GREEN STAR – DESIGN & AS BUILT NZv1.0

SHARED SERVICES AND LOW-CARBON ENERGY SUPPLY ASSESSMENT GUIDELINES

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This guide is to be used for the Greenhouse Gas Emissions and Peak Electricity Demand Reduction Credits in the Energy Category.

greenstar Developed by the Green Building Council of Australia

Document Information

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This document is updated regularly. It can be found at www.nzgbc.org.nz/.

Change Log

Release	Date	Description of changes
Green Star - Design & As Built v1.0 *Release 1*	16/10/2014	Initial release
Green Star - Design & As Built v1.1 *Release 1*	22/07/2015	Re-released for Design and As Built v1.1, no changes.
Green Star – Design & As Built NZv1.0	11/04/2019	Initial release in New Zealand.

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1 INTRODUCTION

Credit *15 Greenhouse Gas Emissions* makes provision for the selection of energy supply in rewarding projects for a reduction in Greenhouse Gas (GHG) emissions. The intent of this approach is to reward buildings which connect to low-carbon energy sources at a utility-scale, rather than only reward those projects which produce low-carbon energy on-site. This methodology is to be applied wherever the grid is used to transmit power between the source and the consumer, and also for any scenarios where energy is transferred between independent retail customers even if they are within the same building (e.g. base building and tenant).

This approach is intended to cover the procurement opportunities for district energy and utility systems including:

- District thermal networks;
- Shared cogeneration or trigeneration systems;
- Private wire networks with embedded renewable energy;
- Renewable energy sources; and
- Grid connected low-carbon energy (e.g. biomass or biogas systems).

This approach does not include carbon offsets.

Where shared systems are intended to meet the full building load for a particular energy stream, the energy contracts must demonstrate that sufficient capacity is available.

Where shared thermal energy systems are only intended to meet a portion of the building load, the energy contracts must identify the total annual capacity which can be accessed. Any building systems required to meet the full load must be assessed in accordance with the *Building Energy Consumption and Greenhouse Gas Emissions Calculation Guidelines* and use the applicable greenhouse gas emission factors for the energy source used; the shared service greenhouse gas emission factors apply only to the energy delivered by that service.

There is a wide variety of assessment approaches to the analysis of complex energy utility arrangements in combination with building systems. For the purposes of credit *15 Greenhouse Gas Emissions*, projects procuring energy from alternative sources (i.e. other than or supplementary to the electricity grid and natural gas network) will calculate a project specific GHG emissions factor to be applied to the energy demand assessed for the building.

Due to the complexity of analysing shared utility systems, project teams must submit a method statement to the NZGBC for review prior to implementation in the *Building Energy Consumption and Greenhouse Gas Emissions Calculation*.

There are two approaches to assessing the GHG impact of low-carbon utilities described in this document:

- Procurement Contract Approach: Identify the GHG emissions co-efficient on the Power Purchase Agreement (PPA) and/or Thermal Power Purchase Agreement (TPPA).
- Design Analysis Approach: Prepare a Design Intent Report (DIR) that calculates the GHG co-efficient for the project.

2 PROCUREMENT CONTRACT APPROACH

Applicable to projects seeking to be rewarded based on the disclosure of the carbon intensity nominated within an energy procurement contract. GHG emission coefficients must be individually disclosed within the PPA and TPPA documentation for each of the following, as applicable to the project:

- Electricity;

- Chilled water;
- Heating Hot Water; and
- Domestic hot water.

These GHG emissions coefficients must be applied to the corresponding energy demand in the *Building Energy Consumption and Greenhouse Gas Emissions Calculator*.

3 DESIGN ANALYSIS APPROACH

Projects that do not have GHG Emissions Coefficients embedded within their procurement documentation must undertake a detailed analysis of the shared utility to calculate the GHG factors for their project.

