# Greenhouse gas emissions

# Modelled performance pathway

### Credit 15

### Design Review Submission As Built Submission

|  |  |  |  |
| --- | --- | --- | --- |
| Total Points Available: | 20 | Points Claimed: | [#] |

|  |  |  |
| --- | --- | --- |
| Criteria | Points Available | Points Claimed |
| Energy Consumption Reduction | 4 | [#] |
| GHG Emissions Reduction | 16 | [#] |
| **TOTAL** | 20 | [#] |

## Project-specific technical questions (formerly tcs and cirs)

|  |  |
| --- | --- |
| There are no project-specific Technical Questions for this credit. |  |
| There are project-specific Technical Questions for this credit and all responses received from the NZGBC are attached. |  |

## 15 modelled performance pathway

Summarise the projects systems and initiatives that have been included to reduce greenhouse gas emissions compared to the reference building.

## 15.1 Conditional requirement

|  |  |
| --- | --- |
| The proposed building GHG emissions are less than those of the equivalent benchmark building, which represents at least a 10% improvement on reference building. |  |

Identify where this information can be found within the supporting documentation provided.

|  |  |
| --- | --- |
| **Supporting Documentation** (Name / title / description of document) | **Reference** (Page no. or section) |
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## 15.2 Credit requirements

### 

### Building Energy Consumption and Greenhouse Gas Emissions Calculator

[Insert hyperlink to Building Energy Consumption and Greenhouse Gas Emissions Calculator]

### Analysis Software

|  |  |
| --- | --- |
| **Building energy simulation analysis software summary** | |
| Software name and version |  |
| Software developer |  |
| Software validation standard (evidence of developer’s compliance to be provided) |  |
| Simulator’s name (include description of training and experience with software) |  |

### Building Description

|  |  |  |
| --- | --- | --- |
| **Building general parameters** | | |
|  | **Proposed Building** | **Reference Building** |
| Climate zone |  | |
| Weather data (location and data format) |  | |
| Number of building storeys (below ground/above ground) |  | |
| Total modelled building gross floor area (GFA) (m²) |  | |
| Heating fuel(s) |  |  |
| Cooling fuel(s) |  |  |

Identify where this information can be found within the supporting documentation provided.

|  |  |
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| **Supporting Documentation** (Name / title / description of document) | **Reference** (Page no. or section) |
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### 

### Producer statement

|  |  |
| --- | --- |
| A Producer Statement has been submitted by an Accredited Energy Modeller. |  |

Note that the following information do not need to be provided when a producer statement has been submitted.

### Building Space Summary

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Building area summary** | | | | |
| Space Type | Building Level | Gross Floor Area (m²) | | |
| Conditioned | Unconditioned | Total |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Project teams may provide a set of drawing mark ups rather than a Table summary if this is more convenient.

Identify where this information can be found within the supporting documentation provided.

|  |  |
| --- | --- |
| **Supporting Documentation** (Name / title / description of document) | **Reference** (Page no. or section) |
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| [####] | [####] |

### Building Simulation Inputs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Building simulation input summary** | | | | |
| Space Type | Operating Profile(s) Applied | Temperature Control Range (°C) | Occupancy Density (m²/person) | Equipment Load (W/m²) |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Where operating profiles have been modified from the default values provided in the calculation, guidelines this should be noted and justification given in an accompanying document.

Identify where this information can be found within the supporting documentation provided.

|  |  |
| --- | --- |
| **Supporting Documentation** (Name / title / description of document) | **Reference** (Page no. or section) |
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### Building Fabric Description

|  |  |  |
| --- | --- | --- |
| **Building opaque fabric parameters (Wall and floor)** | | |
| Values must be reported for all wall and roof system types used in the building/Parameter | Proposed Building | Reference Building |
| External above-grade envelope wall construction and R value |  |  |
| External below-grade envelope wall construction and R value |  |  |
| Internal envelope wall construction and R value |  |  |
| Roof construction, solar absorptance and R value |  |  |
| Floor construction and R value |  |  |
| Cool, cold or hot room construction and R value |  |  |

Identify where this information can be found within the supporting documentation provided.

|  |  |
| --- | --- |
| **Supporting Documentation** (Name / title / description of document) | **Reference** (Page no. or section) |
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**Transparent Fabric Components**

[Insert documentation demonstrating that glazing system performance values satisfies the compliance requirements.]

