4 POPULATION AND HUMAN HEALTH

4.1 FIRLOUGH INTRODUCTION

4.1.1 Background and Objectives

This Chapter of the EIAR assesses the impacts of the Proposed Development (**Figure 1.2**) on population and human health. The Proposed Development refers to all elements as defined in **Chapter 2: Project Description**. Where negative effects are predicted, the chapter identifies appropriate mitigation strategies therein. The assessment considers the potential effects during the following phases of the Proposed Development:

- Construction of the Proposed Development
- Operation of the Proposed Development
- Decommissioning of the Proposed Development

This chapter is supported by **Appendix 4.1: Shadow Flicker Assessment** and **Appendix 1.3: Common Acronyms.**

4.1.2 Statement of Authority

This chapter has been prepared by Sarah Jones, Aileen Byrne and David Kiely.

Sarah Jones is an Environmental Scientist and Planner and holds a first-class MSc in Environmental Sustainability from University College Dublin and a Bachelor (Hons.) Degree in Geography from Manchester Metropolitan University. Sarah has recently developed a specialist knowledge of hydrogen production and her key capabilities include Environmental Impact Assessment (EIA) screenings, Appropriate Assessment (AA) screenings, Planning and Environmental reports and Applications, Environmental Impact Assessments, Feasibility Studies, Construction Environmental Management Plans, Stakeholder Engagement, Project Management.

Ms. Aileen Byrne is an Environmental Scientist, who holds a Bachelor (Hons) Degree in Geography and Information Technology from the National University of Ireland, Galway, and a Higher Diploma in Environmental Science from the University of Limerick. She forms part of the Environmental team responsible for preparing the EIAR Chapters. Aileen has experience in writing EIARs, Feasibility Studies and in Shadow Flicker analysis.

David Kiely is a Director of JOD who holds a BE in Civil Engineering from University College Dublin and MSc in Environmental Protection from IT Sligo. He is a Fellow of Engineers Ireland, a Chartered Member of the Institution of Civil Engineers (UK) and has over 40 years'

experience. He has extensive experience in the preparation of EIARs and EISs for environmental projects including Wind Farms, Solar Farms, Wastewater Projects, and various commercial developments. David has also been involved in the construction of over 60 wind farms since 1997.

4.1.3 Relevant Legislation and Guidance

The population and human health section of this EIAR is carried out in accordance with legislation and guidance contained in **Chapter 1: Introduction** and the separate report titled**: Planning Policy Context**. The design and construction of the Proposed Development including the installation of associated equipment such as the Hydrogen Plant, switchgear and substations is governed by the 2005 Safety, Health and Welfare at Work Act, The Safety, Health and Welfare at Work (General Application) Regulations 2007 and also by S.I. 291 The Safety, Health and Welfare at Work (Construction) Regulations, 2013 as amended and, in the case of the Hydrogen Plant, Directive 2012/18/EU on the control of major accident hazards involving dangerous substances (the "Seveso III Directive"), along with the Chemical Act (Control of Major Accident Hazards involving Dangerous Substances) Regulations, 2015 which implements the SEVESO in Ireland.

The EIA Directive does not define the term 'human health', however the 2017 EC Guidance[1] on the preparation of the EIAR states that "*human health is a very broad factor that would be highly project dependent. The notion of human health should be considered in the context of the other factors in Article 3(1) of the EIA Directive and thus environmentally related health issues (such as health effects caused by the release of toxic substances to the environment, health risks arising from major hazards associated with the Project, effects caused by changes in disease vectors caused by the Project, changes in living conditions, effects on vulnerable groups, exposure to traffic noise or air pollutants) are obvious aspects to study. In addition, these would concern the commissioning, operation and decommissioning of a Project in relation to workers on the Project and surrounding population*".

4.1.4 Assessment Structure

In line with the EIA Directive as amended and current EPA guidelines[2] the structure of this chapter is as follows:

- Assessment Methodology and Significance Criteria – a description of the methods used in desktop surveys and in the assessment of the significance of effects.

[1] EC. (2017). Guidance on EIAR. https://circabc.europa.eu/ui/group/3b48eff1-b955-423f-9086-0d85ad1c5879/library/b7451988-d869-4fee-80de-0935695f67f2/details
[2] *Guidelines on the Information to be contained in Environmental Impact Assessment Reports* (EPA, 2022)

- Baseline Description – a description of the socio-economic profile of the local area of the Development, i.e., of local electoral areas and of County Mayo and County Sligo and based on a desk-based study using Central Statistics Office (CSO) data.
- Assessment of Potential Effects – identifying the ways in which the population and human health of the area could be affected by the Development.
- Mitigation Measures and Residual Effects – a description of measures recommended to avoid, prevent, reduce or, if necessary, offset any potential significant adverse effects and a summary of the significance of any residual effects of the Development after mitigation measures have been implemented.
- Cumulative Effects – identifying the potential for effects of the Development to combine with those from other existing and / or permitted projects to affect the population and human health.
- Summary of Significant Effects.
- Statement of Significance.

With respect to the EIA Directive as amended, Section 1.2.2 of the Revised EIA Directive Consultation (outlined in **Section 4.1.3**), this chapter of the EIAR amalgamates the findings of other assessments undertaken as part of the EIA process. Limited interactions with Human Health are possible and consideration has been given to the findings of the following assessments:

- Soils and Geology: Chapter 8
- Hydrology and Hydrogeology: Chapter 9
- Air and Climate: Chapter 10
- Noise: Chapter 11
- Traffic and Transportation: Chapter 15
- Major Accidents and Natural Disasters: Chapter 16

Where appropriate, mitigation measures have been proposed to avoid, prevent, reduce or, if necessary, offset any identified significant adverse effects.

All activities on the Development will be in accordance with the requirements of the Safety, Health and Welfare at Work Act 2005 as amended and Regulations made under this Act.

4.1.5 Scope of the Assessment

The effect of a development on population and human health includes the following broad areas of investigation:

- Public Interest

- Population and Settlement Patterns
- Economic Activity
- Employment
- Tourism
- Residential Amenity
- Property Value
- Human Health including Shadow flicker, Major Accidents and Natural Disasters

Where a significant negative impact can be foreseen, it is prevented, reduced, avoided or, if necessary, offset by way of practical mitigation measures. This assessment considers the following criteria:

- Sensitive receptors in the area
- General amenities in the area
- Potential effects from electromagnetic fields, water, noise, shadow flicker, air quality and major accidents and natural disasters

4.2 ASSESSMENT METHODOLOGY

A desk study was undertaken using the Central Statistics Office (CSO) data (2022 preliminary results, 2016 and 2011) with a review of the Mayo County Development Plan 2022-2028 and Sligo County Development Plan 2017-2023. Consideration was also given to the 2015[3] report produced by the EPA entitled 'Investigation into the Assessment of Health Impacts within National Environmental Regulation Processes' that outlines how human health impacts are dealt with, throughout the European Union (EU) by environmental regulators with an emphasis on the role at the planning / environment interface.

4.2.1 Definition of Study Areas

Four geographical Study Areas have been outlined for this assessment:

- Study Area One: The Development and Environs; 231.1 km^2
- Study Area Two: Mayo County; 5,588 km^2
- Study Area Three: Sligo County; 1,837 km^2
- Study Area Four: Ireland; 70,274 km^2

Note: Study Area One lies within Study Area Two and Three and information outlined for Study Area Two and Three incorporates data for Study Area One.

[3] Golder Associates (2015) *Investigation into the Assessment of Health Impacts within National Environmental Regulation Processes*. Available online at: https://www.epa.ie/publications/research/environment--health/assessment-of-health-impacts-report.php , Accessed 06/12/2022.

Study Area One: The Development and Environs – Electoral Divisions (EDs) Kilgarvan (Co. Mayo), Castleconor East (Co. Mayo), Castleconor West (Co. Sligo), Ardnaree North (Co. Mayo), Mullagheruse (Co. Sligo) and Breencorragh (Co. Sligo).

To make inferences about the population and other statistics in the vicinity of the Wind Farm Site and Hydrogen Plant Site, Electoral Divisions (ED) in Study Area One were analysed. The Wind Farm Site lies within Kilgarvan ED, Co Mayo, the Hydrogen Plant Site lies within the ED of Castleconor West, Co. Sligo. The neighbouring EDs of Castleconor East, Ardnaree North, Mullagheruse and Breencorragh have been included in Study Area One. These are shown in **Figure 4.1.**

The townlands within these EDs are shown in **Table 4.1.**

Table 4.1: Townlands within the Electoral Divisions (EDs) of Study Area One

Castleconor West	Ardnaree North	Castleconnor East	Mullagheruse	Kilgarvan	Breencorragh
Attichree	Ardvally	Carns	Bellanaboy	Bunnyconnellan East	Castlerock
Ballymoghany	Bellanir	Cloonkeelaun	Crowagh or Dunneill	Bunnyconnellan West	Cloonca
Ballymoneen	Castleconor	Muingwore	Fiddandarry	Carha	Drummartin
Bartragh	Corimla North	Tawnalaghta	Letterunshin	Carrowleagh	Gortersluin
Bunnanilra	Corimla South	Tullylin	Tawnadremira	Carrownaglogh	Largan
Carraun	Dooyeaghny		Tawnamore	Carrownlabaun	Meenagleragh
Carrowcardin	Farrangarode		Tawnatruffau	Cloonta	Meenaglogh
Carrowgarry	Farranmorgan		Trasgarve	Drumsheen	Meenamaddoo
Carrowgun	Lugnamannow			Rathreedaun	Ounagh
Carrownurlar	Quignalegan				Tawnaneilleen
Corballa	Quignamanger				Tullaghaglass
Cottlestown	Quignashee				
Doneen	Rathdonnell				
Emlymoran	Rathmeel				
Farranimrish					
Fiddaun					
Killanly					
Knockàgower					
Knockbrack					
Lecarrownaveagh					
Muckduff					

Castleconor West	Ardnaree North	Castleconnor East	Mullagheruse	Kilgarvan	Breencorragh
Newtown					
Rathglass					
Rathmurphy					
Rinroe					
Scurmore					

4.2.2 Consultation

Consultation with relevant organisations began during the initial stage of the EIA process to identify any effects that could be initiated by the Project. In relation to Population and Human Health, two responses were received and are shown in **Table 4.2.**

Table 4.2: Summary of Consultation response on Human Health

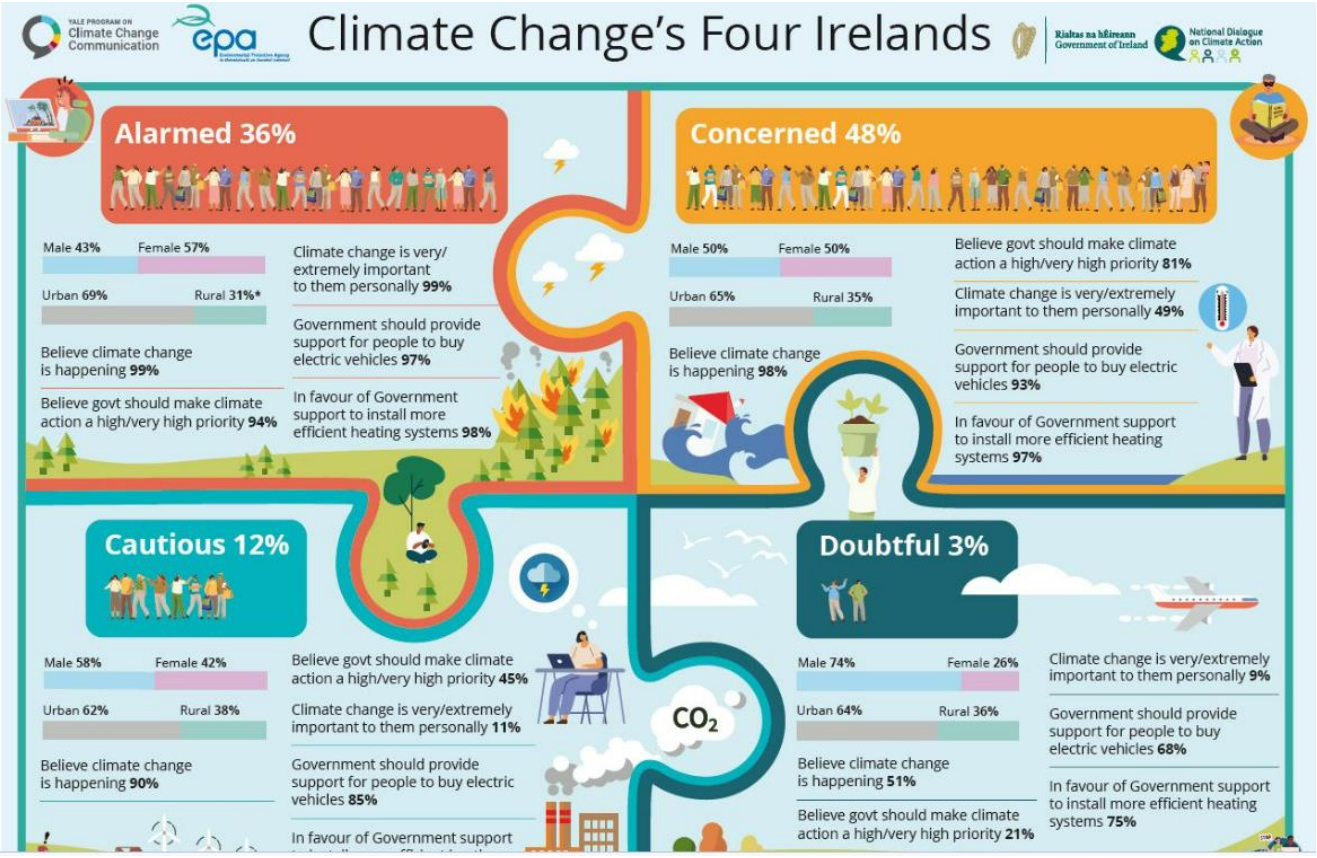
Health Service Executive	Letter in Response to first round of scoping received on 7th January 2021	The HSE recommendation that the following matters be considered in the EIAR; Positive and negative likely significant impacts, Public Consultation; Decommissioning phase; Siting and location of turbines, Opportunity for Health Gain; Noise and Vibration; Shadow Flicker; Air Quality; Surface and Groundwater Quality; Geological Impacts; Ancillary facilities; and Cumulative impacts. Recommendation that a dedicated website for the proposed wind energy project be created. **Opportunity for Health Gain**: "*The proposed development should be assessed with a view to the potential to include opportunities for health gain within the site of the proposed wind farm by including greenways, cycle-paths or walking trails within the development site.*"
Health Service Executive	Letter in response to second round of scoping (including hydrogen element) received 21/4/2022	As Hydrogen production is a new technology in Ireland, it is important that clear, easy to understand and site specific information is provided to the public at the earliest opportunity Sensitive receptors and stakeholders should be identified and mitigation put in place to avoid complaints. Link should be demonstrated between public consultations and decision making process. Details requested on the decommissioning of the Hydrogen facility. Details of underground storage tanks for hydrogen should be provided if these are to be used. (they are not) The source and volume of water required for hydrogen production should be detailed in the EIAR.

		EIAR should include measures proposed to mitigate the impact of any potential hydrogen leakage during production, storage and transportation. Methods of disposal and the potential impacts of any wastewater generated as a result of the purification process should be described as should method/disposal/treatment and impacts of waste water produced by the electrolyser.

4.3 BASELINE DESCRIPTION

4.3.1 Public Interest

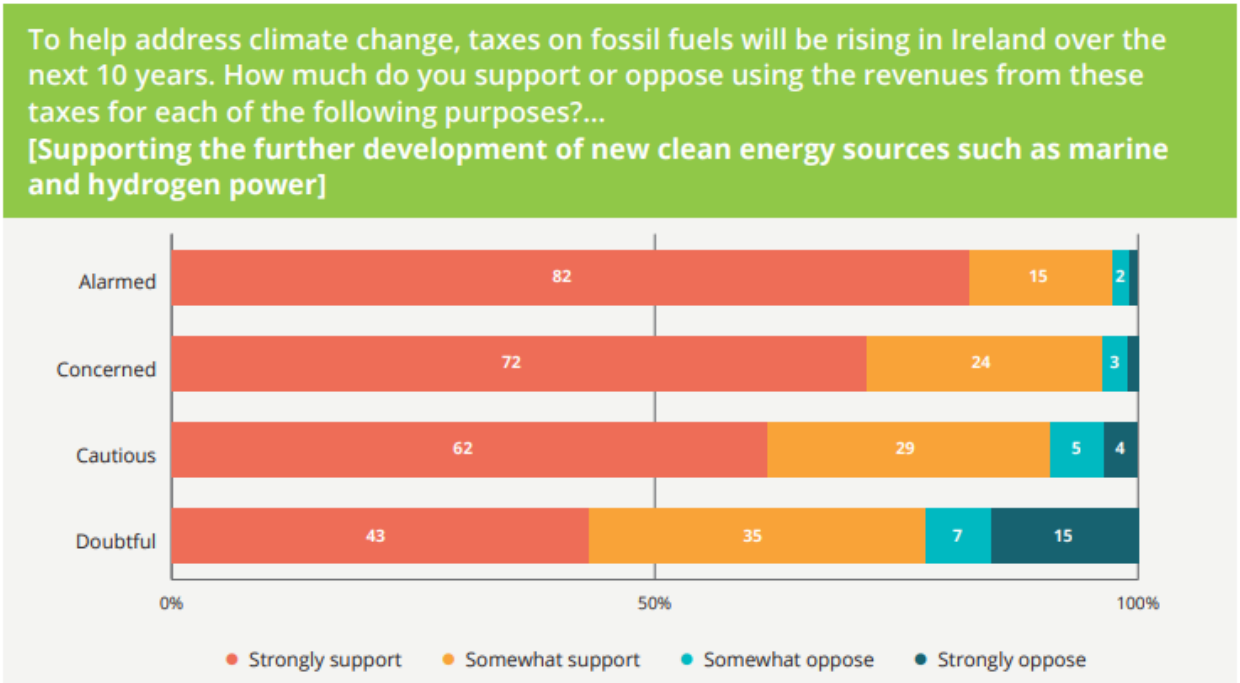
In 2022, the EPA released The Climate Change in the Irish Mind report[4], a study of the Irish population's beliefs, attitudes, policy preferences and behaviours regarding climate change. The report found that 84% of the 84,961 people interviewed were either "Alarmed" or "Concerned" about Climate Change. **Graphic 4.1** shows an infographic produced for the report that displays the headline results.



Graphic 4.1: Headline Results of the EPA's (2022) Climate Change's Four Irelands; An Audience Segmentation Analysis.

[4] EPA. (2022). https://www.epa.ie/publications/monitoring--assessment/climate-change/climate-changes-four-irelands.php Accessed 06/12/2022.

The results show that the pressing and urgent need to address climate change is no longer a fringe issue, the overwhelming majoring of the Irish public surveyed view climate change as a concern and want to see action taken to combat it. One of the survey questions included supporting the use of new technologies, with hydrogen given as an example, the results show the overwhelming support of the Irish public surveyed for these new technologies to tackle climate change (**Graphic 4.2**).



Graphic 4.2: Survey Results regarding New Renewable Energy Technology from the EPA's (2022) Climate Change's Four Irelands; An Audience Segmentation Analysis

The European Commission presented the REPowerEU plan on 18 May 2022[5]. The plan recommended that an amendment be made to the Renewable Energy Directive which would recognise renewable energy as an "overriding public interest". Since the Russian invasion of Ukraine, energy prices in Ireland have increased significantly. The SEAI's Electricity Prices in Ireland Report; January to June 2022[6], found on average residential electricity prices increased 10.4% in the 12 months prior to June 2022 (note this includes a €200 rebate).

[5] REPowerEU: A plan to rapidly reduce dependence on Russian fossil fuels and fast forward the green transition; European Commission – Press Release. Available online: https://ec.europa.eu/commission/presscorner/detail/en/IP_22_3131 Accessed 06/12/2022.
[6] SEAI. (2022). https://www.seai.ie/publications/SEAIs-EPR-data-for-JAN-to-JUN-2022.pdf Accessed 06/12/2022.

Concern over energy costs amongst the population of Ireland is high, a survey by the Journal in October 2022[7] found that 77% of people said that they already or intend to use their home heating less often, while 76% have already or intend to delay putting the heating on. The Economic and Social Research Institute (ESRI)[8] report on Energy Poverty published in 2022, has also warned that as many as 43% of households could now be in energy poverty, defined as when more than 10% of the household's income is spent on electricity and gas bills.

4.3.2 Population and Settlement Patterns

Study Area One: The Development and Environs; EDs; Kilgarvan (Co. Mayo), Castleconor East (Co. Mayo), Castleconor West (Co. Sligo), Ardnaree North (Co. Mayo), Mullagheruse (Co. Sligo) and Breencorragh (Co. Sligo).

The Wind Farm Site measuring an area of 445 hectares, is located on the western hill slopes of the Ox Mountains or Slieve Gamph Mountains, 6.7 km east of the N59 national route which connects Sligo City via Ballysadare, with Ballina town. The Wind Farm Site lies within the administrative area of Mayo County Council in the Kilgarvan ED (population 847 in 2022, see **Table 4.3**). The surrounding area is largely rural, with a mixture of agricultural grassland, commercial forestry plantations, private roads and public roads. Isolated residences and farmsteads are also scattered throughout the area. Rough grazing accounts for the largest proportion of farmland, followed by pasture.

