

# Tidal Lagoon Schemes and Regional Development:

## Work Package 1: Report

# Electricity Generation Infrastructure in Wales: Ownership, financing and regulation



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## Summary

This Welsh Government Tidal Lagoon Challenge project is led by Cardiff University. We address the objectives of the Challenge Fund by examining potential financing and ownership options for novel tidal range renewables on the coast of Wales.

In this first report we examine extant ownership/financing models for energy generation infrastructure to date in Wales and in comparator regions, and to assess their outcomes in terms of sustainable economic development, supporting regional wellbeing, and improving ecosystems condition and functioning.

In developing this first report we have undertaken reviews of academic, industry, policy and other literature around ownership and financing of large energy projects.

We first examine the contemporary nature of electricity generation in the Welsh economy. The second section then examines the connections between regional electricity generation and local economic development. The third section then explores themes of ownership, regulation and the funding of electricity generation infrastructure in Wales. The fourth section then draws conclusions on connections between different regulatory, financial and ownership models and examines how they link to Welsh economic development outcomes.

The report finds that themes in respect of capital ownership link closely with themes in respect of finance. This is all in terms of a current position i.e. our review suggests that it is these themes that have contributed to the economic development pathways around renewable electricity generation in Wales and its current impacts on the residents and businesses of Wales. Future progress in Wales (and other parts of the UK) towards larger scale tidal range projects is expected to relate to these same themes.

# 1 Tidal Lagoon Challenge project

## 1.1 This project

This Welsh Government Tidal Lagoon Challenge project is led by Cardiff University. We address the objectives of the Challenge Fund by examining potential financing and ownership options for novel tidal range renewables on the coast of Wales. The research seeks to examine how different approaches might better support the long-term prosperity and wellbeing of the people of Wales, for example through:

- Increased local receipts from the sale of tidal generated electricity, for example through joint equity ownership or regulatory/fiscal instruments,
- Financing approaches that lock-in a higher level of local economic engagement, through direct employment or along supply chains,
- Novel ‘multifunctional cluster’ financing and development whereby predictable, guaranteed power is used for industrially or socially high value activities (e.g. Green Hydrogen) thus opening a wider set of viable financing opportunities,
- Multifunctional economic use of tidal range infrastructure e.g. lagoons used for recreation, flood mitigation, aquaculture or housing.

Our Tidal Lagoon Challenge project has key objectives that map directly to five work packages (WPs) as follows:

WP1: To examine extant ownership/financing models for energy generation infrastructure to date in Wales and in comparator regions, and to assess their outcomes in terms of sustainable economic development, supporting regional wellbeing, and improving ecosystems condition and functioning.

WP2: To examine how far existing developmental and financial models are practicable for potential tidal range schemes given capital requirements, operational timescales, uncertainties and risk, and potential future electricity prices (and pricing schemes).

WP3 To develop a simple economic model through which the consequences of different ownership and financial models can be explored with respect to effects on the Welsh economy.

WP4 To provide a framework matrix whereby an indicative typology of different financing, development and ownership models can be reconciled with a range of potential regional socio-economic, community acceptance, supply chain, environmental and climate outcomes.

WP5 To reflect on the scope for, and barriers to, a range of more innovative financial, development and ownership models that involve regional stakeholders, and increase positive local engagement across private, public and third sectors.

Our work seeks to contribute directly to Welsh Government research priorities, with a central focus on revealing and addressing the barriers to tidal development in ways that improve socio-economic and environmental outcomes. We also believe the project on completion:

- Will provide an evidence basis for better policy to be made by Welsh Government, revealing the potential synergies and trade-offs between different development models, for example in terms of regional benefits, and the scale and speed of development (and hence GHG savings).
- Will indicate where Welsh Government might need to spend political capital, regulatory effort and potentially legislative time to make a significant difference, rather than expending energy in areas that have limited impact.
- Will provide information on how energy generation investments interact with Wales' development and wellbeing.
- Will provide learnings that are relevant to other forms of electricity supply investment where Wales and Welsh Government has active interest (such as onshore wind via Trydan Gwyrdd Cymru, new nuclear etc.).
- Will inform other debates around how far renewables generation enables the co-location of industrial activities, not least in terms of offshore Celtic Sea wind.

There are wider contexts within which our project takes place. In November 2023 the *Economic Mission: Priorities for a Stronger Economy* reinforced the focus on a net-zero economy that respects environmental limits and reduces inequalities – and on the need for fairness, partnership opportunity and wider upskilling. All this is placed within the context of the Wellbeing of Future Generations (Wales) 2015 Act. This vision provides a framing for our approach to assessing the suitability of different development approaches for Wales, uncovering where there may be tensions and synergies between tidal range development approaches and this wider set of objectives. At the same time, the now established Welsh Government focus on local and community ownership of electricity generation (and the concomitant benefits) will form a central thread of our analysis of potential development approaches.

## 1.2 Research methods

In developing this first report we have undertaken reviews of academic, industry, policy and other literature around ownership and financing of large energy projects. The review material has also fed into a framework for a series of consultations with a cross section of participants in industry, developers, banks and finance institutions, Welsh and UK Government, and with staff in regulatory agencies. In this WP1 report we are focusing on the findings from our initial review and in WP2 we will summarise the findings/themes from our consultations in terms of answering questions on how far current regulatory and ownership trends might support tidal range schemes at larger scale.

Later (in WP3) we will bring an economic modelling lens to bear in pursuit of quantifying the potential regional impacts of tidal range development, and then assessing whether these elements are *a priori* likely to be influenced in their scale based on the developmental, funding and ownership model.

## 1.3 WP1 Report Structure

This report summarises progress through our first work package. This report also serves as context for the following work packages.

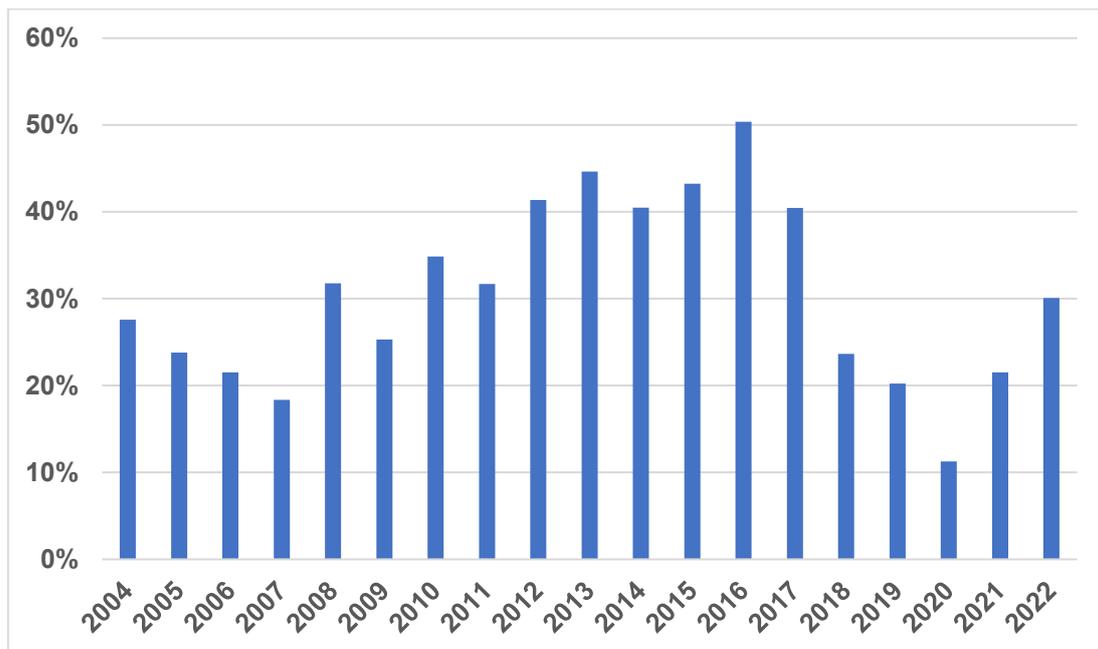
We first examine the contemporary nature of electricity generation in the Welsh economy. The second section then examines the connections between regional electricity generation and local economic development. The third section then explores themes of ownership, regulation and the funding of electricity generation infrastructure in Wales. The fourth section then draws conclusions on connections between different regulatory, financial and ownership models and examines how they link to Welsh economic development outcomes.

## 2 Electricity generation in Wales

### 2.1 Introduction

Wales has a long history in the development and operation of electricity supply, both for territorial use, and for export to England. For reasons of coalfield location, industrial history, port availability and more latterly abundant natural resource, Wales has long had a generation capacity significantly higher than the per-capita UK average. Indeed, during the 21<sup>st</sup> century, Wales has exported around 30% of its gross electricity generation, with this figure reaching between 40%-50% from 2012 – 2017, before the closure of the export-oriented Wylfa nuclear power plant (Figure 2-1)<sup>1</sup>.

**Figure 2-1 Percent of Wales' Gross Electricity Supply Exported to England (net of receipts)**



Source: Energy Trends, 2023

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<sup>1</sup> Derived from Energy Trends: December 2023, special feature article - Electricity generation and supply in Scotland, Wales, Northern Ireland and England, 2018 to 2022 <https://www.gov.uk/government/statistics/energy-trends-december-2023-special-feature-article-electricity-generation-and-supply-in-scotland-wales-northern-ireland-and-england-2018-to-20>

Despite this concentration of generation activity, there has long been a perception that the activity is inequitable in socio-economic and developmental terms. These arguments have strengthened in recent years with the *perception* that Wales' strength in territorially-embedded renewables (especially wind) is driving the export of kilowatts; that the underpinning resources are somehow 'Welsh'; and that the benefits that accrue to Wales from their exploitation (usually by non-Welsh corporate entities), for example via community benefit funds or moderate employment opportunities, are too low<sup>2</sup>.

These arguments gain weight because Wales has no corporations of any size involved in generation infrastructure development<sup>3</sup>, meaning ownership returns on capital invested are (with few exceptions) low-to-zero, and because, as electricity markets are not devolved, there has been no ability for any Welsh regulation or levy to direct surpluses from electricity generation to specifically Welsh uses (although the voluntary contributions from some developments via community benefit funds are not negligible).