The documentation of the GHG Emissions analysis must be shown in three distinct steps:

- Step 1: Define the shared utility system.
- Step 2: Calculate the carbon emissions coefficient for utility services.
- Step 3: Apply the overall GHG Emissions Factors to the targeted demand-side energy in the Energy Calculator.

3.1 Defining the Utility System

The proposed low-carbon utility must be clearly defined in terms of its:

- Component parts (e.g. chillers, boilers, cogeneration engines, renewable energy systems, generators, thermal storage systems etc);
- Inputs (e.g. fuel, grid electricity etc);
- Outputs (e.g. electricity, chilled water, hot water); and
- Total connected load (or the 'design load').

The GHG emissions performance of cogeneration systems in particular is highly sensitive to the intended operating profile. Any utility systems being assessed in this manner must be modelled on the basis of their intended actual operation. The operational profile must be embedded within the energy supply contracts as it is material to the GHG performance of the energy supply.

Furthermore, the contractual parties relevant to the energy procurement must be identified. At a minimum, this must include the energy retailer and the building owner.

3.2 Calculating the GHG Emissions

The calculation of the overall energy performance of complex shared utilities requires detailed system modelling of the full utility system; including those elements outside the boundary of the building under assessment. The proposed utility system must be assessed using utility system modelling software (such as energyPRO (http://www.emd.dk/energypro/frontpage)) to assess the overall performance of the central utility.

Where detailed connection information beyond the building boundary is not known, an assessment of future connected load is required. This assessment should include a plausible development profile (with evidence from zoning or development plan documentation), building load profiles (default to minimum code compliant buildings if no other requirements are documented in local regulations) and occupancy profiles (on the basis of the primary use of the buildings). Calculations must include allowances for losses from and gains to thermal energy distribution systems.

The outputs of the system modelling must include (as applicable to the project):

- Total annual electricity produced;
- Total annual chilled water generated;

- Total annual heating hot water generated;
- Total annual domestic hot water generated; and
- Total annual GHG emissions.

For each system, the total annual GHG emissions attributable to the system must be calculated (based on the fuel and energy inputs) and attributed evenly to the total annual energy stream that it produces:

- For electricity: $kgCO_2e$ $/kWh_{electricity}$
- For chilled water: $kgCO_2e$ $/MJ_{thermal}$
- For heating hot water: $kgCO_2e$ $/MJ_{thermal}$
- For domestic hot water: $kgCO_2e$ $/MJ_{thermal}$

Where a single process produces multiple energy streams, the total emissions must be apportioned on the basis of the proportion of primary energy used to generate them with any waste heat elements split equally between the energy streams.

Where the shared utility does not meet 100% of the energy requirements of the building, grid energy should be used for any unmet demand. A blended GHG emissions factor should be calculated based on the proportion of demand met from each source. The final GHG emissions factors should reflect the overall, blended emissions factors for each energy stream.

3.3 Applying the GHG Factors to the Building

The GHG emission factors must be applied to the Energy and Thermal Load outputs of the Proposed Building energy assessment as follows:

- Electricity demand: The overall blended GHG factor for electricity supplied to the building for electrical demands within the building.
- Thermal energy: The overall GHG factors for chilled water, heating hot water and domestic hot water should be applied to the ***heating and cooling loads*** for the Proposed Building.

The grid GHG factors must be applied to the Reference Building and the Intermediate Building. The final GHG emissions for the Proposed Building will be compared to the GHG emissions of the Reference Building to determine the number of points awarded for the credit, with the following limitations on the emissions reduction benefit able to be derived from off-site energy supplies:

