# EAST CLAYDON BATTERY ENERGY STORAGE SYSTEM (BESS)

## Environmental Statement: Appendix 9.1.2 - Climate Risk

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## Tables

# 1 CLIMATE CHANGE RISK

## 1.1 Overview

1.1.1 This appendix to Volume 9, Chapter 1: Climate Change summarises potential changes in climatic parameters at the Proposed Development location and considers whether there is potential for likely significant environmental effects.

1.1.2 Besides climate risks to the Proposed Development itself, there are potential inter-relationships between climate change and several other environmental topic areas reported in other chapters of the Environmental Statement (ES), most notably flood risk. The climate projections summarised in this appendix have been provided to all ES chapter authors in order that any changes in the future baseline or sensitive receptors due to climate change can be evaluated if relevant to the respective impact assessments. The resultant assessment of in-combination climate impacts is detailed within Volume 9, Chapter 1: Climate Change.

## 1.2 Climate Change Projections

1.2.1 The Met Office Hadley Centre (MOHC) publishes both probabilistic climate change projections and downscaled global circulation model outputs for the UK at various spatial scales. This is called the UKCP18 dataset, first published in November 2018 and at v2.8.0 (MOHC, 2023) at the time of writing. The projections are based on representative concentration pathway (RCP) scenarios used by the Intergovernmental Panel on Climate Change, thereby giving a low-high range in potential global GHG reduction initiatives and resulting rate of climatic effects over a given time period.

1.2.2 The probabilistic projections published at 25 km grid cell scale are considered the most useful for this assessment, being designed to show a range of projection values that reflect uncertainty in modelled outcomes. The CP18 Overview Report (MOHC, 2018a) and supporting factsheets (MOHC, 2018b) for the wider regional and UK context have also been drawn from.

1.2.3 The Proposed Development is expected to be of a long-term/permanent nature as a key piece of electricity grid infrastructure. Climate change projections for two periods in the mid- and late century have therefore been considered: average conditions during 2040-2069 and 2070-2099.

1.2.4 The Overview Report and factsheets indicate that in general, warmer, wetter winters and hotter, drier summers are predicted, though of course still with natural variations in that pattern from year to year. No clear trend in wind speeds or storminess is predicted, though the data currently published cannot make projections for local conditions and wind gusts.

1.2.5 Within the last two decades, annual average temperature and precipitation records have been consistently set in the UK relative to the preceding baseline period, although generally wetter rather than drier summers have been seen in this period. In the near future, roughly the next years to decade, these natural variations will likely continue to be the most visible year-to-year changes in climate but in subsequent decades, within the Proposed Development's operating lifetime, the anthropogenic climatic changes are expected to become more apparent.

1.2.6 **Table 1.1** and **Table 1.2** show potential climatic changes from the UKCP18 probabilistic dataset averaged over the 2040-2069 and 2070-2099 time periods relative to the 1981-2010 baseline for the 25 km grid square in which the site is located. The data presented here is for the emissions pathway RCP8.5, which is a high-emissions scenario assuming 'business as usual' growth globally with little additional mitigation. This is a conservative (worst-case) approach for the assessment.

1.2.7 In summary, the data within **Table 1.1** shows increased intensity in seasonal precipitation trends: precipitation is predicted to increase during the wettest season and decrease during the driest season. Temperatures are anticipated to increase across the year, both during the coldest and hottest seasons and months. Additionally, humidity is anticipated to increase. **Table 1.2** indicates that these trends will continue and amplify towards the end of the century.

**Table 1.1: Climate Parameter Projections 2040–2069[1]**

| Parameter† | Units | 10th percentile | Median value | 90th percentile |
|---|---|---|---|---|
| Precipitation – annual average | % | -10.16 | -2.34 | 5.52 |
| Precipitation – driest season | % | -42.67 | -16.82 | 8.12 |
| Precipitation – wettest season | % | -9.50 | 1.82 | 14.32 |
| Precipitation – driest month | % | -10.85 | 11.04 | 35.61 |
| Precipitation – wettest month | % | -20.56 | 6.20 | 30.56 |
| Temperature – annual average | ºC | 1.04 | 1.98 | 2.97 |
| Temperature – hottest season average | ºC | 1.17 | 2.59 | 4.05 |
| Temperature – coldest season average | ºC | 0.51 | 1.66 | 2.88 |
| Temperature – hottest month maximum | ºC | 0.99 | 3.31 | 5.68 |
| Temperature – hottest month average | ºC | 1.18 | 2.96 | 4.79 |
| Temperature – coldest month minimum | ºC | 0.42 | 1.74 | 3.16 |
| Temperature – coldest month average | ºC | 0.36 | 1.61 | 2.93 |
| Humidity – annual average | % | 3.62 | 10.36 | 17.79 |
| Humidity – winter | % | 1.09 | 11.03 | 21.40 |
| Humidity – summer | % | 0.56 | 10.49 | 20.78 |

