global energy system models, assuming these technologies all meet their European SET Plan cost targets by 2030.

The results of this study quantify the potential economic benefit, in GVA terms, of this future deployment of wave, tidal stream and floatingoffshore wind technologies offered to the UK economy.

Results from this work can be summarised as:

- Global deployments of wave, tidal stream, and floating offshore wind technologies produce **a total of £24.6bn to £79.6bn in GVA to the UK economy**, dependent on supply chain assumptions.
- Of this total figure, domestic deployments result in £16.4bn to £41.4bn in GVA for the UK economy. Within this obtained GVA range, a 152% increase in GVA can be observed, due to more ambitious retention assumptions reflecting a stronger UK supply chain.
- UK content in international deployments therefore generates £8.2bn to £38.2bn in GVA for the UK economy. Within this obtained GVA range, a 221% increase in GVA can be observed from global deployments, due to more ambitious retention assumptions reflecting a stronger UK supply chain.
- Translating this per MW of deployment, **domestic ORE deployments result in GVA per MW values which range from £258k/MW to £745k/MW**, dependent on technology and retention assumptions. International ORE deployments result in values of £35k/MW to £179k/MW.
- Lifetime OPEX is the cost centre that contributes the most to the incurred GVA for all technologies and scenarios. In terms of the CAPEX-related GVA, the balance of plant supply generates the highest CAPEX-related GVA for FOW, and the generating device results in the highest CAPEX-related GVA for wave and tidal.

These results highlight the significant potential value to the UK if the UK government invests in developing the local supply chain ahead of these deployments. It should be stressed that this economic benefit to the UK economy is only achievable through focused investment for the development and deployment of these innovative offshore renewable technologies - encouraging and enabling the reduction of LCOE through performance improvement, cost efficiencies and supply chain development.

WHAT IS THE VALUE OF INNOVATIVE ORE DEPLOYMENT TO THE UK ECONOMY?

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