The Hydrogen Plant Site measuring 6.5 hectares, lies within the administrative area of Sligo County Council, in the Castleconnor West ED (population 1,097 in 2022). It is 600 m off the national road N59 on agricultural lands currently used for horse grazing.

The total population of Study Area One was 3,506 in 2022, this has increased from 3,266 in 2016 (+7.25%) see **Table 4.3**. The village of Bunnyconnellan, (Co. Mayo), with a population of 188[9] in the 2016 census, is located 4 km to the southwest of the Wind Farm Site and 5.3 km southwest of the Hydrogen Plant Site. The main centre for this region, Ballina, population 10,171, (Co. Mayo), is located 12 km to the west of the Wind Farm Site and 5.5 km southeast of the Hydrogen Plant, Tobercurry, population 1,986, (Co Sligo), is located 17 km to the southeast and Inishcrone, population 1,156, (Co. Sligo), is located 12 km to the northwest of the Wind Farm Site.

[7] The Journal. (2022). Cost of living crisis: Most households intend to use their home heating less often this winter https://www.thejournal.ie/poll-energy-use-ireland-heating-5891701-Oct2022/ Accessed 06/12/2022.
[8] ESRI. (2022). Energy poverty at highest recorded rate https://www.esri.ie/news/energy-poverty-at-highest-recorded-rate Accessed 06/12/2022.
[9] Central Statistics Office (CSO). 2016 Census data. https://www.cso.ie/en/databases/ Accessed 06/12/2022

Table 4.3: Population Dynamics Study Areas One to Four according to the CSO 2022 Census (preliminary results).

Study Area		Total Population 2022
Study Area One	Kilgarvan ED	847
	Castleconor East ED	239
	Templeboy South/ Mullagheruse ED	264
	Breencorragh ED	110
	Castleconor West ED	1097
	Ardnaree North ED	946
	Total Study Area One	**3,506**
Study Area Two	Mayo County	**137,231**
Study Area Three	Sligo County	**69,819**
Study Area Four	Ireland	**5,123,536**

The population density of Study Area One is 15.16 persons per km^2, this compares to a population density of 72 persons per km^2 for Study Area Four (Ireland). Housing density in the area surrounding the Wind Farm Site is generally very low, there are no inhabited houses on one side as the topography rises towards the Ox Mountains. Inhabited houses only start to appear lower down to the west and south of the Wind Farm Site within farmland. Inhabited houses are primarily farmhouses, one-off-houses and some ribbon development nearer to villages. There are no inhabited houses within the mandatory minimum setback distance of 500 m from any turbine. There is one inhabited house located within 740 m of the turbines (4 x maximum tip height), which is located 725 m from T3. The owner and occupier of this house is financially involved in the project and has provided written agreement accepting the reduced setback distance and has no objection to the proposed wind energy development. There are 18 inhabited houses in total within 1.5 km of any turbine and 46 houses within a 2 km radius of the Wind Farm Site. Housing density in the area surrounding the Hydrogen Plant Site is also generally low with 22 houses within 1 km of the Hydrogen Plant Site. The Project includes the demolition of 1 no. house near to the entrance to the Hydrogen Plant from the N59 and the construction of a new dwelling. These findings confirm that the Proposed Development is located within a sparsely populated area.

Over the last five years, Mayo County Council and Sligo County Council have granted planning permissions in Study Area One which include two extensions to wind farms, two grid connections relating to wind energy, a meteorological mast, extensions to a substation,

one off housing, alterations to existing dwelling houses, development of new housing, agricultural buildings, retail units, care home facilities, offices, childcare facilities, forestry access roads, communications antennas, school extensions, landfill sites, dog boarding kennels, recreational facilities include extensions to a golf club, hotels/hostels, glamping facilities, sports facility upgrades.

In the Mayo County Development Plan 2022-2028 in Chapter Three Housing, Ardnaree North ED is classified as a Rural Area Under Strong Urban Influence, described as:
"*These areas include the open rural countryside around the Tier I (Strategic Growth Towns) and Tier II (Self-Sustaining Growth Towns) towns. They have been designated to support the sustainable growth of the urban areas, to provide for the immediate, local rural community who have a genuine housing requirement, while directing urban generated housing into designated settlements, maintaining their vitality and viability."*

Kilgarvan ED is classified as a Remaining Rural Area, defined as:
"*These areas comprise of all other rural areas outside of the identified pressure areas under strong urban influence…..In these areas, the Council recognises the importance of retaining population and supporting the rural economy, while seeking to consolidate the existing rural town and village network."*

Previously, the Kilgarvan ED was classified as a Structurally Weak area in the Mayo County Development Plan 2014-2020, and prior to this it was classified as "unzoned rural lands". These are areas that have experienced low population growth or decline in recent decades, are outside the positive influence of Linked Hub towns and Key Towns and have been identified in the National Planning Framework as areas requiring encouragement to sustain population levels. Within Kilgarvan, the area around Bunnyconnellan is classified as Tier IV Rural Settlements Towns and Villages With Populations Of Greater Than 50 But Less Than 500, described as; "*Towns and villages with local service and limited employment functions, which play an important role in supporting the social, economic and cultural life within rural communities."*

The Sligo County Development Plan 2017-2023 states that the four Sligo Co. Eds; Castleconor West, Castleconor East, Templeboy South/Mullagheruse and Breencorragh are classified as "Rural Areas in Need of Regeneration", described as:
"*These areas have a weaker economy and fewer settlements. Historically, they experienced persistent or significant population decline. In these areas, the challenge is to retain*

population and support the rural economy while seeking to consolidate existing settlements."

Study Area Two: County Mayo

County Mayo is located on the west coast of Ireland in the province of Connacht. It is the third-largest county by area in Ireland and the second largest county in Connacht in size and population. Mayo has a population of 137,231 (Preliminary results; CSO 2022), this has increased slightly (5.15%) from the 2016 census (see **Table 4.3**). County Mayo experienced significant population decline from the Great Famine (population 390,000 in 1841) until the 1970s (population 10,000 in 1971). During the period 1971-1991 the population fluctuated, before reaching a gradual increase over the 1991-2022 period.

Population density in County Mayo is 23 people per km^2 compared to 72 per km^2 in Study Area Four (Ireland). The total number of households in County Mayo was 48,899 in 2016 (the most recent figure available for this metric), a small increase (0.02%) from the 2011 census.

Castlebar is the largest town in Study Area Two with a population of just over 12,000, followed by Ballina (10,171), Westport (6,198), Claremorris (3,687) and Ballinrobe (2,786). Ballina, Castlebar and Westport are classified as Strategic Growth Towns in the Mayo County Development Plan 2022-2028 and are considered the main regional urban areas and strategic employment centres. Castlebar is the main administrative, public health, education and commercial centre in the county, providing over 9,000 jobs. Over 71% of people in Mayo live in rural areas. Mayo has the third largest Gaeltacht region in Ireland with 10,886 inhabitants, representing 11.5% of the total Gaeltacht population in the state.

Study Area Three: County Sligo

Located in the province of Connacht in northwest Ireland, County Sligo encompasses a total area of approximately 1,837 km^2, with over 200 km of coastline. The total population in the 2022 census was 69,819, which has increased (6.54%) from the 2016 census. Between the 1996 and 2022 Census, the population of Sligo increased by 29%, following the overall state growth trend. Population density is 35.7 people per km^2 compared to 72 per km^2 in Ireland. The total number of households was 24,831 in 2016 a small increase (0.01%) from 2011.

The city of Sligo Is the largest centre of population in northwest Ireland, with a population of 19,199 in 2016. Sligo serves as an administrative, employment, commercial, health and

education centre for a large hinterland. Sligo has two third-level colleges; the Atlantic Technological University Sligo and the associated St. Angela's College.

Study Area Four: Ireland

The population of Ireland has increased from 4,761,865 in 2016 to 5,123,536 in the preliminary 2022 census results, an increase of 7.6%[10]. This is the highest population figure since 1851 and the first time the population has exceeded five million since 1851. A comparison to other study areas in shown **Table 4.4**. Ireland has seen rapid population growth in recent years with an improved standard of living and infrastructure growth resulting in a net inflow of the population.

Table 4.4: Population change over Study Areas One to Four from 2016 to 2022

Study Area	Population 2016 Census	Population 2022 Census	Percentage Population Change
Study Area One; Development and Surrounds	1,286	3,506	7.25
Study Area Two: Mayo County	130,507	137,231	5.5
Study Area Three; Sligo County	65,535	69,819	6.54
Study Area Four; Ireland	4,761,865	5,123,536	7.6

4.3.3 Economic Activity

4.3.3.1 Primary Sectors

Study Area One: The Development and Environs

The main sectors in this Study Area are agriculture and commercial forestry. These eDs exhibit characteristics of a weaker economic structure.

Study Area Two: Mayo County

The county has a strong network of towns, villages and settlements that provide a diverse range of services, including civic uses, retailing, professional services, hospitality and

[10] CSO. (2022). https://www.cso.ie/en/csolatestnews/pressreleases/2022pressreleases/pressstatementcensusofpopulation2022-preliminaryresults/ Accessed 06/12/2022

tourism related services. Mayo has an extensive national road and rail network, strong digital infrastructure and has a broad range of industries with over 4,000 businesses ranging from start-ups to large multinational companies including Baxter, Allergan, Hollister and Ballina Beverages.

Ballina is identified as a key town in the Mayo County Development Plan 2022-2028 and a key economic driver in the northwest of the county. Castlebar, also a key town, is identified as the main centre for commerce and enterprise, administration, healthcare and education in the county. Westport is identified as a key economic driver in the county and as a national tourism hub.

Much of the population in County Mayo is rural based. Significant areas of rural economic activity include agriculture, construction, engineering, manufacturing, quarrying, tourism related services, transport, energy production, equine, forestry, food, education, waste disposal and health care. Agriculture is a significant source of economic activity across the county contributing to exports and providing the raw materials for the food processing industry. There were 11,920 farms in 2020[11], however had decreased from 12,458 farms in 2010[12].

Mayo had 15 no. wind farms, producing 266 MW of renewable energy in Q1 2020, approximately 6% of Irelands overall wind energy production[13].

The county contains Ireland West Airport Knock, which provides an international gateway to the region. This is located within a Strategic Development Zone which has the potential to become a major enterprise and employment hub within the Atlantic Economic Corridor.

Study Area Three: Sligo County

The economy of County Sligo has strengths in the areas of professional services, commerce and trade, manufacturing and the public sector. Sligo city has become a regionally important urban centre, serving as the administrative, commercial, service, health and educational focus for a large hinterland. It has a significant industrial role and acts as a distribution centre for the northwest region. Several international companies have located here, including 19 multinational companies in the IDA business parks in County Sligo (Finisklin, Ballytivnan, Collooney, Tobercurry and Ballymote). These business parks are the centre of industry and

[11] CSO (2020) https://data.cso.ie/# Accessed 06/12/2022
[12] Census of Agriculture CSO 2010 https://www.cso.ie/en/releasesandpublications/ep/p-1916/1916irl/economy/ag/ Accessed 06/12/2022
[13] https://www.mayo.ie/getmedia/aae4ebe0-808a-40ac-a306-01d849cd1fa0/Vol-1-Draft-Mayo-County-Development-Plan-2021-2027-FINAL.pdf Accessed 06/12/2022

employment for the county with 7,133 employees in 2016, 27% of the total working population of the county. Sligo City is served by road and rail-based public transport as well as a port facility, allowing for the import and export of goods. Tobercurry is the County's second largest employment centre.

Agriculture is an important part of the local economy outside of major urban areas with 4,181 farms in 2020. This has decreased from 4,395 farms in 2010. The Sligo County Development Plan 2017-2023 identifies that the constant decline in agricultural employment over past decades has led to high deprivation in rural areas and suggests that diversification in rural County Sligo is needed to combat the continuation of decline. Tourism and other small-scale, rural-based economic activities continue to support a substantial population living in villages and in the countryside.

4.3.4 Employment

4.3.4.1 Study Area One: The Development and Environs

In Study Area One, 51.83% of people are in the "At Work" category, which is below the national average of 61.9%. The largest group not at work in this area are "Retired" with 19%, followed by "Student" with 10% and "looking after home or family" at 8.6% (CSO 2016, the latest available employment sector metrics at the time of writing).

Study Area One has the highest employment in the sectors Professional services with 23%, Commerce and trade with 23%, Agriculture, forestry and fishing with 15%, Manufacturing with 13%, Public administration 7%, Building and construction 7% and Transport and communications 4%. 147 people in this study area work in the construction and transport industries which will potentially benefit from increased employment from the Proposed Development (CSO 2016).

4.3.4.2 Study Area Two: Mayo County

There were 51,439 people either working or looking for work in County Mayo in 2016, giving a Labour Force Participation Rate of 57.7%, which is below the national average of 61.9%. The breakdown of labour force is shown in **Graphic 4.3**. The labour force in Co. Mayo declined by 1.5% between 2011 and 2016, this compares to a 3.2% growth nationally. By industry, 11,985 (23%) are employed in professional services, 10,285 (20%) in commerce and trade and 7,312 (14%) in manufacturing industries. Agriculture, forestry and fishing with 4,395 employees remains an important sector in rural areas. Co. Mayo has double the

national average employment in agriculture, however, since 2011 this has declined by 17.9%, higher than the national average decline of 2.6%[14].

The largest employers in County Mayo are Wholesale and Retail, Industry and Health. Industry employment grew strongly between 2011 and 2016, increasing by 14%, higher than the national growth of 9.4%. Health also grew more than the national rate, increasing by 15.7% compared to 13.4% nationally.

The industries most relevant to the Development are Building and Construction and Transport and Communications, in Co. Mayo, in the 2016 census 5,513 people were employed in these industries, representing approximately 11% of the employed work force.

In the census, the category 'Intermediate Occupational Group' gives a more detailed breakdown of employment types. In "Skilled Construction and Building Trades" 2,781 people were employed in 2016 in County Mayo, this has reduced by 24% since 2011. In "Transport and Mobile Machine Drivers and Operatives" 1,996 people were employed in 2016, a reduction of 6% since 2011.

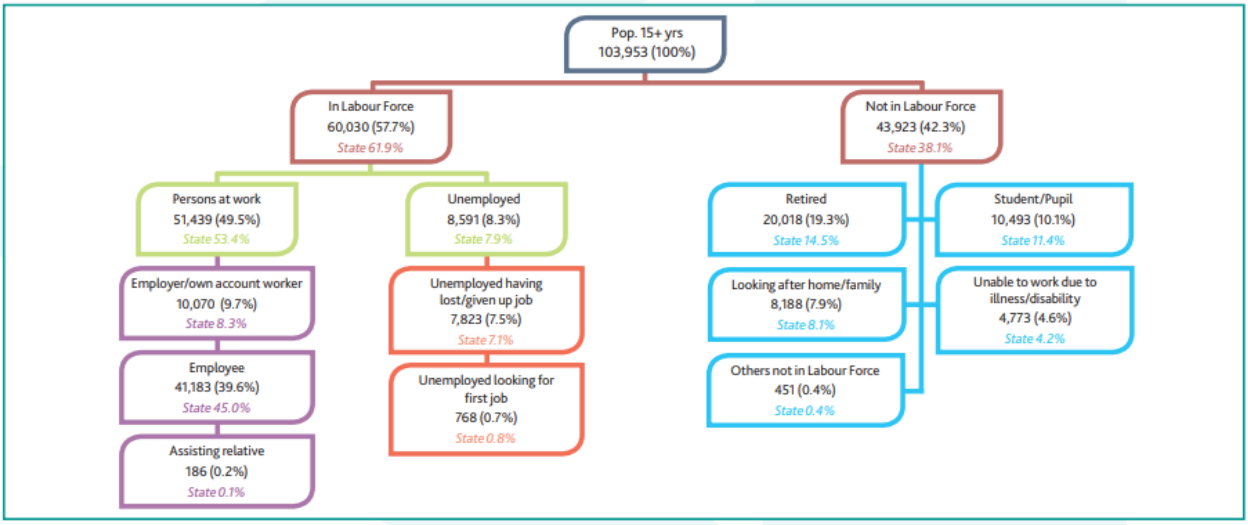
Of those outside the labour force, "Retired" is the largest group at 19.3% which is higher than the national average of 14.5%, and the highest in the state. This is linked to the 17.6% of population aged over 65 in County Mayo, higher than the state average of 13.4% (shown in **Table 4.5)**. The next highest not in work group is "Student" at 10.1% which is slightly below the national average of 11.4%. "Looking after home/family" accounts for 7.9% and "Unable to work due to permanent sickness or disability" makes up 4.6%.

Table 4.5: Percentage of Population by Age categories of Study Areas 1-4

Area	Age Category				
	0-14	15-24	25-44	45-64	65+
Study Area One; The Development and Environs	17.9%	11%	20.3%	30.8%	20%
Study Area Two County Mayo	20.4%	10.8%	24.6%	26.6%	17.6%
Study Area Three County Sligo	20.3%	12.2%	25.6%	25.7%	16.2%
Study Area Four Ireland	21.1%	12.1%	29.5%	23.8%	13.4%

[14] WDC. (2016). https://westerndevelopment.ie/wp-content/uploads/2020/08/WDC-Insights-County-Mayos-Labour-Market-Census-2016-Oct-17.pdf Accessed 06/12/2022.

Table 4.5 indicated that there is a general migration of younger people out of Study Areas One, Two and Three as the age category 25-44 is higher in Study Area 4, Ireland.



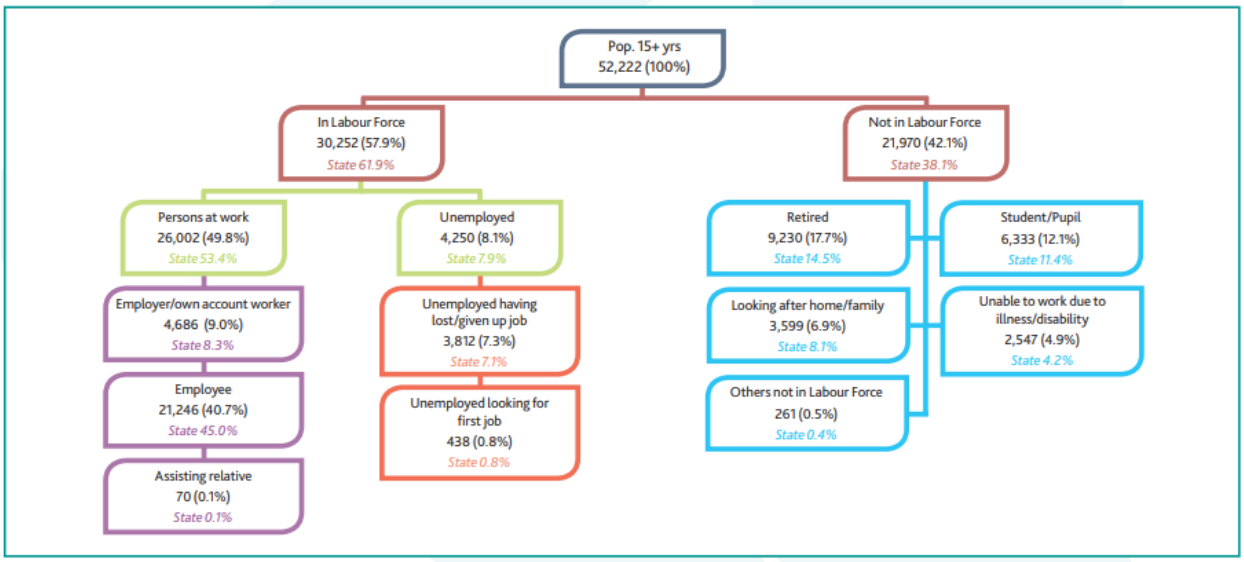
Graphic 4.3: Population of County Mayo aged 15 years and over by principal and labour force status, 2016 from Western Development Commission analysis[15].

4.3.4.3 Study Area Three: Sligo County

There were 26,002 people either working or looking for work in County Sligo in 2016, giving a Labour Force Participation Rate of 57.9%, which is below the national average of 61.9%. The labour force in Co. Sligo increased by 2.2% since 2011, which compares to 3.2% growth nationally. The breakdown of labour force status for Co. Sligo is shown in **Graphic 4.4**.

[15] WDC. (2017). https://westerndevelopment.ie/wp-content/uploads/2020/08/WDC-Insights-County-Mayos-Labour-Market-Census-2016-Oct-17.pdf Accessed 06/12/2022.

Fig. 1: Population of county Sligo aged 15 years and over by principal and labour force status, 2016



Graphic 4.4: Population of county Sligo by labour force status 2016 from the Western Development Commission[7].

By industry, 7,203 people (27.7%) are employed in Professional Services, 4,894 (18.8%) in Commerce and Trade, 3,262 (12.5%) in Manufacturing Industries and 1,952 (7.51%) in Public Administration. The industries most relevant to the Proposed Development are Building and Construction and Transport and Communications, in County Sligo, in the 2016 census, 2,389 people were employed in these industries, representing approximately 9% of the employed work force. The census category 'Intermediate Occupational Group' gives a more detailed breakdown of employment types. In 2016 in Co. Sligo 834 people were employed in "Transport and Mobile Machine Drivers and Operatives", a decline of 20% since 2011. Similarly, "Skilled Construction and Building Trades" also declined, from 1,573 in 2011 to 1,080 in 2016, a 31% decrease. Overall, construction between 2011 and 2016 declined by 0.3%, this contrasts with strong national growth of 16.6%, showing that County Sligo did not benefit from the national upswing in the sector.

