Applicant Name: Sheila Harty

Contact Details:
Email: ***sheila.harty@ucdconnect.ie***

Phone Number: 00353 83 8314753

Address: The Energy Institute, O'Brien Science Building, University College Dublin (UCD), Stillorgan Road, Belfield, Dublin 4, Ireland.

Webpage: ***Sheila Harty | UCD Smurfit School***

Thesis Title: Optimal Financing of Offshore Windfarms

Date of Anticipated Completion of PhD Research: December 2026

University: University College Dublin (UCD)

Supervisor: Cormac MacFhionnlaoich

Contact Details:
Email: ***cormac.macfhionnlaoich@ucd.ie***

Phone Number: 00353 1 716 8004

Address: University College Dublin, School of Business, Graduate School of Business Carysfort Avenue Blackrock Co. Dublin, Ireland.

Webpage: ***Cormac MacFhionnlaoich | About | University College Dublin***

Date: 04 August 2025

Dear Sir/Madam,

My name is Sheila Harty and I'm a 3rd year PhD candidate at University College Dublin. The title of my thesis "The Optimal Financing of Offshore Windfarms".

Thank you for the opportunity to apply for your PhD Student Workshop on Climate Finance. It feels like a very exciting opportunity, both to meet and share ideas with like-minded PhD candidates and to get expert feedback on my work to date and other insights from your panel of established researchers.

I am a Fellow of the Institute and Faculty of Actuaries and have spent many years working in life insurance across a broad range of functions in Ireland and the UK. Having always had concern for climate change and the natural world I felt motivated by the school strikes and a call to action from Europe to use my financial modelling skills to support the fight against climate change. This has led me to the PhD I am pursuing today.

The paper I am submitting for your review is titled: "Does the Offshore Renewable Energy Support Scheme (ORESS1) meet Ireland's commitment to a Just Transition?" which I wrote under the guidance of my then supervisor, Professor Julie Byrne (who has since moved from UCD to Dublin City University). It has not yet been submitted to any journal (or elsewhere) for publication.

This paper reflects my interests in offshore wind as one of Ireland's key tools for combatting climate change and in social justice and equity.

Since completing this (draft) paper I have been examining the application of a real options framework to assess the economic feasibility of offshore windfarms in Ireland. This involves assessing the feasibility of a fixed bottom windfarm under a number of scenarios, including under ORESS1, a range of grid capacity scenarios when surplus energy is not purchased by The State, when inflation protection of capital costs is not provided and without any state support.

In terms of future research, I hope to consider floating offshore windfarms. This is due to the fact that Ireland has a significant wind resource based off its north-west coast. The seabed in this region is particularly deep, therefore requiring the development of floating offshore wind to take advantage of this resource. To date, the Irish government has yet to invest in supporting floating windfarm development. My future research therefore aims to apply a real options framework to assess the economic feasibility of floating offshore windfarms in Ireland with and without state support.

Thank you again for spreading the news about your workshop and giving me the opportunity to apply. I am sure the competition for places will be high and wish you the best of luck with your deliberations. I appreciate your taking the time to read and consider my application, thank you. May I also say "Well Done" for undertaking this initiative. It feels both hopeful and exciting that this support is being provided to young researchers in our field at this time.

Yours sincerely,

S.Harty

Sheila Harty

Curriculum Vitae

Sheila Harty

Thesis Title: Optimal Financing of Offshore Windfarms

Institute: University College Dublin

Profile

I am a Fellow of the Institute and Faculty of Actuaries in the UK and have spent many years working in life insurance across a broad range of functions in Ireland and the UK. Through my PhD I am working towards building on these skills for the purpose of playing a part in supporting the global effort to tackle climate change.

Having always had concern for climate change and the natural world I felt motivated by the school strikes and a call to action from Europe for people with financial modelling skills to get involved in climate finance. This led me to completing the short course in Sustainable Finance and Masters in Renewable Energy and Environmental Finance, which subsequently led me to my PhD.

EDUCATION AND QUALIFICATIONS:

Year	Education
2023 – Present	PhD Candidate at University College Dublin: Optimal Financing of Offshore Windfarms
2021-2022	MSc in Renewable Energy and Environmental Finance at University College Dublin
2021	Sustainable Finance Short Course with Cambridge Institute for Sustainable Leadership
2010	Fellow of Institute and Faculty of Actuaries

PhD Activities to Date:

As part of my PhD programme, I have completed a number of modules:

- Strategic Finance
- Machine Learning for Finance
- Research Design & Measurement
- Entrepreneurship
- Approaches and Methods in Qualitative Research
- I have also audited an Introduction to Programming module.

Other PhD activities include:

Attendance at Model UNFCC in Cologne - May 2023. As part of the successful SATLE funding bid UCD hosted a module for the Model UNFCC in 2024. I was invited to observe the program in Cologne and have supported its development in Dublin.

I also took part in the week-long workshop in UCD given by Professor Sarosh Kuruvilla: PhD Workshop on Research Quality & Productivity. This provided an introduction to qualitative research, research quality and publishing standards, what is impactful research, writing research papers and using feedback productively.

I have presented my paper at the Irish Academy of Finance conference in May 2025.

I'm treasurer of the Sandymount Sustainable Energy Community Committee.

I have participated in a number of workshops and events aimed at making science and research (including climate solutions) more exciting and accessible for school students.

EMPLOYMENT HISTORY:

September 2020 to December 2022 Reassure and Phoenix Life (Department transfer from L&G)

I have successfully lead the ReAssure Operational Risk Companywide process and quarterly oversight work and managed the process of EUC quality alignment with Phoenix standards

Sep 2016 to September 2020 Legal & General (L&G), Hove

April 2020 to September 2020 Head of With Profits Actuarial Operations

- Managed a team of 7
- Turned the team from having significantly poor morale (as demonstrated in staff surveys) to feeling confident, happy and engaged.
- Collaborated remotely across functions to deliver the highest quality results within agreed timelines and ensuring the best experience for all involved.

Sep 2016 to March 2020 With-Profits Reporting & Projects Actuary

- As part of the With-Profits Reporting team I had a number of responsibilities including
- Managing the team delivering the bonus rates process for the whole book.
- Delivering various modelling projects – including re-evaluation of the fund's operational risk capital requirement and oversight and communication of changes to Prophet models under tight deadlines to support the Part VII transfer of the L&G With Profits business
- Delivering and presenting reports to the boards; With-Profits Committee, With-Profits Management Committee and Technical Review Committee

Dec 2015 to Mar 2016 Vitality Health, Bournemouth Solvency II Actuary (Fixed-Term Contract)

Sep 2014 to Aug 2015 KPMG, Dublin Life Consultant

Aug 2013 to Sep 2014 SCOR Global Life, Dublin Prophet Modelling Actuary (Fixed-Term Contract)

Jan 2013 to July 2013 Travel

Oct 2012 to Jan 2013 Generali Pan Europe, Dublin

2006 to Sep 2012 Prudential International Assurance, Dublin

2010 to Sep 2012 Pricing and Product Development Actuary

2006 to 2010 Trainee Actuary in With-Profits Reporting Team

Volunteering and Leisure Interests:

- Psychotherapy – In my spare time I have been training as a Gestalt psychotherapist with Metanoia Institute in London. As part of this programme, I provide 1 to 1 therapy on a voluntary basis to a number of regular clients each week. I have recently completed the 3rd year of a 5-year programme and am taking time out from the training this coming year.
- Dog walking, reading, knitting, Netflix, gym and sometimes yoga to unwind
- Travelling including South America where I spent time volunteering at a wild animal rehabilitation centre in Peru and migrant centre in Mexico.
- I volunteered as Board Secretary for 1 year prior to the pandemic with an organisation providing healthcare support via UK based specialist doctors to remote healthcare clinics in Zambia and Malawi called Virtual Doctors
- Sailing – I sailed regularly with a team of 9 while living in the UK and also as a child and have completed a number of training programmes up to and including Yachtmaster Coastal level.
- Irish Taekwondo National champion in power, sparring and patterns on numerous occasions and placed third in European competition

Does the Offshore Renewable Energy Support Scheme (ORESS1) meet Ireland's commitment to a Just Transition?

Sheila Harty (*University College Dublin*) & Professor Julie Byrne (*Dublin City University*)

Abstract

Offshore wind is a crucial renewable energy to enable Ireland to meet her climate commitments as set out in CAP23 and the Climate Action and Low Carbon Development (Amendment) Act 2021. Appropriate government policies are critical for supporting the private investment needed to materialise this goal. However, there is a risk that these policies might not support the advancement of our parallel commitments to a Just Transition and the alleviate energy poverty and may even impede them. Employing a DCF model, this paper compares the financial costs and benefits of operating Codling Wind Park (CWP) with the financial benefits of the associated community benefit fund (CBF). It then considers the financial benefits of a hypothetical community share scheme (CSS). The paper finds that CWP will be profitably under a range of scenarios when either a CBF or a CSS is in place. Under the base case scenario, the developer is over €900m worse off where a CSS is in place with the majority of that benefit (and additional risk) being passed onto the community. It also finds that the profitability of the windfarm is particularly sensitive to the assumed capacity factor (a €2.4bn difference between 45% and 54.51%), the average of which is rapidly advancing with turbine technology advancements.

Introduction

Ireland has committed to significant reductions in CO2 emissions (ref). An important step in achieving this is the harnessing of Ireland's offshore wind energy potential. This will require major capital investment. This capital will be derived from both the public and private sectors. State policy supports are a necessity in leveraging the private capital available. Given the scale of Ireland's energy transition and the potential for unequal impacts across society, the government of Ireland has also committed to making it a "Just Transition" including doing no significant harm to any community. The Irish government has also committed to alleviating energy poverty during this time.

In this paper we explore whether the benefit sharing operationalised by the government of Ireland in its Offshore Renewable Energy Support Scheme (ORESS1) is the most effective and efficient method of benefit sharing available and whether it is consistent with our commitments to a Just Transition and to tackling energy poverty. We assess the financial feasibility of an example Offshore Wind Farm (OWF) and examine whether the community benefit fund (CBF) associated with the project meets Ireland's commitments as expected. Using a discounted cash flow approach, we find that with the support of ORESS1, the project is profitable to developers over a wide range of scenarios. We find that the CBF approach favours the developer when compared to an alternative hypothetical scenario of a community share scheme (CSS) where the cumulative value of a 20% stake is over €900m higher than the current CBF. We also argue that a "one size fits all" communities approach to ORESS1 could have the effect of widening existing inequalities, particularly in cases where the recipients of the CBF are wealthier communities.

We therefore argue that more consideration should be given to the socio-economic conditions of the beneficiaries of OWF community benefits. We suggest that the approach should be tailored so that CBFs can be offered to communities where there is a real need for additional support for essential services and infrastructure, rather than to all communities regardless of socio-economic status. We also suggest that where communities are willing and able to bear the upfront cost and additional risk of a CSS then 20% of the OWFs shares should be offered to the local community for purchase. This approach is more aligned with the just transition principle than the existing one.

The remainder of the paper proceeds as follows: in section 2 we explore the motivation and related literature, Codling Wind Park is introduced in section, while the results are presented in section 4. The community benefit fund, energy poverty, and the just transition are discussed in section 5, and section 6 presents concluding remarks.

Motivation and related literature

Ireland's Climate Ambitions

Ireland's Climate Action Plan (CAP23) sets a target of achieving a 51% reduction in greenhouse gas emissions relative to 2018 by 2030, and to achieve net-zero emissions no later than 2050. This is in keeping with the legally binding objectives set out in the Climate Action and Low Carbon Development (Amendment) Act 2021 and aligns with the requirements set out by the Paris Agreement.

The transition from a fossil-fuel-based energy system to one based on renewable energy is fundamental to Ireland's journey to a climate neutral society and economy. A key objective of CAP23 is that 80% of all electricity be generated from renewable sources by 2030. Ireland has set a target of generating 9 GW of energy from onshore wind and at least 5 GW of offshore wind. It is further proposed that an additional 2 GW of offshore wind will be developed during this period for the purpose of green hydrogen production (National Hydrogen Strategy). A longer-term objective in Ireland's "Programme for Government – Our Shared Future" is to harness the vast potential of offshore wind energy along the Atlantic Coast, enabling Ireland to play a significant role in contributing to a pan-European renewable energy generation and transmission network. The cost of these developments is significant and will require large-scale private investment alongside Exchequer expenditure.

With Ireland's renewable energy landscape previously composed primarily of onshore wind, recent policy changes have successfully attracted offshore wind and utility scale solar, which had been unfeasible in the absence of policy support (Assereto and Byrne, 2021). The primary policy tool to encourage private investment in offshore wind is the Offshore Renewable Electricity Support Scheme (ORESS), providing support to offshore wind farms in Ireland. With the intention to leverage private equity while simultaneously supporting sustainable development and a just transition for Irish citizens. Two core elements of the scheme are the cost-effective financial support from the state, and "significant community participation". In the first offshore wind auction, four projects with a combined capacity of almost 3,100 MW were selected, one of which is the Codling Wind Park (CWP) located off the east coast of Ireland.

