NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014)

HELP

Building name/description: The Star - North Tower - Sky Villas

Application: other

Climate zone: 5

Storey: Level 60

Facade areas

	N	NE	E	SE	S	SW	W	NW	Internal
Option A	26.1m²	29.6m²	53.9m²	28.2m²	7.58m²		28.3m²	30.6m²	
Option B									
Glazing area (A)	*22.2m²*	*25.1m²*	*45.8m²*	*23.9m²*	*6.44m²*	.....	*24m²*	*26m²*	

Number of rows preferred in table below: 14 *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS								SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance		P&H or device	Shading		Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	P/H	G (m)	Heating (S_H)	Cooling (S_C)	Area used (m²)	Element share of % of allowance used
1	PSuite_SW	S		2.95		6.44	2.9	0.25				0.00	1.00	1.00	6.44	100% of 92%
2											ROW SKIPPED (OK if intentional)					
3	PSuite_W	W		2.95		24.04	2.2	0.17				0.00	1.00	1.00	24.04	100% of 92%
4											ROW SKIPPED (OK if intentional)					
5	PSuite_W	NE		2.95		25.13	1.4	0.15				0.00	1.00	1.00	25.13	100% of 100%
6											ROW SKIPPED (OK if intentional)					
7	Suite A_E	E		2.95		45.80	2.2	0.17				0.00	1.00	1.00	45.80	100% of 95%
8											ROW SKIPPED (OK if intentional)					
9	Suite A_SE	SE		2.95		23.90	2.8	0.18				0.00	1.00	1.00	23.90	100% of 98%
10											ROW SKIPPED (OK if intentional)					
11	PSuite_N	N		2.95		22.16	2.8	0.18				0.00	1.00	1.00	22.16	100% of 96%
12											ROW SKIPPED (OK if intentional)					
13	PSuite_NW	NW		2.95		26.03	2.8	0.18				0.00	1.00	1.00	26.03	100% of 95%
14																

IMPORTANT NOTICE AND DISCLAIMER IN RESPECT OF THE GLAZING CALCULATOR

The Glazing Calculator has been developed by the ABCB to assist in developing a better understanding of glazing energy efficiency parameters. While the ABCB believes that the Glazing Calculator, if used correctly, will produce accurate results, it is provided "as is" and without any representation or warranty of any kind, including that it is fit for any purpose or of merchantable quality, or functions as intended or at all. Your use of the Glazing Calculator is entirely at your own risk and the ABCB accepts no liability of any kind.

if inputs are valid

Figure 21: NCC Glazing Calculator - The Star North Tower – Level 60 Glazing

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014)

HELP

Building name/description: The Star - North Tower - Sky Villas

Application: other

Climate zone: 5

Storey: Level 61

Facade areas

	N	NE	E	SE	S	SW	W	NW	Internal
Option A	31.4m²	32.3m²	58.9m²	31.6m²	8.3m²		37.1m²	27.3m²	
Option B									
Glazing area (A)	*26.7m²*	*27.5m²*	*50.1m²*	*26.9m²*	*7.05m²*	.....	*31.5m²*	*23.2m²*	

Number of rows preferred in table below: 14 *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS								SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance		P&H or device	Shading		Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	P/H	G (m)	Heating (S_H)	Cooling (S_C)	Area used (m²)	Element share of % of allowance used
1	PSuite_SW	S		3.20		7.05	2.9	0.25				0.00	1.00	1.00	7.05	100% of 92%
2											ROW SKIPPED (OK if intentional)					
3	PSuite_W	W		3.20		31.54	2.2	0.17				0.00	1.00	1.00	31.54	100% of 92%
4											ROW SKIPPED (OK if intentional)					
5	PSuite_W	NE		3.20		27.49	1.4	0.15				0.00	1.00	1.00	27.49	100% of 100%
6											ROW SKIPPED (OK if intentional)					
7	Suite A_E	E		3.20		50.10	2.8	0.18				0.00	1.00	1.00	50.10	100% of 100%
8											ROW SKIPPED (OK if intentional)					
9	Suite A_SE	SE		3.20		26.89	2.8	0.18				0.00	1.00	1.00	26.89	100% of 98%
10											ROW SKIPPED (OK if intentional)					
11	PSuite_N	N		3.20		26.66	2.8	0.18				0.00	1.00	1.00	26.66	100% of 96%
12											ROW SKIPPED (OK if intentional)					
13	PSuite_NW	NW		3.20		23.23	2.8	0.18				0.00	1.00	1.00	23.23	100% of 95%
14																

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if inputs are valid

Figure 22: NCC Glazing Calculator - The Star North Tower – Level 61 Glazing

APPENDIX C NABERS FOR HOTEL ENERGY AND WATER

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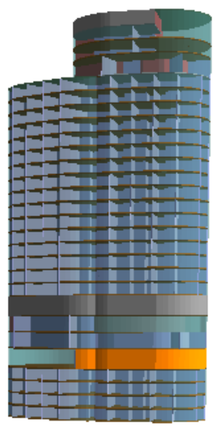
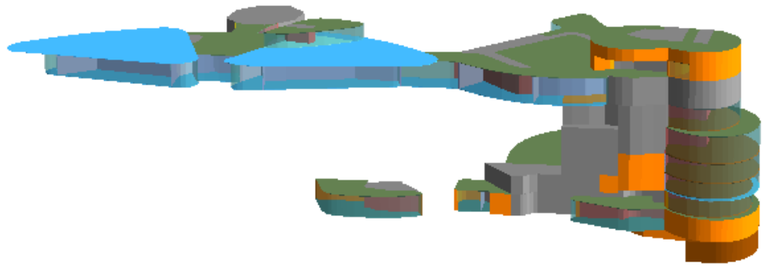
THE STAR, SYDNEY RITZ CARLTON HOTEL

NABERS FOR HOTELS ENERGY AND WATER PREDICTIVE MODELLING AND ASSESSMENT





JUNE 2017

THE STAR, SYDNEY RITZ CARLTON HOTEL

Prepared for The Star Entertainment Group Ltd

Project: 2305180U
Date: 09/06/2017

WSP Buildings Pty Ltd
Level 27, 680 George St
Sydney NSW 2000
Australia

QUALITY MANAGEMENT

ISSUE/REVISION	FOR ISSUE	UPDATED FOR ISSUE	
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Prepared by	MJT	MJT	NJA
Checked by	SNH	SNH	SNH
Authorised by	TRP	TRP	TRP
Project number	2305180U	2305180U	2305180U
Report number	00	01	02
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SIGNATURES

PREPARED BY

Martin Timperley,
Sustainability Consultant

AUTHORISED BY

Sean Holmes
Senior Sustainability Consultant

TABLE OF CONTENTS

EXECUTIVE SUMMARY

This report outlines the results of a preliminary National Australian Built Environment Rating System (NABERS) assessment of the predicted annual energy and water consumption of the Ritz Carlton Hotel development at The Star, Sydney at 80 Pyrmont Street, Pyrmont, NSW.

The energy simulation modelling has been undertaken in accordance with the *NABERS 'Energy Guide to Building Energy Estimation Version, June 2011'* and where appropriate the *Green Star Design & As Built 'Energy Consumption and Greenhouse Gas Emissions Calculation Guide, May 2016'*. The simulation was carried out utilising the software package TAS version 9.4, by Environmental Design Solutions Limited.

Two energy models have been developed for the project and represent the following scenarios:

- "On Axis" this model represents the building with the construction, commissioning and system efficiencies all working as per the design
- "Off Axis" this model represents the building with inefficiencies and faults incorporated into the model

The initial results of the energy simulation indicate that the Ritz Carlton Hotel is capable of achieving a 5.5 Star NABERS Energy for Hotels rating under "On Axis" conditions and a 3 Star rating under the "Off Axis" condition.

Table 1: NABERS for Hotels energy modeling results

SCENARIO	Energy Consumption (MJ/annum)	Greenhouse Gas Emissions (kgCO2-e/annum)	NABERS Star Rating	% Improvement on Current Star Rating
On Axis	75,866	1,070,368	5.5	16%
Off Axis	82,987	3,539,117	3.0	7%

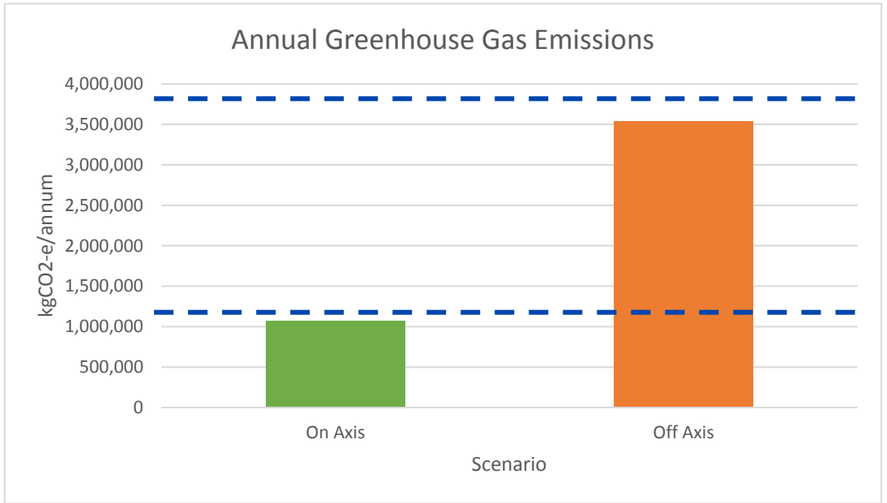

Figure 1: "On Axis" and "Off Axis" greenhouse gas emission results

As evident in Figure 1 the "On Axis" scenario achieves a 16% improvement over the NABERS Energy for Hotels Rating of 5.5 Star emission budget. Similarly, the Off Axis scenario achieves a 7% improvement over the NABERS Energy for Hotels Rating of 3.0 Star emission budget.

The preliminary results of the water simulation indicate that the Ritz Carlton Hotel can achieve a 4 Star NABERS Water for Hotels rating under the "On Axis" condition and a 3.5 Star rating under the "Off Axis" condition, where the hotel's annual water consumption is increased by 10% for a conservative assessment.

Table 2: NABERS for Hotels water modeling results

Scenario	Annual Water Use (kL/annum)	NABERS Star Rating	% Improvement on Current Star Rating
On Axis	19,825	4.0	2%
Off Axis	21,947	3.5	13%

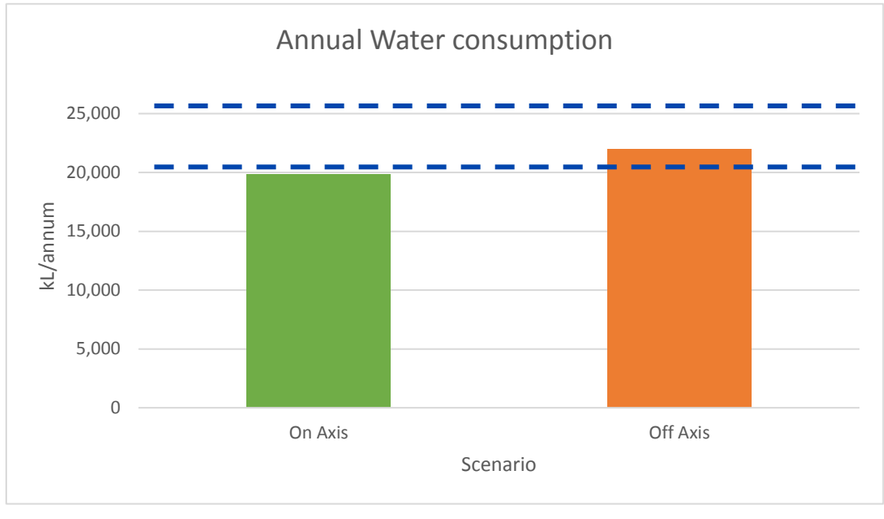

Figure 2: On axis and off axis water modelling results

As evident in Figure 2 the "On Axis" scenario achieves a 2% improvement over the NABERS Water for Hotels Rating of 4.0 Stars. Similarly, the "Off Axis" scenario achieves a 13% improvement over the NABERS Water for Hotels Rating of 3.5 Stars.

The above results are based on the current information available to the project team, and the predicted operation of the Ritz Carlton Hotel. It is a requirement that appropriate metering services will exist to separate the hotel's energy (electrical and thermal) and water consumption from the rest of the development in accordance with the NABERS rules. Without appropriate metering, the project will risk being ineligible to achieve a rating.

DISCLAIMER

Computer building simulation provides an estimate of building performance. This estimate is based on a necessarily simplified and idealised version of the building that does not and cannot fully represent all of the intricacies of the building once built. As a result, simulation results only represent an interpretation of the potential performance of the building. No guarantee or warrantee of building performance in practice can be based on simulation results alone.

1 INTRODUCTION AND METHODOLOGY

1.1 BACKGROUND

WSP has been engaged by The Star Entertainment Group Ltd (SEGL) to provide NABERS advisory services with respect to the Ritz Carlton Hotel development within The Star, Sydney site at 80 Pyrmont Road, Pyrmont, NSW. This exercise has been undertaken to determine the potential ratings achievable through the NABERS Energy and Water Rating. The calculations have considered hotel rooms, lobbies, car parking facilities and function rooms within the Ritz Carlton Hotel development as highlighted in Figure 3 below.

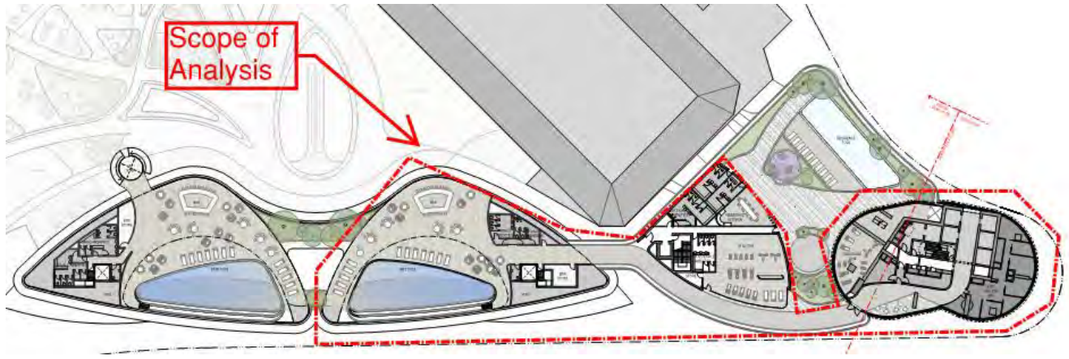

Figure 3: Ritz Carlton Hotel elevation – Scope of NABERS assessment

This report outlines the methodology, inputs, assumptions and results of the NABERS Energy and Water for Hotels modelling exercise undertaken. This exercise has involved necessary simplifications of highly automated systems. Whilst all assumptions and inputs have been incorporated to produce an accurate result, it should be noted that due to the dynamic nature of energy consumption, the actual energy and water consumption of the site is likely to differ from the predicted result.

1.2 MODELLING SOFTWARE PACKAGE

The computer simulation package used for the thermal simulation was Tas version 9.4, by Environmental Design Solutions Limited. It is an EN ISO 13791 validated dynamic simulation modelling (DSM) software tool and is approved under the *ABCB Protocol for Building Energy Analysis Software, Version 2006.1*.

The tri-generation system has been modelled using a utility modelling software package energyPRO. Energy PRO is a sophisticated urban utility, techno-economic modelling software package from EMD International.

1.3 CLIMATE DATA

Climate data for the dynamic thermal simulation includes:

- Global radiation
- Diffuse radiation
- Cloud cover
- Dry bulb temperature
- Relative humidity
- Wind speed
- Wind direction

The building is located on the current The Star, Sydney site at 80 Pyrmont Road, Pyrmont, NSW approximately 1.5km away from the Sydney CBD, hence the Sydney 1987 TRY weather file is used for the simulation. A 'TRY weather file' is a weather file for a year without unusual extremes in temperature, which is suitable for energy simulation modelling.

The weather file used in the simulation is listed in Table 3.

Table 3: Climate data used in the building simulations

WEATHER FILE	AUS_SYDNEY_TRY
Location	Sydney, NSW (Lat -33.87, Long 151.02)
Year	1987
Altitude	0.0m
Ground Temperature	22°C

1.4 REFERENCE DRAWINGS AND SCHEDULES

The NABERS energy and water modeling has been based on the best available information and drawings at the time of the analysis. The following sources of information have been used to form the basis of the energy and water modelling:

- Architectural plan, elevation and section drawings prepared by FJMT
- The Star – Ritz Carlton Hotel and Residential Tower Green Star Design & As Built Greenhouse Gas Emissions Report

The modelling is based on the design in the early development phase, as such, necessary simplifications and assumptions have been made in the energy modelling process. Where building components, operational and energy consumption attributes have yet to be specified, values and schedules have been based on the most appropriate source available, primarily the following sources:

- NABERS 'Energy Guide to Building Energy Estimation Version, June 2011'
- National Construction Code Series 2016, Volume 1, Building Code of Australia.
- Green Star Design & As Built '*Energy Consumption and Greenhouse Gas Emissions Calculation Guide, May 2016*'

1.5 ON AXIS AND OFF AXIS SCENARIO MODELING

Two energy models have been developed for the project and represent the following scenarios:

- “On Axis” this model represents the building with the construction, commissioning and system efficiencies all working as per the design
- “Off Axis” this model represents the building with inefficiencies and faults incorporated into the model

Their purpose of the “Off Axis” model is to demonstrate the building energy and water performance if it were not properly maintained, commissioned, tuned or operated to ensure efficient operations. An “Off Axis” scenario has been included into the analysis for the energy and water models and are detailed in Table 4 below.

Table 4: “Off Axis” model inputs

MODEL	OFF AXIS SCENARIO DETAILS
Energy	Exclusion of the proposed low carbon tri-generation system. All electrical demands for the hotel are provided by grid electricity and thermal loads met by the existing central energy plant located in the existing Star Sydney site.
Water	A 10% increase in annual onsite water consumption.

2 NABERS CALCULATOR INPUTS

2.1 NUMBER OF GUEST ROOMS

Within the NABERS Energy and Water for hotel rating tool, the size of the hotel is measured through the number of guest rooms. This figure is used, along with other factors, to adjust the allowable energy and water budget for each development. This ensures a fair comparison can be made between hotels of different size and service level.

Based on the current drawing set, the hotel will have 220 guest rooms.

2.2 HOTEL STAR RATING

The overall range and quality of the hotel's services is measured through the hotel star rating. This is based on Australia's official accommodation accreditation program, the Star Rating Scheme, managed by Star Ratings Australia.

The rating provides an index of the overall level of service, with hotels generally rating between 2 stars (budget brands) and 5 stars (luxury brands). A wide range of energy consuming services, features and facilities within hotels correlate with this rating and is very important in determining the energy and water consumption of the hotel.

The Ritz Carlton hotel will target a 6 star rating. As NABERS only distinguished hotels with ratings between 2 and 5 stars, for the purpose of this modeling it has been assumed that the hotel will achieve 5 stars, the maximum available rating.

2.3 LAUNDRY SERVICED ROOMS

The potential impact of on-site laundry services is measured through the number of guest rooms that the on-site laundry services within the hotel. This figure is adjusted by the scale of service provided, being either full service (towel and bed linen) or half service (towels or bed linen).

For the purpose of this assessment it has been assumed that all laundry will be services through external laundry facilities.

2.4 FUNCTION ROOM SEATS

The potential impact of on-site function room facilities is measured through the function room seats. This figure is compiled from the maximum occupancy of the hotel's function room facilities.

There is currently no plan to include a hotel function room in the project.

2.5 AREA OF HEATED POOL

The potential impact of heated swimming pools and spas is accounted for through the area of the heated pool. This figure is calculated for all swimming pools (indoor and outdoor) that are heated for at least 6 months a year.

There is currently no onsite pool dedicated specifically for the exclusive use of hotel patrons. As such no heated pool allowances have been included.

2.6 ENERGY COVERAGE

The following end uses have been included within the scope of energy coverage for this assessment:

- Common area, guest room and back of house HVAC
- Common area, guest room, exterior and back of house lighting
- Vertical transportation servicing the hotel
- Car park lighting and ventilation, where provided for the exclusive use of hotel guests or hotel staff
- On-site hotel kitchens and restaurants servicing guests with charge-to-room facilities
- Small light and power for both front and back of house
- Lighting, power and HVAC services to any function rooms on site
- Gyms guest use
- Day spas with guest use

2.7 WATER COVERAGE

The following end uses have been included within the scope of water coverage for this assessment:

- Water for taps and sinks, both back and front of house
- Water used in air conditioning and other base building services
- All water used for services supplied to guests
- Water use in fire services
- Water used in restaurants that have charge-to-room facilities for guests
- Water used for toilets

3 ENERGY MODELLING RESULTS

3.1 PREDICTED ANNUAL ENERGY DEMAND

The total hotel annual energy demand for the Ritz Carlton Hotel development is as itemised in Table 5 and Figure 4.