### Heating ventilation and cooling systems

|  |  |  |
| --- | --- | --- |
| **Air conditioning system parameters** | | |
| Parameter | Proposed Building | Reference Building |
| Primary Air conditioning system type |  |  |
| Other air conditioning system type(s) |  |  |
| Space served |  |  |
| Design supply air temperature difference (K) |  |  |
| Supply air temperature control |  |  |
| Outside air design volume flow rate (L/s) |  |  |
| Fan design supply air volume flow rate (L/s) |  |  |
| Fan design absorbed power (kWe) |  |  |
| Minimum flow rate turndown (%) |  |  |
| Economy cycle control |  |  |
| Demand-controlled ventilation |  |  |
| Heat recovery type |  |  |
| Heat recovery effectiveness |  |  |
| Heat recovery parasitic power (kWe) |  |  |

|  |  |  |
| --- | --- | --- |
| **Ventilation system parameters** | | |
| **Parameter** | **Proposed Building** | **Reference Building** |
| Ventilation system type |  |  |
| Fan design supply air volume (L/s) |  |  |
| Fan design absorbed power (kWe) |  |  |

Identify where this information can be found within the supporting documentation provided.

|  |  |
| --- | --- |
| **Supporting Documentation** (Name / title / description of document) | **Reference** (Page no. or section) |
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|  |  |  |
| --- | --- | --- |
| **Unitary plant parameters** | | |
| **Parameter** | **Proposed Building** | **Reference Building** |
| Packaged equipment cooling performance (EER) |  |  |
| Packaged equipment heating performance (COP) |  |  |

Identify where this information can be found within the supporting documentation provided.

|  |  |
| --- | --- |
| **Supporting Documentation** (Name / title / description of document) | **Reference** (Page no. or section) |
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|  |  |  |
| --- | --- | --- |
| **Cooling and heat rejection plant parameters** | | |
| Parameter | Proposed Building | Reference Building |
| Chiller type |  |  |
| Chiller capacity (kWr) |  |  |
| Design CHW flow temperature (°C) |  |  |
| Design CHW temperature difference (K) |  |  |
| Design CCW entering temperature (°C) |  |  |
| Design CCW temperature difference (K) |  |  |
| Chiller full-load performance (EER) |  |  |
| Chiller part-load performance (NPLV) |  |  |
| CHW flow temperature control |  |  |
| Chiller sequencing and staging control |  |  |
| System distribution losses (kW) |  |  |
| Primary pump absorbed power (kWe) |  |  |
| Primary pump control |  |  |
| Primary pump minimum flow (if variable flow) (%) |  |  |
| Secondary pump number and absorbed power (kWe) |  |  |
| Secondary pump control |  |  |
| CCW heat rejection type |  |  |
| CCW heat rejection capacity (kW) |  |  |
| Fan absorbed power (kWe) |  |  |
| Leaving CCW temperature set point (°C) |  |  |
| Fan speed control |  |  |
| Heat rejection equipment drift loss (%) |  |  |
| Heat rejection equipment cycles of concentration |  |  |

*Note that chiller part-load performance should be stated in terms of net part-load value (NPLV), calculated at the design operating conditions, not integrated part-load value (IPLV), and calculated at the reference operating conditions.*

Identify where this information can be found within the supporting documentation provided.

|  |  |
| --- | --- |
| **Supporting Documentation** (Name / title / description of document) | **Reference** (Page no. or section) |
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|  |  |  |
| --- | --- | --- |
| **Heating plant parameters** | | |
| **Parameter** | **Proposed Building** | **Reference Building** |
| Heat source type |  |  |
| Heat source capacity (kWr) |  |  |
| Design HHW flow temperature (°C) |  |  |
| Design HHW temperature difference (K) |  |  |
| Heat source full-load performance (gross efficiency) |  |  |
| HHW flow temperature control |  |  |
| Heat source sequencing and staging control |  |  |
| System distribution losses (kW) |  |  |
| System thermal inertia (kW) |  |  |
| Primary pump absorbed power (kWe) |  |  |
| Secondary pump absorbed power (kWe) |  |  |
| Primary pump control |  |  |
| Secondary pump control |  |  |