The Just Transition

Central to both the EU Taxonomy and Ireland's Climate Action Plan (2023) is the principle that the shift to a low-carbon society must be a just one. A just transition aims to rectify inequities caused by the transition to a low carbon economy by ensuring that low-income and minority communities are not further harmed (Bullard, 2007), and should be considered as not only a policy of fairness but also an opportunity to transform economies to sustainable and equitable futures (Sweeney and O'Neill, 2009). To ensure a just transition to net zero, the "do no significant harm" (DNSH) criteria is outlined in the

EU Taxonomy, the premise being that any measures taken to mitigate or adapt to climate change must also consider and address any adverse effects these actions might have on individuals or specific groups within society. Consistent with this DNSH principle, CAP23 intends that "no community, no sector and no person get left behind".

Energy Poverty

The European Pillar of Social Rights[1] and the UN Sustainable Development Goals adopted in 2015, recognize energy as one of the essential services that everyone has the right to access and notes that support must be provided to those who are in need to access these services. A household is energy poor, if / when that household is unable to achieve an adequate (i.e., comfortable and safe) standard of warmth, and supply of energy services at an affordable cost. (Energy Poverty in Ireland). Ireland's transition to a low carbon economy, carbon taxation, changing demographics, and ageing population may increase the vulnerability of "at risk" groups (ibid). The European Green Deal stresses that the transition must be fair and inclusive, putting people first and paying particular attention to supporting those regions, industries, workers, households, and consumers that will face the greatest challenges in that transition[2].

Community Benefits

The concept of benefit sharing and community benefits emerged in international environmental law as an example of the operationalisation of equity, with equity understood as a distribution of costs and benefits that satisfies participants' expectations (Morgera, 2014). It is recognised that while the benefits of offshore windfarms accrue nationally and even globally (reduced CO2 emissions, secure electricity source) (get ref) the disbenefits accrue locally. Furthermore, Ireland's existing transport and electricity infrastructure are essential for offshore windfarms to operate successfully. The principle of benefit sharing recognises that significant economic benefits will be derived by private entities in the production of energy….ref morgera …

Previous research has identified multiple potential disbenefits to communities from the establishment of an offshore windfarm in the area (Rudolph et al, 2017). These include concerns about impacts on fishing (Gray et al., 2005; MacKinson et al., 2006) and recreational activities (Firestone and Kempton, 2007; Haggett, 2010a) as well as bird populations and their flight paths (Haggett, 2008; OSPAR Commission, 2004) and the natural beauty and scenery of their area (De Groot and Bailey, 2016; Ellis et al., 2007; n, 2009; Rudolph, 2014).

---

[1] COMMISSION RECOMMENDATION (EU) 2023/2407

[2] COMMISSION RECOMMENDATION (EU) 2023/2407

Specific community benefits (like community benefit funds, electricity tariff reductions etc) are more relevant in regions where the wider benefits (including employment and local taxes) accruing as a result of windfarm developments are limited (Hassan et al,2005). While Denmark, with a population similar to Ireland employed 35,400 in the offshore wind industry in 2018, Ireland is estimated to create up to 5,000 jobs in offshore wind and related industries by 2030 (Powering Prosperity, Government of Ireland). A significant proportion of the capital investment in Ireland's OW industry is expected to go to other European nations that, unlike Ireland, have turbine manufacturing capacity.

Furthermore, a common perception is that community benefits will improve the social acceptability of windfarms (Cowell et al, 2011; Centre for Sustainable Energy & Hassan, G, 2005; Simon et al, 2019; Kerr et al, 2017; Dimitopoulos & Kotoleon, 2009; Liu et al, 2013; Nadai, 2007). However, evidence of this in Ireland is limited. In one study, the level of resistance Irish citizens have to a hypothetical onshore windfarm more than halved when community benefit payments were offered, with similar levels of reduction in resistance also found with other forms of community financial participation. (Hyland et al, 2018). A much higher level of support among Irish citizens for onshore windfarms was found during the operating phase than the planning phase (SEAI). Very strong rates of acceptance for offshore wind have been found among Irish citizens (Cronin et al., 2021) and Danish citizens (Upham and Johansen, 2020), with more reluctance illustrated when RES technologies are close to their places of residence (Bertsch et al., 2017). Although often subject to intense public and political debate, permanent residents have been found to be positive to planned near-shore windfarms suggesting silent support (Johansen, 2019), perhaps attributable to representation biases emphasising windfarm opposition in the wider debate (Johansen, 2021).

Despite this, community benefit schemes aimed at gaining public acceptance of renewable energy systems have been deployed across Europe. They are offered as an affordable strategy to enhance the likelihood of project approval (Kass et al, 2010; Kerr et al, 2017). They have been challenged as being compensation for impacts without any clear implication that they should change social attitudes including acceptance (Cowell et al, 2011), unlikely to lead to earlier planning success or increased public acceptance (Hassan, 2005, Knauf, 2022) and having no place in the success of the wind implantation process (Simón et al 2019).

It is critical to develop an in-depth understanding of how benefit sharing is diffusing particularly in the face of power asymmetries (Cowell et al,2011, Morgera, 2014) and that it may in practice be a 'disingenuous win-win rhetoric, 'a trojan horse of initial promises and later loss of control legitimised by narrative framings of the global public good': it may help avoid 'more fundamental negotiations over access which is the real justice requirement' (Martin et al 2014, 84) and exercises power through framing, by imposing a dominating knowledge approach on the less powerful. (Morgera, 2014). With public

resistance to offshore windfarms in Ireland documented to be quite low, it is questionable as to whether it should be a key policy concern at this time.

It is evident that the goal of the equitable distribution of the benefits of the energy transition to the people of Ireland, along with the principle of justice for its citizens, are key priorities in the State's plan. A public consultation held in 2017 on the design principles of the Renewable Electricity Support Scheme (RESS) revealed significant support from both the public and industry for community-driven proposals, including mandatory investment opportunities for those living closest to renewable energy projects. A proposed national citizens' investment scheme, the Renewable Electricity Participation Scheme (REPS), was included in the consultation for the first RESS auction (RESS-1) terms and conditions. The proposed REPS model allowed for citizens to invest but not 'own' a renewable electricity project. The investor would rely on project revenues to deliver his/her return. While support in principle for citizen investment was expressed by Community Enterprises, developers, the EU Commission and across Government, The Irish Department of the Environment, Climate Change and Communications (DCCAE) decided to withdraw the mandate for REPS on the grounds that it may unduly expose citizen investors to financial risks (Rialtas na hEireann, 2020, (a) & (b)). Instead, ORESS1 mandates that developers contribute €2 per MW/h to a community benefit fund for the 20-year period of the support scheme, the proceeds of which are to benefit the broader economic, environmental, social, and cultural well-being of the local community.

Community Share Schemes (CSS) where citizens are offered a chance to purchase shares in the wind farm provide an alternative to community benefit funds. It differs in that there is an upfront cost to the investors in return for part ownership of the project, as well as a claim on all future profits. In such schemes, citizens have been found to display a preference for co-owned renewable energy projects over fully developer-owned projects (Ek and Persson, 2014; Lienhoop, 2018). There is evidence that Irish citizens are willing to invest in local energy projects (Salm et al., 2016; Sirr et al., 2023), but they demonstrate a preference for investing small amounts (Curtin et al., 2019, Sirr et al., 2023). Income is also found to be a key factor of citizen investment (Johansen and Emborg, 2019), as is the level of educational attainment (Sirr et al., 2023). Compensation is expensive and therefore developers may seek to downplay this fact, thereby diminishing the reason the compensation might be effective in the first place (Baxamusa, 2008). While the payments of a community benefit fund is fixed, tying compensation to a profit share offers a structured, long-term approach to addressing the unequal distribution of profits. Sharing in the profits of renewable energy often provides significant economic benefits to local communities (Strachen et al., 2015; Kerr et al., 2017).

The Danish Promotion of Renewable Act 2008 mandates that all developers offer 20% of the wind farm project in shares to the local community. The Act provides that the first offer to purchase is made to citizens over the age of 18 who's permanent dwellings are

within 4.5km of the installation site. If those citizens do not purchase all the available shares, then they are offered to those within the local municipality but outside the 4.5km radius. Additionally, the developer must also compensate local citizens for any loss in the value of their property caused by the development.

The decision of the Irish government to withdraw the mandate for the Renewable Electricity Participation Scheme (REPS), citing issues such as the administrative burden for developers and the exposure of citizens to financial risks, means there is just one avenue remaining for community participation in ORESS1 – the community benefit fund.

The ORESS1 sets a requirement that every developer must contribute €2 per MWh of electricity generated by the windfarm to a community benefit fund (CBF) (ORESS1 T&Cs). The ownership of these CBFs is assigned directly to the local community. A dedicated independent fund administrator must be appointed and a CBF committee established to make decisions about how those funds will be allocated across the local community based on funding applications submitted by members of the community. The Sustainable Energy Authority of Ireland (SEAI) will oversee the operation of CBFs. In the first offshore wind auction, four projects with a combined capacity of almost 3,100 MW were selected. Each one is mandated to contribute €2 per MWh of electricity generated to a CBF. Based on a capacity factor of 45%, the expected contribution to each CBF is outlined in table 1

Table 1: Expected annual and total contribution to CBF from offshore windfarms under ORESS-1

Wind Farm	Estimated Annual CBF Contribution (€m)	Total Estimated Contribution (€m)
Codling Wind Park	10	200
North Irish Sea Array	3.9	78
Dublin Array	6.5	130
Sceirde Rocks	3.55	71

Given that offshore wind acceptance is already high in Ireland, its purpose must not be to improve public acceptance of offshore windfarms. If its sole purpose is to share the benefits of Ireland's offshore wind development with the citizens of Ireland in line with Ireland's commitment to a Just Transition, does it do that in the most effective, efficient and equitable way? Or is it a "disingenuous win-win rhetoric" which will result in a "loss of control.." of our national resources"... legitimised by narrative framings of the global public good." (Martin et al 2014, 84). Would a more equitable and efficient approach include a community share scheme like the REPs?

Approach

Methodology

To examine the financial equity of ORESS1 and its community participation requirements we consider a case study of one of the developments successful in securing this support, Codling Wind Park (CWP). We compare the community benefits, expected windfarm profitability, and a hypothetical community share scheme alternative that may be more aligned to a just transition. One of the key methods for assessing the financial viability of offshore wind projects is discounted cash flow (DCF) analysis (as used by (Prässler & Schaechtele, 2012; Ioannou et al, 2020; Malleret et al, 2024; Judge et al, 2019)), which evaluates the present value of expected future cash flows (Refs). DCF analysis considers factors such as capital costs, operational expenses, feed in tariff, electricity prices, and the long-term lifespan of offshore wind farms to estimate profitability. We implement a traditional discounted cashflow (DCF) model, whereby the cashflows are projected over the 30-year operational life of the OWF and then discounted to the commercial operation date (COD).

Each cashflow is projected over the 30-year operational life, the net annual cashflow is determined and then the Net Present Value (NPV) is calculated as:

$$NPV = \sum_{n=0}^{N} \frac{C_n}{(1+r)^n} \qquad (2)$$

Where r is the WACC; n is a given year, N is the total number of years of operation assumed i.e. 30, and C is the net cashflow in a specific year.

This allows us to examine the profitability of the windfarm under a range of different scenarios and sensitivities. DCF analysis is widely used to evaluate renewable energy projects, with its effectiveness dependent on accurately forecasting key parameters (Morthorst et al., 2011; Klessmann et al., 2013). It has been found to be a reliable method for evaluating renewable energy projects when complemented with sensitivity analysis to account for market and policy changes (Gonzalez et al., 2014), providing valuable insights into the financial performance of renewable energy projects as long as uncertainties related to energy market forecasts and technological developments are accounted for (Böhringer et al., 2015). DCF analysis is sensitive to discount rates chosen and cashflow assumptions (Hledik et al., 2008).

We have also determined the Internal Rate of Return (IRR) which is is the discount rate r which results in an NPV of 0. It is used to assess the profitability of projects, including windfarms (Prässler & Schaechtele, 2012; Ioannou et al, 2020; Malleret et al, 2024; Judge et al, 2019)

Case Study: Codling Wind Park (CWP)

Codling Wind Park (CWP) is a proposed offshore windfarm off the East Coast of Ireland accounting for just over one quarter of Ireland's 2030 target for grid connected offshore energy, with the expectation that over its operational lifetime it will displace over 1.7m tonnes of carbon. It is one of the first 4 offshore windfarms successful in securing state support in Ireland's ORESS1 auction. It is expected to cover a total area of $125km^2$ from the coast of Wicklow in the South to Dublin in the North (Codling Wind Park – EDF Renewables) with turbines at distances of between 13km and 22km from the shoreline. The total expected capacity of the windfarm is 1,300 MW, which is expected to be sufficient electricity to power up to 1 million homes in Ireland. It is anticipated that there will be no more than 75 turbines and no fewer than 60 turbines in the array. The construction phase of the project is likely to create up to 1000 jobs, while there are expected to be 75 permanent jobs created for the purpose of operations and maintenance of the windfarm (Codling Wind Park).

