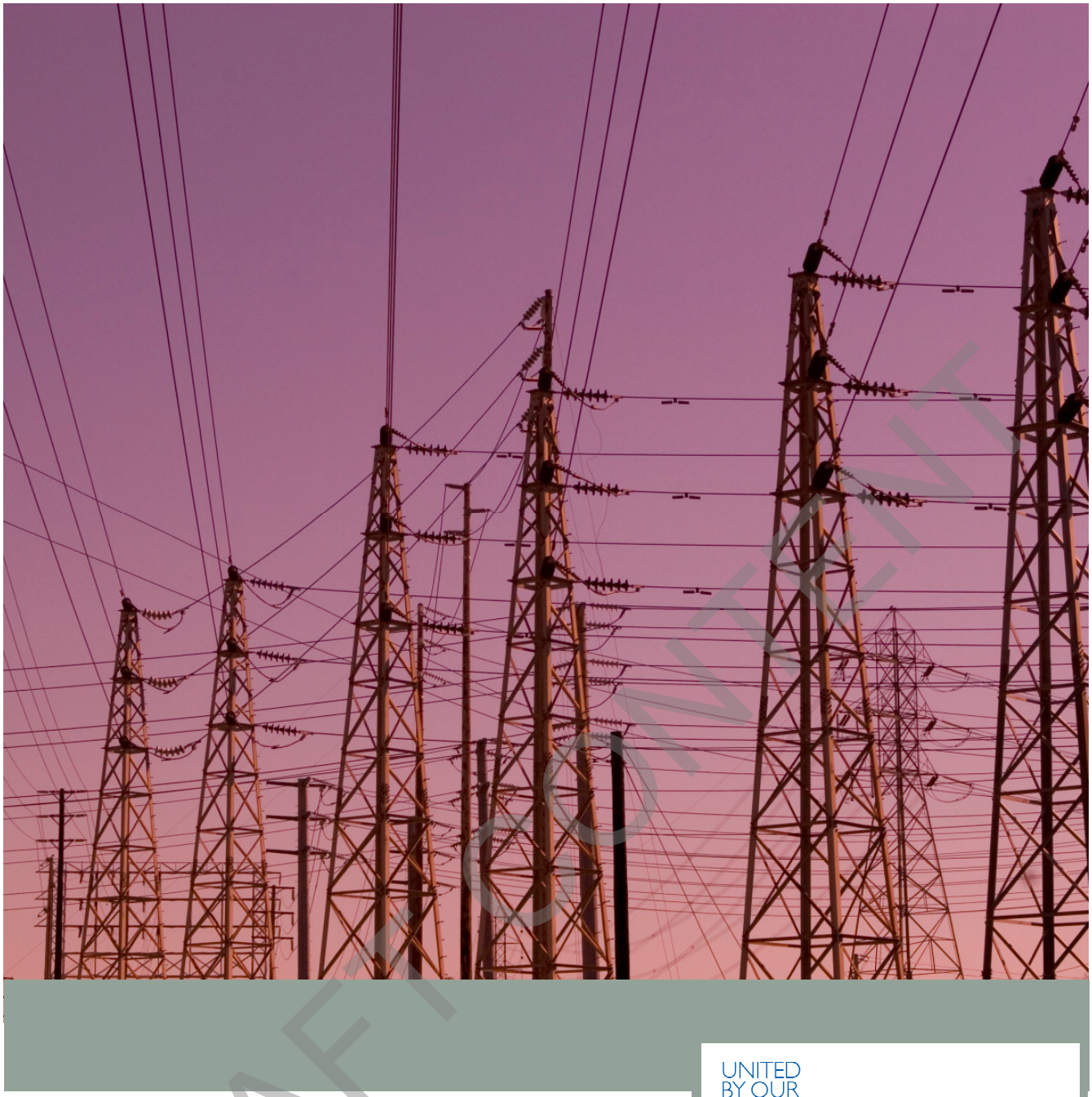

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Green Star - Design and As Built

NERGY CATEGORY
SCUSSION AND
ESEARCH PAPER

4/2014

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Energy Category Discussion and Research Paper

23/04/2014

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Executive Summary

Background

This Discussion Paper presents an overview of the development of the proposed revised Energy Consumption and Greenhouse Gas Emissions Reduction and Peak Electricity Demand Reduction credits which will form part of the Green Star Design and As Built rating tool to be launched in 2014. This paper presents the key issues reviewed in development of the revised credits, including feedback from stakeholders and the consultation undertaking by GBCA with industry representatives through the various working groups.

The development of the revised credits has been completed by a consortium of consultants comprising Norman Disney & Young (lead consultant), WSP and Aurecon.

Energy Category

The scope of the current credit development work encapsulates both of the following credits:

- Energy consumption and greenhouse gas emissions reduction; and
- Peak electricity demand reduction.

It is proposed that all other existing Energy category credits are either removed or are incorporated into the scope of the new greenhouse gas emissions reduction credit.

Energy Consumption and Greenhouse Gas Emissions Reduction Credit

The revised credit comprises three compliance pathways:

- Deemed-to-Satisfy;
- Existing Frameworks; and
- Reference Building.

The intent of this structure is to provide projects with the optimal flexibility to demonstrate energy performance:

- Without the necessity of energy modelling;
- Taking account of alternative frameworks which are recognised by the industry;
- While still strongly advocating and supporting a performance approach to energy.

A deemed-to-satisfy option was strongly supported by industry and has been implemented based on demonstration of performance improvement relative to the deemed-to-satisfy provisions of NCC Section J.

Existing frameworks recognised by the credit are NABERS (Class 5 parts of buildings only) and NatHERS (Class 2 and associated parts of buildings only). Owing to the scope of these assessment methods being less than the nominal energy coverage required by the credit, additional deemed-to-satisfy type criteria are incorporated to address those elements otherwise excluded.

The detailed, modelled approach to energy has been retained, with only the Reference Building pathway being rewarded with full points. The credit structure makes allowance for rewarding passive design initiatives which reduce energy demand independently of the energy source; and for rewarding improved building services efficiency which reduces the total GHG emissions, and energy supply initiatives which reduce the carbon intensity of the energy supply. On-site renewable energy has also been supported, with a double benefit accruing from renewable energy produced on-site.

A 10% improvement on the building code has been selected as the benchmark for rewarding performance – this has been applied uniformly across the various compliance pathways.

For Class 2 buildings (multi-unit residential), the building code does not include a JV3 equivalent as the NatHERS requirement is a performance calculation of sorts. To provide a pathway that is consistent for all buildings, the Reference Building pathway can be used for Class 2 buildings, applying the process as though they were a Class 3 building (e.g. a hotel).

The applicability of the compliance pathways to buildings of different classifications is summarised as follows:

Pathway	Class 2	Class 3	Class 5	Class 6	Class 7	Class 8	Class 9
DTS	×	✓	✓	✓	✓	✓	✓
Existing framework	✓ (NatHERS, plus specification items)	×	✓ (NABERS, plus office lighting efficiency)	×	×	×	×
Reference building	✓ (reference building based on Class 3)	✓	✓	✓	✓	✓	✓

Peak Electricity Demand Reduction Credit

The proposed structure for the peak electricity demand reduction credit follows the same form as for the Energy/GHG emissions credit with multiple compliance pathways:

- Deemed to satisfy
- Performance approaches

The deemed-to-satisfy approach is based on the provision of a minimum on-site generation capacity as a proportion of the maximum demand load, with the proviso that it must generate to its maximum available capacity at all times (i.e. not load lopping or controlled to only run at peak times).

The performance approach is aligned with the Reference Building Pathway approach to the energy/GHG reduction credit, rewarding the peak electrical demand reduction of the Proposed Building compared to the Reference Building.

The applicability of the compliance pathways to buildings of different classifications is summarised as follows:

Pathway	Class 2	Class 3	Class 5	Class 6	Class 7	Class 8	Class 9
DTS	✓	✓	✓	✓	✓	✓	✓
Reference building	✓ (reference building based on Class 3)	✓	✓	✓	✓	✓	✓

Mixed-Use Assessment

For buildings which comprise of multiple uses (as identified by multiple classifications in accordance with the NCC), the project may be rated by application of different pathways to different parts of the building.

For Class 3 to 9 parts of a building, these may be assessed collectively using either the DTS or performance-based assessment method, or assessed in multiple separate components using a combination of the DTS, existing framework (where applicable), and reference building assessment methods.

Class 2 parts of the building may be assessed independently using the existing framework (NatHERS), or included in the reference building assessment method with other non-Class 2 uses.

Where buildings use different pathways for different uses, the assessment of mixed use buildings is based on an area-weighted calculation of points achieved within each assessment method. Owing to the many possible combinations of assessment methods that could be applied to a building, and the use of different metrics within each pathway, the assessment can only be applied based on points achieved, not on weighted energy intensity, energy consumption or greenhouse gas emissions.

Shared Services

Assessment of the contribution of shared services to the reduction of a building's greenhouse gas emissions is included within the reference building compliance pathway, and to the extent allowable by the NABERS Energy guidelines when using the Existing Framework pathway. In this context, shared services relate to any energy supply other than the grid electricity and gas supplies typically provided to buildings, and include: shared thermal systems, cogeneration, tri-generation, district renewable energy, green power and any other alternative generation approaches.

Although a divisive issue, we have included in this approach the use of accredited GreenPower, as we consider there to be no difference in the principle of accepting the benefit of low-carbon energy from a local embedded generator, and from a grid-connected renewable energy generation system. In both cases the claim is substantiated on the basis of a supply contract only; there is no physical demarcation as with a building-integrated energy system.

The approach will be to identify the utility inputs (including renewable energy sources, grid energy, fuel and its intended operating conditions) and the utility outputs (including electricity, fuel and thermal energy (heating and chilled water)) applicable to the shared service. From this information, the GHG emissions attributable to each of the energy streams can be assessed and applied to the input energy to each building connected to the service.

It will be a requirement of the rating assessment process that the contractual parties are clearly identified, including the building seeking certification and the utility provider at a minimum.

Emissions may be calculated on the basis of:

- Emissions for co- and tri-generation systems should be defined in line with the recommendations of the Energy Efficiency Council Emissions Allocation Protocol; OR
- Energy stream calculated on the basis of the total carbon intensity of the utility (combined GHG emissions) pro-rated to the energy streams based on the proportion of the total primary energy that they represent during 'typical' operational conditions.

Shared services are not considered eligible for points under the Peak Electricity Demand Reduction credit as load displaced to a shared utility is another form of infrastructure.

Points Allocation

The proposed distribution of points within the category and between compliance pathways is summarised as follows. The absolute number of points is not specified since this is the subject of review by the GBCA in line with the proposed removal of category weightings from Green Star.

Pathway	Energy and Greenhouse Gas Reduction			Peak Electricity Demand Reduction
	Energy	GHG	Renewable	
DTS (Class 2 to 9 buildings)	NA			1 point
DTS (Class 3 to 9 only)	1 point per item achieved		NA	NA
NatHERS (Class 2 only)	45% [50%]		(SHW in main calculation only)	NA
NABERS Energy (Class 5 only)	54% [60%] (with adjustment for GFA)		In main calculation only	NA
All Performance (Class 2 to 9)	18% [20%] (benchmarked between 100% and 75% of NCC reference)	72% [80%] (benchmarked between 90% and 0% of NCC reference)	+9% [+10%] (SHW in main calculation only)	10% [100%] (benchmarked between 90% and 70% of NCC reference)

Note that in the above tables percentage values represent the proportion of the total points available for the Energy category which are available to be awarded by the respective pathway for the respective component of the credit. Values in brackets indicate the proportion of points for the individual credit.

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1 Introduction

1.1 Purpose

As part of the Green Star 2014 project, all existing Design and As Built rating tools (Office v3, Multi-Unit Residential v1, Healthcare v1, Industrial v1, Retail Centre v1, Education v1 and Public Buildings v1) are being rationalised into a single rating tool that will be applicable to all building types, including mixed-use projects: Green Star Design & As-Built.

The Energy category, and principally the Greenhouse Gas Emissions Reduction credit (also referenced as the Energy Improvement credit in Office v3), has been the subject of a detailed peer review by WSP, on the basis of which major recommendations have been made regarding the structure and scope of the category credits. This current projects expands on and develops the work previously completed by WSP based on further guidance from the GBCA, and consultation feedback and comment from industry.

This discussion paper captures the various recommendations, comments and issues raised in the primary reference material provided to us by the GBCA, and those items raised and discussed within the project team during the course of developing the new credit documentation.

This paper captures the key points raised by others, and for each records the various responses from within the project team and the action taken in response to the issue raised. In some cases, potential future actions are also discussed where it is considered that there is further value to be derived but current knowledge or scope does not allow appropriate action to be taken at this time.

1.2 Project Team

This credit development project has been undertaken by Norman Disney & Young in collaboration with WSP and Aurecon.

- Team Leader: Richard Jelbert (NDY)
- NDY Support: Chris Nunn
- Aurecon Lead: Quentin Jackson
- Aurecon Support: Ben Gibbs and Digby Hall
- WSP Lead: Richard Palmer
- WSP Support: Patrick Campbell

1.3 Information Sources

The following information sources have been used in preparing this report, and the associated credit deliverables:

- Green Building Council of Australia
  - Green Star Design and As Built Feedback Report (21st January 2014)
  - Green Star Public Building v1 Energy Category credits (Ene – Conditional Requirement, Ene-0 Introduction, Ene-1 Greenhouse Gas Emissions and Ene-3 Peak Energy Demand Reduction)
  - Green Star Public Building v1 calculators and Greenhouse Gas Emissions Calculator Guide
  - Green Star Performance Pilot Ene-2 Peak Electricity Demand credit documents (Credit Text, Calculator Guide and Calculator)
  - Green Star Design and As Built Ene Greenhouse Gas Emissions v0 draft credit text

- Green Star Recurring Energy, GHG Emission Credit Issues (20th August 2013)
- Greenhouse Gas Emission Credit Consultation Responses (7th February 2014)

- WSP
  - Green Star Design and As Built Energy Category Review (Final, 2nd December 2013)
- Energy Efficiency Council
  - CHP Best Practice and Emissions Protocol
- Additional Research: refer to Section 9 for references

2 Category Structure Summary

2.1 Introduction

In line with the recommendation of the Peer Review report and the endorsement of the TAG, the scope of the current credit development work encapsulates both of the following credits:

- ENE-1: Greenhouse gas emissions reduction; and
- ENE-2: Peak electricity demand reduction.

It is proposed that all other existing Energy category credits are either removed or are incorporated into the scope of the new greenhouse gas emissions reduction credit.

2.2 ENE-1: Proposed Credit Structure

The credit structure for GHG Emissions and Energy has been based on the recommendations of the peer review report and the endorsement of the TAG.

It comprises three compliance pathways:

- Deemed-to-Satisfy;
- Existing Frameworks; and
- Reference Building.

The intent of this structure is to provide projects with the optimal flexibility to demonstrate energy performance:

- Without the necessity of energy modelling;
- Taking account of alternative frameworks which are recognised by the industry;
- While still strongly advocating and supporting a performance approach to energy.

Feedback from the TAG supported the specific rewarding of passive design separately from building services to redress a perceived perverse outcome against passive design optimisation. The consultant team have considered two models for embedding the building fabric performance:

- Ring-fence passive demand benefits from building services benefits
- Include passive design performance within the minimum requirements for the credit.

