61253

Environmental Impact Assessment Report

# Cummeennabuddoge Wind Farm

## Chapter 15: Shadow Flicker

## Cummeennabuddoge Wind (DAC)

September 2024

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## Tables



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## Glossary of Terms

| Term | Definition |
|---|---|
| The Applicant | Cummeennabuddoge Wind Designated Activity Company (DAC) |
| The Agent | Atmos Consulting Limited |
| Environmental Advisors and Planning Consultants | Atmos Consulting Limited |
| Environmental Impact Assessment | A means of carrying out, in a systematic way, an assessment of the likely significant environmental effects from a development |
| Environmental Impact Assessment Regulations | Schedule 6 of the Planning and Development Regulations 2001(as amended) |
| Environmental Impact Assessment Report | A document reporting the findings of the EIA and produced in accordance with the EIA Regulations |
| The Proposed Development | Cummeennabuddoge Wind Farm |
| The Proposed Development Site | The land enclosed by the red line shown on Figure 1-1a |
| The Planning Act | Directive 2011/92/EU (as amended by Directive 2014/52/EU, the EIA Directive). |

## List of Abbreviations

| Abbreviation | Description |
|---|---|
| DECC | Department of Energy and Climate Change |
| DoHLGH | Department of Housing, Planning and Local Government |
| DTM | Digital Terrain Model |
| EIA | Environmental Impact Assessment |
| EIAR | Environmental Impact Assessment Report |
| IWEA | Irish Wind Energy Association |

# 15 Shadow Flicker

## 15.1 Introduction

This Chapter considers the potential effects of shadow flicker on all properties within the shadow flicker study area of the Proposed Development.

Shadow flicker can arise from the passing of the moving shadow of a wind turbine rotor-blade over a narrow opening such as the window of a nearby residence. A similar effect can also occur when the gloss blades of a rotating turbine reflect the sun causing a flashing light.

Shadow flicker happens only when a certain combination of conditions coincide at particular times of the day and year, mainly in the winter months when the sun is low in the sky (DECC, 2011).

The occurrence of shadow flicker and the extent of its effects are dependent on a number of factors, namely:

- Distance from the wind turbine;
- Turbine hub height and rotor diameter;
- Speed of blade rotation;
- The proportion of sunny weather during the months when flicker can occur; and
- The size, shape and orientation of any windows or doors of neighbouring properties.

The flickering may have the potential to cause disturbance and annoyance to residents. It is, however, not possible for turbines to cause photosensitive epilepsy.

People with photosensitive epilepsy are usually sensitive to flickering light between 16-25 Hertz (Hz), although some people may be sensitive to rates as low as 3 Hz and as high as 60 Hz (Epilepsy Action, 2022).

Modern wind turbines are designed to operate at a frequency of less than 1 Hz and are therefore well below the frequencies known to trigger photosensitive epilepsy (Epilepsy Action, 2022).

### 15.1.1 Development Outline

The Proposed Development comprises the following:

- 17 wind turbines and associated hardstand areas; and
- The range / value of turbine dimensions are as follows:
  - a total tip height of 200m;
  - hub height in the range of 118m minimum to 125.5m maximum inclusive; and
  - rotor diameter in the range of 149m minimum to 163m maximum.

A full description of the Proposed Development is presented in Chapter 4.

In order to consider the full range of shadow flicker effects that could occur across the full Proposed Turbine Range two shadow flicker scenarios were assessed which accounts for the full range with all other turbine/hub dimensions falling within the shadow flicker envelope encompassed by the dimensions of the turbines below:

- Figure 15-1a - Rotor diameter – 163m, Hub Height – 118m, Tip Height – 200m (largest rotor diameter with the lowest hub); and
- Figure 15-1b - Rotor diameter – 149m, Hub Height – 125.5m, Tip Height – 200m (smallest rotor diameter with the highest hub).

### 15.1.2 Statement of Authority

This chapter has been prepared by Richard Newsham, Senior Consultant at Atmos. Richard has significant experience of preparing shadow flicker prediction models and assessments for proposed and permitted wind energy developments.

Richard Newsham (Project Manager). Richard has over 6 years in the renewable energy industry, including 3 years as an EIA Project Manager and 1 year as a renewable energy developer.