Agriculture, Forestry and Fishing with 1,868 employees, remains an important sector in rural areas and increased 8.5% from 2011 to 2016, this compared to a 2.6% decline nationally. The Accommodation and Food Service sector grew 7.8% compared with 12.9% nationally. This sector could benefit from the Proposed Development during the construction and decommissioning phases.

Knowledge intensive services for example, Professional, Scientific and Technical activities, Financial, Insurance and Real Estate and Information and Communications, are among the smallest employers in the county and less important than nationally. Though growth was

seen in Information and Communications of 7.4% and Professional Services of 13.2% this was below the State averages of 31.4% and 22.2% respectively[16].

Of those outside the labour force, "Retired", is the largest group at 17.7% which is higher than the national average of 14.5%. Sligo has a higher proportion of population over 65 at 16.2% compared to the national average of 13.4% as shown in **Table 4.5**. The category of "Student" is at 12.1% which is above the national average of 11.4%, this was likely influenced by IT Sligo, now ATU Sligo. "Unemployed Having Lost or Given Up Previous Job" accounts for 7.3%, "Looking After Home/Family" 6.9% and "Unable to Work Due to Permanent Sickness or Disability" makes up 4.8%.

4.3.5 Tourism

Fáilte Ireland published guidelines in 2011 for the treatment of tourism in an EIS, which describes the effects of projects on tourism. Many of the issues covered in the report are similar to those covered in this EIAR, for example, scenery is assessed in **Chapter 10: Landscape and Visual Amenity**.

4.3.5.1 Tourist Attractions

Study Area One: Development and Environs (10 km)

There are no tourist attractions at the Wind Farm Site or at the Hydrogen Plant Site. The varied natural landscape and scenic amenity of the area surrounding the Wind Farm Site provide opportunities for outdoor recreation in the wider area, including walking, cycling and horse-riding. The main visitors to the Wind Farm Site are those with involved in seasonal peat cutting and harvesting. The roads leading to the Wind Farm Site are rarely frequented by outdoor enthusiasts and tourists. The main walking and cycling routes in the area follow the route of the 'Western Way', which leads through the Ox Mountains towards Foxford, 17 km south of the Wind Farm Site. There are no visitors to the Hydrogen Plant Site.

The main tourist routes in the Study Area, the R294 and N59 bypass the Wind Farm Site by 2.5 km and 5 km respectively, with the N59 bypassing 600 m to the west of the Hydrogen Plant Site. Tourists to the region are generally attracted to coastal parts of Counties Sligo and Mayo, largely outside of Study Area One. However, the Study Area does include a small section of the Atlantic Coast south of Inishcrone, including parts of the Wild Atlantic Way and the southern part of the town of Inishcrone, which includes the Enniscrone Golf Course (Inishcrone), a 27 hole links golf facility. The town of Bunnyconnellan, 4 km to the

[16] WDD. (2016) https://westerndevelopment.ie/wp-content/uploads/2020/08/WDC-Insights-County-Sligos-Labour-Market-Census-2016-Oct-17.pdf Accessed 06/12/2022

southwest of the Wind Farm Site, is a popular tourist destination with walking trails, archaeological sites and is home to the Bunnyconnellan Agricultural Show (Bunnyconnellan), the second largest agricultural show in Ireland, attracting crowds of 20,000-40,000 people and held annually on the August Bank Holiday.

Study Area Two: Mayo County

County Mayo has a varied and unique landscape with a broad range of natural and cultural heritage. These include water bodies, agricultural land, forestry, soil, geology, mineral deposits and flora and fauna, settlements, archaeological monuments and built heritage. Amenities such as walkways, cycle ways, bathing areas, boating areas, fishing rivers and lakes attract tourists to the area. Public rights of way and walking routes constitute an important recreational amenity for local people and visitors and are recognised in the Mayo County Development plan 2022-2028 as important assets to protect and further develop. Popular walks and outdoor attractions include Croagh Patrick, Westport House, Ballycroy National Park, Turlough House, Ballintubber Abbey, Céide Fields, Knock Shrine, the Moy River and Tochar Phadraig.

The Great Western Greenway from Westport to Achill (approximately 50 km southwest of the Proposed Development) is a successful walking and cycling amenity and tourist attraction. Several other established cycling routes have been developed such as the Turlough Greenway and cycle network in Castlebar and the railway walking and cycle route in Westport.

Internationally popular destinations in County Mayo include Downpatrick Head, Knock Shrine, Westport/Clew Bay, Cong, the offshore islands and Achill Island. Large numbers of tourists are attracted to the annual July Salmon Festival in Ballina and the River Moy fishing pools.

County Mayo has the longest coastline in Ireland, at 1,168 km, approximately 21% of the total coastline of the State. The Wild Atlantic Way is one of the longest defined coastal routes in the world, stretching approximately 2,500 km. The section of the Wild Atlantic Way which runs through County Mayo is a 543 km coastal drive, from Killary Harbour in the south, to Ballina in the north and into County Sligo. The route highlights the natural assets and scenery of County Mayo and is an economic driver for the county.

Activity and adventure tourism are popular along County Mayo's coastline, lakes and rivers, including swimming, surfing, canoeing, kayaking and sailing. Fishing and angling are

popular activities due to the abundance of productive lake, river and sea angling fisheries, including those located at Carrowmore, Errif, Beltra and Furnace and the Moy, which is the most productive salmonoid river in Ireland. Excellent quality angling is available in County Mayo's lakes including at Conn, Cullen, Mask and Lough Corrib. The waters off Killala Bay, Clew Bay, Achill and Béal an Mhuirthead (Belmullet) are popular sea angling destinations. Several blue flag and Green Coast Beaches which offer surfing, kite-surfing, swimming, paddle boarding, kayaking, walking, jogging and general enjoyment of the coastal area are located along County Mayo's coasts.

County Mayo has many islands, with their own cultures, communities and history. 150 festivals and events are held annually in County Mayo. These are mainly small and community managed and include historical/heritage themes, music, arts, horseracing, regattas, walking festivals and agricultural shows. Buildings of interest in County Mayo include the Jackie Clarke Museum, Museum of Country Life, Westport House, Mary Robinson Centre and Moore Hall.

Study Area Three: Sligo County

County Sligo tourism industry contributed over €110 million to the local economy, attracted almost 450,000 visitors annually and provided about 2,700 in 2018 according to the County Sligo Tourism Strategy[17]. The county has a varied natural landscape, with beautiful scenery and relatively unspoilt areas including mountains, forests, woodlands, lakes, rivers, coastline and offshore islands. These features, along with its cultural heritage and accessibility by road, rail and air have contributed to a significant tourism industry.

Spectacular scenery is provided by Benbulben, the Dartry Mountains and the Ox Mountains which attract visitors for activities such as touring, sightseeing, mountaineering, hillwalking and pony-trekking. Co. Sligo contains large forests, include Slish Wood and Union Wood which are mainly under state control and open to the public. These have a high recreational value and contain forest walkways to enable visitors to enjoy them.

Lakes in the county, including Lough Gill and the Garavogue River, Lough Arrow, Lough Gara, Glencar Lake, Templehouse Lake, Lough Talt and Lough Easky offer recreational activities such as sailing, boating, fishing and lakeshore walks. These, along with their attraction as wildlife refuges and literary, archaeological and historical significance draw high numbers of tourists to the area. Along the coastline of County Sligo, the resorts of

[17]Sligo. (2018). County tourism Strategy https://www.sligococo.ie/tourism/CountySligoTourismStrategy2018-2023/sts2018.pdf Accessed 06/12/2022

Mullaghmore, Rosses Point, Strandhill and Inishcrone and the popular beaches at Culleenamore, Streedagh and Dunmoran attract many visitors.

Cultural, literary, traditional music, historical and archaeological heritage are also majors part of County Sligo's tourism economy for example Coleman Traditional Music Centre, in Gurteen, is a community based, state of the art traditional music and cultural centre.

Study Area Four: Ireland:

Across Ireland, tourism is a major contributor to the national economy and employment. In 2019, 9.7 million overseas tourists visited Ireland, which amounted to a €9.5 billion industry, see **Graphic 4.5**.

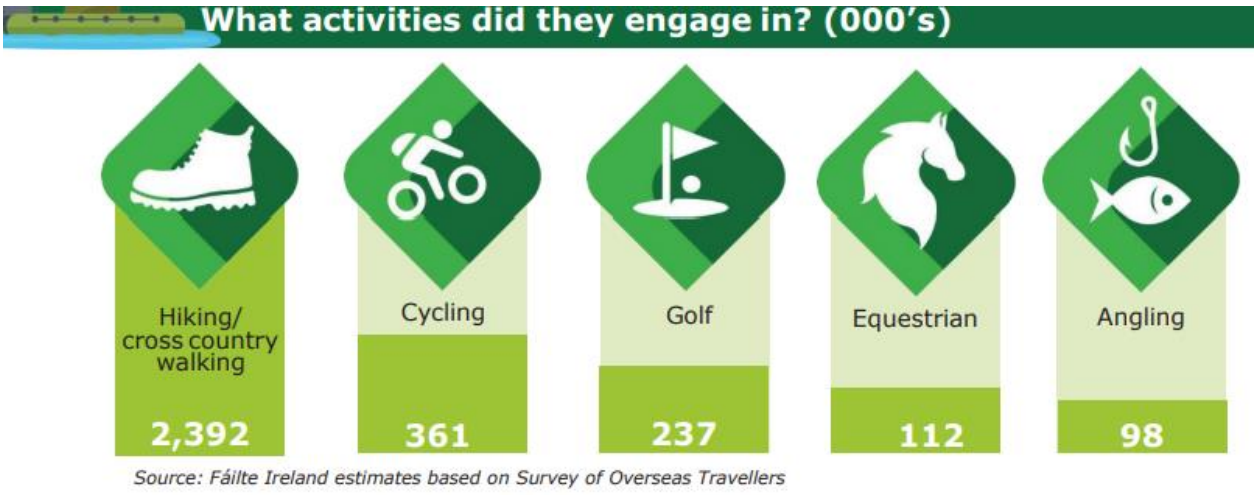
Revenue (€m)	2015	2016	2017	2018	2019	Change 19 vs 18
Britain	**1,017.9**	**1,109.8**	**1,046.5**	**1,024.8**	**1,022.1**	**-0.3%**
Mainland Europe	**1,555.3**	**1,657.5**	**1,763.0**	**1,845.8**	**1,853.6**	**0.4%**
North America	**1,199.7**	**1,337.4**	**1,525.5**	**1,746.7**	**1,705.7**	**-2.3%**
Other Overseas	**492.6**	**533.3**	**588.9**	**599.9**	**592.5**	**-1.2%**
TOTAL OVERSEAS	**4,265.3**	**4,638.0**	**4,923.9**	**5,217.3**	**5,174.0**	**-0.8%**
Northern Ireland[3]	338.2	366.9	371.3	394.6	402.0	1.9%
TOTAL OUT-OF-STATE	**4,603.5**	**5,004.9**	**5,295.2**	**5,611.9**	**5,576.0**	**-0.6%**
Carrier receipts[4]	1,322.0	1,487.0	1,611.0	1,725.0	1,766.0	2.4%
Overseas same-day visits	38.0	48.0	53.0	47.0	44.0	-6.4%
TOTAL FOREIGN EXCHANGE EARNINGS	**5,963.5**	**6,539.9**	**6,959.2**	**7,383.9**	**7,386.0**	-
Domestic trips[5,6]	*1,725.3*	*1,797.7*	*1,879.1*	*2,006.0*	*2,146.6*	7.0%
TOTAL TOURISM REVENUE	**7,688.8**	**8,337.6**	**8,838.3**	**9,389.9**	**9,532.6**	**1.5%**
TOURISM REVENUE EXCLUDING CARRIER RECEIPTS	*6,366.8*	*6,850.6*	*7,227.3*	*7,664.9*	*7,766.6*	1.3%

Graphic 4.4: Revenue and tourists numbers coming to Ireland from Fáilte Ireland 2021.

Fáilte Ireland, in their Key Tourism Facts report (2021)[18] based on figures from 2019, estimates that approximately 260,000 jobs were provided by the tourism and hospitality industry across Ireland. The report stated that 2,392,000 overseas visitors engaged in

[18] Fáilte Ireland (2021) Key Tourism Facts 2019 https://www.failteireland.ie/FailteIreland/media/WebsiteStructure/Documents/3_Research_Insights/4_Visitor_Insights/KeyTourismFacts_2019.pdf?ext=.pdf Accessed 06/12/2022

Hiking and Cross-Country Walking, see **Graphic 4.5**. This highlights the importance of the quality of the outdoor environment to the tourism industry.



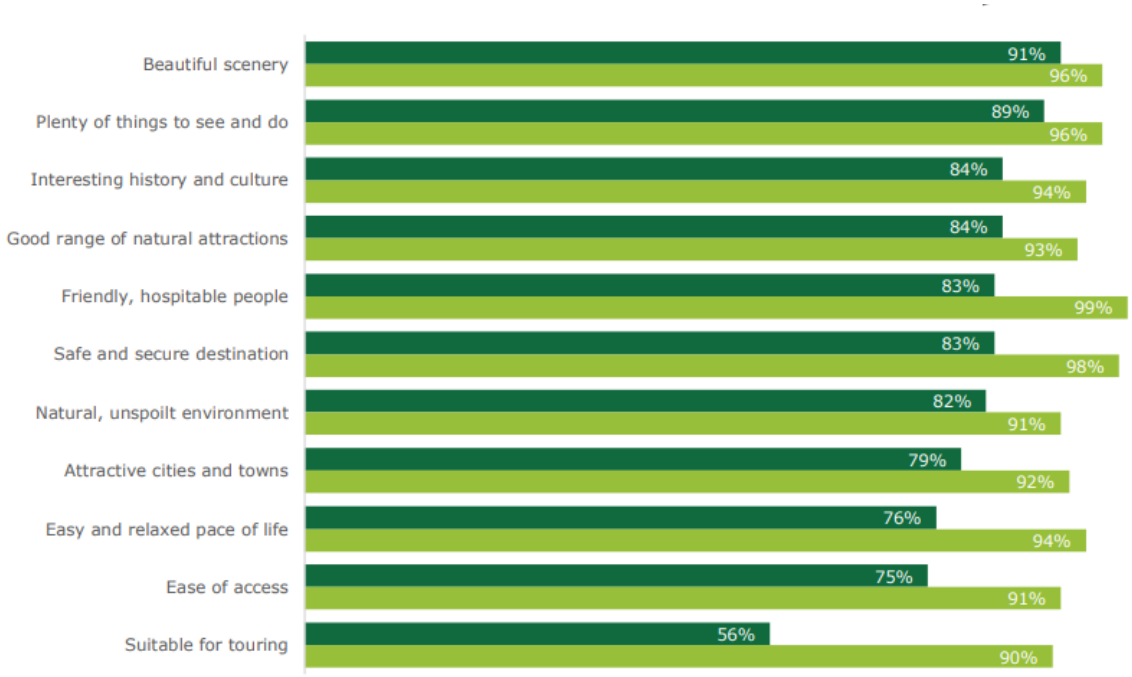
Graphic 4.5: Overseas Visitor Activity From Fáilte Ireland Key Tourism Facts 2019

4.3.5.2 Visitors Attitude on Wind Farms

The first wind farm in Ireland was completed in 1992 in County Mayo at Bellacorrick, since then wind farms have elicited a range of reactions from Irish people. In 2002, Sustainable Energy Ireland (SEI), now the Sustainable Energy Authority of Ireland (SEAI), commissioned a survey aimed at identifying public attitudes to renewable energy, including wind energy in Ireland[19]. The survey found that, in general, Irish people are positively disposed towards the development of wind farms. However, the survey also indicated that people will not accept wind farms everywhere and that special care should be taken so that wind farms respond to contextual landscape characteristics.

Ireland's scenery has been a cornerstone of international tourism marketing campaigns for decades. The future sustainability of Ireland's tourism industry is therefore inextricably linked to the maintenance of the character and scenic qualities of the Irish landscape. **Graphic 4.6** from Fáilte Ireland shows the importance of visual amenity to tourists visiting from overseas.

[19] Sustainable Energy Ireland (2003), Attitudes towards the Development of Wind Farms in Ireland, Dublin



Source: Fáilte Ireland's Tourism Experience Port Survey 2019

Graphic 4.6: Importance and rating of destination issues among overseas holidaymakers (%) from Fáilte Ireland[20]

Fáilte Ireland, in association with the Northern Ireland Tourist Board (NITB), decided in 2007 to survey both domestic and overseas holidaymakers to Ireland to determine their attitudes to wind farms. The survey drew on many aspects of the SEI survey, in particular, the landscape types that were used to elicit a reaction from respondents. The purpose of the survey was to assess whether the development of wind farms would impact on the visitors' enjoyment of Irish scenery. In 2012, this research was updated by Millward Browne Lansdowne on behalf of Fáilte Ireland to determine if there was any change in visitor attitudes during this period.

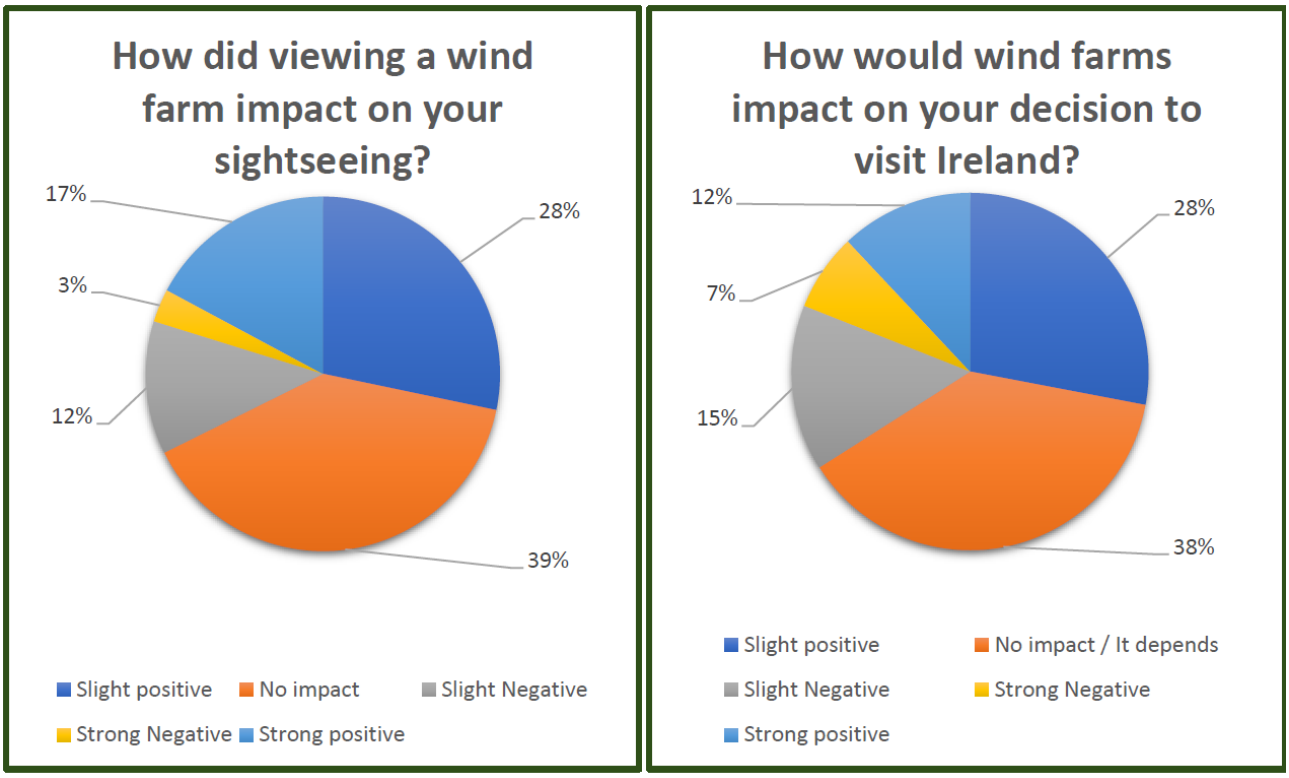
The 2012 research indicated that 47% of visitors felt an increased positive impact on landscape, compared to 32% in 2007. Negative responses also increased, showing 30% in 2012 against 17% in 2007. However, 49% of visitors felt that wind farms had no impact on the landscape in 2007 in comparison to 23% in 2012. It was notable that those interviewed who did not see a wind farm during their trip held more negative perceptions and opinions on wind farms to those that did.

[20] Fáilte Ireland (2021) Key Tourism Facts 2019 https://www.failteireland.ie/FailteIreland/media/WebsiteStructure/Documents/3_Research_Insights/4_Visitor_Insights/KeyTourismFacts_2019.pdf?ext=.pdf Accessed 06/12/2022

Despite that there had been an increase in the number of visitors who have seen at least one wind farm on their holiday, there was also a slight increase (from 45% in 2007 to 48%) in the number of visitors who felt that this had no impact on their sight-seeing experience. Importantly, and as has been seen in the previous research, the type of landscape in which a wind farm is sited can have a significant impact on attitudes.