Table 5: Predicted annual electricity consumption

Energy End-Use	Electricity Demand (kWh-e)	Cooling Demand (MJ)	Heating Demand (MJ)
Internal Lighting	222,439	-	-
Exterior Lighting	6,951	-	-
Appliances	170,693	-	-
Vertical Transport	107,900	-	-
Domestic Hot Water	-	-	1,773,499
Space Heating	-	-	1,241,743
Space Cooling	-	3,729,825	-
Heat Rejection	73,361	-	-
HVAC Fans	716,081	-	-
HVAC Pumps	71,062	-	-
Diesel Generator	-	-	-
Total	1,368,488	3,729,825	3,015,242

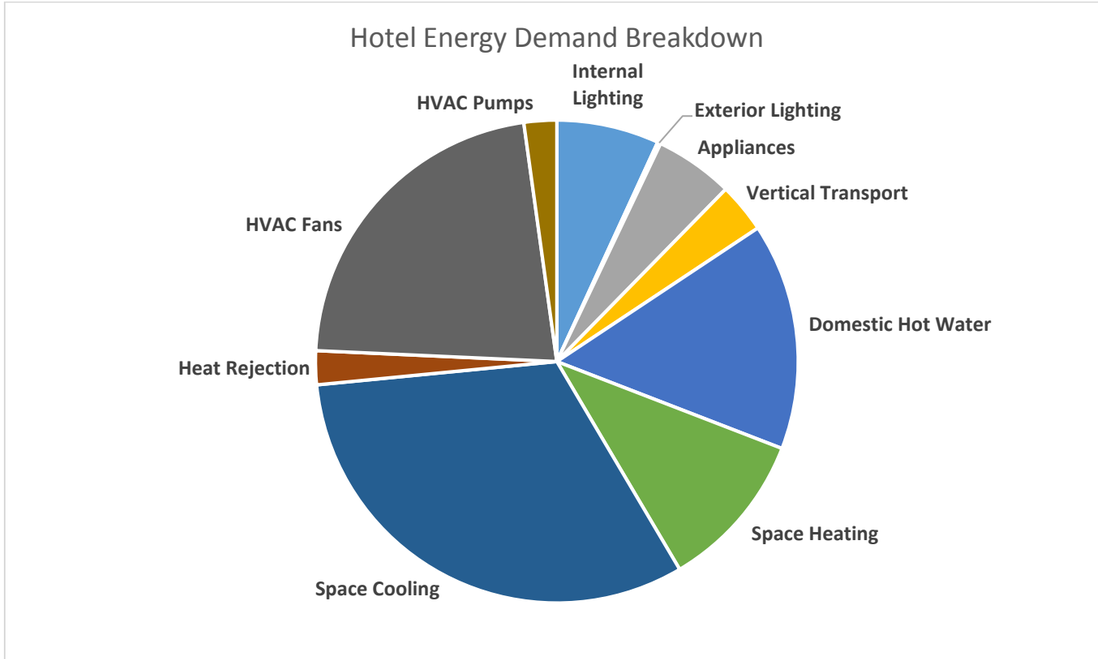

Figure 4: NABERS Hotel Energy demand breakdown

3.2 PREDICTED ANNUAL ENERGY CONSUMPTION

The total "On Axis" and "Off Axis" annual energy consumption for the Ritz Carlton Hotel is itemised by energy source in Table 6 and Figure 5 below.

Table 6: Predicted On Axis and Off Axis annual electricity consumption by energy type

Energy Source	On Axis	Off Axis
Grid Electricity (kWh/annum)	-	2,979,500
Natural Gas (MJ/annum)	16,690,600	9,190,900

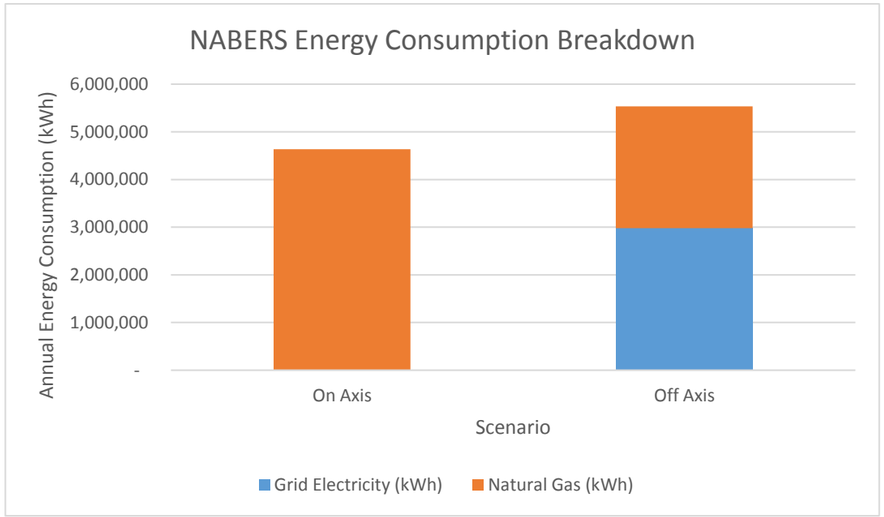

Figure 5: NABERS Hotel Energy "On Axis" and "Off Axis" energy consumption

3.3 NABERS FOR HOTELS ENERGY RATING

The energy modelling results of the Ritz Carlton Hotel indicate that the hotel can potentially achieve a 5.5 Star NABERS Energy for Hotels rating under the “On Axis” scenario, and a 3.0 Star rating under the “Off Axis” scenario. The results are summarised below in Table 7 and Figure 6.

Table 7: NABERS Energy for Hotels energy modelling results

SCENARIO	Energy Intensity (MJ/m² annum)	Greenhouse Gas Emissions (kgCO2-e/annum)	NABERS Star Rating	% Improvement on Current Star Rating
On Axis	75,866	1,070,368	5.5	16%
Off Axis	82,987	3,539,117	3.0	7%

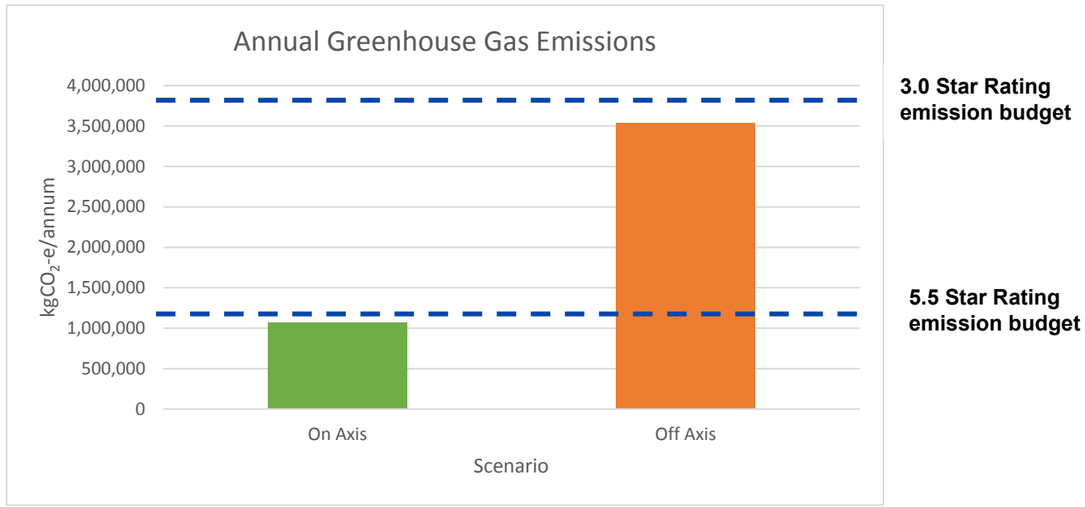

Figure 6: “On Axis” and “Off Axis” greenhouse gas emission results

As evident in Figure 6 the “On Axis” scenario achieves a 16% improvement over the NABERS Energy for Hotels Rating of 5.5 Star emission budget. Similarly, the Off Axis scenario achieves a 7% improvement over the NABERS Energy for Hotels Rating of 3.0 Star emission budget.

NABERS calculator extracts are presented in Appendix A.

3.4 PREDICTED ANNUAL WATER CONSUMPTION

The total “On Axis” and “Off Axis” annual water consumption for the Ritz Carlton Hotel is outlined in Table 8 below.

Table 8: Predicted “On Axis” and “Off Axis” annual water consumption

	ON AXIS	OFF AXIS
Water Consumption (kL/annum)	19,825	21,947

3.5 NABERS FOR HOTELS WATER RATING

The preliminary results of the water simulation indicate that the Ritz Carlton Hotel can achieve a 4 Star NABERS Water for Hotels rating under the “On Axis” condition and a 3.5 Star rating under the “Off Axis” condition, where the hotel’s annual water consumption is increased by 10% for a conservative assessment. These results are presented below in Table 9 and Figure 7.

Table 9: NABERS Water for Hotels water modeling results

Scenario	Annual Water Use (kL/annum)	NABERS Star Rating	% Improvement on Current Star Rating
On Axis	19,825	4.0	2%
Off Axis	21,947	3.5	13%

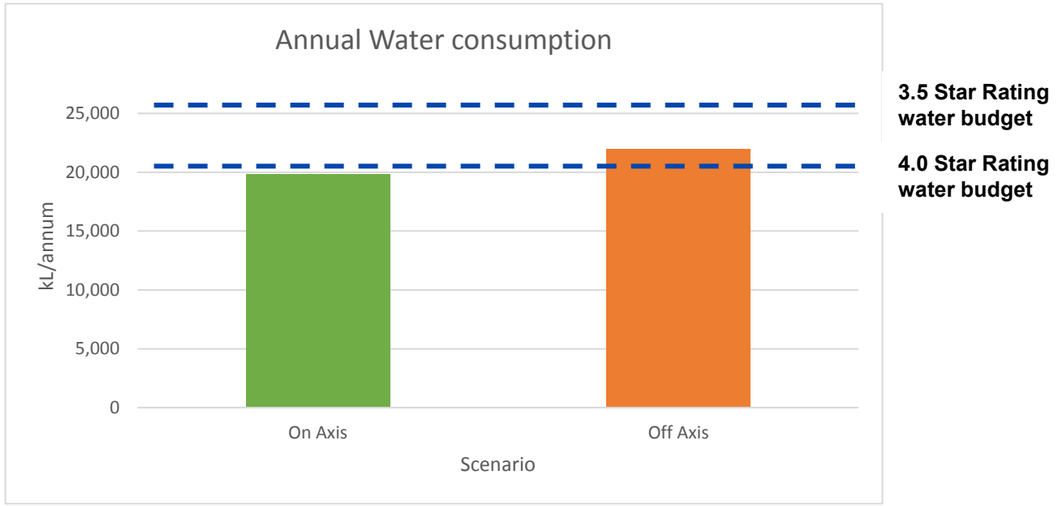

Figure 7: “On Axis” and “Off Axis” water modelling results

As evident in Figure 7 the “On Axis” scenario achieves a 2% improvement over the NABERS Water for Hotels Rating of 4.0 Stars. Similarly, the “Off Axis” scenario achieves a 13% improvement over the NABERS Water for Hotels Rating of 3.5 Stars.

NABERS calculator extracts are presented in Appendix A.

3.6 METERING REQUIREMENTS

The above results are based on the current information available around the expected design and operation of the Ritz Carlton Hotel. In order to allow for the hotel to be eligible for a NABERS for Hotels Energy and Water rating, appropriate metering services will must be installed to separate the hotel’s energy (electrical and thermal) and water consumption from the rest of the development in accordance with the NABERS rules. The consultants below in Table 10 will be responsible for ensuring the new and existing plant is metered appropriately to apportion all greenhouse gas emissions to the hotel, separate from other areas on the site served by the central plant.

Table 10: NABERS metering responsibilities

METER TYPE	REPSPONSIBILITY
Electrical metering	Electrical consultant
Thermal metering	Mechanical consultant
Water metering	Hydraulic consultant

The meters are to allow the separation and apportioning of energy and water consumption to the hotel only. This will require a mix of electrical, thermal and water meters and will be addressed during detailed design. As a minimum, the meters will provide the energy and water coverage through new and existing meters as follows:

- Harbour heat rejection pump set, condenser water loop pump set, chilled water loop pump set, domestic hot water pump set, hydraulic and fire system pump set, stormwater and subsoil pump set
- Fan coil units, outside air fans, relief air fans, exhaust air fans, kitchen exhaust fans, toilet exhaust fans, smoke exhaust fans, stair pressurisation fans, carpark supply and exhaust fans
- Electric chillers (thermal and electrical)
- Gas boilers and tri-generation system (thermal and gas)
- Lifts
- Car stacker system
- Internal lighting, external lighting, carpark lighting
- Miscellaneous plug loads

APPENDIX A NABERS CALCULATOR

Nabers rating calculator results

NABERS

Premise type	Hotel	**Guest rooms**	220
Building details	The Star, Pirrama Road,	**Guest rooms with full service laundering**	0
State and postcode	PYRMONT 2009	**Function room seats**	240
Hotel star rating	5 stars	**Surface area of heated pools**	0 m^2

Energy Star rating (Calculator version number: 2.0)

Excellent performance
Your hotel demonstrates excellent greenhouse performance and reflecting excellent design and management practices, high efficiency systems and equipment and/or energy sources with low emissions.

Results for the 12 months rating period	Nabers energy rating		Nabers energy rating without GreenPower	
Star rating	5.5 stars		5.5 stars	
GreenPower included	0	%	0	%
Energy intensity	75866	MJ/m^2	75866	MJ/m^2
Total greenhouse gas emissions (Full fuel cycle - scope 1,2 & 3)	1070368	kg CO_2-e p.a.	1070368	kg CO_2-e p.a.
Actual greenhouse gas emissions per room	4865	kg CO_2-e/m^2p.a.	4865	kg CO_2-e/m^2p.a.
Predicted average greenhouse gas emissions for a comparable hotel performing at 5 stars	18463	kg CO_2-e/m^2p.a.	18463	kg CO_2-e/m^2p.a.

Your energy data source inputs

Fuel type	Quantity	Unit	Emissions (Full fuel cycled - Scope 1,2 & 3)	GreenPower
Electricity	-	kWh	-	0 %
Gas	16690600.0	MJ	1070368 kg CO_2-e p.a.	Not applicable
Deisel	-	L	-	Not applicable
Coal	-	T	-	Not applicable

Figure 8 NABERS Energy for Hotels “On Axis” calculator extract

Nabers rating calculator results

NABERS

Premise type	Hotel	**Guest rooms**	220
Building details	North Tower, Pirrama Road	**Guest rooms with full service laundering**	0
State and postcode	PYRMONT 2009	**Function room seats**	240
Hotel star rating	5 stars	**Surface area of heated pools**	0 m^2

Energy Star rating (Calculator version number: 2.0)

Above average performance
Your hotel is performing better than the current market average in terms of greenhouse performance. There are still opportunities for reducing emissions and improving energy efficiency in your hotel.

Results for the 12 months rating period	Nabers energy rating		Nabers energy rating without GreenPower	
Star rating	3 stars		3 stars	
GreenPower included	0	%	0	%
Energy intensity	90532	MJ/m^2	90532	MJ/m^2
Total greenhouse gas emissions (Full fuel cycle - scope 1,2 & 3)	3539117	kg CO_2-e p.a.	3539117	kg CO_2-e p.a.
Actual greenhouse gas emissions per room	16087	kg CO_2-e/m^2p.a.	16087	kg CO_2-e/m^2p.a.
Predicted average greenhouse gas emissions for a comparable hotel performing at 5 stars	18463	kg CO_2-e/m^2p.a.	18463	kg CO_2-e/m^2p.a

Your energy data source inputs

Fuel type	Quantity	Unit	Emissions (Full fuel cycled - Scope 1,2 & 3)	GreenPower
Electricity	2979500.0	kWh	2949705 kg CO_2-e p.a.	0 %
Gas	9190900.0	MJ	589412 kg CO_2e p.a.	Not applicable
Deisel	-	L	-	Not applicable
Coal	-	T	-	Not applicable

Figure 9 NABERS Energy for Hotels “Off Axis” calculator extract

Nabers rating calculator results

NABERS

Premise type	Hotel	**Guest rooms**	220	
Building details	The Star, Pirrama Road,	**Guest rooms with full service laundering**	0	
State and postcode	PYRMONT 2009	**Function room seats**	240	
Hotel star rating	5 stars	**Surface area of heated pools**	0	m^2

Water star rating (Calculator version number: 2.0)

Strong performance
Your hotel has good water performance, reflecting good equipment and management practices.

Results for the 12 months rating period	Nabers water rating (excluding externally supplied recycled water)		Nabers water rating if no externally supplied recycled water was used	
Star rating	4 stars		3.5 stars	
% of externally supplied water that is recycled water	6.4	%	0	%
Total water use, excluding externally supplied recycled water	19825.0	kL p.a.	21180.0	kL p.a.
Water use per room, excluding externally supplied recycled water	90.11	kL/room p.a.	96.28	kL/room p.a.
Predicted average water consumption for a hotel with the same facilities performing at 5 stars	146.69	kL/room p.a.	146.69	kL/room p.a.

Your water data source inputs

Externally supplied water (excluding recycled water)	19825.0	kL
Recycled water	1355.6	kL

Figure 10 NABERS Water for Hotels “On Axis” calculator extract

Nabers rating calculator results

NABERS

Premise type	Hotel	**Guest rooms**	220	
Building details	North Tower, Pirrama Road,	**Guest rooms with full service laundering**	0	
State and postcode	PYRMONT 2009	**Function room seats**	240	
Hotel star rating	5 stars	**Surface area of heated pools**	0	m^2

Water star rating (Calculator version number: 2.0)

Above average performance
Your hotel has above average water performance. Your building probably has some water efficient equipment and management practices and reflects an awareness of the importance of conserving water. Some improvements may still be possible.

Results for the 12 months rating period	Nabers water rating (excluding externally supplied recycled water)		Nabers water rating if no externally supplied recycled water was used	
Star rating	3.5 stars		3.5 stars	
% of externally supplied water that is recycled water	5.8	%	0	%
Total water use, excluding externally supplied recycled water	21947.0	kL p.a.	23299.0	kL p.a.
Water use per room, excluding externally supplied recycled water	99.76	kL/room p.a.	105.90	kL/room p.a.
Predicted average water consumption for a hotel with the same facilities performing at 5 stars	146.69	kL/room p.a.	146.69	kL/room p.a.

Your water data source inputs

Externally supplied water (excluding recycled water)	21947.2	kL
Recycled water	1351.3	kL

Figure 11 NABERS Water for Hotels “Off Axis” calculator extract

APPENDIX D GREEN STAR PATHWAY AND DOCUMENTATION

THE STAR ENTERTAINMENT GROUP PTY LTD

Greenhouse Gas Emission Report ENE-1

THE STAR, SYDNEY - RITZ CARLTON HOTEL AND RESIDENTIAL TOWER

FEBRUARY 2017

Greenhouse Gas Emission Report ENE-1

THE STAR, SYDNEY - RITZ CARLTON HOTEL AND RESIDENTIAL TOWER

The Star Entertainment Group Pty Ltd

REV	DATE	DETAILS
00	28/02/2017	For Planning Submission
01	24/03/2017	Updated For Planning Submission
02	30/06/2017	Updated For Planning Submission

AUTHOR, REVIEWER AND APPROVER DETAILS

Prepared by:	Martin Timperley	Date: 30/06/2017	Signature:
Reviewed by:	Sean Holmes	Date: 30/06/2017	Signature:
Approved by:	Tim Parker	Date: 30/06/2017	Signature:

WSP
Level 27, Ernst & Young Centre
680 George Street
Sydney NSW 2000
GPO Box 5394
Sydney NSW 2001

Tel: +61 2 9272 5100
Fax: +61 2 9272 5101

www.wsp-pb.com

Filename: 2305180U-ESD-REP-03 Rev02 Greenhouse Gas Emissions ENE-1

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EXECUTIVE SUMMARY

This report details the preliminary energy and greenhouse gas emissions modelling process and results for the Ritz Carlton Hotel and Residential Tower development at the existing site of The Star, Sydney in Pyrmont, NSW. All procedures in this report have been based on the requirements in the GBCA's Energy Consumption and Greenhouse Gas Emissions Calculation Guide, May 2016.

The proposed development is a 61 story tower consisting of hotel rooms, serviced apartments as well as a community centre, restaurant and club lounge. The proposed design is the result of a design competition won by Francis-Jones Morehen Thorp (FJMT). The development is being documented for planning approval submission in July 2017.

The building fabric and glazing performance requirements comply with NCC Section J which has been demonstrated using a Performance Solution, Verification Method JV3.

The following building models are defined within the Green Star Guidelines.