† daily mean, maximum or minimum, as applicable, averaged over time period specified
n.b. 10th and 90th percentile and median values for scenario RCP8.5.

[1] Precipitation during the driest and wettest months (both within Table 1.1 and Table 1.2) show an unexpected projected increase in precipitation during both. It is understood that this is due to February being the driest month in the year in this area of the UK; as winters get milder and wetter it can be expected that precipitation is likely to increase during February as projections indicate.

**Table 1.2: Climate Parameter Projections 2070–2099**

| Parameter† | Units | 10th percentile | Median value | 90th percentile |
|---|---|---|---|---|
| Precipitation – annual average | % | -12.69 | -1.88 | 8.98 |
| Precipitation – driest season | % | -64.02 | -35.44 | -0.57 |
| Precipitation – wettest season | % | -10.46 | 6.75 | 25.78 |
| Precipitation – driest month | % | -13.91 | 18.08 | 55.79 |
| Precipitation – wettest month | % | -23.19 | 12.19 | 42.45 |
| Temperature – annual average | ºC | 2.23 | 3.80 | 5.47 |
| Temperature – hottest season average | ºC | 2.63 | 5.13 | 7.72 |
| Temperature – coldest season average | ºC | 1.21 | 3.02 | 5.02 |
| Temperature – hottest month maximum | ºC | 2.77 | 6.95 | 11.19 |
| Temperature – hottest month average | ºC | 2.79 | 6.05 | 9.31 |
| Temperature – coldest month minimum | ºC | 1.10 | 3.24 | 5.52 |
| Temperature – coldest month average | ºC | 0.89 | 2.94 | 5.01 |
| Humidity – annual average | % | 10.52 | 20.94 | 32.25 |
| Humidity – winter | % | 6.52 | 22.66 | 39.28 |
| Humidity – summer | % | 4.66 | 19.49 | 34.96 |

† daily mean, maximum or minimum, as applicable, averaged over time period specified
n.b. 10th and 90th percentile and median values for scenario RCP8.5

1.2.8 No clear trend for change in wind speed during this time period is shown in the regional projections data. Probabilistic projections do not provide wind speed data.

## 1.3 Climate Risk and Resilience Scoping

1.3.1 Based on the information available for the Proposed Development, a high-level risk assessment has been undertaken, considering the hazard, potential severity of effect on the development and its users, probability of that effect, and level of influence the development design can have on the risk. The severity of effect score considers the potential consequences of the hazard and the sensitivity of the receptor(s) affected. Each element of the risk assessment has been scored on a scale of one to three, representing low, medium or high; the scores are then summed to give a total risk score. **Table 1.3** defines each of these terms.

1.3.2 Given the variability in the nature of the potential effects of climate change on the development, receptors have been identified on a risk-specific basis, whereby all receptors relate to the continued safe and effective operation of the Proposed Development. In line with IEMA (2020) guidance, the vulnerability and susceptibility have been considered in determining the severity of risk.

1.3.3 A risk score of five or more has been defined as a risk that could lead to a significant effect of or on the development, prior to mitigation, as this is the minimum score where at least two elements of the risk assessment score are above 'low'.

1.3.4 By considering the good practice design measures incorporated into the Proposed Development, professional judgement is used in determining whether the potentially significant effects would result in significant adverse of beneficial effects.