Visitors were asked to rate the beauty of five different, typical Irish landscapes: coastal, mountain, farmland, bogland and urban industrial land, and then rate the scenic beauty of each landscape and the potential impact of siting a wind farm in each landscape. The results indicated that each potential wind farm and site must be assessed on its own merits, due to the scenic value placed on certain landscapes by the visitor and the preferred scale/ number of wind turbines within a wind farm. Looking across all landscapes, wind farms are seen to have an enhancing effect on the landscapes seen as less beautiful, particularly urban/ industrial and bogland. Coastal areas (91%) followed by mountain moorland (83%) and fertile farmland (81%) continue to be rated as the most scenic, and resistance was greatest to wind farms in these areas. There was a greater relative negativity expressed about potential wind farms on coastal landscapes (40%), followed by fertile farmland (37%) and mountain moorland (35%). Less than one in four were negatively disposed to the construction on bogland (24%) or urban industrial land (21%). Most visitors also still favoured large turbines (47%) over small turbines (28%), and in smaller numbers, with the option of five turbines proving the most popular, followed by two clusters of ten and finally wind farms of 25 turbines.

Seven out of ten visitors claimed that potentially greater numbers of wind farms in Ireland over the next few years would have either no impact or a positive impact on their likelihood to visit Ireland (**Graph 4.1**). Of those who felt that the potentially greater number of wind farms would impact positively on future visits, the key driver was support for renewable energy, followed by potential decreased carbon emissions. Given the scenario where more wind farms will be built in Ireland in the future, the most widely held view is that this would not impact their likelihood to visit the area again, with a slightly greater majority saying that this would have a positive rather than a negative impact.



Graph 4.1: Visitors Attitudes on the Environment – Wind Farms (source: Fáilte Ireland, 2008)

BiGGAR Economics carried out research in Scotland on 28 wind farms and tourism trends (2017)[21]. No pattern emerged that would suggest that onshore wind farm development has had a detrimental impact on the tourism sector, even at a very local level. No relationship was identified between the development of onshore wind farms and tourism employment at the level of the Scottish economy, at local authority level nor in the areas immediately surrounding wind farm development.

4.3.6 Residential Amenity

Residential amenity relates to the human experience of one's home, derived from the general environment and atmosphere associated with the residence. The quality of residential amenity is influenced by a combination of factors, including site setting and local character, land-use activities in the area and the relative degree of peace and tranquillity experienced in the residence. The Wind Farm Site is located in a rural setting and housing density in the area is low. There are 18 inhabited houses within a 1.5 km radius of the turbines. The Hydrogen Plant Site is also located in a rural area with 22 inhabited houses within 1 km.

[21] BiGGAR (2017) Wind Farms and Tourism Trends in Scotland. Available online at: https://biggareconomics.co.uk/wp-content/uploads/2020/01/Wind-farms-and-tourism-trends-in-Scotland.pdf Accessed 06/12/2022

When considering the amenity of residents in the context of the Wind Farm the main potential impacts of relevance are Shadow Flicker, Noise, and Visual Amenity. In the context of the Hydrogen Plant this includes Noise, Visual Amenity and Health and Safety.

4.3.7 Property Value

There are currently no Irish studies undertaken to assess the impact of wind farms or hydrogen plants on property prices. However, a number of studies have been undertaken in the UK in relation to wind farms, with findings set out in **Table 4.6**. A study undertaken in 2014 by the Centre of Economic Research found that house prices were driven by the property market and not the presence or absence of wind farms[22]. Another study was undertaken in 2014 by the London School of Economics which did find the presence of wind farms negatively impacted property values within 2 km of very large wind farms[23]. In 2016, following on from the contrasting results of the 2014 studies, ClimateXChange carried out their own research in Scotland. The ClimateXChange study found no significant effect on the change in price of properties within 2 km or 3 km or found the effect to be positive[24]. This study also found that some wind farms can provide economic and amenity benefits to an area. The Proposed Development will include for the upgraded roads that can be used by walkers within the Wind Farm Site and will provide a significant community benefit fund for the local area. The Hydrogen Plant Site is set back from properties and will not be accessible to the public.

Table 4.6: Summary of Research finding between Wind Farms and Property Values

Year	Country	Research Group	Finding
2014	UK	Centre of Economic Research	In summary the analysis found that country-wide property market drives local house prices, not the presence or absence of wind farms. The econometric analysis established that construction of wind farms at the sites examined across England and Wales has not had a detectable negative impact on house price growth within a 5 km radius of the sites.

[22]Renewable UK. (2014) https://cdn.ymaws.com/www.renewableuk.com/resource/resmgr/publications/reports/ruk-cebr-study.pdf Accessed 06/12/2022

[23]SERC. (2014). http://eprints.lse.ac.uk/58422/1/__lse.ac.uk_storage_LIBRARY_Secondary_libfile_shared_repository_Content_SERC%20discussion%20papers_2014_sercdp0159.pdf Accessed 06/12/2022

[24] Heblich, D. S., Olner, D. D., Pryce, P. G. and Timmins, P. C., 2016. *Impact of wind turbines on house prices in Scotland,* Scotland: ClimateXChange. Accessed 06/12/2022

Year	Country	Research Group	Finding
2014	UK	London School of Economics	There was an average reduction in the value of houses (based on 125,000 house sales between 2000 and 2012) of between 5% and 6% within 2 km of very large wind farms.
2016	UK (Scotland)	ClimateXChange	The study did not find a consistent negative effect of wind turbines or wind farms when averaging across the entire sample of Scottish wind turbines and their surrounding houses. Most results either show no significant effect on the change in price of properties within 2 km or 3 km, or found the effect to be positive. Some wind farms provide economic or leisure benefits (e.g. community funds or increasing access to rural landscapes through providing tracks for cycling, walking or horse riding)

In terms of the Hydrogen Plant, data available from the CSO on property values is presented in terms of Eircode Routing Key areas. The Hydrogen Plant is located within Eircode Routing Key F26: Ballina. The median price for residential properties sold in December 2022 is €180,000[25]. The national median is €305,000. There are relatively few residential dwellings in the area surrounding the Hydrogen Plant, with 22 inhabited houses within 1 km of the Hydrogen Plant Site, the closest inhabited house is 299 m to the north-east. The Hydrogen Plant Site is located in an area designated as a 'Normal Rural Area' for landscape and a "Rural Area in Need of Regeneration" in the core strategy, these designations allow for resource dependent activities such as renewable energy. The location is also within the guidelines set in the Sligo CDP for the location of new Seveso/COMAH sites in that it is not in the vicinity of houses (299 m to the closest), places of concentrated public use or any environmentally sensitive areas or designated conservation areas.

4.3.8 Human Health

Common concerns around wind farms in terms of human health are generally associated with electromagnetic fields, shadow flicker and noise. The concerns around hydrogen production are generally associated with health and safety and risk of accidents including hydrogen leakage, fire, explosion and water contamination. These topics are considered in

[25] CSO. (2022). House Prices https://visual.cso.ie/?body=entity/rppi#

this assessment in addition to air quality and water contamination. Major Accidents and Natural Disasters are assessed in **Chapter 16**.

4.3.8.1 General Health of Population

The health of communities can vary greatly owing to a number of factors including susceptibility to disease, location, income, inequality, access to health care etc. In 2019 the Department of Health published Health in Ireland; Key Trends 2019[26], this report showed population health at the national level presented a picture of decreasing mortality rates and high self-perceived health. The report also indicated that Ireland had the highest self-perceived health status in the EU, with 82.9% of people rating their health as good or very good.

The 2016 census data (the latest available for health metrics) for the general health of the population is shown in **Table 4.7**. This data indicates the health status across all four study areas is "Very Good" to "Good".

Table 4.7: Population by General Health (2016) Percentage

General Health	Study Area One; The Development and Environs	Study Area Two; County Mayo	Study Area Three; County Sligo	Study Area Four; Ireland
	Percentage (%)			
Very good	60	56	58	59
Good	28	30	28	28
Fair	9	10	9	8
Bad	1	1.5	2	1
Very bad	0	0.5	0	0
Not stated	1	2	3	3

4.3.8.2 Health Impact Studies

While there are anecdotal reports of negative health effects on people who live near operational wind farms there is no peer reviewed scientific research in support of these views. Several peer reviewed scientific research publications are outlined in this section.

[26] Department of Health. (2019). Health in Ireland - Key Trends 2019. https://www.gov.ie/en/publication/f1bb64-health-in-ireland-key-trends-2019/ [accessed Accessed 06/12/2022

Frontiers in Public Health published a study[27] in 2014 on wind turbines and human health. This review summarised and analysed the science in relation to this issue specifically in terms of noise (including audible noise, low-frequency noise, and infrasound), EMF, and shadow flicker. The study noted that:

"*Based on the findings and scientific merit of the research conducted to date, it is our opinion that the weight of evidence suggests that when sited properly, wind turbines are not related to adverse health effects. This claim is supported (and made) by findings from a number of government health and medical agencies and legal decisions*".

The National Health and Medical Research Council, Australia's leading medical research body, concluded that there is no reliable or consistent evidence that wind farms directly cause human health problems as part of their Systematic Review of the Human Health Effects of Wind Farms published in December 2013[28]. The review was commissioned to determine whether there is a direct association between exposure to wind farms and negative effects on human health or whether the association is casual, by chance or bias.

Objectors to wind farms often refer to wind turbine syndrome as a condition that can be caused by living in close proximity to wind farms. The symptoms allegedly include sleep deprivation, anxiety, nausea and vertigo. It has been rejected by the wind industry as there is no scientific backing to these claims. The National Health and Medical Research Council review began in 2012 and included a literature and background review of all available evidence on the exposure to the physical emissions produced by wind turbines. These emissions were noise, shadow flicker and electromagnetic radiation produced by wind turbines. The review concludes that the evidence considered does not support any direct association between wind farms and human health problems and that confounding bias could be possible explanations for any reported association.

In general, there are no specific health considerations in relation to the operation of a wind turbine. Noise and Shadow Flicker are operational Health and Safety issues and have been addressed in **Chapter 11: Noise** and **Section 4.3.9 and 4.4.9.**

There are no specific green hydrogen and health research studies available at the time of writing (May 2023). The use of green hydrogen has been identified as a means to displace fossil fuels and indirectly improve air quality across the planning policy review conducted for this EIAR. A 2018 Research paper on the Evidence-based review of the effects of electric

[27] L. D. Knopper, *et al*. (2014) *Wind turbines and human health*.
[28] National Health and Medical Research Council. (2015). Systematic review of the human health effects of wind farms https://www.nhmrc.gov.au/sites/default/files/documents/reports/systematic-review-wind-farms-eh54.pdf Accessed 06/12/2022

mobility on air pollutants, greenhouse gas emissions and human health[29], included Fuel Cell Electric Vehicle (FCEVs) which are powered by hydrogen. The research selected 65 articles for a detailed review and found the studies reviewed consistently showed reductions in greenhouse gas emissions and emissions particularly on PM and SO_2 in electric vehicle use compared to fossil fuels, which reduces human exposure to these pollutants.

The Environmental Protection Agency (EPA, 2020)[30], European Environmental Protection Agency (EEA, 2020)[31] and World Health Organisation (WHO, 2014) reports estimate that poor air quality accounted for premature deaths of approximately 600,000 people in Europe in 2012, with 1,300 Irish deaths predominantly due to fine particulate matter ($PM_{2.5}$) in 2020 and 30 Irish deaths attributable to Ozone (O_3) in 2016[32,33]. Fine particulate matter, ozone, along with others including carbon dioxide (CO_2), nitrogen oxides (NO_x) and sulphur oxides (SO_x) are produced during the burning of fossil fuels for energy generation, transport or home heating. The only emission to air from the Hydrogen Plant is Oxygen (O_2), this is not considered a pollutant in the Air Quality Standard Regulations 2011 or IE Directive (Directive 2008/50/EC) or by the WHO or EPA.

The EU Hydrogen Strategy notes that
"*Hydrogen can be used as a feedstock, a fuel or an energy carrier and storage, and has many possible applications across industry, transport, power and buildings sectors. Most importantly, it does not emit CO_2 and almost no air pollution when used. It thus offers a solution to decarbonise industrial processes and economic sectors where reducing carbon emissions is both urgent and hard to achieve."*

In the European Parliament EU Hydrogen Policy report[34], hydrogen is stated to be;
"Expected to play a key role in a future climate-neutral economy, enabling emission-free transport, heating and industrial processes as well as inter-seasonal energy storage."

4.3.8.3 Electromagnetic fields

Electromagnetic fields ("EMF") are invisible lines of force that surround electrical equipment, power cords, wires that carry electricity and outdoor power lines. Electric and magnetic

[29] Requia, W., Mohamed, M., Higgings. C., Arain, A. and Ferguson. M. (2018). How clean are electric vehicles? Evidence-based review of the effects of electric mobility on air pollutants, greenhouse gas emissions and human health. https://www.sciencedirect.com/science/article/abs/pii/S1352231018302711
[30] Ireland's Environment – An Integrated Assessment 2020, EPA, 2020, accessed 01/12/2022
[31] EEA (European Environment Agency), 2020b. Air Quality in Europe 2020. EEA Report No. 09/2020. EEA, Copenhagen, accessed 01/12/2022
[32] WHO. (2014). https://www.who.int/europe/news/item/25-03-2014-almost-600-000-deaths-due-to-air-pollution-in-europe-new-who-global-report accessed 01/12/2022
[33] Irelands Environment 2016 – An Assessment', EPA, 2016, accessed 01/12/2022
[34] European Parliament. (2021). EU hydrogen policy Hydrogen as an energy carrier for a climate-neutral economy. https://www.europarl.europa.eu/RegData/etudes/BRIE/2021/689332/EPRS_BRI(2021)689332_EN.pdf Accessed 02/12/2022

fields can occur together or separately and are a function of voltage and current. When an electrical appliance is plugged into the wall, an electric field is present (there is voltage but no current); when that appliance is turned on, electric and magnetic fields are present (there is both voltage and current). Both electric and magnetic fields decrease with distance. Electric fields are also dissipated by objects such as building materials. On a daily basis, people are exposed to extremely low frequency ("ELF") EMF as a result of using electricity.

The provision of underground electric cables of the capacity proposed is common practice throughout the country and installation to the required specification does not give rise to any specific health concerns.

National and international health and scientific agencies have reviewed more than 35 years of research including thousands of studies. None of these agencies has concluded that exposure to ELF-EMF from power lines or other electrical sources is a cause of any long-term adverse effects on human, plant, or animal health. The International Commission on Non-Ionising Radiation Protection (ICNIRP) Guidelines give a limit of 100 µT for sources of AC magnetic fields. This compares to 0.13 µT that arises from a 110 kV underground cable when directly above it; 1.29 µT that arises from a 220 kV underground cable when directly above it and 11.4 µT that arises from a 400 kV AC underground cable that is one metre deep and measured directly above it. This is detailed in information booklet published by ESB in 2017 called "EMF and You" which provides information about Electric and Magnetic Fields and the electricity network in Ireland[35].

In 2014, a study was undertaken in Canada[36], measuring electromagnetic fields around wind farms and the impact on human health. The study found that:
"there is nothing unique to wind farms with respect to EMF exposure; in fact, magnetic field levels in the vicinity of wind turbines were lower than those produced by many common household electrical devices and were well below any existing regulatory guidelines with respect to human health".

From the limit of 100 µT for sources of AC magnetic fields given by the ICNIRP, a comparison of between 0.02 µT and 0.41 µT arises when turbines operate under "high wind" scenarios.

[35] EMF and You, ESB, 2017 - https://esb.ie/docs/default-source/default-document-library/emf-public-information_booklet_v9.pdf?sfvrsn=0, Accessed 06/12/2022
[36] Lindsay C McCallum, *et al*. (2014) *Measuring electromagnetic fields (EMF) around wind turbines in Canada: is there a human health concern?*

4.3.9 Shadow Flicker

The Department of Energy and Climate Change for England stated in its report Update of UK Shadow Flicker Evidence Base (2011) that it is considered that the frequency of the flickering caused by the wind turbine rotation is such that it should not cause a significant risk to health.

Section 4.4.9 provides the full assessment of shadow flicker for this EIAR.

4.4 ASSESSMENT OF POTENTIAL IMPACTS

4.4.1 Public Interest

The public interest in combating climate change and public concern over the cost of energy is at a high level. The REPowerEU plan recommended that the Renewable Energy Directive be amended to recognise renewable energy as being of *"Overriding Public Interest*".

The Proposed Development would produce two versatile renewable energy sources locally, helping to mitigate climate change by reducing the demand for fossil fuel use in Ireland. This improves Ireland's energy security and helps to stabilize and reduce energy costs for households and businesses. The Proposed Development would have a moderate positive long-term impact in relation to public interest.

4.4.2 Population and Settlement Patterns

The Proposed Development includes the demolition and rebuilding of a single house at the Hydrogen Plant site, with a neutral effect. This is not considered to have any direct positive or negative impact on the local or regional population levels. Construction workers who are not based locally may temporarily relocate to the region, this is more likely for the construction and decommissioning phases than for the operational phase of the Proposed Development. The overall impact is considered to be imperceptible in terms of population.

In the longer term, 10 to 20 new permanent jobs working at the Wind Farm and Hydrogen Plant, will be created. These are likely to be local workers, or potentially attracted to live in the area, slightly increasing population. The predicted effect on the immediate settlement patterns and social patterns is not significant. There is however the benefit which would accrue to the region in terms of the ability to provide renewable electricity to industry and business in a high-quality supply. This will lead to the region becoming more attractive to business with the subsequent benefit of increased employment opportunities in the region. The production of green hydrogen as a zero emissions fuel for the industry and transport sectors could also attract new business to the region and Ireland.

While this is not likely to result in a marked increase in settlement in the area, or a change in social patterns, it should provide a positive influence by stimulating regional growth and providing employment and economic opportunities. Study Areas One (the Development and Environs), Two (Co. Mayo) and Three (Co. Sligo) have experienced lower growth than the national average, as laid out in **Table 4.4**. Population growth is a key feature of both the Mayo and Sligo County Development Plans so the Proposed Development could contribute to these objectives.

The overall impact of the construction and decommissioning phases on population and settlement patterns is predicted to be slight positive, not significant and short-term in nature effect should construction workers relocate to the area for the duration of these phases. The overall impact is predicted to be slight positive, not significant effect at the local level in terms of settlement patterns where increased business is attracted to the region during the operational phase.

4.4.3 Economic Activity

During the construction phase, there will be economic effects resulting from the expenditure on items such as site preparation, general construction, purchase and delivery of materials, plant, equipment and components. It is envisaged that labour and materials will be sourced from the local area during construction where possible. Ready-mix concrete will also be sourced from a local supplier, subject to authorisation and to quality and quantity being available. Due to the unsuitability of the Wind Farm Site to provide stone via borrow pits, crushed stone will be sourced from local quarries. Employees involved in the construction and operation of the Proposed Development will most likely use shops, restaurants and accommodation in the area. Local businesses such as accommodation providers would benefit from the construction contractors using their accommodation on a year-round basis, including periods of the year that are traditionally considered 'low season'. The benefits of increased business, although temporary, can allow businesses to invest in improvements that would not otherwise be affordable, leading to a long-term enhancement. Therefore, overall, there will be a slight, positive, but not significant impact on employment in the region.

BVG Associates carried out extensive assessments on the economic benefits from eight onshore wind farms in Southwest Scotland[37]. Each contract value was assigned to one or more relevant elements of a supply chain. Capital expenditure (CAPEX) was found to relate to turbine, civil works and electrical works supply chains, whereas the operational

[37] BVG Associates. (2017) Economic Benefits from onshore wind farms, https://bvgassociates.com/wp-content/uploads/2017/09/BVGA-18510-Economic-impact-onshore-wind-report-r3.pdf Accessed 06/12/2022

expenditure (OPEX) relates to transmission operations, Maintenance and Service (OMS) supply chain, the wind farm OMS and also the decommissioning supply chain.

Based on this research and the largest capacity being installed (78 MW), the CAPEX for the Development is estimated to be approximately €78 million. This expenditure will result in economic benefit at a national, regional and local level. The OPEX (based on a conservative 24-year period) in nominal terms is estimated to be €88 million. The BVG report found, for the eight projects studied, that 66% of the total project spend (CAPEX and OPEX) was retained within the National economy, 17% of the total was retained in the local region hosting the project.

In 2021, Wind Energy Ireland produced a report entitled, Economic Impact of Onshore Wind in Ireland[38]. The report reviews the historic and potential contribution of onshore wind energy to Ireland's economy. By 2020, the report finds that onshore wind contributed €1.1bn in total industrial output across operating and capital activities and €401m in additional Gross Value Added to the Irish economy. By 2030, these two figures are expected to reach €1.5bn and €550m respectively. Jobs created throughout the sector and its supply chain in Ireland reached 5,130 in 2020 with €225m in total payments to workers. This is expected to increase to 7,020, with €305m in payments to workers by 2030.

A Baringa report in 2019, 'Wind for a Euro: Cost-benefit analysis of wind energy in Ireland 2000-2020[39] found that wind energy in this time has delivered €2.3bn in savings in the wholesale electricity market.