- **Proposed building**. The proposed design of the development with parameters linked to the performance of the designed / installed building.
- **Reference building**. The performance criteria are generally in line with the Deemed-to-Satisfy criteria in the Building Code of Australia (BCA), unless variations specified in the Green Star Guidelines.
- **Intermediate building**. Proposed building fabric but all services modelled as per the reference building.

A **Benchmark Building** is subsequently established as a building representing a 10% reduction in greenhouse gas emissions compared to the reference building.

To be eligible for a Green Star rating, the predicted greenhouse gas emissions of the proposed building model must be lower than that of the Benchmark Building. Furthermore, Credit 15E *'Greenhouse Gas Emissions- Reference Building Pathway'* awards up to 20 points on a sliding scale as follows:

- 4 points available for reductions in predicted operational energy of the intermediate building vs. the reference building (1 point per 5%)
- 16 points available for reductions in predicted greenhouse gas emissions of the proposed building vs. the benchmark building (1.6 point per 10%)

Table 1.1 summarises the results of the predictive energy modelling for the proposed building design and the reference building.

The proposed building achieves an improved greenhouse gas emissions performance compared to the Benchmark Building. Therefore, it meets the conditional energy requirement to be eligible for a Green Star rating.

The results of the modelling show that the development achieves a 76% reduction in greenhouse gas emissions compared with the Benchmark Building. The project is therefore eligible to claim 12.14 points out of 16 for the Credit 15 *Greenhouse Gas Emissions*. An improvement in building fabric (Intermediate building energy consumption compared against the Reference Building energy) is also targeted for this project. The project achieves a 4% reduction in energy consumption under this pathway. The project is therefore eligible to claim 0.69 points out of 4 under this pathway of the credit. Combined, the project therefore claims 12.8 out of 20 points for Credit 15 *Greenhouse Gas Emissions*.

Table 1.1 Summary of energy results for the Ritz Carlton Hotel and Residential Tower

RESULTS - Energy Consumption Reduction		**Units**
Reference Building Energy	31077802	MJ/annum
Intermediate Building Energy	29729601	MJ/annum
Improvement	4%	Percentage
Energy Consumption Reduction Points	**0.69**	**Points**
Greenhouse Gas Emissions Reduction		
Benchmark Building GHG	6778535	kgCO2e/annum
Proposed Building GHG	3931379	kgCO2e/annum
Proposed Building GHG	1634542	kgCO2e/annum
Conditional Requirement	PASS	
Improvement	76%	Percentage
GHG Emissions Reduction Points	**12.14**	**Points**
Renewable GHG Reduction (excluding GreenPower)	0	
Innovation - Renewable Energy	0	
Total Points Achieved	**12.8**	
Total Points Available	**20.0**	

1 INTRODUCTION

This report details the preliminary energy and greenhouse gas emissions modelling process and results for the Ritz Carlton Hotel and Residential Tower development at the existing site of The Star, Sydney in Pyrmont, NSW. The content and structure of this report are as per the requirements of the Green Star Design & As-Built *'Energy Consumption and Greenhouse Gas Emissions Calculation Guide, May 2016'* These guidelines set out the energy modelling methodology to benchmark the greenhouse gas emissions performance of a proposed design for Green Star purposes.

The proposed development is a 61 story tower consisting of hotel rooms, serviced apartments as well as a community centre, restaurant and club lounge. The proposed design is the result of a design competition won by Francis-Jones Morehen Thorp (FJMT). The development is being documented for planning approval submission in July 2017.

The building fabric and glazing performance requirements comply with NCC Section J which has been demonstrated using a Performance Solution, Verification Method JV3.

The modelling process involves the development of three distinct models:

- **Proposed building**. The proposed design of the development with parameters linked to the performance of the designed / installed building.
- **Reference building**. The performance criteria are generally in line with the Deemed-to-Satisfy criteria in the Building Code of Australia (BCA), unless variations specified in the Green Star Guidelines.
- **Intermediate Building**. Proposed building fabric but all services modelled as per the reference building.

A **Benchmark Building** is a building representing a 10% reduction in greenhouse gas emissions compared to the Reference Building.

To be eligible for a Green Star rating, the predicted greenhouse gas emissions of the Proposed Building model must be lower than that of the Benchmark Building.

Furthermore, Credit 15 *'Greenhouse Gas Emissions'* awards 20 points on a sliding scale as follows:

- 4 points available for reductions in predicted operational energy of the intermediate building vs. the reference building (1 point per 5%)
- 16 points available for reductions in predicted greenhouse gas emissions of the proposed building vs. the benchmark building (1.6 point per 10%)

Dynamic thermal modelling of the development has been undertaken in EDSL's Thermal Analysis Software v9.4 (TAS) package to predict the annual energy consumption of all primary HVAC systems, internal lighting and equipment. The energy consumption from systems such as external lighting, exhaust ventilation, domestic hot water, vertical transport and car stacker have been calculated through static calculation.

The proposed building will be serviced by the existing central energy plant as well as a proposed tri-generation system. To determine the annual greenhouse gas intensity of the thermal and electrical energy provided to the proposed building, the energyPRO software package has been used. energyPRO is an urban utility modelling software package from EMD International.

The annual electricity and gas consumption for the reference, intermediate and proposed building models has been entered in the Green Star Greenhouse Gas Emissions Calculator to determine the points achieved for Credit 15 *Greenhouse Gas Emissions.*

1.1 Sources of information

The following sources of information have been used in this report:

- Green Star Design & As Built v1.1 Submission Guidelines
- Green Star Design & As Built '*Energy Consumption and Greenhouse Gas Emissions Calculation Guide, May 2016*'
- National Construction Code Series 2016, Volume 1, Building Code of Australia.
- Architectural plan, elevation and section drawings prepared by FJMT 23/11/2016
- NCC Section J Glazing Calculators – Appendix A

1.2 Limitations

This report is intended to provide only an indication of this development's performance with respect to greenhouse gas emissions against the Green Star energy modelling criteria for greenhouse gas emission benchmarking. To this end, assumptions have been made about the development's energy consumption that may not reflect the true consumption of the building. Many factors relating to the tenancy of the building, such as process equipment loads, occupancy rates and schedules of operations, will affect the building's actual energy consumption. As a result, any information pertaining to the specific energy consumption and greenhouse gas emissions of this development is not likely to truly represent the building's performance.

Instead, this report can provide a guide to how well the development is likely to perform against a standard practice similar development with similar form and function, for benchmarking purposes in Green Star only.

2 ANALYSIS SOFTWARE

The Green Star Design & As Built *'Energy Consumption and Greenhouse Gas Emissions Calculation Guide, May 2016'* detail the methodology used for the predictive energy modelling. The requirements include the usage of appropriate software to simulate the dynamic performance of the building for certain energy categories (i.e. HVAC services). The software used for this report to perform the thermal modelling is EDSL TAS Building Designer v 9.4. TAS meets the criteria of the ABCB Protocol of Building Energy Analysis Software (v2006-1) and is therefore listed as compliant software in the GBCA's Energy Consumption and Greenhouse Gas Emissions Calculation Guide May 2016). The following four applications of the EDSL TAS Suite have been used in the modelling of HVAC loads and energy consumption of the development:

- TAS 3D Modeller
- TAS Building Designer
- TAS Results Viewer
- TAS Systems

The model requires the following input information:

- Geometry of building form and all associated exposure of surfaces,
- All material constructions,
- All internal diversified load profiles for people, lights and equipment,
- Shadowing and overshadowing of the building.

To accurately model the dynamic nature of buildings thermal response, hourly-recorded weather data is used in the thermal simulation. Such weather data contains records of radiation, temperature, humidity, sunshine duration and additionally wind speed and direction.

A Test Reference Year for Sydney has been used for this study. A Test Reference Year is hourly weather data for a year for use in simulation of the performance of active and passive solar energy systems, building energy consumption and indoor climate calculations.

The software models the solar gain through glazing accurately, calculating this value dynamically using material parameters, including solar transmittance, external solar reflectance, internal solar reflectance, external emissivity and internal emissivity, for each pane of glass in the glazing system and the internal and external conditions at each calculation time step. The software represents the U-values and shading coefficient of the glazing and the frame, calculating a total U-value and shading coefficient for the total window.

Air conditioning systems are modelled using TAS Systems, part of the EDSL TAS v 9.4 suite (Outlined in Table 2.1). TAS Systems is a component based simulation program, which allows systems to be developed from their component parts and control arcs from which parameters are set. The simulation procedure traces the thermal state of the system and that of the building as it is installed, enabling a detailed analysis for each hour throughout the year. The outputs from TAS System, allows plant sizing, prediction of energy consumption, energy targeting and assessment of energy conservation options.

Table 2.1 Energy Simulation analysis software reporting requirements

Software name and version	EDSL TAS v 9.4
Software Developer	EDSL
Software validation standard (evidence of developer's compliance to be provided)	TAS Building Designer v 9.4 TAS meets the criteria of the ABCB Protocol of Building Energy Analysis Software (v2006-1)
Simulator's name (include description of training and experience with software)	Martin Timperley

3 ENERGY MODELLING CRITERIA

This section outlines the parameters used in the energy modelling process for both the reference and the proposed building models.

3.1 Building Description

The Ritz Carlton Hotel and Residential Hotel development is a mixed use tower consisting of hotel rooms and serviced apartments as well as a community centre, restaurant and club lounge, as outlined in red in illustrated in Figure 3.1 below.

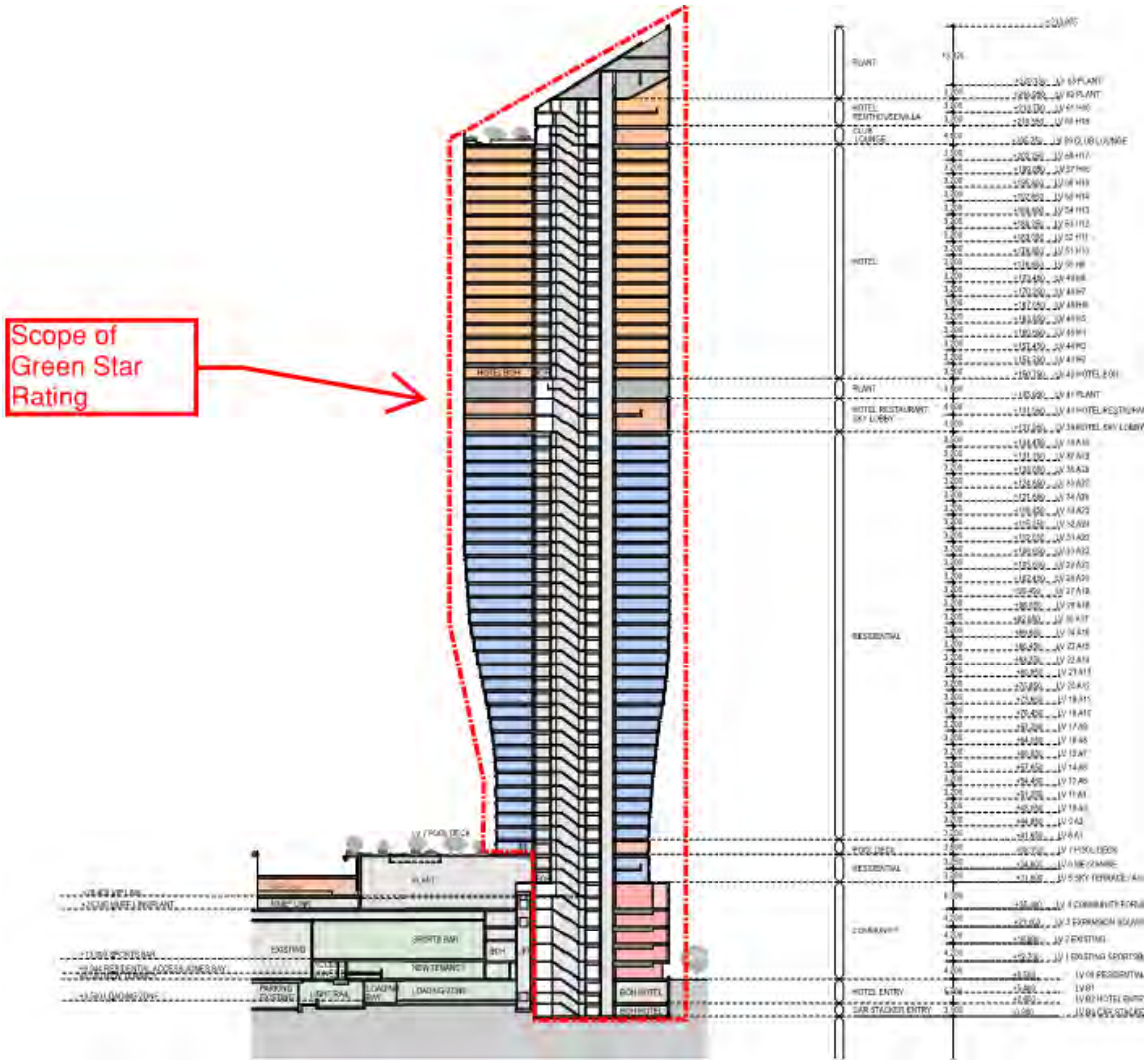

Figure 3.1 Ritz Carlton Hotel and Residential Tower elevation – scope of Green Star rating

The building is located within the current Star Sydney site on 80 Pyrmont Road, Pyrmont NSW.

Table 3.1 below provides some of the essential building parameters used in the energy modelling.

Table 3.1 General parameters reporting requirements

Parameter	Proposed	Reference
Climate zone	Sydney Urban, Climate Zone 5	Sydney Urban, Climate Zone 5
Weather data (location and data format)	Sydney, Test Reference Year (TRY)	Sydney, Test Reference Year (TRY)
Number of building storeys (below ground/above ground)	61	61
Heating fuel(s)	Natural Gas	Natural Gas
Cooling fuel(s)	Electricity	Electricity + Natural Gas

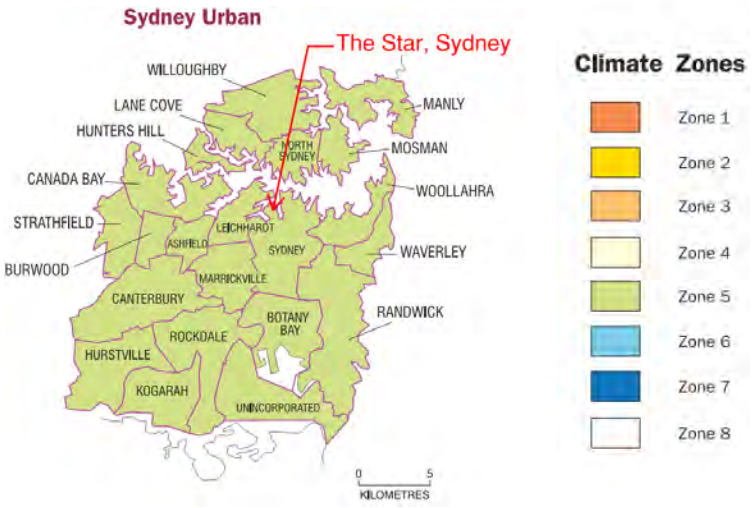

Figure 3.2 Site location and climate zone

3.2 Building form

The geometry of building has been accurately modelled using the in-built geometry creator in TAS and is shown in Figure 3.3 and Figure 3.4. The geometry of the model, including orientation, glazing extent and shading is as documented in the architectural drawings.

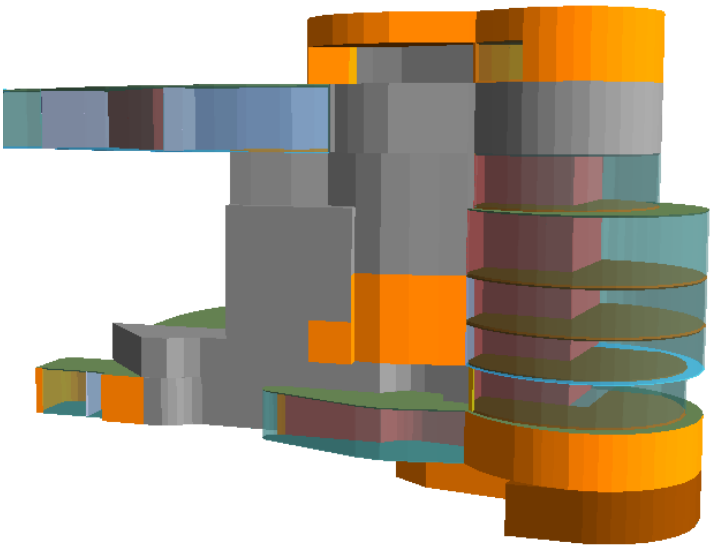

Figure 3.3: 3D Model – North-east Facade of the Ritz Carlton Hotel and Residential Tower podium

Figure 3.4 3D Model – North-east facade of the Ritz Carlton Hotel and Residential Tower

The HVAC zoning of the building has been modelled (as shown in Figures 5 to 11) to be consistent with the HVAC design. Note that different coloured areas represent distinct HVAC zones. Perimeter and internal zoning has been implemented where appropriate.

