FUTURE ECONOMY PROGRAMME

Government of JERSEY

Economic analysis regarding the economic potential of offshore wind for Jersey

Analysis carried out June 2023

Introduction

Purpose of this document

The Department for Economy has recently completed work to explore the economic potential of renewable energy generation for Jersey under a range of generation scenarios.

To aid ongoing Ministerial discussions, this document shows the analysis for a 1,000 MW wind farm and provides information about the underlying methodology.

It is also important to emphasise it is intended as initial analysis and further in-depth feasibility and appraisal work would be needed as part of building a full business case.

This document is intended to help inform the debate and future economic and financial analysis will be required.

Contents

Rationale for why offshore wind has the greatest economic potential

Summary of societal rationale for offshore wind

Work to date indicates that, of all the technologies assessed*, offshore wind has the strongest potential set of benefits for the island as a whole. This is because:

- ✓ The total potential available seabed is larger, so that the potential generation is significant (and could be scaled over time in a modular approach)
- ✓ The energy generation production capacity per unit of area is the highest, making efficient use of area available
- ✓ The technology is mature and well understood, such that the costs and risks are lower
- ✓ The potential to contribute significantly to Jersey's economy (GVA, tax revenue, jobs, balance of trade etc.) is the highest by a long way, **however** this does depend on how the energy market is structured, which will drive the ability of the island to capture benefits such as jobs and tax revenues
- ✓ The opportunity cost is lower (land-based technologies require a tradeoff against other land uses such as farming)
- ✓ Scores highest in Multi-Criteria Analysis that aligned to the Future Economy Programme Strategy (see right)

* Technologies assessed: offshore wind; tidal: lagoon/barrage and tidal stream; solar: rooftop, floating and ground mounted.

Summary of initial view of different technologies against the five themes of the Future Economy Programme Strategy. Offshore wind scores well across the board.

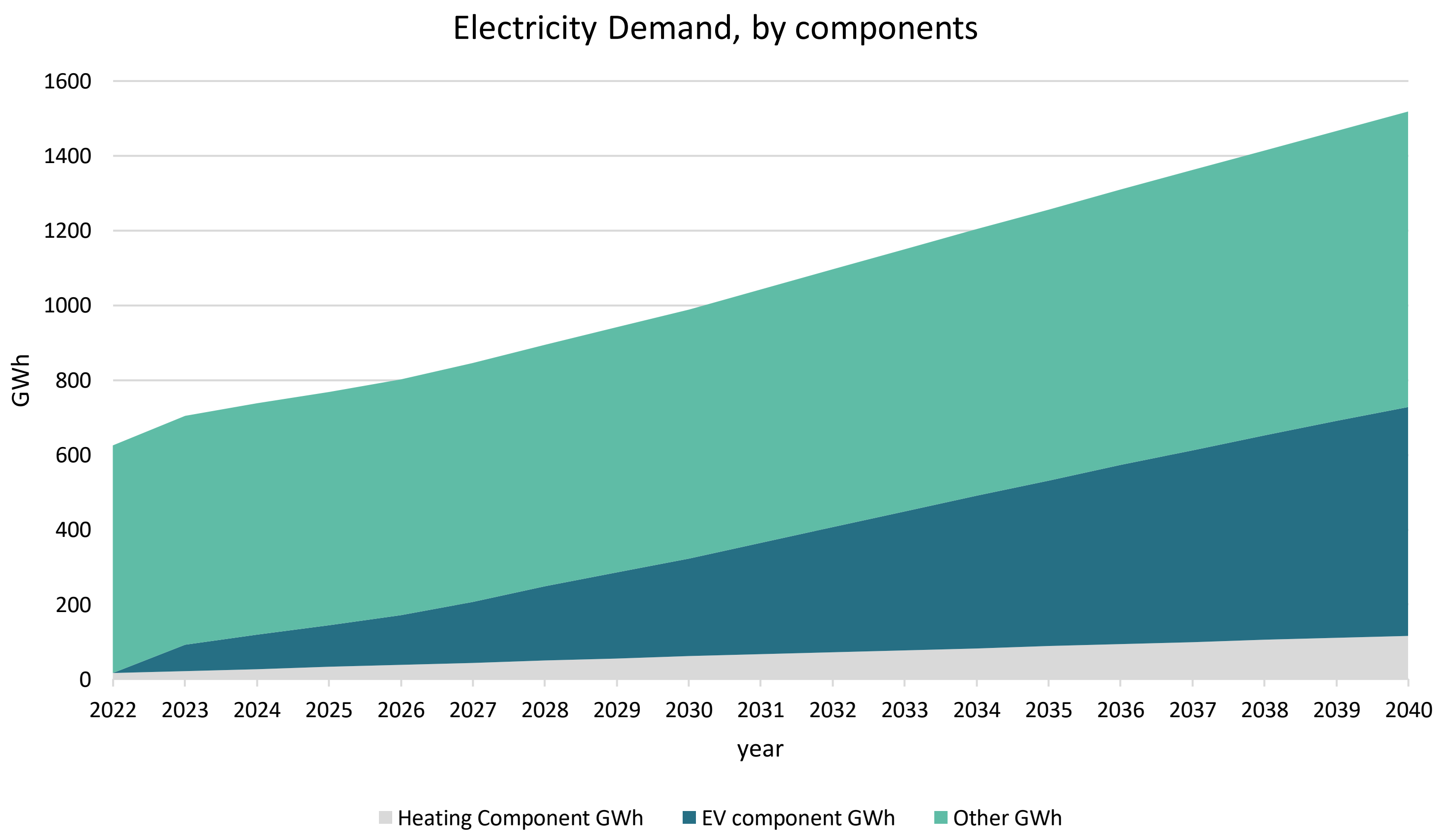
Criteria considered within the Multi Criteria Analysis:

- Resilient: Variability of Energy Generation
- Resilient: Complementarity with other renewable generation technologies
- Skilled: Job Creation (Quantity)
- Skilled: Job Creation (Quality)
- Fair: Potential to support local development
- Fair: Public Preference
- Innovative: Technology Maturity (potential for quick rollout)
- Innovative: Technology Maturity (potential for innovation)
- International: Capacity
- International: Annual Output
- Implementable: Area Required
- Implementable: Capacity Cost Value

Technology	Overall Score	Ranking
Offshore Wind	**4.40**	**1**
Tidal Lagoon / Barrage	3.90	2
Tidal Stream	3.50	3
Rooftop Solar	2.70	4
Floating Solar	2.70	5
Ground Mounted Solar	2.50	6

Context: **Indicative** estimate of Jersey's future energy demand

Although a full energy demand model is not yet available for Jersey, and was not in scope of this economic analysis, a model previously created for a similar jurisdiction was re-run for Jersey as a proxy. The key message both here and elsewhere is that **electricity demand is expected to increase significantly by 2040 under all scenarios, whilst overall energy demand will decrease slightly.** This will have an impact on the amount of energy which is available for net export from the island, which has a knock on effect on wider economic benefits.



Energy production milestone	Consumption in GWh (central scenario)
Jersey's 2021 current combined energy use	1,664 GWh
Of which, electricity	636 GWh (38%)
Projected energy use by 2040 (approx. -10% decline)	1,491 GWh
Of which, electricity	859 GWh (58%)

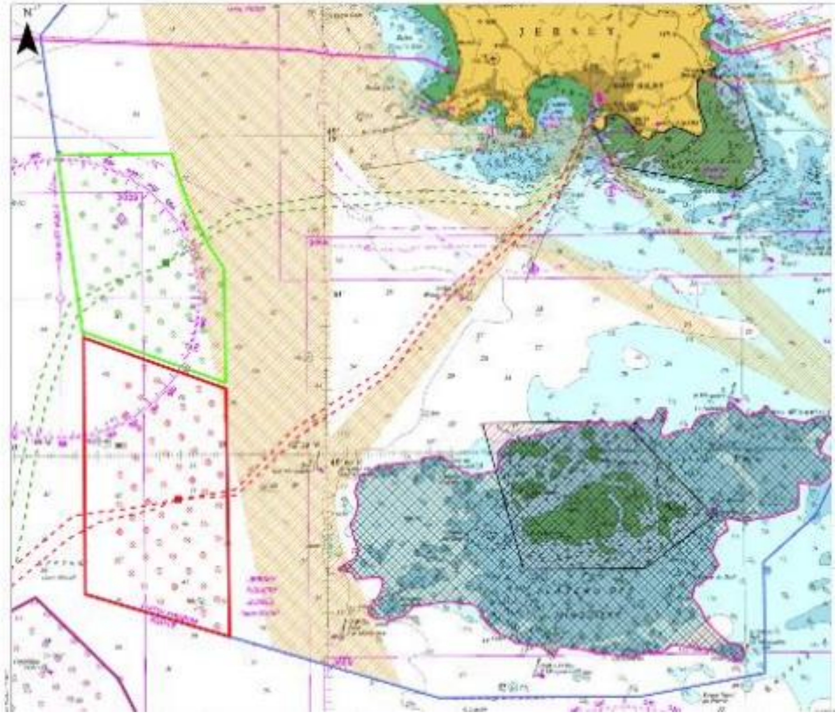
Note: Results are dependent on several, high-level, assumptions which should be refined through future phases of work