Furthermore, the TAG responses were divided on the question of making allowance for the procurement of low-carbon energy. The proposed approach to shared services (discussed in detail in later sections) supports the inclusion of energy contracting in order to take a utility approach to shared services.

The credit structure makes allowance for rewarding passive design initiatives which reduce energy demand independently of the energy source; and for rewarding improved building services efficiency which reduces the total GHG emissions, and energy supply initiatives which reduce the carbon intensity of the energy supply. On-site renewable energy has also been supported, with a double benefit accruing from renewable energy produced on-site.

Also in accordance with the feedback from the TAG, a 10% improvement on the building code has been selected as the benchmark for rewarding performance – this has been applied uniformly across the various compliance pathways.

The continued support of a detailed, modelled approach to energy has been retained, with only the Reference Building pathway being rewarded with full points (endorsed by the TAG).

For Class 2 buildings (multi-unit residential), the building code does not include a JV-3 equivalent as the NatHERS requirement is a performance calculation of sorts. To provide a pathway that is consistent for all buildings, the Reference Building pathway **can** be used for class two buildings, using the process as though they were class 3 (hotels).

2.3 ENE-2: Proposed Credit Structure

The proposed structure for the peak electricity demand reduction credit follows the same form as for the Energy/GHG emissions credit with multiple compliance pathways:

- Deemed to satisfy
- Performance approaches

The deemed-to-satisfy approach is based on the provision of a minimum on-site generation capacity as a proportion of the maximum demand load, with the proviso that it must generate to its maximum available capacity at all times (i.e. not load lopping or controlled to only run at peak times).

The performance approach is aligned with the Reference Building Pathway approach to ENE-1, rewarding the peak improvement of the Proposed Building compared to the Reference Building.

2.4 Energy and GHG Emissions

The TAG has supported the separate approach to energy efficiency and GHG emissions to encourage passive design. This approach is embedded within the current JV-3 structure within the BCA Section J and is only applicable to the Reference Building compliance pathway.

In line with feedback from the TAG, a 10% improvement on the BCA Section J has been applied throughout the credit as the minimum compliance threshold and baseline for rewarding performance.

The ENE-1 credit has been based on the following definitions:

- Reference Building = reference building envelope/reference services
- Benchmark Building = 10% improvement on Reference Building (energy and GHG)
- Intermediate Building = design building envelope/reference services
- Proposed Building = design building envelope/design services/project GHG emission factor

The assessment of performance under the comparing these four building assessments is noted below:

Step 1: Conditional Requirement

The conditional requirement is that the Proposed Building is better than the Benchmark Building on the basis of GHG emissions only.

Step 2: Passive Design Assessment

The credit assesses energy demand performance of the *Intermediate Building* relative to the *Reference Building*.

This step is assessed against 20% of the available points (i.e. 20% of the points can only be achieved by demonstrating an improvement independent of building services or utility supply).

Step 3: Systems and Grid Assessment

The credit assesses the overall GHG emissions by comparing the *Proposed Building* to the *Benchmark Building*.

This step is assessed against 80% of the available points (i.e. 80% of the points can be achieved by demonstrating an improvement in the effective GHG emissions compared to a reference building). Where onsite renewable energy contributes to the building performance, the benefit from onsite renewable sources is rewarded with double points.

2.5 Mixed Assessment

For buildings which comprise of multiple uses (as identified by multiple classifications in accordance with the NCC), the project team is required to select the assessment pathway that will be applied to each part.

For Class 3 to 9 parts of a building, these may be assessed collectively using either the DTS or performance-based assessment method, or assessed in multiple separate components using a combination of the DTS, existing framework (where applicable), and performance-based assessment methods.

Class 2 parts of the building may be assessed independently using the applicable DTS method, or included in the performance-based assessment method with other non-Class 2 uses.

Where buildings use different pathways for different uses, the assessment of mixed use buildings is based on an area-weighted calculation of points achieved within each assessment method

Owing to the many possible combinations of assessment methods that could be applied to a building, and the use of different metrics within each pathway, the assessment, not on weighted energy consumption or greenhouse gas emissions.

Within the performance-based assessment method, no distinction is made between different parts of the building having different energy intensities; ultimately, the rating tool assesses the building as a single entity and that building is responsible for a fixed quantity of greenhouse gas emissions (according to the stated modelling protocol) irrespective of how these are distributed over the site.

2.6 Shared Services

The assessment of the benefit of shared utilities will be addressed in "Step 3: The Systems and Grid Assessment" of the credit by developing a project-specific GHG co-efficient for the building demand met by the utility.

Shared services relate to any energy supply other than the grid electricity and gas supplies typically provided to buildings, including: shared thermal systems, cogeneration, tri-generation, district renewable energy, green power and any other alternative generation approaches.

The approach will be to identify the utility inputs (including renewable energy sources, grid energy, fuel and its intended operating conditions) and the utility outputs (including electricity, fuel and thermal energy - hot an chilled water. This will allow the GHG emissions to be for each of the energy streams to be assessed.

The contractual parties must be clearly identified, including the building seeking certification and the utility provider at a minimum.

Emissions will be calculated on the basis of:

- Emissions for co- and tri-generation systems should be defined in line with the recommendations of the Energy Efficiency Council Emissions Allocation Protocol; OR
- Energy stream calculated on the basis of the total carbon intensity of the utility (combined GHG emissions) pro-rated to the energy streams based on the proportion of the total primary energy that they represent during 'typical' operational conditions.

Apply the energy stream GHG Emissions Factors to the energy of the Proposed Building in the Energy Calculator:

- Electricity (blended rate of the grid, renewable energy and low-carbon energy supply): $kgCO_2e/kWh$
- Gas (natural gas factor): $kgCO_2e/MJ$
- Chilled Water: $kgCO_2e/MJ_{thermal}$
- Heating Hot Water: $kgCO_2e/MJ_{thermal}$
- Domestic Hot Water: $kgCO_2e/MJ_{thermal}$

Shared services are not considered eligible for points under the ENE-2: Peak Electricity Demand Reduction as load displaced to shared utility is another form of infrastructure.

3 Points Allocation

3.1 Summary

The proposed distribution of points within the category and between compliance pathways is summarised as follows. The absolute number of points is not specified since this is the subject of review by the GBCA in line with the proposed removal of category weightings from Green Star.

Pathway	Ene-1: Energy and Greenhouse Gas Reduction			Ene-2: Peak Electricity Demand Reduction
	Energy	GHG	Renewable	
DTS (Class 2 to 9 buildings)	NA			1 point
DTS (Class 3 to 9 only)	1 point per item achieved		NA	NA
NatHERS (Class 2 only)	45% [50%]		(SHW in main calculation only)	NA
NABERS Energy (Class 5 only)	54% [60%] (with adjustment for GFA)		In main calculation only	NA
All Performance (Class 2 to 9)	18% [20%] (benchmarked between 100% and 75% of NCC reference)	72% [80%] (benchmarked between 90% and 0% of NCC reference)	+9% [+10%] (SHW in main calculation only)	10% [100%] (benchmarked between 90% and 70% of NCC reference)

Note that in the above tables percentage values represent the proportion of the total points available for the Energy category which are available to be awarded by the respective pathway for the respective component of the credit. Values in brackets indicate the proportion of points for the individual credit.

Derivation of the above values is discussed in the following sections.

3.2 Points Graduation

In all cases it is proposed to use a continuous scale of point award, rather than the current system of incremental thresholds. For this reason, where pathways adopt star-rating systems as the basis of assessment, all calculations will be based on the base metric rather than the star score, i.e. MJ/m² for NatHERS and kgCO_2e for NABERS. (Note that this also avoids the issue with buildings which exceed the notional 6.5-star performance threshold not otherwise being fairly rewarded until the NABERS rating scale is extended beyond 6-star.)

One particular reason for adopting this approach is to minimise the perverse incentive that currently exists for oversizing of equipment in order to jump to the next point threshold (particularly with respect to peak electricity demand reduction), and for favourable adjustment of the simulation analysis model in order to push the result beyond the next applicable point threshold. A continuous scale provides fair reward for any incremental performance improvements a project is able to achieve.

All calculations will be displayed to two decimal places, with final rounding occurring only on the summary score sheet.

3.3 Linear versus Non-Linear Points Scale

Discussion was given to the relative merits of linear and non-linear points reward (that is to say, whether the same incremental improvement is equally or differently rewarded across the improvement continuum). The following arguments for each were discussed:

Linear	Non-Linear
Is simple and straightforward to implement Is consistent with BREEAM and LEED rating tools (although LEED v4 is implementing a non-linear scale) Is consistent with past Green Star rating tools and therefore preserves fairness of comparison	Recognises the increasing difficulty, complexity and therefore cost of achieving marginal improvement as the overall performance increases Is a mechanism for reducing the barriers to high-performance buildings

The feedback received from the consultation was ambivalent, showing no clear preference within the industry for either approach. In the absence of a clear consensus of opinion, we have proposed that the existing linear system is retained.

3.4 Rewarding Restorative Performance

Discussion was given to the relative merits of rewarding restorative performance (that is to say, improvement beyond net-zero carbon) within the credit, rather than in the Innovation category as at present. The following arguments for each were discussed:

In Innovation	In Credit
Restorative building performance is rare / uncommon. Green Star should focus on improving the performance of the bulk of the market to best practice, rather than focusing on creating additional rewards for the leading edge. Make it a defined Innovation Challenge: list the requirements required to achieve restorative performance points	Desire to recognise the performance gap between the top of the GS scale (6 star) and really world leading sustainable building (e.g. a Living Building Challenge building). Sends a strong signal about expectations for the future; net-zero carbon is not innovative, but the next step in design evolution.

The feedback received from the consultation was marginally in favour of retaining restorative performance in the Innovation category, with 60% of respondents preferring this approach. We concluded that the location of the points within the rating tool is a minor issue, so long as there is a clear pathway defined for rewarding restorative performance. As such, we have proposed that the existing arrangement is retained, with improvement beyond net-zero carbon rewarded in the Innovation category (either as an Innovation Challenge or existing Improvement on Green Star Benchmarks). Additionally, we recommend that this item requires no additional documentation beyond the standard energy modelling report (though this may necessarily be the subject of a more rigorous assessment review).

3.5 Deemed to Satisfy - Class 3 to 9

Owing to the large variation in building types, and their level of serving provision, assessable by this method, we have not attempted to provide a detailed variable points award, unlike that for the Class 2 buildings (refer to next section). Further, since there is no fixed benchmark for the improvements achieved by improvement beyond the DTS performance requirements, there is no simple basis on which to consider the relative improvements achievable by any given measure.

For this reason, we have applied the simplest possible approach which is to award a single point for each measure, or group of measures, achieved. The HVAC component of the credit includes requirements for all of pumps, fans, chillers and/or packaged air conditioning units, and boilers. Recognising that, depending on the

HVAC system selected, not all of these components may be present, this part of the credit requires only that the applicable equipment efficiencies are satisfied.

We consider one point per item to be a fair reward in the context of the total points available for the credit remaining similar to the overall credit total weighting in the current Green Star rating tools (i.e. 25-30%). In this context, the maximum 5 points available will present approximately 15-20% improvement. Should the total credit points be significantly reduced, then the straight allocation of one point per item may need to be reviewed (note that we see no issue with fractional points since we are recommending the implementation of a continuous points scale).

3.6 Multi-Unit Residential Buildings: NatHERS

Applies only to Class 2 dwellings and the immediate adjacent areas used for access to dwellings and which provide common amenities for use by residents only.

It is not proposed to consider energy efficiency/GHG separately as energy consumption is predominantly electricity, and therefore reductions in each will be (approximately) proportional. In general it is anticipated that buildings will not approach or achieve net zero operation, since the issues with central energy supplies to retail electricity customers have to date disincentivised (and are expected to continue to disincentivise) this approach by developers.

As such points will be capped at a limit which represents the probable limit of energy efficient design/equipment selection. Based on the split of domestic energy consumption (DEWHA, 2008), this limit is estimated as follows:

End Use	Proportion of Household Energy Consumption	Limit of Improvement	Max Permissible Reduction	Proportion of Points
Lighting	6%	50%	3%	5%
Heating and Cooling	40%	90%	36%	60%
Water Heating	21%	60%	12%	20%
Appliances and Equipment	33%	30%	10%	15%
TOTAL	**100%**		**61%**	**100%**

Note: assumptions for lighting operation used in source modelling are low, and therefore expected that lighting would account for a larger proportion of energy consumption. Appliances and equipment includes computer and home entertainment which are not within the scope of Green Star Design and As Built assessments, but detailed breakdown within this category is not provided to facilitate its exclusion.

Regional variations will occur in both the split of energy consumption and the potential for improvement (more northerly locations will be able to achieve greater reductions due to solar thermal water heating, but less scope for reducing cooling requirements), so these are not absolute.

Also, the report considers the housing stock as a whole, and therefore incorporates both detached dwellings and multi-unit apartment buildings; very little information on the variation between building typologies is provided to inform a more refined estimation applicable to multi-unit residential only. Therefore no attempt has been made to refine these figures to represent multi-unit residential buildings only. However, it provides an indication of the extent to which points in the category can be meaningfully awarded; on this basis, 50-60% seems appropriate, based on 100% representing net zero carbon.

Owing to the degree of uncertainty in the overall figures, we consider that erring on the side of conservatism is appropriate, and hence propose 50% as the limit of points rewarded here, until more detailed information is available on Class 2 energy performance.

There is ongoing research in this area, with the Residential Energy Monitoring Program (REMP) being of primary note, and this continuing effort should be monitored as it will afford opportunities for refining the basis of analysis presented here (E3, 2014).

One additional point to note is that for the majority of locations the maximum performance (i.e. 10-star) is close to 0 MJ/m² (NatHERS, 2014), and therefore represents close to 100% improvement in heating and cooling energy demand; exceptions are the tropical north coast regions, such as Darwin, Broome and Cairns which are much higher (>50 MJ/m² at 10-star), but these will likely represent only a small proportion of ratings, and are therefore not considered to be a significant concern regarding consistency of application and outcomes achieved.

This is illustrated in the following graph for state/territory capitals and other locations.