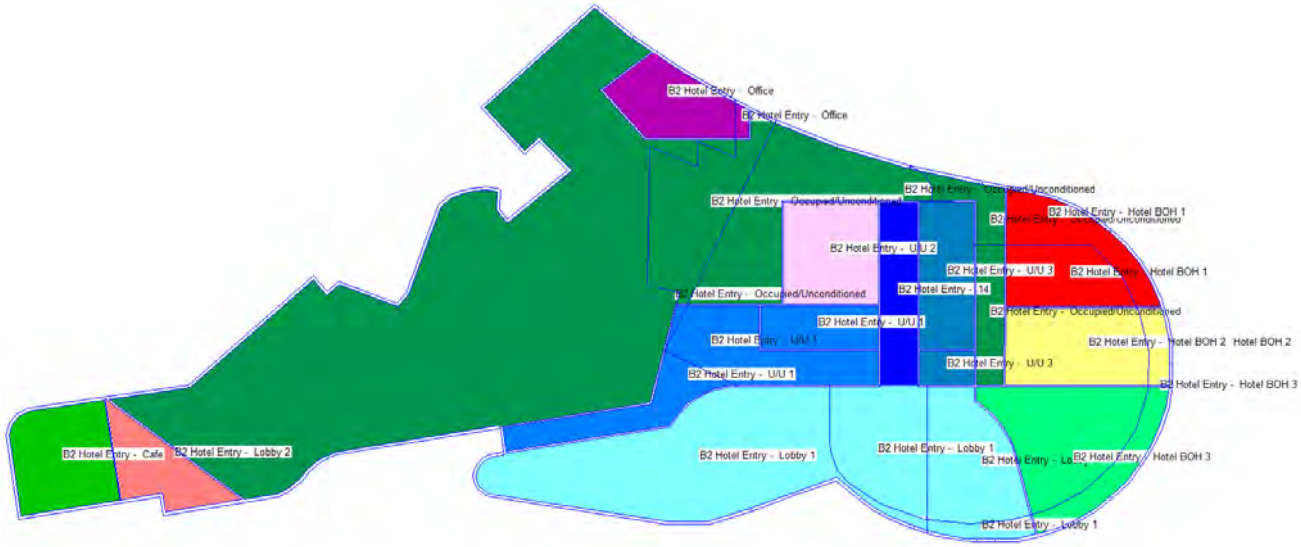

Figure 3.5 Level B2 – Hotel Basement Lobby - HVAC Zoning

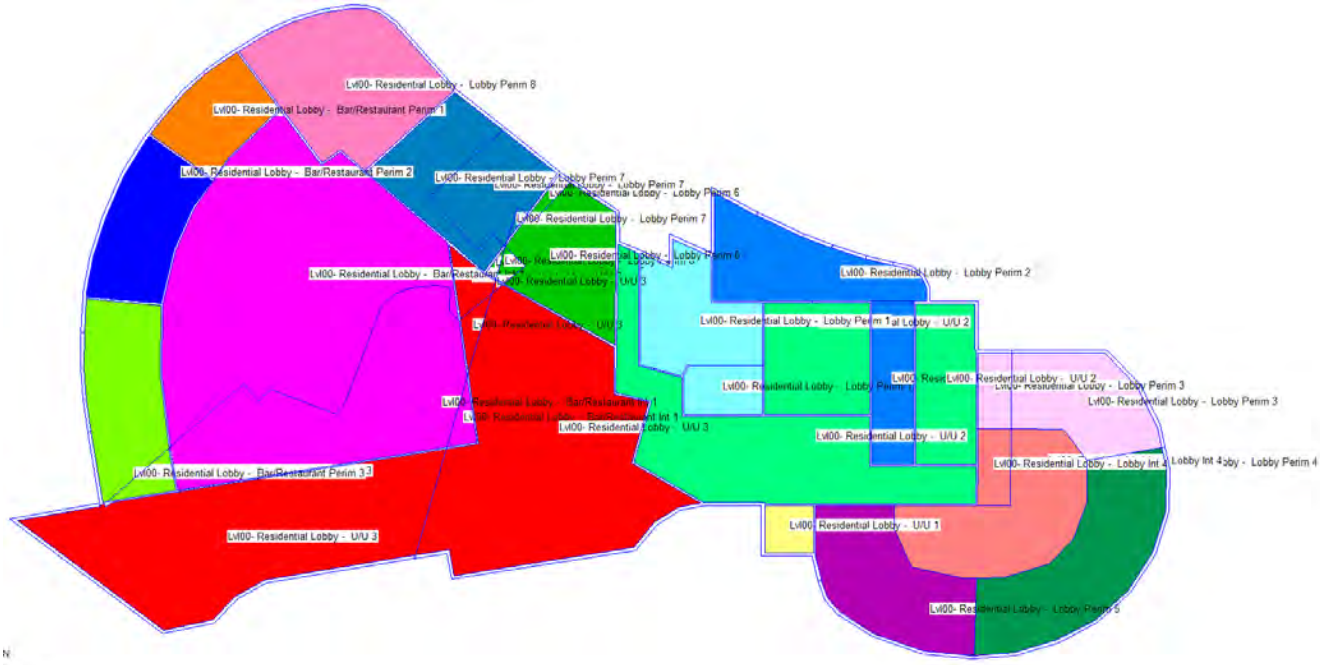

Figure 3.6 Ground Floor Residential Lobby HVAC Zoning

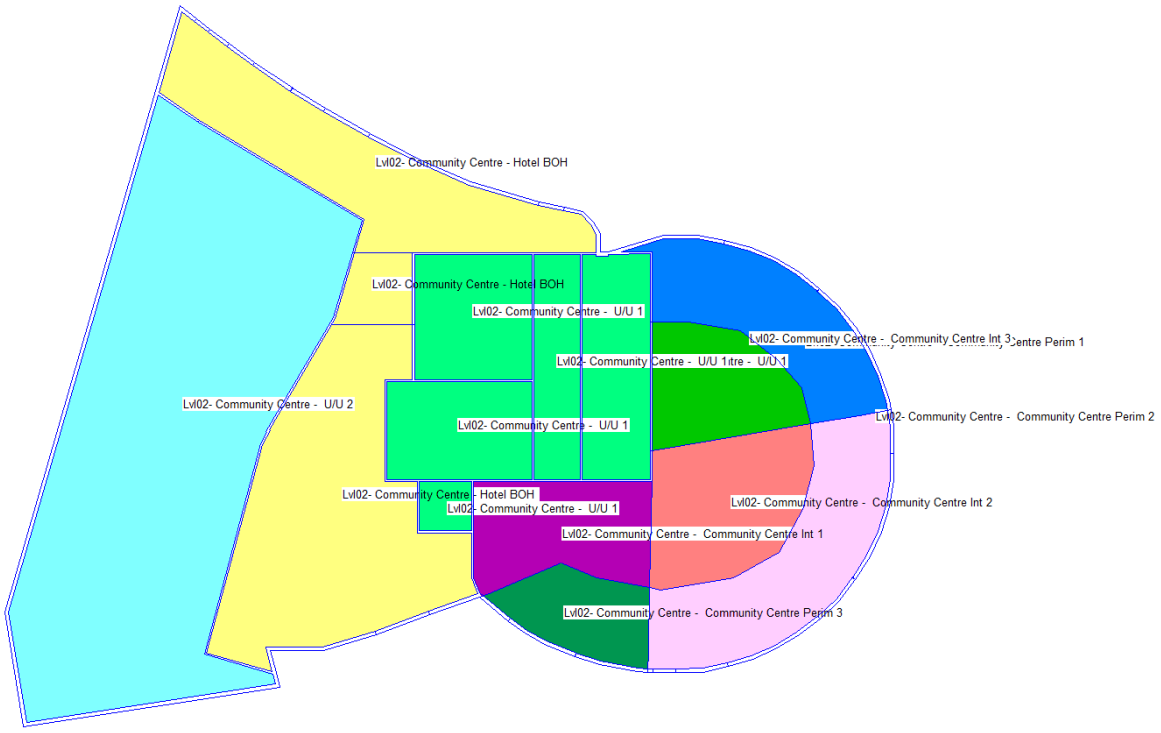

Figure 3.7 Level L2 – Community Centre - HVAC Zoning

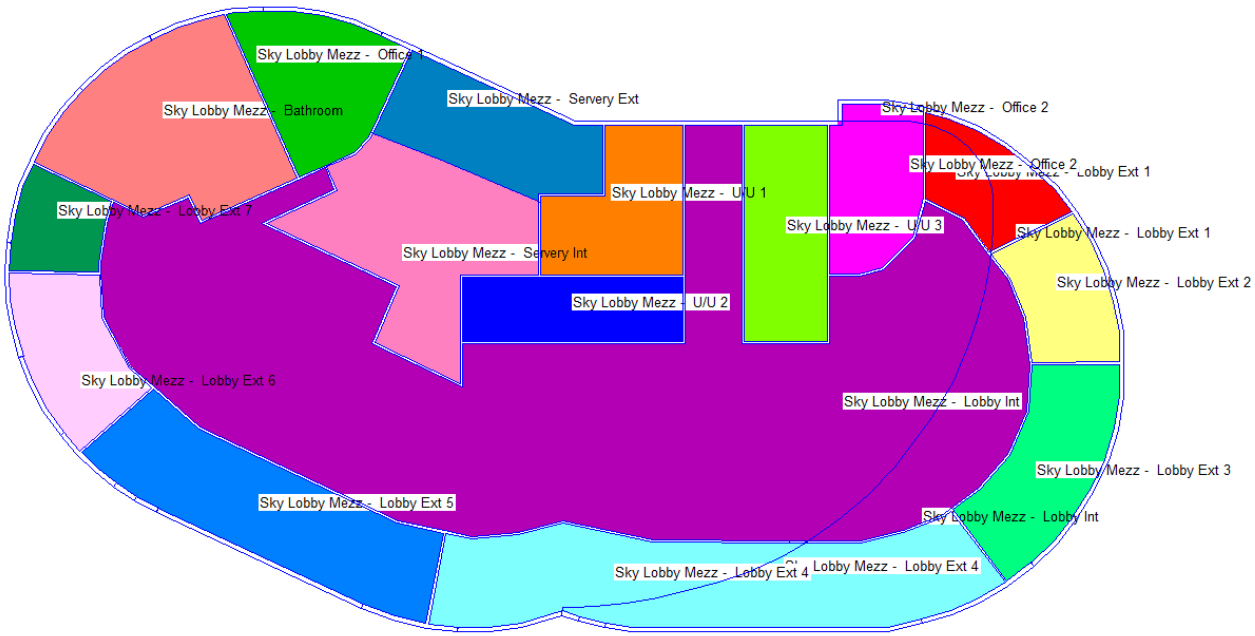

Figure 3.8 Level 40 - Sky Lobby Mezzanine – HVAC Zoning

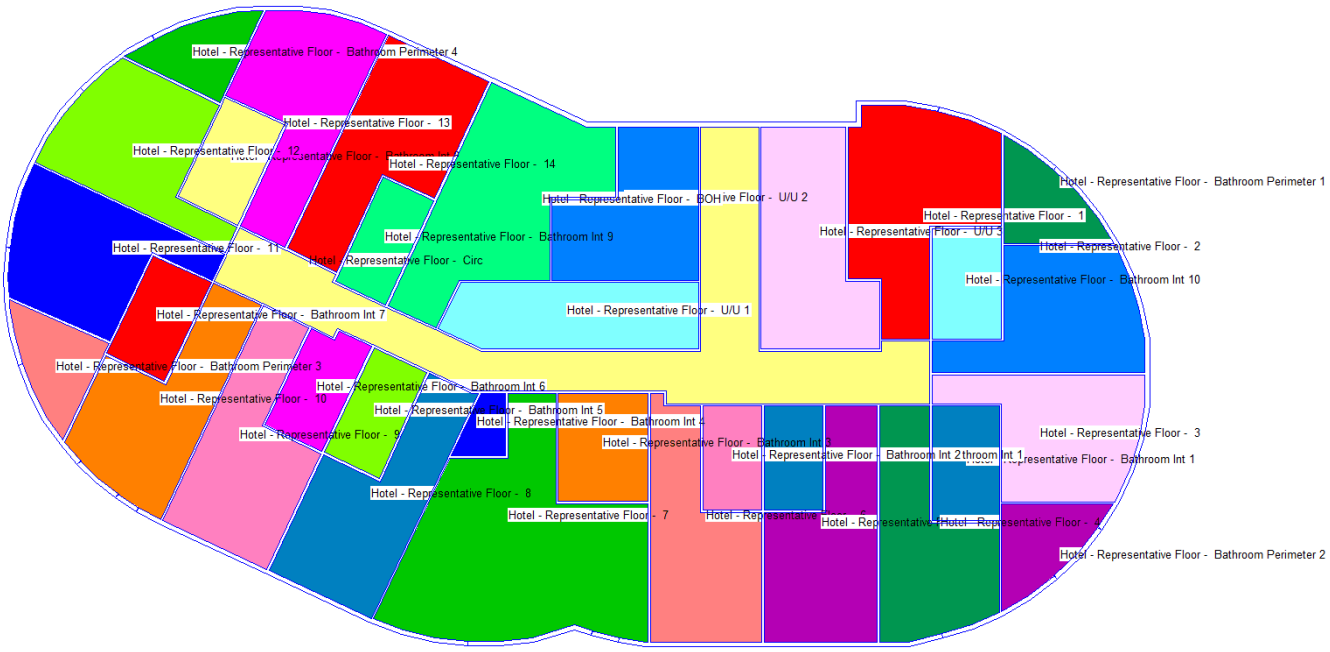

Figure 3.9 Typical Hotel Floor - HVAC Zoning

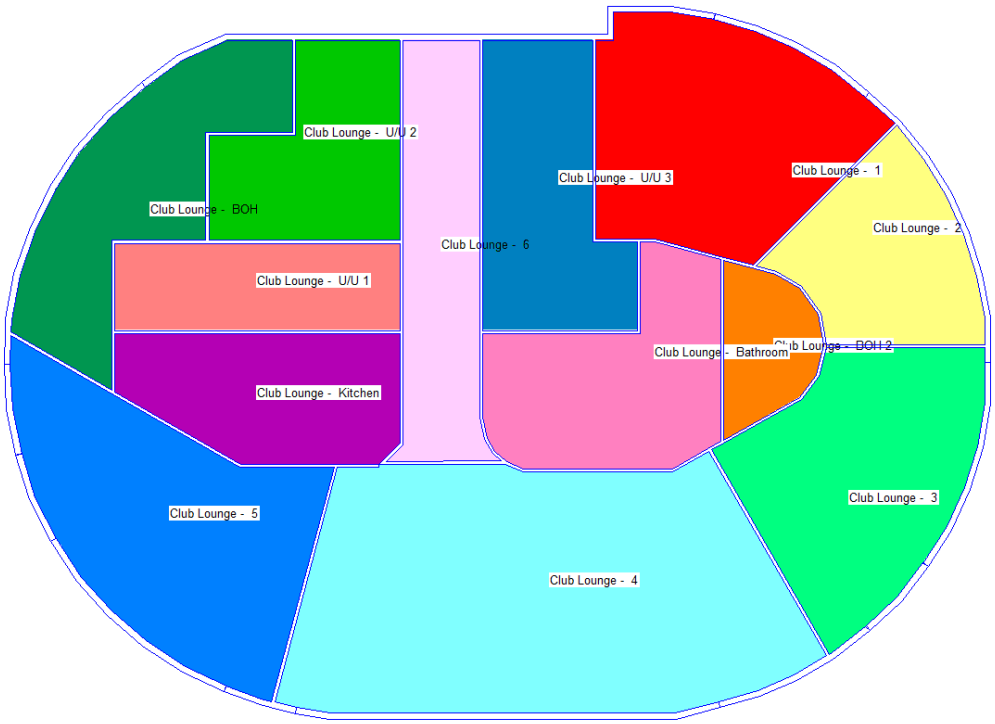

Figure 3.10 Level 60 - Club Lounge - HVAC Zoning

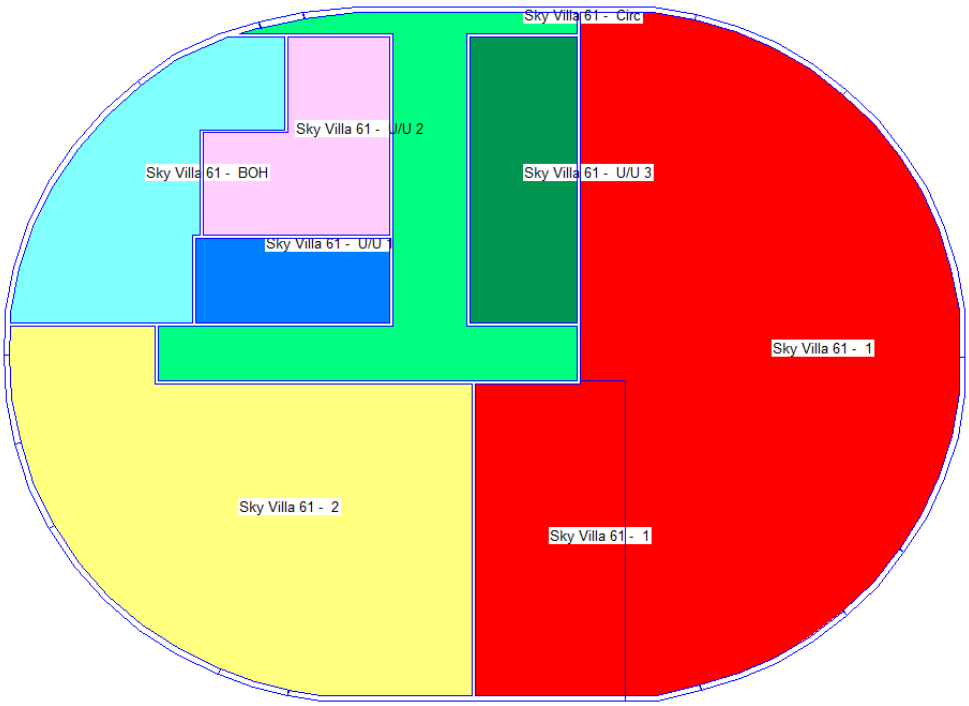

Figure 3.11 Level 62 – Sky Villa – HVAC Zoning

3.3 Shading

The level 01 community centre exposed floor (as shown below in Figure 3.12) provide shading to the ground floor residential lobby. At this stage of the design development no other shading features have been included in the envelope construction, therefore no additional shading features have been included in the model. As such there is no requirement to include shading to achieve the results presented in this report.

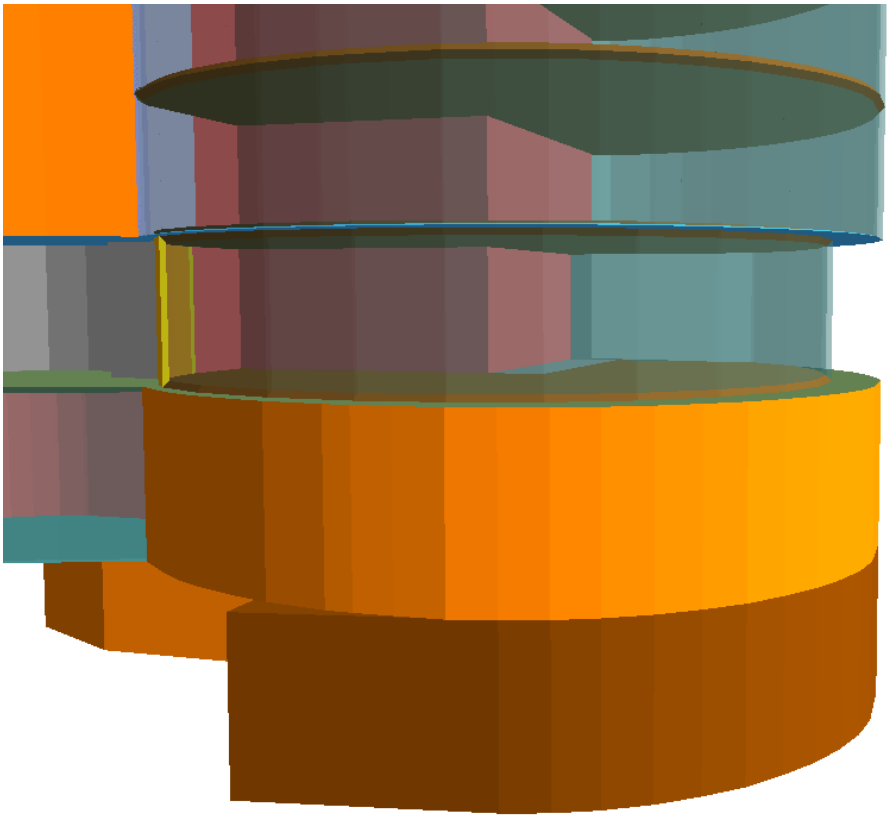

Figure 3.12 External shading on to the ground floor residential lobby from the exposed floor of the L01 community centre

3.4 Overshadowing

There are no surrounding buildings or structures that would provide any significant overshadowing to the Star Ritz Carlton Hotel and Residential Tower development. Thus, no adjacent buildings or overshadowing features have been incorporated in the geometry of the model.

Figure 3.13 Aerial photograph showing surrounding buildings

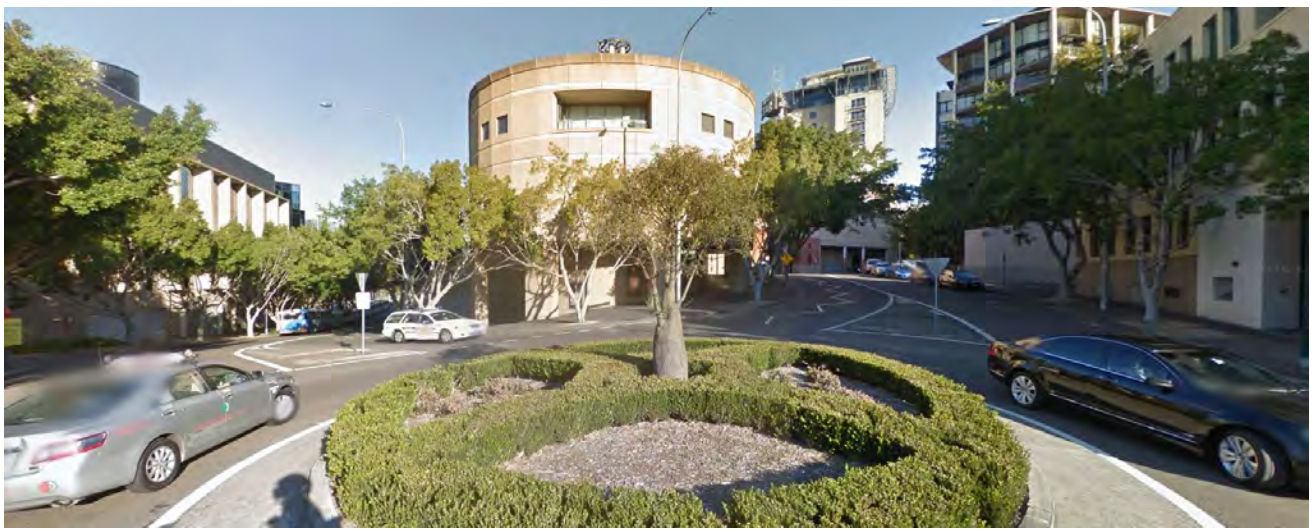

Figure 3.14 Street view of northern aspect of the Ritz Carlton Hotel and Residential Tower site, Pyrmont NSW

3.5 Building Simulation Inputs

There are many inputs which contribute to a dynamic thermal simulation. They can broadly be categorised into internal and external inputs.

Building simulation internal inputs specific to define the building's internal loads and include:

- Temperature control range and operational schedule
- Occupancy density and profile
- Occupant sensible and latent loads
- Equipment sensible and latent loads and profile
- Lighting loads and profile

Each of these inputs apart from the internal lighting loads have remained constant across the Reference Building and Proposed Building. The project will be implementing a high efficiency LED lighting system.

The occupancy density, occupant sensible and latent loads and equipment sensible and latent loads within each space type has been determined in accordance with the recommended values from The National Construction Code Series 2016, Volume 1, Building Code of Australia and is outlined in Table 3.2.

Operating profiles have been modelled as per the tables outlined in Section 14.3 - Green Star Energy Consumption and Greenhouse Emissions Calculation Guide. If no appropriate GBCA profile could be sourced from the Data Green Star Energy Modelling Guidelines then operating profiles were sourced from Section 2 of Specification JV – Annual Energy Consumption Criteria of the 2016 National Construction Code (denoted by NCC).

Table 5.1 in Section 5 presents the lighting power densities modelled for the Proposed Building and the Reference Building, including the incorporation of the high efficiency LED lighting system.