1,000 MW offshore wind scenario

Overview of 1,000 MW offshore wind

- Assuming a density of 5 MW per square kilometre, a 1,000 MW wind farm would take up approximately 9% of Jersey's marine area.
- The ITPEnergised report suggests a development area to the south-west of Jersey presents the best opportunity for a continuous wind farm of this scale in Jersey waters. Extension further north is also technically feasible should a size of greater than 1,000 MW be desired, as well as between Jersey and Les Minquiers.
- The pace and scale of deployment of offshore wind is accelerating rapidly: there are four larger projects currently under construction and a further twenty larger projects are at proposal stage, including a single 43,300 MW project in China [1], having all achieved at least some of the formal consents required for construction.
- A 1,000 MW wind farm would produce approximately 3,796 GWh of electricity per year. This is around six times Jersey's 2021 electricity consumption, or a little over double Jersey's total energy consumption when including hydrocarbons such as road transport and domestic heating, which are expected to be electrified during Jersey's transition to net zero.
- In 2021 terms, this installation would shift the overall energy balance for the island to approximately 50/50 split domestic consumption and international export.

Source: ITPEnergised OSW Feasibility Study 2022



Red box: Offshore A (496 MW)
Green box: Offshore B (400 MW)
Purple (bottom left corner): St Brieuc (496 MW)
Yellow shaded area: Shipping lanes

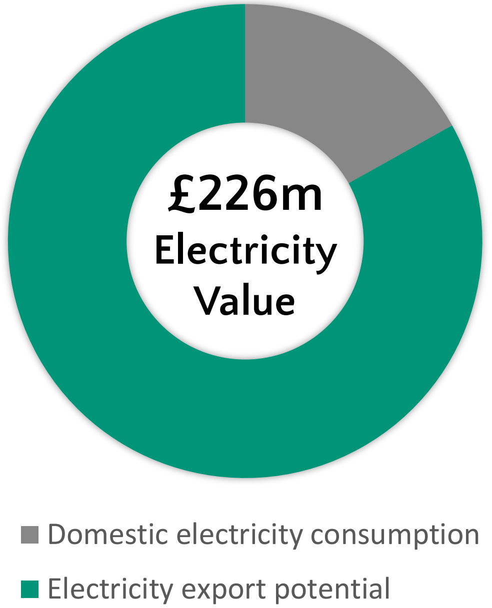
[1] https://ieefa.org/articles/southern-china-city-plans-433-gigawatt-offshore-wind-project

Economic potential for Jersey of 1,000MW offshore wind

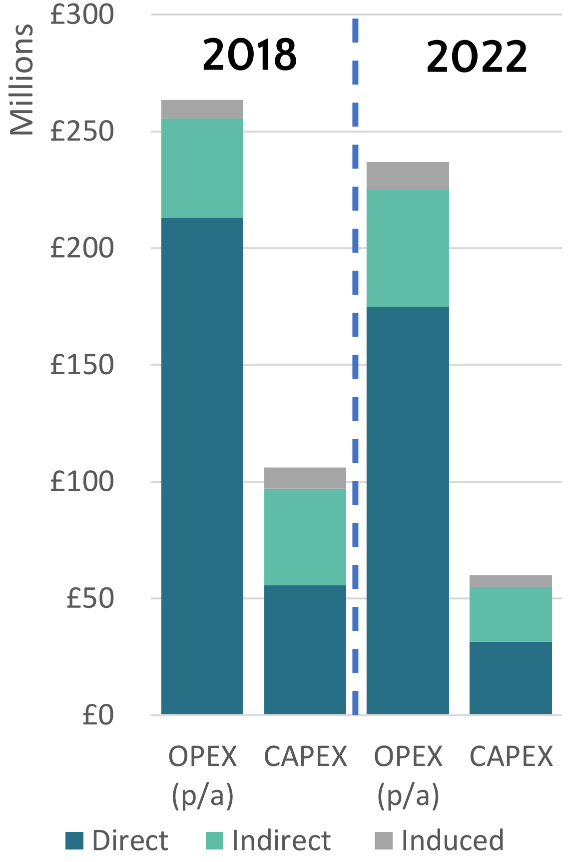
Overview: The following figures illustrate the impact of a **1,000 MW** offshore wind farm on Jersey's economy, assuming a price per unit of 6p / kWh. Modelling has been carried out using cost data from the 2018 ITPEnergised feasibility study, supplemented by their 2022 update (the latter showing significantly reduced costs due to technology maturity and supply chain improvements). The below distinguishes between the construct phase [CAPEX] and operational phase [OPEX]. CAPEX GVA, employment and tax liability figures are based on an assumption of local spending of less than 10% with the rest off-island. The OPEX phase assumes 100% of spending is within Jersey.