Identify where this information can be found within the supporting documentation provided.

|  |  |
| --- | --- |
| **Supporting Documentation** (Name / title / description of document) | **Reference** (Page no. or section) |
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### Co- and Tri-generation Systems

|  |  |
| --- | --- |
| **Co- and tri-generation plant parameters reporting requirements** | |
| **Parameter** | **Proposed Building** |
| Cogeneration unit type |  |
| Electrical output (kWe) |  |
| Useful thermal output (kWth) |  |
| Waste thermal output (kWth) |  |
| Total fuel input (gross) (kW) |  |
| Minimum turndown (%) |  |
| Minimum import threshold (kWe) |  |
| Installation altitude (m) |  |
| Derating threshold temperature (°C) |  |
| Demand control method |  |
| Absorption chiller minimum operating load (kWr) |  |
| Absorption chiller hydraulic configuration |  |
| Heating or cooling priority control |  |
| Preventative maintenance regime |  |

Identify where this information can be found within the supporting documentation provided.

|  |  |
| --- | --- |
| **Supporting Documentation** (Name / title / description of document) | **Reference** (Page no. or section) |
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### Lighting

|  |  |  |
| --- | --- | --- |
| **Internal lighting parameters** | | |
| **Parameter** | **Proposed Building** | **Reference Building** |
| Lighting type |  |  |
| Design illuminance (lux) |  |  |
| Nominal lighting power density (W/m²) |  |  |
| Occupant sensor controls |  | NA |
| Daylight controls |  | NA |
| Other lighting controls |  | NA |
| Adjustment factor applied |  | NA |
| Modelled lighting power density (W/m²) |  |  |

|  |  |  |
| --- | --- | --- |
| **External lighting parameters** | | |
| **Parameter** | **Proposed Building** | **Reference Building** |
| Lighting type |  |  |
| Lighting category |  |  |
| Category minimum illuminance (lux) |  |  |
| Design illuminance (lux) |  |  |
| Design lighting power density (W/m²) |  |  |
| Modelled lighting power density (W/m²) |  |  |
| Controls |  |  |

Identify where this information can be found within the supporting documentation provided.

|  |  |
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| **Supporting Documentation** (Name / title / description of document) | **Reference** (Page no. or section) |
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### Domestic Hot Water Services

|  |  |  |
| --- | --- | --- |
| **Domestic hot water services** | | |
| **Parameter** | **Proposed Building** | **Reference Building** |
| System description |  |  |
| System heat source |  |  |
| Hot water usage (L/day) |  |  |
| Hot water usage profile |  |  |
| System storage capacity (L) |  |  |
| System heating efficiency (gross) (%) |  |  |
| System distribution losses (kW) |  |  |
| System design supply temperature (°C) |  |  |
| System minimum storage temperature (°C) |  |  |

Identify where this information can be found within the supporting documentation provided.

|  |  |
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| **Supporting Documentation** (Name / title / description of document) | **Reference** (Page no. or section) |
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### Appliances

|  |  |  |
| --- | --- | --- |
| **Appliance parameters** | | |
|  | **Proposed Building** | **Reference Building** |
| Refrigerator/freezer manufacturer and model |  | NA |
| Refrigerator/freezer energy consumption (kWh/annum) |  |  |
| Dish washer manufacturer and model |  | NA |
| Dish washer energy consumption (kWh/annum) |  |  |
| Clothes washer manufacturer and model |  | NA |
| Clothes washer energy consumption (kWh/annum) |  |  |
| Clothes dryer manufacturer and model |  | NA |
| Clothes dryer energy consumption (kWh/annum) |  |  |

Identify where this information can be found within the supporting documentation provided.