These findings are relevant to the construction of the Wind Farm, further economic contribution is expected from the construction of the Hydrogen Plant. Northwest Ireland has been at the forefront of production on renewable energy with the Irelands first commercial wind farm in 1992 at Bellacorrick, County Mayo. Developing a Hydrogen Plant would once again place the west and northwest as a leading example for the progression of renewable energy technologies. The Proposed Development would be one of the first of a kind in Ireland, where renewable energy is converted to green hydrogen to provide a clean and low-cost fuel that can be utilised for transportation, heating systems and industrial processes, areas which have been difficult to decarbonise with electrification. Green hydrogen produced domestically can help to reduce the costs of decarbonising these

[38] WEI. (2021). Economic Impact of Onshore Wind in Ireland. https://windenergyireland.com/images/files/economic-impact-of-onshore-wind-in-ireland.pdf Accessed 06/12/2022
[39] Baringa. (2019). Wind for a Euro. https://windenergyireland.com/images/files/baringa-wind-for-a-euro-report-january-2019.pdf Accessed 06/12/2022

industries. The green hydrogen market in Europe is worth 283.2 million USD according to research by Markets and Markets[40]. This is led by Germany with a green hydrogen industry worth 169.5 million USD, followed by Austria worth 42.1 million USD.

The Proposed Development would benefit local communities and Ireland, though facilitating the future requirements of a growing demand for hydrogen-based fuels. It could also be expected that the Hydrogen Plant would encourage the development of other projects of the same nature, making a significant step towards green hydrogen becoming a valuable market in Ireland. The production of wind energy by products, including hydrogen is discussed in the Mayo County Development plan 2022-2028 and identified in several objectives of the plan. The plan also notes the need to introduce new technologies that can harness energy that would otherwise be wasted. It highlights the need to increase energy security to promote economic development. The Sligo County Development Plan 2017-2023 while not mentioning green hydrogen directly, does have policies relating to measures that reduce man-made GHGs, including low-carbon buildings and sustainable transport, promoting the use of renewable energy across all sectors and promoting and supporting the research and development of local renewable energy sources.

The SEAI's report on Energy Security in Ireland[41] explains what energy security means:
"Energy security, in its simplest terms, means having uninterrupted access to reliable, affordable supplies of energy. Secure supplies of energy are essential for our economy and for maintaining safe and comfortable living conditions."

The report notes that Ireland's fossil fuel imports costs in 2018 were €5 billion, giving an import dependency of 67%. Ireland, despite improvements in recent years remains one of the most import dependent countries in the EU. The report notes that indigenous energy sources are generally considered to be more secure than imported energy. By locally producing two versatile renewable energy sources the Proposed Development contributes to energy security in County Mayo, County Sligo and Ireland, reducing the expenditure on fossil fuel imports and helping to stabilize and reduce energy costs for households and businesses. Mayo County Council and Sligo County Council will benefit from payments under both the Development Contribution Scheme and from the annual rate payments. Win Energy Ireland[42] found that the onshore wind energy sector in 2020:

[40]Markets and Markets (2022). https://www.marketsandmarkets.com/Market-Reports/green-hydrogen-market-92444177.html
[41] SEAI. (2020). Energy Security in Ireland. https://www.seai.ie/publications/Energy-Security-in-Ireland-2020-.pdf Accessed 06/12/2022
[42] WEI. (2021). Economic Impact of Onshore Wind in Ireland. https://windenergyireland.com/images/files/economic-impact-of-onshore-wind-in-ireland.pdf Accessed 06/12/2022

"Provides a stable source of revenue for many local authorities, with total contributions of ~€45 million annually, and providing local authorities with a valuable source of revenue that can be reinvested in local communities. As the sector's footprint grows over the next decade to 2030, its financial contribution to many local authorities will also increase, and has the potential to reach €100 million by 2030."

The Developer is also committed to a 'Community Benefit' package. This package will be advertised annually and managed by the local community or an independent body by the local community. The purpose of the community fund is to enable the local community to share in the benefits of the Proposed Development. These community benefit funds typically support local projects, with funds allocated to projects from all aspects of the community.

The Developer has proposed to prioritise supply of green hydrogen to local businesses and residents. This could enable the local community to become sustainable energy champions in Ireland's journey towards achieving climate action targets. The Developer welcomes the Irish Government's efforts to make it easier and more affordable for homeowners and households to undertake home energy upgrades for warmer houses in return for lower energy bills. At present, SEAI grants do not cover hydrogen boilers, but the Developer is engaging with policymakers to find alternative grant funding supports to help local residents convert to hydrogen boilers and cooking systems. The Developer will also work with local businesses that already consume hydrogen in their business activities or are involved in industrial processes that can convert to consuming hydrogen, to develop a pathway for them to avail of our locally produced green hydrogen with a view to reducing their dependency on fossil fuels. The Developer intends to provide local residents and businesses with Firlough Green hydrogen at a fixed, discounted price for 15 years. This will ensure a secure supply of energy from a local source.

The overall impact on economic activity is predicted to be a moderate, positive, short-term impact during the construction phase of the Proposed Development and moderate, positive and long-term during the operational phase. There will be similar effects to the construction phase during decommissioning.

4.4.4 Employment

The employment effects that are attributable to the Development can be outlined as direct, indirect and induced:

- **Direct**: Employment and other economic outputs that are directly attributable to the delivery of the Development. These include any new jobs that are created to manage and supervise the construction phase, operational and decommissioning phases of the Proposed Development and that are filled by employees of the Developer or the appointed Contractor (or sub-contracted employees).
- **Indirec**t: Employment and other outputs created in other companies and organisations that provide services to the Proposed Development, (i.e. procurement and other supply chain effects). Most manufactured materials like towers, blades and subcomponents are assumed to be imported (import intensity of 66%) with major infrastructure delivery through Killybegs Port; fewer indirect manufacturing jobs will be generated domestically in Ireland.
- **Induce**d: Additional jobs and other economic outputs that are created in the wider economy, as a result of the spreading of employee incomes and other ripple effects that occur as a result of the direct and indirect effects of the Proposed Development.

The Proposed Development will create local employment opportunities throughout the construction, operational and decommissioning phases. These opportunities include local contractors being employed, local suppliers being sourced when possible, and the use of hotels and other services.

In 2014, Siemens[43] published a report analysing the job creation potential of the wind sector in Ireland in conjunction with the Irish Wind Energy Association. The report states that:
'*A major programme of investment in wind could have a sizeable positive effect on the labour market, resulting in substantial growth in employment.'*

Direct employment identified in the report includes; Installation, Development, Planning, Operation and maintenance, Investor Activity, Grid network employment and potential Turbine Manufacturing employment.

The 2021, Wind Energy Ireland report; Economic Impact of Onshore Wind in Ireland[44], notes that the onshore wind sector employed approximately 5,130 people in 2020, not including employment in grid development. This includes significant employment in rural communities. The majority (62%) of income generated is in the sectors supply chain, showing that the sector acts as a catalysis for wider employment. In the SEAIs Wind energy

[43] Siemens. (2014). An Enterprising Wind. https://www.esri.ie/publications/an-enterprising-wind-an-economic-analysis-of-the-job-creation-potential-of-the-wind Accessed 06/12/2022
[44] WEI. (2021). Economic Impact of Onshore Wind in Ireland. https://windenergyireland.com/images/files/economic-impact-of-onshore-wind-in-ireland.pdf

Roadmap 2011-2050[45], it is estimated that onshore and offshore wind could have an investment potential of €6 to12 million by 2040 and create 20,000 direct installation and operation/maintenance jobs.

A report on Hydrogen and Wind Energy from Wind Energy Ireland[46] estimates that at EU level, green hydrogen could generate up to 1 million jobs by 2030 and 5.4 million by 2050. In Ireland this is estimated at between 80-600 new jobs directly in green hydrogen by 2030 and 170-1,200 indirectly related to the sector. These jobs are likely to be in the technical/construction sector and will be considered high quality and skilled.

In terms of its capacity to capture capital investment domestically, Ireland has strong indigenous feasibility, planning, foundations and engineering expertise, with the skills and knowledge base to potentially supply niche markets in controls and instrumentation, albeit the bulk of heavy manufacturing (blades, towers) is imported. Similarly, the Irish supply chain is very well positioned in all the preliminary design and operational aspects of the electricity grid, providing a significant boost to local employment. However, some manufactured materials such as cables, underground pipes, insulators and conductors are sourced from abroad. According to SEAI, there are approximately 0.34 new long-term jobs per MW, which falls in line with European Wind Energy Association (EWEA) estimates for direct employment in Europe. In the case of the Proposed Development, this translates to 26 new long-term jobs for the 78 MW wind farm.

An estimated breakdown of the potential construction employment is shown in **Table 4.8.**

Table 4.8: Estimated Employment breakdown during the construction phase of the Development

Occupation/Task	No. of People (Employment Period)
Foundation team	eight (30 weeks)
Roads (truck drivers)	eight (40 weeks)
Plant drivers	four (60 weeks)
Foreman	one (64 weeks)
Engineer	one (64 weeks)
Engineer	two (15 weeks)
Substation Civils	ten (10 weeks)
Substation electrical	sixteen (16 weeks)

[45] SEAI. (2011). Wind Energy Roadmap 2011-2050 https://www.seai.ie/publications/Wind_Energy_Roadmap_2011-2050.pdf Accessed 06/12/2022
[46] Wind Energy Ireland. https://windenergyireland.com/images/files/final-hydrogen-and-wind-energy-report.pdf Accessed 06/12/2022

Occupation/Task	No. of People (Employment Period)
Foreman	two (15 weeks)
General operatives	three (64 weeks)

Approximately 150 persons will be employed during the peak of the construction phase of civil engineering of Site Access roads, Turbine Hardstand, Turbine Foundation, Substations and Hydrogen Plant Site construction. These numbers will be somewhat less for the turbine delivery, assembly and commissioning activities. A mixture of skills will be required, including unskilled/semi-skilled/skilled manual (construction labour and machine operators), non-manual (administration roles), managerial and technical (civil, electrical, mechanical technical and engineering) and professional roles (legal, business and accounting). The manual roles will be site-based with the other roles being predominately office-based, with site visits as and when required. During construction, personnel will be at the Proposed Development over a number of months and during these times will likely use local accommodation and restaurants and other facilities.

According to the 2016 census, in Study Area One; The Development and Environs, 147 people work in the sectors, Transport and Communications" and "Building and construction" in Study Area Two; Mayo, this number is 5,513 persons and in Study Area Three; Sligo, its 2,389. Both construction and transportation jobs in Mayo and Sligo have reduced between 2011 and 2016. The Proposed Development will bring new jobs to these industries.

The wind farm will create approximately two no. full-time jobs in wind energy during the operational phase. The Hydrogen Plant will be operating 24 hours a day, seven days a week and will provide circa six to seven equivalent full-time jobs. While the plant will be monitored remotely, there will be locally based technicians capable of monitoring and operating the plant. Though harder to quantify, new jobs will also be created in the transportation industry locally and national wide.

During the operation phase of the Wind Farm, the operation and reliability, maintenance (turbines, civil works and electrical infrastructure) finance, ongoing compliance with permissions and permits, safety, security, community relations and benefits and land-owner agreements must be continually managed. These requirements are widely distributed over various employment sectors and are an integral part of the ongoing operation of the Development and will provide continuous employment for the lifetime of the wind farm.

A general outline of the employment associated with the operational phase of the Firlough Wind Farm and Hydrogen Plant is outlined in **Table 4.9.**

Table 4.9: Parties involved during the operational phase adapted from IWEA[47]

Maintenance Contracts	Financial and Services Contracts	Other Stakeholders
Project Manager	Lenders	Local Community
Asset Management	PPA Provider	Local Authority (incl. rates payments)
Turbine Contractor • Transport Companies • Crane Hire • Plant and Vehicle Hire • Site Facilities	Landowner Agreements	Construction and Maintenance material suppliers: • Local shops • Food providers • Accommodation providers
	Insurance	Plant Hire companies
	Accountancy	Telecom provider
	Safety Consultants	Wastewater management companies
	Community Liaison Officer	Hydrogen apprentice Program
Electrical Works Contractor		Hydrogen Distribution Network
Civil Works Contractor		
Utility	Environmental Monitoring • Noise • Ornithology • Habitat Management	
Hydrogen Production Plant technicians		
Maintenance contract with equipment manufacture		
Hydrogen Distribution		

The persons fulfilling these roles may live and work anywhere in Ireland, visiting the Proposed Development as and when required, to operate and maintain the plant and equipment. During major service operations, personnel may be at the Proposed Development over several days and during these times may use local accommodation and restaurants. Overall, there will be a slight positive, but not significant short-term impact on employment in the area during construction, operation and decommissioning.

[47] Irish Wind Energy Association (2019) *Life-cycle of an Onshore Wind Farm.* Ionic Consulting. Available online at: https://www.iwea.com/images/files/iwea-onshore-wind-farm-report.pdf Accessed 06/12/2022

4.4.5 Tourism

The upgrading of the access roads on the Wind Farm Site will provide an additional local amenity to walkers in the area. The Hydrogen Plant Site will resemble a large agricultural shed and be assimilated into the surrounding landscape as far as possible with landscaping and careful design.

The 2017, BiGGAR Economics[48] study found that sustainable tourism appeared to perform better in areas surrounding wind farms compared to tourism at the level of the local authority area. Public transport facilities have made good use of green hydrogen production to date such as buses in Aberdeen and Dublin. In Orkney, Scotland green hydrogen is produced[49] using wind and tidal energy and used for energy storage and as a fuel, part of the project aims to complete the design of an Orkney ferry powered by hydrogen. The Island's green hydrogen strategy[50] includes the aim to encourage more sustainable tourism. The provision of green hydrogen fuel in the northwest of Ireland could potentially attract eco-tourism businesses with a view to promote their sustainable operations.

Fishing is a major tourism industry for Mayo, especially in Ballina. The Hydrogen Plant Site will produce wastewater which, should it get into the river systems untreated, could potentially impact fish stocks and the related fishing tourism that the region enjoys. Apart from the discharge of the trade effluent from the Hydrogen Plant and effluent from welfare facilities on site, there are additional risks to aquatic environment from the accidental spillage or release of chemicals or other pollutants. A range of chemicals will be used within the Hydrogen Plant which include:

- Potassium Hydroxide (KOH) for the electrolysis process (lye).
- Sodium bisulphite for de-chlorination of mains water, should it be used for process.
- Antiscalant used to prevent/reduce scaling of water treatment equipment (i.e. from build-up of salts and calcite).
- Glycol for coolant.
- Oils used by hydraulic systems, compressors and transformers and diesel,
- Facility cleaning chemicals.

As all chemicals used in the Hydrogen Plant Site will be stored in bunded facilities in accordance with specified legislation (Safety, Health and Welfare at Work (Chemical

[48]BiGGAR. (2017). Wind Farms and Tourism Trends in Scotland. https://biggareconomics.co.uk/wp-content/uploads/2020/01/Wind-farms-and-tourism-trends-in-Scotland.pdf Accessed 06/12/2022
[49] OIC. (2022).Hydrogen. https://www.orkney.com/life/energy/hydrogen Accessed 06/12/2022
[50]Orkney Energy. Orkney Hydrogen Strategy https://www.oref.co.uk/wp-content/uploads/2020/11/Hydrogen-Strategy.pdf Accessed 06/12/2022

Agents) Regulations 2001 to 2021), the risk of accidental spillage or release is considered to be unlikely.

Potassium hydroxide and glycol are used only in the closed-loop electrolysis process and will not enter the waste water stream. As the source water for the Hydrogen Plant will be groundwater or rainwater, this should be free of chemicals or dangerous substances. Sodium bisulphite will only be used if mains water is used in the process which would require de-chlorination. In large quantities sodium bisulphite can depress pH and dissolved oxygen, causing mortality of fish (Ryon et al, 2002). However, expected levels of treatment that would be required are at most 5 mg/l (5ppm), typically 2-3 mg/l. Sodium bisulphite is regularly used in the treatment of drinking water supplies and is a non-hazardous solution commonly used as a waste water dechlorination agent. While high concentrations will contribute to elevated chemical oxygen demand in aquatic environments, but it is subject to rapid biological decomposition. Antiscalants will be used in small quantities to prevent/reduce scaling of water treatment equipment and therefore is likely to occur in the waste water stream. While the specific Antiscalant to be used has not been identified, most antiscalants are proprietary organic man-made polymers. These products are considered non-hazardous as defined by the US Occupational Safety and Health Act regulations.

The wastewater arising from the Hydrogen Plant will be treated through constructed wetlands and regulated discharge rates before being discharged to the Dooyeaghny River to the south of the Hydrogen Plant. A wastewater storage, sized c.1500 m^3 will be constructed to achieve the ability to stop discharging to constructed wetlands or surface water completely for a minimum duration of one month, without having to stop the production process. In line storage throughout the process will facilitate buffering flow and discharge rates. This includes wastewater storage with a view to buffering inflow and regulating discharge from wastewater treatment works on site. See **Chapter 6: Aquatic Ecology** and **Chapter 9: Hydrology and Hydrogeology** for further details.

With appropriate wastewater treatment and controls to avoid risks of accidental spillage or release of chemicals, potential adverse impacts on the aquatic environment, and therefore the fishing industry can be mitigated.

Based on the findings of the collective assessments, and the low level of tourism in Study Area One, it was considered that the Proposed Development will not give rise to any significant effects. Overall effects of the Proposed Development with regards to tourism are considered to be short-term, slight, not significant, negative during both the construction

and decommissioning phases and a long-term, slight, not significant positive impact during operation.

4.4.6 Residential Amenity

During the construction phase there is the potential for limited impacts on the residential amenity of the local population. These are likely to be short-term impacts relating primarily to an increase in construction traffic causing noise, dust, and an increase in traffic volume. The impacts of each on nearby properties have been found to be slight, not significant negative in the construction and decommissioning phases and imperceptible in the operational phase.

Potential impacts on residential amenity during the operational phase of the Proposed Development could arise primarily due to noise, shadow flicker, changes to visual amenity, concerns over health and safety, increase in traffic, loss of privacy, disruption to property access or interference with telecommunications.

Detailed noise and shadow flicker modelling have been carried out as part of this EIAR, which shows that the Proposed Development will be capable of meeting all required guidelines in relation to noise thresholds and the Wind Farm is capable of meeting shadow flicker thresholds set out in the 2006 DoEHLG Wind Energy Guidelines see **Section 4.4.9** for Shadow Flicker and **Chapter 11: Noise**. To ensure the Wind Farm Site is compliant with noise limits, some of the turbines may need to be operated in noise reduced modes of operation to protect residential amenity. The wind farm system shall include a kill switch that can be operated at any time with an overriding manual shutdown system in case of an emergency.

The visual impact of the Proposed Development is addressed comprehensively in **Chapter 12** of this EIAR. Given the separation distance of the residential properties from the proposed turbines and the Hydrogen Plant, and the level of existing screening in the area, the Proposed Development will have no significant impact on existing visual amenity at inhabited houses. In terms of noise, the assessment in **Chapter 11** finds no significant impacts to residential amenity from the Proposed Development.

Chapter 16: Major Accidents and Natural Disasters assesses the impact of the Proposed Development on Health and Safety, it finds that; Hydrogen has a proven safety track record as a fuel for more than 100 years worldwide. It is non-toxic and non-poisonous, unlike conventional fuels and a hydrogen leak will not contaminate the environment or endanger the health of humans or wildlife. Hydrogen does not create "fumes" and is 14 times lighter

than air, consequently when it is released it dilutes quickly into a non-flammable concentration, significantly reducing the risk of ignition at ground level. Hydrogen has a higher oxygen requirement for explosion and a lower radiant heat than conventional gasoline.

The Developer has been engaging with various stakeholders and safety specialists for almost 2 years. Actions to date include:

- Incorporation of safety considerations and internationally recognised safety standards and codes to initial Hydrogen Plant design
- Development of Preliminary Hazard Analysis Report
- Engagement with the Health and Safety Authority IA)
- Engagement with Sligo Fire Service
- Engagement with Sligo and Mayo County Councils
- Development of a Major Accidents Prevention Policy (MAPP)
- Completion of Quantitative Risk Assessment

Health and Safety has been a key consideration in the design of the Hydrogen Plant Site, and the approach has incorporated good practice principles such as inherently safer design and the hierarchy of controls. The Seveso III Directive, the main EU legislation dealing specifically with the control of onshore major accident hazards involving, along with the Chemical Act (Control of Major Accident Hazards involving Dangerous Substances) Regulations 2015 which implements the SEVESO directive, governs the inventory of substances stored at the Hydrogen Plant Site. Strict ignition controls are in place in line with COMAH and ATEX regulations. Design standards specific to hydrogen production facilities (Shown in Table 2.4 in Chapter 2; Project Description) have been used throughout the preliminary design phase and regulations and separation distances required by industry good practice have been incorporated into the design. Major Accident Prevention Policy and Emergency Response Plan (recommended, not required for lower-tier COMAH sites) will be produced for the plant. A risk management programme, ATEX Assessment and Safety Management System will be in place for the Hydrogen Plant Site.