- The total number of points awarded in the credit will not be more than double the points achieved for emissions reduction due to building design initiatives alone. This is to avoid the scenario where poor building energy efficiency is traded for low-carbon intensity energy supplies. In order to determine this reduction, the following standalone emission factors are assumed for off-site energy supplies:
  - Electricity: equal to the grid electricity emission intensity for the project location.
  - Chilled water:

$$E_{CHW,ref} = \frac{E_{elec,ref}}{COP_{ref} \times 3.6}$$

1. Where $E_{elec,ref}$ is the baseline electricity emission intensity, COP_{ref} is a reference coefficient of performance for a typical chilled water refrigeration system (taken as 6.0), and the factor of 3.6 converts from kWh to MJ.
2. Heating hot water:

$$E_{HHW,ref} = \frac{1.1 \times E_{gas,ref}}{\eta_{ref}}$$

Where $E_{gas,ref}$ is the baseline natural gas emission intensity, η_{ref} is a reference efficiency for a typical heating hot water heating system (taken as 83%), and the factor of 1.1 accounts for system heat losses and thermal inertia effects.

- Domestic hot water: as for heating hot water.

- The benchmark duration for PPAs and TPPAs is ten years. Where a contract enters into an agreement(s) of duration less than 10 years then the emissions reduction benefit is prorated accordingly, as follows:

$$E_{N,prorated} = E_{N,ref} - \frac{T_{actual}}{T_{ref}}\left(E_{N,ref} - E_{N,contract}\right)$$

  - Where $E_{N,prorated}$ is the prorated emission factor for energy source N, $E_{N,ref}$ is the reference emission factor for energy source N (as defined above), T_{actual} is the actual duration of the PPA or TPPA for energy source N, T_{ref} is the reference duration of the PPA or TPPA for energy source N (defined as 10 years), and $E_{N,contract}$ is the contracted emission factor for energy source N, as defined in the PPA or TPPA.
  - For thermal energy supplies, if the capacity of conventional thermal systems installed in the building (e.g. chillers, boilers and water heaters) is less than 90% of the design capacity required for the building, then the building can be awarded the full emissions reduction benefit of the off-site supply since it will require the connection to be maintained for security of building operation.
  - Currently, no additional benefit is awarded for agreement durations of greater than 10 years.

These calculations are all incorporated within the *Building Energy Consumption and Greenhouse Gas Emissions Calculator*.

4 NABERSNZ APPROACH

The NABERSNZ approach is similar to that described above, but is only applicable to co- and tri-generation systems; it also cannot be used where electricity is transferred via the grid. Buildings seeking certification that are served by just co- or tri-generation systems may use the NABERSNZ protocol and calculator to assess the energy inputs attributable to the building. A simple calculator has been produced for assessing these systems with total emissions allocation as the output. This calculator must be completed by the project seeking certification with contractual documentation evidence demonstrating that the inputs and outputs are accurately represented.

5 DOCUMENTATION

Documentation requirements are outlined in the Green Star – Design & As Built Submission Guidelines.

6 EXAMPLE

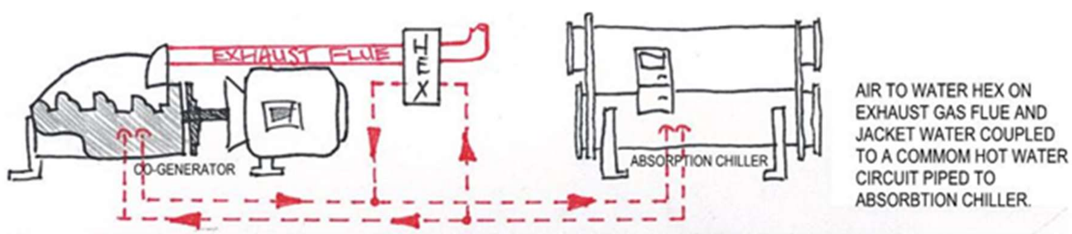
Step 1: Defining the utility

The utility is a district thermal system including a tri-generation process distributing electricity, heating hot water, chilled water and domestic hot water.