Richard has a degree in BSc (Hons) Geography and Natural Hazard Management and is a Prince2 Foundation and Practitioner.

Richard's experience includes the management and delivery of large scale wind consent applications including the management of the entire EIA process from initial screening and scoping to the submission of the completed EIAR.

## 15.2 Methodology and Approach

### 15.2.1 Legislation, Planning Policy and Guidance

There is no applicable legislation setting out any relevant rules or requirements for the assessment or control of shadow flicker.

#### DoHLGH - 2006 Wind Energy Development Guidelines

However, this assessment takes into consideration two sets of guidelines released by the Department of Housing, Local Government and Heritage. The first is the in force 2006 Wind Energy Development Guidelines for Planning Authorities 2006 (DoHLGH, 2006). The 2006 Guidelines state that:

> *"Careful site selection, design and planning, and good use of relevant software, can help avoid the possibility of shadow flicker in the first instance. It is recommended that shadow flicker at neighbouring offices and dwellings within 500m should not exceed 30 hours per year or 30 minutes per day. 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".*

#### DoHLGH - 2019 Draft Revised Wind Energy Development Guidelines

The Draft Revised 2019 Wind Energy Development Guidelines are not currently in force.

The Draft 2019 Guidelines state:

> *"With careful site design and appropriate mitigation, and most critically the use of appropriate equipment and computer software, no existing dwelling or other*

*affected property (e.g. existing work places or schools) should experience shadow flicker."* (DoHLGH, 2019).

The Proposed Development will abide by the 2006 Guidelines and is also aligned with the requirements of the Draft 2019 Guidelines should they come into force in the future.

### IWEA – Best Practise Guidelines for the Irish Wind Energy Industry

The Irish Wind Energy Association (IWEA) released best practise guidelines in 2012 (IWEA, 2012). The IWEA guidelines state:

> *"In times of direct sunshine, wind turbine blades could occasionally cast moving shadows on residences in close proximity to the turbines. At certain times of the year, the moving shadows of the turbine blades could periodically reduce light to a room causing the light to appear to flicker. This would not generally have any effect on health or safety, but could on limited occasions present a brief nuisance effect for some neighbours."*

Regarding cumulative shadow flicker impacts the IWEA guidelines state the following:

> *"It is important to determine if there are other existing and/or permitted but not constructed wind farms in the vicinity of the proposed development which could contribute towards a cumulative shadow flicker impact on any receptors. Any such wind farm developments within 2 km of the proposed development should be considered in a separate cumulative shadow flicker assessment."*

## 15.2.2 Assessment Methodology

### Study area

The 2006 Guidelines state that the likelihood of shadow flicker being experienced at distances greater than 10 times the rotor diameter from a turbine is very low. As such the study area for this assessment of shadow flicker on sensitive receptors is 10 times the rotor diameter.

The Draft 2019 Guidelines do not outline a shadow flicker study area range.

The Proposed Development consists of rotor diameters ranging from 149m to 163m inclusive. As such two shadow flicker models have been produced to account for this range. Figure 15-1a assesses the maximum rotor diameter with a 1,630m study area and Figure 15-1b assesses the minimum rotor diameter with a 1,490m study area. All dwellings within these study areas will be assessed for shadow flicker effects.

### Receptors

The location of all properties within the study area was identified using OSI data, a detailed planning registry search and a physical survey of the area. A total of two receptors within the study area were identified as being at risk of shadow flicker effects (See Table 15-1, Figure 15-1a and Figure 15-1b).

All dwellings within the study area have a sensitivity of 'High'.

**Table 15-1: Dwellings within Study Area at Risk of Shadow Flicker Effects**

| Receptor ID | ITM X | ITM Y |
|---|---|---|
| 1 | 517407 | 583967 |

| Receptor ID | ITM X | ITM Y |
|---|---|---|
| 2 | 519142 | 583765 |

There are two additional dwellings to the south of the Proposed Development which are within the largest study area of the maximum rotor diameter (1,630m) as shown in Figure 15-1a. These two dwellings are not at any risk of experiencing shadow flicker effects from the Proposed Development.

This is due to their location relative to the Proposed Development, these two dwellings are located to the south and therefore the sun will at no point throughout the year be positioned behind the Proposed Development relative to the dwellings, as such no shadow flicker is possible as shown in Figure 15-1a and Figure 15-1b.