Chapter 15: Traffic and Transport assesses the impact of construction traffic on sensitive receptors in the locality. The chapter finds that due to the short-term nature of the construction phase, impacts will be short term, moderate and negative. During the operational phase, green hydrogen will be transported from the Hydrogen Plant using tube trailers. The additional volume of traffic will have a moderate, negative, long-term effect on the existing public road network due to the increase of up to 26 additional HGVs per day. There is a section of approximately 10 m of local road before the operational haul route

joins the national road network, this section does not contain any houses (aside from the dwelling to be demolished as part of the Project). In terms of residential amenity this will have a not significant, negative long-term impact.

The Proposed Development is adequately distanced from existing properties and associated open space areas to maintain residential amenity and ensure the privacy of local residents. No aspects of the Proposed Development overlooks or overshadows residential properties in the vicinity. The Proposed Development will not restrict access to any private or communal amenity spaces. **Chapter 13: Material Assets and Other Issues** addresses impacts to telecommunications from the Development. After scoping with consultees and assessment the Proposed Development will result in no significant impacts to telecommunications.

4.4.7 Property Value

Construction works will be short-term and there is no evidence to suggest that this would impact house prices. Based on the available published studies, that the operation of a wind farm at the Wind Farm Site would not significantly impact on property values in the area. The Hydrogen Plant Site is in an area with relatively few inhabited houses, with 22 within 1 km of the Hydrogen Plant Site. The electrolyser building will resemble a large agricultural shed on completion which should blend into the type of buildings in the area, the landscape and visual impact assessment in **Chapter 12**, found no significant visual impacts of the Hydrogen Plant. Hydrogen tube trailers will be used to transport green hydrogen from the Hydrogen Plant Site during operation. The noise and vibration caused by these vehicles are assessed in **Chapter 11: Noise** and the Traffic impacts in **Chapter 15**. HGV vehicles are already present on the National Road N59 and there is only a very short section of local road (circa 10 m) which will be used for transporting the green hydrogen.

The Proposed Development will have a long-term imperceptible impact on property values.

4.4.8 Human Health

As set out in the Department of Housing, Planning, Community and Local Government Key Issues Consultation Paper on the Transposition of the EIA Directive 2017, the consideration of the effects on populations and on human health should focus on health issues and environmental hazards arising from the other environmental factors, for example water contamination, air pollution, noise, accidents, and disasters.

4.4.8.1 Water Contamination

The main potential impacts to water contamination that occur in the construction and the decommissioning phases are from the release of suspended solids, accidental spillages of cement, hydrocarbons or HDD fluid. There is also a risk from landslides that peat soils can enter drinking water and cause contamination. Landslides occur naturally on peatland and have occasionally been linked to wind farm development. The risks at the Proposed Development have been assessed as not significant the full assessment can be found in **Chapter 8: Soils and Geology**.

Chapter 9: Hydrology and Hydrogeology provides an assessment of the hydrological impacts in relation to the Proposed Development, including the potential for water contamination and any impacts to private water supplies. Precautionary measures and emergency response protocols have been established and specified in Management Plans 1 and 3 of the CEMP, **Appendix 2.1.** During the operational phase of the Hydrogen Plant, source water will be treated as part of the hydrogen production process. Welfare waste from toilet facilities will also be produced. This wastewater will be treated by means of a septic tank (welfare waste) and series of constructed wetland and regulated discharge (combined welfare and processes wastewater).

Apart from the discharge of the trade effluent from the Hydrogen Plant and effluent from welfare facilities on site, there are additional risks to aquatic environment from the accidental spillage or release of chemicals or other pollutants. A range of chemicals will be used within the Hydrogen Plant which include:

- Potassium Hydroxide (KOH) for the electrolysis process (lye).
- Sodium bisulphite for de-chlorination of mains water, should it be used for process.
- Antiscalant used to prevent/reduce scaling of water treatment equipment (i.e. from build-up of salts and calcite).
- Glycol for coolant.
- Oils used by hydraulic systems, compressors and transformers and diesel,
- Facility cleaning chemicals.

As all chemicals used in the Hydrogen Plant Site will be stored in bunded facilities in accordance with specified legislation (Safety, Health and Welfare at Work (Chemical Agents) Regulations 2001 to 2021), the risk of accidental spillage or release is considered to be unlikely.

Potassium hydroxide and glycol are used only in the closed-loop electrolysis process and will not enter the waste water stream. As the source water for the Hydrogen Plant will be

groundwater or rainwater, this should be free of chemicals or dangerous substances. Sodium bisulphite will only be used if mains water is used in the process which would require de-chlorination. In large quantities Sodium bisulphite can depress pH and dissolved oxygen, causing mortality of fish (Ryon et al, 2002). However, expected levels of treatment that would be required are at most 5 mg/l (5ppm), typically 2-3 mg/l. Sodium bisulphite is regularly used in the treatment of drinking water supplies and is a non-hazardous solution commonly used as a waste water dechlorination agent. While high concentrations will contribute to elevated chemical oxygen demand in aquatic environments, but it is subject to rapid biological decomposition. Antiscalants will be used in small quantities to prevent/reduce scaling of water treatment equipment and therefore is likely to occur in the waste water stream. While the specific Antiscalant to be used has not been identified, most antiscalants are proprietary organic man-made polymers. These products are considered non-hazardous as defined by the US Occupational Safety and Health Act regulations.

The wastewater arising from the Hydrogen Plant will be treated through constructed wetlands and regulated discharge rates before being discharged to the Dooyeaghny River to the south of the Hydrogen Plant. Unmitigated discharging to surface waters will potentially impact adversely on the receiving surface water quality and potentially human health if these enter drinking water supplies.

The water treatment process, controls to avoid risks of accidental spillage or release of chemicals, controlled discharge and assimilative capacity of the receiving waters will mitigate this risk. Groundwater and surface water quality, levels and discharge rate in the receiving river will be monitored on a routine and continuous basis. A wastewater storage tank, sized c.1,500 m^3 will be constructed to achieve the ability to stop discharging to constructed wetlands or surface water completely for a minimum duration of one month. This means that should contaminants that could potentially impact human health be found in the wastewater discharge, the discharge can be halted and wastewater stored and recirculated until acceptable levels are attained or taken off site for disposal at registered waste water treatment facilities.

4.4.8.2 Air Pollution

The main potential source of impacts on air quality during construction is dust. There is potential for the generation of dust from excavations and from construction of access roads and hardstands at the Wind Farm Site, the underground water storage tanks and electrolyser buildings at the Hydrogen Plant Site and the trench for the cable ducting for the Grid Connection and Interconnector. The potential impact from dust becoming friable and

being a nuisance to workers, and local road users, if unmitigated, is considered, a slight, not significant negative, short-term, direct impact during the construction phase.

Emissions from plant and machinery, including trucks, during the construction of the Proposed Development are a potential impact. The engines of these machines produce emissions such as carbon dioxide (CO_2), carbon monoxide (CO), Nitrogen Oxides (NO_x), and Particulate Matter (PM_{10} and $PM_{2.5}$). The construction phase is likely to result in an increase in exhaust emission from construction vehicles and transport vehicles associated with the site works. The impact on air quality from an increase in exhaust emissions will be a short-term, slight not significant negative impact.

Environmental Protection Agency (EPA, 2016), EU and World Health Organisation (WHO, 2014) reports estimate that poor air quality accounted for premature deaths of approximately 600,000 people in Europe in 2012, with 1,200 Irish deaths attributable to fine particulate matter (PM2.5) and 30 Irish deaths attributable to Ozone (O_3)[51,52]. These emissions, along with others including nitrogen oxides (NO_x) and sulphur oxides (SO_x) are produced during the burning of fossil fuels for energy generation, transport or home heating. There are no such emissions associated with the operation of wind turbines and the use of wind energy helps to displace fossils fuels. It is not anticipated that there will be any air pollution or hazardous emissions generated by the Hydrogen Plant Site. The green hydrogen produced by electrolysis at the Hydrogen Plant Site will result in zero greenhouse gas emissions due to using renewable wind energy. The only atmospheric emission to be emitted from the electrolysis process will be oxygen. Oxygen (O_2) is produced as a biproduct of the green hydrogen production process at a volume of 8 kg O_2 for 1 kg hydrogen. This is released to the atmosphere via a vent stack. A license will be required from the EPA for the process of venting O_2, application process for this license and consultation with the EPA is underway at the time of application. O_2 is not considered a pollutant or dangerous to human health by either the Air Quality Standard Regulations 2011, WHO, EPA or CAFE Directive (Directive 2008/50/EC). This has an imperceptible neutral impact.

The Proposed Development displaces electricity generated from fossil fuels with electricity generated with renewable wind energy. It also displaces fossil fuels used in heavy duty transportation, industrial processes and heating with zero emissions green hydrogen. Operating at the maximum capacity of 80 MW, the Hydrogen Plant will produce a maximum

[51] WHO. (2014). https://www.who.int/europe/news/item/25-03-2014-almost-600-000-deaths-due-to-air-pollution-in-europe-new-who-global-report , Accessed 06/12/2022
[52] EPA. (2016). Irelands Environment 2016 – An Assessment. https://www.epa.ie/publications/monitoring--assessment/assessment/state-of-the-environment/irelands-environment-2016---an-assessment.php Accessed 06/12/2022

of 31,200 kg of green hydrogen per day However based on the available wind data, this value will vary day-to-day and month-to-month, therefore hydrogen production per year has been more conservatively estimated at 4,547 tonnes (average 12.5 tonnes per day). Using the calculations on abatement in the haulage research paper, this avoids 49,883 tonnes of CO_2 per year by displacing approximately 669 diesel HGVs. By replacing 669 diesel HGVs with green hydrogen, the 80 MW electrolyser gives a saving of 30,774 kg of NO_x and 669 kg of PM per year.

Over 40 years, the Proposed Development would displace between 1.6 and 2.5 million tonnes of CO_2. This reduces air pollution, improving air quality and bringing benefits to human health. There will be slight, not significant, long term, positive effects on air quality from the Firlough Wind Farm and Hydrogen Plant during operation. The full assessment can be found in **Chapter 10: Air and Climate.**

As with most combustion fuel sources, hydrogen is flammable, so any storage or handling of it has the potential to lead to a fire (This is addressed in **Chapter 16 Major accidents and Natural Disasters)**. Hydrogen fires do not typically produce noxious or toxic combustion products and do not produce exhaust fumes, the only product is water and is therefore not considered to be a threat with the potential to affect air quality. There is a potential that other materials at the Hydrogen Plant could be impacted by a hydrogen fire and create emissions that impact air quality. These include:

- Potassium hydroxide (KOH), also known as lye, used as an electrolyte and stored as a 25% KOH solution in tanks within the electrolyser building. KOH itself does not burn however poisonous gases can be produced in fires including potassium oxides. Inhaling potassium hydroxide can irritate the lungs and higher exposures can cause a build up of fluid in the lungs (pulmonary edema). Exposure can cause headache, dizziness, nausea and vomiting.
- Sodium bisulphite is used for the for de-chlorination of raw water. This is not combustible, however during a fire it produces irritating and toxic gases.
- Glycol for coolant. Thermal decomposition can lead to release of irritating gases and vapors including Carbon monoxide (CO) and Carbon dioxide (CO_2).
- Nitrogen gas and will be used at the facility to purge equipment and piping for both safety and maintenance purposes. Nitrogen is an inert gas and so is not toxic.
- Antiscalant used to prevent/reduce scaling of water treatment equipment (i.e., from build up of salts).
- Combustible building materials used in the construction of the Hydrogen Plant.
- Oils and lubricants.

- Cleaning Chemicals.

The Hydrogen Plant Site location is a significant distance from receptors. The public would have no access to the Hydrogen Plant. The nearest public road L6611 is 600 m to the west and the nearest buildings which are not associated with the facility are 299 m away. Due to these separation distances, fire safety mechanisms (outlined in **Chapter 2: Project Description** Section 2.6.6.2 and **Chapter 16: Major Accidents and Natural Disasters**) and the dilution effect of any air pollution created during a fire, the effects to air quality have been assessed as an unlikely temporary small adverse and direct impact in the event of a fire or explosion.

4.4.8.3 Noise

There is likely to be some noise and vibration from traffic within the vicinity of the Haul Route during construction and decommissioning which may cause disturbance to residents. However, the effects are not predicted to be significant and will be short term in nature.

A study by the EPA in South Australia on low frequency noise near wind farms[53] and in other environments found that:
'Overall, the study demonstrates that low frequency noise levels near the wind farms in the study are no greater than levels in urban areas at comparable rural residences away from wind farms'.

The noise assessment in **Chapter 11: Noise**, found that at the Wind Farm the noise levels predicted at the nearest receptors are orders of magnitude below the level at which risk of hearing damage, or indeed negative health effects are possible. The turbine rotor blades will be fitted with a serrated extension of the trailing edge which will mitigate noise emission by design by effectively breaking up turbulence. Operational noise, designed to meet the limits in the 2006 Wind Energy Development Guidelines will have a residual effect within the guideline limits and can be described as not significant. The noise assessment for the Hydrogen Plant found that the maximum predicted noise levels are well within the noise limits for areas of low background as recommended by the EPA's NG4 for day, evening and night-time. The assessment is based on the Hydrogen Plant operating at maximum capacity. It should be noted that when wind speeds (which generates the electrical energy to operate the Hydrogen Plant) are below the cut-in speed of 3 m/s then the Hydrogen Plant

[53]ÈPA Australia. (2013). Low frequency noise near wind farms and in other environments. https://www.epa.sa.gov.au/files/477913_low_frequency.pdf Accessed 06/12/2022

does not operate and when below wind speeds of 5 m/s the plant will operate at lower capacity thereby generating lower noise levels at all receptors.

4.4.8.4 Accidents and Disasters

There is limited potential for significant natural disasters to occur at the development. Ireland is a geologically stable country with a mild temperate climate. A wind farm is not a recognised source of chemical pollution. Should a major accident or natural disaster occur, the potential sources of pollution onsite during both the construction and operational phases are limited. Sources of chemical pollution with the potential to cause significant environmental pollution and associated negative effects on health include bulk storage of hydrocarbons or chemicals and storage of wastes. Spills and leaks can occur if they are not mitigated against which may cause negative effects to human health, if contamination of food or water occurs. The occurrence of such spills and leaks is unlikely as bunding and safe storage practices will be complied with. The full assessment can be found in **Chapter 16: Major Accidents and Natural Disasters** and **Appendix 2.1: Construction Environmental Management Plan.**

A 2020 article in Wind Power Engineering Magazine estimated that 1 in 2,000 wind turbines catch fire each year[54]. Overall, the data shows that wind turbine fires are relatively rare[55]. It is therefore considered that the risk of significant fire occurring, affecting the wind farm and causing the wind farm to have significant environmental effects is limited. The spacing of the turbines and distance of turbines from any properties at the Wind Farm Site and the lack of significant sources of pollution in the wind farm, limits the potential for impacts on human health.

Hydrogen has a proven safety track record as a fuel for more than 100 years worldwide. Producing hydrogen from water is a well-established and safe technology. Across Europe and around the world, hydrogen is quickly becoming the green fuel replacement for fossil fuels. In Ireland, BOC, a British based gas company, has been producing hydrogen at a Dublin plant for over 25 years, supplying key Irish industry sectors such as aerospace, electronics, pharmaceutical, and medical. More recently, the company supplied the green hydrogen used by the three hydrogen powered buses owned by Dublin Bus, which began serving residential routes in July 2021. As with all fuels, the production and handling of hydrogen has an inherent degree of risk. Whilst some properties of hydrogen make it safer than other fuels, there is still a requirement to adopt controls and best practice to ensure safety. Hazards and issues involved with handling hydrogen include combustion, the size of the molecule, interactions with materials and pressure hazards. Health and Safety has

[54] Wind Powered Engineering. (2020). https://www.windpowerengineering.com/is-rope-based-descent-emergency-evacuation-at-the-end-of-its-tether/ Accessed 06/12/2022
[55] Fire Trace International. (2019) https://www.firetrace.com/fire-protection-blog/wind-turbine-fire-statistics Accessed 06/12/2022

been a key consideration in the design of the hydrogen production facility, and the approach has incorporated good practice principles such as inherently safer design, the hierarchy of controls and safety standards as set out in **Table 2.4** in **Chapter 2; Project Description.**

Once fully operational, the Hydrogen Plant Site will be classified as a Lower Tier COMAH site. The Chemicals Act (Control of Major Accident Hazards Involving Dangerous Substances) Regulations 2015 (the "COMAH Regulations"), implement the Seveso III Directive (2012/18/EU). All activities carried out by the appointed contractor at the Hydrogen Plant will be in accordance with the requirements of the Safety, Health and Welfare at Work Act, 2005. The Construction and Environmental Management Plan (CEMP) sets out the Health and Safety requirements for the Proposed Development including the erection of fencing, signage and notification of commencement of works to the Health and Safety Authority (HSA).

A Major Accident Prevention Policy has been produced for the Hydrogen Plant. This policy document establishes senior management's commitment to ensuring the achievement of high standards of control of major accidents and hazards, specifically in relation to the operation of Hydrogen Plant. Guaranteeing a high level of protection to human health and the environment. It sets out the methods employed, controls, training required, the adoption of best practice principles, the mitigation of hazards through design, and the following of relevant guidance and regulations. The Hydrogen Plant Site will be designed and operated to reduce the risk of industrial accidents in so far as is reasonably practicable.

The full impact assessment can be found in **Chapter 16: Major Accidents and Natural Disasters.**

4.4.8.5 Electromagnetic fields

The extremely low frequency (ELF) electric and magnetic fields (EMF) associated with the operation of the proposed cables fully comply with the international guidelines for ELF-EMF set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP), a formal advisory agency to the World Health Organisation, as well as the EU guidelines for human exposure to EMF. Accordingly, there will be no operational impact on properties (residential or other uses), construction staff, operational and maintenance staff or recreational users of the Wind Farm Site as the ICNIRP guidelines will not be exceeded at any distances even directly above the cables. Electromagnetic fields from wind farm infrastructure, including the grid connection, substation and Hydrogen Plant Site are very localised and are considered to be imperceptible, long-term impact.

4.4.9 Shadow Flicker

This section assesses the potential shadow flicker effects of all scenarios within the Turbine Range of the Development. The potential impacts that could arise from the Development during the construction, operation and decommissioning phases relate to potential shadow flicker impacts during operation. No shadow flicker will occur during the construction or decommissioning phases.

The study area is defined as 10 times the widest potential rotor diameter within the range (10 x 155 m = 1,550 m). A study area of 2,000 m is used for completeness. A shadow flicker computer model was used to calculate the occurrence of shadow flicker at relevant receptors to the Development. The output from the calculations is analysed to identify and assess potential shadow flicker impacts. Wind turbines, like other tall structures, can cast long shadows when the sun is low in the sky.

The 2018 Review of the 2006 Guidelines confirms that:
"Shadow Flicker occurs when the sun is low in the sky and the rotating blades of a wind turbine casts a moving shadow which, if it passes over a window in a nearby house or other property results in a rapid change or flicker in the incoming sunlight. The time period in which a neighbouring property may be affected by shadow flicker is completely predictable."

In order to ensure the full extent of the moving shadow which would be created by the Turbine Range is considered in the assessment the following scenarios were modelled:

- Carrowleagh Wind Farm on its own to establish baseline
- Specimen Turbine – 107.5 m hub, 155 m rotor diameter, 185 m tip height
- Alternative Scenario 1 – 102.5 m hub, 155 m rotor diameter, 180 m tip height
- Alternative Scenario 2 – 110.5 m hub, 149 m rotor diameter, 185 m tip height

The three distinct scenarios were included in the assessment along with the cumulative impacts of adjacent Carrowleagh Wind Farm in order to fully assess the range of turbine parameters discussed in **Chapter 2: Project Description**.

Where negative effects are predicted, this section identifies appropriate mitigation strategies. The assessment considers the potential effects during the operational phase of the Proposed Development. A shadow flicker computer model was used to calculate the occurrence of shadow flicker at relevant receptors to the Proposed Development. The output from the calculations is analysed to identify and assess potential shadow flicker impacts. This is further detailed in **Appendix 4.1**.

Shadow flicker lasts only for a short period and happens only in certain specific combined circumstances. The circumstances require that:

- the sun is shining
- the turbine is directly between the sun and the affected property, and
- there is enough wind energy to ensure that the turbine blades are moving.

If any one of these conditions is absent, shadow flicker cannot occur.

The recently published 2019 Draft Revision of the Wind Energy Development Guidelines (WEDG) also added the circumstance where:

- *"there is sufficient direct sunlight to cause shadows (cloud, mist, fog or air pollution could limit solar energy levels)" and note that*
- *"Generally only properties within 130 degrees either side of north, relative to the turbines, can be affected at these latitudes in the UK and Ireland – turbines do not cast long shadows on their southern side".*

Shadow flicker may have the potential to cause disturbance and annoyance to residents if it affects occupied rooms of a house.

Careful site selection, design and planning, and good use of relevant software to control the turbine operation can help reduce the possibility of shadow flicker. Modern wind turbines have the facility to measure sunlight levels and to reduce or stop turbine rotation if the conditions that would lead to excess shadow flicker at any neighbouring property.