Assumptions

In order to conduct discounted cashflow analysis, we need to estimate a number of parameters. The assumptions used and their sources for the cashflow model of Codling Wind Park under the Base Case scenario are set out in table 2.

Table 2: Assumptions

Parameter	Value	Comment/Source
CAPEX (EUR/MW)	3,600,000	Average of 3 sources as described below
OPEX (EUR pa)	116,811,950	Average of 4 sources as described below
DECEX (EUR)	0.0	Assumption is OWF will continue operating after y30
WACC	7.00%	Derived using IRENA model
Operational Lifetime of Windfarm	30 Years	Project delivery - Codling Wind Park
Depreciation Period	30 Years	
Depreciation Rate per year	18%	Double Declining Balance over 11 year period
ORESS1 Support (€ /MWh pa)	86.05	ORESS1 T & Cs
Term of FIT / ORESS Support Period	20	ORESS1 T & Cs
Electricity Price after ORESS Support Period	100.00	SEMOpx day-ahead and intraday electricity market trading for Ireland and Northern Ireland | Home
Capacity Factor	50.00%	DEA & IEA as described below
Construction Period	3 Years	Project delivery - Codling Wind Park
Corporate Tax Rate	12.50%	Basis of charge (revenue.ie)
Constraints & Curtailments after y20	15%	Estimate based on current value see below

CAPEX

Capital expenditures are the largest outgoings for an offshore windfarm. In recent years these have been escalating at unexpected rates due to high inflation, rising interest rates and wind turbine supply chain disruptions. (Durakovic. 2022c). These must be estimated by the developer for the purpose of submitting a bid to the auction for state support. However, they won't be known fully until the final investment decision date a few years later before construction starts. Therefore, the developer is potentially exposed to the risk of cost inflation between these two dates. This impacted a number of proposed

developments in the USA where 8 projects cancelled their offtake agreements in 2023 (nREL, Offshore Wind Market Report: 2024 Edition). Furthermore, the UK government failed to secure any successful bids in its 5th round of offshore wind auctions (AR5) due to the huge rise in costs in recent years making the strike price ceiling implemented too low (Wind energy in Europe, 2023 Statistics and the outlook for 2024-2030). To mitigate against this risk the Irish government has guaranteed inflation protection on equipment costs (ORESS1 T&C), with a similar approach being taken by many US states (nREL, Offshore Wind Market Report: 2024 Edition). Therefore we have not allowed for inflation on CAPEX in our model.

We estimate our CAPEX based on estimates provided by IRENA and Wind Europe respectively for European windfarms and from BVG Associates for a UK based windfarm. The estimate provided by BVG Associates is based on 2019 data. We have adjusted the equipment costs within this figure upwards by 40% to allow for inflation since then (REFs). By getting the arithmetic average of these figures we arrive at a total CAPEX of €3.6m / MW. This is slightly above the CAPEX estimate of €3.5m / MW published by SSE Renewables for their Arklow Bank Wind Park 2 project which is expected to be operational by 2030 (Arklow Bank Wind Park 2). Further details of estimated CAPEX used is presented in table 3.

Table 3: Codling Wind Park Estimated CAPEX

Codling Wind Park Estimated CAPEX			
Source Link/Citation	**(EUR m / MW)**	**Year**	**Location**
*BVG Associates with Equipment x1.4	3.6	*2024	UK
Wind Europe	3.5	2023	**EUR Avg
IRENA	3.6	2022	EUR Avg
Average	**3.6**		
*These are 2019 base costs from BVG Assoc. with all equipment costs increased by 40%			
** Average CAPEX for 9 European OWFs with final investment decisions in 2023			

OPEX

Operations and Maintenances expenses, including, cost of maintenance, repairs, rents, insurance and management vary depending on a number of factors including number of turbines, any synergies with nearby windfarms, and the approach taken (e.g. the use of independent service providers, turbine OEMs' own service arms, in house maintenance etc). Operations & Maintenance (O&M) costs for windfarms have been reducing over time, likely due to the refining of O&M practices through use of specialised vessels and digitisation, developments in turbine manufacturing and increased competition in O&M provision. O&M costs per kWh have been falling because of improved capacity factors as turbine ratings increase. For example, Orsted, major developer of offshore wind with a portfolio of 9.9 GW reduced its O&M costs from USD 118/kW/year in 2015 to USD 67/kW/year in 2018. (IRENA Renewable Power Generation Costs in 2022).

To estimate the O&M costs for CWF, we used an average of three estimates, set out in table 4, arriving at an estimated cost of €117m per annum. This assumption equates to €89,855 per MW pa which is 33% higher than the estimate of €67,500 per MW pa provided by SSE Renewables for their proposed Arklow Bank Wind Park 2 project but closely aligned with the middle of the range (20%-25% of revenues) suggested by World Forum Offshore Wind (WFO), Financing Offshore Wind (REF).

Table 4: Codling Wind Park Estimated OPEX

Codling Wind Park Estimated OPEX pa				
Eur (m) pa	**Source Link/Citation**	**% of Revenue**	**Note**	**Year**
120	World Forum Offshore Wind	23%	Midpoint between estimate for new and developed markets	2022
114	IRENA	21%	Midpoint between estimate for new and developed markets	2022
116	BVG Associates	22%	Estimate for a UK based OWF	2019
117	**Average OPEX**	**22.45%**		

OPEX +/-20% is also tested.

DECEX

We have assumed €0 for DECEX on the basis that it is likely that the OWF will continue in operation after the 30-year lifespan modelled and they are not a material expense being of the order of €0 to €0.2m /MW (ref KPMG 2010 by Prässler & Schaechtele, 2012)

WACC

Offshore wind, like other infrastructure projects, is capital intensive and the cost of capital is a key factor in determining whether a project is profitable or not (US Dept of Energy; Offshore Wind Market Report: 2023 Edition, WFO – Financing Offshore Wind, p13). This cost varies not only across countries and technologies but also by developer, offtake arrangement and other project specific factors (IRENA) yet despite its importance, reliable data on the cost of financing is not readily available. (IRENA (2023), *The cost of financing for renewable power*, International Renewable Energy Agency, Abu Dhabi, p6.). A survey conducted by IRENA industry experts indicated that the average technology premium of offshore wind is higher than that of solar PV and onshore wind as a result of its earlier stage of development and the more complex nature of project planning and execution. (ibid). To estimate the WACC for CWP, we use the benchmark tool developed by IRENA, defined as follows:

WACC = % Debt x Cost of Debt + % Equity x Cost of Equity (1),

Where: Cost of debt = (global risk-free rate + country default spread + lender margin + technology premium beyond lender margin) x (1 – tax rate)

Cost of equity = (global risk-free rate + equity risk premium + country premium + technology premium)

The figures for the WACC were taken from the sources outlined in table 5. Using this formula and assumptions results in a cost of debt of 5.31%, cost of equity of 10.9% and

a WACC of 7%, consistent with the expectations of a range of 5-8% provided in the IEA Offshore Wind Outlook 2019 and the range of estimates published by a number of offshore windfarm developers including SSE, Engie, RWE and EDPR.
WACC +/-20% is also tested.

Table 5: Inputs for WACC calculation

Values	Description	Note/Source
3.72%	Global risk-free rate	nominal yield of 10-year US treasury bonds; Resource Center | U.S. Department of the Treasury
0.65%	Country default spread	Calculated by Prof A. Damodaran; https://pages.stern.nyu.edu/%7Eadamodar/New_Home_Page/datafile/ctryprem.html
2%	Lender margin	A value of 2% is used as a global baseline
1.70%	Technology premium beyond lender margin	3.25% to 1.5% over the LIBOR. Since LIBOR rates, and not country-specific bond rates, are used as reference rates here, the lender margin must be subtracted when the cost of debt is calculated
4.60%	Equity risk premium	US equity risk premium is based on the US sovereign bond premium, adjusted for (multiplied by) the volatility of the S&P 500, the most important US equity index.
0.88%	Country premium	Calculated by Damodaran
12.50%	Corporate Tax IRL	Basis of charge (revenue.ie)
70.00%	Debt Share	The debt share is taken to be 80% for mature markets, 70% for intermediate markets and 60% for new markets.

Electricity Price

Given the uncertainty of electricity market conditions at the end of the ORESS1 support period, a simple approach was taken to estimating electricity prices, coupled with sensitivity testing. A constant electricity price is assumed using the average day-ahead price for the 12-month period up to October 2024 rounded down to the nearest 10's of Euros. Electricity Price +/-40% is also tested.

Capacity Factor

According to IRENA, "The range of capacity factors for offshore wind farms is very wide due to differences in the meteorology between wind farm sites, the technology used and the wind farm's configuration, i.e. the optimal turbine spacing to minimise wake losses and increase energy yields. Optimisation of the O&M strategy over the life of the project is also an important determinant of the realised lifetime capacity factor". ORESS1 specifies a net capacity factor of 45%. CWP estimates the number of turbines to be between 60 and 75. This implies that the likely turbine size will be between 17MW and 20MW approximately. As the capacity factor is related to the size of turbines, the Danish Energy Agency (DEA) have estimated that after allowing for losses the capacity factor for a 15 MW turbine is expected to be 54.51%, increasing to 54.79% for a 20 MW turbine. The weighted average capacity factor across European Offshore windfarms was 49% in 2022 (IRENA Renewable Power Generation Costs 2022) and it is expected to rise to 56% by 2030 (IEA World Energy Outlook, 2023) – the year CWP becomes operational. If these

expectations are borne out, then CWP will have the capacity to deliver significantly more electricity than the 45% capacity factor in ORESS1 implies.

Given that turbines of this size are not yet in commercial operation, we assume a net capacity factor of 50% in our Base Case scenario, consistent with the IEA and DEA's estimates of current average capacity factors for new offshore windfarms. This allows for the possibility that the technology is either not delivered on time for CWP or does not perform as expected. Furthermore we have tested the impact of a 45% and a 54.51% CF on the results.

Constraints & Curtailments

"There are two reasons for the dispatch-down of wind and solar energy: constraint and curtailment. Constraint refers to the dispatch-down of wind and solar generation for localised network reasons (where only a subset of wind/solar generators can contribute to alleviating the problem). Curtailment refers to the dispatch-down of wind/solar for system-wide reasons (where the reduction of any or all wind/solar generators would alleviate the problem). The SEM Committee approved the difference between constraint and curtailment in their SEM-13-011 paper." (EIRGRID, 2024)

While ORESS1 guarantees to pay compensation for electricity produced by the windfarm which isn't used by the grid, the windfarm will be susceptible to the constraints and curtailments of the grid, which may prevent the windfarm from selling some of the electricity it produces after the end of the ORESS1 support period. The total dispatch down energy from all wind resources in the republic of Ireland in 2023 was 8.9%. The majority of wind resources in Ireland currently are onshore. As more offshore windfarms and other renewable resources are developed there is a risk that this rate will increase. Efforts are underway to adapt the grid to ensure it can successfully incorporate the new electricity produced. (22, 135, 153) For the purpose of this research, we have assumed a higher rate of 15% from 2050 to reflect the risk that the grid might not be fully adapted before the ORESS1 period ends.

Assumptions used for Scenario Analysis

We begin by implementing DCF analysis and scenario analysis based on the set of assumptions set out above. Offshore wind projects are characterized by significant uncertainty in key variables such as electricity prices, technological advancements, operational costs, and regulatory frameworks. DCF analysis relies heavily on the accuracy of our assumptions. Scenario analysis helps by exploring a range of possible outcomes based on different assumptions about future conditions. The rapid development of new technologies in offshore wind could lead to faster-than-expected cost reductions, while delays or technological failures could increase costs. Scenario analysis has been demonstrated to be a useful complement to DCF when assessing offshore wind (Luderer et al., 2012; Roe, 2019). The assumptions for the upper and lower bound scenarios are presented in table 6. These values were selected to represent

reasonably possible future scenarios to provide a measure of the potential range of likely results.

Table 6: Assumed operational costs, WACC/discount rate, and electricity price under three different scenarios

Parameter	Value for Scenario 1	Value for Base Case	Value for Scenario 2
OPEX (EUR pa)	93,449,560	116,811,950	140,174,340
WACC	5.60%	7.00%	8.40%
Electricity Price after Year 20	140.00	100.00	60.00

Assumptions used for Sensitivity Testing

To further examine the potential variability in our results we examined their sensitivity to a number of key parameters. The sensitivity to each movement in the individual parameters was tested separately. These values are set out in the table below.

Assumptions Used in Sensitivity Testing			
	Test 1	Base Value	Test 2
OPEX Sensitivity	93,449,560	116,811,950	140,174,340
Electricity Price (EP) Sensitivity	140	100	60
Capacity Factor Sensitivity	45.00%	50.00%	54.51%
WACC Sensitivity	5.60%	7.00%	8.40%

Results

Base Case and Scenarios 1 & 2

We begin by examining the results of our DCF analysis and scenario analysis based on the sets of assumptions set out above. These results are presented in table 7.