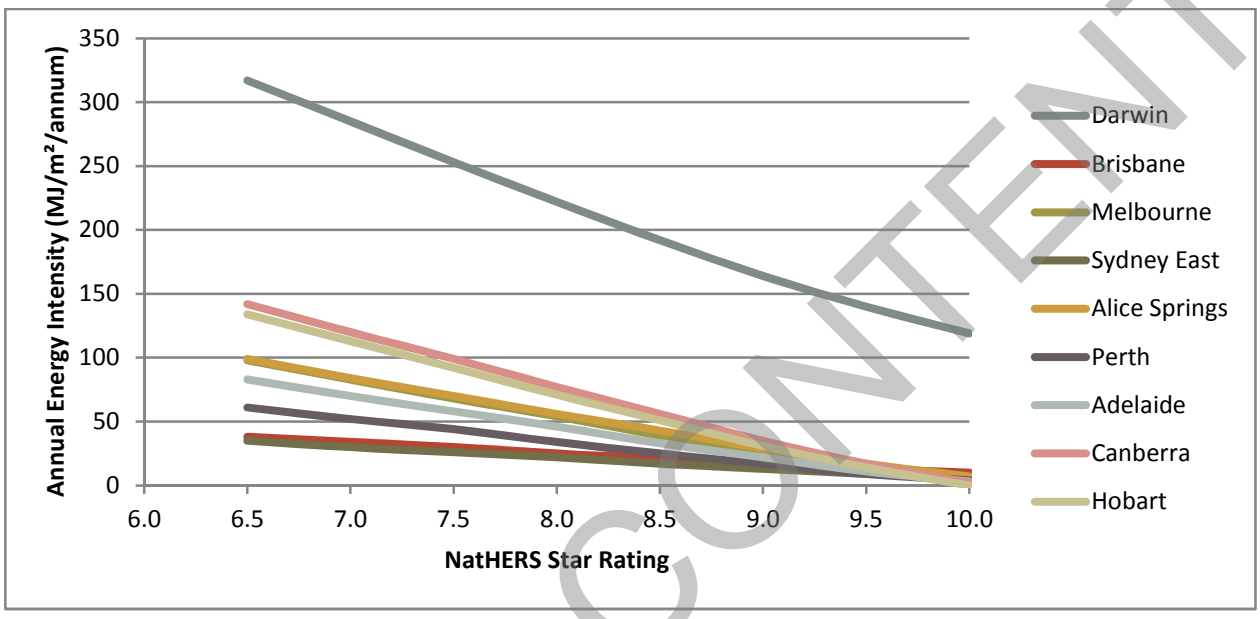


Figure 1: Annual energy intensity as a function of NatHERS rating for a number of locations

Owing to the varying relative benefit derived from improvements in each end use area, it is proposed that the points awarded for individual inclusions are weighted according the relative contribution from each end use to overall energy consumption/GHG emission reduction. This will ensure that low-cost/low-impact and high-cost/high-impact design and specification features are appropriately incentivised.

As per the peer review recommendations, a simple checklist of items is proposed for points in each area to encourage the application of energy-efficient technologies and, as a counterbalance, to promote right-sizing of equipment (i.e. avoid situations in which the most efficient item is chosen for its efficiency but which is inappropriately sized for the application). In general, each item will be awarded one point (weighted within each end use category as per the above factors), but, where there is a ranking to items (e.g. energy-star rating of air conditioners), a hierarchical score will apply.

In order to recognise the benefit of the non-installation of air conditioning, this will be recognised subject to the demonstration of an appropriate cross ventilation design (there is no net benefit achieved by awarding developers for defraying the cost of installing air conditioning which by default has to be met by the occupant during the first summer as a result of unacceptable overheating).

The reduction of heating and cooling energy is a function of the both the NatTHERS rating (reduced building fabric load) and the efficiency of the installed systems (improved efficiency of delivery of heating and cooling). Hence, as the NatHERS rating improves, the marginal benefit of unit improvement in heating and cooling equipment efficiency reduces. Consequentially, the relative benefit of improved plant specification must take account of the NatHERS rating achieved. The proportional weighting of these two components to the overall heating and cooling category score, and the overall total, is indicatively illustrated below:

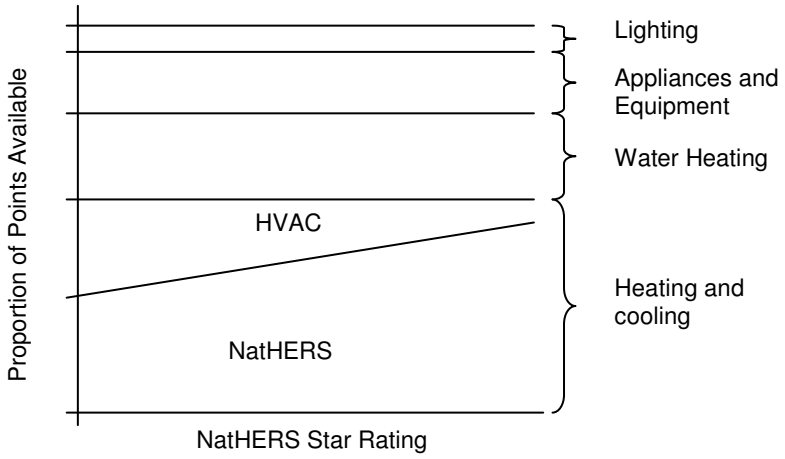


Figure 2: Illustration of relative proportion of total points available for HVAC as NatHERS rating varies

A similar argument can be made for the proportion of energy intensity represented by heating and cooling (e.g. cooling performance would of minimal impact in Tasmania). This additional complexity is not proposed to be considered at this time.

To encourage the application of renewable energy technologies, strong scoring emphasis will be placed on the inclusion of solar thermal hot water within the water heating end use category. Additionally, the installation of PV will be encouraged with a catch all "bonus" point available for installations exceeding some minimum threshold. For practical reasons, the panels would need to be installed to service the base building only, or to have a dedicated panel per apartment.

In order to benchmark the solar thermal heating requirement to achieve a meaningful contribution towards hot water energy demand reduction, the following methodology has been applied. The primary determinant of hot water usage is the number of people in the dwelling (note that the relationship is generally not directly proportional to the number of occupants as washing machines and dishwashers use fixed quantities of water for a given cycle, and the number of cycles will vary with lifestyle factors).

There is very limited data available regarding residential hot water usage, though this is currently the subject of active research (REMP, 2012). Based on the very limited REMP pilot study (5 dwellings in Melbourne), the average domestic hot water consumption is 23.1 L/day/person (88 L/day/dwelling). Clearly, this data does not reflect variation between different climate zones, dwelling types, demographic or socioeconomic groups, or provide detail regarding the variation due to selection of appliances, fittings and other factors. Comparison with other data from international studies demonstrates a level of variability: UK average of 40-50 L/day/person (BRE, 2005) (data based on modelling using survey data, not direct consumption monitoring) and US average of 240 L/day/household (giving 48-80 L/day/person depending on the average household size (range based on 3-5 people per household)) (ASHRAE, 2011). The lower Australian value may reflect the greater focus on household water efficiency in recent years due to the extended period of drought that Australia has experienced. For the purpose of establishing a benchmark, we have assumed usage of 30 L/day/person. (For reference, the assumptions in the existing Green Star MUR water calculator result in usage of the order of 50-60 L/day/person depending on fixture and appliance WELS ratings, and also assuming 50% hot water flow at fittings (GBCA, 2013).) Assuming a cold water supply temperature of 18 ℃ and storage temperature of 70 ℃, the daily water heating demand is:

$$E = \frac{30}{1000} \times 1000 \times 4.2 \times (70 - 18) = 6{,}552 \text{ kJ/day/person} = 1.82 \text{ kWh/day/person}$$

Assuming that system inefficiencies and losses result in 80% overall generation efficiency, the required heat input is 2.28 kWh/day/person, or 830 kWh/annum/person. Setting a benchmark of minimum 20% contribution for solar thermal heating to achieve a reward in Green Star, the required number of Renewable Energy Certificates (RECs) for a project is:

$$N = \frac{830}{1000} \times 10 \times 0.2 = 1.66 \text{ REC/person}$$

Note that RECs are normalised based on the energy generated over 10 years expressed in MWh, hence the factors applied in the above equation. It is proposed to reward contribution from 20% to 60% of heating demand met by solar thermal (more than 60% is typically not practical in all climate zones owing to design constraints due to seasonal variation), i.e. from 1.66 to 4.98 REC/person. As with all other components of this credit, a continuous scale is applied from zero to maximum.

Note that the energy demand assumptions used in assessment of RECs (as per SA, 2008) result in significantly higher water usage rates than the above assumption. For example, using the same temperature assumptions as above, 18 MJ/day (the energy demand for a small system in zone 1 or 2) equates to approximately 80 L/day (2-3 people), and 63 MJ/day (the energy demand for a large system in zone 4) equates to approximately 290 L/day (9-10 people). These values therefore probably better represent peak rather than average usage, and an adjustment factor of 70% is therefore introduced to account for the variation in absolute contribution from the solar panels, increasing the thresholds to 2.37 and 7.11 REC/person.

Note that the usage assumptions in this credit need to be consistent with those applied in the water credit calculation and may therefore require adjustment for the pilot credit release. This includes the requirement for a standardised approach to calculation of building occupancy.

3.7 Existing Frameworks for Office Buildings: NABERS Energy

This pathway will recognise NABERS Energy Commitment Agreements, where a full peer review of the building design and associated energy performance simulation assessment has been completed by a NABERS-recognised Independent Design Reviewer. The scope of the NABERS Energy rating is base building only, and applies to offices (Class 5) only.

It would be possible to recognise energy and GHG reduction, but this would necessitate more information than the basic level of information envisaged for this pathway. Projects which want to account for the benefits of their design in full are encouraged to use the performance pathway. Using this approach it is proposed that a building will be able to gain the full benefit for base building greenhouse gas reduction and a notional benefit for improvement of fabric design on the basis that high-performing buildings will necessarily have improved substantially on BCA minimum standards.

In order to avoid rorting of the system, buildings will be required to declare the proportion of the total GFA (excluding car parks, etc) which is not associated with the Class 5 function of the building. This is to enable buildings with small retail inclusions to use this path without being forced to undertake additional modelling, while ensuring that larger inclusions are robustly assessed. (Note that the mixed assessment calculation will allow the NABERS pathway to be used for the Class 5 part of the building, while requiring use of either the DTS or modelling assessment pathways for the rest of the building.)

For consistency with existing Green Star guidelines, it is proposed that this limit is set at 80% of total GFA as Class 5 usage. As a further precaution, the proportion of points available to be awarded will be reduced in proportion with the Class 5 area (assumes that the remainder of the building satisfies the benchmark without further improvement).

Points will not be independently awarded for energy and GHG emissions for this pathway; the two will be combined. However, to bring this pathway in line with the minimum energy performance scope, it is required that some evaluation of lighting energy performance is included with this pathway. This could be through a whole building NABERS assessment but this would include other energy end uses which are outside of the minimum scope (i.e. computers and server rooms).

Further, this would represent a significant additional burden on the project team, particularly where building tenants have not been secured, or where fit out design is not completed at the same time as base building works. For these reasons, it is considered that the simplest solution is to incorporate a lighting performance criterion equivalent to the current Ene-3 Lighting Power Density.

The benchmark for this criterion needs to be considered in the context of the continuing improvement in lighting energy efficiency and the changes that Green Star has encouraged to date in alternative lamp technologies and luminaire arrangements. A minimum 10% reduction on the current first threshold of 2.5 W/m²/100 lux is recommended. Since it is not physically realistic to reduce installed lighting load to zero, the upper limit of the range will be similarly in line with the existing credit. A range of 2.2 to 1.2 W/m²/100 lux is therefore proposed.

In order to determine the appropriate point allocation for this pathway, consideration has been given to the relative base building and tenancy GHG emissions, and assumptions made on the commensurate energy consumption as follows:

- Evaluate raw GHG emissions rate at 4.5-star NABERS Energy for base building and tenancy (based on the same hours of building operation, and nominal assumption for number of computers) (NABERS, 2014);
- Assume proportion of tenancy GHG emissions accounted for by lighting; based on a range of analyses previously completed this is assumed to be approximately one-third;
- Assume proportion of overall energy consumption represented by each. This is dependent on the fuel mix for the building and the location. On the basis that the majority of state capitals use gas for heating in larger Class 5 buildings (those which are most likely to be applying a Commitment Agreement and hence adopting this pathway), it is expected that the proportion of the energy consumption due to lighting is smaller than for GHG emissions (due to electricity having a high GHG emission intensity);
- Assume extent of improvement that can be achieved in energy and GHG component, and hence the overall reduction that can be achieved.

Location	Base Building GHG Emissions ($kgCO_2e/m^2$/annum)	Tenancy GHG Emissions ($kgCO_2e/m^2$/annum)			Base Building + Tenancy Lighting GHG Emissions ($kgCO_2e/m^2$/ annum)	Proportion of GHG Emissions due to Tenancy Lighting
		Total	Proportion Lighting	Lighting		
ACT	63.5	113	33%	37.7	101.2	37.2%
NSW	94.3	113	33%	37.7	131.9	28.5%
NT	91.5	56	33%	18.7	110.2	16.9%
QLD	108.5	93	33%	31.0	139.5	22.2%
SA	67.4	77	33%	25.7	93.1	27.6%
VIC	88.9	116	33%	38.7	127.6	30.3%
WA	77.5	81	33%	27.0	104.5	25.8%

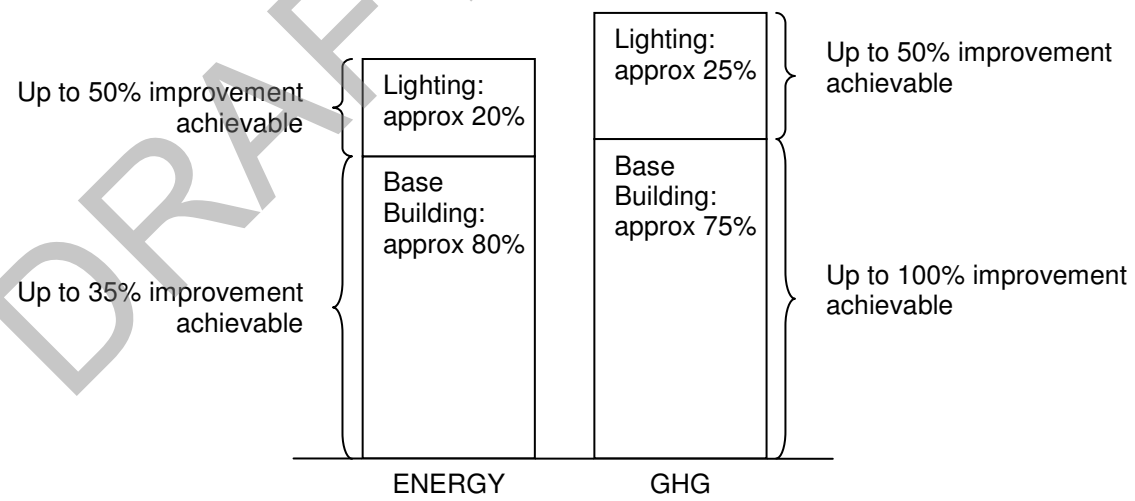


Figure 3: Illustration of relative energy consumption and GHG emissions for NABERS Energy framework

On this basis, the maximum proportion of points attainable under the NABERS Energy pathway is:

$$(0.5 \times 0.2 + 0.35 \times 0.8) \times X + (0.5 \times 0.25 + 1.0 \times 0.75) \times Y = 0.38X + 0.75Y$$

Where *X* and *Y* are the proportion of points allocated to the energy and GHG components of the credit under the performance pathway. For *X*:*Y* ratios from 30:70 to 70:30, the resulting proportion varies from 49.1% to 63.9%. Hence, an upper limit of 50-60% will be appropriate for this pathway. (Note that the proportion will be further reduced as the proportion of Class 5 GFA reduces; refer above.) We propose that the points available for this pathway are capped at 60% of the credit total, irrespective of the energy/GHG split in the performance pathway. This will be further apportioned according to the base building/lighting split based on the above relative contributions, which equates to 78% base building/22% lighting.