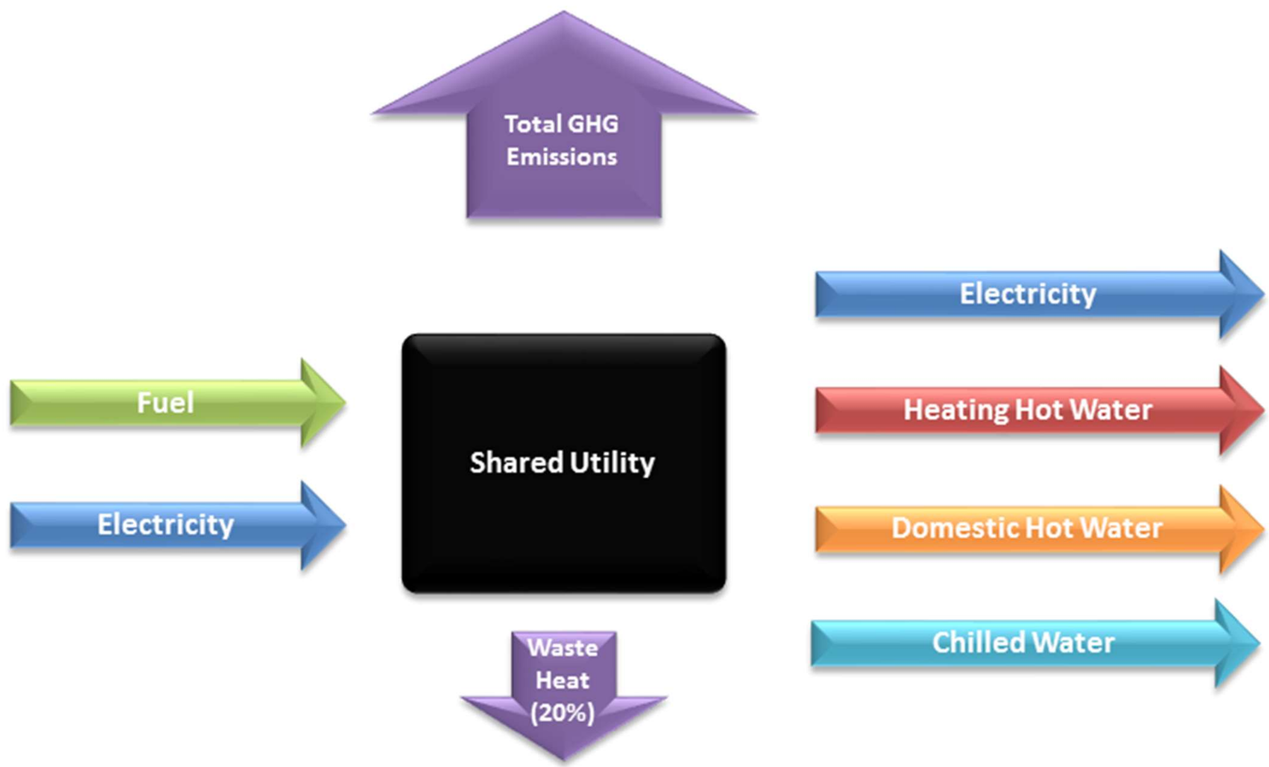
Inputs:
- Fuel for generation
- Grid energy for mechanical chillers
- Grid energy for small power

Outputs:
- Electricity
- Chilled Water (CHW)
- Heating hot Water (HHW)
- Domestic Hot Water (DHW)