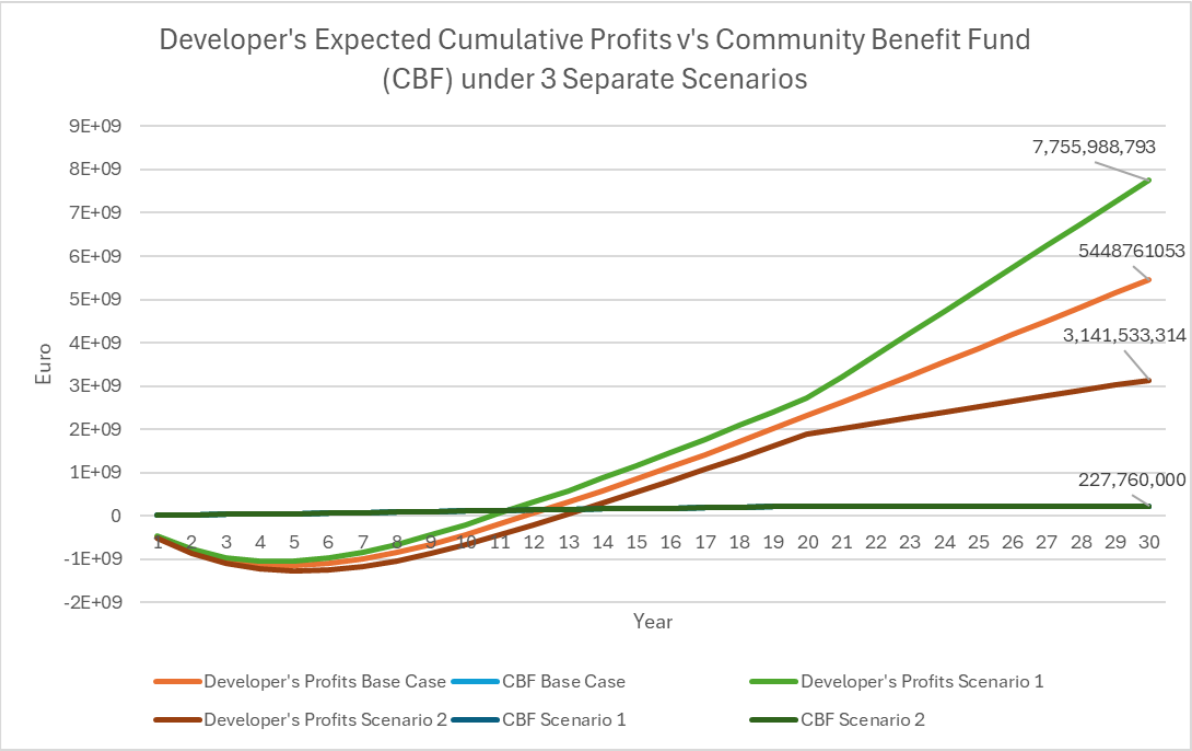
Table 7: Discounted Cashflow Analysis

Results of Scenario Analysis			
Results	Scenario 1	Base Case	Scenario 2
NPV of Net Profits (€'m)	1,796	758	101
IRR	14.53%	12.17%	9.37%
PV Community Benefit Fund (€'m)	135	121	109
Cumulative Value of Profits (€'m)	7,756	5,449	3,142
Cumulative Value of CBF (€'m)	228	228	228

It is evident from the results presented here that even under our worst-case scenario (scenario 2), the windfarm is expected to be profitable for the developer. Our results are consistent with those of (Prässler & Schaechtele, 2012) who applied DCF analysis to several hypothetical European projects and found that large-scale offshore wind farms can be profitable with the right policy supports. Other authors have confirmed positive NPVs and IRRs for existing European OWFs (Ioannou et al, 2020; Judge et al, 2019)), particularly where CAPEX inflation is allowed for by the FIT (Malleret et al, 2024). Under the base case scenario, the IRR is 12.17% (considerably higher than the 7% cost of financing the project) leading to an estimated NPV of €758m. Under the most conservative scenario, the NPV is €101m, with the IRR of 9.37% still exceeding the cost of capital. If Scenario 1 materialises then the developer's net profits are expected to be considerably higher, with an NPV of €1,796m and an IRR of 14.53%. Therefore, we conclude that the Codling Wind Farm is likely to be materially profitable to developers.

We next compare the expected returns to developers against the degree to which the local community benefits via the CBF. As evident in Table 7 above the cumulative value of the CBF remains the same at €228m under all 3 scenarios, despite significant variation in developer's net profits from €3,142m under Scenario 2 to €7,756m under Scenario1. This is further illustrated in Figure 1.

Figure 1



The cumulative value of the community benefit fund remains the same under each scenario due to the fact that the payment is a fixed monetary amount linked to the volume of electricity produced. The PV of same changes when the WACC changes. One of the main criticisms of CBFs is the imbalance of power between developers and local communities. The authors believe this is a valid concern in the case of ORESS1 community requirements. The structure and distribution of the funds often favours the developer's objectives rather than addressing the genuine needs of the community. While CBFs can provide short-term financial relief, there are concerns about their long-term impact on local communities and often fail to build long-term capacity in communities (Aldrich et al., 2013). Communities reliant on CBFs, particularly in rural or economically disadvantaged areas often face large challenges when the funds cease (Foord, 2019).

Results of Sensitivity Testing

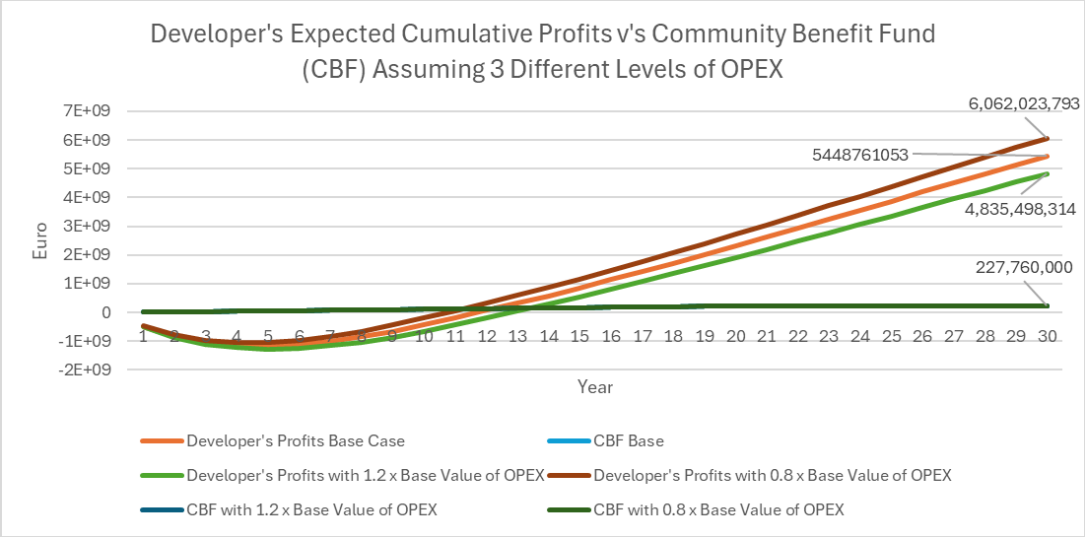
The next step was to examine the sensitivity of our results to variations in key parameters, OPEX, Electricity Price between years 20 and 30, Windfarm Capacity Factor and WACC.

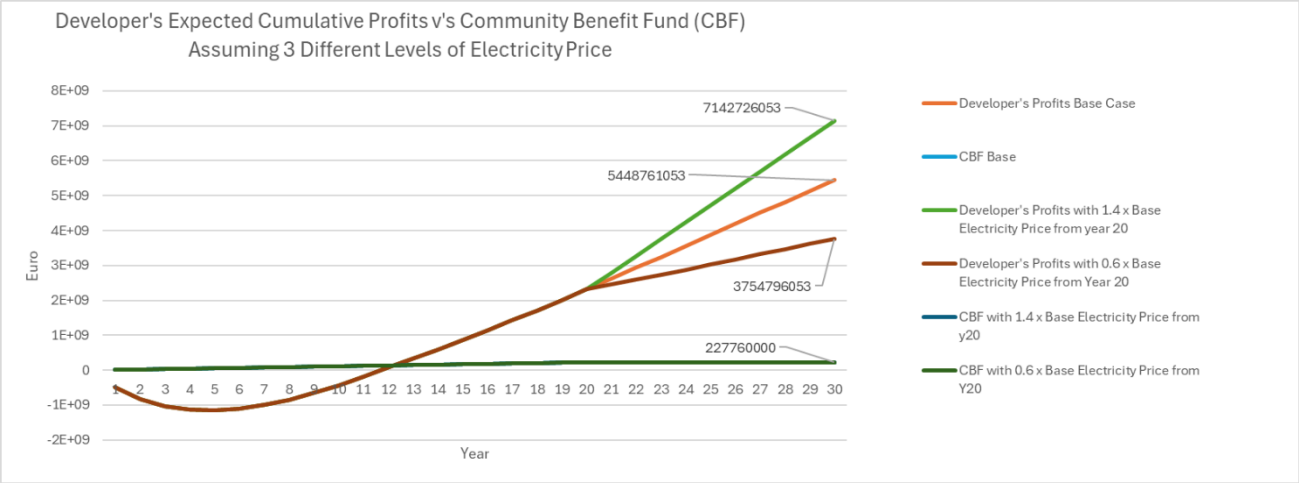
Sensitivity Tests: OPEX & Electricity Price

We find that a 20% increase (Scenario 2) or decrease (Scenario 1) in OPEX have almost equal and opposite impacts of about €213m on the NPV of profits. In fact, a 40% increase (Scenario 1) or decrease (Scenario 2) in electricity price has quite a similar impact on NPV profits of €251m both ways.

A 40% change in electricity price has a much larger impact on cumulative profits of €1,694m either way. Whereas the 20% change in OPEX has an impact of €613m both ways. This illustrates the greater vulnerability of developers to electricity prices, a variable which they have no control over, and the critical role of the 20-year feed-in-tariff provided by ORESS1. The impact of discounting is evident in how these adjustments have similar impacts on NPV.

OPEX Sensitivity			
Results	Base Value Opex * 0.8	Base Value Opex *1	Base Value Opex * 1.2
NPV of Net Profits (€'m)	971	758	544
IRR	13.84%	12.17%	10.61%
PV Community Benefit Fund (€'m)	121	121	121
Cumulative Value of Profits (€'m)	6,062	5,449	4,835
Cumulative Value of CBF (€'m)	228	228	228
Electricity Price (EP) Sensitivity			
Results	Base Value EP * 0.6	€100 EP	Base Value EP*1.4
NPV of Net Profits (€'m)	507	758	1,009
IRR	11.15%	12.17%	12.98%
PV Community Benefit Fund (€'m)	121	121	121
Cumulative Value of Profits (€'m)	3,755	5,449	7,143
Cumulative Value of CBF (€'m)	228	228	228





We can see that the cumulative value of CBF remains unchanged for each test as expected.

Sensitivity Tests: Capacity Factor

Developer's profits are driven by the volume of electricity produced by the windfarm and are therefore particularly sensitive to the assumed capacity factor. The size of the capacity factor depends on the wind resource in the windfarm and the turbine technology.

ORESS1 has assumed a capacity factor of 45% for all offshore windfarms. This is significantly below the current average net capacity for new offshore windfarms in Europe which the DEA and IEA reported was 50% in 2020. Due to technological advances, they are expecting this figure to reach 54.79% and 56% respectively by 2030 (based on 20MW turbines), the year CWP expects to be operational. The DEA expects the average net capacity factor to be 54.51% by 2025 based on a 15MW turbine. We have used this value in our sensitivity and scenario analysis despite the fact that we expect CWP turbines will be larger than 15MW. The DEA assumptions are based on an average

wind speed of 10m/s at 100m (adjusting appropriately for higher hub heights) which is comparable to the 10.18 at 150m found at Codling Wind Park.