Revenue

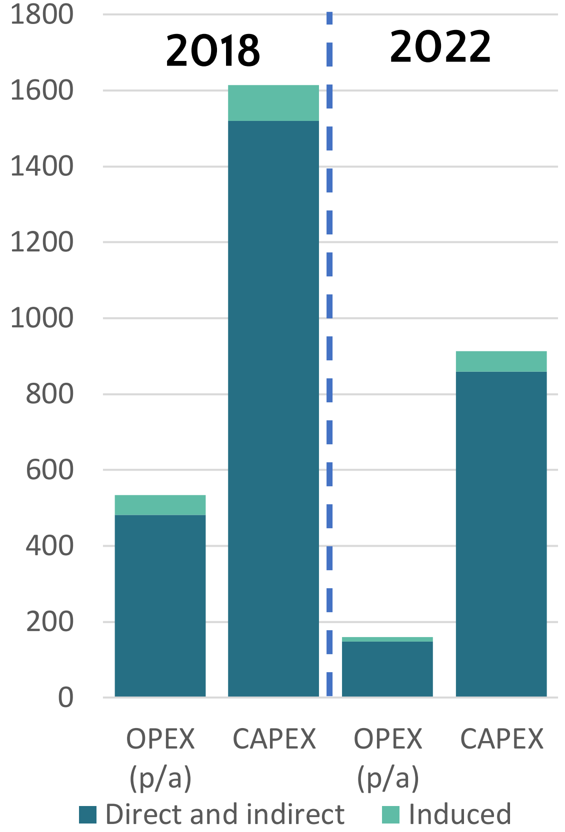
Based on a conservative price per unit of 6p, a 1,000 MW wind farm could generate electricity worth **£226million**; of which **17%** could be locally consumed *(based on 2021 energy demand)* whilst the remainder could be planned export.



GVA



Employment



Key takeaways

- **CAPEX:** During the construction phase, the model suggests ~**913** jobs could be created locally, with a further **12,510** jobs created off-island through supply chain spending. This represents a **GVA** boost to the economy of **£60m** through the construction phase.
- **OPEX:** Applying the 2022 report scenario, the model suggests **~113** direct jobs could be created in Jersey in the OPEX phase, with a further **56** indirect and induced jobs. Annually, the GVA boost to the economy is anticipated to be over **£250m**.
- **Tax:** Based on the 2022 Wind Feasibility Study, a **1,000 MW** project would generate annual tax liability of approx. **£42m**

Note: Please note the energy balance of consumption is based on current local consumption of electricity and does not reflect the expected change in the profile of energy demand locally, with less demand for fossil fuels, being compensated for by increasing demand for electricity in the economy decades. The 6p unit price can be flexed and was used as a conservative estimate.

Comparing 1,000MW offshore wind to alternatives

Below are key details for a 1,000 MW wind farm as well as 500 MW and 1,500 MW examples to show the potential added value to be derived from increasing the development size. The economic benefits increase significantly between 500MW and 1,000MW. This is because it is only once capacity gets to around 1,000MW that there is meaningful net renewable energy export potential.