The distance and direction between the turbine and property is of significance because:

- The duration of the shadow will be shorter the greater the distance (i.e., it will pass by quicker)
- The shadow flicker cast by rotating wind turbine blades will be reduced, the further a dwelling is from an operating turbine

The path of the sun varies over the seasons resulting in a changing potential for a shadow to be cast throughout the year. Similarly, the sun's position in the sky over the course of a day is changing such that the shadow cast by a turbine is constantly changing. Shadow flicker is more likely to occur on sunny winter days, when the sun is lower in the sky and shadows are cast a greater distance from the turbine. Shadow flicker is more likely to occur

to the west or south-west of the Wind Farm Site with some occurrences also predicted to the north or north-east and south-east. This can be seen in **Appendix 4.1**.

Persons with photosensitive epilepsy can be sensitive to flickering light between 3 and 60 Hertz (Hz)[56]. This is supported by research in recent years asserting that flicker from turbines must interrupt or reflect sunlight at frequencies greater than 3 Hz to pose a potential risk of inducing photosensitive seizures. The frequencies of flicker caused by modern wind turbines are less than 1 Hz[57], and are well below the frequencies known to trigger effects in these individuals. Therefore, any potential shadow flicker effect from the Proposed Development is considered an effect on residential amenity, rather than having the potential to affect the health of residents.

4.4.9.1 Relevant Guidance

The relevant Irish guidance for shadow flicker is derived from the 'Wind Energy Development Guidelines for Planning Authorities' (Department of the Environment, Heritage and Local Government (DoEHLG), 2006) and the 'Best Practice Guidelines for the Irish Wind Energy Industry' (Irish Wind Energy Association, 2012).

The Department of Environment, Community and Local Government in its Wind Energy Development Guidelines (2006) (the 2006 Guidelines) considers that:
"*At distances greater than 10 rotor diameters from a turbine, the potential for shadow flicker is very low. Where shadow flicker could be a problem, developers should provide calculations to quantify the effect and where appropriate take measures to prevent or ameliorate the potential effect, such as by turning off a particular turbine at certain times".*
The 2006 Guidelines also state that:
"It is recommended that shadow flicker at neighbouring offices and dwellings within 500 m should not exceed 30 hours per year or 30 minutes per day".

Although the DoEHLG thresholds apply to inhabited houses located within 500 metres of a proposed turbine location, for the purposes of this assessment, the guideline thresholds of 30 hours per year or 30 minutes per day have been applied to all properties located within ten rotor diameters (i.e., assumed at 1,550 metres as the widest potential rotor diameter within the range (155 m) and 2,000 metres for completeness) of the proposed turbines within the Wind Farm Site (as per IWEA guidelines, 2012). The DoEHLG Guidelines state

[56] Epilepsy Action (2012) *Other Possible Triggers of Photosensitive Epilepsy*. http://www.epilepsy.org.uk/info/photosensitive-epilepsy Accessed 06/12/2022
[57] Harding, G., Harding, P., and Wilkins, A. (2008). *Wind turbines, flicker, and photosensitive epilepsy*. *Epilepsia* (49) 6, pp. 1095-1098.

that at distances greater than 10 rotor diameters from a turbine, the potential for shadow flicker is very low.

The adopted 2006 DoEHLG guidelines are currently under review. The DoHPLG released the 'Draft Revised Wind Energy Development Guidelines' in December 2019. The revised draft of Wind Energy Development Guidelines 2019 provides for zero shadow flicker. The Draft 2019 Guidelines are based on the recommendations set out in the 'Proposed Revisions to Wind Energy Development Guidelines 2006 – Targeted Review' (December 2013) and the 'Review of the Wind Energy Development Guidelines 2006 – Preferred Draft Approach' (June 2017).

The assessment herein is based on compliance with the current DoEHLG Guidelines limit (30 hours per year or 30 minutes per day). However, it should also be noted the Proposed Development can be brought in line with the requirements of the 2019 draft guidelines, should they be adopted while this application is in the planning system, through the implementation of the mitigation measures outlined herein.

Taking the above into consideration, JOD examined maps and aerial photographs to identify receptors (inhabited houses) up to and including ten rotor diameters (1,550 m) of all turbines with a rotor diameter of a maximum of 155 m of the Development. The house survey was ground truth-ed to confirm there are 46 inhabited houses within 2 km of any turbine. A distance of 2 km was used to assess the effects of shadow flicker for completeness. Once the properties within 2 km were identified shadow flicker was assessed for a range of turbines. The following scenarios were assessed:

- Carrowleagh Wind Farm on its own to establish baseline
- Specimen Turbine – 107.5 m hub, 155 m rotor diameter, 185 m tip height
- Alternative Scenario 1 – 102.5 m hub, 155 m rotor diameter, 180 m tip height
- Alternative Scenario 2 – 110.5 m hub, 149 m rotor diameter, 185 m tip height

4.4.9.2 Shadow Flicker Modelling

An industry standard wind farm assessment software package, WindPRO from EMD International Version 3.6 was used to prepare a model of the Development. The programme facilitates the analysis of a wind farm for possible shadow flicker occurrence at nearby houses. It allows for the production of maps, and shadow flicker prediction. The data output from the programme has been analysed and the receptors potentially vulnerable to shadow flicker were identified. The significance of shadow flicker effects was assessed.

Generic windows of 2 m width, 2 m height and 0.5 m from bottom line above ground are applied in the model to each side of the house. The model assumes the receptor will not face any particular direction, but instead will face all directions. These windows represent an approximation of the existing windows on the houses facing north, south, east and west and provide an estimate of potential shadow flicker to a window on each side of the house. The software determines the times of day/year when the sun will be in line with the rotational components of the turbine and the house/receptor, thereby having the potential to cause shadow flicker. The software outputs details of potential shadow flicker, in this case by mean and maximum duration of the shadow flicker events, days per year and times of occurrence and maximum hours per year and maximum minutes per day of shadow flicker.

The following data inputs were required and used to produce an estimate of the effect of shadow flicker from the wind farm:

- Digital elevation model of the Development and areas around all properties within the model (10 m resolution – OS X, Y, and Z data points)
- Turbine locations
- Turbine dimensions (rotor diameter and hub height)
- Receptor locations (i.e. property locations)
- Bottom line height above ground 'window' (0.5 m above ground level)
- Wind speed and direction for the Wind Farm Site to determine the period that the wind turbines will be in operation from the different wind directions during the year

The software creates a mathematical model of the Development and its surroundings and uses this information to calculate specific theoretical times and durations of flicker effects for the identified properties. The following 'worst-case' assumptions were initially incorporated into the shadow flicker modelling:

- there are no clouds and sunlight is always bright and direct
- the turbines are always rotating whereas this might not be the case due to maintenance works or break downs
- there is no intervening structures or vegetation (other than topography) that may restrict the visibility of a turbine, preventing or reducing the effect
- a limit to human perception of shadow flicker is not considered by the model

The model operates by simulating the path of the sun during the year. The results of the model provide a calculation of theoretical specific times and durations of flicker effects for the identified properties. As previously stated, given the assumptions incorporated into the model, the calculations overestimate the duration of effects. The worst-case assumption is

considered to be sufficient for the purposes of this assessment as it assumes the sky is always clear, the turbines are always aligned face-on to each window and that there is a clear and undisturbed line of sight between the windows of the receptors and the turbines (except where this is prevented due to topography). In reality, this will not occur; the turbines will not always be orientated as described, clouds will obscure the sun and line of sight may also be obscured (for example, from leaves on trees). The flicker effects will be substantially less than this and will not meet the results of the worst-case assumption.

The model also outputs a more realistic scenario, or "expected values". In this scenario, the only change in assumptions is that the statistically likely monthly sunshine frequency and wind direction frequency data is assessed. This assessment only changes the annual hours per year metric and is not applied to the daily'data. 'This is because it could be sunny, with the wind coming from the relevant direction, on any individual day The data used in the model was the:

- Long-term sunshine probability data from the Met Éireann synoptic station in Belmullet
- Long-term wind rose data for the onsite met mast

4.4.9.3 Baseline Description

Taking the above into consideration, JOD examined maps to identify receptors (inhabited houses) in the local area within a study area, a distance ten times the maximum proposed rotor diameter of the proposed turbines (10 x 155 m = 1,550 m). A range of turbine parameters was assessed, however, a maximum rotor diameter of 155 m was used to calculate this distance which was then rounded up to 2 km to allow for a complete assessment. This dimension will give the most significant outcome as smaller rotor diameters will cast less shadow. The properties were identified using a combination of Ordnance Survey of Ireland (OSI) Maps, AutoCAD drawings and from internet mapping resources including *Eircode Finder, Google Street View*, *Google Earth*, *Bing Maps,* a planning permission search using the Sligo and Mayo County Councils web resource and from a visit to the Study Area. There are 46 properties within the shadow flicker study area radius. The majority of houses are located to the west, northwest and southwest of the Proposed Development. The coordinates of each inhabited house and its distance to the closest proposed turbine are listed in **Table 4.10** and are shown in **Figure 1.2.**

Table 4.10: Properties within the shadow flicker study area 2 km

Property No.	Easting (ITM)	Northing (ITM)	Altitude (m)	Closest Turbine	Distance to Turbine (m)
H1*	535070	822103	96.9	5	554

Property No.	Easting (ITM)	Northing (ITM)	Altitude (m)	Closest Turbine	Distance to Turbine (m)
H2*	535267	821598	109.3	5	660
H3	535188	821210	107.3	3	725
H4*	535124	823263	102.7	6	735
H5	535061	823316	97.9	6	810
H6	535574	819899	128.1	2	923
H7	535387	820024	125.9	2	929
H8	535857	819660	114.4	1	964
H9	535644	819809	127.2	2	974
H10	535747	819724	119.9	1	976
H11	535966	819584	109.6	1	981
H12	535210	820136	101.1	2	988
H13	534401	822381	84.2	6	1032
H14	534306	822410	78.7	6	1120
H15	534999	823644	94.2	6	1135
H16	534907	820371	97.1	2	1158
H17	534321	822162	82	6	1171
H18	534233	822602	79.2	6	1179
H19	536282	819253	117.6	1	1231
H20	534230	822231	76.3	6	1234
H21	535711	819425	128.9	1	1241
H22	534198	822255	75.4	6	1258
H23	535670	819393	128.7	1	1290
H24	534175	822187	77.3	6	1300
H25	534988	823817	92.4	6	1302
H26	534775	820212	97.6	2	1335
H27	535082	823941	90.2	6	1394
H28	536542	819091	122.8	1	1402
H29	534421	820709	89.1	3	1579
H30	536673	818878	127.7	1	1633
H31	534352	820705	87.6	3	1646
H32	534961	824183	86.4	6	1659
H33	533812	822112	73.6	6	1669
H34	533788	822143	73.5	6	1683
H35	535220	824333	93.9	6	1757
H36	534326	820215	104.3	2	1759
H37	536569	818707	133.9	1	1786
H38	534868	824326	86.6	6	1823
H39	534270	820167	102.1	2	1827
H40	534280	820106	104.4	2	1836
H41	536492	818590	140	1	1896
H42	535188	824469	92.8	6	1896
H43	536527	818584	145	1	1904
H44	533553	822169	70.9	6	1905
H45	534052	820668	77.5	3	1943

Property No.	Easting (ITM)	Northing (ITM)	Altitude (m)	Closest Turbine	Distance to Turbine (m)
H46	533495	822184	70.1	6	1959

*NB: H1, H2 and H4 are derelict buildings.

4.4.9.4 Assessment of Potential Effects

This assessment considers the potential shadow flicker impact of the Development on the surrounding properties in terms of:

- Predicting and assessing the extent of shadow flicker experienced by all properties within the shadow flicker study area
- Specifying mitigation measures, where deemed necessary

Other developments within ten rotor diameters were then considered in the assessment of the Development. Carrowleagh Wind Farm is located adjacent from the Wind Farm Site boundary. The baseline study of Carrowleagh Wind Farm showed that it has no effect on any of the receptors in the study.

The following scenarios were assessed:

- Carrowleagh Wind Farm on its own to establish baseline
- Specimen Turbine – 107.5 m hub, 155 m rotor diameter, 185 m tip height
- Alternative Scenario 1 – 102.5 m hub, 155 m rotor diameter, 180 m tip height
- Alternative Scenario 2 – 110.5 m hub, 149 m rotor diameter, 185 m tip height

Table 4.11: Summary of Potential Shadow Flicker Listing for All Properties of Specimen Turbine

Property No.	Closest Turbine	Distance to Closest Turbine (m)	Potential Maximum Daily Shadow Flicker (hrs:mins/day)	Potential Worst-Case Annual Shadow Flicker (hrs:mins/year)	Expected Annual Shadow Flicker (hrs:mins/year)
H1*	5	554	1:30	229:28	37: 16
H2*	5	660	1:16	233:59	36:55
H3	3	725	1:10	108:30	19:10
H4*	6	735	0:55	88:09	9:29
H5	6	810	0:50	79:31	8:31
H6	2	923	0:23	11:11	1:54
H7	2	929	0:47	54:55	10:26
H8	1	964	*0:00*	*0:00*	*0:00*
H9	2	974	*0:00*	*0:00*	*0:00*
H10	1	976	*0:00*	*0:00*	*0:00*
H11	1	981	*0:00*	*0:00*	*0:00*
H12	2	988	*0:00*	*0:00*	*0:00*
H13	6	1032	0:36	74:33	12:07
H14	6	1120	0:33	62:44	10:06
H15	6	1135	0:25	30:33	3:17
H16	2	1158	0:33	34:14	6:49
H17	6	1171	0:34	76:36	13:27
H18	6	1179	0:31	39:27	6:08
H19	1	1231	*0:00*	*0:00*	*0:00*
H20	6	1234	0:31	63:34	10:47
H21	1	1241	*0:00*	*0:00*	*0:00*
H22	6	1258	0:30	54:04	9:05
H23	1	1290	*0:00*	*0:00*	*0:00*
H24	6	1300	0:29	53:13	9:11
H25	6	1302	0:23	26:12	2:41
H26	2	1335	0:34	49:34	9:42
H27	6	1394	0:22	24:26	2:17
H28	1	1402	*0:00*	*0:00*	*0:00*
H29	3	1579	0:24	45:18	8:28
H30	1	1633	*0:00*	*0:00*	*0:00*
H31	3	1646	0:23	40:40	7:26
H32	6	1659	0:19	15:52	1:26
H33	6	1669	0:23	26:15	4:44
H34	6	1683	0:22	25:18	4:30

Property No.	Closest Turbine	Distance to Closest Turbine (m)	Potential Maximum Daily Shadow Flicker (hrs:mins/day)	Potential Worst-Case Annual Shadow Flicker (hrs:mins/year)	Expected Annual Shadow Flicker (hrs:mins/year)
H35	6	1757	0:16	9:01	0:43
H36	2	1759	0:21	32:41	6:08
H37	1	1786	*0:00*	*0:00*	*0:00*
H38	6	1823	0:16	6:44	0:31
H39	2	1827	0:21	30:28	5:42
H40	2	1836	0:21	27:01	5:04
H41	1	1896	*0:00*	*0:00*	*0:00*
H42	6	1896	*0:00*	*0:00*	*0:00*
H43	1	1904	*0:00*	*0:00*	*0:00*
H44	6	1905	0:20	13:15	2:21
H45	3	1943	0:19	27:39	5:10
H46	6	1959	0:19	12:13	2:09

*NB: H1, H2 and H4 are derelict buildings.

It can be demonstrated from **Table 4.11**, that in the case of the Specimen Turbine where a hub height of 107.5 m and a rotor diameter of 155 m are used for the proposed turbines, there will be 32 receptors out of 46 that will experience some degree of shadow flicker and 14 receptors that will experience no shadow flicker.

In Alternative Scenario 1, where a hub height of 102.5 m and a rotor diameter of 155 m are used for the proposed turbines, there will be 29 receptors out of 46 that will experience some degree of shadow flicker and 17 receptors that will experience no shadow flicker.

In Alternative Scenario 2, where a hub height of 110.5 m and a rotor diameter of 149 m are used for the proposed turbines, there will be 32 receptors out of 46 that will experience some degree of shadow flicker and 14 receptors that will experience no shadow flicker.

In the first scenario of the Specimen Turbine, the worst impacted receptor is H1, which will experience 37 hours and 16 minutes of shadow flicker per year. In Alternative Scenario 1, the worst impacted receptor is H2, which is expected to experience up to 36 hours of shadow flicker in a year. In the third scenario, Alternative Scenario 2, the worst impacted receptor is H1, which is expected to experience 35 hours and 11 minutes of shadow flicker per annum. These exceed the WEDG (2006) of 30 hours per year shadow flicker using the worst-case assumptions of the model. To mitigate against this, the relevant turbines will be shut down (NB: H1, H2 and H4 are derelict buildings). This mitigation measure is discussed further in Section 4.4.9.7.

As H1 and H2 are currently derelict, the potential effects on current occupied receptors are assessed. In the first scenario of the Specimen Turbine, the worst impacted occupied receptor is H3, which will experience 19 hours and 10 minutes of shadow flicker per year. In Alternative Scenario 1, the worst impacted occupied receptor is also H3, which is expected to experience up to 18 hours and 47 minutes of shadow flicker in a year. In the third scenario, Alternative Scenario 2, the worst impacted occupied receptor is also H3, which is expected to experience 17 hours and 46 minutes of shadow flicker per annum. While the expected results do no exceed the WEDG 2006, mitigation measures can be applied as necessary, should any issues arise.

The calculated worst-case shadow flicker occurrences in the **Table 4.11** assumes the sun is always shining, that there is no cloud cover and the dwelling is always occupied. As previously stated, this calculation is based on topography alone and excludes vegetation, buildings and other man-made structures. As can be seen in the shadow flicker assessment attached as **Appendix 4.1** all of the proposed turbines give rise to some degree of cumulative shadow flicker, if unmitigated.

4.4.9.5 Assessment of Expected Shadow Flicker Impact

In order to calculate more realistic and 'real world' occurrences of shadow flicker for the receptors that are identified as potentially vulnerable to shadow flicker (**Table 4.11**), it is necessary to identify the likely meteorological conditions which are expected to be experienced at the Wind Farm Site. To estimate the likely duration of sunshine occurrence at the Wind Farm Site, historical meteorological data from the Belmullet Met Éireann is automatically uploaded by the software. Data from onsite Meteorological Mast was used for windrose. This gives a good representation of data for the Development. This data was utilised to consider the probability of sunshine occurrence, and thus allow the determination of 'projected' values for shadow flicker occurrence.

The worst-case predicted hours for shadow flicker are reduced by the average time the weather is cloudy annually. As discussed above, to estimate the impact of sunshine occurrence, historical meteorological data is utilised to consider the likelihood of sunshine (the sunshine probability) at different times of the year. This allows the determination of 'expected' values for shadow flicker occurrence. This is achieved by applying a reductive factor to the worst-case total hours per year of shadow flicker. 'Long term average sunshine hours' refers to data collected by Met Éireann.

Table 4.11 shows the potential and the expected shadow flicker values per year which are likely to be experienced by each receptor. 'Potential sunshine hours' refers to the intervening time period between modelled sunrise and sunset. Although the projected duration of shadow flicker is reduced substantially for each inhabited house, they are not eliminated entirely for all of the 46 receptors within the shadow flicker study area of the Development. The Draft Revised Wind Energy Development Guidelines, December 2019, recommend that shadow flicker should not impact any inhabited house, therefore the relevant turbine or turbines must be shut down on a temporary basis until the potential for shadow flicker ceases.

4.4.9.6 Cumulative Effects

Cumulative shadow flicker impacts could arise if inhabited houses are at risk from potential shadow flicker impacts as a result of more than one wind farm. While separate wind farms are not likely to cause effects simultaneously, they could increase the cumulative total hours where a receptor is impacted. In this instance, there is one consented windfarm, Stokane Wind Farm and two operational windfarms, Carrowleagh Wind Farm and Black Lough Wind Farm, within a 2 km range of the turbines that may cause cumulative effects.

The assessment showed that there will be no cumulative shadow flicker impacts. The installation of a blade shadow control system on all wind turbines will eliminate shadow flicker impacts from the Proposed Development, therefore, removing the possibility of cumulative shadow flicker impacts.

4.4.9.7 Mitigation Measures and Residual Effects

Due to the potential for shadow flicker to affect receptors within the shadow flicker study area, it is proposed that a shadow control system will be installed on each of the wind turbines. The control system will calculate, in real-time:

- Whether shadow flicker has the potential to affect nearby properties, based on pre-programmed co-ordinates for the properties and turbines
- Wind speed (can effect how fast the turbine will turn and how quickly the flicker will occur)
- Wind direction
- The intensity of the sunlight
- When the control system detects that the sunlight is strong enough to cast a shadow, and the shadow falls on a property or properties, then the turbine will automatically shut down; and will restart when the potential for shadow flicker ceases at the affected properties.

The WEDG (2006) recommends a 30 hours per year threshold for shadow flicker. The Draft Revised Wind Energy Development Guidelines, December 2019, recommend that shadow flicker should not impact any dwelling, meaning the relevant turbine or turbines must be shut down on a temporary basis until the potential for shadow flicker ceases.

It is intended that the measures outlined above, subject to safe shut down time of approximately 60 seconds, will ensure the WEDG (2006) shadow flicker thresholds are not exceeded at any of the properties within the study area, this will be the case regardless of which turbine is selected within the turbine range.

The control system can be adjusted to automatically shut-down the turbine when the control systems detects the sunlight is strong enough to cast a shadow thereby complying with the 2019 Draft WEDG if/when they come into effect.