The UK electricity network is meanwhile in transition, moving towards an ever-increasing reliance on renewables (largely offshore wind and solar PV) to respond to the urgent demand for net-zero carbon supply, and with new-generation nuclear power plants also under development and in planning<sup>4</sup>. The transition of power generation in Wales has however been slow. No renewables project of over 100MW has become operational since Vattenfall's Pen-y-Cymoedd windfarm in 2017<sup>5</sup>, although the Awel-y-Môr extension to the offshore wind farm at Gwynt-y-Môr (576MW, operational 2012) may add around 100MW. In recent decades Wales has seen the repeated 'failure-to-launch' of both a new nuclear plant at Wylfa, on Ynys Môn, and of a tidal lagoon at Swansea, whether under the guise of the original 320MW development, or more recent (and more ambitious) public sector-backed plans<sup>6</sup>.

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<sup>2</sup> Cowell R, Bristow G and Munday M, (2011) "Acceptance, acceptability and environmental justice - the role of community benefits in wind farm development" *Journal of Environmental Planning and Management*, 54(4), 539-557.

Munday M, Bristow G and Cowell R (2011) "Wind farms in rural areas: how far do community benefits from wind farms represent a local economic development opportunity?" *Journal of Rural Studies*, 27, pp.1-12.

<sup>3</sup> Note Bute Energy is headquartered in Cardiff with around 50 employees involved in a number of wind developments, but is owned outside Wales .

<sup>4</sup> Including in Wales. See for example <https://www.newcivilengineer.com/latest/last-energy-plans-four-20mw-micro-reactors-in-south-wales-to-support-manufacturing-15-10-2024/>

<sup>5</sup> <https://group.vattenfall.com/uk/what-we-do/our-projects/pen-y-cymoedd>

<sup>6</sup> See <https://www.swansea.gov.uk/BlueEden?lang=en>

This is important context for this wider report. There is a strong need to identify mechanisms whereby new renewables infrastructure can be financed, and at the same time deliver higher levels of regional benefit – be that socio-economic, developmental, or in terms of helping Wales deliver on its net zero commitments.

## 2.2 The shape of electricity generation in Wales

Despite the high profile of Wales’ net zero commitments and carbon budgets, electricity generation remains the most fossil-fuel dependent of any part of the UK. England does not generate enough electricity to service its own demand, so the comparison is somewhat invidious. Almost two thirds of all generation in Wales is gas-fuelled, compared to under 40% for the UK as a whole.

**Figure 2-2 Electricity Generation by Technology Type**

<i>Percentage</i>	<b>UK Total</b>	<b>Scotland</b>	<b>Wales</b>	<b>Northern Ireland</b>	<b>England</b>
<b>All fossil fuels</b>	<b>40.8</b>	<b>11.4</b>	<b>65.3</b>	<b>55.7</b>	<b>43.4</b>
Coal	1.7	0.0	0.0	10.9	1.9
Oil	0.7	1.0	0.0	0.2	0.7
Gas	38.4	10.3	65.3	44.6	40.8
Nuclear	14.7	15.8	0.0	0.0	16.9
<b>All renewables</b>	<b>41.5</b>	<b>71.0</b>	<b>26.8</b>	<b>44.3</b>	<b>36.9</b>
Hydro natural flow	1.7	10.3	1.0	0.3	0.1
Wind	24.7	55.2	17.6	32.5	18.7
Solar	4.1	0.8	3.7	2.9	4.9
Bioenergy	11.0	4.7	4.6	8.5	13.3
Other fuels	2.4	0.8	3.0	0.0	2.8
Pumped storage	0.6	1.1	4.8	0.0	0.0
<b>All low carbon</b>	<b>56.2</b>	<b>86.8</b>	<b>26.8</b>	<b>44.3</b>	<b>53.9</b>

Source: Energy Trends, 2023

It should be noted that this outcome is a product more of history than regional policy. For example, despite a long history of (publicly owned) nuclear generation Wales does not currently have an operational plant, but nuclear accounts for over 15% of generation in Scotland and England. More fundamentally, Wales does not have the geography and climate which enables Scotland to source 10% of its power from (now, at least at scale, very old) natural hydropower. Nonetheless, even where Wales does have natural advantages – in Wind and Solar – it has failed to even match the generation share of England, where renewables policy has been significantly more restrictive (Figure 1-27).

Wales' electricity generation is relatively concentrated, with a small number of large plants providing the bulk of power. The largest of these is the 2200MW gas-fired Pembroke power station, owned by RWE and commissioned in 2012, and with another large gas fired plant in North East Wales at Connah's Quay (1,380MW). The next-largest sites are renewables, Gwynt-y-Môr, offshore the north Wales coast (576MW) and the Pen-y-Cymoedd windfarm on Natural Resources Wales land in the south Wales valleys (228MW). No other site in Wales has an installed capacity of over 100MW, although the pumped storage plants at Dinorwig and Ffestiniog can generate significant power from their storage reservoirs; 1800MW and 360MW respectively.<sup>8</sup>

**Figure 2-3 Major (>100MW) Power Plants in Wales, 2023**

Company Name	Site Name	Technology	Type	Installed Capacity (MW)	Year Commissioned
RWE Npower	Pembroke	Fossil Fuel	Gas	2199	2012
ENGIE/First Hydro	Dinorwig	Pumped hydro	Pumped hydro	1800	1984
Uniper UK	Connahs Quay	Fossil Fuel	Gas	1380	1996
RWE Npower	Gwynt y Mor	Wind	Offshore wind	576	2013
ENGIE/First Hydro	Ffestiniog	Pumped hydro	Pumped hydro	360	1963
Vattenfall	Pen-y-Cymoedd	Wind	Onshore wind	228	2016

Source: Digest of UK Energy Statistics, 2023.

<sup>7</sup> See footnote 1

<sup>8</sup> Digest of UK Energy Statistics (DUKES) 2023 Chapter 5 – Electricity, Table 5.11

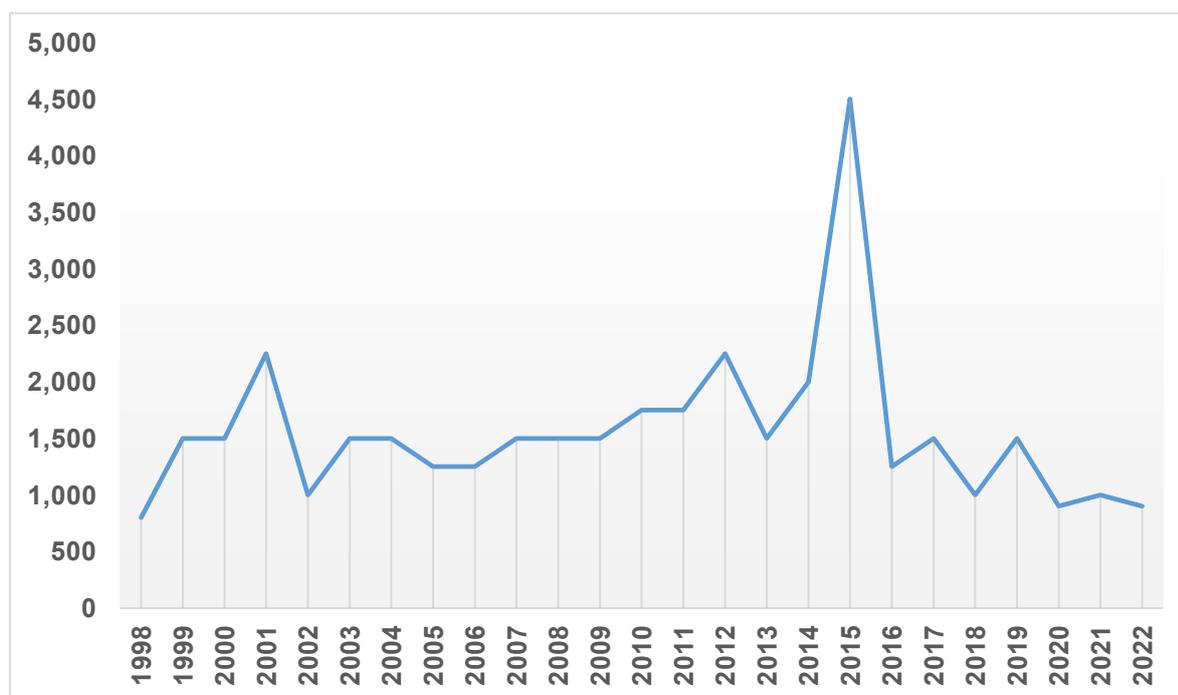
<https://www.gov.uk/government/statistics/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes>

### 3 The regional economic benefits (or not) of electricity generation

#### 3.1 Regional returns to electricity generation in Wales

The majority of regional economic returns to electricity generation have occurred in the form of employment. As Figure 3-1 shows, direct employment in electricity generation activities has varied between 800 and 4,500, the latter very much an outlier<sup>9</sup>. Over this period, employment averaged around 1,500 workers. In 2022, employment (900) was less than 0.1% the relevant Welsh total.

**Figure 3-1 Employment in Electricity Production in Wales 1998-2022**



Source: Business Register & Employment Survey / Annual Business Inquiry<sup>10</sup>

<sup>9</sup> Driven possibly by developmental activity classified as generation, and/or decommissioning at Wylfa.

<sup>10</sup> Nomisweb [www.nomisweb.co.uk](http://www.nomisweb.co.uk)

Generation also creates financial returns in Wales. A detailed analysis of the generation sector for 2007 revealed, for example, a direct gross value added (GVA) contribution of £475m, this being some 1.2% of Wales' estimated aggregate GVA in that year, 8.5 times higher than the 2007 employment share<sup>11</sup>. Notably, the bulk of this GVA, 70% was in the form of gross operating surplus (profit) which, given ownership patterns, may not have remained in Wales.

The bulk of financial impacts in Wales therefore relate to income. Here, the 2023 Annual Survey of Hours and Earnings<sup>12</sup> suggests a median gross wage<sup>13</sup> of £44,350, implying a total gross aggregate wages for the *generation* part of the sector of some £40m<sup>14</sup>. Median wages in this broad sector are estimated to be 60% higher than the Welsh all-sector average.