The temperature bandwidth has been determined in accordance with the best practice for each space type and is outlined in Table 3.2.

External inputs include dynamic weather conditions for the site. The weather file used for the has been outlined in Section 3, Table 3.1.

Table 3.2 Simulation input summary reporting requirements

Space Type	Operating Profile Applied	Temperature Control Range (°C)	Occupancy Density (m²/person)	Occupant Sensible Load (W/m²)	Occupant Latent Load (W/m²)	Equipment Load (W/m²)
Hotel room	GS Table 57 (apartment living space) and GS Table 58 (apartment bedroom)	21-24	15	5	3.7	5
Conditioned Apartment	GS Table 57 (apartment living space) and GS Table 58 (apartment bedroom)	21-24	15	5	3.7	5
Circulation	GS Table 35	21-24	10	7.5	5.5	0
Club lounge	NCC Table 2d	21-24	1	80	80	5
Bar/Restaurant	NCC Table 2d	21-24	1	80	80	5
Kitchen	GS Table 34	21-24	10	8	8	5
Lobby	GS Table 49	21-24	15	5	3.7	0
Office	GS Table 27	21-24	10	7.5	5.5	15
Community Centre	GS Table 27	21-24	10	7.5	5.5	15
Gym/Spa	GS Table 44	21-24	3	26.9	44.6	35
Back of house (conditioned)	GS Table 37	21-24	30	2.5	1.8	0

3.6 Building Fabric

The opaque building fabric for the reference building and the proposed building has been modelled as per the '"Deemed to Satisfy" provisions of The National Construction Code (NCC) 2016. Table 3.3 outlines the thermal performances used for the opaque building envelope elements.

Table 3.3 Building opaque fabric parameters reporting requirements

Parameter	Reference Model Thermal Performance (W/m$_2$K)	Proposed Model Thermal Performance (W/m$_2$K)
External above-grade envelope wall construction and R value	R 2.8	R 2.8
External below-grade envelope wall construction and R value	R 2.8	R 2.8
Internal envelope wall construction and R value	R 1.8	R 1.8
Roof construction, solar absorptance and R value	R 3.2 Solar Absorptance 0.7	R 3.2 Solar Absorptance 0.7
Floor construction and R value	Suspended floor to unconditioned space below: R 2.0 Slab on ground: Nil	Suspended floor to unconditioned space below: R 2.0 Slab on ground: Nil

3.7 Transparent Fabric Components

For both the reference building, the NCC DTS Glazing Calculations have been completed and are presented in Appendix A.

Table 3.4 outlines the thermal performance used for the visual glazing elements of the Proposed Building.

Table 3.4 Proposed Building visual glazing element thermal performance values (MID PANE)

Building Transparent fabric parameters	Proposed Building	Reference Building
All glazing	China southern 6SJ68S-1 on Clear +12A + 6C, Aluminium Frame U-Value: 1.67 SHGC: 0.32	See Appendix A for NCC DTS Glazing Calculators

4 HVAC SERVICES DESCRIPTION

The modelling parameters for the air-conditioning and ventilation systems for the Star Ritz Carlton Hotel and Residential Tower development Reference Building and Proposed Building designs are outlined in this section.

4.1 Air Condit ioning S ystem Parameters

Heating and cooling is provided to the entire development via a four pipe Fan Coil Unit (FCU) system.

The reference mechanical systems are as defined by the Green Star Design & As Built 'Energy Consumption and Greenhouse Gas Emissions Calculation Guide, May 2016'. As a non-residential building with less than 2,300m^2 of conditioned area, HVAC system type 1 is applicable.[1]

However, a VAV system type is unsuitable as a benchmark for a development of this type, as such the Reference Building has been modelled with a DTS compliance four pipe FCU system.

System details are presented below in Table 4.1.

Table 4.1 Air conditioning system parameters

Parameter	Proposed	Reference
Primary air conditioning system type	Four Pipe Fab Coil Unit (FCU) System	Four Pipe Fab Coil Unit (FCU) System
Other air conditioning system type(s)	NA	NA
Space served	All conditioned areas	All conditioned areas
Design supply air temperature difference (C)	8°C	8°C
Supply air temperature control	Temperature sensors in zones	Temperature sensors in zones
Outdoor air design volume flow rate (L/s)	See Table 4.2	See Table 4.2
Fan design supply air volume flow rate (L/s)	See Table 4.2	See Table 4.2

Table 4.2 Fan motor power to air ratio used for supply and relief air fans (W/L/S)

Zone Reference	Nominal Flow Rate (L/s)		Fan Power to Air Ratio (W/L/s)			
			Reference Building		Proposed Building	
	Outside Air Fan	Relief Air Fan	Outside Air Fan	Relief Air Fan	Outside Air Fan	Relief Air Fan
Hotel - Representative Floor - 1	31	158	1.32	1.32	0.1	0.15
Hotel - Representative Floor - 2	25	102	1.54	1.54	0.1	0.15

[1] As per Table 61: Reference project HVAC system types by project type, Energy Consumption and Greenhouse Gas Emissions Calculation Guide, May 2016

Hotel - Representative Floor - 3	24	93	1.66	1.66	0.1	0.15
Hotel - Representative Floor - 4	24	278	1.14	1.14	0.1	0.15
Hotel - Representative Floor - 5	26	272	0.69	0.69	0.1	0.15
Hotel - Representative Floor - 6	26	271	0.69	0.69	0.1	0.15
Hotel - Representative Floor - 7	53	490	0.78	0.78	0.1	0.15
Hotel - Representative Floor - 8	27	167	1.09	1.09	0.1	0.15
Hotel - Representative Floor - 9	26	174	1.03	1.03	0.1	0.15
Hotel - Representative Floor - 10	25	191	0.93	0.93	0.1	0.15
Hotel - Representative Floor - 11	25	97	1.61	1.61	0.1	0.15
Hotel - Representative Floor - 12	25	112	1.43	1.43	0.1	0.15
Hotel - Representative Floor - 13	25	136	1.22	1.22	0.1	0.15
Hotel - Representative Floor - 14	26	122	1.39	1.39	0.1	0.15
Hotel - Representative Floor - Circ	92	234	1.50	1.50	0.1	0.15
Sky Villa 60 - 1	192	785	1.56	1.56	0.1	0.15
Sky Villa 60 - 2	101	974	0.75	0.75	0.1	0.15
Sky Villa 61 - 1	192	1,008	1.27	1.27	0.1	0.15
Sky Villa 61 - 2	101	852	0.84	0.84	0.1	0.15
Lvl01- Community Centre - Community Centre Perim 1	63	599	0.91	0.91	0.6	0.25
Lvl01- Community Centre - Community Centre Perim 2	80	1,050	0.98	0.98	0.6	0.25
Lvl01- Community Centre - Community Centre Perim 3	32	532	1.27	1.27	0.6	0.25
Lvl02- Community Centre - Community Centre Perim 1	63	654	0.84	0.84	0.6	0.25
Lvl02- Community Centre - Community Centre Perim 2	80	1,118	0.92	0.92	0.6	0.25
Lvl02- Community Centre - Community Centre Perim 3	32	593	1.15	1.15	0.6	0.25
Lvl03- Community Centre - Community Centre Perim 1	64	1,143	1.18	1.18	0.6	0.25
Lvl03- Community Centre - Community Centre Perim 2	87	1,705	1.08	1.08	0.6	0.25
Lvl03- Community Centre - Community Centre Perim 3	32	1,283	0.29	0.29	0.6	0.25

Lvl05- Community Centre - Community Centre Perim 1	57	633	0.78	0.78	0.6	0.25
Lvl05- Community Centre - Community Centre Perim 2	39	593	0.85	0.85	0.6	0.25
Lvl05- Community Centre - Community Centre Perim 3	61	565	0.92	0.92	0.6	0.25
Lvl01- Community Centre - Community Centre Int 1	52	184	1.17	1.17	0.6	0.25
Lvl01- Community Centre - Community Centre Int 2	62	172	1.40	1.40	0.6	0.25
Lvl01- Community Centre - Community Centre Int 3	45	136	1.32	1.32	0.6	0.25
Lvl02- Community Centre - Community Centre Int 1	52	198	1.10	1.10	0.6	0.25
Lvl02- Community Centre - Community Centre Int 2	62	180	1.36	1.36	0.6	0.25
Lvl02- Community Centre - Community Centre Int 3	45	149	1.23	1.23	0.6	0.25
Lvl03- Community Centre - Community Centre Int 1	52	297	0.79	0.79	0.6	0.25
Lvl03- Community Centre - Community Centre Int 2	55	215	1.08	1.08	0.6	0.25
Lvl03- Community Centre - Community Centre Int 3	44	198	0.97	0.97	0.6	0.25
Lvl05- Community Centre - Community Centre Int 1	26	124	0.93	0.93	0.6	0.25
Lvl00- Residential Lobby - Bar/Restaurant Perim 1	303	397	0.96	0.96	0.6	0.25
Lvl00- Residential Lobby - Bar/Restaurant Perim 2	433	582	0.95	0.95	0.6	0.25
Lvl00- Residential Lobby - Bar/Restaurant Perim 3	546	932	1.13	1.13	0.6	0.25
B2 Hotel Entry - Cafe	454	853	1.07	1.07	0.6	0.25
B2 Hotel Entry - Bar/Restaurant	1,658	3,128	1.06	1.06	0.6	0.25
Sky Lobby Restaurant - Pvt Room 1	262	342	0.96	0.96	0.6	0.25
Sky Lobby Restaurant - Pvt Room 2	376	443	1.02	1.02	0.6	0.25
Sky Lobby Restaurant - Restaurant Ext 1	436	655	1.23	1.23	0.6	0.25

Sky Lobby Restaurant - Restaurant Ext 2	648	974	1.23	1.23	0.6	0.25
Sky Lobby Restaurant - Restaurant Ext 4	262	414	1.19	1.19	0.6	0.25
Lvl00- Residential Lobby - Bar/Restaurant Int 1	3,138	3,174	1.10	1.10	0.6	0.25
Sky Lobby Restaurant - Restaurant Int	2,946	2,847	1.13	1.13	0.6	0.25
B2 Hotel Entry - Hotel BOH 1	20	71	3.43	3.43	0.1	0.15
B2 Hotel Entry - Hotel BOH 2	19	66	3.56	3.56	0.1	0.15
B2 Hotel Entry - Hotel BOH 3	26	128	2.72	2.72	0.1	0.15
Lvl02- Community Centre - Hotel BOH	89	384	3.00	3.00	0.1	0.15
Lvl01- Community Centre - Hotel BOH	53	179	3.64	3.64	0.1	0.15
B4 Hotel BOH - BOH	148	227	6.27	6.27	0.1	0.15
Hotel BOH - BOH Ext 1	23	999	0.92	0.92	0.1	0.15
Hotel BOH - BOH Ext 2	11	379	0.79	0.79	0.1	0.15
Hotel BOH - BOH Ext 3	12	176	0.99	0.99	0.1	0.15
Hotel BOH - BOH Ext 4	9	236	1.07	1.07	0.1	0.15
Hotel BOH - BOH Ext 5	18	395	0.69	0.69	0.1	0.15
Hotel BOH - BOH Ext 6	1	56	0.91	0.91	0.1	0.15
Hotel BOH - BOH Int	83	401	2.73	2.73	0.1	0.15
Lvl09- Resi Gym - Spa Perim 1	76	172	0.88	0.88	0.6	0.25
Lvl09- Resi Gym - Spa Perim 2	221	486	0.90	0.90	0.6	0.25
Lvl09- Resi Gym - Spa Perim 3	220	547	0.83	0.83	0.6	0.25
Lvl09- Resi Gym - Gym Perim 1	147	533	0.89	0.89	0.6	0.25
Lvl09- Resi Gym - Gym Perim 2	283	768	1.11	1.11	0.6	0.25
Lvl10-Resi Gym + Adj Resi - Gym Perim	201	678	0.95	0.95	0.6	0.25
Club Lounge - 1	602	713	1.02	1.02	0.6	0.25
Club Lounge - 2	337	475	0.92	0.92	0.6	0.25
Club Lounge - 3	573	717	0.99	0.99	0.6	0.25
Club Lounge - 4	1,287	1,423	1.05	1.05	0.6	0.25
Club Lounge - 5	686	816	1.01	1.01	0.6	0.25

Club Lounge - 6	367	361	1.12	1.12	0.6	0.25
Club Lounge - Kitchen	13	118	1.49	1.49	0.6	0.25
Sky Lobby Mezz - Servery Ext	13	327	1.06	1.06	0.6	0.25
Sky Lobby Restaurant - Kitchen Ext 1	8	235	0.89	0.89	0.6	0.25
Sky Lobby Restaurant - Kitchen Ext 2	20	489	1.07	1.07	0.6	0.25
Sky Lobby Mezz - Servery Int	22	181	1.64	1.64	0.6	0.25
Sky Lobby Restaurant - Kitchen Int	41	333	1.67	1.67	0.6	0.25
Sky Villa 60 - Circ	61	286	0.93	0.93	0.1	0.15
Sky Villa 61 - Circ	61	317	0.85	0.85	0.1	0.15
B2 Hotel Entry - Office	35	125	1.15	1.15	0.1	0.15
Sky Lobby Mezz - Office 1	37	295	1.05	1.05	0.1	0.15
Sky Lobby Mezz - Office 2	29	187	0.70	0.70	0.1	0.15
B2 Hotel Entry - Lobby 1	187	3,491	1.04	1.04	0.6	0.25
B2 Hotel Entry - Lobby 2	20	656	0.97	0.97	0.6	0.25
Lvl00- Residential Lobby - Lobby Int 4	48	242	1.30	1.30	0.6	0.25
Lvl00- Residential Lobby - Lobby Perim 1	38	180	1.37	1.37	0.6	0.25
Lvl00- Residential Lobby - Lobby Perim 2	49	781	0.84	0.84	0.6	0.25
Lvl00- Residential Lobby - Lobby Perim 3	35	382	0.67	0.67	0.6	0.25
Lvl00- Residential Lobby - Lobby Perim 4	48	470	0.74	0.74	0.6	0.25
Lvl00- Residential Lobby - Lobby Perim 5	38	552	0.92	0.92	0.6	0.25
Lvl00- Residential Lobby - Lobby Perim 6	31	262	0.85	0.85	0.6	0.25
Lvl00- Residential Lobby - Lobby Perim 7	42	437	0.70	0.70	0.6	0.25
Lvl00- Residential Lobby - Lobby Perim 8	51	386	0.92	0.92	0.6	0.25
Sky Lobby Mezz - Lobby Ext 1	15	284	1.04	1.04	0.6	0.25
Sky Lobby Mezz - Lobby Ext 2	17	243	0.92	0.92	0.6	0.25
Sky Lobby Mezz - Lobby Ext 3	26	441	0.78	0.78	0.6	0.25

Sky Lobby Mezz - Lobby Ext 4	65	2,118	0.98	0.98	0.6	0.25
Sky Lobby Mezz - Lobby Ext 5	43	1,106	1.25	1.25	0.6	0.25
Sky Lobby Mezz - Lobby Ext 6	20	463	0.84	0.84	0.6	0.25
Sky Lobby Mezz - Lobby Ext 7	11	143	1.01	1.01	0.6	0.25
Sky Lobby Mezz - Lobby Int	279	1,264	1.44	1.44	0.6	0.25

Table 4.3 Supply Air Specific Fan power zone summary

Zone Reference	Supply air specific fan pressure (W/L/s)	
	Reference Building	Proposed Building
Hotel - Representative Floor - 1	1.10	0.25
Hotel - Representative Floor - 2	1.24	0.25
Hotel - Representative Floor - 3	1.31	0.25
Hotel - Representative Floor - 4	1.05	0.25
Hotel - Representative Floor - 5	0.63	0.25
Hotel - Representative Floor - 6	0.63	0.25
Hotel - Representative Floor - 7	0.70	0.25
Hotel - Representative Floor - 8	0.94	0.25
Hotel - Representative Floor - 9	0.90	0.25
Hotel - Representative Floor - 10	0.82	0.25
Hotel - Representative Floor - 11	1.28	0.25
Hotel - Representative Floor - 12	1.17	0.25
Hotel - Representative Floor - 13	1.04	0.25
Hotel - Representative Floor - 14	1.14	0.25
Hotel - Representative Floor - Circ	1.08	0.25
Sky Villa 60 - 1	1.81	0.25
Sky Villa 60 - 2	1.75	0.25
Sky Villa 61 - 1	1.88	0.25
Sky Villa 61 - 2	1.69	0.25
Lvl01- Community Centre - Community Centre Perim 1	1.89	0.6
Lvl01- Community Centre - Community Centre Perim 2	1.89	0.6
Lvl01- Community Centre - Community Centre Perim 3	1.88	0.6

Lvl02- Community Centre - Community Centre Perim 1	1.89	0.6
Lvl02- Community Centre - Community Centre Perim 2	1.89	0.6
Lvl02- Community Centre - Community Centre Perim 3	1.89	0.6
Lvl03- Community Centre - Community Centre Perim 1	0.93	0.6
Lvl03- Community Centre - Community Centre Perim 2	1.24	0.6
Lvl03- Community Centre - Community Centre Perim 3	1.29	0.6
Lvl05- Community Centre - Community Centre Perim 1	0.82	0.6
Lvl05- Community Centre - Community Centre Perim 2	1.26	0.6
Lvl05- Community Centre - Community Centre Perim 3	0.68	0.6
Lvl01- Community Centre - Community Centre Int 1	1.07	0.6
Lvl01- Community Centre - Community Centre Int 2	0.75	0.6
Lvl01- Community Centre - Community Centre Int 3	0.82	0.6
Lvl02- Community Centre - Community Centre Int 1	0.91	0.6
Lvl02- Community Centre - Community Centre Int 2	1.20	0.6
Lvl02- Community Centre - Community Centre Int 3	0.76	0.6
Lvl03- Community Centre - Community Centre Int 1	0.86	0.6
Lvl03- Community Centre - Community Centre Int 2	1.09	0.6
Lvl03- Community Centre - Community Centre Int 3	1.12	0.6
Lvl05- Community Centre - Community Centre Int 1	1.03	0.6
Lvl00- Residential Lobby - Bar/Restaurant Perim 1	0.29	0.6
Lvl00- Residential Lobby - Bar/Restaurant Perim 2	0.72	0.6
Lvl00- Residential Lobby - Bar/Restaurant Perim 3	0.80	0.6
B2 Hotel Entry - Cafe	0.83	0.6
B2 Hotel Entry - Bar/Restaurant	0.91	0.6
Sky Lobby Restaurant - Pvt Room 1	1.03	0.6
Sky Lobby Restaurant - Pvt Room 2	0.99	0.6
Sky Lobby Restaurant - Restaurant Ext 1	0.87	0.6
Sky Lobby Restaurant - Restaurant Ext 2	1.01	0.6
Sky Lobby Restaurant - Restaurant Ext 4	0.95	0.6
Lvl00- Residential Lobby - Bar/Restaurant Int 1	0.67	0.6
Sky Lobby Restaurant - Restaurant Int	0.86	0.6
B2 Hotel Entry - Hotel BOH 1	0.79	0.25

B2 Hotel Entry - Hotel BOH 2	0.77	0.25
B2 Hotel Entry - Hotel BOH 3	0.55	0.25
Lvl02- Community Centre - Hotel BOH	0.54	0.25
Lvl01- Community Centre - Hotel BOH	0.72	0.25
B4 Hotel BOH - BOH	0.70	0.25
Hotel BOH - BOH Ext 1	0.70	0.25
Hotel BOH - BOH Ext 2	0.55	0.25
Hotel BOH - BOH Ext 3	0.55	0.25
Hotel BOH - BOH Ext 4	0.74	0.25
Hotel BOH - BOH Ext 5	0.74	0.25
Hotel BOH - BOH Ext 6	0.73	0.25
Hotel BOH - BOH Int	0.55	0.25
Lvl09- Resi Gym - Spa Perim 1	0.55	0.6
Lvl09- Resi Gym - Spa Perim 2	2.69	0.6
Lvl09- Resi Gym - Spa Perim 3	2.76	0.6
Lvl09- Resi Gym - Gym Perim 1	2.25	0.6
Lvl09- Resi Gym - Gym Perim 2	2.43	0.6
Lvl10-Resi Gym + Adj Resi - Gym Perim	2.81	0.6
Club Lounge - 1	3.80	0.6
Club Lounge - 2	0.90	0.6
Club Lounge - 3	0.77	0.6
Club Lounge - 4	0.93	0.6
Club Lounge - 5	1.03	0.6
Club Lounge - 6	0.66	0.6
Club Lounge - Kitchen	0.89	0.6
Sky Lobby Mezz - Servery Ext	2.26	0.6
Sky Lobby Restaurant - Kitchen Ext 1	0.61	0.6
Sky Lobby Restaurant - Kitchen Ext 2	0.62	0.6
Sky Lobby Mezz - Servery Int	0.59	0.6
Sky Lobby Restaurant - Kitchen Int	0.70	0.6
Sky Villa 60 - Circ	0.81	0.25
Sky Villa 61 - Circ	0.73	0.25

B2 Hotel Entry - Office	0.55	0.25
Sky Lobby Mezz - Office 1	0.54	0.25
Sky Lobby Mezz - Office 2	0.55	0.6
B2 Hotel Entry - Lobby 1	0.55	0.6
B2 Hotel Entry - Lobby 2	0.55	0.6
Lvl00- Residential Lobby - Lobby Int 4	0.55	0.6
Lvl00- Residential Lobby - Lobby Perim 1	1.34	0.6
Lvl00- Residential Lobby - Lobby Perim 2	1.01	0.6
Lvl00- Residential Lobby - Lobby Perim 3	0.86	0.6
Lvl00- Residential Lobby - Lobby Perim 4	1.03	0.6
Lvl00- Residential Lobby - Lobby Perim 5	1.47	0.6
Lvl00- Residential Lobby - Lobby Perim 6	1.49	0.6
Lvl00- Residential Lobby - Lobby Perim 7	0.76	0.6
Lvl00- Residential Lobby - Lobby Perim 8	0.71	0.6
Sky Lobby Mezz - Lobby Ext 1	0.90	0.6
Sky Lobby Mezz - Lobby Ext 2	0.93	0.6
Sky Lobby Mezz - Lobby Ext 3	0.61	0.6
Sky Lobby Mezz - Lobby Ext 4	0.99	0.6
Sky Lobby Mezz - Lobby Ext 5	0.94	0.6
Sky Lobby Mezz - Lobby Ext 6	1.09	0.6
Sky Lobby Mezz - Lobby Ext 7	1.14	0.6
Sky Lobby Mezz - Lobby Int	0.79	0.6

4.2 Cooling a nd Heat Rejection Pl ant

Presented below in Table 4.4 is the modelled cooling system and heat rejection plant for the project.