By-products:
- GHG Emissions
- Waste heat



Step 2: Calculating GHG Emission Factors



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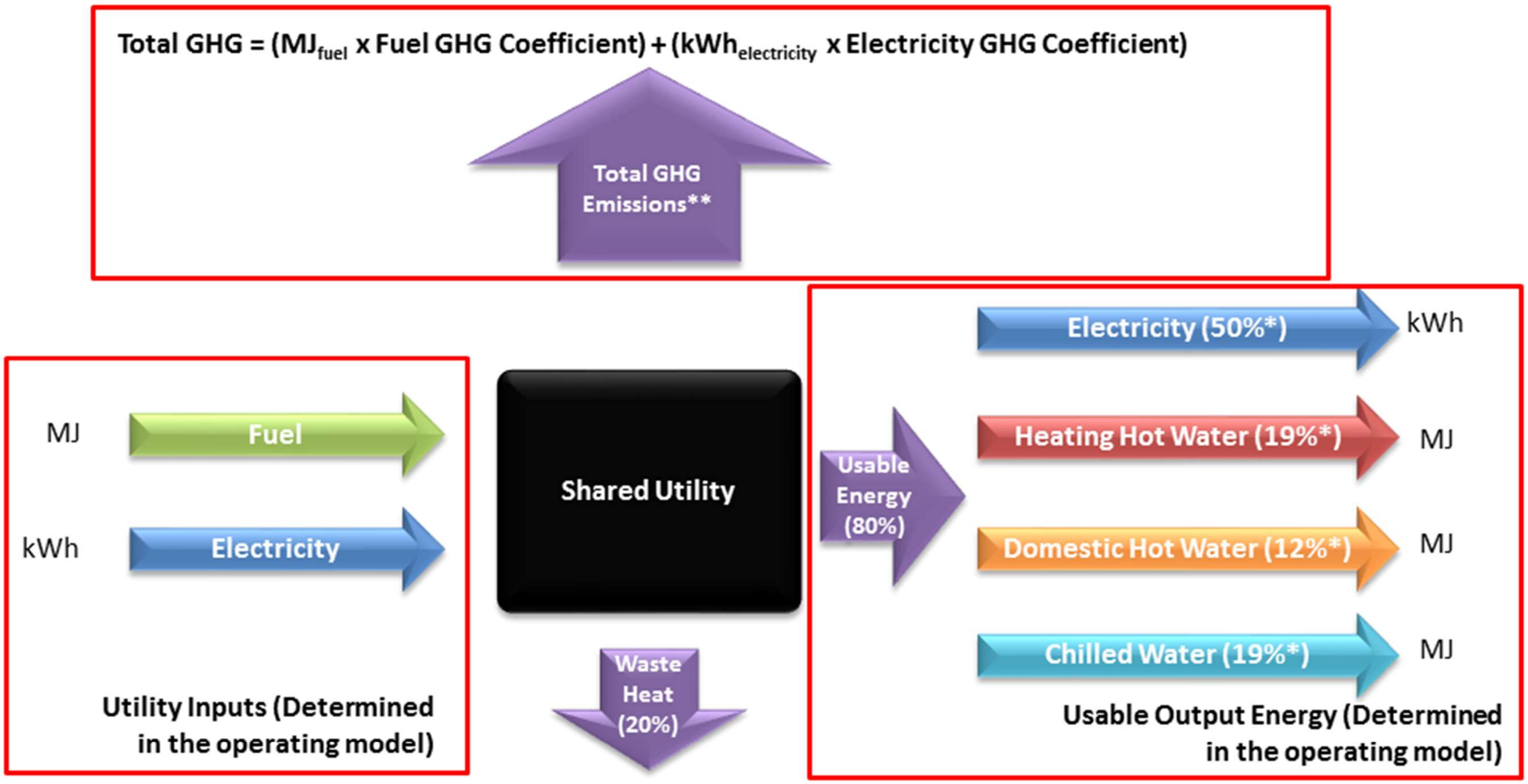


*The GHG emissions must be split proportionally between usable energy streams, requiring consideration in the same units.

**The natural gas and electricity GHG factors used must be the applicable state/territory values as per the Green Star Energy Calculator.