Electricity generation does not of course happen in a vacuum: even in operational phases, infrastructure requires maintenance, operations demand professional and other services, often local, and workers in generation re-spend their wages creating 'induced' economic effects across Wales. These effects can be estimated using Input-Output Table (IOT) multiplier analysis, the latest available being the 2019 Input Output Tables for Wales<sup>15</sup>.

The IOTs for 2019 provide multipliers for the broader electricity, gas and water supply sector. These multipliers are high, relative to other sectors, in part due to the high level of wages in the sector, but also due to its extreme capital intensity – which can give rise to very high multipliers which may poorly reflect reality. Nonetheless, Figure 3-2 provides the IOT estimates of indirect FTE employment and gross wages, suggesting perhaps 2,500 employees are directly or indirectly dependent on electricity generation activities in Wales<sup>16</sup>.

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<sup>11</sup> [https://www.cardiff.ac.uk/\\_data/assets/pdf\\_file/0010/698869/input-output-tables-2007-final-30-6.pdf](https://www.cardiff.ac.uk/_data/assets/pdf_file/0010/698869/input-output-tables-2007-final-30-6.pdf)

<sup>12</sup>

<https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/datasets/regionbyindustry2digitsicashetable5>

<sup>13</sup> For the 2-digit SIC covering electricity, gas and water supply

<sup>14</sup> Albeit here mixing data sources.

<sup>15</sup> [https://orca.cardiff.ac.uk/id/eprint/151984/1/Project\\_Report\\_Input\\_Output\\_Tables\\_Wales\\_2019.pdf](https://orca.cardiff.ac.uk/id/eprint/151984/1/Project_Report_Input_Output_Tables_Wales_2019.pdf)

<sup>16</sup> Type 2 Multipliers.

**Figure 3-2 Estimated Direct & Indirect Employment & Gross Wages (2022/3)**

	<b>Employment</b>	<b>Gross wages (£m)</b>
Direct	900	40.0
Indirect	1,660	50.4
<b>Total</b>	<b>2,560</b>	<b>90.4</b>

### **3.2 The development and construction phase**

Whilst operational-phase employment is likely modest, there is a stronger argument that the development and construction phase of generation projects provide significant employment and supply chain benefits. An examination of this potential was undertaken in 2017, bespoke to Wales, which looked to quantify the *overall* employment impacts of electricity generation projects<sup>17</sup>. A number of findings emerged from this analysis:

- Regional employment generation was more limited for ‘tried and tested’ large scale technologies, especially for gas in its construction phase with a reliance on bought-in and self-contained combined cycle turbines,
- Nuclear-power related employment was somewhat higher (per MW installed) in part due to safety requirements,
- ‘Novel’ technologies such as marine renewables (including tidal) had far higher job creation per MW installed, but this was part of an overall cost envelope that made them (at least a decade ago) uncompetitive.<sup>18</sup>

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<sup>17</sup> Bryan, J., Evans, N., Jones, C., & Munday, M. (2017). Regional electricity generation and employment in UK regions. *Regional Studies*, 51(3), 414-425. <https://doi.org/10.1080/00343404.2015.1101516>

<sup>18</sup> See for example also Fanning T, Jones, C and Munday, M. (2014) The regional employment returns from wave and tidal energy: A Welsh analysis. *Energy* 76, pp.958-966

Overall, the picture on pre-commissioning phase employment impact is that they are significant for the short period of construction, but once ameliorated across the operational lifetime of the facility in question, they are typically somewhat less than ongoing operational employment. Of those technologies that are currently at, or near, grid parity, Solar PV, Offshore wind and Onshore wind have the highest proportion of jobs created in the pre-commissioning rather than operational phase. This employment is, in the round and over the long term, lower in terms of 'job years' than operational phase employment, and hence of very modest regional importance. Additionally, but more difficult to quantify is the potential for large energy developments to grow beyond regional labour supply (or skills) capacity, leading to higher labour leakage (i.e. peripatetic workers) at times of peak demand<sup>19</sup>.

### **3.3 Electricity generation & economic development in Wales**

Limited returns from ownership, and an employed cohort that is well-paid but relatively small, mean socio-economic returns to Wales are unlikely to be regionally significant, at least in quantitative terms. However, given Wales' concentration of electricity generation activities, across a number of firms and technologies both land and marine, 'cluster' related benefits might result in technology and knowledge transfer, Industry 4.0 developments, greater factor productivity and hence wider industrial improvement<sup>20</sup>.

It is clear that electricity generation activities have, especially in their development and construction stages, generated demand for a variety of related occupations and industries, both in heavy work (such as construction and grid) and in knowledge sectors – planning and surveying consultants, ecologists etc. – as well as for public services such as regulation and land provision (which are appropriately remunerated). However, the prospects for wider industrial upgrading appear, historically at least, to have been limited.

A study in 2020<sup>21</sup> examined two decades of electricity generation investment in Wales, looking for examples of clustering, innovation and wider regional economic upgrading. Evidence for these was scant, with authors pointing to:

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<sup>19</sup> See Shuai, X. (2010). Who benefits from job creation at county level? An analysis of leakage and spillover of new employment opportunities in Virginia. *Business Economics*, 45(1), 38-48.

<sup>20</sup> See Bergman, E. M., & Feser, E. J. (2020). *Industrial and regional clusters: concepts and comparative applications*. Web Book of Regional Science <https://researchrepository.wvu.edu/rri-web-book/>

<sup>21</sup> Jones, C., & Munday, M. (2020). Capital ownership, innovation and regional development policy in the economic periphery: An energy industry case. *Local Economy*, 35(6), 545-565. <https://doi.org/10.1177/0269094220968048>

- Multinational energy firms which typically concentrate innovation near headquarters, or in core regions, often far away from where their electricity is actually generated,
- Relatedly, investments in peripheral but energy-rich regions like Wales is functionally narrow, focused only on generating watts, and of low economic value,
- Supply chains for specialist equipment remain resolutely national and international, rather than localising to Wales,
- Cross-organisation activity concentrates on ‘softer’ lobbying and messaging activities (e.g. to regulators and communities) rather than exchanges of technical knowledge,
- The ‘flipping’ of developments – whereby (renewables) projects (often repeatedly) change ownership between inception and commissioning limits the development of local-non local economic relationships.

The study suggested these troubling facets were a product of both Wales’ existing economic peripherality (and hence lack of a broad-based and competitive supply-side), and of the multinational ownership of energy capital in the region. The latter means that owners of capital have limited incentives to develop meaningful and deep economic relationships with economic entities in the regions where they have generation infrastructure.

### 3.4 Electricity generation and wider regional objectives

Societies care about more than economics, and Wales is no different – except the things it *does* care about are effectively codified in the Wellbeing of Future Generations (Wales) Act of 2015 (WBFGA) <sup>22</sup>. This Act outlines seven Goal areas: given Wales’ territorial advantages for fossil, nuclear and renewable production mean that related investments might be expected to impact on their achievement.

The seventh Goal of the WBFGA is ***a globally responsible Wales***, and this has been in part incorporated into Welsh Government policy via a strong commitment to Net Zero, and the development of sequential Wales-national carbon budgets<sup>23</sup>. Wales second carbon budget aspirations (for 2021-25) exist within a context where emissions from electricity generation comprised 19% (and falling) of Wales’ total territorial emissions in 2019, but with total emissions on a rising trend since 1995<sup>24</sup> - with the exception of 2017-19 which saw the withdrawal of Wales last coal-fired power station at Aberthaw, then closing in 2020.

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<sup>22</sup> <https://www.gov.wales/well-being-future-generations-act-essentials-html>

<sup>23</sup> <https://www.gov.wales/net-zero-wales-carbon-budget-2-2021-2025>

<sup>24</sup> Ibid Figure 8

Despite a commitment to install 1GW of renewables capacity by 2025, progress since 2019 has been slow, with an average of 74MW installed per annum between 2020 and 2022. This is significantly slower than the 2014-17 period when several larger projects were commissioned and leaves the region very considerably ‘off-track’ for 2025<sup>25</sup>. Indeed, the target is now probably not reachable.

It is notable that few nationally significant renewables developments have been commissioned in Wales in the 21<sup>st</sup> century, despite the rapid decarbonisation of the UK grid in this period. This speaks to the way the UK grid has effectively foregrounded the (levelized) cost of electricity per kWh via (latterly) the Contracts for Difference/strike price mechanism when enabling new generation capacity<sup>26</sup>. This has favoured low-cost locations and large-scale projects, and established technologies – such as Scottish onshore wind and North Sea offshore wind – over higher-cost locations (e.g. deeper, rougher seas) and smaller development sites, both of which apply, relatively, to Wales.

Whilst this approach has been successful in its core objective of UK-national grid decarbonisation, it has restricted both geographic and technological diversity – for example, the UK has been unable to use the existing market mechanism to fund its aspirations for a fleet of new nuclear power stations. Notably, the inability to negotiate a mutually acceptable strike price between the UK Government and Tidal Lagoon (Swansea Bay) Ltd was, notionally at least, a key reason why that project was not developed. The ability of the UK market mechanism to enable innovative trials at grid scale, or the willingness of a UK government to step outside such mechanisms to fund innovative projects, remains at question.

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<sup>25</sup> <https://www.regen.co.uk/publications/energy-generation-and-use-in-wales/>

<sup>26</sup> <https://www.gov.uk/government/collections/contracts-for-difference> <https://www.lowcarboncontracts.uk/our-schemes/contracts-for-difference/strike-price-adjustments/>

Electricity generation has long been considered as potentially delivering significant co-benefits Community Energy for the WBFGA Goal areas of **a more equal Wales** and **a Wales of cohesive communities**. Here, the prospect, at the start of the renewables transition was possibly for a widespread and decentralised set of community-owned generation facilities that could deliver community income through power export and price supports such as Feed in Tariffs (FiTs). There also existed the (perceived) possibility of such assets providing lower cost electricity, potentially increased community resilience (e.g. through local grids), and higher levels of climate awareness<sup>27</sup>. Specifically in Wales, the location of in-stream hydropower potential close to rural and struggling North Wales communities meant such developments were seen as having the potential to retain young people in those areas<sup>28</sup>, thus contributing to the Goal of a **Wales of vibrant culture and thriving Welsh language**.