In the event that complaints of shadow flicker are received by the Developer / Site Operator or by Mayo or Sligo County Councils, an investigation will take place and the complaints frequency, duration and time of complaints will be considered and specialist modelling software will be used to confirm the occurrence(s). Should the complaint persist, a shadow flicker survey involving the collection of light data will also be carried out at the property in which the complaint was made. Further refinement of the blade shadow control system will be conducted to eliminate the shadow flicker occurrence. This could result in the shutting off turbines at specific times of day.

4.4.9.8 Summary of Significant Effects

This assessment has identified the potential for shadow flicker to affect between 29 No. and 32 No. out of 46 No. receptors within the shadow flicker study area. It is proposed that a shadow control system be installed to eliminate the potential for shadow flicker from the Proposed Development. Such systems are common in many wind farm developments and the technology has been well established. A case study in Scotland found that the use of turbine shut-down control modules for turbines which were causing shadow flicker at nearby offices was successful[58].

[58] Department of Energy and Climate, UK Government. (2011) Update of UK Shadow Flicker Evidence Base, Parsons Brinckerhoff for Department of Energy and Climate Change, United Kingdom. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/48052/1416-update-uk-shadow-flicker-evidence-base.pdf Accessed 06/12/2022

4.4.9.9 Statement of Significance

This assessment has identified that by installing a blade shadow control system on the proposed turbines, there will be no significant impacts. Given that only effects of significant impact or greater are considered "significant" in terms of the EIA Regulations, the potential effects of the Development as a result of shadow flicker, when mitigated, are considered to be not significant.

4.5 MITIGATION MEASURES AND RESIDUAL EFFECTS

Although no negative impacts of significance have been established, there are a number of measures, which may be implemented for the safety of workers and the public during the construction, operational and decommissioning phases and to optimise any positive benefit opportunities.

4.5.1 Embedded Mitigation

The Proposed Development, as described in **Chapter 2: Project Description**, incorporates good practice measures for limiting the adverse effects of the construction works. The principal potential effects arising from works tend to relate to construction traffic affecting the use of National Primary roads, local primary roads and access roads by the general public and drainage. Measures are set out in **Chapter 15: Traffic and Transportation** relating to how delivery of goods and services will be managed during works to minimise impacts and details of mitigations and the use of Sustainable Drainage Systems can be found in **Chapter 9: Hydrology and Hydrogeology**. The proposed mitigation measures have been further developed in the **Construction and Environmental Management Plan (CEMP)** (**Appendix 2.1**).

4.5.2 Public Interest

Given that no negative impacts have been identified, no mitigation measures are proposed.

4.5.3 Population and Settlement Patterns

Given that no negative impacts have been identified, no mitigation measures are proposed.

4.5.4 Economic Activity

Given that no negative impacts have been identified, no mitigation measures are proposed to reduce or remedy any adverse effect. To maximise positive impacts, the Developer is committed to employing good practice measures with regard to maximising local procurement and will adopt measures such as those set out in the Renewable UK Good Practice Guide, 2014: 'Local Supply Chain Opportunities in Onshore Wind' (Renewable UK,

2014). The Developer will work with a variety of contractors who will be actively encouraged to develop local supply chains throughout the local area, and work with subcontractors to invest in training and skills development.

4.5.5 Employment

Given that no negative impacts have been identified, no mitigation measures are proposed. To maximise positive impacts, the Developer would aim to employ local workforce and procure goods and services locally wherever possible.

4.5.6 Tourism

Mitigation measures for recreation and tourism are primarily related to the preliminary design stage of the Development, which has allowed for the prevention of unnecessary or inappropriate development to occur that will significantly affect any recreational or tourist amenity. In designing the Proposed Development, careful consideration was given to the potential impact on landscape amenity.

Allowing for the implementation of embedded mitigation, no significant effects have been identified in respect of tourist receptors arising from the construction of the Proposed Development and therefore no mitigation measures are required to reduce or remedy any adverse effect.

Though no significant negative impacts have been identified, best practice means that the transportation of abnormal loads would be programmed to avoid peak hours on the road network, thus reducing delays and disruption, and avoid peak tourist periods or events where practicable, for example during the Bunnyconnellan Agricultural Show (Bunnyconnellan). Construction activities would be limited to normal working hours to minimise noise and other impacts during recreational and leisure periods.

4.5.7 Residential Amenity

With the implementation of the mitigation measures outlined in relation to noise and vibration, dust, traffic, shadow flicker, telecommunications and visual amenity, the Development will have no significant impact on residential amenity and therefore no further mitigation measures are required beyond those explained in the relevant chapters/sections.

4.5.8 Human Health

4.5.8.1 Water Contamination

Detailed mitigation measures proposed are outlined in **Chapter 9: Hydrology and Hydrogeology** and include details on release of Suspended Sediments, hydrocarbon spillages, chemical spillages and cement-based products. To ensure effective implementation of mitigation measures, an Environmental Clerk of Works (EnvCoW) will be assigned to carry out monitoring during the construction and operational phases of the Proposed Development. The EnvCoW will have the authority to temporarily stop works in a particular area of the site to ensure corrective measures are implemented and adverse environmental impacts are minimised if not avoided. Monitoring of pollution prevention and mitigation undertaken by the EnvCoW assigned by the Developer will include:

- Monitoring site pollution prevention plan
- Water quality monitoring;
- Advising on required pollution prevention measures and monitoring their effectiveness.
- Liaison with local authorities in relation to pollution instances if applicable.
- Considering the EnvCoW will be responsible for monitoring a broad range of environmental factors, technical monitoring and advice will be sought such as from specialist consultants as the need arises e.g., installation and website for telemetry.

To mitigate against any spills, emergency spill kits with oil boom and absorbent materials will be kept on-site; in construction compounds, vehicles transporting fuel and smaller spill control kits will be kept in all construction machinery. All construction personnel will be notified of the location of spill kits as part of the site induction and will be trained on the site procedures for dealing with spills. Full details are included in the CEMP in **Appendix 2.1**.

4.5.8.2 Air Pollution

Mitigation measures proposed include:

- Approach roads and construction areas will be cleaned on a regular basis to prevent mud built-up and from migrating around the site and off-site;
- Wheel wash facilities will be provided near the site compounds to prevent mud/dirt being transferred from the site to the public road network;
- A mechanised road sweeper will be used along access roads if required;
- 'Damping down' will be used if dust becomes an issue on any part of the site;
- Vehicles delivering materials to the site will be covered appropriately when transporting materials that could result in dust, e.g., crushed rock or sand;
- Ready-mix concrete will be delivered to site and it is envisaged that no batching of concrete will take place on site;

- Speed restrictions on access roads at the Wind Farm Site and Hydrogen Plant Site will be implemented to reduce the likelihood to dust becoming airborne;
- Public roads along the construction haul route will be inspected regularly and if dirt / mud is identified that could result in dust generation then the road will be cleaned as necessary;
- Stockpiling of materials will be carried out in such a way as to minimise their exposure to wind where possible and damping down will be carried out where needed; and
- A complaints procedure will be implemented on site where complaints will be reported to the site manager, logged and appropriate action taken.

The assessment of impacts and mitigation measures is included in **Chapter 10: Air and Climate.**

4.5.8.3 Noise

Although no significant noise impacts are identified in **Chapter 11: Noise**, best practice measures for noise control will be adhered to onsite during the construction phase of the Development. These measures include:

- Sensitive location of equipment, taking account of local topography and natural screening.
- Working methods: construction noise will be controlled by prescribing that standard construction work shall be restricted to the specified working hours as outlined in **Chapter 2: Project Description**. Any construction work carried out outside of these hours shall be restricted to activities that will not generate noise of a level that may cause a nuisance. The phasing of works has also been designed with regard to avoidance of noise impacts.
- Plant will be selected taking account of the characteristics of noise emissions from each item. All plant and machinery used on the site shall comply with relevant E.U. and Irish legislation in relation to noise emissions. The timing of on- and off-site movements of plant near occupied properties will be controlled.
- Operation of plant: all construction operations shall comply with guidelines set out in British Standard documents '*BS 5338: Code of Practice for Noise Control on Construction and Demolition Sites'* and '*BS5228-1:2009+A1:2014: Code of Practice for Noise and Vibration Control on Construction and Open Sites'*. The correct fitting and proper maintenance of silencers and/or enclosures, the avoidance of excessive and unnecessary revving of vehicle engines, and the parking of equipment in locations that avoid possible impacts on noise sensitive locations will be employed.

- Training and supervision of operatives in proper techniques to reduce site noise, and self-monitoring of noise levels, if appropriate.

A warranty will be sought from the selected turbine and Hydrogen Plant equipment manufacturers to confirm that an assessment of noise would result in noise levels at all receptors being less than or equal to the noise limits set out in **Chapter 11: Noise**. The warranty will include the provision that there will be no clear tonal components audible at any receptor.

To ensure the Wind Farm Site is compliant with noise limits, some of the turbines may need to be operated in noise reduced modes of operation to protect residential amenity. The wind farm system shall include a kill switch that can be operated at any time with an overriding manual shutdown system in case of an emergency.

4.5.8.4 Accidents and Disasters

A competent, adequately resourced site supervisor will be appointed for the works. All relevant information relating to health and safety will be passed on to the site supervisor. The site supervisor will notify the relevant safety authorities and prepare the pre-tender health and safety plan and see that a construction phase health and safety plan is adequately developed. The site supervisor will collate information from the designers and principal contractor to produce a health and safety file for the Proposed Development.

The site health and safety file will be completed as soon as is possible after the construction of the Proposed Development. It will contain all relevant health and safety information relating to the Proposed Development in relation to the day to day running and maintenance operations and eventual decommissioning. It is the owner's duty to hold and make available any information contained in the file to anyone who would need such information.

To maintain safety and avoid health impacts on construction workers and the general public, best practice site safety and environmental management will be maintained. The Proposed Development will be designed, constructed, operated and decommissioned in accordance with the following:

- Safety, Health and Welfare at Work (Construction) Regulations 2013 Safety
- Health and Welfare at Work Act 2005 Safety
- Health and Welfare at Work (General Applications) Regulations 2007

Construction and Decommissioning

All construction staff will be adequately trained in health and safety and will be informed and aware of potential hazards. All hazards will be identified, and risks assessed. Where elimination of the risk is not feasible, appropriate mitigation and/or control measures will be followed. The contractor will be obliged under the construction contract and current health and safety legislation to adequately provide for all hazards and risks associated with the construction phase of the Proposed Development.

Safe Pass registration cards are required for all construction, delivery and security staff. Construction operatives will hold a valid Construction Skills Certificate Scheme card where required. The Developer is required to ensure a competent contractor is appointed to carry out the construction works. The Contractor will be responsible for the implementation of procedures outlined in the Safety and Health Management Plan.

Once mitigation measures and health and safety measures are followed, the potential for impact on human health on the construction site during construction and decommissioning is expected to be not significant and temporary to short-term.

Public safety will be addressed by restricting access to the public in the vicinity of the Proposed Development works during the construction and decommissioning stage. This measure aims to avoid potential injury to members of the public as a result of construction activities. Appropriate warning signage will be posted at the construction site entrance, directing all visitors to the site manager. Appropriate signage will be provided on public roads approaching site entrances and along haul routes.

In relation to the turbine delivery route, extra safety measures will be employed when large loads are being transported, for instance, Garda escort will be requested for turbine delivery and a comprehensive turbine delivery plan will be utilised to avoid potential impact to human safety for road users and pedestrians.

For the installation of the grid connection cable in the public road, a traffic management plan has been developed (**Appendix 2.1**) in discussion with locals who will be directly impacted by the works, and in agreement with the Local Authority. Public consultation will be conducted along the grid cable route to inform local residents ahead of construction and decommissioning works.

Once mitigation measures and health and safety measures are implemented and followed, the potential for impact on human health for members of the public during construction and decommissioning of the Development is expected to be not significant and temporary to short-term.

Operation

For operation and maintenance staff working at the Proposed Development, appropriate site safety measures will be utilised during the operational phase by all permitted employees. All personnel undertaking works in or around the turbines will be fully trained and will use appropriate Personal Protective Equipment (PPE) to prevent injury. Equipment within high voltage substations presents a potential hazard to health and safety. The Wind Farm Substation and Hydrogen Plant Substation will be enclosed by palisade fencing and equipped with intruder and fire alarms in line with ESB and EirGrid standards. All on-site electrical connections are carried by underground cable and will be marked out above ground where they extend beyond the Access roads or hardstanding surface. Details of cables installed in the public road will be available from ESBN.

Lightning conductors will be installed on each turbine as all structures standing tall in the sky require this protection. Turbines specifically require this to prevent power surges to electrical components. Turbines will be fitted with ice detection systems which will stop the turbine from rotating if ice is forming on a turbine blade.

Rigorous statutory and engineering safety checks imposed on the turbines during design, construction, commissioning and operation will ensure the risk posed to humans is negligible. 24-hour remote monitoring and fault notifications are included as standard in the Turbine Operations and Maintenance Contracts. A Supervisory Control and Data Acquisition ("SCADA") system will monitor the Development's performance. If a fault occurs, then a message is automatically sent to the operations personnel preventing emergency situations. In addition to scheduled maintenance, the maintenance contracts will allow for call out of local engineers to resolve any issues as soon as they are picked up on the remote monitoring system. Access to the turbines inner structure will be locked at all times and only accessed by licenced employees for maintenance.

In line with the Health Service Executive's Emergency Planning recommendations, any incident which may occur at the site which requires emergency services, incident information will be provided in the 'ETHANE' format:

- Exact location

- Type of incident
- Hazards Access and egress
- Number of casualties (if any) and condition
- Emergency services present and required

The design of the Proposed Development has considered the susceptibility to natural disasters. The proposed site drainage will mitigate against any potential flooding risk due to run off with the use of Sustainable Drainage Systems (SuDS). Construction drainage will be left in-situ for the lifespan of the Development through to decommissioning.

The Contractor's fire plans are reviewed and updated on a regular basis. A nominated competent person shall carry out checks and routine maintenance work to ensure the reliability and safe operation of firefighting equipment and installed systems such as fire alarms and emergency lighting. A record of the work carried out on such equipment and systems will be kept on site at all times.

A Supervisory Control and Data Acquisition ("SCADA") system will monitor the Proposed Development's performance. If a fault occurs, then a message is automatically sent to the engineer preventing emergency situations. Warning signs and security infrastructure will be in place around the onsite switchgear and control building to provide for public safety.

A Safety Management Programme is to be developed for the Hydrogen Plant site. This process has already commenced through a Preliminary Hazard Analysis and a Major Accident Prevention Policy. The Developer has engaged with the HSA, Mayo County Council and Sligo County Council in relation to the development of an Emergency Response Plan for the Hydrogen Plant Site. These processes will help identify and mitigate hazards onsite and reduce the risk to employees, the public and the environment during the construction and operational phase of the facility. The Hydrogen Plant Site will be remotely monitored and manned 24 hours a day. Warning signs and security infrastructure will be in place around the switchgear and control building and Hydrogen Plant Site to provide for public safety. Access to the Hydrogen Plant Site will be restricted to authorised personnel and security fencing will prevent egress by the public.

Design standards specific to hydrogen production facilities (Shown in **Table 2.4 in Chapter 2: Project Description**) have been used throughout the preliminary design phase and regulations and separation distances required by industry good practice have been incorporated into the design. A Major Accident Prevention Policy has been prepared and

will be refined post-consent and prior to operations. An Emergency Response Plan (recommended, not required for lower-tier COMAH sites) will be produced for the plant. A risk management programme, ATEX Assessment and Safety Management Programme will be in place for the Hydrogen Plant Site.

Safety equipment installed will include:

- Leak/fire detection + isolation/automatic shut-off
- Emergency stops
- Building ventilation (passive + active)
- Piping pressure/flow rate monitoring
- Impact sensors at dispensers
- Audible and visual alarms
- Fire protection and suppression equipment

The detection system in place at the Hydrogen Plant Site will be capable of detecting hydrogen gas or hydrogen fire and a Supervisory Control and Data Acquisition ("SCADA") system will monitor the facilities performance. Firefighting systems will include dedicated firefighting water tanks, alarms, water spray deluge systems, sprinkler systems, carbon dioxide suppression systems and mobile fire protection equipment in accordance with the relevant codes and standards.

The location of the Hydrogen Plant Site has been specifically selected to minimise the potential to affect any receptors. The public will have no access to the Hydrogen Plant Site. The nearest public road L-6612-1 is 600 m to the west and the nearest buildings which are not associated with the Hydrogen Plant Site are also 299 m away.

All chemicals stored on-site will be subject to a COSHH (Control of Substances Hazardous to Health) assessment and compliance with the requirements of REACH, i.e., European Communities Regulation 1907/2006 for the Regulation, Evaluation, Authorisation and Restriction of Chemicals. Chemicals will be managed in accordance with European Chemicals Agency's Guidance for Downstream Users (2014). Final selection of bulk chemicals will be subject to an assessment of trace elements to ensure that they are within acceptable limits. Storage of large volumes of oils and other hazardous substances will have a secondary containment such as a bund to prevent hydrocarbon contamination to land/water. Waste oils and other chemicals, including oil rags/wipes will be disposed of as hazardous waste. Operational staff will receive training on the handling, containment, use, and disposal requirements for all potentially polluting products on-site. A more detailed assessment can be found in **Chapter 16: Major Accidents and Natural Disasters.**

4.5.8.5 *Electromagnetic fields*

All electrical elements of the Development are designed to ensure compliance with electro-magnetic fields (EMF) standards for human safety. No mitigation measures beyond the mitigation by design (avoidance of potential impacts) are considered to be required.

4.5.8.6 *Residual Risk*

Once the above mitigations are taken into account, the residual risk on population and human health is assessed to be an imperceptible, long-term effect.

4.6 CUMULATIVE EFFECTS

For the assessment of cumulative impacts, any other existing, permitted or proposed developments (wind energy or otherwise) have been considered where they had the potential to generate an in-combination or cumulative impact with the Proposed Development. A list of project for cumulative assessment can be found in **Appendix 2.3**. The nearest wind farm to the Proposed Development is the operational Carrowleagh Wind Farm and Carrowleagh Extension adjacent to the east and northeast of the site boundary, which comprises 17 No. Enercon E70/2300 Turbines. Stokane Wind Community Led Wind Energy Project, a single 150 m turbine was granted in 2022 (Sligo planning reference 22161) this is located 1.09 km to the north of the Wind Farm. The next closest wind farms to the Wind Farm is the Black Lough Wind Farm, located approximately 2.4 km to the east and Bunnyconnellan Wind Farm, 5 km south. Bunnyconnellan East Turbine is a single turbine extension to the Bunnyconnellan Wind Farm, located 5 km to the south of the Wind Farm. There are no other major development works planned, proximate to the Proposed Development at the time of writing of this EIAR (June 2023).[59]

The Proposed Development, along with Carrowleagh Wind Farm and Extension and other Irish renewable energy systems, is considered to be a fundamental change in Ireland's energy systems impact on the climate. This is an important, positive effect that is significant under the EIA regulations and will contribute to Ireland's legally binding reduction targets and contribution to the global transition away from fossil fuel use and towards a low carbon society and economy with energy security. By offsetting fossil fuels, the Proposed Development along with Carrowleagh Wind Farm and Extension and other Irish renewable energy systems will contribute to improving air quality and positively impacting human health. The improvements to energy security also cumulatively help to improve public

National Planning Search; https://housinggovie.maps.arcgis.com/apps/webappviewer/index.html?id=9cf2a09799d74d8e9316a3d3a4d3a8de, Accessed 23/07/2023 Mayo Planning Search https://mayococo.maps.arcgis.com/apps/webappviewer/index.html?id=2b1fc4da0e214d25b5727fecb908ae27 Accessed 23/07/2023 and Sligo Planning Search https://www.sligococo.ie/planning/SearchPlanningApplications/ Accessed 23/07/2023

interest in terms of stabilising energy prices and reducing the concerns around inaction on climate change. Renewable energy developments cumulatively contribute to employment and economic development in Ireland. The cumulative impact of the Proposed Development can be predicted to be a small, short-term negative impact on tourism and amenity during construction.

The Landscape and Visual Impact Assessment contained in **Chapter 12** summarises that overall, it is considered that there will be notable cumulative impacts arising from the addition of the proposed wind farm to the series of existing wind farms that existing along the plateau at the base of the Ox Mountains, but it will reinforce a legible and compatible combination of large scale low intensity land use in this setting. Therefore, the contribution of the Proposed Development to cumulative impacts is deemed to be **Medium** and this is not a significant level of cumulative impact.

Cumulative noise assessment in **Chapter 11** assessed the cumulative effects of all windfarms within 3 km, these have been predicted and assessed and found to be in compliance with limits set in the Wind Energy Development Guidelines 2006. The noise levels predicted at the nearest receptors are orders of magnitude below the level at which risk of hearing damage, or indeed negative health effects are possible.

4.7 SUMMARY OF SIGNIFICANT EFFECTS

The assessment has not identified any likely significant effects from the Project on population and human health.

4.8 STATEMENT OF SIGNIFICANCE

This chapter has assessed the significance of potential effects of the Project on population and human health. The Project has been assessed as having the potential to result in effects of a slight, but not significant positive, long-term impact overall. Through the implementation of mitigation measures, the cumulative effects associated with the Project are predicted to be not significant.