Step 2: Calculating GHG Emission Factors

$$\text{Total GHG} = (\text{MJ}_{fuel} \times \text{Fuel GHG Co-efficient}_{fuel}) + (\text{kWh}_{electricity} \times \text{Electricity GHG Co-efficient}_{electricity})$$

Total GHG Emissions

Electricity (40%*)

$kgCO_{2elec}$ = Electricity Proportion (output) / Usable Energy Input x Total GHG

Heating Hot Water (15%*)

$kgCO_{2HHW}$ = HHW Proportion (output) / Usable Energy Input x Total GHG

Domestic Hot Water (10%*)

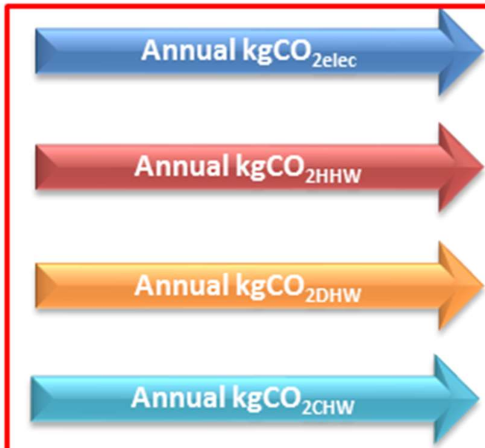
$kgCO_{2DHW}$ = DHW Proportion (output) / Usable Energy input x Total GHG

Chilled Water (15%*)

$kgCO_{2CHW}$ = CHW Proportion (output) / Usable Energy Input x Total GHG

***The GHG emissions must be split proportionally between energy streams, requiring consideration in the same units.**

Step 2: Calculating GHG Emission Factors



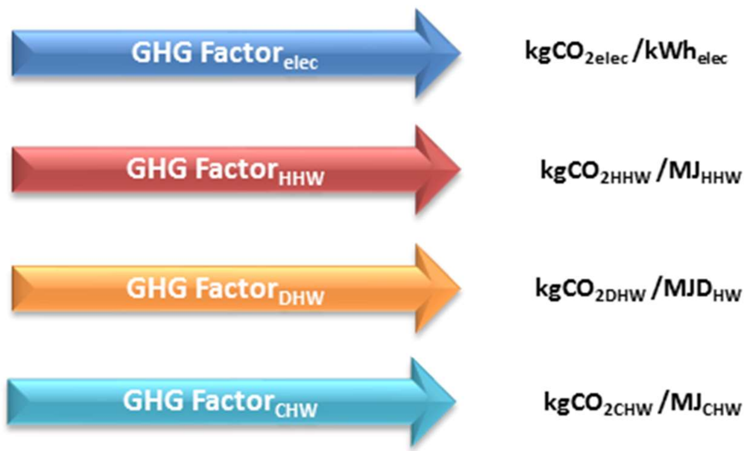
$$\text{GHG Factor}_{elec} = \text{Annual kgCO}_{2elec} / \text{Annual kWh}_{elec}$$

$$\text{GHG Factor}_{HHW} = \text{Annual kgCO}_{2HHW} / \text{Annual MJ}_{HHW}$$

$$\text{GHG Factor}_{DHW} = \text{Annual kgCO}_{2DHW} / \text{Annual MJD}_{HW}$$

$$\text{GHG Factor}_{CHW} = \text{Annual kgCO}_{2CHW} / \text{Annual MJ}_{CHW}$$

Step 3: Applying GHG Emission Factors



Enter GHG Emission Factors into the Green Star Energy Calculator

GHG Emission Intensity Factors		Units	
Grid Electricity	Select Location	$kgCO_2e/kWh$	Location dependent
Natural Gas	Select Location	$kgCO_2e/MJ$	Location dependent
LPG	0.0649	$kgCO_2e/MJ$	Location independent
Diesel	0.0748	$kgCO_2e/MJ$	Location independent
Coal	0.0930[illegible]	$kgCO_2e/MJ$	Location independent
Biomass	0.0018	$kgCO_2e/MJ$	Location independent
Liquid Biofuels	[illegible]	$kgCO_2e/MJ$	Location independent
District CHW		$kgCO_2e/MJ$	Site dependent
District HHW		$kgCO_2e/MJ$	Site dependent
District DHW		$kgCO_2e/MJ$	Site dependent
District Electricity		$kgCO_2e/kWh$	Site dependent