## Significance criteria

For this assessment, shadow flicker effects will be considered 'significant' if either receptor experiences shadow flicker over 30 minutes per day or 30 hours per year (DoHLGH, 2006).

## Impact Prediction Model & Assumptions

In assessing the effect of shadow flicker, the commercial software Garrad Hassan Windfarmer was used to calculate the expected number of hours of shadow flicker that could occur at each receptor.

The model takes into account the movement of the sun relative to the time of day and time of year and predicts the time and duration of expected shadow flicker at a window of an affected receptor. The input parameters used in the model are as follows:

- The turbine location;
- The Proposed Turbine Dimensions; and
- The location of the receptors to be assessed.

The Garrad Hassan Windfarmer model is based upon a Digital Terrain Model (DTM) of 25m resolution.

Calculations were undertaken to predict shadow flicker periods at each of the receptors using the following assumptions:

- All receptors have a window facing directly towards the turbine;
- The turbine blades were assumed to be rotating for 365 days per year;
- There is a clear sky 365 days per year;
- The turbine blades are always orientated in a perpendicular direction between the receptor and the sun, this orientation would result in the maximum possible shadow flicker;
- The receptor is occupied at all times; and
- No screening is present.

These assumptions result in a highly conservative assessment. The modelling results are typically considered to be a theoretical worst-case estimation of the actual impacts experienced, which would not arise in practice given the assumptions listed above.

## 15.3 Assessment of Effects and Mitigation

### 15.3.1 Do-Nothing Scenario

If the Proposed Development were not to proceed, there would be no potential for shadow flicker effects on dwellings within the study area of the Proposed Development as shown on Figures 15-1a and 15-1b.

### 15.3.2 Construction Effects

As the proposed wind turbines will not be operational during the construction phase, shadow flicker will not occur.

### 15.3.3 Operational Effects

The maximum possible extent of shadow flicker across the full Proposed Turbine Range is shown in Table 15-2. Both daily and annual shadow flicker predictions show incidence of shadow flicker at both receptors in excess of the significance threshold. Therefore, curtailment of wind turbines will be required.

**Table 15-2: Shadow Flicker Results**

| Month | Receptor 1 | | Receptor 2 | |
|---|---|---|---|---|
| | Maximum minutes per day | Hours per month | Maximum minutes per day | Hours per month |
| **January** | 10 | 3.17 | 70 | 55.83 |
| **February** | 10 | 1.67 | 60 | 29.17 |
| **March** | 0 | 0.00 | 20 | 5.00 |
| **April** | 0 | 0.00 | 30 | 3.50 |
| **May** | 0 | 0.00 | 30 | 7.50 |
| **June** | 0 | 0.00 | 0 | 0.00 |
| **July** | 0 | 0.00 | 30 | 2.00 |
| **August** | 0 | 0.00 | 30 | 9.17 |
| **September** | 0 | 0.00 | 20 | 3.00 |
| **October** | 0 | 0.00 | 50 | 15.50 |
| **November** | 20 | 6.00 | 70 | 56.83 |
| **December** | 10 | 4.33 | 70 | 48.50 |
| **Totals** | | **15.17** | | **236.00** |

#### Mitigation

Shadow flicker effects have been minimised as far as practicable through the iterative design process as described in Chapter 3 which resulted in only two properties being within the shadow flicker study area. While the Proposed Development strikes the best balance between the minimisation of shadow flicker and achieving the objectives of the project, shadow flicker effects remain at both receptors.

Technological mitigation is available, and widely implemented, on wind farm developments where shadow flicker is predicted. These mitigation measures effectively limit (curtail) the operation of turbines during the infrequent and rare periods when shadow flicker occurs.

The wind turbines will each be fitted with shadow flicker curtailment software, inherent to their design, to facilitate their shut down as required.

If shadow flicker is predicted to occur based on the prediction model, the software will safely shut down the turbines at the predetermined times based on the prediction model.

This approach will be implemented, as necessary, to ensure that the levels of shadow flicker do not exceed the 2006 or 2019 Guideline values once the turbines have completed their safe shutdown cycle. The Applicant has committed to zero shadow flicker subject to the time needed for safe shutdown during community consultations and will curtail on this basis.