Few of these aspirations were subsequently met. Community ownership has been extremely low and slow in Wales, for a number of reasons that are summarised from across the literature below – and where many of the underlying issues remain unresolved.

- Many and enduring barriers to community development including (but not only) planning, water abstraction & licensing, land ownership/control, and local capacity and human capital,
- The cost and feasibility of grid access, especially at rural sites,
- Related to the above. the long gestation period for many developments, and the requirement to have capital at risk for an extended period,
- The swift movement of commercial entities and relatively well-off householders to install renewables and fully exploit the best sites, and fixed UK Government budgets for FiTs, leaving little for communities to utilise,
- The more general move by the UK government to move away from FiTs post-2015,
- A lack of available capital within communities to enable development, especially in poorer communities and during recent austerity.

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<sup>27</sup> For a review see Brummer, V. (2018). Community energy—benefits and barriers: A comparative literature review of Community Energy in the UK, Germany and the USA, the benefits it provides for society and the barriers it faces. *Renewable and Sustainable Energy Reviews*, 94, 187-196.  
<https://doi.org/10.1016/j.rser.2018.06.013>

<sup>28</sup> Bere, J., Jones, C., Jones, S., & Munday, M. (2017). Energy and development in the periphery: A regional perspective on small hydropower projects. *Environment and Planning C: Politics and Space*, 35(2), 355-375  
<https://doi.org/10.1177/0263774X16662029>

These issues slowed community energy development such that community owned installations comprise an estimated only 1.1% of all renewable installed capacity in Wales. Indeed, community ownership accounts for only 6% of locally owned renewable capacity – and under 3% of locally-owned generation<sup>29</sup>. The level of ownership mitigates against any significant regional impact from the community sector on Wales’ objectives economically, in terms of net zero or in contributing to wider WBFGA Goals. As we write, communities have become not disengaged, but resentful towards new electricity infrastructure pylons as well as generating sites<sup>30</sup> – in part due to the lack of prior benefits<sup>31</sup>.

### **3.5 Conclusion**

Wales has a strong territorial advantage across a variety of electricity generation, whether this is renewable wind or tidal, or longer established technologies – for example the Haven’s deep water port enabling LNG imports, and Wylfa ‘shovel ready’ for nuclear. These advantages mean that even long after the disappearance of coal as a fuel for power, Wales has retained a very high level of generation capacity per capita, and relatedly high levels of regional export to England.

Reading across Sections 1 and 2 however reveal a region that has not seen wider or longer-term benefits emerge from this concentration of infrastructure. Wales’ peripherality and a lack of ownership limits both the regional returns to capital (e.g., through power sales), and the extent of inter-organisation clustering activities, knowledge transfer and productivity improvement. In a situation where the capital intensity of production restricts regional employment to only a few thousand, this is a real issue.

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<sup>29</sup> <https://www.regen.co.uk/publications/energy-generation-and-use-in-wales/> p.6 & p.10

<sup>30</sup> <https://nopylons.wales>

<sup>31</sup> See <https://communityenergy.wales/news/its-the-community-stupid>

Added to the above is a UK-grid context that has (understandably) advantaged low-cost, and large-scale renewables in ways that mean Wales has seen a very low number of significant renewables projects launched especially in the last decade. This has left Wales' grid – or at least the southern half of it – amongst the most carbon-intense of all British regions<sup>32</sup>. Not only have renewables developments been relatively slow and small, but where they do occur, a range of regulatory, financial and other issues have largely kept communities 'out of the game', then limiting the ability of generation to contribute to Wales' wider and long term objectives.

Few of the issues listed above have been solved, or indeed are near to being solved. The elements that limit economic-developmental and other benefits to Wales – and having the ability to ameliorate or circumvent them – will thus be a key consideration in assessing how any tidal range projects can make a real difference to Wales' future.

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<sup>32</sup> See <https://carbonintensity.org.uk> for live updates.

## 4 Focus on Ownership, Financing and Regulation

### 4.1 Introduction

Following from Section 2 and 3 there is an expectation that a number of factors might influence the extent to which renewable electricity generation might impact on economic prospects for Wales. Among factors that need to be considered here are issues of capital ownership, regulatory (and subsidy) framework, and the financing of projects. These three factors are tightly interconnected. In this section we briefly consider how prior electricity generation projects in Wales have been financed and operated and the main regulatory frameworks that have been employed. In Section 5 we then seek to make linkages between the regulation/finance/ownership paradigm and impacts on local economic development. This then becomes context for the WP2 report which explores how far existing models are appropriate for tidal range schemes at scale.

### 4.2 Ownership

Electricity generation at scale in the UK was nationalised in 1948. This process brought together plants owned by local government and private facilities such as the extant hydro power stations in Wales (for example Cwm Dyli in Gwynedd).

In 1990 electricity generation facilities were privatised and with three companies formed (PowerGen, National Power and Nuclear Electric) alongside a National Grid company<sup>33</sup>. National Power was vertically integrated, meaning that it produced electricity as well as selling electricity to domestic customers.

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<sup>33</sup> UK Parliament 1997. The electricity supply industry and liberalisation.  
<https://publications.parliament.uk/pa/cm/199697/cmselect/cmtrdind/279i/ti0209.htm>

Although nuclear and coal power stations have subsequently closed in Wales, some facilities funded and opened in public ownership still exist. For example, Norwegian company Statkraft<sup>34</sup> own the Rheidol hydro schemes, with the facilities having initially belonged to PowerGen. The significant pumped hydro schemes at Dinorwig and Ffestinionog are now in the hands of First Hydro (see below) having belonged to National Power. Of note, the Cardiff Capital Region bought the former Aberthaw coal power station in 2022<sup>35</sup> partly with a view for future energy generation on the site.

Following privatisation there has been diversification in the energy supply market in terms of both ownership and types of businesses involved. In terms of large power generation facilities Wales has an estimated 22 different operators involved across 133 individual power generation sites. However, in 2024, three power generation sites are estimated to supply 5,400MW of installed capacity or approximately two thirds of the potential supply in Wales<sup>36</sup>. Moreover, a further three facilities offer between 100MW and 1,000MW (combined 1.16GW) and these are owned by large operators RWE, First Hydro, and Vattenfall.

**Figure 4-1 Power stations in Wales by Installed Capacity Ranges (MW)**

	Number	Installed capacity MW	% total
> 1000MW	3	5,379	66.2%
100MW - 1000MW	3	1,164	14.3%
50MW - 100MW	7	487	6.0%
10MW - 50MW	34	684	8.4%
< 10MW	86	407	5.0%
<b>Total</b>	<b>133</b>	<b>8,121</b>	<b>100.0%</b>

Source: Estimated for Digest of UK Energy Statistics, 2024

Figure 4-2 reveals that RWE, First Hydro and Uniper have a little over 82% of Wales's installed power generation capacity. It is also important to recognise in Figure 4-2 that installed capacity does not equate with shares in power generation in any one year because of different load factors in the different technologies.

<sup>34</sup> Statkraft. Rheidol Hydro Scheme <https://www.statkraft.co.uk/a-history-of-statkrafts-rheidol-hydropower-scheme/>

<sup>35</sup> Cardiff Capital Region. Aberthaw Power Station <https://www.cardiffcapitalregion.wales/investment-ops/aberthaw-power-station/>

<sup>36</sup> National Statistics publication Digest of UK Energy Statistics (DUKES) produced by the Department for Energy Security & Net Zero (DESNZ). Dated 30.07/2024.

**Figure 4-2 Large power generators in Wales (numbers are rounded)**

<u>Company</u>	<u>Origin</u>	<u>Main generation facilities</u>	<u>State interest %</u>	<u>Number of power stations</u>	<u>MW Inst</u>	<u>% Wales installed capacity</u>
RWE Npower	Germany	Gas; On/Offshore	0%	13	3,155	38.9%
First Hydro (Engie) *	France	Hydro	24%	1	1,620	20.0%
First Hydro*	P Equity	Hydro	0%	1	540	6.7%
Uniper UK	Germany	Gas	99%	1	1,380	17.0%
Vattenfall	Sweden	Onshore	100%	1	228	2.8%
Nadara	Italy	Onshore	0%	10	196	2.4%
Greencoat Capital	P Equity	Onshore, Solar	0%	22	157	1.9%
Lightsource BP	UK	Solar	0%	18	133	1.6%
Pennant Walters	UK	Onshore	0%	6	126	1.6%
RES Group	UK	Onshore	0%	11	114	1.4%
Foresight Group	P Equity	Solar	0%	3	87	1.1%
Statkraft	Norway	Natural flow and Onshore	100%	8	79	1.0%
Anesco	UK	Solar	0%	13	78	1.0%
Octopus Invest.	UK	Solar	0%	9	70	0.9%
Nuclear Decomm.	UK	NA	100%	1	35	0.4%

Source: Digest of UK Energy Statistics, 2024 and Author research

\* Note that First Hydro has been split into two parts to demonstrate the 75% split between Engie and 25% to the private equity. In turns this helps to illustrate the degree of state ownership by the French government.

RWE is by far the largest owner of power generation facilities in Wales. This capacity includes the large combined cycle gas power station in Pembrokeshire, two large offshore wind, two large onshore wind and eight small plants including natural flow hydro schemes in the Rheidol Valley. RWE is a German-based multinational firm with an estimated 90% of the stock owned by global institutional shareholders<sup>37</sup>. First Hydro owns an estimated 27% of Welsh electricity generation capacity (combined 2,160MW) through the two pumped hydro schemes in North Wales (Dinorwig and Ffestiniog). Again, these are facilities built originally by the UK State. A 75% share of First Hydro belongs to French-based multinational Engie, which emerged from the French state gas company and remains roughly a quarter state-owned.<sup>38</sup> The remaining 25% belongs to a Canadian asset manager CDPQ<sup>39</sup>. The third biggest player is Uniper (1,380MW and 17%) a German company which is almost entirely state-owned.