Table 4.4 Cooling and heat rejection plant details

Parameter	Proposed	Reference
Chiller type	Electric	Electric, Absorption
Chiller capacity (kWr)	2MW	2MWth, 0.3MWth
Design CHW flow temperature (°C)	6	6
Design CHW temperature difference (K)	6	6
Design CCW entering temperature (°C)	29.5	29.5
Design CCW temperature difference (K)	5.5	5.5
Chiller full-load performance (EER)	4.2	6.4 / 0.7
Chiller part-load performance (NPLV)	5.2	6.4 / 0

4.3 Heating Pl ant

Presented below in Table 4.4 is the modelled heating system for the project.

Table 4.5 Heating plant details

Parameter	Proposed	Reference
Heat source type	Natural gas	Natural gas, Cogeneration
Heat source capacity (kWr)	800kW	800kW / 1.5MW
Design HHW flow temperature (°C)	80	80
Design HHW temperature difference (K)	20	20
Heat source full-load performance (gross efficiency)	83	83 / heat recovered

4.4 Tri-generation Sy stems Description

Presented below in Table 4.6 is the modelled tri-generation system for the project.

Table 4.6 Tri-generation plant details

Parameter	Proposed Project
Cogeneration unit type	Capstone C1000 Series Microturbine System
Electrical output (kWe)	1,000
Useful thermal output (kWth)	1,500
Waste thermal output (kWth)	Unspecified
Total fuel input (gross) (kW)	3226
Minimum turndown (%)	1% (modular microturbine system)
Minimum import threshold (kWe)	Nil
Installation altitude (m)	0
Derating threshold temperature (°C)	Unspecified
Demand control method	Electrically Driven Operation
Absorption chiller minimum operating load (kWr)	300
Absorption chiller hydraulic configuration	Unspecified
Heating or cooling priority control	Cooling
Preventative maintenance regime	Unspecified

5 LIGHTING DESCRIPTION

5.1 Internal lighting

Lighting forms a major component of the energy consumption in the Ritz Carlton Hotel and Residential Tower development. Hours of operation are as per the profiles specified in Table 3.2 for both the Reference Building and Proposed Building model. As defined in the Greenhouse Gas Emissions Calculation Guidelines v1.1, May 2016, the lighting power densities used in the Reference Building model are as per the DTS requirements of the BCA, with no adjustment factors.

The Proposed Building model uses lighting power densities that are typically achievable through the utilisation of LED lighting technologies. The Reference Building and Proposed Building lighting power densities have also been used as the internal gains for the HVAC modelling as prescribed in the Greenhouse Gas Emissions Calculation Guidelines v1.1, May 2016. Table 5.1 presents the lighting power densities modelled for the Proposed Building and the Reference Building.

Table 5.1 Internal lighting parameters per space type

Space type	Daylight controls	Occupant sensor controls	Adjustment factor applied	Modelled lighting power density (W/M^2)	
				Reference	Proposed
Hotel room	N/A	N/A	N/A	5	4
Conditioned Apartment	N/A	N/A	N/A	5	4
Circulation	N/A	N/A	N/A	8	5
Club lounge	N/A	N/A	N/A	18	6
Bar/Restaurant	N/A	N/A	N/A	18	6
Kitchen	N/A	N/A	N/A	8	5
Lobby	N/A	N/A	N/A	15	6
Office	N/A	N/A	N/A	9	7
Community Centre	N/A	N/A	N/A	10	7
Gym/Spa	N/A	N/A	N/A	8	6
Back of house (conditioned)	N/A	N/A	N/A	8	5

5.2 Internal lighting calculations

A summary of the energy consumption for internal lighting is summarised in Table 5.2.

Table 5.2 Summary of internal lighting energy consumption

Model	Energy consumption (per year)	Fuel Source
Reference Building	842,076 kWh	Electricity
Proposed Building	521,092 kWh	Electricity

5.3 External lighting

The proposed external lighting types will comply with AS1158.3.1 based on their relevant category. These category values have been used in the calculation of the Reference Building, as per the Green Star – Greenhouse Gas Emissions Calculator Guide and are presented below in Table 5.3. Table 5.4 summarises the annual external lighting energy consumption for both Reference Building and Proposed Building.

Table 5.3 External lighting parameters reporting requirements

Parameter	Reference	Proposed
Lighting type	Unspecified	LED
Lighting category	P6	P6
Design lighting power density (W/m²)	4.0	1.0
Modelled lighting power density (W/m²)	4.0	1.0
Controls	N/A	N/A

Table 5.4 Summary of External Lighting Energy Use

Model	Energy consumption (per year)	Fuel Source
Reference Building	68,836 kWh	Electricity
Proposed Building	17,209 kWh	Electricity

6 DOMESTIC HOT WATER SERVICES DESCRIPTION

The Domestic Hot Water demand (DHW) for the Reference Building and Proposed Building has been determined based on the Green Star Potable Water Calculator and used for the calculation as per Section 6.9 in the Green Star Design & As Built 'Energy Consumption and Greenhouse Gas Emissions Calculation Guide, May 2016' Table 6.1 lists the parameters used in the calculation of Domestic Hot Water heating energy consumption.

Table 6.1 Domestic hot water services parameters reporting requirements

Parameter	Reference	Proposed
System type	Unspecified	Unspecified
System heat source	Natural Gas	Natural Gas
Solar thermal collector (Y/N)	N	N
Hot water usage (L/annum)	24,737,242	28,631,842
System storage capacity (L)	0	0
Storage tank volume, each (L)	0	0
Heater thermal efficiency (%)	83	83
System supply water temperature (°C)	8	60
System make up water temperature (°C)	18	18
Recirculation pump (Y/N)	N	N
Operating days (days/annum)	365	365
No. of connected outlets	Unspecified	Unspecified
System standing loss factor[2]	0.03	0.03
System distribution loss factor[3]	0.13	0.13
Total Energy Demand (MJ/year)	**6,079,427**	**7,036,564**

Energy consumption of circulation pumps have been accounted for in this energy model using dynamic thermal modelling within the TAS systems applications based on the expected DHW demand. The following parameters have been used in this analysis and are presented below in Table 6.2.

[2] Standing loss factor for gas fired instantaneous and continuous flow water heaters, as per Table in Section 14.4.4, Energy Consumption and Greenhouse Gas Emissions Calculation Guide

[3] Distribution loss factor for a system with Recirculation pumps, as per Table in Section 14.4.4, Energy Consumption and Greenhouse Gas Emissions Calculation Guide

Table 6.2 Circulation pump energy calculation parameters

Parameter	Proposed	Reference
Pump efficiency	0.75	0.75
Peak pressure (kPa)	100	100
Days/yr	365	365
Hours/day	24	24
Total circulation energy (kWh/yr)	289	289

7 APPLIANCES DESCRIPTION

The current design is not developed in enough detail to specify the energy performance of the appliances to be included as part of the fitout of the residential (BCA class 2) areas of the development. For the purposes of energy modelling, an appliance load of 5W/m2 has been applied to the, kitchen, living, dining and bedroom areas of the residential apartments, based on Table 2h of Specification JV – Annual Energy Consumption Criteria of the 2016 National Construction Code (NCC).

8 LIFT ENERGY CONSUMPTION

The building has six lifts servicing all floors with an additional lift servicing the podium levels (B4 to L09). The total expected energy use has been calculated as per the methodology outlined in Section 14.4.6 of the Energy Consumption and Greenhouse Gas Emissions Calculation Guide. The results are detailed below in Table 8.1, Table 8.2 and Table 8.3.

Table 8.1 Lift energy calculation Inputs comparison

Lift	Trips per day	Trips per year	Ave trip time (s)	Motor size (kW)	Standby power (W)	Standby hours per day	Standby days per year
Reference Building	600	219,000	36.24	15.56	0.15	24	365
Proposed Building	600	219,000	36.24	15.56	0.15	24	365

Additionally, a car stacker is located in the basement to store vehicles for residents and hotel patrons. Based on preliminary details of the expected system, following parameters have been used to model the annual energy use of this system, based on information provided by the product supplier.

Table 8.2 Car stacker calculation inputs comparison

Parameter	Reference Building	Proposed Building
Cars stacked per day	500	500
Number of stacker lifts	2	2
Stacker lift rated power (kW)	2	30
Average stacker lift trip time (s)	12	12
Number of entry lifts	2	2
Entry lift rated power (kW)	30	30
Average entry lift trip time (s)	9	9
Number of shuttles	7	7
Shuttles rated power (kW)	2.2	2.2
Average shuttle trip time (s)	20	20
Number of car pickers	2	2
Car picker rated power (kW)	2.2	2.2
Average car picker operation time (s)	14	14
Number of turn tables	2	2
Turn table rated power (kW)	0.5	0.5
Average turn table operation time (s)	20	20

Table 8.3 Summary of lift energy use

Model	Lift Energy Consumption (kWh)	Car Stacker Energy Consumption (kwh)	Total Vertical Transport Energy Consumption (kwh)	Fuel
Reference Building	35,629	72,270	107,900	Electricity
Proposed Building	35,629	72,270	107,900	Electricity

9 PEAK ELECTRICITY DEMAND REDUCTION – CREDIT 16

The Peak Electricity Demand reduction is calculated based on an analysis of the building's peak hourly electrical demand, as per Section 10 and 12 of the Energy Consumption and Greenhouse Gas Emissions Calculator Guide, v1.1.

The utility modelling software package energyPRO has been utilised to determine the peak electrical demand of the Proposed Building, taking into account the utilisation of the tri-generation system. With the intent to dedicate 1MWe of the total 8MWe of the tri-generation system's electrical generation capacity to the Ritz Carlton Hotel and Residential Tower development it is expected that the site will not need to draw electricity from the grid at all throughout the year, even during peak events. Additionally, the peak electrical demand of the site if further reduced due to 300kW of chilled water demand to be provided by an absorption chiller fuelled by waste heat from the tri-generation system. These findings are outlined in Table 9.1 below.

Table 9.1 Peak Electricity Demand - Hourly consumption of proposed and reference building

Parameter	Reference	Proposed
Time	Day 16, Hour 19	N/A
HVAC (kWh)	492.20	363.12
Lighting (kWh)	147.10	91.59
Equipment (kWh)	156.84	156.85
Fan Energy (kWh)	508.33	157.22
DHW (kWh)	0	0
Hydraulic pumps (kWh)	21.15	16.40
Lift Energy (kWh)	56.94	56.95
TOTAL	1383.48	748.37
Tri-generation electrical production during day 16, hour 19	N/A	748.37
TOTAL including PV generation	1383.48	0
% Improvement	N/A	100%

The annual total electrical and cooling load profiles for the proposed project can be seen in Figure 9.1, identifying the peak hour of demand. The percentage improvement above the reference building is 100% due to the ability of the tri-generation unit to meet the entire peak electrical demand of the site. Therefore, the Ritz Carlton Hotel and Residential Tower development is eligible for 2 Green Star points for Credit 16, Peak Electricity Demand Reduction

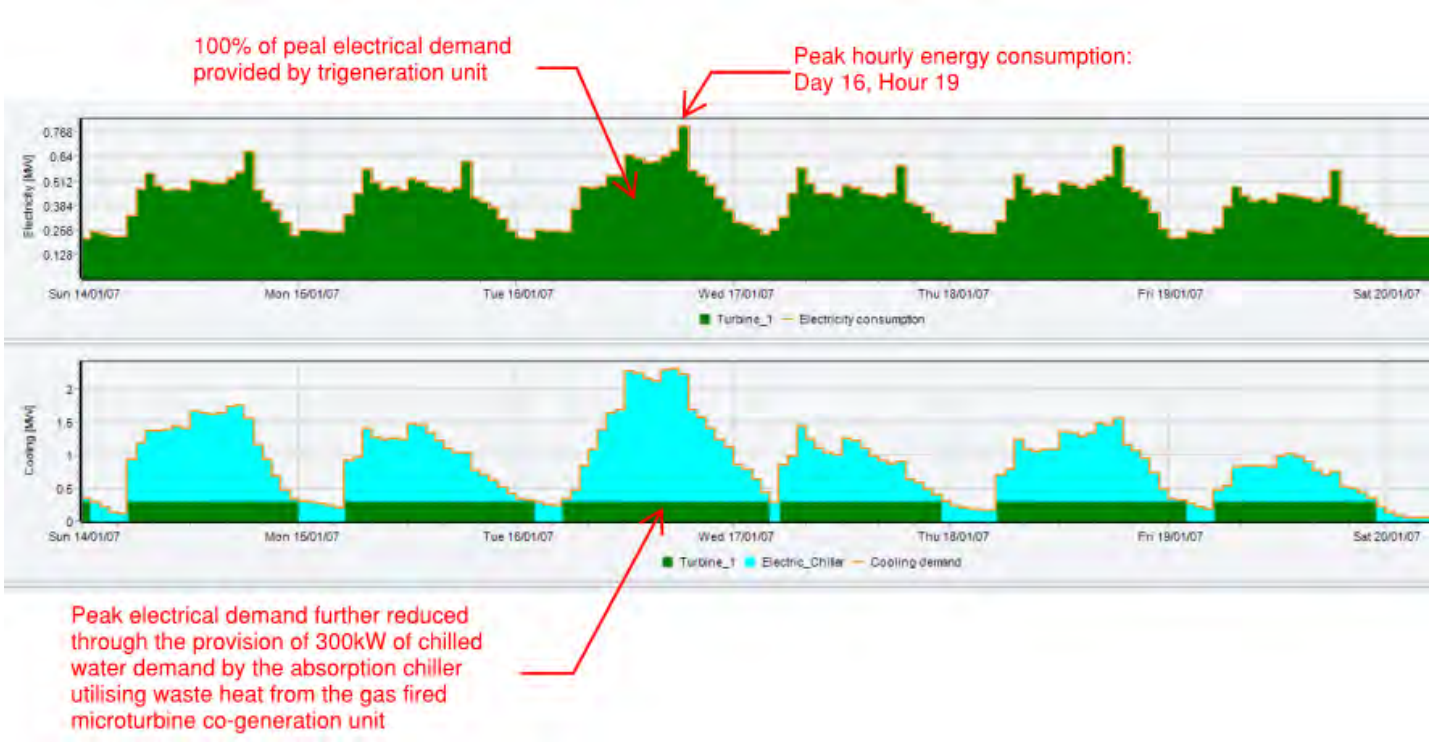

Figure 9.1 Hourly electrical and cooling load profile - Proposed Building

10 RESULTS

The results of the Ritz Carlton Hotel and Residential Tower development energy modelling analysis are summarised in this section of the report. Overall, an improvement of 4% is predicted from the Intermediate Building to Reference Building in terms of energy. An improvement of 76% is expected for the Proposed Building when compared to the Benchmark Building in terms of greenhouse gas emissions. Ritz Carlton Hotel and Residential Tower development is therefore eligible to claim a total of 12.8 points for Credit 15 – Greenhouse Gas Emissions.

10.1 Annual Energy Usage

Table 10.1 to Table 10.4 has been taken from the Green Star Design and As-Built Greenhouse Gas Emissions Calculator – 15E Modelled Pathway. These tables present a summary of the inputs and results of the energy analysis for the Ritz Carlton Hotel and Residential Tower development.

Table 10.1 Green Star Design and As-Built Greenhouse Gas Emissions Calculator - HVAC

HVAC	Reference Building			Intermediate Building		Proposed Building		
	Source	Annual Energy Consumption	GHG Emissions	Annual Energy Consumption	GHG Emissions	Source	Annual Energy Consumption	GHG Emissions
Heating (MJ/yr)	Natural Gas	1,494,964	95,872	1,170,500	75,064	District DHW	3,097,115	252,540
Cooling (kWh/yr)	Grid Electricity	645,401	677,671	702,628	737,760	District Electricity	340,431	99,932
Heat Rejection (kWh/yr)	Grid Electricity	645,401	677,671	702,628	737,760	District Electricity	340,431	99,932
Air Conditioning Fans (kWh/yr)	Grid Electricity	4,323,989	4,540,189	3,994,134	4,193,841	District Electricity	1,325,795	389,182
Pumps (kWh/year)	Grid Electricity	185,053	194,306	179,285	188,249	District Electricity	143,344	42,078

Table 10.2 Green Star Design and As-Built Greenhouse Gas Emissions Calculator - SERVICES

Services	Reference Building			Intermediate Building		Proposed Building		
	Source	Annual Energy Consumption	GHG Emissions	Annual Energy Consumption	GHG Emissions	Source	Annual Energy Consumption	GHG Emissions
Domestic Hot Water (MJ/yr)	Natural Gas	5,240,886	336,098	5,240,886	336,098	District DHW	6,170,078	503,112
DHW Circulators and Controls (kWh/yr)	Grid Electricity	288	303	288	303	District Electricity	288	85
DCW Pumps and Controls (kWh/yr)	Grid Electricity	-	-	-	-	District Electricity	-	-
Lifts (kWh/yr)	Grid Electricity	107,900	113,295	107,900	113,295	District Electricity	107,900	31,673
Artificial Lighting – Internal (kWh/yr)	Grid Electricity	842,077	884,180	842,077	884,180	District Electricity	521,092	152,964
Artificial Lighting – External (kWh/yr)	Grid Electricity	68,836	72,278	68,836	72,278	District Electricity	17,209	5,052
Appliances (kWh/yr)	Grid Electricity	388,020	407,421	388,020	407,421	District Electricity	388,020	113,902
TOTALS (MJ/year)		**31,077,802**	**7,531,706**	**29,729,601**	**7,212,308**		**20,045,751**	**1,634,542**

Table 10.3 Green Star Design and As-Built Greenhouse Gas Emissions Calculator - Greenhouse Gas Emissions

Subtotal GHG Emissions	Reference Building		Intermediate Building		Proposed Building	
	Annual Energy Consumption	GHG Emissions	Annual Energy Consumption	GHG Emissions	Annual Energy Consumption	GHG Emissions
Grid Electricity (KWh/yr)	6,761,653	7,099,736	6,477,282	6,801,146	-	-
Natural Gas (MJ/yr)	6,735,850	431,970	6,411,386	411,162	-	-
District CHW (MJ/yr)	-	-	-	-	1,225,552	99,932
District HHW (MJ/yr)	-	-	-	-	3,097,115	252,540
District DHW (MJ/yr)	-	-	-	-	6,170,078	503,112
District Electricity (kWh/yr)	-	-	-	-	2,653,613	778,957
Total (kWh/yr)					**13,146,358**	**1,634,542**

Table 10.4 Green Star Design and As-Built Greenhouse Gas Emissions Calculator - RESULTS

RESULTS - Energy Consumption Reduction		**Units**
Reference Building Energy	31,077,802	MJ/annum
Intermediate Building Energy	29,729,601	MJ/annum
Improvement	4%	
Energy Consumption Reduction Points	69%	
Greenhouse Gas Emissions Reduction		
Benchmark Building GHG	6,778,535	kgCO2e/annum
Proposed Building GHG (excluding off-site supply)	3,633,502	kgCO2e/annum
Proposed Building GHG	1,634,542	kgCO2e/annum
Conditional Requirement	PASS	
Improvement	76%	
Off-site supply max points	7.42	
GHG Emissions Reduction Points	**12.14**	
Renewable GHG Reduction (excluding GreenPower)	0	
Innovation - Renewable Energy	0	
Total Points Achieved	**12.84**	
Total Points Available	**20.00**	

10.2 Peak Electricity Demand Reduction

Table 9.1 in Section 9 provides a summary of the peak electricity demand reductions. A total reduction of 100% has been achieved for the Proposed Building compared with the Reference Building. This project hence is eligible for 2 out of 2 points for Credit 16 – Peak Electricity Demand Reduction.