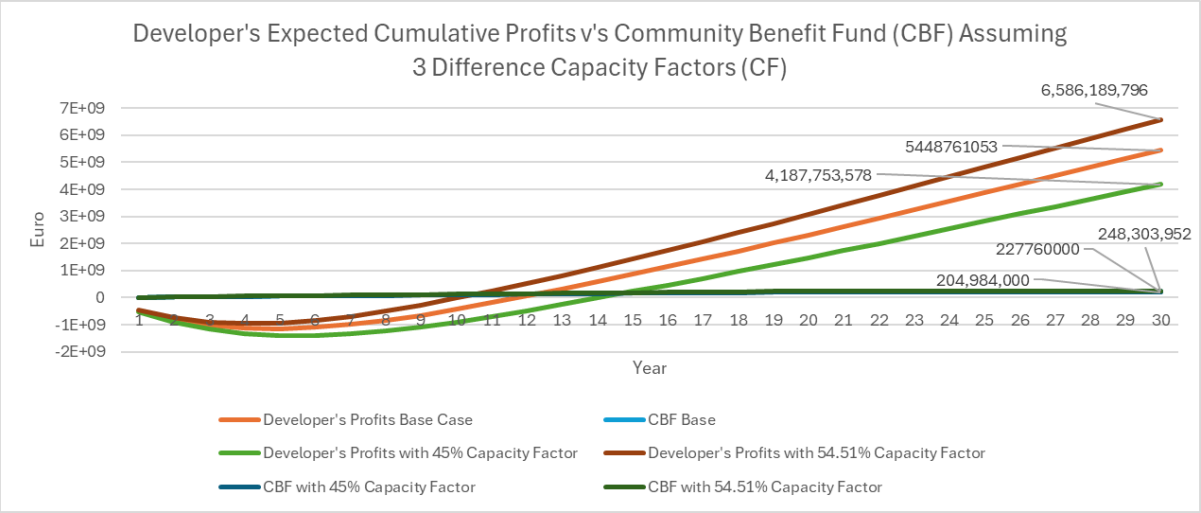
Based on the information published by CWP we have estimated that they expect to use turbines of at least 17mw or more. To date the 15MW turbine from Vestas has been tested and certified but they are yet to be used in an operational windfarm. Therefore, we have used the 54.51% net capacity factor associated with a 15MW turbine in our sensitivity and scenario analysis. As the capacity of turbines increase the net capacity factor of windfarms also rises.

The table below sets out the results of Capacity Factor (CF) sensitivity testing. We find that developer's profits increase by €1.261bn for a 5% increase in CF from 45% to 50%. Increasing the CF to 54.51%, the level expected for 15MW turbines results in an increase in cumulative profits of €1,137m.

Capacity Factor Sensitivity			
Results	45%	50%	54.51%
NPV of Net Profits (€ 'm)	318	758	1,152
IRR	9.06%	12.17%	15.37%
PV Community Benefit Fund (€ 'm)	109	121	132
Cumulative Value of Profits (€ 'm)	4,188	5,449	6,586
Cumulative Value of CBF (€ 'm)	205	228	248

Therefore, the total difference in cumulative profits between a 45% and 54.51% CF is €2.398bn, a 57% increase. This contrasts with a much smaller variation in the cumulative value of CBF from €205m assuming a 45% CF to €248m assuming the higher CF of 54.51%. These results are illustrated in figure 2 below.

Figure 2



The IRR is also expected to be significantly higher at 15.37% compared to 9.06%.

We also looked at how the capacity factor influences the FIT assuming a target IRR of 8% (i.e. a margin of 1% over WACC). We found that when a 45% CF was assumed a FIT of €82.18 per MWh resulted in an IRR of 8% and cumulative profits of €3.84bn over the 30-year operational life of the project. When the CF was increased to 50% a FIT of €73 /MWh resulted in an IRR of 8% and a cumulative value of profits of €4.15bn. A further step up to 54.51% resulted in a FIT of €66.14 / MWh for the same target IRR. This results in a cumulative profits value of €4.42bn. If the CF of CWP is as high as 54.51% or more these results suggest that a much lower FIT is sufficient to provide a reasonable return for developers. This is similar to the weighted average LCOE of $0.067 / kWh (approx. €64 / MWh) for new offshore wind projects in Europe in 2023 (IRENA, "Renewable Power Generation Costs 2023").

Sensitivity Tests - WACC

The final sensitivity test was to variations in the value of WACC. As OWF development is highly capital intensive this is a key variable in determining developer's profits. As expected, the IRR and cumulative values of profits and CBF remain unchanged. However, a 20% drop in WACC results in NPV profits increasing by €420m compared to the base case and a 20% increase results in the falling by €301m relative to same.

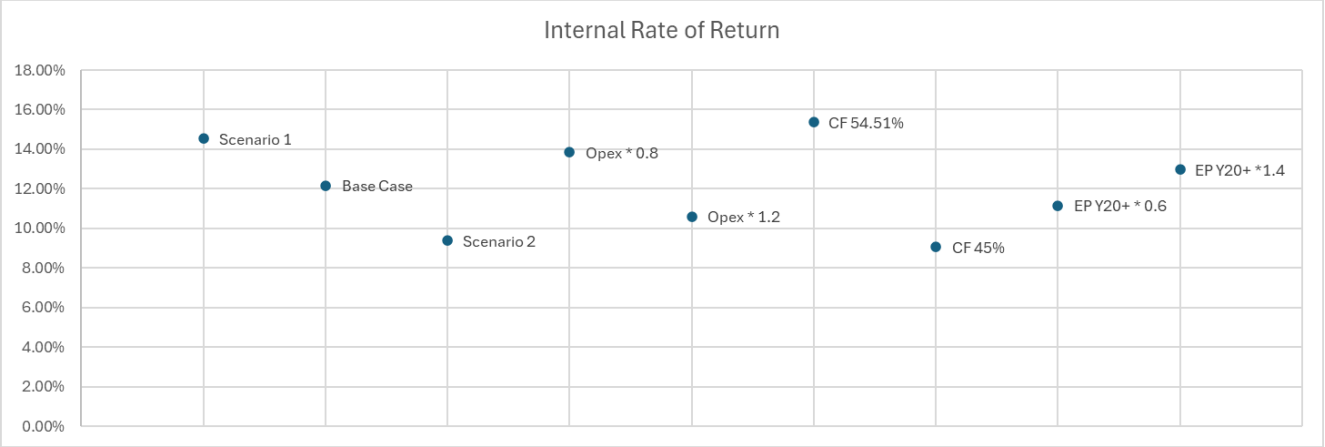
WACC Sensitivity			
Results	Base Value WACC * 0.8	7% WACC	Base Value WACC*1.2
NPV of Net Profits (€ 'm)	1,178	758	457
IRR	12.17%	12.17%	12.17%
PV Community Benefit Fund (€ 'm)	135	121	109
Cumulative Value of Profits (€ 'm)	5,449	5,449	5,449
Cumulative Value of CBF (€ 'm)	228	228	228

Results: Summary of Internal Rate of Return (IRR) for all scenarios and sensitivity tests.

We next turn our attention to the Internal Rate of Return in each scenario and sensitivity test. A margin over the WACC (7%) is required if the project is to be profitable and succeed. We find that the expected IRR is over 9% in all situations considered i.e. at least 2% greater than the assumed WACC. At 12.17% the Base Case IRR is expected to deliver a material margin of 5.17% over the WACC. If the capacity factor of CWP is in line with DEA and IEA expectations of at least 54.51% then the IRR will be even higher at 15.37% or more, giving a very large margin of 8.37% over assumed WACC.

The range of IRRs calculated for CWP are presented in the graph below.

Figure 3: IRR under each scenario and sensitivity



It is evident that the developer's profits, and therefore their ability to contribute to a CBF are sensitive to a range of variables, including the electricity price, OPEX and capacity factor of the windfarm. However, the offshore wind industry has developed a number of risk mitigation strategies to manage the variability. For example, multiple methods and reliable experts can be used to measure the wind resource at a specific site ensuring relative accuracy in expectations of wind speeds and therefore capacity factors. Warranties, availability guarantees and warranty payments by manufacturers help to mitigate against the risk of technological problems causing poor turbine performance and therefore lower capacity factors than expected and higher than expected operations and maintenance costs (WFO Financing Offshore Wind). Furthermore, the guaranteed price of €86 / MWh for 20 years mitigates against the risk of lower than anticipated electricity prices.

Examination of Developer's Profitability Compared to a Hypothetical Community Share Scheme

We now present an alternative hypothetical scenario whereby instead of a CBF, the community purchases 20% shares in the windfarm i.e. a community share scheme (CSS). We then repeat our analysis.

Base Case and Scenarios 1 & 2

Table x below sets out the expected profitability under all 3 scenarios assuming that the CBF is replaced by a CSS.

Results of Scenario Analysis			
Results	**Scenario 1**	**Base Case**	**Scenario 2**
NPV of Net Profits (€'m)	1,788	830	182
IRR	15.30%	12.93%	10.15%
PV Shares of 20% of Project (€'m)	447	208	46
Cumulative Value of Developer Profits (€'m)	6,364	4,518	2,673
Cumulative Value of Community Shares (€'m)	1,591	1,130	668

Under the base scenario, the cumulative value of 20% shares at €1.13bn is significantly higher (over €900m) than the current CBF requirements under ORESS1 (approx. €228m). This equates to an average contribution of €6.61 /MWh to the local community over a 30-year period or €9.92/MWh over the 20-year period of ORESS1, significantly higher than the €2/MWh currently required. While the cumulative value of developer's profits is lower in all scenarios relative to the CBF case it is still materially positive with a minimum value of €2,673m for scenario 2 and a maximum value of €6,364 for scenario 1.

Figure 4(a)

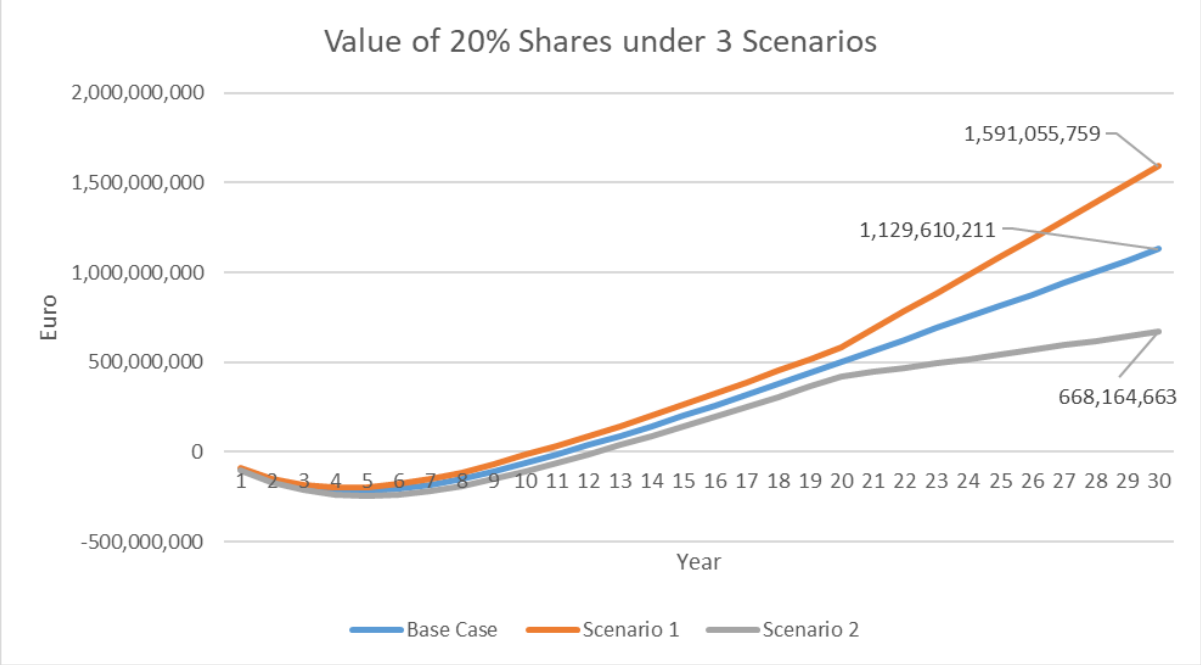
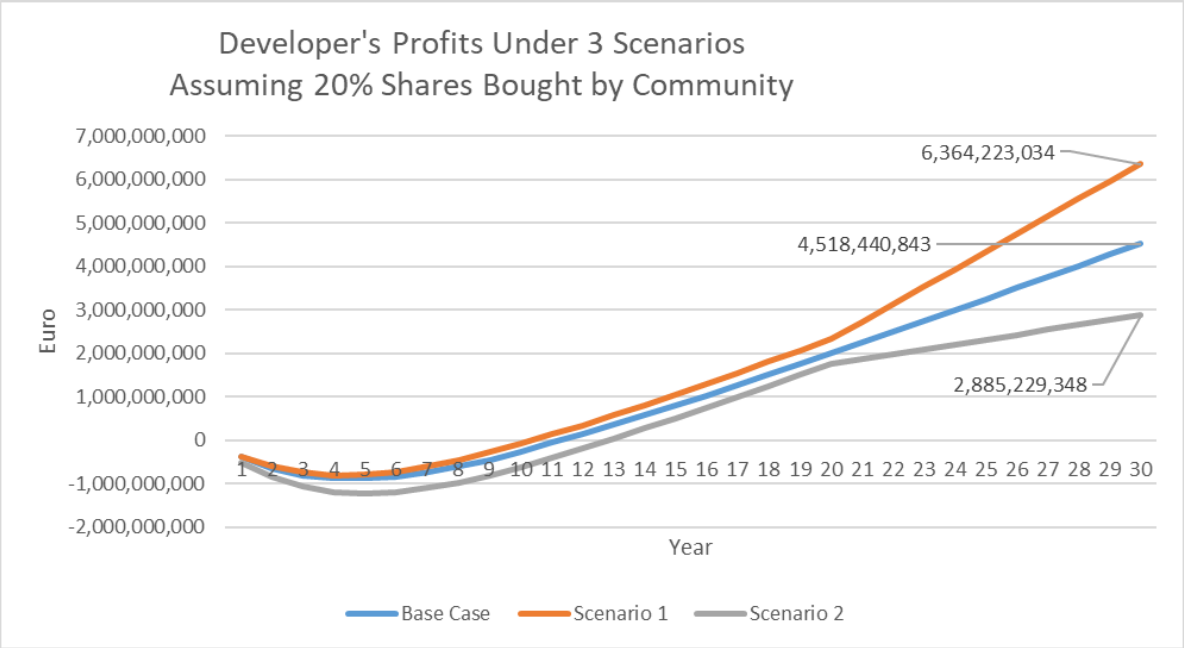


Figure 4(b)



As illustrated in figure 4(c) below, the value of the shares is negative in the early years, and it should be expected that dividends would not be payable during that time. However, the value continues to accumulate for the full operational life of the windfarm unlike the current community benefit fund which stops accumulating after 20 years.