3.8 Reference Building Pathway

This will be split into two parts: energy efficiency and greenhouse gas emissions. Recognition of energy efficiency independently of greenhouse gas emissions is included to incentivise passive building design features which can currently be circumvented by the inclusion of low-carbon technologies (particularly cogeneration). This will compare only the energy demand of the building, i.e. the energy supplied to fans, pumps, chillers and lighting systems, etc, to maintain the required internal environmental conditions; it will not consider the source of the energy.

Owing to complexities with the alignment of thermal energy and electrical energy measurements in buildings utilising district heating and cooling from a shared service utility, the method for assessing projects incorporating these systems will differ from other buildings. For this minority of buildings, the full JV3 method of assessment, wherein the proposed building envelope is assessed with both reference and design services, will be adopted. Comparing reference envelope and reference services with proposed envelope and reference services creates a common baseline allowing consistent evaluation, but means that in this case only envelope efficiency (as measured through the impact on building services energy consumption) is rewarded. All services efficiency gains are rewarded through the GHG emissions reduction.

Owing to the limited extent of assessment for energy efficiency it is proposed that the points allocated to this is similarly restricted, and 20% of the total is proposed. Rather than rewarding reduction to zero, as with GHG emissions, since the façade only accounts for a modest proportion of the heating and cooling load in most non-residential buildings (the majority being outside air and internal heat gains), this will be scaled accordingly. Although this varies according to location; 25% is considered to be a generally representative value.

We have completed a review of the projects that have been previously assessed using the JV3 method to determine the extent of improvement that is seen between the Reference Building and Intermediate Building cases. From this we have identified that very few projects have achieved improvement beyond 10% of energy consumption (it is this comparison, which assesses relative building fabric performance only, which generally places the greatest limits on design flexibility, and hence most projects seek only to ensure that compliance is achieved, not to achieve significant improvements). By placing the limit of reward at 25% improvement over the Reference Building, we believe that this creates an incentive for pushing improvements to the envelope design which do not currently exist, as per much of the industry feedback received, while recognising that there is a point beyond which the façade cannot provide further benefit.

The benchmark for comparison for both energy and GHG reduction is BCA+10% improvement; in this context, this will be applied as a 10% reduction on the reference building.

It is proposed that projects installing renewable energy generation systems (PV or wind turbines) will achieve additional points up to 10% of the total allocation for 10% reduction of GHG emissions by their application. The maximum credits in the category will be capped at 100% (so projects achieving 90% or more in the energy/GHG emission reduction parts will not receive all of the available 10% for the renewable energy if they qualify). This incentivises the uptake of renewable energy by providing double rewards for small-scale systems installed on all but the very best-performing buildings. Solar thermal hot water is not proposed to be included in this assessment for several reasons:

- Within the calculation, other factors will contribute towards energy reduction for water heating other than the implementation of solar thermal. These include efficiency of the primary heating plant and reduction in the hot water usage demand (from water-efficient fixtures, etc). In order to evaluate the reduction due to solar thermal only, a separate calculation would be required.
- In most non-residential buildings hot water accounts for only a small proportion of energy consumption, and is therefore unlikely to contribute greatly towards GHG emission reduction.

- Most large-scale systems use gas as the energy source, which is inherently lower GHG intensity, and therefore further reduces the potential to achieve significant emission reductions.

Where projects consider that the implementation of solar thermal deserves to be recognised, then they may submit a CIR requesting its inclusion and specifying the calculation method by which the improvement due to the inclusion of solar thermal alone will be determined.

3.9 Peak Electricity Demand Reduction

3.9.1 Deemed to Satisfy Pathway

A single criterion has been applied for all of Class 2 to 9 buildings based on the provision of electrical generation capacity. This reduces the potential range of measures which can achieve peak demand reduction compared to the existing Multi-Residential Unit rating tool which recognises measures such as non-provision of air conditioning and non-electric cooking equipment. This has primarily been done for simplicity to allow a consistent method of assessment across all buildings. Buildings adopting unconventional or innovative designs are encouraged to use the Reference Building Pathway.

The credit rewards a defined peak demand at only a single threshold. This is a change from the existing credit which generally allows for two points at two thresholds. In principle substantial further improvements in peak demand can be rewarded using the Innovation category. However, for buildings using technologies which are likely to achieve substantially in excess of the threshold reduction, application of the Reference Building Pathway will probably be required to attain the maximum potential points benefit for energy and greenhouse gas emissions reduction.

For consistency with the approach to deemed-to-satisfy in the other credit, a single point is awarded for achieving the credit criterion without adjustment.

3.9.2 Existing Frameworks

It is not proposed to award NABERS Energy or NatHERS under this credit. This is primarily because there is no way to establish the relevant baseline in isolation. Projects using this pathway for Ene-1 can apply the DTS pathway for peak demand reduction. Otherwise, projects which have completed the required simulation for the NABERS Commitment Agreement can develop this and use it as the basis of the Reference Building pathway.

3.9.3 Reference Building Pathway

The assessment of peak demand reduction using the Reference Building is consistent with the existing Green Star methodology (e.g. Public Buildings). In general, the balance of maximum peak demand reduction points relative to maximum greenhouse gas emissions points currently awarded in Green Star (i.e. 2:20) is considered to be representative of the relative environmental impacts and benefits achieved from implementation. The proportionate points award between credits have therefore been set on this basis. The peak demand reduction is benchmarked between 10% and 30% reduction relative to the Reference Building; this is a modification of the current lower threshold, primarily to bring it into alignment with the general benchmark of 10% improvement on NCC.

3.10 Application of Multiple Assessment Pathways

For buildings which comprise of multiple uses (as identified by multiple classifications in accordance with the NCC), the project team is required to select the assessment pathway that will be applied to each part. For Class 3 to 9 parts of a building, these may be assessed collectively using either the DTS or performance-based assessment method, or assessed in multiple separate components using a combination of the DTS, existing framework (where applicable), and performance-based assessment methods. Class 2 parts of the building may

be assessed independently using the applicable DTS method, or included in the performance-based assessment method with other non-Class 2 uses.

Owing to the many possible combinations of assessment methods that could be applied to a building, and the use of different metrics within each pathway, the assessment of mixed use buildings is based on an area-weighted calculation of points achieved within each assessment method, not on weighted energy consumption or greenhouse gas emissions. Within the performance-based assessment method, no distinction is made between different parts of the building having different energy intensities; ultimately, the rating tool assesses the building as a single entity and that building is responsible for a fixed quantity of greenhouse gas emissions (according to the stated modelling protocol) irrespective of how these are distributed over the site. This also applies for peak demand reduction.

The application of the method is illustrated by way of an example. The diagram illustrates a building comprising three uses, for each of which a different compliance method is adopted. The gross floor area (which will be used as the basis of the area-weighting calculation) is also indicated; the building total area is 45,000 m². (Note that the total points available for each compliance path are notional only and subject to confirmation.)

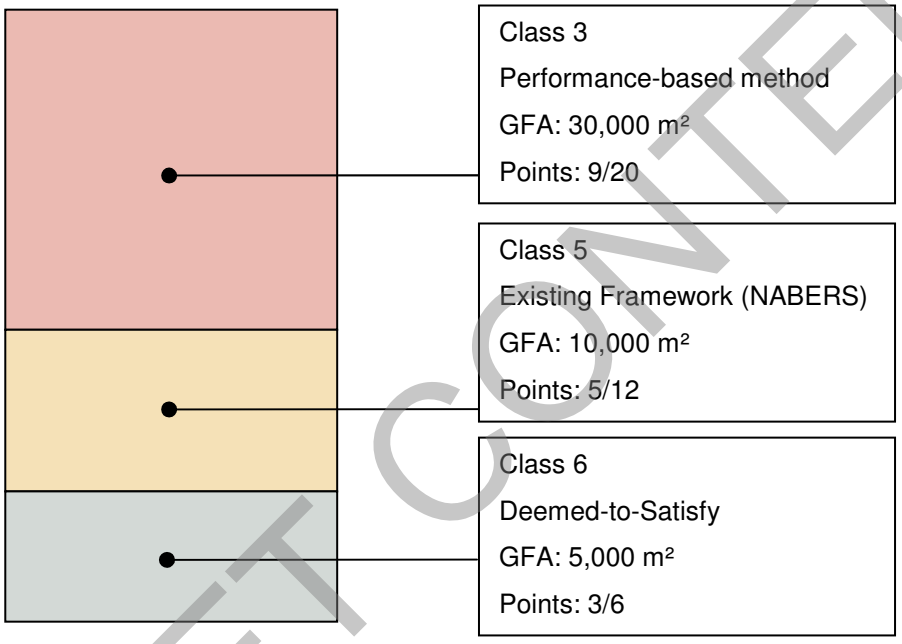


Figure 4: Example of the application of mixed assessment pathways to a mixed-use building

The calculation of total points achieved in the credit is as follows:

$$P_{total} = \frac{30{,}000}{45{,}000} \times 20 \times \frac{9}{20} + \frac{10{,}000}{45{,}000} \times 12 \times \frac{5}{12} + \frac{5{,}000}{45{,}000} \times 6 \times \frac{3}{6} = 6.0 + 1.1 + 0.3 = 7.4$$

In general, the calculation is:

$$P_{total} = \sum_i \frac{GFA_i}{GFA_{total}} \times P_{max,i} \times \frac{P_i}{P_{max,i}}$$

Where P_{total} is total points awarded for the credit, GFA_i is the gross floor area assessed using pathway i, GFA_{total} is the building total gross floor area (m²), $P_{max,i}$ is the maximum points available using pathway i, and P_i is the number of points achieved using pathway i. This method is applied for both the energy and greenhouse gas emissions reduction, and the peak electricity demand reduction credits.

4 Deemed to Satisfy

4.1 Introduction

The aim of the Green Star Deemed to Satisfy pathway is to provide a simplistic methodology of achieving and rewarding energy saving initiatives. The deemed to satisfy criteria have been based on the review of a number of DTS frame works and opportunities in existing rating tools including LEED and BREEAM. ASHRAE 50% Advanced Energy Design Guidelines (AEDG) were also reviewed. As project teams using Green Star may not be familiar with these tools and their specific requirements, the use of Australian requirements have been utilised where possible.

The credit criteria aims to reward fundamental building initiatives, both passive and active, such that the majority of buildings applying for Green Star certification can effectively utilise this pathway. Noting, however, in the case where the building cannot achieve DTS – it can then pursue either the existing framework or reference building approach. A further aim was to minimise the amount of documentation that project teams would be required to produce when using this pathway.

4.2 ENE and GHG Emissions

Upon review of the existing tools and Green Start credits six deemed to satisfy credit criteria were developed and are as follows:

- Building Fabric
- Glazing
- Lighting
- HVAC
- Building Sealing
- Peak Electricity Demand Reduction (as a separate credit)

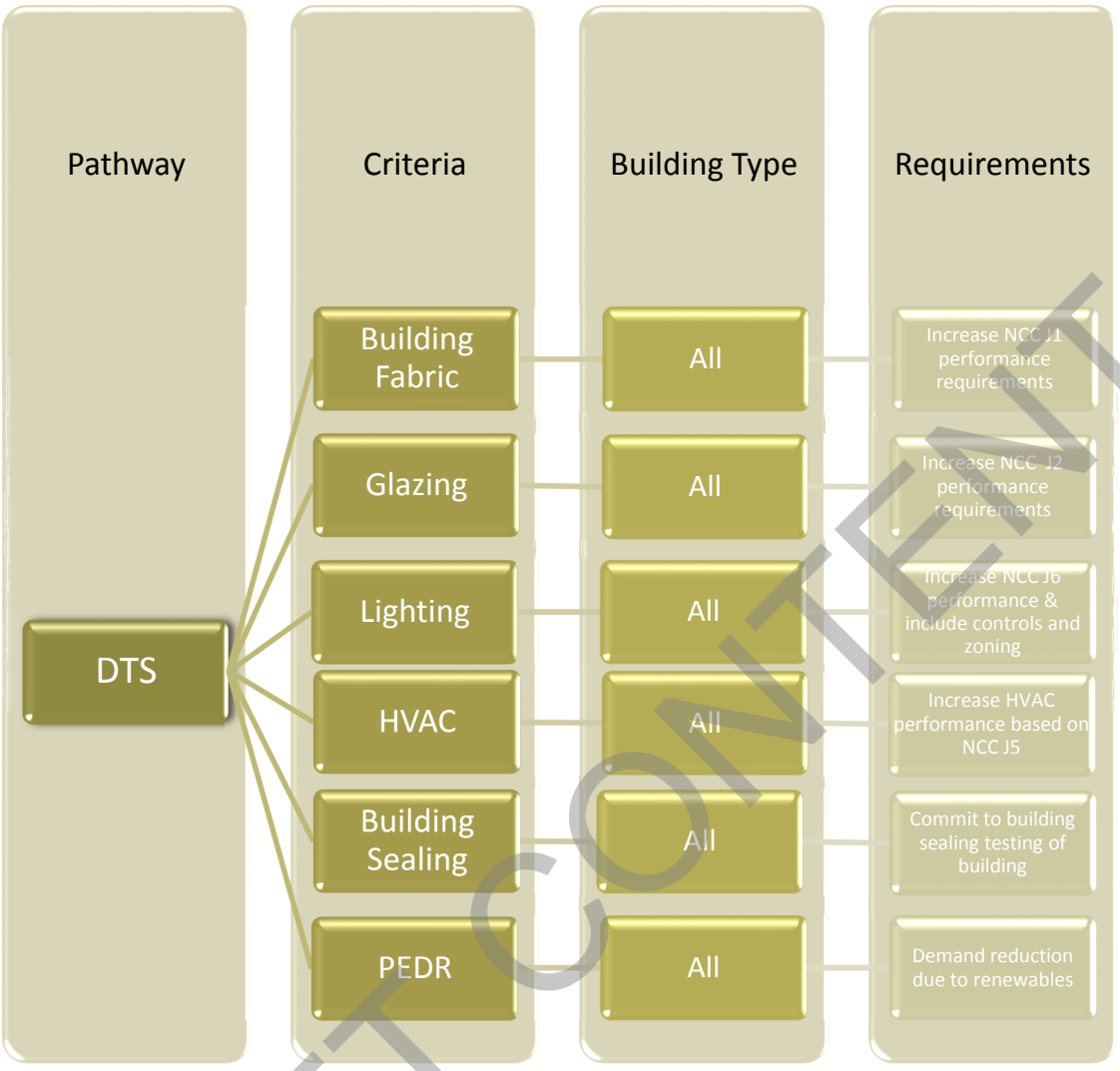
Upon achieving each of the above criteria the project team will be awarded 1 point, up to a maximum of 6 points.

The building fabric, glazing, lighting and HVAC credits have been developed largely based on the existing LEED v4 prescriptive compliance requirement to achieve the ASHRAE 50% Advanced Energy Design Guidelines (AEDG), however this has been adjusted to be more applicable to the Australian industry.

The ASHRAE 50% AEDGs were produced using extensive modelling of prototypical buildings in each of the climate zones. The results of which, produced specific target values for each building type and credit. As this level of detail is not possible in this project timeframe, a set increase on the required values specified in Section J of the National Construction Code (NCC) have been used in most cases.