Alongside German company Uniper, wholly state-owned companies are significant, but relatively small, players for the moment. They include Sweden's Vattenfall (228MW and 2.8%) and Norway's Statkraft (79MW and 1.0%). It is also noted here that the UK Government announced the purchase of former nuclear site at Wylfa on Ynys Môn/Anglesey in March 2024. The same deal includes purchasing Oldbury-on-Severn, close to Wales.<sup>40</sup> It is important to recognise differences in vertical integration between power generation businesses. Then in terms of sales of electricity to Wales consumers this would be poorly understood from examining the information in Figure 4-2.

Immediately evident from the latter Figure is the fairly small share of electricity generation capacity held by UK registered businesses. Of course, the nature of ownership is complex. For example, UK pension funds and other UK institutions (including private equity businesses) can be invested in multinational utilities that produce electricity in Wales. However, Figure 4-2 indicates that less than 7% of total capacity in Wales belongs to UK companies and organisations (and that includes UK Government ownerships of potential sites for future electricity generation).

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<sup>37</sup> RWE shareholders <https://www.rwe.com/en/investor-relations/rwe-share/share-at-a-glance/shareholder-structure/>

<sup>38</sup> Engie shareholder structure <https://www.engie.com/en/shareholders/engie-share/shareholder-structure>

<sup>39</sup> First Hydro <https://www.hydroreview.com/hydro-industry-news/pumped-storage-hydro/cdpq-acquiring-25-of-first-hydro-company-in-uk-from-brookfield/>

<sup>40</sup> GB Nuclear buys sites from Hitachi <https://www.gov.uk/government/news/great-british-nuclear-to-buy-two-hitachi-sites-for-new-nuclear-development>

There is a much greater diversity of ownership in smaller (less than 15MW) sites. These include some ownership by communities and co-op groups, for example the Awel Coop near Ammanford with around 5MW of onshore wind capacity (and related, Egni solar PV). However, together these cumulatively account for an estimated 7% of total Welsh installed capacity which would be equivalent to the capacity of just one of RWE's offshore windfarms (Gwynt-y-Môr off North Wales).

Clearly, ownership of power generation facilities is dynamic. Changes in ownership can occur through merger and acquisition activity. Moreover, there are plenty of examples of companies either gaining planning permissions and consent, or then building solar and onshore windfarms and then selling them on. For example, Nadara is a private company based in Italy which has bought up onshore wind from developers Ventient Energy and Renantis. This company now operates one of the very first windfarms built in Wales, which opened at Gilfach Goch, Taff Ely in 1993. Moreover, ownership changes can occur when facilities are re-powered. For example, Llandinam Windfarm (a 31MW facility originally opened in 1993) belongs to Celtpower Limited, but has ultimately been owned since 2016 by Scottish Energy Renewables with operating partners Amsterdam-based Eurus Energy. Together they are looking to repower the site and get more energy with new turbines<sup>41</sup>.

Interest on ownership of facilities provides some indication of the geographical direction of returns, but as highlighted earlier, ultimate ownership in terms of stock holding can be complex. For example, Greencoat Capital (see Figure 4-2) started out in Ireland, but its UK sites are now managed by Schrodgers Greencoat LLP in London<sup>42</sup>. They operate one Welsh windfarm at Maerdy<sup>43</sup> and another 21 solar sites in Wales. Generally, each of these sites belongs to its own limited company which may have been founded a year or two before the schemes were completed. The largest Greencoat site had a stake belonging to Spanish firm Quintas until 2022. Schrodgers Greencoat LLP took control in 2024.

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<sup>41</sup> Llandinam Windfarm repowering [https://www.scottishpowerrenewables.com/pages/llandinam\\_repowering.aspx](https://www.scottishpowerrenewables.com/pages/llandinam_repowering.aspx)

<sup>42</sup> Greencoat <https://www.schrodgers.com/en/global/individual/media-centre/schrodgers-greencoat-to-acquire-c-700m-toucan-energy-portfolio---the-largest-operational-solar-portfolio-traded-in-the-uk/>

<sup>43</sup> Greencoat UK Wind <https://www.greencoat-ukwind.com/>

A detailed account of genuine community or resident ownership of power generation facilities is very difficult to estimate there being no explicit register. Community Energy Wales revealed that there was 398 MW installed capacity across the UK as of 2023 in community ownership.<sup>44</sup> In 2022 Wales had 36 active community energy groups, with an associated 29 MW of community owned energy capacity (this was a 6% increase from the 2021 total).<sup>45</sup> In 2024 the Institute of Welsh Affairs recommended a minimum of 30% of community ownership on Trydan Gwyrdd Cymru's future developments, with at least 15% community and local ownership in renewable projects above 5MW by 2028. They also called for a Wales Wealth Fund.<sup>46</sup> Welsh Government have targets for community ownership and have a £10m fund designed to support the development of Smart Local Energy Systems.<sup>47</sup>

### 4.3 Intervention fundamentals in Wales

Interventions in the broad area of electricity generation in Wales occur at different governance levels and at different stages of the capital cycle. Critically there are different powers related to electricity generation held at UK Government and Welsh Government levels. In the broadest terms the UK Government sets overarching energy policies such as the Contracts for Difference framework, has greater scope to directly invest capital - for example, recent decisions on carbon capture and storage,<sup>48</sup> and determines significant planning applications through Development Control Orders for energy schemes of over 350MW. Examples from Wales<sup>49</sup> include the 500MW Awel-y-Môr offshore wind scheme, given approval in 2023.

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<sup>44</sup> Community Energy Wales. Community energy ownership UK in 2023

<https://communityenergy.wales/publications>

<sup>45</sup> Community Energy Wales. State of the sector 2023 <https://communityenergy.wales/content/publications/state-of-the-sector-2023.pdf>

<sup>46</sup> Institute Welsh Affairs report 2024 Sharing Power, Spreading Wealth, [https://www.iwa.wales/wp-content/media/IWA\\_Sharing-Power-Spreading-Wealth\\_v2b.pdf](https://www.iwa.wales/wp-content/media/IWA_Sharing-Power-Spreading-Wealth_v2b.pdf)

<sup>47</sup> Welsh Government Smart Local Energy Systems grant <https://www.gov.wales/10-million-community-driven-energy-projects-power-wales-green-future>

<sup>48</sup> Government confirms funding to launch the UK's first carbon capture sites (4 October 2024) <https://www.gov.uk/government/news/government-reignites-industrial-heartlands-10-days-out-from-the-international-investment-summit>

<sup>49</sup> National Infrastructure Planning (applications from Wales)

<https://infrastructure.planninginspectorate.gov.uk/projects/wales/>

Welsh Government has powers which, in some cases, aim to speed up planning decisions in the 'space' between local and UK government. This includes Planning and Environment Decisions Wales (PEDW) applications for 10-350MW renewal electricity generation projects. In 2024 there have been 10 electricity generation applications for Developments of National Significance (DNS).<sup>50</sup> There are 4 power plants in Wales generating more than 350MW and 86 which generate under 10MW (total 133 - see above Figure 4-1). Welsh Government has some scope to invest in the wider electricity generation system but is constrained by its borrowing limits. The Welsh Government controlled Development Bank of Wales has supported renewable energy schemes. First through the Local Energy Fund which is worth about £12.5 million. Activity here mostly comprises loans to communities. Much of the activity under the Local Energy Fund is in terms of small-scale hydro solar and wind. Second, through Green Business Loans which has financed activity such as placing solar PV on industrial premises.

It is notable that Welsh Government has potential to gain more powers. For example, the Crown Estate has been devolved to the Scottish Government since 2017. The Scotland Estate owns rights to minerals, some fishing and licence moorings, aquaculture sites and access to other parties. The Estate in Wales is estimated to own 65% of Wales's foreshore and riverbeds, and more than 50,000 acres of land.<sup>51</sup> Crown Estate land across the UK could host around 11.8GW of offshore wind power. In the 2023-24 financial year, profits jumped £658.1 from the previous year to a record £1.1 billion - mostly due to offshore wind leasing.<sup>52</sup> Control of the coastal land in Wales could provide funding and greater discussion making about offshore wind and tidal.

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<sup>50</sup> Welsh Government takes action to accelerate infrastructure planning decisions <https://www.gov.wales/welsh-government-takes-action-accelerate-infrastructure-planning-decisions>

<sup>51</sup> What does the Crown Estate own in Wales and how much money would Wales get if it was devolved? Will Hayward, Wales Online. <https://www.walesonline.co.uk/news/what-crown-estate-wales-how-24503743>

<sup>52</sup> Crown estate: why it's time to devolve it and put Wales on par with Scotland <https://www.bangor.ac.uk/news/2024-08-12-crown-estate-why-its-time-to-devolve-it-and-put-wales-on-par-with-scotland>

A fundamental underlying UK Government intervention has been the need to develop renewable generation capacity and with this associated with targets to combat climate change. However, perhaps more critical context for interventions is that innovative renewable technologies can be expensive to develop and might not be cost competitive in their evolutionary stages and associated with high levels of financial and regulatory risk compared to established (and sometimes more polluting) technologies. Interventions then promote new development in the hope that with learning and scale, costs will come down through time. There is also an issue that renewable electricity generation projects typically have very high upfront expenses. For example, Beitter et al. (2023)<sup>53</sup> in a recent analysis show that for fossil fuel technologies expenses incurred during the development and capital build process are around 15% of life cycle costs (i.e. gas power stations incur high costs in purchasing feedstocks during operation affecting the balance between capital and operations costs). However, with offshore wind almost two thirds of life cycle costs are incurred upfront, and then with the remaining third linked to expenses incurred during operations and maintenance.

This hard reality particularly in respect of more untested renewable electricity generation technologies means that different elements of the intervention framework (in the UK and elsewhere) are framed around:

- Encouraging private capital into developing new renewable electricity generation technologies by reducing uncertainty around future project revenues.
- Encouraging private developers to work with the public sector in developing projects where risks are high because of the scale of upfront capital costs.
- Encouraging innovative business models among project developers; and allowing project developers to more clearly lay out project specifications to banks, finance providers etc.
- Encouraging a clear and consistent environmental impact assessment approach.
- Encouraging private capital to invest in R&D around renewable electricity generation projects.
- Encouraging pathfinder projects which others can use to develop their business models, and more accurately forecast costs and revenues.