500 MW

Estimated project benefits

- 8MW turbines: 62
- 4% of Jersey waters
- £30m (at any price/kWh) Jersey CAPEX GVA
- £102m (4p/kWh) to £145m (6p/kWh) Jersey OPEX GVA p/a
- Number of direct jobs created in Operations & Maintenance: 69
- Gross value of electricity: £75m (4p/kWh) to £113m (6p/kWh)
- Value of net export potential: £8.8m (4p/kWh) to £13.2m (6p/kWh)
- Tax liability: £13.9m (4p/kWh) £21.4m pa (6p/kWh)

1,000 MW

Estimated project benefits

- 8MW turbines: 125
- 9% of Jersey waters
- £60m (at any price/kWh) Jersey CAPEX GVA
- £181m (4p/kWh) to £263m (6p/kWh) Jersey OPEX GVA p/a
- Number of direct jobs created in Operations & Maintenance: 112
- Gross value of electricity: £151m (4p/kWh) to £228m (6p/kWh)
- Value of net export potential: £84m (4p/kWh) £126m (6p/kWh)
- Tax liability: £27m pa (4p/kWh) to £42m (6p/kWh).

1,500 MW

Estimated project benefits

- 8MW turbines: 188
- 13% of Jersey waters
- £90m (at any price/kWh) Jersey CAPEX GVA p/a
- £257m (4p/kWh) to £376m (6p/kWh) Jersey OPEX GVA p/a
- Number of direct jobs created in Operations & Maintenance: 156
- Gross value of electricity: £226m (4p/kWh) to £339m (6p/kWh)
- Value of net export potential: £159m (4p/kWh) to £239m (6p/kWh)
- Tax liability: £40m pa (4p/kWh) £62.6m (6p/kWh)

For context, Jersey's electricity, gas and water sector is worth £62.5 million as of 2021 [GoJ data]. The sector is currently worth 1.2% of the economy (in GVA terms). A 1,000MW offshore wind capacity, under a 6p/kWh scenario could increase the value of the sector to become 6.3% of the economy's GVA [GoJ FEP analysis].

Comparing 1,000MW to the findings of the CNR and other renewables

This research has drawn from existing available sources to estimate energy generation potential as follows. These have been used as the basis for analysis of the economic impact in this report.

Jersey 2021 final energy consumption
Electricity sources: 636 GWh
Non-electricity sources: 1,027 GWh
Combined: 1,663 GWh

Technology		1,000 MW scenario (with updated costs)				CNR aligned			
	Cost per kWh	1p	4p	8p	16p	1p	4p	8p	16p
Ground-mounted Solar PV	Annual generation	No further analysis				25 GWh			
	Gross value of energy					£289k	£1.2m	£2.3m	£4.6m
	GVA					£494.8k			
Rooftop Solar PV	Annual generation	No further analysis				12.7 GWh			
	Gross value of energy					£127k	£509k	£1m	£2m
	GVA					£283k			
Floating Solar PV	Annual generation	No further analysis				4 GWh			
	Gross value of energy					£40k	£67k	£321k	£266k
Offshore Wind (2018)	Annual generation	3,766 GWh				1,889 GWh			
	Gross value of energy	£38m	£151m	£301m	£603m	£19m	£76m	£151m	£302m
	GVA	£41m	£181m	£343m	£651m	-£192m	£21m	£125m	£293m
Tidal Lagoon/ Barrage	Annual generation	No further analysis				N/A			
	Gross value of energy					N/A			
Tidal Stream	Annual generation	No further analysis				36 GWh			
	Gross value of energy					£360k	£1.4m	£2.9m	£5.8m
Total	**Annual generation**	**3.77 TWh**				**1.97 TWh**			
	Gross value of energy	**£38m**	**£151m**	**£301m**	**£603m**	**£19.8m**	**£79m**	**£157m**	**£315m**
	GVA (where applicable)	**£41m**	**£181m**	**£343m**	**£651m**	**-£191.2m**	**£21.8m**	**£125.8m**	**£293.8m**

Case studies: growth in size of offshore wind arrays

	East Anglia One [1]	Saint Brieuc [2]	Jersey "Offshore A" (hypothetical) [3]	Sofia, Dogger Bank [4]
Project approval	2014	2012	2024	2019
Completion date	2020	2023	2031	2026
Installed capacity	714 MW	496 MW	496 MW	1400 MW
Turbine size	7	8	8	14
Annual generation	2,810 GWh	1,820 GWh	1,883 GWh	6,000 GWh
Cost	£2.5 billion	€2.4 billion	£644 million	£3 billion
Cost per MW	£3.5 million	€4.8 million	£1.3 million	£2.1 million
Surface area	300 km²	75 km²	100 km²	593 km²
Estimated O&M jobs supported	100	134	150	Unknown

As technology matures and costs reduce, the trend is towards larger wind farms at lower cost than previously.