The level of turbine curtailment required to ensure that shadow flicker limit values are not exceeded will have an imperceptible effect on the overall renewable energy output of the proposed development.

Within 12-months of the commencement of commercial operations, a shadow flicker survey will be undertaken by a suitably qualified person to verify the results of the prediction model and to ensure the effective operation of the curtailment software. Monitoring will be undertaken when and where the model predicts shadow flicker is expected to occur.

The data which will be collected during the survey will include:-

- The date, time, location (turbine ID) and duration of the measurement;
- Sunlight intensity and direction;
- Wind speed and direction/rotor angle; and
- Time, date and duration of any sensor triggered curtailment.

A site visit will be carried out by a suitably qualified person during each calendar season, to obtain representative samples of year-round conditions, and to monitor the site when shadow flicker is predicted to occur to verify the effectiveness of the technological solutions.

In addition, should any third party complaints be raised in respect of shadow flicker at any time during the lifetime of the proposed development, additional specific monitoring will be undertaken as per the methods described above.

The primary proposed mitigation is curtailment. Other options will be discussed with the affected homeowner, including:

- Installation of appropriate window blinds in the affected rooms of the residence;
- Planting of screening vegetation; and
- Other site-specific measures which might be agreeable to the affected party and may lead to the desired mitigation.

If agreement can be reached with the homeowner, then it will be arranged for the above options to be implemented in cooperation with the affected party as soon as practically possible and for the full costs to be borne by the wind farm operator.

### 15.3.4 Decommissioning Effects

As the proposed turbines will not be operational during the decommissioning phase, shadow flicker will not occur.

### 15.3.5 Cumulative Effects

Cumulative effects may arise if any dwelling identified in the study area for the Proposed Development are also within the respective study areas for the other cumulative wind farm sites, as shown in Figure 15-2a and 15-2b.

There are two additional dwellings within the shadow flicker envelope of both the Proposed development and Knocknamork windfarm, as shown in Figure 15-2a. However, there is no risk of shadow flicker from the Proposed Development at these two dwellings as they lie to the south of the Proposed Development. They are at no risk of experiencing cumulative effects.

No other receptors are located within overlapping study areas for other windfarms.

## 15.4 Residual Effects

### Residual Effects

The proposed mitigation measures (See Section 15.3.3) will ensure that if any residual effects arise, following their implementation, they will not be significant. Technological mitigation will effectively exclude any likely significant shadow flicker effects.

The proposed mitigation measures will, where necessary, ensure that shadow flicker levels which may be experienced at receptor locations from the Proposed Development will fall below the prescribed limits of the 2006 Guidelines after the brief safety slowdown of the turbine rotors, while the proposed monitoring will confirm the efficacy of the mitigation measures.

### Cumulative Residual Effects

There are no cumulative effects arising from the Proposed Development in combination with any nearby cumulative sites. Therefore, there will be no residual effects.

## 15.5 Summary and Statement of Significance

This Chapter has assessed the full Proposed Turbine Range for likelihood of shadow flicker effects at all dwellings located within 10-times the rotor diameter (1,630m & 1490m) of the proposed wind turbines using a shadow flicker model.

Shadow flicker is a rare phenomenon and can only occur during the infrequent coincidence of a number of specific, variable meteorological and geographic factors. The shadow flicker model is also based on a number of precautionary assumptions which significantly overestimate the likely shadow flicker impact at any receptor.

There is no likelihood of any significant effects during the construction or decommissioning phases as the proposed wind turbines will not be operational.

Technological mitigation measures are available, and widely implemented, to exclude the likelihood for shadow flicker to occur. These measures will ensure that no dwelling experiences shadow flicker arising from the Proposed Development, in line with the 2006 Guidelines, and the Draft Revised 2019 Guidelines should they come into force in the future, and the Applicant's commitment to near zero shadow flicker.

Therefore, it is concluded that the Proposed Development will not result in any likely significant shadow flicker effects, either individually or in combination with other existing, permitted or proposed developments.

## 15.6 References

Department of Energy and Climate Change (DECC) (2011). Update to the Shadow Flicker Evidence Base. Available: https://www.gov.uk/government/publications/update-of-uk-shadow-flicker-evidence-base

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