The building sealing and peak electricity demand reduction credits have been included to reward projects that go beyond the basic fundamentals of building design.

A summary of the DTS credits are shown below (note that peak electricity demand reduction (PEDR) is assessed as a separate credit):



The following sections detail the specifics of each credit criteria.

4.3 Building Fabric

The aim of this credit is to reward the use of passive design principles within the building fabric. This credit applies to the floor, wall, ceiling and roof constructions that make up the conditioned envelope of a building.

The credit criteria for the building fabric DTS credit is:

Where a building is required to comply with Section J1 of the NCC;

- *An 10% increase on the required R-values specified in sections J1.3, J1.5 and J1.6 must be achieved.*

As project teams will already have produced documentation showing how they comply with the NCC, the additional documentation to show the required 10% increase to achieve this credit will be minimal.

4.4 Glazing

The aim of this credit is to reward the use of high performance glazing or glazing with high levels of shading that will reduce the energy usage of the building.

The credit criteria for the glazing DTS credit is:

Where a building is required to comply with Section J1 and J2 of the NCC:

- *For vertical glazing, the total energy used for orientation of each storey must not be greater than 10% of the total allowance according to the Australian Building Codes Board glazing calculator or the calculated aggregated air-conditioning energy value, and;*
- *For roof lights, a 10% improvement on the requirements of section J1.4 is to be achieved. If there are no roof lights in the building, then this item is Not Applicable.*

As with building fabric, project teams will already have produced documentation showing how they comply with the NCC, the additional documentation to show the required 10% increase to achieve this credit will be minimal.

4.5 Lighting

The aim of this credit is to reward energy efficient lighting design that incorporates a level of automated control and zoning.

The credit criteria for the Lighting DTS credit are:

- *For all building types an 10% decrease on the NCC Section J6 maximum illumination power densities, as defined in Table J6.2a must be achieved; and*
- *Automated lighting control system(s), such as occupant detection and daylight adjustment is (are) provided to 95% of the nominated area, and;*
- *For Class 5 and 9a buildings, the size of individually switched lighting zones does not exceed 100 m^2 for 95% of NLA.*

The credit criteria incorporates a part that requires an improved performance on the NCC J6 requirements as projects team will already be required to produce this documentation when required to comply with the NCC. The second and third parts relate to the existing Green Star credit Ene-4 Lighting Zoning such that occupant detection and zoning must be used in the lighting design.

4.6 HVAC

The aim of this credit is to reward HVAC design that reduces energy usage by selecting equipment with better performance values than required by the NCC.

The credit criteria for the HVAC DTS credit are:

Where a building is required to comply with Section J5 of the NCC:

- *the required fan motor power and pump power as defined in Tables J5.2 and J5.4a must be reduced by at least 10% ; and*
- *the required minimum thermal efficiency of the water heater as defined in Table J5.4b must be increased by at least 10%; and*
- *the required minimum energy efficiency ratio for packaged air conditioning equipment and refrigerant chillers as defined in Tables J5.4d and J5.4e or MEPS, where Section J does not apply to the equipment capacity, must be increased by at least 10%.*

The credit criteria aims to provide project teams with a simplistic way of achieving this point as compliance with section J5 of the NCC will be required in most cases. The credit criteria covers all tables in section J5 which are seen as the biggest energy contributors in a HVAC design.

4.7 Building Sealing

The aim of this credit is to reward projects that commit to a building sealing test of their building, and thereby encourage the uptake of this type of testing which is mandatory in other countries (e.g. UK).

The credit criteria for the building sealing DTS credit is:

Mechanically Air-Conditioned and Mixed Mode Ventilated Spaces

- *1 point is awarded where a pressurised building air leakage test is carried out on the completed building in accordance with one of the following standards:*
  - *ASTM E779-10*
  - *ATTMA TSL2*

Naturally Ventilated Spaces

- *1 point is awarded where the building is naturally ventilated in accordance with credit IEQ-1.*

For the design stage of a project a contractual commitment is required to achieve this requirement and for As Built stage commissioning results are required. The criteria does not include a specific air leakage rate to be achieved as this is the first time building sealing has been included in a Green Star credit or any local regulations and needs to be tested in the market prior to a performance requirement being set. Guidance of expected leakage rates ranges have been provided as part of the credit guidance.

4.8 Peak Electricity Demand Reduction

The aim of this credit is to reward that include renewable energy or on-site generation sources as part of the building design to reduce the peak electricity demand.

The credit criteria for the peak electricity demand reduction DTS credit is:

- *One point is awarded where it is demonstrated that the use of renewable energy or on-site generation sources reduces the peak electricity demand by at least 10%.*

4.9 Deemed to Satisfy Exclusions

The deemed to satisfy credits have been selected based on building design fundamentals, minimising documentation and rewarding new initiatives. As such a number of possible credits were considered as part of the credits but have ultimately been excluded.

- Under the lighting credit, external lighting was excluded due to its limited contribution to the total lighting energy usage of the majority of buildings.
- Under the glazing credit, shading elements that cannot be included in the glazing calculator such as vertical shading are not rewarded as this would add additional documentation and modelling. Projects wanting to demonstrate the benefit of these will be required to adopt the Reference Building pathway, just as they would need to apply JV3 under the BCA compliance assessment.

4.10 Conclusion

The six selected deemed to satisfy credits provide project teams with a simpler method of achieving Green Star points under the Energy and Greenhouse Gas Reduction credit compared to the other available pathways. The credits aim to reward the fundamentals of good building design as well as promoting new initiatives such as building sealing that have previously not been included in the Australian Green Star rating tools.

It is possible that the DTS credit criteria may not apply or be effective in every project. This may be the case if projects are in certain climate zones or where they go well beyond the DTS requirements in terms of design. If

this is the case, the other two pathways available to project teams should provide them with an effective way to achieve as many points as possible under the Greenhouse Gas Emissions credit.

5 Building Energy Performance Assessment Guidelines

The main areas of focus in developing the revised Building Energy Consumption and Greenhouse Gas Emissions Calculation Guidelines have been as follows:

- Provide definite guidance on the requirements for modelling of building energy performance, in terms of end use inclusions and key modelling considerations;
- Provide flexibility to the project team to adjust default operating profiles where appropriate to reflect better the anticipated operation of the building;
- Provide meaningful information from the energy analysis model to inform the ongoing monitoring management of building energy performance; and
- Consolidate existing guidance into a single comprehensive reference document applicable to all Design and As Built rating assessments.

Where appropriate we have also considered updating of the supplementary calculation methods to be consistent with the latest industry developments.

The guidelines use the most recently updated Green Star calculation method guidelines for the Public Building tool as their basis. This document has been supplemented with additional information from the sector-specific guidelines (Healthcare, Education, Multi-Unit Residential, Industrial and Retail Centre) and the supplementary calculation guidelines (solar thermal and photovoltaic) to produce a single, universal document suitable for use in conjunction with the unified Design and As Built rating tool.

The use of the BCA Section J Verification Method JV3 as the basis of the modelling approach is a sensible basis for the tool since it builds from a regulated standard which is becoming increasingly more commonly applied on building projects, and is consistent with the approach already taken in a number of the Green Star rating tools.

However, the issue for modellers has always been the areas where JV3 is silent, but which are important inputs for the application of the simulation method; differing assumptions can lead to divergent outcomes. In the interests of consistency, the revised guidelines have therefore sought to provide definite guidance for as many of these areas as practicable (while trying to avoid the possibility of accusations of being overly prescriptive).

Some of the key changes are outlined in the following sections.

5.1 Lift Energy Consumption Calculation

The lift calculation details have been updated, but retain the use of the same methodology as previously. We have reviewed the latest developments of ISO 25745 (the methodology being adapted from the draft version of this document). The current status is as follows:

- Part 1 (now adopted) addresses testing and measurement procedures to establish baseline metrics for lift operation (ISO, 2011); and
- Part 2 (currently draft) provides a methodology for classification of lift energy usage (similar to the star-rating system for appliances, etc) (ISO, 2012).

The issue with the use of the new methodology of ISO 25745 is that it requires knowledge of the lift energy consumption for the ISO reference cycle (a single return trip from terminal floor to terminal floor for an unladen lift car; by definition, this will be different for every installation), which cannot be readily analytically determined. At this time, we have therefore preferred to retain the existing Green Star method until the knowledge base has developed.

There are two main observed issues with the current methodology:

- the Reference Building lift definition has a lift rated speed of 1 m/s and a fixed motor power of 40 kW. These two values are contradictory in that it would equate to a lift carrying capacity which far exceeds any

conventional lift car. We have therefore proposed that the lift speed is varied according to the scale of the project according to nominal lift travel times (which in turn equate to a nominal quality of service), and the lift motor rating is estimated according to rule-of-thumb first principles methods as applied by lift engineers. The Reference Building uses the same rated carrying capacity for each lift as the actual design; and

- both the Reference Building and Proposed Building use the same number of lift trips per day. This is in principle a sensible approach, but the specifics of the lift installation design and operating parameters would in reality potentially result in different values. By bringing the operating parameters into closer alignment (as discussed above) this becomes a more valid assumption. However, experience has shown that the number of lift trips documented appear low, particularly for office HQ buildings, based on results obtained from lift traffic simulations for a small number of cases (typically 2,000 per day, c.f. 1,000 per day in the previous guidance). This is further substantiated by comparison with the metrics of ISO/DIS 25745.2 (Barney, 2013) which documents lift trips up to 2,500 per day (also based on simulation results). By comparison, the current Green Star calculation method references only 1,000 lift trips per day for office HQ. While the current parameters permit comparison, they will not necessarily realistically reflect actual building operation. We therefore propose that all values of lift trips per day are doubled in order to bring them into closer alignment with experience.

5.2 Reduction of Artificial Lighting Due to Daylight Contribution

Existing guidance documents include a methodology for calculation of the reduction of artificial lighting energy due to daylight contribution. This methodology considers the proportion of the year for which a certain threshold external horizontal illuminance is exceeded. It is proposed to omit this methodology for two reasons:

- The latest Public Buildings guidelines include an adjustment factor for lighting power density that can be applied to luminaires controlled by photoelectric cells. This can be directly applied in energy models and requires no further calculation, and is therefore a simpler approach that is more likely to be adopted by project teams;
- The majority of building energy performance simulation software programs now include functionality for the calculation of internal daylight illuminance as part of the simulation, allowing direct coupling of the lighting and associated HVAC energy consumption impacts. Again, this requires no further calculation, and is therefore a simpler approach that is more likely to be adopted by project teams.

The opportunity to use either of these approaches is considered to make the inclusion of the existing methodology superfluous, and provide a suitable balance between simplicity and rigour.

5.3 Modelling of Natural and Mixed-Mode Ventilation

Clarification of the methodology to be applied when assessing the performance, both for energy/GHG and thermal comfort, of naturally-ventilated and mixed-mode buildings has been included in the guidelines. The basic premise is that the building should be modelled in accordance with the anticipated operation, including equipment schedules, occupancy and controls strategies. Where naturally-ventilated buildings are entirely dependent on the actions of occupants for the opening and closing of ventilation devices, we have specified standard modelling parameters to reflect expected occupant behaviour. These same parameters must be applied to both the energy/GHG model and the thermal comfort model, and may not be varied. Similarly, we have specified default parameters for automated control; again, these same parameters must be applied to both the energy/GHG model and the thermal comfort model, but they may be varied according to the specific strategy implemented on a project.

5.4 Inclusion of PV Modelling Guidelines

The existing PV modelling guidelines have been incorporated into the document. No significant changes to the guidelines have been made, other than to adjust the presentation for consistency with the rest of the document.

5.5 Inclusion of Solar Thermal Modelling Guidelines

The existing guidelines are generally considered to be excessively onerous as they require the use of TRNSYS software, which is not routinely used by consultants (it is more commonly used for academic and industrial R&D). This requirement was presumably adopted as it forms the basis of assessment in AS4234 (SA, 2008) which is used in the evaluation of the number of Renewable Energy Certificates (RECs) applicable to a solar thermal system. An alternative and significantly simplified calculation method was implemented for the Custom tool which simply converts the number of RECs for the system to an annual energy offset value. This is considered to be a sufficiently robust approach for the majority of buildings, for which domestic hot water accounts for only a small proportion of the total energy consumption, and avoids the considerable complexity associated with the TRNSYS assessment. In order that the limited accuracy of this approach does not excessively reward projects, a caveat is included that where the domestic hot water heating accounts for more than 20% of the Proposed Building net energy consumption, a more rigorous approach may be required;

The TRNSYS approach was specific to the multi-unit residential rating tool calculation; for this building type, domestic hot water does represent a greater proportion of energy use than for the majority of commercial buildings. A more rigorous approach would generally be required here, but in the interest of implementing a Deemed-to-Satisfy style checklist, a similar REC-based calculation is implemented here. Where a project is assessed using the performance based method, a more rigorous calculation may be necessitated by the above caveat.

5.6 Reference Building HVAC Systems Definition

The Reference Building HVAC servicing provision is generally defined based on the requirements of ASHRAE Standard 90.1 Appendix G. This is consistent with the existing Green Star methods and is justified on the basis that it provides a consistent baseline against which innovative HVAC systems may be rewarded for energy efficiency benefits; this is not the case with JV3 which requires the use of the same system type in the Proposed and Reference Buildings. Modifications to the Appendix G definitions have already been incorporated into the Public Building calculation guidelines in order to better reflect Australian design and market practices. We have further clarified these provisions with plant sizing distribution (including the use of a low-load chiller), control methodologies (including chiller staging and condenser water temperature control) and other such details. We considered modifying the baseline heating system for northern and tropical climate zones (1 to 3) to direct electric to reflect general design practice, but this would not comply with the Performance Requirement JP3 of NCC Section J, and therefore application of fossil fuel-fired boilers (using natural gas or diesel oil according to site availability) has been retained.

5.7 Operating Profiles

All of the existing schedules from the various rating tool guidelines have been consolidated into this document. Where profiles are the same or similar, they have been consolidated into generic profiles, rather than retained as individual profiles differentiated by building type (e.g. circulation spaces). All profiles are presented as percentage variations rather than as absolute values which allows for further rationalisation (particularly for schools); the peak values are separately tabulated. Some adjustments have been made to profiles where there were inconsistencies (such as large steps in equipment or lighting values which were unrelated to variations in occupancy), and to reflect actual operating practice (such as maintaining HVAC operation 24 hours a day in healthcare interventional suites irrespective of whether they are in use).

5.8 GHG Emission Factors

GHG emission factors for fuels and synthetic gases have been updated based on the latest National Greenhouse Accounts publications. State and territory dependent values have been retained. Although one of the general principles of the updated Design and As Built rating tool is to remove location-specific weightings, we consider that the application of location-dependent GHG factors does not compromise this since the BCA references climate zones which drive different responses to climatic variation; similarly the use of location-

specific GHG factors will drive responses which are more appropriate to the building location and its fuel supply.

5.9 Weather Data

We have added the Reference Meteorological Year (RMY) format as the preferred format for weather data files because they cover a more recent period than the older Test Reference Year (TRY) datasets, and are composite years built from average months, rather than an average whole year. However, we are aware that that there is an as-yet-uncorrected error in the calculation of solar radiation values (split of direct and diffuse components) in some RMY datasets. The effect of these errors on calculation results in unknown. Based on our experience with RMY datasets to date, and comparison with simulation outputs based on equivalent TRY data, the variance is likely to be small (or at least less than due to the wide range of other potential simulation errors), and we think they can be used without concern.