11 SUMMARY AND CONCLUSION

Building energy modelling has been undertaken in accordance with the Green Star Design & As-Built *'Building Energy Consumption and Greenhouse Gas Emissions Calculations Guidelines v1.1, May 2016'*. Three building models were created of the development: the Proposed Building, an Intermediate Building and a Reference Building. A Benchmark Building is established as a 10% improvement in energy consumption compared to the reference building.

The modelling has been undertaken on the basis of post competition design documentation. Furthermore, the purpose of the energy modelling conducted in this report is for benchmarking purposes for the Green Star Design & As-Built v1.1 Credit 15 Greenhouse Gas Emissions. The energy modelling methodology stated in the Green Star guidelines and consequently the energy modelling results presented in this report may therefore not necessarily form an accurate prediction of the actual energy consumption for the development.

The predicted building greenhouse gas emissions consumption of the Intermediate Building is a 4% improvement on the Reference Building. Furthermore, the Proposed Building achieves a 76% reduction in greenhouse gas emissions compared to the Benchmark Building. The development therefore meets the conditional energy performance requirement necessary to be eligible for a Green Star Design & As-Built rating and claims 12.8 points out of an available 20 for Credit 15 *Greenhouse Gas Emissions*.

Appendix A

REFERENCE BUILDING NCC 2016 GLAZING CALCULATORS

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014)

HELP

Building name/description: **The Star - North Tower - Hotel Entry**

Application: **shop display**

Climate zone: **5**

Storey: **Basement 2**

Facade areas

	N	NE	E	SE	S	SW	W	NW	internal
Option A		195m²	36.3m²	36m²					
Option B									
Glazing area (A)		*162m²*	*30.9m²*	*30.7m²*					

Number of rows preferred in table below: **8** *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS										SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance			P&H or device		Shading		Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)		P (m)	H (m)	P/H	G (m)	Heating (S_H)	Cooling (S_C)	Area used (m²)	Element share of % of allowance used
1	Retail1_NE	NE		9.65	5.85		4.4	0.43		4.450	4.850	0.92	-4.80	0.22	0.37	56.45	22% of 99%
2												ROW SKIPPED (OK if intentional)					
3	Retail2_NE	NE		4.85	21.76		4.4	0.43		2.110	4.850	0.44	0.00	0.80	0.66	######	78% of 99%
4												ROW SKIPPED (OK if intentional)					
5	Retail2_E	E		4.85	6.37		2.9	0.25					0.00	1.00	1.00	30.89	100% of 95%
6												ROW SKIPPED (OK if intentional)					
7	Retail2_SE	SE		4.85	6.32		3.0	0.43					0.00	1.00	1.00	30.65	100% of 98%
8																	

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if inputs are valid

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Figure 11.1 NCC Glazing Calculator – Retail Glazing

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014)

HELP

Building name/description: **The Star - North Tower - Hotel Entry**

Application: **other**

Climate zone: **5**

Storey: **Basement 2**

Facade areas

	N	NE	E	SE	S	SW	W	NW	Internal
Option A		65.1m²	149m²	10.4m²	6.67m²	10.4m²			
Option B									
Glazing area (A)		*55.3m²*	*82.4m²*	*8.82m²*	*5.67m²*	*8.82m²*			

Number of rows preferred in table below: **12** *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS										SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance			P&H or device		Shading		Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)		P (m)	H (m)	P/H	G (m)	Heating (S_H)	Cooling (S_C)	Area used (m²)	Element share of % of allowance used
1	Hotel_SW	SW		4.85		8.82	2.7	0.65		device		2.00	0.00	0.39	0.34	8.82	100% of 86%
2												ROW SKIPPED (OK if intentional)					
3	Hotel_S	S		4.85		5.67	2.9	0.25		device		2.00	0.00	0.64	0.54	5.67	100% of 89%
4												ROW SKIPPED (OK if intentional)					
5	Hotel_SE	SE		4.85		8.82	2.7	0.65		device		2.00	0.00	0.39	0.32	8.82	100% of 91%
6												ROW SKIPPED (OK if intentional)					
7	Hotel_E	E		4.85		64.92	4.4	0.53		7.660	4.850	1.58	0.00	0.02	0.30	64.92	56% of 93%
8	Hotel_E	E		4.85		17.44	4.4	0.53					0.00	1.00	1.00	17.44	44% of 93%
9												ROW SKIPPED (OK if intentional)					
10	Hotel_NE	NE		4.85		48.21	4.4	0.43		0.680	0.450	1.51	-4.40	0.00	0.24	48.21	58% of 87%
11	Hotel_NE	NE		4.85		7.12	4.4	0.43					0.00	1.00	1.00	7.12	42% of 87%
12																	

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if inputs are valid

Figure 11.2 NCC Glazing Calculator – Hotel Lobby Glazing

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014)

HELP

Building name/description: **The Star - North Tower - Hotel**

Application: **other**

Climate zone: **5**

Storey: **Basement 2**

Facade areas

	N	NE	E	SE	S	SW	W	NW	internal
Option A		81.9m²							
Option B									

Glazing area (A) *25.1m²*

Number of rows preferred in table below: **5** *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS								SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance		P&H or device		Shading		Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	P/H	G (m)	Heating (S_H)	Cooling (S_C)	Area used (m²)	Element share of % of allowance used
1	Ribbon_NE	NE		9.65	2.60		6.2	0.79	7.110	4.850	1.47	-4.80	0.00	0.25	25.09	100% of 43%
2																
3																
4																
5																

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if inputs are valid

Figure 11.3 NCC Glazing Calculator – Ribbon Lobby Glazing

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014)

HELP

Building name/description: The Star - North Tower - Resi

Application: other

Climate zone: 5

Storey: Ground

Facade areas

	N	NE	E	SE	S	SW	W	NW	internal
Option A	28.7m²	29.1m²	31m²	39m²	73.1m²		112m²	47.8m²	
Option B									n/a
Glazing area (A)	*23.6m²*	*23.9m²*	*25.3m²*	*23.3m²*	*22.4m²*	.....	*83.6m²*	*37.4m²*	

Number of rows preferred in table below: 26 *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS									SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance		P&H or device		Shading		Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	P/H	G (m)	Heating (S_H)	Cooling (S_C)	Area used (m²)	Element share of % of allowance used
1	Apartment Lobby_S	S		3.95	2.54		6.2	0.79				0.00	1.00	1.00	10.03	45% of 68%
2											ROW SKIPPED (OK if intentional)					
3	Apartment Lobby_W	W		3.95	8.76		2.8	0.20				0.00	1.00	1.00	34.60	42% of 95%
4											ROW SKIPPED (OK if intentional)					
5	Apartment Loby_NW	NW		3.95	0.52		2.8	0.20	0.750	3.950	0.19	0.00	0.95	0.85	2.05	5% of 93%
6											ROW SKIPPED (OK if intentional)					
7	Apartment Lobby_N	N		3.95	0.75		2.8	0.20	device		2.00	0.00	0.00	0.19	2.96	
8											ROW SKIPPED (OK if intentional)					
9	Resi1_W	W		3.95	4.95		2.8	0.20	2.350	4.550	0.52	0.60	0.95	0.91	19.55	22% of 95%
10											ROW SKIPPED (OK if intentional)					
11	Resi1_NW	NW		3.95	5.32		2.8	0.20	1.840	4.550	0.40	0.60	0.99	0.93	21.01	55% of 93%
12											ROW SKIPPED (OK if intentional)					
13	Resi1_N	N		3.95	5.23		2.8	0.20	1.840	4.550	0.40	0.60	0.99	0.90	20.66	100% of 80%
14											ROW SKIPPED (OK if intentional)					
15	Resi1_NE	NE		3.95	6.06		2.9	0.25	4.840	4.550	1.06	0.60	0.87	0.65	23.94	100% of 97%
16											ROW SKIPPED (OK if intentional)					
17	Resi1_E	E		3.95	6.40		2.8	0.18	0.720	4.550	0.16	0.60	0.99	0.98	25.28	100% of 95%
18											ROW SKIPPED (OK if intentional)					
19	Resi1_S	S		3.95	3.14		6.2	0.79				0.00	1.00	1.00	12.40	55% of 68%
20											ROW SKIPPED (OK if intentional)					
21	Resi2_SE	SE		3.95	5.90		2.9	0.43				0.00	1.00	1.00	23.31	100% of 100%
22											ROW SKIPPED (OK if intentional)					
##	Resi2_W	W		3.95	7.46		2.8	0.20				0.00	1.00	1.00	29.47	36% of 95%
24											ROW SKIPPED (OK if intentional)					
##	Resi2_NW	NW		3.95	3.62		2.8	0.20				0.00	1.00	1.00	14.30	41% of 93%
26																

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Figure 11.4 NCC Glazing Calculator – Residential Lobby Glazing

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014)

HELP

Building name/description: The Star - North Tower - Resi

Application: other

Climate zone: 5

Storey: Level 01

Facade areas

	N	NE	E	SE	S	SW	W	NW	internal
Option A	39.1m²	39.1m²	42m²	19.9m²		20.1m²	33.6m²	39.6m²	
Option B									
Glazing area (A)	*31.7m²*	*31.4m²*	*34.1m²*	*2.63m²*	.....	*16.3m²*	*27.2m²*	*32.1m²*	

Number of rows preferred in table below: 14 *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS								SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance		P&H or device	Shading		Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	P/H	G (m)	Heating (S_w)	Cooling (S_c)	Area used (m²)	Element share of % of allowance used
1	Resi_SW	SW		3.65	4.46		2.9	0.25				0.00	1.00	1.00	16.28	100% of 97%
2											ROW SKIPPED (OK if intentional)					
3	Resi_W	W		3.65	7.46		2.8	0.18				0.00	1.00	1.00	27.23	100% of 97%
4											ROW SKIPPED (OK if intentional)					
5	Resi_NW	NW		3.65	8.80		2.8	0.18				0.00	1.00	1.00	32.12	100% of 91%
6											ROW SKIPPED (OK if intentional)					
7	Resi_N	N		3.65	8.69		2.8	0.18				0.00	1.00	1.00	31.72	100% of 91%
8											ROW SKIPPED (OK if intentional)					
9	Resi_NE	NE		3.65	8.60		1.4	0.15				0.00	1.00	1.00	31.39	100% of 95%
10											ROW SKIPPED (OK if intentional)					
11	Resi_E	E		3.65	9.33		2.8	0.18				0.00	1.00	1.00	34.05	100% of 96%
12											ROW SKIPPED (OK if intentional)					
13	Resi_SE	SE		3.65	0.72		6.2	0.79				0.00	1.00	1.00	2.63	100% of 44%
14																

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if inputs are valid

Figure 11.5 NCC Glazing Calculator – Level 1 Glazing

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014)

HELP

Building name/description: The Star - North Tower - Resi

Application: other

Climate zone: 5

Storey: Level 02

Facade areas

	N	NE	E	SE	S	SW	W	NW	internal
Option A	43.5m²	44.5m²	46.7m²	22.2m²		24.4m²	37.3m²	44m²	
Option B									
Glazing area (A)	*36.1m²*	*35.7m²*	*38.7m²*	*2.99m²*	.....	*18.5m²*	*31m²*	*36.5m²*	

Number of rows preferred in table below: 14 *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS								SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance		P&H or device	Shading		Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	P/H	G (m)	Heating (S_H)	Cooling (S_C)	Area used (m²)	Element share of % of allowance used
1	Resi_SW	SW		4.15	4.46		2.9	0.25				0.00	1.00	1.00	18.51	100% of 91%
2											ROW SKIPPED (OK if intentional)					
3	Resi_W	W		4.15	7.46		2.8	0.18				0.00	1.00	1.00	30.96	100% of 100%
4											ROW SKIPPED (OK if intentional)					
5	Resi_NW	NW		4.15	8.80		2.8	0.18				0.00	1.00	1.00	36.52	100% of 93%
6											ROW SKIPPED (OK if intentional)					
7	Resi_N	N		4.15	8.69		2.8	0.18				0.00	1.00	1.00	36.06	100% of 93%
8											ROW SKIPPED (OK if intentional)					
9	Resi_NE	NE		4.15	8.60		1.4	0.15				0.00	1.00	1.00	35.69	100% of 94%
10											ROW SKIPPED (OK if intentional)					
11	Resi_E	E		4.15	9.33		2.8	0.18				0.00	1.00	1.00	38.72	100% of 98%
12											ROW SKIPPED (OK if intentional)					
13	Resi_SE	SE		4.15	0.72		6.2	0.79				0.00	1.00	1.00	2.99	100% of 45%
14																

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if inputs are valid

Figure 11.6 NCC Glazing Calculator – Level 2 Glazing

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014)

HELP

Building name/description: The Star - North Tower - Resi

Application: other

Climate zone: 5

Storey: Level 03

Facade areas

	N	NE	E	SE	S	SW	W	NW	Internal
Option A	60.8m²	60.8m²	65.3m²	31m²		35.2m²	52.2m²	61.6m²	
Option B									
Glazing area (A)	*53.4m²*	*53.4m²*	*57.4m²*	*4.43m²*	.....	*27.4m²*	*45.9m²*	*54.1m²*	

Number of rows preferred in table below: 14 *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS								SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance		P&H or device	Shading		Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	P/H	G (m)	Heating (S_w)	Cooling (S_c)	Area used (m²)	Element share of % of allowance used
1	Resi_SW	SW		6.15	4.46		2.9	0.25				0.00	1.00	1.00	27.43	100% of 93%
2											ROW SKIPPED (OK if intentional)					
3	Resi_W	W		6.15	7.46		1.4	0.15				0.00	1.00	1.00	45.88	100% of 79%
4											ROW SKIPPED (OK if intentional)					
5	Resi_NW	NW		6.15	8.80		1.4	0.15				0.00	1.00	1.00	54.12	100% of 87%
6											ROW SKIPPED (OK if intentional)					
7	Resi_N	N		6.15	8.69		1.4	0.15				0.00	1.00	1.00	53.44	100% of 92%
8											ROW SKIPPED (OK if intentional)					
9	Resi_NE	NE		6.15	8.68		1.2	0.13				0.00	1.00	1.00	53.38	100% of 90%
10											ROW SKIPPED (OK if intentional)					
11	Resi_E	E		6.15	9.33		1.4	0.15				0.00	1.00	1.00	57.38	100% of 86%
12											ROW SKIPPED (OK if intentional)					
13	Resi_SE	SE		6.15	0.72		6.2	0.79				0.00	1.00	1.00	4.43	100% of 48%
14																

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if inputs are valid

Figure 11.7 NCC Glazing Calculator – Level 3 Glazing

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014)

HELP

Building name/description: **The Star - North Tower - Resi**

Application: **other**

Climate zone: **5**

Storey: **Level 05**

Facade areas

	N	NE	E	SE	S	SW	W	NW	internal
Option A	50m²	45.8m²	34.3m²				25.9m²	39.8m²	
Option B									
Glazing area (A)	*42.6m²*	*38.9m²*	*29.1m²*				*22.1m²*	*33.9m²*	

Number of rows preferred in table below: **10** *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS										SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance			P&H or device		Shading		Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)		P (m)	H (m)	P/H	G (m)	Heating (S_H)	Cooling (S_C)	Area used (m²)	Element share of % of allowance used
1	Resi_W	W		4.85	4.55		2.2	0.17					0.00	1.00	1.00	22.07	100% of 92%
2												ROW SKIPPED (OK if intentional)					
3	Resi_NW	NW		4.85	6.99		2.8	0.18					0.00	1.00	1.00	33.90	100% of 95%
4												ROW SKIPPED (OK if intentional)					
5	Resi_N	N		4.85	8.78		2.8	0.18					0.00	1.00	1.00	42.58	100% of 96%
6												ROW SKIPPED (OK if intentional)					
7	Resi_NE	NE		4.85	8.03		1.4	0.15					0.00	1.00	1.00	38.95	100% of 100%
8												ROW SKIPPED (OK if intentional)					
9	Resi_E	E		4.85	6.01		2.8	0.18					0.00	1.00	1.00	29.15	100% of 100%
10																	

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if inputs are valid

Figure 11.8 NCC Glazing Calculator – Level 5 Glazing

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014)

HELP

Building name/description: The Star - North Tower - Ribbon/Function & Business Centre

Application: other

Climate zone: 5

Storey: Level 07

Facade areas

	N	NE	E	SE	S	SW	W	NW	internal
Option A	114m²	684m²	532m²	129m²	164m²	552m²	365m²	168m²	
Option B									n/a
Glazing area (A)	*107m²*	*580m²*	*479m²*	*121m²*	*154m²*	*510m²*	*342m²*	*152m²*	

Number of rows preferred in table below: 46 *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS									SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance		P&H or device		Shading		Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	P/H	G (m)	Heating (S_H)	Cooling (S_C)	Area used (m²)	Element share of % of allowance used
1	Kitchen/BOH_SW	SW		6.75	2.47		2.8	0.20				0.00	1.00	1.00	16.67	4% of 93%
2											ROW SKIPPED (OK if intentional)					
3	Kitchen/BOH_W	W		6.75	20.71		2.8	0.20				0.00	1.00	1.00	######	51% of 98%
4											ROW SKIPPED (OK if intentional)					
5	Kitchen/BOH_NW	NW		6.75	19.57		2.8	0.18				0.00	1.00	1.00	######	92% of 96%
6											ROW SKIPPED (OK if intentional)					
7	Kitchen/BOH_N	N		6.75	2.59		2.8	0.20				0.00	1.00	1.00	17.48	20% of 97%
8											ROW SKIPPED (OK if intentional)					
9	Kitchen/BOH_S	S		6.75	16.46		2.9	0.25				0.00	1.00	1.00	######	73% of 100%
10											ROW SKIPPED (OK if intentional)					
11	Kitchen/BOH_E	E		6.75	3.23		2.9	0.25				0.00	1.00	1.00	21.80	7% of 99%
12											ROW SKIPPED (OK if intentional)					
13	Kitchen/BOH_SE	SE		6.75	2.99		2.2	0.17				0.00	1.00	1.00	20.18	18% of 86%
14											ROW SKIPPED (OK if intentional)					
15	Pre Function_NE	NE		6.75	33.90		2.8	0.20				0.00	1.00	1.00	######	60% of 84%
16	Pre Function_NE	NE		6.75	12.13		2.8	0.20	6.200	6.750	0.92	0.00	0.21	0.37	81.88	7% of 84%
17	Restaurant_NE	NE		6.75	37.83		2.8	0.20	4.360	6.750	0.65	0.00	0.59	0.51	######	31% of 84%
18	Bar_NE	NE		6.75	2.04		2.8	0.20	3.340	6.750	0.49	0.00	0.74	0.61	13.77	2% of 84%
19											ROW SKIPPED (OK if intentional)					
20	Restaurant_SE	SE		6.75	2.72		2.2	0.17	3.070	6.750	0.45	0.00	0.76	0.69	18.36	14% of 86%
21	Bar_SE	SE		6.75	2.07		2.2	0.17	9.780	6.750	1.45	0.00	0.47	0.38	13.97	9% of 86%
22	Bar/Restaurant_SE	SE		6.75	10.08		2.2	0.17				0.00	1.00	1.00	68.04	59% of 86%
23											ROW SKIPPED (OK if intentional)					
24	Restaurant_S	S		6.75	3.61		2.9	0.25	3.070	6.750	0.45	0.00	0.85	0.79	24.37	16% of 100%
25	Bar_S	S		6.75	2.76		2.9	0.25	5.750	6.750	0.85	0.00	0.76	0.67	18.63	12% of 100%
26											ROW SKIPPED (OK if intentional)					
27	Pre Function_E	E		6.75	24.28		2.9	0.25				0.00	1.00	1.00	######	51% of 99%
28	Restaurant_E	E		6.75	2.72		2.9	0.25	device		2.00	0.00	0.00	0.25	18.36	2% of 99%
29	Bar_E	E		6.75	40.68		2.9	0.25	6.230	6.750	0.92	0.00	0.30	0.45	######	40% of 99%
30											ROW SKIPPED (OK if intentional)					
31	Bar_SW	SW		6.75	31.51		2.8	0.20	4.740	6.750	0.70	0.00	0.70	0.60	######	39% of 93%
32	Bar/Restaurant_SW	SW		6.75	25.11		2.8	0.20				0.00	1.00	1.00	######	36% of 93%
33	Restaurant_SW	SW		6.75	2.04		2.8	0.20	3.540	6.750	0.52	0.00	0.77	0.68	13.77	3% of 93%
34											ROW SKIPPED (OK if intentional)					
35	Pre Function_N	N		6.75	0.51		2.8	0.20	6.200	6.750	0.92	0.00	0.12	0.31	3.44	1% of 97%
36	Bar_N	N		6.75	2.72		2.8	0.20	device		2.00	0.00	0.00	0.19	18.36	
37	Bar/Restaurant_N	N		6.75	10.08		2.8	0.20				0.00	1.00	1.00	68.04	79% of 97%
38											ROW SKIPPED (OK if intentional)					
39	Bar_NW	NW		6.75	2.92		2.8	0.18	3.070	6.750	0.45	0.00	0.81	0.63	19.71	8% of 96%
40											ROW SKIPPED (OK if intentional)					
41	Bar_W	W		6.75	2.72		2.8	0.20	3.220	6.750	0.48	0.00	0.75	0.67	18.36	5% of 98%
42	Restaurant_W	W		6.75	27.24		2.8	0.20	4.540	6.750	0.67	0.00	0.60	0.57	######	44% of 98%
43											ROW SKIPPED (OK if intentional)					
44	Prefunction/Restaurant_	SW		6.75	8.91		2.8	0.20	3.900	6.750	0.58	0.00	0.75	0.65	60.14	11% of 93%
45	Prefunction/Restaurant_	SW		6.75	5.50		2.8	0.20				0.00	1.00	1.00	37.13	8% of 93%