Figure 4(d) shows the cumulative developer's profits, which are over €900m lower when 20% of the project's shares are bought by the local community rather than paying a €2 / MWh to a community benefit fund for a limited period of 20 years.

Figure 4 (c)

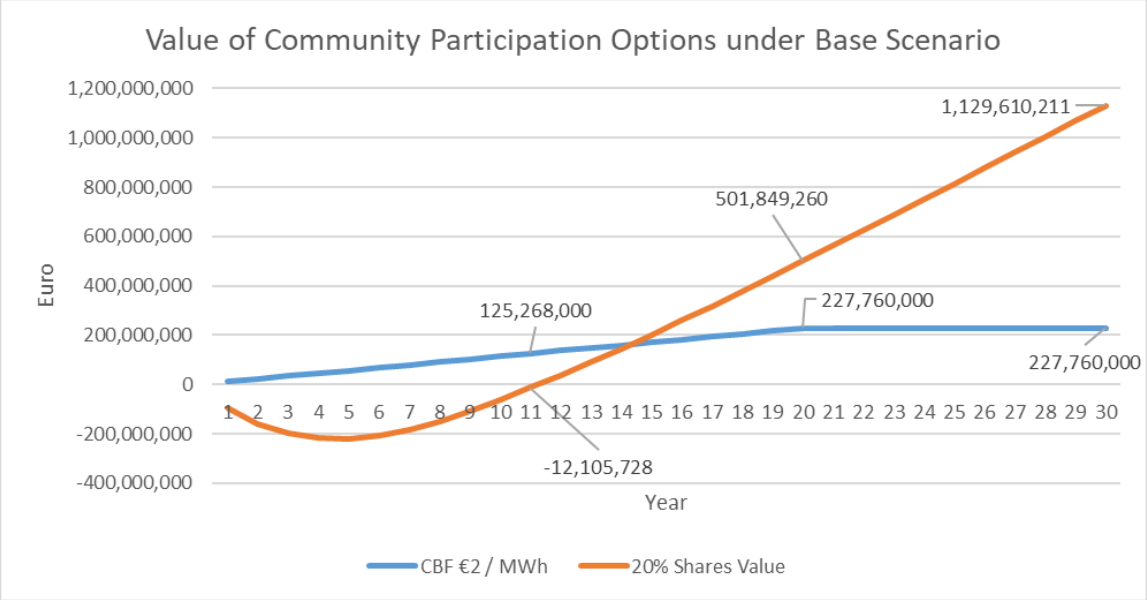
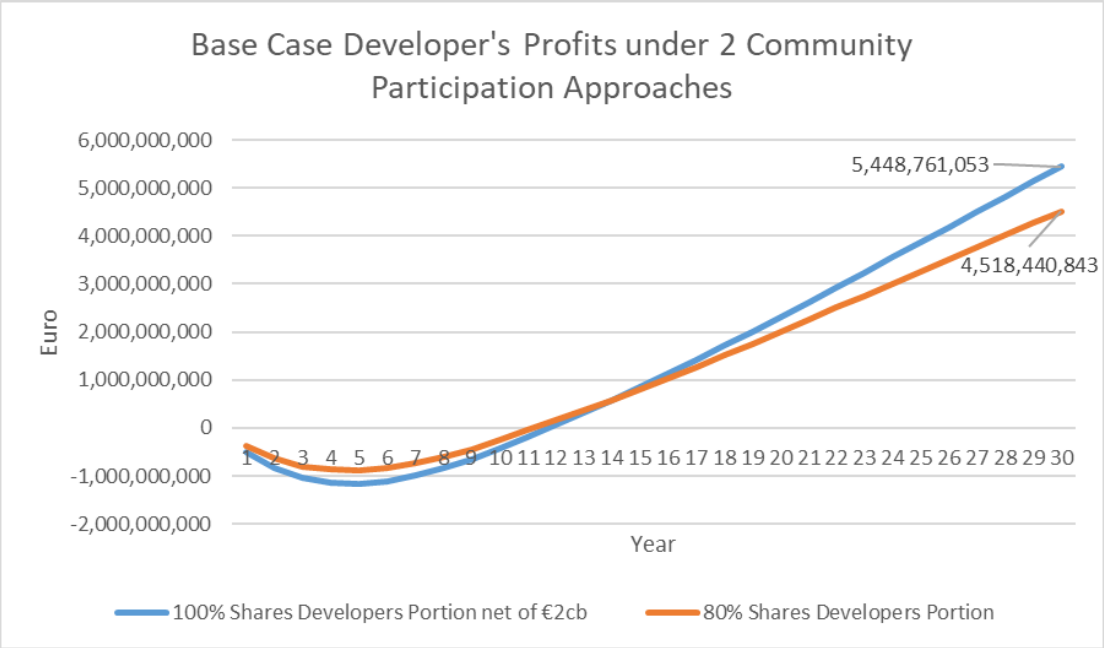


Figure 4(d)



These results clearly demonstrate that while there is a monetary loss to the developer as a result of the CSS, CWP is still expected to be highly profitable under all scenarios. We find a similar result for all sensitivities tested as set out in the tables below. We also find that, over the 30 year period, the community is materially better off with a CSS rather than a CBF under all sensitivities tested.

Table (x) Results of sensitivity tests assuming CBF is replaced with a CSS.

OPEX Sensitivity			
Results	Base Value Opex * 0.8	Base Value Opex *1	Base Value Opex * 1.2
NPV of Net Profits (€'m)	1,039	830	621
IRR	14.66%	12.93%	11.30%
PV Shares of 20% of Project (€'m)	260	208	155
Cumulative Value of Developer Profits (€'m)	5,009	4,518	4,028
Cumulative Value of Community Shares (€'m)	1,252	1,130	1,007
Electricity Price (EP) Sensitivity			
Results	Base Value EP * 0.6	€100 EP	Base Value EP*1.4
NPV of Net Profits (€'m)	584	830	1,076
IRR	11.98%	12.93%	13.68%
PV Shares of 20% of Project (€'m)	146	208	269
Cumulative Value of Developer Profits (€'m)	3,163	4,518	5,874
Cumulative Value of Community Shares (€'m)	791	1,130	1,468

Capacity Factor Sensitivity			
Results	45%	50%	54.51%
NPV of Net Profits (€'m)	391	830	1,223
IRR	9.63%	12.93%	16.33%
PV Shares of 20% of Project (€'m)	98	208	306
Cumulative Value of Developer Profits (€'m)	3,494	4,518	5,443
Cumulative Value of Community Shares (€'m)	873	1,130	1,361
WACC Sensitivity			
Results	Base Value WACC * 0.8	7% WACC	Base Value WACC*1.2
NPV of Net Profits (€'m)	1,207	830	545
IRR	12.93%	12.93%	12.93%
PV Shares of 20% of Project (€'m)	302	208	136
Cumulative Value of Developer Profits (€'m)	4,518	4,518	4,518
Cumulative Value of Community Shares (€'m)	1,130	1,130	1,130

The literature suggests that developers often prefer CBFs over Community Share Schemes because they provide a way to demonstrate corporate social responsibility and secure local approval for a project without requiring the lasting financial stake in the community or a continuing involvement in the project's governance (Bell et al, 2013). Community Share Schemes involve long-term commitments, as community shareholders expect returns on their investment over the life of the project. CBFs allow developers to avoid potential conflicts such as disagreements about how profits should be shared or invested (Walker et al., 2010).

Our findings show that a community share scheme offers the potential for long-term financial returns for community members. We find that the financial return to the local community is higher under the CSS than CBF model. This is likely to be in part because shares purchased by local residents can provide a continuous stream of income to participants (Firth et al. 2013; Huybrechts et al., 2014) that is not confined to the length (20 years) of the policy support provided. This is consistent with the finding that community share schemes can help build wealth in the community and foster economic resilience over time (Murray, 2013). While community share schemes offer higher potential financial returns to communities, they also come with risks, particularly related to the performance of the renewable energy projects. However, the higher returns from CSS are generally considered to justify these risks, especially given the community's involvement in managing and mitigating risks. Local ownership and active participation in decision-making processes in CSS allow communities to have more control over the risk factors and financial outcomes (Aiken et al., 2013).

Discussion

Ensuring that the economic benefits of a just transition are equitably distributed is challenging. In the absence of targeted policies, the benefits of a low-carbon transition may be concentrated in wealthier regions or among more educated populations, exacerbating inequalities (Cox et al., 2020). Each community will have different challenges and opportunities in the transition to net zero, and a just transition requires community-specific transition policies that address local needs, economic structures, and environmental contexts (Foster et al., 2019).

Energy poverty in Ireland is a pressing issue with Irish households facing some of the highest energy costs in Europe (European Commission, 2022). Furthermore, income inequality is increasing. Low-income households are disproportionately affected. Exacerbating the vulnerability of these households to high energy costs is their lack the resources to make energy-efficient improvements (Watson et al., 2020). Almost half of the Irish housing stock was built before 1970, with many of these homes lacking adequate insulation (Irish Green Building Council, 2020), worsening the situation for low-income households. There is also a spatial aspect to energy poverty in Ireland with rural communities more adversely affected due to limited access to affordable, reliable, and modern energy sources (Healy & Clinch, 2002; Szulecka et al., 2020). The Irish government has a number of policies in place to address energy poverty, including the fuel allowance, The Energy Poverty Action Plan (Department of the Environment, Climate and Communications, 2023), the Warmer Homes Scheme, and targeted energy efficiency programmes for vulnerable groups. However, policy frameworks must be more responsive to the diverse realities of energy poverty, ensuring that vulnerable populations are not left behind in the shift to a low-carbon economy. This paper asks whether the current CBF requirements work in opposition to the government's existing policies for tackling energy poverty.

Community Benefit Funds can be a powerful policy tool to address energy poverty. However, the effectiveness of CBFs in tackling energy poverty depends on their design, governance, and targeting. CBFs associated with wind farms in Scotland have been successfully used to reduce energy costs for vulnerable residents (McCluskey et al., 2019), have been deployed in rural communities in Wales to fund energy efficiency upgrades for homes in nearby communities (Toke, 2015), and funded community-owned renewable energy projects in Finland which have lowered energy costs for communities and provided economic benefits through local job creation (Kivimaa & Koskela, 2020).

To maximize their impact, community participation policies must be integrated into comprehensive energy poverty strategies, ensuring that they are used efficiently and equitably to benefit those impacted by the disbenefits of renewable energy projects and those who are most vulnerable to energy poverty. The impact of CBFs can be limited if the funds are not targeted towards households who are most vulnerable (Toke, 2015).

The distribution of funds can sometimes be inequitable, with wealthier communities receiving a disproportionate share of the benefits. Ensuring that CBFs are distributed fairly and reach the communities most affected by energy poverty is essential for maximizing their impact (McCluskey et al., 2019).

Given Ireland's commitment to a just transition, community participation policies should also address issues of social justice and equity, including energy poverty. A framework is essential for ensuring that renewable energy projects benefit local populations equitably and progressively, especially in areas that have been economically or environmentally marginalized (Heffron et al., 2015). Addressing local concerns about fairness in the distribution of benefits from renewable energy technologies is essential (Sovacool, 2019). The importance of addressing regional inequalities in the shift to a sustainable, low-carbon economy has been documented in the academic literature, with economic opportunities arising from the transition not always distributed equitably (Walker, 2011; Lacey et al., 2020). Spatial injustice arising from the rural-urban divide (Johansen et al., 2021) and sustained underinvestment in rural Ireland (Banerjee and Schuitema, 2023) may further exacerbate existing inequalities.