**Table 1.3: Severity, Probability and Influence Factor Definitions**

| Factor | Score definitions |
|---|---|
| **Severity:** the magnitude and likely consequences of the impact should it occur. | **1 =** unknown or low impact: for example, low-cost and easily repaired property damage; small changes in occupiers' behaviour. |
| | **2 =** moderate impacts with greater disruption and/or costs |
| | **3 =** severe impact, e.g. risk to individual life or public health, widespread property damage or disruption to business |
| **Probability:** reflects both the range of possibility of climatic parameter changes illustrated in CP18 projections and the probability that the possible changes would cause the impact being considered | **1 =** unknown or low probability of impact; impact would occur only at the extremes of possible change illustrated in projections |
| | **2 =** moderate probability of impact, plausible in the central range of possible change illustrated in projections |
| | **3 =** high probability of impact, likely even with the smaller changes illustrated as possible in the projections |
| **Influence:** the degree to which design of the proposed development can affect the severity or probability of impacts | **1 =** no or minimal potential to influence, outside control of developer, e.g. reliance on national measures or individuals' attitudes/actions; or hypothetical measures would be impracticable |
| | **2 =** moderate potential to influence, e.g. a mixture of design and user behaviour or local and national factors; measures may have higher costs or practicability challenges |
| | **3 =** strong potential to influence through measures that are within the control of the developer and straightforward to implement |

1.3.5 **Table 1.4** shows the climate change risks to the proposed development that have been identified and the risk scores assigned, following the approach set out in paragraph 1.11 and **Table 1.3.**

**Table 1.4: Risk Scores for the Proposed Development**

| Risk | Severity | Probability | Influence | Total score | Potentially significant? | Embedded mitigation |
|---|---|---|---|---|---|---|
| Flooding of site | Flood risk is assessed in Volume 4: Hydrology and Flood Risk of the Environmental Statement | | | | | |
| Structural damage to container crates housing battery from extreme weather. | 2 | 1 | 2 | 5 | Yes | The container crates will be mounted on concrete bases for stability and surrounded by permeable gravelled areas to promote infiltration and reduce the risk of flooding. |
| High winds leading to damage to distribution and transmission lines resulting in battery down time. | 2 | 1 | 1 | 4 | No | Cabling within the Proposed Development will be underground, and as such will not be at risk from high winds.<br>Network operators have a statutory requirement to keep overhead power lines clear of vegetation for public safety reasons. Since 2006, operators have also been required to undertake a risk-based programme of resilience vegetation management. |
| Increased relative humidity leading to risk of moisture damage to battery packs. | 1 | 1 | 2 | 4 | No | |
| Extreme high temperatures and increased ambient temperatures leading to battery efficiency losses (either via reduced round trip efficiency losses due to overheating or via increased parasitic load due to increased cooling demand). | 1 | 2 | 2 | 5 | Yes | Battery cooling plant will be designed to account for a range of temperature conditions. |
| Transmission and distribution line de-rating (from increased ambient temperatures) leading to battery output capacity constraints. | 1 | 2 | 1 | 4 | No | |
| Shrinking and swelling of clay soils due to excessive rainfall and drought leading to container crate, switch and control unit, and inverter house subsidence. | 2 | 1 | 2 | 5 | Yes | Relevant earthworks will be undertaken, upon which concrete bases will be installed on loose gravel platforms to support the container crates. The switch and control units and inverter houses will be built to comply with Building Regulations for structural design. |

1.3.6 The Climate Change Risk & Adaptation Response for UK Electricity Generation (Energy UK, 2015) concluded that risks to energy infrastructure from climate change remain relatively low. Climate change does not introduce any significant new risks which energy infrastructure developments do not already manage. It does however increase the likelihood and severity of such risks.

1.3.7 Short-term weather events may present more of a risk to the proposed development than long-term climate trends. Furthermore, the industry identifies engineering-related faults as more of a risk to losses in generation than changing weather patterns.

1.3.8 The most significant risk from climate change to the proposed development arises from flooding due to increased levels of precipitation. This is assessed in Volume 4: Hydrology and Flood Risk and appropriate flood management and resilience measures have been provided.

1.3.9 With the exception of flood risk, the greatest risks to the proposed development due to climate change have been identified as those arising from high temperatures affecting operation of the development and storms affecting power transmission and building damage.

1.3.10 Network operators have a statutory requirement to keep overhead powerlines clear of vegetation that is a risk in storms and since 2006, operators have also been required to undertake a risk-based programme of resilience vegetation management.

1.3.11 Overall, it is considered that the potentially significant risks screened in Table 1.4 do not represent new or unexpected issues, and that best practice for the safe operation of electricity generation facilities would mitigate against the likelihood of significant adverse effects thereby reducing the effect to negligible.

# References

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