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if inputs are valid

Figure 11.9 NCC Glazing Calculator – Level 7 Ribbon Glazing

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014)

HELP

Building name/description: The Star – North Tower –Hotel Gym/Hotel Spa

Application: other

Climate zone: 5

Storey: Level 09

Facade areas

	N	NE	E	SE	S	SW	W	NW	internal
Option A	47m²	106m²	47m²		69m²	34m²	67m²	37m²	
Option B									n/a
Glazing area (Ai)	*40m²*	*90m²*	*40m²*	.....	*58m²*	*29m²*	*57m²*	*31m²*	

Number of rows preferred in table below: 28 *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS										SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element			Facing sector		Size			Performance		P&H or device		Shading		Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	P/H	G (m)	Heating (S_H)	Cooling (S_C)	Area used (m²)	Element share of % of allowance used
1	Hotel Gym_W	W		3.85		38.86	2.8	0.20	0.820	####	0.21	0.00	0.91	0.86	38.86	67% of 99%
2											ROW SKIPPED (OK if intentional)					
3	Hotel Gym_NW	NW		3.85		4.70	2.8	0.20	1.480	####	0.38	0.00	0.86	0.68	4.70	11% of 92%
4											ROW SKIPPED (OK if intentional)					
5	Hotel Gym_N	N		3.85		11.01	2.8	0.20	1.480	####	0.38	0.00	0.87	0.63	11.01	18% of 85%
6											ROW SKIPPED (OK if intentional)					
7	Hotel Gym_NE	NE		3.85		70.19	2.8	0.20	1.480	####	0.38	0.00	0.84	0.69	70.19	71% of 91%
8											ROW SKIPPED (OK if intentional)					
9	Hotel Gym_E	E		3.85		12.44	2.8	0.20	device		###	0.00	0.00	0.25	12.44	13% of 81%
10											ROW SKIPPED (OK if intentional)					
11	Hotel Gym_S	S		3.85		42.38	2.9	0.43	2.270	####	0.59	0.00	0.81	0.74	42.38	71% of 85%
12											ROW SKIPPED (OK if intentional)					
13	Hotel Gym_SW	SW		3.85		18.19	2.9	0.25	2.270	####	0.59	0.00	0.74	0.65	18.19	59% of 91%
14											ROW SKIPPED (OK if intentional)					
15	Hotel Spa_W	W		3.85		18.19	2.8	0.20	0.400	####	0.10	0.00	0.96	0.93	18.19	33% of 99%
16											ROW SKIPPED (OK if intentional)					
17	Hotel Spa_NW	NW		3.85		26.66	2.8	0.20	0.400	####	0.10	0.00	0.97	0.92	26.66	89% of 92%
18											ROW SKIPPED (OK if intentional)					
19	Hotel Spa_N	N		3.85		29.17	2.8	0.20	0.400	####	0.10	0.00	0.98	0.90	29.17	82% of 85%
20											ROW SKIPPED (OK if intentional)					
21	Hotel Spa_NE	NE		3.85		20.28	2.8	0.20	0.400	####	0.10	0.00	0.97	0.92	20.28	29% of 91%
22											ROW SKIPPED (OK if intentional)					
23	Hotel Spa_E	E		3.85		27.15	2.8	0.20	0.400	####	0.10	0.00	0.96	0.93	27.15	87% of 81%
24											ROW SKIPPED (OK if intentional)					
25	Hotel Spa_SW	SW		3.85		10.63	2.9	0.25				0.00	1.00	1.00	10.63	41% of 91%
26											ROW SKIPPED (OK if intentional)					
27	Hotel Spa_S	S		3.85		16.66	2.9	0.43				0.00	1.00	1.00	16.66	29% of 85%
28																

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if inputs are valid

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Figure 11.10 NCC Glazing Calculator – Level 9 Glazing – Hotel Gym/Spa

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014)

HELP

Building name/description: **The Star - North Tower - Resi/Gym**

Application: **other**

Climate zone: **5**

Storey: **Level 09**

Facade areas

	N	NE	E	SE	S	SW	W	NW	internal
Option A				27.8m²	26.7m²	53.5m²	11.9m²		
Option B									n/a
Glazing area (A)				*14.9m²*	*25.1m²*	*50.3m²*	*10.7m²*		

Number of rows preferred in table below: **8** *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS								SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance		P&H or device		Shading		Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	P/H	G (m)	Heating (S_H)	Cooling (S_C)	Area used (m²)	Element share of % of allowance used
1	Resi Gym_W	W		3.85	2.79		2.8	0.20	0.300	0.700	0.43	-3.15	0.78	0.70	10.74	100% of 89%
2											ROW SKIPPED (OK if intentional)					
3	Resi Gym_SW	SW		3.85	13.06		2.8	0.20	0.300	0.700	0.43	-3.15	0.82	0.73	50.28	100% of 91%
4											ROW SKIPPED (OK if intentional)					
5	Resi Gym_S	S		3.85	6.52		2.8	0.20	0.300	0.700	0.43	-3.15	0.86	0.80	25.10	100% of 97%
6											ROW SKIPPED (OK if intentional)					
7	Resi Gym_SE	SE		3.85	3.86		4.4	0.43	0.300	0.700	0.43	-3.15	0.77	0.70	14.86	100% of 96%
8																

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if inputs are valid

Figure 11.11 NCC Glazing Calculator – Level 9 Glazing – Resi Gym/Spa

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014)

HELP

Building name/description: **The Star - North Tower - Resi/Gym**

Application: **other**

Climate zone: **5**

Storey: **Level 10**

Facade areas

	N	NE	E	SE	S	SW	W	NW	internal
Option A				21.4m²	20.5m²	41.1m²	8.95m²		
Option B									
Glazing area (A)				*11.2m²*	*18.9m²*	*37.9m²*	*8.24m²*		

Number of rows preferred in table below: **8** *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS								SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance		P&H or device		Shading		Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	P/H	G (m)	Heating (S_H)	Cooling (S_C)	Area used (m²)	Element share of % of allowance used
1	Resi Gym_W	W		2.90	2.84		2.8	0.20	0.300	0.700	0.43	-2.20	0.78	0.70	8.24	100% of 91%
2											ROW SKIPPED (OK if intentional)					
3	Resi Gym_SW	SW		2.90	13.06		2.8	0.20	0.300	0.700	0.43	-2.20	0.82	0.73	37.87	100% of 90%
4											ROW SKIPPED (OK if intentional)					
5	Resi Gym_S	S		2.90	6.52		2.8	0.20	0.300	0.700	0.43	-2.20	0.86	0.80	18.91	100% of 96%
6											ROW SKIPPED (OK if intentional)					
7	Resi Gym_SE	SE		2.90	3.86		4.4	0.43	0.300	0.700	0.43	-2.20	0.77	0.70	11.19	100% of 94%
8																

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if inputs are valid

Figure 11.12 NCC Glazing Calculator – Level 10 Glazing

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014)

HELP

Building name/description: **The Star - North Tower - Hotel BOH**

Application: **other**

Climate zone: **5**

Storey: **Level 39**

Facade areas

	N	NE	E	SE	S	SW	W	NW	internal
Option A			35.8m²	42.3m²	45m²	41.4m²	77.1m²		
Option B									n/a
Glazing area (A)			*30.4m²*	*36m²*	*38.3m²*	*35.2m²*	*65.5m²*		

Number of rows preferred in table below: **10** *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS								SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance		P&H or device		Shading		Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	P/H	G (m)	Heating (S_H)	Cooling (S_C)	Area used (m²)	Element share of % of allowance used
1	Hotel BOH_SW	SW		4.45		35.21	2.8	0.20				0.00	1.00	1.00	35.21	100% of 93%
2											ROW SKIPPED (OK if intentional)					
3	Hotel BOH_W	W		4.45		65.52	2.2	0.17				0.00	1.00	1.00	65.52	100% of 92%
4											ROW SKIPPED (OK if intentional)					
5	Hotel BOH_E	E		4.45		30.44	2.8	0.18				0.00	1.00	1.00	30.44	100% of 100%
6											ROW SKIPPED (OK if intentional)					
7	Hotel BOH_SE	SE		4.45		35.99	2.8	0.18				0.00	1.00	1.00	35.99	100% of 98%
8											ROW SKIPPED (OK if intentional)					
9	Hotel BOH_S	S		4.45		38.27	2.9	0.25				0.00	1.00	1.00	38.27	100% of 92%
10																

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if inputs are valid

Figure 11.13 NCC Glazing Calculator – Level 39 Glazing

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014)

HELP

Building name/description: The Star - North Tower - Sky Lobby(Hotel)

Application: other

Climate zone: 5

Storey: Level 40

Facade areas

	N	NE	E	SE	S	SW	W	NW	internal
Option A	68m²	87.3m²	179m²	38.7m²	23.1m²	10.1m²	151m²	74.8m²	
Option B									
Glazing area (A)	*57.8m²*	*74.2m²*	*152m²*	*32.9m²*	*19.7m²*	*8.6m²*	*128m²*	*63.6m²*	

Number of rows preferred in table below: 25 *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS								SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance			P&H or device		Shading	Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)		P (m)	H (m)	P/H	G (m)	Heating (S_H)	Cooling (S_C)	Area used (m²)	Element share of % of allowance used
1	Office/Servery_SW	SW		3.65		8.60	2.8	0.20					0.00	1.00	1.00	8.60	100% of 93%
2												ROW SKIPPED (OK if intentional)					
3												ROW SKIPPED (OK if intentional)					
4	Office/Servery/Lounge_	W		3.65		58.72	2.2	0.17					0.00	1.00	1.00	58.72	46% of 92%
5	Office/Lounge_W	W		7.75		69.77	2.2	0.17					0.00	1.00	1.00	69.77	54% of 92%
6												ROW SKIPPED (OK if intentional)					
7	Lounge_NW	NW		7.75		63.58	2.8	0.18					0.00	1.00	1.00	63.58	100% of 95%
8												ROW SKIPPED (OK if intentional)					
9	Lounge_N	N		7.75		57.80	2.8	0.18					0.00	1.00	1.00	57.80	100% of 96%
10												ROW SKIPPED (OK if intentional)					
11	Lounge_NE	NE		3.65		10.64	1.4	0.15					0.00	1.00	1.00	10.64	14% of 100%
12	Lounge_NE	NE		7.75		63.58	1.4	0.15					0.00	1.00	1.00	63.58	86% of 100%
13												ROW SKIPPED (OK if intentional)					
14	Lounge/Bar_E	E		3.65		58.79	2.8	0.18					0.00	1.00	1.00	58.79	39% of 100%
15	Lounge/Bar_E	E		7.75		93.43	2.8	0.18					0.00	1.00	1.00	93.43	61% of 100%
16												ROW SKIPPED (OK if intentional)					
17	Bar_SE	SE		3.65		32.91	2.8	0.18					0.00	1.00	1.00	32.91	100% of 98%
18												ROW SKIPPED (OK if intentional)					
19	Bar_S	S		3.65		19.65	2.9	0.25					0.00	1.00	1.00	19.65	100% of 92%
20																	
21																	
22																	
23																	
24																	
25																	

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if inputs are valid

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Figure 11.14 NCC Glazing Calculator – Level 40 Glazing

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014)

HELP

Building name/description: The Star - North Tower - Sky Lobby-Mezz (Hotel)

Application: other

Climate zone: 6

Storey: Level 41

Facade areas

	N	NE	E	SE	S	SW	W	NW	internal
Option A		11.9m²	72.6m²	32.3m²	7.4m²	75.2m²	78.6m²		
Option B									
Glazing area (A)		*10.1m²*	*61.7m²*	*27.4m²*	*6.29m²*	*64m²*	*66.8m²*		

Number of rows preferred in table below: 15 *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS								SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance		P&H or device	Shading		Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	P/H	G (m)	Heating (S_H)	Cooling (S_C)	Area used (m²)	Element share of % of allowance used
1	Office/Servery_SW	SW		3.65		63.95	1.0	0.10				0.00	1.00	1.00	63.95	100% of 78%
2											ROW SKIPPED (OK if intentional)					
3											ROW SKIPPED (OK if intentional)					
4	Office/Servery/Lounge_W	W		3.65		66.81	1.3	0.10				0.00	1.00	1.00	66.81	100% of 93%
5											ROW SKIPPED (OK if intentional)					
6	Lounge_NE	NE		3.65		10.10	5.0	0.10				0.00	1.00	1.00	10.10	100% of 58%
7											ROW SKIPPED (OK if intentional)					
8											ROW SKIPPED (OK if intentional)					
9	Lounge/Bar_E	E		3.65		61.71	1.7	0.10				0.00	1.00	1.00	61.71	100% of 96%
10											ROW SKIPPED (OK if intentional)					
11											ROW SKIPPED (OK if intentional)					
12	Bar_SE	SE		3.65		27.44	1.0	0.10				0.00	1.00	1.00	27.44	100% of 80%
13											ROW SKIPPED (OK if intentional)					
14	Bar_S	S		3.65		6.29	1.7	0.70				0.00	1.00	1.00	6.29	
15																

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if inputs are valid

Figure 11.15 NCC Glazing Calculator – Level 41 Glazing

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014)

HELP

Building name/description: The Star - North Tower - Typical Hotel Plan

Application: other

Climate zone: 5

Storey: Level 58

Facade areas

	N	NE	E	SE	S	SW	W	NW	internal
Option A	22.9m²	24.8m²	101m²	8.26m²	26.8m²	10.6m²	58m²	13.6m²	
Option B									
Glazing area (A)	*19.4m²*	*21.1m²*	*86.1m²*	*7.02m²*	*22.8m²*	*9.03m²*	*49.3m²*	*11.6m²*	

Number of rows preferred in table below: 16 *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS								SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance		P&H or device	Shading		Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	P/H	G (m)	Heating (S_w)	Cooling (S_c)	Area used (m²)	Element share of % of allowance used
1	Typical_SW	SW		2.95		9.03	2.8	0.20				0.00	1.00	1.00	9.03	100% of 93%
2											ROW SKIPPED (OK if intentional)					
3	Typical_W	W		2.95		49.29	2.2	0.17				0.00	1.00	1.00	49.29	100% of 92%
4											ROW SKIPPED (OK if intentional)					
5	Typical_NE	NE		2.95		21.05	1.4	0.15				0.00	1.00	1.00	21.05	100% of 100%
6											ROW SKIPPED (OK if intentional)					
7	Typical_E	E		2.95		86.14	2.8	0.18				0.00	1.00	1.00	86.14	100% of 100%
8											ROW SKIPPED (OK if intentional)					
9	Typical_SE	SE		2.95		7.02	2.8	0.18				0.00	1.00	1.00	7.02	100% of 98%
10											ROW SKIPPED (OK if intentional)					
11	Typical_N	N		2.95		19.45	2.8	0.18				0.00	1.00	1.00	19.45	100% of 96%
12											ROW SKIPPED (OK if intentional)					
13	Typical_NW	NW		2.95		11.56	2.8	0.18				0.00	1.00	1.00	11.56	100% of 95%
14											ROW SKIPPED (OK if intentional)					
15	Typical_S	S		2.95		22.79	2.9	0.25				0.00	1.00	1.00	22.79	100% of 92%
16																

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if inputs are valid

Figure 11.16 NCC Glazing Calculator – Level 58 Glazing – Representative Hotel Floor

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014)

HELP

Building name/description: The Star - North Tower - Club Lounge

Application: other

Climate zone: 5

Storey: Level 59

Facade areas

	N	NE	E	SE	S	SW	W	NW	Internal
Option A	47.1m²	41.3m²	83.7m²	42.2m²	21.3m²	8.16m²	33.4m²	41.8m²	
Option B									
Glazing area (A)	*40.8m²*	*35.7m²*	*72.3m²*	*36.5m²*	*18.4m²*	*7.06m²*	*28.8m²*	*36.1m²*	

Number of rows preferred in table below: 16 *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS								SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance		P&H or device	Shading		Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	P/H	G (m)	Heating (S_w)	Cooling (S_c)	Area used (m²)	Element share of % of allowance used
1	Library_SW	SW		4.15	1.70		2.8	0.20				0.00	1.00	1.00	7.06	100% of 94%
2											ROW SKIPPED (OK if intentional)					
3	Library_W	W		4.15	6.95		2.2	0.17				0.00	1.00	1.00	28.84	100% of 94%
4											ROW SKIPPED (OK if intentional)					
5	Bar_NE	NE		4.15	8.61		1.2	0.13				0.00	1.00	1.00	35.73	100% of 88%
6											ROW SKIPPED (OK if intentional)					
7	Dining_E	E		4.15	17.43		2.2	0.17				0.00	1.00	1.00	72.33	100% of 96%
8											ROW SKIPPED (OK if intentional)					
9	Dining_SE	SE		4.15	8.80		2.8	0.18				0.00	1.00	1.00	36.52	100% of 100%
10											ROW SKIPPED (OK if intentional)					
11	Bar_N	N		4.15	9.82		2.8	0.18				0.00	1.00	1.00	40.75	100% of 97%
12											ROW SKIPPED (OK if intentional)					
13	Library/Bar_NW	NW		4.15	8.71		2.8	0.18				0.00	1.00	1.00	36.15	100% of 97%
14											ROW SKIPPED (OK if intentional)					
15	Dining_S	S		4.15	4.44		2.9	0.25				0.00	1.00	1.00	18.43	100% of 93%
16																

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if inputs are valid

Figure 11.17 NCC Glazing Calculator – Level 59 Glazing

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014)

HELP

Building name/description: The Star - North Tower - Sky Villas

Application: other

Climate zone: 5

Storey: Level 60

Facade areas

	N	NE	E	SE	S	SW	W	NW	Internal
Option A	26.1m²	29.6m²	53.9m²	28.2m²	7.58m²		28.3m²	30.6m²	
Option B									
Glazing area (A)	*22.2m²*	*25.1m²*	*45.8m²*	*23.9m²*	*6.44m²*	.....	*24m²*	*26m²*	

Number of rows preferred in table below: 14 *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS								SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance		P&H or device	Shading		Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	P/H	G (m)	Heating (S_H)	Cooling (S_C)	Area used (m²)	Element share of % of allowance used
1	PSuite_SW	S		2.95		6.44	2.9	0.25				0.00	1.00	1.00	6.44	100% of 92%
2											ROW SKIPPED (OK if intentional)					
3	PSuite_W	W		2.95		24.04	2.2	0.17				0.00	1.00	1.00	24.04	100% of 92%
4											ROW SKIPPED (OK if intentional)					
5	PSuite_W	NE		2.95		25.13	1.4	0.15				0.00	1.00	1.00	25.13	100% of 100%
6											ROW SKIPPED (OK if intentional)					
7	Suite A_E	E		2.95		45.80	2.2	0.17				0.00	1.00	1.00	45.80	100% of 95%
8											ROW SKIPPED (OK if intentional)					
9	Suite A_SE	SE		2.95		23.90	2.8	0.18				0.00	1.00	1.00	23.90	100% of 98%
10											ROW SKIPPED (OK if intentional)					
11	PSuite_N	N		2.95		22.16	2.8	0.18				0.00	1.00	1.00	22.16	100% of 96%
12											ROW SKIPPED (OK if intentional)					
13	PSuite_NW	NW		2.95		26.03	2.8	0.18				0.00	1.00	1.00	26.03	100% of 95%
14																

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if inputs are valid

Figure 11.18 NCC Glazing Calculator – Level 60 Glazing