In the case of Codling Wind Farm, the recipients of the Community Benefit Fund are primarily located in Wicklow Town, Greystones, and communities around the Poolbeg area. Many of these communities are among the wealthiest in Ireland. When CBFs are directed to wealthier communities, it can undermine the goals of equity, fairness, and sustainable development. The distribution of funds to wealthier areas, rather than to those most in need, can widen inequalities (therefore exacerbating energy poverty), reduce the effectiveness of the funds, and result in a lack of long-term community engagement. The effectiveness of community benefit schemes depends on transparency, local involvement, and a clear connection to the community's needs. If wealthier communities benefit disproportionately, the broader public may view the entire funding process as unjust, and the trust in the developers and the fund management process could be eroded (Seyfang, 2009). This may also put communities' faith in Ireland's net-zero transition at risk. Further, funds that are directed toward communities with already strong economies are less likely to stimulate long-term, sustainable development. Wealthier communities often have more options for raising funds independently, meaning that community benefit funds could fail to maximize their potential for long-term economic or social impact (Aiken et al., 2013). It becomes more challenging to address the needs of vulnerable populations in cases where wealthier regions receive a disproportionate share of the funds (Barton et al., 2015).

Given our findings in this study, we believe there is a weakness in ORESS1 that means it is not aligned with the principles of a just transition and could widen existing inequalities by not offering an alternative to a CBF. In particular, the spatial aspects of the windfarms appear to be ignored. In the case of Codling Wind Farm, the revenue raised from the CBF

will be distributed to already wealthy communities. Poorer communities in surrounding areas may be left without access to the financial support they need to address local challenges, thereby deepening regional inequalities. Our results illustrate that by offering communities such as those local to Codling Wind Park, who may be willing and able to bear the financial risks, an opportunity to participate in a community share scheme, they are likely to experience considerable financial benefits from their initial financial commitment to purchase shares and will transfer some of the risks away from developers. Therefore, CBFs should be offered and implemented in a targeted and strategic manner in areas where these funds will be more transformative and less likely to be used to fund non-urgent amenities (Seyfang, 2009). By offering a choice between CBFs and CSSs, depending on the income level and preferences of the beneficiary community the funds and the amount of risk undertaken by the local community is tailored according to local need.

Concluding Remarks

In order to achieve a successful and just transition to net zero, Ireland aims to significantly increase the amount of electricity generated by renewables, including offshore wind. Policy support for renewable energy technologies is essential if this goal is to be achieved. In the case of offshore wind, this support is provided through ORESS. Using a case study of Codling Wind Park, we assess the financial feasibility to developers of the offshore wind farm, the associated community benefit fund and its' alignment with the just transition principle. One of the features of ORESS is that all developers must provide a community benefit fund, which in the case of Codling Wind Park is estimated to be approximately €10m per year. We find that the Codling Wind Farm is profitable and financially feasible over a wide range of scenarios. Although the community benefit fund poses zero financial risk to the community, it also provides a limited return.

The Department of the Environment, Climate Change and Communications (DCCAE) initially proposed that the Renewable Electricity Participation Scheme (REPS) should be included in ORESS1. This Scheme required developers to offer 20% of the project to the local community as shares, allowing citizens to invest but not 'own' a renewable electricity project. The investor would rely on project revenues to deliver their return. After a period of consultation, the REPS was withdrawn by the DCCAE, citing concerns regarding exposing citizen investors to financial risks and the administrative burden to developers. We analyse the return to the local community if they were offered the opportunity to purchase shares via a community share scheme (CSS) instead of the CBF and find that the expected return is significantly higher than that offered by the CBF and that the returns extend beyond the 20-years required by ORESS1.

We argue that the policy in its current format ignores spatial and regional disparities and, in some cases, such as Codling Wind Park, existing inequalities could be exacerbated as due to the spatial requirements of the scheme, the primary beneficiaries of the CBF will be largely from some of the highest socio-economic groups in the country.

In order to maximise the impact of community benefit funds, in line with our commitments to justice in Ireland's energy transition, it is essential that spatial and economic differences are given due consideration. The funds must be distributed fairly and reach the communities most affected by energy poverty (McCluskey et al., 2019). We argue that in the case of Ireland, the avenue via which funding should be channelled to the local community should be dependent on exactly who the recipients of the funds are.

Communities should be provided the opportunity to choose between CBFs and CSSs. CBFs could be provided to OWF adjacent communities where support is required for critical services, infrastructure improvements, or to address energy poverty, unemployment, poor housing, or inadequate healthcare. We believe that this approach will foster sustained social and economic benefits. CSSs could be offered where the OWF adjacent community has sufficient economic resources to shoulder the upfront

cost and risks involved in purchasing shares, giving them the opportunity to benefit from the significantly higher expected returns than are offered by CBFs.

Our proposed approach allows the funds and the amount of risk undertaken by the local community to be tailored according to local need. It should increase potential to improve social capital, promote economic resilience, and support essential community services in areas that would benefit the most, contributing to the overall long-term wellbeing and prosperity of the citizens of Ireland.

References

1. About the Project - Codling Wind Park
2. Aiken, M., Bode, I., & Walker, A. (2013). Community ownership and development: Strengthening social capital. Journal of Community Development, 39(3), 31-46.
3. Aldrich, A., et al. (2013). "The Community Benefits of Wind Farms: Can They Be Realized?" Energy Policy, 62, 139-148.
4. Allan, G., Mcgregor, P. and Swales, K., 2011. The importance of revenue sharing for the local economic impacts of a renewable energy project: A social accounting matrix approach. Regional Studies, 45(9), pp.1171-1186.
5. Barton, H., Grant, M., & Guise, R. (2015). Shaping neighbourhoods: A guide for health, planning and design. Routledge.
6. Basis of charge
7. Baxamusa, M.H., 2008. Empowering communities through deliberation the model of community benefits agreements. Journal of Planning Education and Research, 27(3), pp.261-276.
8. Bell, D., et al. (2013). "The Role of Community Benefits in Wind Farm Development." Renewable and Sustainable Energy Reviews, 24, 251-262.
9. Bertsch, V., Hyland, M. and Mahony, M., 2017. What drives people's opinions of electricity infrastructure? Empirical evidence from Ireland. Energy Policy, 106, pp.472-497.
10. "Bishop I and Miller D (2007) Visual assessment of off-shore wind turbines: The influence of distance, contrast, movement and social variables. Renewable Energy 32(5): 8114–8131."
11. Böhringer, C., & Vogt, C. (2015). The valuation of renewable energy projects: A comparison of approaches. Journal of Environmental Economics and Management, 74, 1-18.
12. Bullard, R. D. (2007). Environmental justice in the age of the Green New Deal. Environmental Justice, 5(1), 1-7.

13. Cass, N., Walker, G. and Devine-Wright, P., 2010. Good neighbours, public relations and bribes: the politics and perceptions of community benefit provision in renewable energy development in the UK. Journal of environmental policy & planning, 12(3), pp.255-275.
14. Centre for Sustainable Energy & Garrad Hassan, 2005. Community Benefits from Wind Power: Policy Makers Summary Report to Renewables Advisory Board and DTI.
15. Codling Wind Park - EDF Renewables
16. Codling Wind Park reveals final design of project and number of turbines to be constructed - Codling Wind Park
17. Community Engagement in Wind Energy: Innovative approaches to achieving a social license (Co-Wind) | Case Studies | SEAI
18. Cowell, R., Bristow, G. and Munday, M., 2011. Acceptance, acceptability and environmental justice: the role of community benefits in wind energy development. Journal of Environmental Planning and Management, 54(4), pp.539-557.
19. Cox, L., et al. (2020). Equity considerations in climate change policy: A review of the literature. Environmental Politics, 29(1), 133-155.
20. Cronin, Y., Cummins, V. and Wolsztynski, E., 2021. Public perception of offshore wind farms in Ireland. Marine Policy, 134, p.104814.
21. Curtailment: The overlooked challenge to meeting Ireland's renewable energy targets | IIEA
22. Curtin, J., McInerney, C., Gallachóir, B.Ó. and Salm, S., 2019. Energizing local communities—what motivates Irish citizens to invest in distributed renewables?. Energy Research & Social Science, 48, pp.177-188.
23. Danish Energy Agency. 2024. Technology Data - Energy Plants for Electricity and District heating generation. Copenhagen
24. Danish Ministry of Climate and Energy, 2008. Promotion of Renewable Energy Act. Copenhagen.
25. "De Groot J and Bailey I (2016) What drives attitudes towards marine renewable energy in island communities? International Journal of Marine Energy 13: 80–95."

26. Department of Social Protection. (2023). Fuel Allowance. [Government Publication].
27. Department of the Environment Climate and Communications (2021) Renewable Electricity Support Scheme: Good Practice Principles Handbook for Community Benefit Funds. Dublin: Rialtas na hEireann, (Government of Ireland)
28. Department of the Environment Climate and Communications (2022) Energy Poverty Action Plan. Dublin: Rialtas na hEireann, (Government of Ireland)
29. Department of the Environment, Climate and Communications. (2023). Energy Poverty Action Plan. [Government Publication].
30. Devine-Wright, P. and Howes, Y., 2010. Disruption to place attachment and the protection of restorative environments: A wind energy case study. Journal of environmental psychology, 30(3), pp.271-280.
31. "Dimitropoulos, A., Kontoleon, A., 2009. Assessing the determinants of local acceptability of wind-farm investment: a choice experiment in the Greek Aegean Islands. Energy Policy 37, 1842–1854. https://doi.org/10.1016/j.enpol.2009.01.002."
32. "Eirgrid. 2024. Annual Renewable Energy Constraint and Curtailment Report 2023. Dublin"
33. "Ellis G, Barry J and Robinson C (2007) Many ways to say ‘no’, different ways to say ‘yes’: Applying Q-Methodology to understand public acceptance of wind farm proposals. Journal of Environmental
34. Planning and Management 50(4): 517–551."
35. Energy Poverty - Threshold
36. European Commission. (2022). Energy Prices and Bills in Ireland. [European Union Report].
37. Fécamp, France’s First Offshore Wind Farm in Normandy, is Now Operational | EDF FR)
38. "Firestone J and Kempton W (2007) Public opinion about large offshore wind power: Underlying factors. Energy Policy 35(3): 584–598"
39. Firth, R., McGovern, M., & Hemming, G. (2013). Community shares and the UK experience of social enterprise. Social Enterprise Journal, 9(2), 1-22.

40. Foord, J. (2019). "Community Benefit Funds: A Critical Review." Journal of Rural Studies, 66, 234-246.
41. FOSTER, J.B.F., 2019. Ecosocialism and a Just Transition". Monthly Review (online), 22(06).
42. Fred. Olsen Renewables
43. "Gee K (2010) Offshore wind power development as affected by seascape values on the German North Sea coast. Land Use Policy 27(2): 185–194."
44. González, P., Silva, P., & Ortega, P. (2014). Comparative analysis of valuation methods for renewable energy projects. Renewable and Sustainable Energy Reviews, 34, 303-313.
45. Gray T, Haggett C and Bell D (2005) Offshore wind farms and commercial fisheries in the UK: A study in stakeholder consultation. Ethics, Place & Environment 8(2): 127–140.
46. "Haggett C (2008) Over the see and far away? A consideration of planning, politics, and public perceptions of offshore wind farms. Journal of Environmental Policy and Planning 10(3):289–306"
47. Haggett C (2010a) Public perceptions of offshore wind energy. Energy Policy 39(2): 503–510
48. Healy, J. D. (2004). Housing and health: The impact of housing conditions on health inequalities. Policy Press.
49. Healy, J. D., & Clinch, J. P. (2002). Quantifying the severity of fuel poverty in Ireland. Energy Policy, 30(5), 307-314.
50. Hledik, R., Bandyopadhyay, S., & Foster, V. (2008). Discounted cash flow and its application to energy project valuation. Energy Economics, 30(2), 573-586.
51. https://www.edpr.com/sites/edpr/files/2024-09/EDPRInvestorPresentation_Aug24.pdf
52. https://www.engie.com/sites/default/files/assets/documents/2023-02/MU%20Feb%20%202023%20VDEFF.pdf
53. https://www.iberdrola.com/documents/20125/4005786/CMD24-financial-management.pdf

54. https://www.rwe.com/-/media/RWE/documents/05-investor-relations/finanzkalendar-und-veroeffentlichungen/veroeffentlichungen-und-praesentationen/2024-rwe-investor-presentation.pdf
55. Huybrechts, B., Mertens, S., & Wouters, M. (2014). The role of community ownership in the success of renewable energy projects. Renewable Energy, 72, 102-109.
56. Hyland, M. and Bertsch, V., 2018. The role of community involvement mechanisms in reducing resistance to energy infrastructure development. Ecological economics, 146, pp.447-474.
57. IEA. 2019. Offshore Wind Outlook 2019. Paris
58. IEA. 2023. World Energy Outlook, 2023. Paris
59. Ioannou, A., Angus, A. and Brennan, F., 2020. Stochastic financial appraisal of offshore wind farms. Renewable Energy, 145, pp.1176-1191.
60. IRENA (2023), Renewable power generation costs in 2022, International Renewable Energy Agency, Abu Dhabi. ISBN 978-92-9260-544-5
61. IRENA (2023), The cost of financing for renewable power, International Renewable Energy Agency, Abu Dhabi.
62. Irish Green Building Council. (2020). Energy Efficiency and Irish Housing. [Report].
63. Johansen, K. and Emborg, J., 2018. Wind farm acceptance for sale? Evidence from the Danish wind farm co-ownership scheme. Energy Policy, 117, pp.413-422.
64. Johansen, K., 2019. Local support for renewable energy technologies? Attitudes towards local near-shore wind farms among second home owners and permanent area residents on the Danish coast. Energy Policy, 132, pp.691-701.
65. Johansen, K., 2021. Blowing in the wind: A brief history of wind energy and wind power technologies in Denmark. Energy Policy, 152, p.112139.
66. Joint Committee on Social Protection, Community and Rural Development, and the Islands, (2024) Report on Energy Poverty. Dublin, Houses of the Oireachtas
67. Judge, F., McAuliffe, F.D., Sperstad, I.B., Chester, R., Flannery, B., Lynch, K. and Murphy, J., 2019. A lifecycle financial analysis model for offshore wind farms. Renewable and Sustainable Energy Reviews, 103, pp.370-383.