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<sup>53</sup> Beiter, P., Guillet, J., Jansen, M. *et al.* The enduring role of contracts for difference in risk management and market creation for renewables. *Nat Energy* **9**, 20–26 (2024). <https://doi.org/10.1038/s41560-023-01401-w>

Intervention is nothing new. Looking to precedents, the UK Government considered new hydro schemes in Wales during the 1950s<sup>54</sup>. The debate then was whether the upfront capital costs, when compared to coal, would be a good long-term decision. The legacy was the North Wales Hydro-Electric Power Acts of 1952 and 1955. The latter led to Ffestiniog pumped hydro (360MW) and Rheidol natural flow schemes opening in the 1960s. The North Wales Hydro Electric Power Act 1973 led to the Dinorwig pumped hydro scheme (1800MW) which opened in 1984. It would have been unlikely these schemes would have been developed without such public support.

#### **4.4 Intervention frameworks renewable electricity generation capacity in the UK**

A series of frameworks have sought to assist developers with the financial security to invest in power generation. It is important to stress that the following models are controlled by the UK Government. Selected of these interventions will be investigated in connection with tidal range projects in our second WP2 report.

##### *Renewables Obligation (RO)*

The scheme was introduced to encourage renewable technologies into the market, and to reduce the cost of capital for developers. The RO places an obligation on electricity suppliers to present to the regulator (OFGEM) a given number of Renewables Obligation Certificates (ROCs) per megawatt hour (MWh) of electricity supplied during each specified obligation period. Suppliers can purchase ROCs which were issued to operators of renewable generating stations. Renewables generators can trade ROCs with other parties or sell them directly to an electricity supplier. While the RO closed to new applicants in 2017, qualifying generating stations continue to be supported until their accreditation expires.<sup>55</sup> The first to be accredited will retire from the scheme in 2027 and the whole scheme will close in 2037. This has been effectively replaced by CfD (see below).

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<sup>54</sup> North Wales Hydro-Electric Power Bill [https://hansard.parliament.uk/commons/1952-04-01/debates/f36dba2d-9f97-4193-a053-9f93993662cb/NorthWalesHydro-ElectricPowerBill\(ByOrder\)](https://hansard.parliament.uk/commons/1952-04-01/debates/f36dba2d-9f97-4193-a053-9f93993662cb/NorthWalesHydro-ElectricPowerBill(ByOrder))

<sup>55</sup> Renewables Obligation (UK Government 2023)

<https://assets.publishing.service.gov.uk/media/64c615a47aea5b00126a8e73/renewables-obligation-fixed-price-certificates-cfe.pdf>

### *Feed-in tariffs (FIT)*

This model was designed to pay renewable energy generators who provide excess energy to the grid. This closed to new applicants in 2019. As of 30 September 2024, there were 869,881 accredited installations across the UK with a total capacity of 6,492 MW.<sup>56</sup> Of this total, solar PV provides the majority (close to 80%) followed by wind (12%), anaerobic digestion (5%) and hydro (4%). Wales has an estimated 6.5% of the total number of installations (c. total of 56,542). Some providers are very small - such as individual households - and therefore are not listed in the earlier Figure 4-1 and Figure 4-2.

The FIT is funded by adding a small charge to all consumer bills and collected by all providers. Although the FIT ceased to grant new awards in 2019, it lasts 10 to 25 years and could still be paying energy generators for another two decades.

### *Capacity Market*

Capacity Market is designed to ensure security of electricity supply by providing a payment for reliable sources of capacity, alongside their electricity revenues, to ensure they deliver energy when needed.<sup>57</sup> The UK Government is reconsidering the model through the Electricity Market Reform package to encourage the investment to provide backup for more intermittent and inflexible low carbon generation sources.<sup>58</sup> A Welsh example is the rapid response 299MW gas power station being developed in Hirwaun. In 2021 Drax in England reached agreement to cover three such powers stations across the UK at a price of £18/kW<sup>(2)</sup>. These contracts are worth around £230 million in that period October 2024 to September 2039.<sup>59</sup>

### *Contracts for Difference (CfD)*

The CfD scheme is the UK Government's main mechanism for supporting low carbon electricity generation. CfD incentives do not directly work to support the initial upfront capital costs of renewables, instead giving investors in renewable energy some clarity on electricity price once schemes are commissioned. They can also protect consumers from paying increased support costs when electricity prices are high.

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<sup>56</sup> Feed-in Tariffs (FIT) Quarterly Report - Issue 57 <https://www.ofgem.gov.uk/publications/feed-tariffs-fit-quarterly-report-issue-57>

<sup>57</sup> Capacity market <https://www.gov.uk/government/collections/electricity-market-reform-capacity-market>

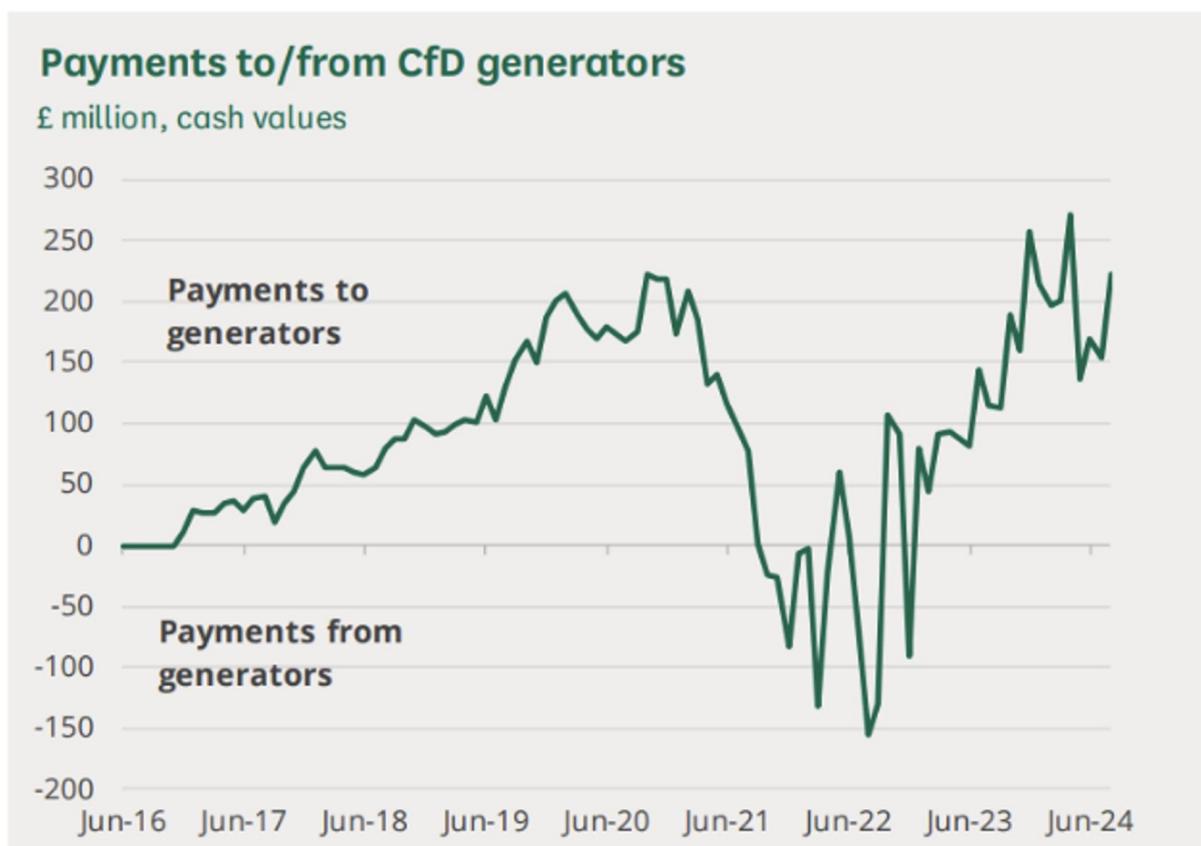
<sup>58</sup> Capacity Market <https://www.gov.uk/government/collections/electricity-market-reform-capacity-market#setting-capacity-market-parameters>

<sup>59</sup> Drax Energy T-4 auction – provisional results for new build system support assets <https://www.drax.com/investors/capacity-market-agreements/>

Renewable generators that meet the eligibility requirements (and it is important to note that there can be significant costs involved in proving eligibility requirements) submit a 'sealed bid'. The strike price mechanism covers the difference between the price of production and the market price. To date there have been 6 auctions, or allocation rounds (AR1-6). This has seen a range of different renewable technologies competing directly against each other for a contract.

In theory the strike price should come down as technologies mature and costs reduce. For example, the strike price (held at 2012 prices) for offshore wind halved between AR1 and AR6 – from £120MWh to £60MWh. Of note, no bids were made for offshore wind in AR5 (September 2023) as the strike price was not deemed sufficient. As the strike price is related to wholesale prices, there are times when energy generators will be making a profit. As such, there are times when they pay back into the fund (see Figure 4-3). It is noted that CfD does not always provide an opportunity for generators to make a great amount of profit.