|  |  |
| --- | --- |
| **Supporting Documentation** (Name / title / description of document) | **Reference** (Page no. or section) |
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### Photovoltaic system and analysis

|  |  |
| --- | --- |
| **Photovoltaic analysis software** | |
| Software name and version |  |
| Software developer |  |

If software other than that recognised by the NZGBC has been used, provide a description of how it satisfies the compliance framework criteria

[Insert documentation demonstrating that it satisfies the compliance framework criteria]

|  |  |
| --- | --- |
| **Photovoltaic array parameters** | |
| **Parameter** | **Proposed Building** |
| PV technology type |  |
| PV module manufacturer and model |  |
| PV rated output at STC (We) |  |
| PV DC conversion efficiency at STC at full-load |  |
| PV DC conversion efficiency at part-load |  |
| Total PV array area (m²) |  |
| Performance degradation |  |
| PV array mounting system |  |
| Inverter rating (kWe) |  |
| Inverter efficiency at full-load and part-load |  |
| System shading description |  |
| PV array azimuth angle (°) |  |
| PV array inclination angle (°) |  |
| PV array losses |  |
| PV cell temperature losses |  |

Identify where this information can be found within the supporting documentation provided.

|  |  |
| --- | --- |
| **Supporting Documentation** (Name / title / description of document) | **Reference** (Page no. or section) |
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### 

### Solar Thermal System

|  |  |
| --- | --- |
| **Solar thermal array parameters reporting requirements** | |
| **Parameter** | **Proposed Building** |
| Solar collector type |  |
| Collector absorber area (total) (m²) |  |
| Collector efficiency coefficients ( (-), (W/m² K) and (W/m² K²)) |  |
| Collector azimuth angle (°) |  |
| Collector inclination angle (°) |  |
| Circulation pump absorbed power (kWe) |  |
| Preheat storage tank volume (L) |  |

Identify where this information can be found within the supporting documentation provided.

|  |  |
| --- | --- |
| **Supporting Documentation** (Name / title / description of document) | **Reference** (Page no. or section) |
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### Wind Turbine

|  |  |
| --- | --- |
| **Wind turbine parameters reporting requirements** | |
| **Parameter** | **Proposed Building** |
| Wind turbine type |  |
| Wind turbine rated output (kWe) |  |
| Wind turbine swept area (m²) |  |
| Wind turbine cut in wind speed (m/s) |  |
| Wind turbine cut out wind speed (m/s) |  |
| Wind turbine part-load aerodynamic efficiency |  |
| Wind speed adjustments applied |  |
| Wind turbine spacing (if more than one) |  |
| Method of adjustment of turbine generated output for proximity effects of other wind turbines |  |

Identify where this information can be found within the supporting documentation provided.

|  |  |
| --- | --- |
| **Supporting Documentation** (Name / title / description of document) | **Reference** (Page no. or section) |
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### Additional Information

Please provide document or insert hyperlinks to documents which provide the following information if required:

**Manual Calculations**

A summary of all manual calculations used in the assessment of the building total energy consumption. This shall include a description of the methodology applied, comments on the limitations of the method, the data sources used in the calculation (including software outputs where applicable) and a summary of the calculation results.

**Output Data**

Software output reports documenting the energy end uses applicable to each of the building models (i.e. Reference, Intermediate and Proposed). This information shall be readily reconcilable against the inputs in the Green Star calculator. Where software output is supplemented with manual calculations, the manual calculation descriptions shall be cross referenced.

**Shared Services**

For shared utility services, the quantity of heating and cooling energy supplied to the building must be stated (as applicable). These, and the total electricity consumption, must be compared to the contractual agreements to demonstrate that they are within the specified limits. If no limits are specified, then demonstrate that they are within the available output based on the details of the utility and any existing buildings’ demands.

[Insert hyperlinks to documents as required]

## DISCUSSION

Outline any issues you would like to highlight and clarify with the Certified Assessor(s).

## DECLARATION

I confirm that the information provided in this document is truthful and accurate at the time of completion.

Provide author details, including name, position and email address:

[Date]

––– **Report end** –––