5.10 Class 2 Appliances

Unlike all other building classes, Class 2 buildings are required to include allowance for the energy consumption of equipment, limited to whitegoods only (fridge/freezers, dish washers, clothes washers, and clothes dryers). For the Proposed Building, the calculation is based on the normalised energy consumption reported on the appliance Energy Rating certificate. For the Reference Building, the benchmark energy consumption is based on an assumed appliance specification as follows:

- Fridge/freezer total capacity of 350 L, split 250:100 between chilled and frozen storage (average of all group 5T models currently listed at E3, 2014);
- Dish washer capacity of 12 place settings (average of all models currently listed at E3, 2014);
- Clothes washer capacity of 7 kg (average of all models currently listed at E3, 2014); and
- Clothes dryer capacity of 6 kg (average of all models currently listed at E3, 2014).

The Reference ratings are set to be consistent with the appliance criteria in the Class 2 Deemed-to-Satisfy pathway. This requires that minimum appliance ratings are no more than 1-star below the maximum available energy rating for the appliance type. Therefore, the reference rating is taken as 1.5-star below the maximum available energy rating for the appliance type. The reference energy consumption is then calculated based on the nominated specification and reference rating in accordance with the applicable Australian Standards (also summarised at E3, 2010).

Appliance type	Specification	Max Available Rating	Reference Rating	Reference Energy Consumption (kWh/annum)
Refrigerator/ freezer	Group: 5T Chilled volume: 250 L Freezer volume: 100 L	4-star	2.5-star	436
Dish washer	Place settings: 12	4.5-star	3.0-star	282
Clothes washer	Capacity: 7 kg	5.0-star	3.5-star	367
Clothes dryer	Capacity: 6 kg	6.0-star	4.5-star	200

6 Shared Services and Utilities

The approach to shared services is founded on the research undertake in the peer review, taking into account the feedback from the TAG.

The key issues which have been addressed include:

- Shared services will be assessed as utilities rather than building attributes.
- Benefit of low-carbon utilities will be addressed through project-specific GHG co-efficients.
- A wide range of shared services which constitute low-carbon supply can be included (such as combined heat and power, district thermal networks, renewable energy and green power although not carbon offsets).
- The concept of retaining a GBCA database of district systems was discarded.
- Energy supply contracts for 3 years post-practical-completion will be required to demonstrate supply availability and quality.
- Shared services will not contribute towards points for peak electricity demand reduction as the shared utilities still constitute 'infrastructure'.

The intent of this approach is to reward buildings which connect to low-carbon energy sources at a utility-scale, rather than only reward those projects which produce low-carbon energy on-site.

Due to the complexity of analysing shared utility systems, project teams must submit a method statement to the GBCA for review prior to completely the ENE-1 credit for submission.

Two approaches have been proposed for including low-carbon utilities in the ENE-1 credit:

- Procurement Contract Approach, whereby GHG emissions co-efficients are contractually committed in Power Purchase Agreements (PPAs) and/or Thermal Power Purchase Agreements (TPPAs); and
- Design Analysis Approach whereby a Design Intent Report (DIR) demonstrates a calculation of the GHG co-efficient for the project based on systems descriptions and operational profiles embedded within the energy contract documentation.

6.1 Guideline Structure

The shared services guideline is structured into three parts:

- Defining the shared utility
- Calculating the GHG emissions co-efficient for each energy stream
- Apply the project specific GHG factors to the results of the energy assessment

The approach undertaken in collaboration between the GBCA and WSP Built Ecology for the Central Park Central Energy Precinct has also been used as a reference in the proposed methodology.

6.1.1 Defining the Utility

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

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

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

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

6.1.2 Calculating the GHG Emissions

The calculation of the overall energy performance of complex shared utilities requires detailed system modelling of the full utility system; including those elements outside the boundary of the building under assessment. The proposed utility system must be assessed using utility system modelling systems (such as EnergyPro) to assess the overall performance of the central utility.

Where detailed connection information beyond the building boundary is not known, an assessment of future connected load is required.

The total connected load assessment must include consideration of:

- a plausible development profile (with evidence from zoning or development plan documentation),
- building load profiles (default to minimum code compliant buildings if no other requirements are documented in local regulations), and
- occupancy profiles (on the basis of the primary use of the buildings).

The outputs of the system modelling must include:

- Total annual GHG emissions
- Total annual electricity produced
- Total annual chilled water generated
- Total annual heating hot water generated
- Total annual domestic hot water generated

The Energy Efficiency Council (EEC) is preparing an Emissions Allocation Protocol for combined heat and power (CHP)systems, which should be used for calculating emissions factors for co- and tri-generation systems once it has been completed.

The paper is far from conclusive at this stage – primarily framing some of the potential approaches that could be followed, and identifying some specific challenges to them. Of most relevance to the Green Star approach to energy is that table in section 5.4 identifying options for allocating emissions, of which option 3 appeared to garner the most support by the working group:

Site-specific calculation of the thermal efficiency of the generator, based on a set of rules. Options include:

- Proportion method: Emissions would be allocated based on the proportion of primary energy required to create the energy stream
- Exergy method: emissions from generation are allocated to the final energy streams in proportion to their individual contribution to the total work potential”

The paper goes into more detail on the mathematical approaches which underpin these options. A common methodology for the assessment of the actual generation of electricity and thermal energy from co- and tri-generation processes is a worthwhile goal, and it would be sensible to align the methodology with one for NABERS. However, this is just one step towards a comprehensive strategy for addressing shared services where the boundaries of ownership are complex and the situations for different projects could be highly variable between projects.

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

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

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

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

6.1.3 Applying the GHG Factors to the Building

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

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

The gird GHG factors must be applied to the Reference Building. The final GHG emissions for the Proposed Building will be compared to the GHG emissions of the Reference Building to determine the final point.

6.2 NABERS Protocol

The NABERS national steering committee has introduced a methodology to allocate emissions for electrical and thermal output of co-generation systems. It has produced a calculator to assist with the calculation.

The NABERS approach also proposes a three-step process:

- Step 1: Determining system location
- Step 2: Measuring energy use and generation products
- Step 3: Allocating energy and emissions to users

This is similar to the proposed approach, albeit the calculator is more focused on metered energy than the design approach required in the Design Intent Report.

However, with the allocation of emissions, there is one significant difference to that recommended for the Green Star Energy credits: the apportionment proposed in NABERS is on the basis of displaced energy, rather than the proportion of emissions attributed to different energy streams.

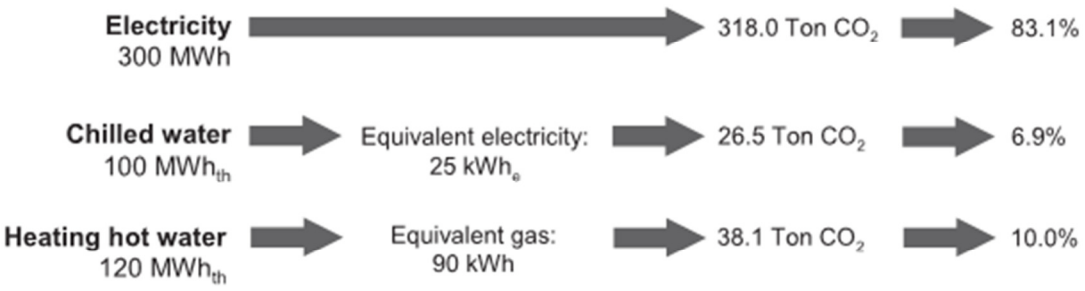


Figure 5: NABERS Emissions Apportionment based on displaced energy

This approach makes sense for a pure co- or tri-generation system only, but is flawed when attempting to address central thermal pant, integrated renewable energy or complex utilities which include a variety of technologies.

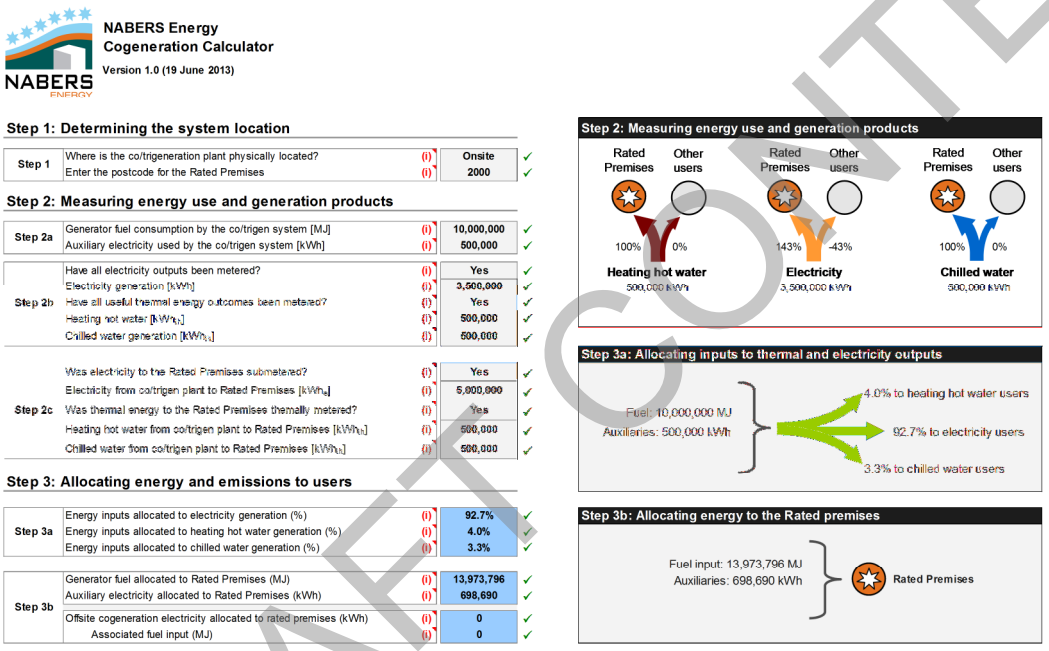


Figure 6: NABERS Cogeneration Calculator

For this reason, it is recommended that the NABERS approach be allowed where appropriate (i.e. co- and tri-generation systems only).

However it is recommended that the process of allocating emissions based on the proportion of energy streams described in Section 6.1.2 be adopted as it provides more flexibility in the assessment of a wide range of potential shared services arrangements and differing technologies used to produce the energy streams.

6.3 Documentation

Beyond the standard design and construction documentation for the building, the following additional documentation is required for shared energy systems:

- Procurement Contractor Approach
  - Power Purchase Agreement (PPA) and Thermal Power Purchase Agreements for ***three years after practical completion*** identifying supply availability and Guaranteed GHG emission factor.

- Design Analysis Approach
  - Design Intent Report (DIR) for the utility identifying its characteristics and associated GHG co-efficient calculations.
  - Power Purchase Agreement (PPA) and Thermal Power Purchase Agreements for ***three years after practical completion*** identifying supply availability and an operational plan which corresponds with the DIR.

Design and construction documentation for the energy utility are ***not*** required for the purposes of the Green Star submission for the buildings.

7 Peak Electricity Demand Reduction

7.1 General

We have referenced the credit throughout as Peak Electricity Demand Reduction, rather than Peak Electricity Demand Reduction. This is to indicate clearly that the credit scope only applies to electricity, not to all energy supplies to the building.

7.2 Method of Assessment

Two basic methodologies are currently used in rating tools to assess peak electricity demand reduction. These are:

- Comparison of instantaneous peak maximum demand values for the proposed building and a reference case. Applied in all existing Design and As Built rating tools; and
- Comparison of average building load factors to the network average. Applied in the Performance rating tool.

Design and As Built ratings also provide an alternative assessment method based on demonstrating that the building peak demand does not exceed the average by more than a specified proportion. However, this method has been applied in only a small number of ratings, and its continued utility is therefore questionable. The use of Credit Interpretation Requests allows projects to proposed alternative means of compliance, and this could therefore be applied for projects which may want to adopt such an approach in future.

For the Design and As Built rating, we have proposed that the existing comparison of peak values is retained as the method of assessment, rather than adopting the Performance tool approach. Although the calculation method of Performance can be applied to the Reference Building pathway (appropriate and sufficient information will be available from the model output), we favour this method for the following reasons:

- Maintains consistency of assessment with existing rating tools;
- Maintains clear demarcation between design and performance assessment tools;
- Simpler assessment metric which can be more intuitively calculated by designers, particularly when considering the marginal benefit (point differential) of different design options. Further, to calculate the average load factor requires a full annual simulation for each design option; this is not necessarily the case with the peak comparison.

7.3 Credit Thresholds

Under the existing PEDR credit, thresholds are set at 15% and 30% for 1 and 2 points respectively; overlaying our recommendation for a continuous points reward (refer to Section 3.2) onto this would mean that more than 0 point is achieved for 0.1% to 14.9% improvement, and more than 1 point for 15.1% to 29.9% improvement. For the new credit, when applying the reference building pathway, we have proposed that the lower threshold is increased to 10%, i.e. 10% is the minimum improvement that needs to be achieved before points start to be awarded, and hence 1 point will now be achieved at 20% improvement rather than 15% (based on the upper threshold remaining at 30%). As such this represents an increase is the minimum standard of performance required in order to be rewarded by Green Star.

Given the above as applied to the reference building pathway, the obvious approach would be to apply the 20% improvement requirement for the DTS pathway, for which 1 point is to be awarded for demonstrable peak demand reduction. However, we have not adopted this for two reasons:

- The DTS pathway does not necessarily provide consistent reward with the reference building pathway for energy/GHG reductions; instead it is seeking to provide some sensible reward for demonstrable measures taken to improve building performance against an established benchmark (i.e. Section J). The principle is the same for PEDR, but with a different benchmark to suit the application (i.e. AS 3000). We have therefore considered some elasticity in the actual outcomes achieved between pathways to be an inevitable compromise in adopting two alternative approaches.
- The peak demand reduction calculated using the reference building pathway is likely to be larger than using AS 3000 owing to the inherent conservatism is AS 3000, all design attributes being equal (i.e. the total building demand calculated by simulation will be less but the peak on-site generation output will be the same). On this basis we considered a threshold less than 20% to be appropriate for achieving one point. 15% as the existing threshold would then be the next obvious choice, but there was concern that this could still preclude recognition for the majority of practically achievable PV installations, hence the tendency for projects to date to have only achieved points for this credit with the inclusion of cogeneration. As such, 10% was the appropriate choice which also aligns with the nominated improvement for benchmark for energy/GHG.

8 Other Issues

The brief to the project team was to address the credit development in the context of the existing assessment framework, and to focus on the credit requirements, not how it may be assessed in future. The focus was also constrained to the credit as it exists in the Design and As Built ratings, not the other Green Star rating tools. In light of these we offer here a summary of some issues which have been raised in the course of our discussions which were not material to our task, but which we believe should be addressed in the future development of Green Star. Other areas of discussion which have not been implemented but which we believe would be of value for future review and investigation are also described.