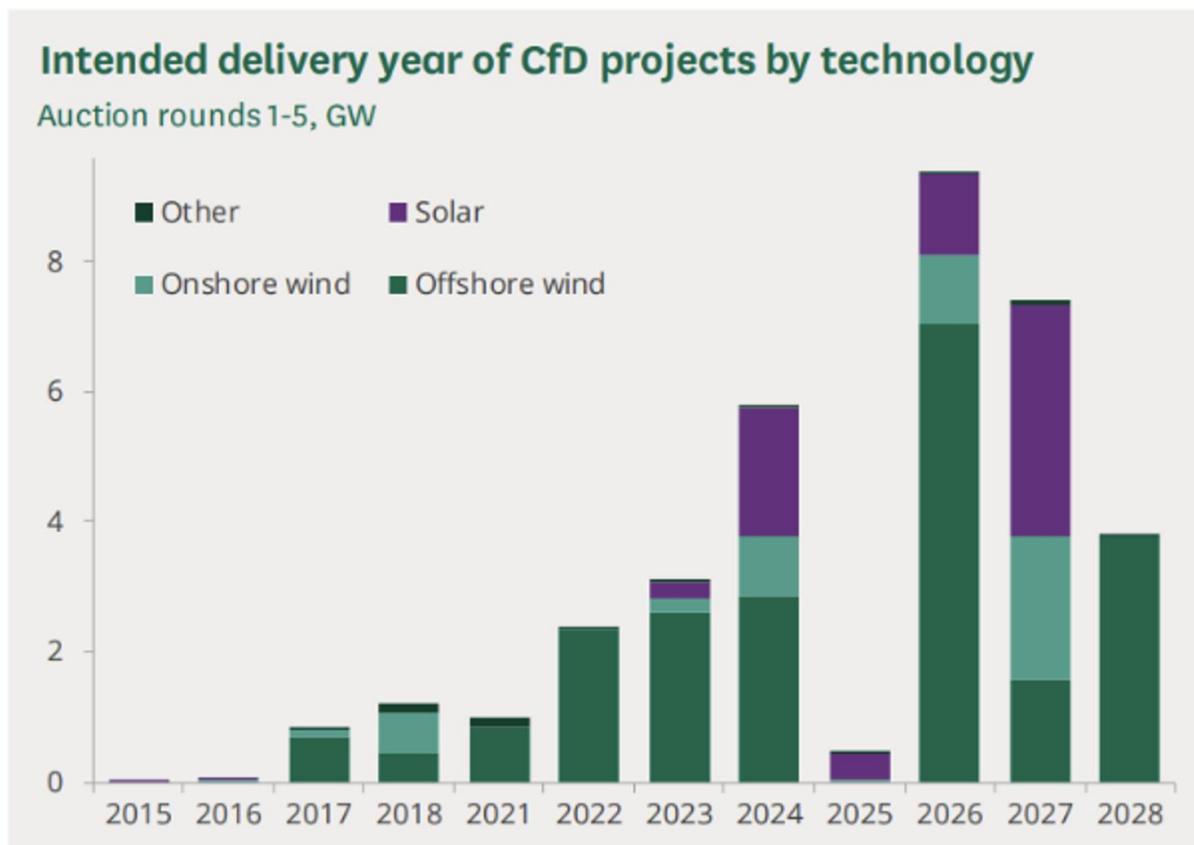
**Figure 4-3 Payments to and from energy generators**



Source: House of Commons Library (2024) derived from [LCCC](#)

There have been changes in the types of power generation technologies which have bid for CfD. Note there had been a de facto ban on significant onshore wind in England until 2024.

**Figure 4-4 Delivery of CfD energy schemes 2015 - 2028**



Source: House of Commons Library (2024) derived from LCCC

### *Regulated Asset Base (RAB)*

Under RAB a developer receives a licence from an economic regulator to charge a regulated price to consumers in exchange for providing the infrastructure in question. Examples used to date include Heathrow Terminal 5 and the Thames Tideway Tunnel in the water industry.<sup>60</sup> The latter case is a vital piece of public infrastructure.

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<sup>60</sup> Innovative financing and operational handover: Thames Tideway nears go-live  
<https://www.apm.org.uk/blog/innovative-financing-and-operational-handover-thames-tideway-nears-go-live/>

Looking to the energy sector, and nuclear specifically, the model enables investors to share some of the project's construction and operating risks with consumers, significantly lowering the cost of capital to construct. This involves some risk-sharing between investors and consumers, while also maintaining the incentive on the private sector to minimise the risk of cost and schedule overruns. Ultimately this should make projects more deliverable as it lowers the cost of capital.<sup>61</sup>

The Nuclear Energy (Financing) Act 2022 introduced the option of a RAB model to help fund future nuclear energy projects. In 2023 the UK Government consulted on whether Sizewell C - a proposed nuclear power station in Suffolk, England - could collect revenues through RAB.<sup>62</sup> The general incentives and penalties to drive the efficient construction, commissioning and operation of the planned plant in Suffolk. Effectively these are cases of the state agreeing that an operator can raise money against the value of a regulated asset.

Clear from the brief review above is that the majority of support mechanisms leave considerable risk with the developer in the case of the more untested technologies. Figure 4-5 provides a summary and then with the final column showing some of the general themes from academic research on the various mechanisms.

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<sup>61</sup> Future funding for nuclear plants: An explanation of the Regulated Asset Base (RAB) model option  
<https://www.gov.uk/government/news/future-funding-for-nuclear-plants>

<sup>62</sup> Modifications to the Sizewell C Regulated Asset Base licence  
<https://www.gov.uk/government/consultations/modifications-to-the-sizewell-c-regulated-asset-base-licence>

**Figure 4-5 – Overview of support mechanisms**

Scheme	Open	Revenue post construction	Upfront capital	Length yrs	Last payment	Funded by	Research themes
RO	No	Strike price	N	10-20	2027	Consumer	Strong debates over ROCs versus FITs in terms of financial returns to investors
CFD	Yes	Strike price	N	12-15	?	Consumer	Well established and understood, some consumer protection; risk held by developers; some projects under AR5 round have not proceeded because of the model
FIT	No	Fixed rate	N	10-25	2024	Consumer	Encouraged new technology – particularly solar; some diversification of supply away from large power stations; high administration costs and questions over value for money
Capacity market	Yes	Fixed rate	N	1 or 4	?	Consumer	Some stability for investors as based on available of installed capacity as opposed to current prices. Lack of flexibility for regulator; relatively expensive
RAB	NA	Ongoing	Y	?	?	Asset users	More certainty to investors, easier securitisation; problems establishing the asset base; moral hazard issues ex post contract

Some of the problems in terms of large scale power generation projects are well exemplified in the case of Sizewell C. At the time of writing in November 2024, there has been considerable unease from developers (in this case EDF) about the risks of proceeding with the project (with costs of up to £30bn forecast) without an explicit equity share by the UK state. In the case of Sizewell there has already been UK Government funding to support the project in getting to a final consent. However, Sizewell C remains an excellent case study of both the funding and regulatory problems associated with developing much needed UK infrastructure and then how one protects the consumer and the developer over an expectation of project cost overruns.

## 4.5 Financing and funding model

The financing and funding model will likely depend on the technology, how mature the technology, the scale of the investment, and then with funding model also intertwined with the nature of state intervention to support projects. So, for example, with individual landowners who wish to finance a renewable electricity generation project (perhaps onshore wind or small hydro) they might have the capacity to self-finance the project (rare) or lease the site once the project is developed if they do not wish to manage it themselves, or use external financing from the banks or private investors.

For large scale renewable electricity projects the typical issue is uncertainty through the consenting and planning process; then in some cases with newer technologies uncertainty in the costs of construction (particularly where construction requires imported high value components that could be associated with tariffs, and where there is a limited local skills and supply side to support development).

Then financing and funding model are expected to be affected by the following:

- The total duration of the project through pre-development, construction, operations and decommissioning, and the proportion of total life cycle costs occurring in the different parts of the project life cycle.
- The nature of the renewable electricity technology concerned (in particular here whether it is mature or not).
- Whether the price of the electricity generated is subject to price supports (i.e. CfD) and then at what stage investors start to earn a return on their investment (i.e. once electricity is generated or perhaps much earlier in the development process, perhaps under a particular regulated asset base model). [Many CfD projects are completed approximately three years after they have been awarded a contract. One exception in the Hinkley Point C, which was awarded a 35-year CfD contract in 2013, but is still under construction.]
- The nature of the developer i.e. private, public or private/public, and with the ownership having connections with the expected costs of capital. Also relevant here is whether the developer/owner of the project is also the landowner.
- The nature of the supply side for finance including how far regulatory frameworks permit foreign ownership, and whether the supply of finance is actually there.
- The expected levels of debt and equity funding used in developing the project.

- The ease and extent to which renewable electricity generation projects can have their ownership transferred easily at different parts of the project process with low transactions costs and low regulatory hurdles.
- The nature of non-financial returns from investment. For example, in some recent infrastructure investment in Wales (A465 Head of the Valleys road) a mutual investment model has been used which allows Welsh Government to link projects to specific local social outcomes. Moreover organisations such as the Development Bank of Wales have a decarbonisation remit. In this respect some finance providers may caveat loan conditions in terms of selected social, environmental and perhaps ownership outcomes.

In the case of Wales the main patterns appear to be:

- Developer is not necessarily the landowner such that royalties are payable to the landowner or Crown Estate, or Welsh Government if the project is on the Welsh Government Woodland estate.
- Developer is a large utility which takes the project through development, construction and operation, and will fund through retained earnings or through a mixture of equity and loan finance. This may or may not include an offer to local communities/private investors to take a stake in the project.
- Developer is another private sector organisation that will take a project through to initial consents using bank finance before selling the project on to a large utility.
- Developer is a cooperative organisation which leases land and then funds projects with a combination of community share and commercial loans (for example, Awel Coop, Mynydd y Gwrhyd, near Ammanford).

To date there has been limited (UK at least) public sector involvement in the development process although we note from earlier in this section that several large overseas owned utilities that are invested in Welsh renewable electricity generation are state owned in full or in part. This could change with the Trydan Gwyrdd Cymru now set to promote and develop projects with the utility companies and others, and push projects towards initial development consents.

Then the future for Wales might see more activity in terms of specific project finance and with greater levels of public-private sector cooperation in financing notwithstanding limits in how far Welsh Government might be able to hold energy generation assets on its balance sheet. The typical business model here would then embrace the greater use of special purpose vehicles (SPVs) in pushing forward renewable energy projects (i.e. a discrete company is used to develop and perhaps operate the project). This has several advantages:

- SPV can be very useful in more risky renewable projects because a utility and/or developer can share risks, but these risks are enclosed in the SPV and with more limited effects on the businesses main shareholders.
- SPV can be a means of transferring the developed electricity generation assets to other parties later on i.e. securitisation.
- Critically the SPV can include 'indirect' involvement from the public sector, thereby 'protecting' the state and allowing the public authority to have an 'arms-length' delivery function to promote new renewables capacity.
- SPVs may allow the state to use private finance to develop and operate a project while also holding a stake in the project; and with the state later paying out a fee to the those operating the asset.
- SPV leads on developing the various finance sources; very often this might be in terms of loans/debt as opposed to equity, and this could make projects cheaper because debt have a lower cost of finance than equity.