The ITPEnergised report gave an example of a~500MW installation, however, this is increasingly on the smaller side compared to newer installations in development in the north-west Europe region.

[1] https://www.scottishpowerrenewables.com/pages/east_anglia_one.aspx
[2] https://www.iberdrola.com/about-us/what-we-do/offshore-wind-energy/saint-brieuc-offshore-wind-farm
[3] ITPEnergised, OSW Feasibility Report 2022
[4] https://sofiawindfarm.com/about/#FactsandFigures

Approach to offshore wind technology analysis

This analysis relies heavily on technical analysis carried out by ITPEnergised for GoJ, originally carried out in 2018 and refreshed in 2022.

MW installed per km²

Key assumptions from ITPEnergised such as MW installed per km², GWh per MW installed and installation cost per MW were sense-checked against publicly available literature and comparable offshore wind projects, and found to be reasonable and were therefore upheld.

Assumptions retained included 8 MW per turbine, approximately 5 MW installed per km², and around 3.77 GWh generated per MW installed, per annum.

Installed vs generated

Wind data has been gathered at Les Minquiers since 2012, with data from 2014 and 2015 used to develop a wind characteristic profile including average annual speed and what conditions can be expected at different times of year. ITPEnergised used this to model annual generation per MW installed, including turbine-specific cut-in speeds (in this case 4 m/s and above).

Approximately 42% overall capacity factor after efficiency losses and wind availability.

Location

ITPEnergised assessed the available ocean area by discounting: land, reefs, Ramsar sites; east of the island due to tidal flows, visual impacts, and ecological preservation; regions of high marine traffic; and a shoreline buffer. Remained an area of 668km², with the potential to achieve 3,300 MW of installed capacity. Further analysis applied a 15km buffer zone, addressing radar visibility and flight path concerns directly west but discounted the north and south. South-west remained the only viable area for large utility scale offshore wind deployment, leading to the creation of "Offshore A" 500MW farm with scope to reach 1GW.

Size of turbines

ITPEnergised modelled with 8 MW wind turbines in their report, which is consistent with typical installations today. Global trends are towards larger turbines, such as the 14 MW turbines for commissioning in 2026 at Sofia, Dogger Bank, which may bring down costs and gradually increase output. However, overall density in the form of MW installed per km² will not increase drastically as a result, nor will GWh per MW.

This represents a maximum energy generation per square kilometre of 18.85 GWh per year.

Approach to the economic analysis

Combining models developed during the Future Economy Programme together with the cost and technical assumptions and allowed for broad economic analysis into expected GVA impact on the island, jobs supported (including breakdown of direct vs indirect jobs) and potential tax liability from both utility income and personal tax of employees involved.

Expenditure

OPEX costs are the annual cost of operations and maintenance, including training staff, onshore and offshore logistics, and turbine "spare parts".

CAPEX costs include, but are not limited to: turbine manufacturing, cables, offshore substations, onshore substations, installation and commissioning, as well as project management which includes environmental surveys, geological surveys and engineering costs.

Local OPEX spending

In the GVA calculations shown on slide 8, OPEX costs were assumed to be 100% spent in Jersey, to show the potential GVA which could be captured.

In practice this will depend on how the project and the energy market context is structured, and how much of the GVA and jobs the island wishes to capture. Alternatively, there could be significant off island spending, such as if O&M jobs were based in a French port rather than Jersey.

Local CAPEX spending

Less than 10% of CAPEX costs were assumed to be in Jersey due to the significant costs and challenges, such as fabrication of wind turbines and installation operations bases at appropriate ports, which would be elsewhere. However, % could be higher, or indeed lower, depending on decisions made in the project design process.

These on/off island splits can be adjusted in our model upon request.

Other limitations & considerations

This is an initial model estimate and would need to be further developed as part of any further business case development.

The extent to which the island wishes to leverage potential jobs, revenue and GVA as a driver of economic growth should influence the shape of the energy market and how any contracts or licensing is agreed.

It is also worth noting that changing from an electricity importer to a net exporter will likely change the dynamics of Jersey's current relationship with off-island electricity exporters and the tariffs and prices available.

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