68. Keegan, Dr. G and Tegen, Dr. S., 2021. IEA Wind Task 28 – Social Science of Wind Energy Acceptance, Colorado State University, Colorado.
69. Kerr, S., Johnson, K. and Weir, S., 2017. Understanding community benefit payments from renewable energy development. Energy Policy, 105, pp.202-211.
70. Kivimaa, P., & Koskela, E. (2020). Local energy solutions: Community benefits and energy poverty alleviation in Finland. Energy Policy, 137, 111089.
71. Klessmann, C., et al. (2013). Financial Valuation of Offshore Wind Projects: A Case Study of Germany. Renewable Energy, 60, 567-576.
72. Knauf, J., 2022. Can't buy me acceptance? Financial benefits for wind energy projects in Germany. Energy Policy, 165, p.112924.
73. "Ladenburg J (2009) Visual impact assessment of offshore wind farms and prior experience. Applied Energy 86(3): 380–387."
74. "Ladenburg J and Dubgaard A (2009) Preferences of coastal zone user groups regarding the siting of offshore wind farms. Ocean and Coastal Management 52(5): 233–242."
75. "Ladenburg J and Lutzeyer S (2012) The economics of visual disamenity reductions of offshore wind farms – Review and suggestions from an emerging field. Renewable and Sustainable Energy Reviews 16(9): 6793–6802"
76. Lawlor, D, Visser, Dr A. (2022) Energy Poverty in Ireland. Dublin: Library and Research Services, Houses of the Oireachtas
77. Le Maitre, M.J., Community Engagement in Wind Energy: Innovative approaches to achieving a social license to operate (CoWind) Final Report.
78. Lienhoop, N., 2018. Acceptance of wind energy and the role of financial and procedural participation: An investigation with focus groups and choice experiments. Energy Policy, 118, pp.97-105.
79. "Lilley MB, Firestone J and Kempton W (2010) The effect of wind power installations on coastal
80. tourism. Energies 3: 1–22."
81. "Liu, W., Wanga, C., Mol, A., 2013. Rural public acceptance of renewable energy deployment: the case of Shandong in China. Appl. Energy 102, 1187–1196. https://doi.org/10.1016/j.apenergy.2012.06.057"

82. Luderer, G., et al. (2012). Economic and environmental impacts of wind energy in Europe. Nature Climate Change, 2, 388–395.
83. "MacKinson S, Curtis H, Brown R, et al. (2006) A report on the perception of the fishing industry into the potential socio-economic impacts of offshore wind farms. CEFAS Science Series Technical Report no. 133."
84. Malleret, S., Jansen, M., Laido, A.S. and Kitzing, L., 2024. Profitability dynamics of offshore wind from auction to investment decision. Renewable and Sustainable Energy Reviews, 199, p.114450.
85. Martin et al (2014), 'Just Conservation? On the Fairness of Sharing Benefits' in The Justices and Injustices of Ecosystem Services edited by Thomas 69.
86. McCluskey, S., et al. (2019). Wind energy and community benefit funds: Impacts on local development and energy poverty. Energy Research & Social Science, 52, 21-32.
87. McCoy, Angel, Walter Musial, Rob Hammond, Daniel Mulas Hernando, Patrick Duffy, Philipp Beiter, Paula Pérez, Ruth Baranowski, Gage Reber, and Paul Spitsen. 2024. Offshore Wind Market Report: 2024 Edition. Golden, CO: National Renewable Energy Laboratory. NREL/TP-5000-90525. https://www.nrel.gov/docs/fy24osti/90525.pdf.
88. "McLachlan C (2009) ‘You don’t do a chemistry experiment in your best china’: Symbolic
89. interpretations of place and technology in a wave energy case. Energy Policy 37(12): 5342–5350."
90. Meacham, T., 2012. SPICe briefing: renewable energy: community benefit and ownership [online]
91. Morgera, E., 2014. Conceptualizing benefit-sharing as the pursuit of equity in addressing global environmental challenges.
92. Morthorst, P. E., et al. (2011). The Role of Financial Models in Offshore Wind Power Development. Energy Policy, 39(11), 7416-7423.
93. 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(1), pp.1-12.

94. Murray, R. (2013). The new bottom line: How social finance is transforming business. Journal of Social Business, 2(3), 48-67.
95. "Nadaï, A., 2007. ‘‘Planning’’, ‘‘siting’’ and the local acceptance of wind power: some
96. lessons from the French case. Energy Policy 35, 2715–2726. https://doi.org/10.
97. 1016/j.enpol.2006.12.003."
98. None. 2005. "Community benefits from wind power: a study of UK practice and comparison with leading European countries. Report to the Renewables Advisory Board and the DTI." United Kingdom.
99. Office of Energy Efficiency and Renewable Energy, US Department of Energy. 2022. Offshore Wind Market Report 2022 Edition. Washington
100. Office of Energy Efficiency and Renewable Energy, US Department of Energy. 2023. Offshore Wind Market Report 2023 Edition. Washington
101. Offshore Wind | Electricity | 2024 | ATB | NREL
102. OperationalOffshoreFarms2009.pdf (ewea.org)
103. "OSPAR Commission (2004) Problems and benefits associated with the development of offshore windfarms.
104. Biodiversity Series. Available at: http://cvi.se/uploads/pdf/Kunskapsdatabas%20miljo/
105. Flora%20och%20fauna/Faglar/utredningar/p00212_Wind%20farms_Problems%20and%
106. 20benefits.pdf"
107. Parks, L. and Morgera, E., 2015. An interdisciplinary model for mapping the normative diffusion of fair and equitable benefit-sharing. Edinburgh School of Law Research Paper, (2015/22).
108. Planning application for 1,300MW Wicklow offshore wind farm to be submitted
109. Prässler, T. and Schaechtele, J., 2012. Comparison of the financial attractiveness among prospective offshore wind parks in selected European countries. Energy Policy, 45, pp.86-101.
110. Project delivery - Codling Wind Park
111. Projects – EDF Renewables

112. Rambøll and Danish Energy Agency (2023): “Job creation in a new industry – learnings from Denmark’s offshore wind journey
113. Record-Breaking Vestas 15 MW Offshore Wind Turbine Now Type-Certified | Offshore Wind
114. Rialtas na hEireann, (Government of Ireland), Department of Enterprise, Trade and Employment, Powering Prosperity: Ireland’s Offshore Wind Industrial Strategy
115. Rialtas na hEireann, (Government of Ireland), Department of the Environment, Climate and Communications, Draft Rules & Guidance for Offshore ORESS 1 Community Benefit Funds; July 2022
116. Rialtas na hEireann, (Government of Ireland), Department of the Environment, Climate and Communications, Renewable Electricity Support Scheme Good Practice Principles Handbook for Community Benefit Funds, 2021.
117. Rialtas na hEireann, (Government of Ireland), Department of the Environment, Climate and Communications; Climate Action Plan 2023 Summary; 2022 published;
118. Rialtas na hEireann, (Government of Ireland), Department of the Environment, Climate and Communications; Climate Action Plan 2023 v2; 2022 published; 2024 updated.
119. Rialtas na hEireann, (Government of Ireland), Offshore Wind Delivery Taskforce, 2023, Offshore Wind Energy Programme: Key Actions for 2023
120. Rialtas na hEireann, (Government of Ireland), Programme for Government: Our Shared Future, Published 2020, updated 2021
121. Rialtas na hEireann, (Government of Ireland), Renewable Electricity Support Scheme High Level Design, Published 2019
122. Rialtas na hEireann, (Government of Ireland), Terms and Conditions for the First Competition under the Renewable Electricity Support Scheme Supplementary Note in Relation to Citizen Investment, 2020
123. Rialtas na hEireann, (Government of Ireland), Terms and Conditions for the First Competition under the Renewable Electricity Support Scheme; Consultation Response Notice; February 2020

124. Rialtas na hEireann, (Government of Ireland), Terms and Conditions for the First Offshore Wind RESS Competition, ORESS 1, 5 April 2023 v1.2
125. Roe, A. (2019). Offshore Wind Power and the Policy Framework: Navigating the Risks and Opportunities. Renewable Energy Journal, 28(3), 123–136.
126. "Rudolph D (2014) The resurgent conflict between offshore wind farms and tourism: Underlying
127. storylines. Scottish Geographical Journal 130(3): 168–187"
128. Rudolph, D., Haggett, C. and Aitken, M., 2018. Community benefits from offshore renewables: The relationship between different understandings of impact, community, and benefit. Environment and Planning C: Politics and Space, 36(1), pp.92-117.
129. Salm, S., Hille, S.L. and Wüstenhagen, R., 2016. What are retail investors' risk-return preferences towards renewable energy projects? A choice experiment in Germany. Energy policy, 97, pp.310-320.
130. SEAI Co-Wind Project ; Community Engagement in Wind Energy: Innovative approaches to achieving a social license (Co-Wind) | Case Studies | SEAI
131. SEAI. (2023). Energy Poverty in Ireland. Sustainable Energy Authority of Ireland.
132. SEMOpx day-ahead and intraday electricity market trading for Ireland and Northern Ireland | Home
133. Seyfang, G. (2009). The New Economics of Community Energy: A Review of the Literature. Environment & Planning A, 41(7), 1721-1746.
134. Shaping Our Electricity Future | EirGrid
135. Simón, X., Copena, D. and Montero, M., 2019. Strong wind development with no community participation. The case of Galicia (1995–2009). Energy Policy, 133, p.110930.
136. Simson, K. for The European Commission (2023) COMMISSION RECOMMENDATION (EU) 2023/2407 of 20 October 2023 on energy poverty. Brussels. The European Commission

137. Sirr, G., Power, B., Ryan, G., Eakins, J., O'Connor, E. and le Maitre, J., 2023. An analysis of the factors affecting Irish citizens' willingness to invest in wind energy projects. Energy Policy, 173, p.113364.
138. SSE Renewables and Biggar Economics. 2024. Environmental Impact Assessment Report. Volume III, Appendix 21.1: Socio Economic Impact Report. Dublin
139. SSE. 2024. Powering Sustainable Growth. 2023/24 Full Year Results. Dublin
140. Strachan, P.A., Cowell, R., Ellis, G., Sherry-Brennan, F. and Toke, D., 2015. Promoting community renewable energy in a corporate energy world. Sustainable development, 23(2), pp.96-109.
141. Sweeney, S., & O'Neill, D. (2009). Just transition: A new path forward. Labour Studies Journal, 34(4), 467-487.
142. Szulecka, J., et al. (2020). Energy poverty in Europe: Mapping and policy recommendations. Energy Policy, 139, 111247.
143. The Carbon Trust; Harnessing Our Potential: Investment and Jobs in Ireland's Offshore Wind Industry, 2020
144. The world's most powerful wind turbine has set a world record | Electrek.
145. Toke, D. (2015). Community Benefit Funds and the role in addressing energy poverty. Energy Policy, 82, 1-8.
146. Upham, P. and Johansen, K., 2020. A cognitive mess: Mixed feelings about wind farms on the Danish coast and the emotions of energy infrastructure opposition. Energy Research & Social Science, 66, p.101489.
147. Vuichard, P., Stauch, A. and Dällenbach, N., 2019. Individual or collective? Community investment, local taxes, and the social acceptance of wind energy in Switzerland. Energy Research & Social Science, 58, p.101275.
148. Walker, B.J., Wiersma, B. and Bailey, E., 2014. Community benefits, framing and the social acceptance of offshore wind farms: an experimental study in England. Energy Research & Social Science, 3, pp.46-54.
149. Watson, D., Williams, J., & O'Rourke, K. (2020). The Impact of Income Inequality on Energy Poverty. Irish Journal of Public Policy, 32(2), 141-157.
150. What Is The Average Gas and Electricity Bill in Ireland?.

151. Wholesale Electricity Prices Ireland | Charts Updated Daily
152. Wind Curtailment Level in Ireland: Past, Present and Future.
153. Wind farm costs – Guide to an offshore wind farm
154. WindEurope. 2024. Offshore wind energy 2024 mid-year statistics. Brussels
155. WindEurope. 2024. Wind energy in Europe, 2023 Statistics and the outlook for 2024-2030. Brussels
156. World Forum Offshore Wind. 2022. Financing Offshore Wind. Location?