## **5 Conclusion**

### **5.1 Introduction**

In this final section we seek to draw some of the threads together from this WP1 report. Recall that the focus of our Tidal Lagoon Challenge project is to examine in the case of future potential tidal range projects how the interplay of ownership, regulation and financial/business model connects through to economic outcomes for the Welsh economy. In order to do this, the first report here needed to consider the current/historical situation in Wales in respect of these themes as they apply to both fossil fuel and renewable electricity generation. We then expect that the current ownership/regulation/financing paradigm around electricity generation speaks to the current economic benefits profile for Wales.

In what follows we briefly rehearse the overarching economic needs of the Welsh economy; then we summarise the ownership/regulation/financing themes considered in this report and seek to connect these to meeting the economic needs of Wales.

### **5.2 Welsh economy – mind the gap**

At the outset one must be mindful that a critical objective of renewable electricity generation is to reduce harmful carbon emissions. Economic returns to areas adjacent to power generation facilities then might be viewed as tangential in debates around climate change. However, the ways in which technology changes affect local economic prospects are very relevant for Wales where there has been a long history of resource extraction, environmental damage and socio-economic disadvantage.

Debates in Wales have focused in the last three decades on how we might understand and measure changes in economic welfare and with different measures having strengths and weaknesses. While measures based on conventional national income accounts (Gross Domestic Product and Gross Value Added) are criticized for what they omit in terms of factors that could affect future generations, these measures are still a useful means of understanding the recent performance of the Welsh economy.

Figure 5-1 picks up on the overarching problem. On many measures of productivity Wales and local authority areas within Wales fare poorly compared to the UK average. Figure 5-1 reveals persistence in the productivity gap in terms of GVA per hour worked (which is also broadly replicated in measures such as GVA per head of the population) and with Welsh productivity persistently around 17%-18% below the UK average, and with variation around this average in some local authority areas.

**Figure 5-1 Current Price (smoothed) GVA (B) per hour worked indices; subregions, 2004 – 2022**

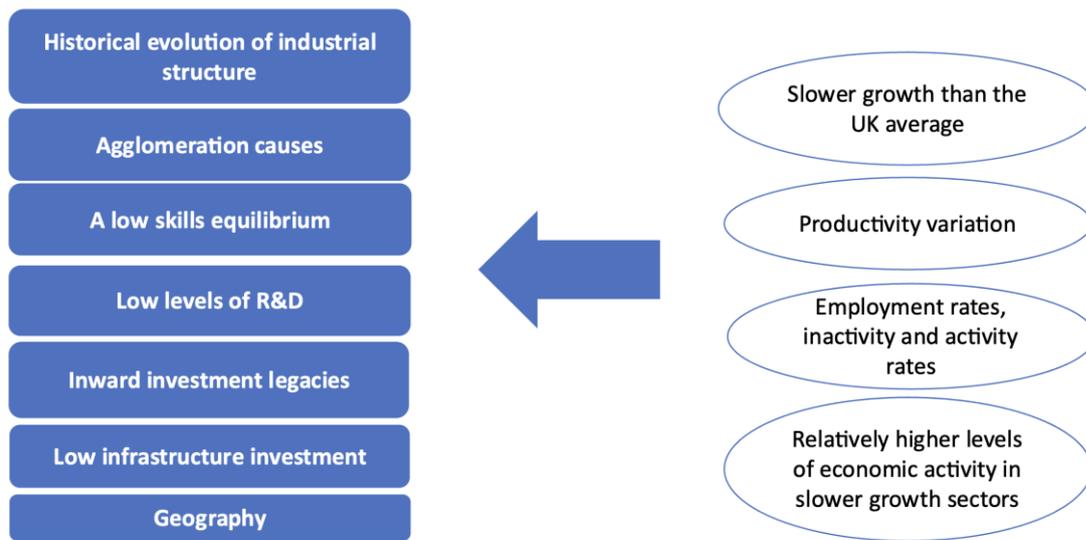
Region_name	Index_2004	Index_2008	Index_2012	Index_2016	Index_2020	Index_2021	Index_2022
Wales	83.3	82.0	84.0	82.9	83.5	83.0	82.6
Isle of Anglesey	87.0	75.6	74.3	73.6	78.4	79.4	79.7
Gwynedd	80.4	78.0	71.1	67.5	69.5	69.6	69.3
Conwy and Denbighshire	73.8	69.8	69.5	68.9	70.6	71.1	71.1
South West Wales	79.7	72.5	71.4	73.3	75.5	75.3	75.2
Central Valleys	79.5	83.3	91.5	93.0	86.7	84.3	82.7
Gwent Valleys	82.5	77.6	81.2	81.6	81.9	80.7	79.9
Bridgend and Neath Port Talbot	87.7	85.8	86.8	85.2	86.8	85.8	85.0
Swansea	82.9	86.6	88.0	83.8	84.0	82.9	82.0
Monmouthshire and Newport	85.2	84.0	86.8	85.7	86.8	87.0	87.1
Cardiff and Vale of Glamorgan	90.0	93.0	96.2	94.0	92.5	91.4	90.5
Flintshire and Wrexham	88.9	88.3	95.3	92.9	93.2	94.2	95.1
Powys	65.7	61.1	58.7	58.3	61.9	62.7	63.1



Source: Productivity figures from ONS

There is a concern when we look at different parts of Wales that the less productive areas are getting less productive and some parts of East Wales more resilient on this measure. Explanations for the gap and its persistence are wide ranging. Figure 5-2 picks up on some of the factors that have been cited in the regional economic literature; not least here picking up on issues of comparative industrial structure, skills, R&D spending, and inward investment legacies.

**Figure 5-2 Explaining the Wales-UK Productivity Gap**



The next question then is how does the electricity generation sector fit with this debate. First, over the last 30 years power station development (at all scales) has represented an important source of inward investment into Wales. While there tends to be interest in inward investments in manufacturing that bring large amounts of explicit jobs, this should not take away from the significance of power station development which can support high levels of well-paid employment during the construction and development phase. At another level new technologies employed in electricity generation could provide for higher levels of local R&D funding and the development of new high productivity industrial structures. For example, the development of onshore wind capacity in the UK was tightly connected to the growth of new industrial complexes producing components, but sadly not in Wales. At yet another level the availability of electricity produced from reliable and renewable sources can lead to other businesses locating in a region. At the same time inward investment in power generation continues a strong trend in the external ownership of productive resources in Wales, and with financial returns directed outside of the immediate region.

The broad issue then is that changes in the ownership/regulation and financing paradigm around electricity generation could have subtle impacts of regional economic development prospects, and with these investigated more fully in the third work package of our research programme in respect of potential tidal range schemes.

### 5.3 Current ownership/regulation and financing themes

Figure 5-3 summarises the main themes identified in WP1 relating to ownership, financing and regulation. To reiterate it is expected that changes in the factors underpinning each of the themes could have implications for returns to the Welsh economy.

The next phase of our research will examine how these identified themes link through to future potential tidal range schemes, and in particular whether current regulatory instruments and financial models are relevant for large scale tidal range projects which serve to exemplify many of the problems in terms of projects with extremely high upfront capital costs.

**Figure 5-3 Key themes from WP1**

<b>Ownership themes</b>	<b>Regulation/intervention themes</b>	<b>Financing themes</b>
Land ownership (forest estate) Developers may lease sites from private individuals and the state	Overarching subsidy regime UK centralised	Supply side for project finance is national and international
Largely exogenous investment. Capital in Welsh renewable electricity generation largely externally owned and controlled	CfD framework AR5 (8 <sup>th</sup> September 2023) reveals just six Welsh projects successful and 3 fairly small scale/exploratory tidal stream. Just 7 Welsh projects in AR6 (3 <sup>rd</sup> September 2024)	Development Bank of Wales provides finance to support higher levels of local ownership. Trydan providing scope to move more projects to consent and scope for greater public financial support in development stages.
Recent history reveals in wind renewables returns to capital not labour	Wales perceived as a 'difficult' and 'uncompetitive' location to develop onshore wind/solar PV due to planning hurdles, track record on hold-up, well publicised debates on grid	Cases of mutual investment model (MIM) in Wales for road and school/hospital infrastructure but not yet linked through to energy infrastructure
Limited scope for community ownership in large-scale power generation projects	Reputational spillovers from publicly funded infrastructure projects and delays in final decisions (M4 relief)	Limited scope/mechanisms for local residents to buy into schemes apart from equity purchase in largest developers.
Community-owned renewables 'ownership' can be nationally diverse	CfD framework issues in terms of tidal lagoons and nuclear given high upfront life cycle costs	Different costs of capital applicable at different stages of typical project life cycle; risk profile of projects
Local economy dependent on renewable technologies developed elsewhere	Difficult to flex centralised regulatory regimes to encourage innovative ownership models	Projects with development consents have few problems finding capital
Supply side in terms of high value components externally owned and controlled	Difficulties setting strike prices with newer technologies, and estimating LCOE	Emerging interest in role of Welsh 'based' pension funds in project finance
Community benefit schemes tied to major renewables infrequently used to purchase shares in developers/operators	Variation in role of Crown Estate in Scotland and Wales	Regulated asset base approaches that might cover off developmental costs and give a different time profile of financial returns
Some foreign states heavily invested in Welsh energy generation infrastructure, but constraints on how far Welsh Government or Local Authorities can directly (or indirectly) invest. (COIs)		
Ease of ownership transfer of schemes at different life cycle stages.		
Selected locally controlled suppliers to the electricity generation sector have evolved to become developers in their own right		

Immediately clear from Figure 5-3 is that there are connections between themes. For example, themes in respect of capital ownership link closely with themes in respect of finance. This is all in terms of a current position i.e. our review suggests that it is these themes that have contributed to the economic development pathways around renewable electricity generation in Wales and its current impacts on the residents and businesses of Wales. Future progress in Wales (and other parts of the UK) towards larger scale tidal range projects is expected to relate to these same themes.

#### **5.4 Progression to WP 2**

The next phase of the research considers how the current ownership/regulatory/funding paradigm could affect the progression of tidal range schemes in particular. The themes thrown up in WP1 formed part of the questioning framework of our consulting programme (undertaken in October-November 2024) which also requested respondents' specific views on the role of tidal range projects in the future UK energy generation mix. The main findings from the consultation will be examined in the WP2 report.