8.1 Connecting Predicted and Actual Building Performance

One of the observations raised in the consultation feedback concerned the rigour of the energy performance simulation method, and the fact that there is no feedback mechanism which differentiates "good" from "bad" modelling practice or outcomes. With this in mind, we briefly discussed a mechanism in Green Star Performance that would reward projects for being in alignment with (or better than) the modelled energy performance at Design and As Built, and potentially penalising those which exceed the allowance. Given the large variation in factors outside of the control of design team and facilities managers, some flexibility would be required in these in terms of tolerances, but this could be an effective way of driving more realistic outcomes from modelling (the perception of a "Green Star model" which differs from an "actual model" is undermined), and incentivising facilities managers to push the building performance beyond the model benchmark.

As an adjunct to this, we are recommending that project teams are required to provide monthly energy benchmarks by submeter from the energy model to assist the ongoing energy performance monitoring and management for the building. This is increasingly becoming a requirement on all projects where a NABERS Energy rating outcome is contractually required in order to inform the building tuning process and beyond.

8.2 Self-Certification of Energy Modelling

Currently the energy model is one of the most significant components of the Green Star assessment, and this does not appear likely to change. Much of the issue with assessment concerns the consistency of assessment and the different issues raised by different assessors, which can often be of a minor nature and not material to the outcome of the assessment. We recommend the adoption of a self-certification system which would allow for those completing or overseeing building energy performance simulation assessments to self-certify the assessment results. Such a system already exists in the New Zealand Green Star system. This would provide a suitable model for the system; the UK system of accreditation for those preparing Energy Performance Certificates (such as the CIBSE Low Carbon Energy Assessor scheme) would be another reference framework. We understand that the GBCA are currently reviewing this option and we strongly support this, and we have provided comments separately on the NZGBC framework which should be considered by GBCA prior to implementation.

8.3 Comparison to Reference Data

An additional pathway was discussed based on the use of reference energy consumption data for buildings against which the proposed building would be compared. Although in principle this is an attractive approach, and which potentially provides for strong coupling between Design and As Built and Performance rating tools, as well as addressing some of the concerns discussed in Section 8.1, a number of issues arise which we believe will make this impractical to implement, at least for the time being. Issues are outlined as follows:

- The extent of available data for existing buildings other than Class 5 buildings (which are covered by NABERS) is limited, though this remains an area of continuing research (e.g. DCCEE, 2012). NABERS offers ratings for building types other than offices, but the uptake of these has been limited. Owing to the

wide variation in usage and operation of institutional and industrial type buildings sufficiently broad data does not currently exist to allow for appropriate benchmarks to be set.

- The wide range of energy intensities of different space functions within buildings requires that energy use data is sufficiently resolved that these differences can be isolated. This is essential to facilitate the setting of appropriate benchmarks specific to the building under assessment. For example, attempting to compare two healthcare buildings, one a metropolitan acute hospital with large area of IPU and interventional suite, compared to a regional subacute hospital with small IPU and outpatient facilities, would not be equitable. Even where sufficient number of buildings may be included in a dataset to provide a meaningful basis for comparison, sufficient resolution is unlikely to be available, particularly for older buildings.
- Even where building energy usage can be suitably resolved, issues with operating profiles remain. Generally, buildings used for similar purposes would be expected to be in operation of similar numbers of hours per week, but even small deviations can result in significant variations in energy consumption depending on end use loads.
- By necessity the performance of the proposed building for a Design and As Built rating can only be determined by the application of computer simulation methods. The analysis would therefore be based on the comparison of a simulated model against a real reference case. As is widely documented, comparison of simulation and reality is fraught with many issues (not least the definition of the reference case as discussed above). Ensuring a fair comparison in all cases is a major challenge to the application of this method. It general, owing to the many simplifications and idealisations inherent in any energy simulation model, the model will provide a result which is better than will be realised in reality (all other things being equal).
- At the time of its introduction, NCC Section J included three verification methods (JV1, JV2 and JV3). Of these, JV2 adopted as its basis of analysis comparing the proposed design against a set reference value. However, this was withdrawn in c.2009 based on feedback from industry which largely concluded that the variations between cases were so large as to be unusable. This highlights the risk as discussed above.

At the current time we consider that the method proposed (i.e. comparison between two simulated cases) provides the greatest assurance of consistency in comparisons. As the dataset of operational building energy consumption is expanded (in which Green Star Performance is likely to be a key element), the potential for application of this method will increase, though any implementation will need to be cognisant of and seek to address the issues discussed above.

8.4 Residential Energy Monitoring Program

As discussed in Section 3.6, there is ongoing research in the area of residential energy consumption and hot water usage, with the Residential Energy Monitoring Program (REMP) being of primary note, and this continuing effort should be monitored as it will afford opportunities for refining the basis of the NatHERS performance calculation presented here (E3, 2014).

8.5 Evaluation of Deemed-to-Satisfy Performance Outcomes

The Deemed-to-Satisfy performance requirements for Class 3 to 9 buildings have been set without detailed assessment of the actual overall benefit that they would be expected to achieve in terms of energy consumption and greenhouse gas emissions reduction. There is therefore potential that the 5 points available will over- or underestimate the actual level of performance improvement that these measures will achieve. We recommend that some attempt is made to quantify these outcomes across climate zones and building types in order to validate the benchmarks set and to confirm their suitability (or otherwise). This could be integrated into the Design and As Built Pilot program when launched.

8.6 Alignment of Energy Performance Modelling Requirements with Indoor Environment Quality Credits

In the course of completing the category documentation, in particular the modelling guidance, we have had discussion with the consultant team preparing the revised Indoor Environment Quality credits (specifically Quality of Indoor Air and Thermal Comfort). These discussions have not proved conclusive at this stage, and we highlight the following items which require coordination in the final credits.

Implicit in the modelling criteria nominated for the assessment of naturally-ventilated buildings is the potential for a naturally-ventilated building to receive no direct ventilation when the ambient temperature is low. This is a real potential outcome, as occupants balance their preferences for control of temperature, draught, adequate ventilation and other factors. The impact of this occurrence on the intent of credit Quality of Indoor Air needs to be considered further, and, at the very least, it is recommended that the frequency of nil ventilation in zones should be reported. Note that AS 1668.4 makes no clear recommendation on this issue.

Owing to the increased risk of overheating occurring in buildings which are naturally ventilated only, i.e. there is no mechanical air conditioning installed, we also recommend that a thermal comfort assessment should be a mandatory requirement. The project would not need to demonstrate that points are achieved, only that the assessment has been completed and that the client is aware of the overheating risk. This is to safeguard against projects being immediately retrofitted with air conditioning after completion if summertime temperatures prove unacceptable, undermining a Green Star rating achieved on the basis of no installed air conditioning.

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Appendix A: TAG Feedback on Peer Review

The GBCA released the WSP recommendations report to the Green Star 2014 Technical Advisory Group (TAG) and Expert Reference Group (ERP) for their comment and response. General comments and queries have been incorporated into the Issues and Responses detailed above, but additional specific questions were raised by the GBCA, the answers to and comments on which are summarised here.

Do You Agree with Combining All Previous Credits into a Single Credit?

- YES: 73%
- NO: 27%

Specific comments were provided by respondents as follows:

In theory yes.

Agree less focus on particular initiatives (so combine) but still need to address a number of issues:

- *Have two separate credits - one for energy, one for CO2. Because it is possible to save energy without reducing CO2 and vice versa. Current approach to only focus on CO2 is meaning some excellent solutions are being missed, and similarly, just focusing on CO2 can allow Green star to be 'gamed'. Having both overcomes these issues.*
- *Separately consider a building's heating/cooling needs with the energy used to achieve comfort. This enables passive solutions that last the life of a building, need little maintenance, and basically can't go wrong to be recognised - at present GS allows an over-engineered solution to be implemented that in some cases is never actually used. IF GS recognised separately a buildings need for energy, and also its efficient use of energy then potential for encouraging perverse outcomes is minimised, users have less ability to 'game' the system and a better environmental outcome is achieved.*

Yes. This provides a clear approach where the Energy Category focuses on operational energy performance and associated GHG emissions.

Lighting power density credit is worth keeping as a separate item. Lighting is a big part of building energy use, and this credit explicitly incentivises low power lighting solutions. Keep it. Don't just put it in as part of the energy model black box.

Lighting zoning credit has incentivised the use of DALI. This is a good thing. This credit should be amended to relate to automated control of lighting systems - rather than focusing on user controls. Incentivising specific design features is a good approach. Lumping them all together into one energy credit won't be as effective.

Add credits relating to building fabric performance:

- *Commitment to air tightness and pressure testing;*
- *External shading for over 80% of E, W and N facades;*
- *Double-glazing and thermally broken frame systems; and*
- *Window-to-wall ratio.*

Change Peak Energy Demand reduction to Renewable Energy Systems. Need a better way of incentivising the installation of sensible renewable energy solutions (PV and Solar Thermal - NOT trigen!). There should

be a point in the renewable energy credit for doing a proper renewable energy feasibility study (like BREEAM).

Projects should be encouraged to utilise specific approaches. The risk with one credit approach is that, for example, a building can be very inefficient with high lighting power densities, but if a gas powered tri-gen is installed the result could be adequate. There should be some specific initiatives that need to be addressed in addition to the overall energy use result. I would support in principle a consolidation of this credit, perhaps retaining Energy, GHG Emissions, Lighting Power Density, and Peak Energy Demand Reduction as separate credits.

Energy category should link into the performance tool which ultimately will be a measurement of the base building energy consumption - including the impacts of renewable energy etc. These items should not be treated as separate items in the analysis.

I don't understand why embodied GHG emissions have not been included. As buildings become more and more efficient, the embodied emissions will become more and more important. I strongly recommend including an additional credit for projects that calculate their embodied emissions and I believe more research should be done to understand the best way to incorporate Scope 3 emissions into the GHG emissions credit. Additionally transport emissions may need to be included in this study so that Scope 1, 2 and 3 emissions can be considered.

The proposed single metric is trying to capture too many aspects of exemplar design and we do not believe that it will successfully achieve this. We would recommend maintaining carbon emission credit, with an expansion of the peak energy demand credit (discussed in depth later) and consider the introduction of a new energy credit that is specific to the promotion of renewable energy technology. The revised 3 credit energy score would tackle carbon emissions reduction, facade efficiency improvement and renewable technology uptake in buildings.

No - some early developing tools (e.g. MUR) need specific guidance on more particular aspects in order to shift the market. Also, the GHG ratings as proposed do not sufficiently cover the required areas, e.g. energy efficient appliances and unoccupied areas.

This category also needs to cover renewable technology in a way that advances the market and does not simply apply this tech at building scale.

Do You Support the Revised Credit Having Three Pathways to Compliance?

- YES: 73%
- NO: 27%

Specific comments were provided by respondents as follows:

Need to be careful with DTS - it can lead to perverse outcomes that are worse for environment. This is particularly true in high performing buildings. As 'low hanging fruit' they can be good, but if the building is designed with a particular system to reduce energy, DTS initiatives can actually reduce performance. Therefore limit points available (and be careful with initiatives).

In principle, yes, however the process of managing 3 pathways will be unnecessary complicated. In the majority of cases, buildings with a NABERS rating would also have had to produce a JV3 model. The three paths are not likely to be comparable (e.g. 7 credits for paths 1, 2 and 3 are not going to be comparable). The administration and assessment of the three options would be difficult, as well as projects determining the best pathway to take. Some paths have limitations (e.g. Path 2 can only be used for Offices due to the use of a NABERS rating).

Path 1: The introduction of a DTS approach is welcome. The use of ASHRAE 90.1 Advanced Energy Design Guide as the compliance path aligns with LEED, which is good, but is not a well-known standard/process in Australia. It may be better to make a bespoke list of DTS requirements that is closely aligned with the 90.1 AEDG, but is tailored for Australian conditions, and uses the BCA Climate Zones, rather than the ASHRAE climate zones. Path 2: Reference to NABERS and NatHERS is good. However, the NatHERS pathway in Table 24 needs work.

I suggest a 4th pathway – comparison of an energy model of the proposed design, against a benchmark with the % improvement above the benchmark determining the number of points. The benchmark would be the average energy consumption (kWh/m2/annum) derived from a data set, managed by the GBCA, with GS Performance buildings feeding data in to it, so the data evolves over time. Starting point for the data set can be the CBBS Report (Baseline Energy Consumption and GHG Emissions in Commercial Buildings in Australia Nov 2012 by the COAG National Strategy on Energy Efficiency). I think using a real world performance benchmark as the starting point is better than creating a reference case energy model.

For any energy model compliance path, include a requirement for Peer Review of the Energy Model like the NABERS Commitment Agreement process. This will bring conservatism and consistency to the energy modelling process.

An observation on Pathways 1 and 3 are that they both rely on the actual building being compared to a simpler version of itself, rather than against a third party developed benchmark as is the case for Pathway 2. For Pathway 2, third party recognised benchmarks have been established for Office, Retail and Data Centres by NABERS, and for residential dwelling thermal load by NatHERS. Other building typologies will require benchmarks to be set for Pathway 2. Pathway 2 is essential for holistic design approaches to be fully recognised.

In line with the aim of making certification simpler and easier 3 pathways allowing flexibility seems a good option.

Whilst I agree that existing frameworks should be utilised as much as possible, care should be taken as the benchmarks/methodoligies set out in these frameworks are outside the control of the GBCA. So any changes (like the way NABERS changed the reporting of the Normalised GHG Emissions) or changes to the benchmarks may/will result in the three pathways providing very different results and may result in different project teams achieving different points by using a different benchmark on essentially the same building. Setting the revision date causes problems with teams

This is a fantastic approach, especially the inclusion of a DTS pathway. This should reduce the complexity and cost of submissions for smaller buildings but also provide guidelines for energy efficient design. Well done.

We support Method 1 DTS, using a metric based on NCC DTS improvement scoring, limiting maximum point score. We support Method 3 Compliance against a reference building improvement.

We do not support Method 2 as the method uses an assessment of energy efficiency against a common baseline performance, which we believe would be difficult to benchmark against the other proposed methodologies. It is important that each metric used correlates accurately to similar building performance. Method 2 has limited application. Generally as an organisation we feel that NABERS is currently progressing down a track that is providing road blocks to low-carbon energy use in shared systems and precincts. I feel that NABERS may still have a place within the rating scheme but should be limited to projects that do not have shared energy systems or cogeneration systems looking to export energy.

Many office buildings are still targeting 4/5 star ratings and do not need to consider expensive energy systems to achieve that outcome. For those projects NABERS can still work quite well, but that should be the only case.

Care must be taken to ensure that points awarded under one method would be commensurate under the other two methods.

Existing frameworks are strong and well established; BCA is a tool that is already being utilised on all projects. BCA + 10% should be base level. Exception is NABERS with cogen, with no reward for off-site cogen in carbon terms. Fundamentally, efficiency of the building should be awarded, with demand and emissions jointly credited (refer NZ Green Star, as well as BREEAM).

In Order to Achieve Maximum Points, the Building Must be Assessed Using the Comparison to Variable Performance Method

Specific comments were provided by respondents as follows:

I think this is a good approach as it provides consistency of approach across all building types.

Yes, strongly agree with this approach. Even NABERS have recognised that fixed benchmark (NABERS Office) have issues - hence their later tools (Shopping centres, hotels etc) both use variable benchmarks - a benchmark that reflects the building configuration and use - and then recognises improvements beyond this. Even BCA follows this method for JV3.

Agree with needing an energy model to achieve the highest number of points. However, many improvements are recommended to be made to the current GS PB methodology however it is a good starting point.

If the GBCA utilise a methodology based on the NCC BCA only, projects will not be able to achieve high comparative reductions and therefore high scores as within the NCC BCA methodology, the proposed building and reference building both have to have the same equipment and profiles. Therefore, projects are not rewarded with major innovations in Building Services delivery.

Yes

Partly. This option should not be available for Offices - because we already have the NABERS Commitment Agreement Process, if an office chooses the modelled approach (rather than the DTS path) they should be required to use the NABERS CA process. It also does not apply to Resi - because they should use the NatHERS method. So this method would only be available for Education, Healthcare, Industrial and Retail Buildings.

Need good guidelines about how to set up the reference case and the proposed building.

All models should have to be peer reviewed. For any energy model compliance path, include a requirement for Peer Review of the Energy Model like the NABERS Commitment Agreement process. This will bring conservatism and consistency to the energy modelling process.

I also think there should be another option - comparison against benchmarks. Comparison of an energy model of the proposed design against a benchmark with the % improvement above the benchmark determining the number of points. The benchmark would be the average energy consumption (kWh/m2/annum) derived from a data set, managed by the GBCA, with GS Performance buildings feeding data in to it, so the data evolves over time. Starting point for the data set can be the CBBS Report (Baseline Energy Consumption and GHG Emissions in Commercial Buildings in Australia Nov 2012 by the COAG National Strategy on Energy Efficiency). I think using a real world performance benchmark as the starting point is better than creating a reference case energy model.

The key issue with this is 'gaming the reference case' to improve performance. Projects will seek to construct hypothetical designs that are more substantial than theirs rather than actually improve energy performance. Policing this would be incredibly difficult.

It seems reasonable.

I would prefer this Pathway to measure the building performance against a benchmark. The problem with the current method is that the team is required to measure their buildings performance against a NCC/BCA DTS version of itself. This does not recognise design features such as orientation, massing, the use of atria, thermal buffers and break zones, additional circulation GFA and so on to reduce thermal loads and energy use. All of these features are required to be present in both the actual and reference buildings, with the only variables allowed being lighting power density, motor efficiencies, glass selections and so on. This is a barrier to holistic building design, passive techniques, and the use of indoor/outdoor spaces as thermal buffers, and promotes the use of technologies as the solution to gaining more points. This is a mistake and has been driving the use of technologies for some years now, rather than good design. In addition, the metric for variable performance improvement should be energy, and not greenhouse gas emissions. GHG should be separately measured and rewarded to provide a balanced reward of energy efficiency, and emissions profile.

I agree that energy modelling should be required to achieve max points. It should be noted that energy modelling is not just a comparative tool - it is also a design tool. Perhaps some evidence of the feedback process used during the design based on the results of the energy modelling.

Yes. To claim maximum points the rigour of the modelling must be demonstrated.

Yes, I agree. I do think that projects should be required to report their energy performance for a number of years, similar to LEED, with the aim of drawing out lessons learned so that the industry can close the design-to-performance gap.

We agree that the comparative energy model assessment is the most robust way forward. We believe the carbon emission assessment could be enhanced if a wider analysis was conducted. We propose a 3 criteria split of the energy assessment with expansion and modification of peak energy demand reduction assessment and specific renewable energy analysis. By reducing external climatic effects on internal conditions of buildings we can reduce resultant energy profile variations, diurnally and annually. A "Utopian" building design with highly insulated facade could reduce cyclic energy responses to that of internal loads only, with very little solar load HVAC peaks present and minimal seasonal energy climatic shifts in consumption. Whilst HVAC technology can smooth peaks, ultimately it is the facade of a building that insulates climatic response from HVAC systems. Peak Energy should consider all energy streams and not just electricity in order to measure this. Combined with carbon emissions assessment the original core goals of current peak demand credit would also still be met. Most importantly this would moderate some of the incentives to install CHP plant. A carbon emission improvement benefit would remain but would no longer gain many credits in demand reduction as the gas consumption would be considered. Better facade performance arguably provides one of the best whole life cycle outcomes for a building. Lifecycle assessment is proposed to be analysed through carbon emissions efficiency in the proposal paper, but we fear that this would be extremely complex. If combined with a stronger energy demand assessment this could be promoted more simply. We also suggest that a dedicated renewable energy system energy reward point system be provided, to improve uptake of renewable systems in building designs, sadly lacking in Australia at the moment.

Yes, this approach should be used. Projects should aim to address the performance gap that exists in most projects though, by establishing anticipated operational profiles (for example) and not simply using defaults.

How Could Compliance Be Demonstrated in a Mixed-Use Building Where Different Compliance Pathways Are Applied?

Specific comments were provided by respondents as follows:

This is tricky, it maybe that mixed use buildings need to have the credit compliance looked at individually.

If a project has gone to the effort of modeling one part of a building, then they should model the entire building. It is not sensible to try and merge.

However, if absolutely necessary, could apportion in similar way to described above for DTS (consider the number of weighted points available (not achieved) for each building class.

There is not clear methodology for how this could be done successfully. The complexity in the differences between building types are too great for a DTS assessment to be appropriate.

Ideally a project should pick one method for the entire site (DTS or modelling).

Based on GHG emissions. Using DTS should have a deemed GHG measurement.

By modelling and then benchmarking each use separately.

If modelling and DTS are used in different sections, points should be restricted to the lower of the two different approaches.

Don't benchmark against ASHRAE 90.1, use NCC a local standard that everyone is familiar with. You can benchmark improvement of baseline lighting, fan power, HVAC efficiency etc against in the NCC for each building type.

Do You Agree with Including a DTS Pathway?

- YES: 100%
- NO: 0%

Specific comments were provided by respondents as follows:

I question the use of a guide that is based projects operating in different climate zones, additionally the guide for office buildings is for small office buildings. How easily does this translate to buildings operating in Australia and of a larger scale?

What is the difference between using ASHRAE to Section J JV3 both are undertaking a comparative analysis and Section J would surely be more appropriate to Australian climates???

As ASHRAE Advanced Energy Design Guides only apply to some building types, an equivalent document will need to be prepared to cover other building types (recognise this is a long-term project)

Presume it is intended that a class of building within a project can EITHER use DTS or a performance assessment (against fixed or variable benchmark). Ie projects can't be rewarded for implementing some DTS provisions,and then getting further points for modeling - to avoid double up.

DTS points should become NA when following a performance approach BUT Performance points should NOT be NA if following a DTS approach. This ensures an incentive remains for projects to pursue an approach that is likely too achieve a better outcome - if this isn't clearly encouraged, then projects are likely to choose to achieve (say) 10points using DTS rather than 12 points for Performance. (as the DTS points would be low risk compared to Performance - so many just would not bother doing the model - and without doing the model many opportunities may not be identified .

AECOM agree with the implementation of a DTS methodology to minimise the cost of obtaining a Green Star rating. This will be of greatest benefit to smaller projects. However, why not use the NCC BCA Section J guidelines?

With respect to the ASHRAE AEDG's, more work needs to be done to confirm the alignment of the climate zones with the BCA. The high level assessment provided does not contain enough technical rigor. There is a lot of work that needs to be done to develop a DTS methodology based on the NCC BCA Section J, therefore, it is recommended that the GBCA hold-off on releasing a DTS methodology until the ASHRAE guidelines are amended to be correct for Australian conditions, rather than release the option based on ASHRAE.

Yes in principle because it aligns GS with LEED.

Need to match up climate zones - The ASHRAE AED Guide has a table of specific minimum performance requirements for each climate zone.

Table 23 on page 52 is not right. It matches ASHRAE Climate Zone 4 (which includes New York City) with BCA Climate Zone 5 (which includes the City of Sydney). Clearly New York and Sydney have different climates. This needs work if it is going to be a sensible guide for Australian buildings.

We should develop an equivalent Australian version of this guide specific to our climate zones.

Yes - A checklist style approach is more preferable in my eyes to energy modelling. Projects should receive points for (as an example) removing cooling/heating systems (appropriately designed by the team). The current approach in modelling focuses on improving the estimated energy consumption rather than improving the actual energy consumption for the building.

It's a great idea. I'm concerned that the guides are in imperial units and written for the US market - what is standard construction practise there, may not translate well here. I would like to see peer reviewed australian versions developed.

Anything that can be done to simplify the process for simple buildings should be encouraged.

Whilst ASHRAE is an American Standard, with suitable guidance on how to 'translate' the climate zones and system types etc, this is a very useful guideline. I am unaware of an Australian document of the same standard. Points should be capped to what would be typical for a 4 Star building only - i.e. buildings should generally need to do modelling for a 5 Star and 6 Star building without necessarily making this an explicit requirement.

A number of the proposed DTS solutions reference performance outcomes can lead to perverse outcomes (i.e. if you have a studio apartment (designed for 1 person) that has installed an a/c system that was designed for the size of a family home, just because the unit installed has a high star rating, is this still energy efficient?). The concept of "right sizing" needs to be considered across all these initiatives.

We do not think the introduction of a foreign standard for the DTS compliance is advisable. We believe that DTS NCC already creates performance standards that could be benchmarked for use in Green Star. We think that strong alignment with local standards is important.

While the intent of the guides is great, they have been developed in and for a US market. They should be revised and/or tested for the local market. They also apply only to a limited range of building types and sizes. They could be useful on this scale.

Should the Number of Points Available via the DTS Pathway Be Limited?

- YES: 80%

- NO: 20%

Are the ASHRAE Advanced Energy Design Guides Suitable as DTS Critieria?

- YES: 53%
- NO: 27%
- Did not respond: 20%

Are There Any Other Suitable DTS Guidelines?

Specific comments were provided by respondents as follows:

Section J improvement? What does a 30% improvement on ASHRAE 90.1 represent in terms of Section J improvement? Are we not better off using a standard/guide that is regularly updated and that we can as a user group petition to change/improve as required, rather than using a guide that we have no influence/interaction with?

It is suggested that the DTS methodology be based on the NCC BCA Section J, and supplemented by ASHRAE 90.1 for unusual equipment types. (e.g. fume cupboards).

The ASHRAE standards are large and complex, therefore, it is recommended that as part of the methodology the GBCA produce an ASHRAE summary document for different building types to ensure inputs are consistent across all projects selecting this compliance pathway. This will also ensure that assessors are easily able to determine compliance.

NCC BCA Section J could be used. With specific performance improvements above the minimum compliance criteria for different aspects of the building fabric and services.

GBCA should develop its own checklist - something like this:

https://www.wattlerange.sa.gov.au/webdata/resources/files/Energy_Efficiency_Checklist_2010_to_go_with_newsletter_300_.pdf

The WA Building Commission has developed two check sheets for class 1 and 10 residential buildings that can be used to aid compliance with Part 3.12 Energy Efficiency of the BCA.
http://www.buildingcommission.wa.gov.au/industry/codes-standards/energy-efficiency/check-sheets

It would be worth conducting an exercise to develop a simpler tool in line with the residential (BASIX style) approach for non-residential buildings; i.e. facade type drop-downs, building services drop-downs, etc. Someone could do a modelling exercise of all permutations to provide guidance on how many points are achieved for any given combination of selections. Imagine how much time, money and modelling this would save!

Should Projects Be Able to Demonstrate Compliance By Providing Evidence of Another Award?

- YES: 73%
- NO: 27%

If Yes, Which Assessments Should Be Recognised?

	NatHERS	NABERS (for Offices)	NABERS Commitment Agreement
▪ YES:	73%	93%	60%
▪ NO:	27%	7%	33%

Specific comments were provided by respondents as follows regarding the use of a NABERS Energy Commitment Agreement:

This could be possible for projects, however they should also show that the modelling/reports have had their peer review undertaken, in order to show that the commitment has been carried through.

Modeling for commitment agreements is always much more conservative (predicting higher energy usage - about 20 to 100% higher), than modeling for Green Star - as the modeler is trying to complete a model that reflects reality. As such, projects following this approach would get less points. So, not many projects would use it, however it is important because of the message it sends to the industry, and it takes away some of the reasons 'not to go Green Star'

Yes. However, this is unlikely to happen very frequently. This approach is likely to result in a poorer rating, as in practice, projects generally design to a higher rating than is committed to ensure the performance is achieved.

Yes. The NABERS Commitment Agreement process, incorporating the Independent Design Review is a very good and robust method for verifying that the energy model is a fair prediction of real world performance. The Commitment Agreement is based on a verified energy model - so it's not really right to say "submit a NABERS Energy Commitment Agreement... RATHER than energy modelling results". All office buildings should have to go through the NABERS Commitment Agreement process. This should be the default modelled compliance path for offices. If you want to get an Office Green Star rating, you should HAVE to do the NABERS Commitment Agreement process.

For a design rating - yes because the rating will lapse after a certain time anyway.

NABERS commitment includes a requirement for computer modelling for 4.5 star performance and better. The use of a commitment agreement should not be allowed for 4-star performance.

This should be removed from all new tools, as it exposes the GBCA to risk that the building does not perform as per the commitment agreement provided. This should be modelled and proven by the project team.

Not for As Built - should be based on actuals.

The commitment agreement requires a detailed review of the energy model. Teams will generally sign a commitment agreement for a lower savings than they really predict - so accepting a commitment agreement would be worst case result for a project - if teams want to accept less points to save the effort of resubmitting the Energy Report in a GBCA approved format then they should be able to - although I doubt I ever would do this.

It is my understanding that a NABERS Energy Commitment Agreement can be put in place without any modelling being undertaken therefore a commitment agreement by itself should not be able to be substituted for energy modelling results.

Green Star should stick to Method 3 approach and create a solid benchmarking structure around this methodology.

Though a Commitment Agreement is not a guarantee of performance - there is no penalty for non-compliance (though the same could be said regarding the current 'performance gap' between any modelling tool and operational performance results).

What Should Be the Minimum Performance Specified for the Conditional Requirement?

4-Star NABERS	4.5-Star NABERS	10% Improvement on BCA	6-Star NatHERS
33%	53%	80%	47%

Specific comments were provided by respondents as follows:

The 1/2 star improvement for residential should be based on the State regulated performance requirements. Remember for MUR it's an average of 6 stars with a minimum of 5, although this will vary in each state.

So the baseline performance should be a 1/2 star improvement on the regulated average for a MUR project.

Be very careful. Remember NATHERS is about a buildings need for heating/cooling, whereas NABERS is about energy used. Combining two completely different benchmarks into one credit will cause problems. Very, very careful wording of credit will be required, but even then there will still be a discrepancy in what the credit actually achieves between these two. This could deliver perverse outcomes or potential gaming of system.

This would be overcome by separating heating/cooling need (NatHERS and first part of BCA Section J) from energy use (NABERS and 2nd part of BCA Section J).

The only other relevant guideline is the PCA guidelines which stipulated that for most building types (all except Premium) a 4 star NABERS Energy rating is required as a minimum performance.

However, the NCC BCA guidelines cover more building types and are therefore the most appropriate baseline for Green Star to use.

10% improvement on NCC Sect J implies a JV3 model. For JV3 there are 3 versions of the model 1) reference fabric + reference services; 2) proposed fabric + reference services; 3) proposed fabric + proposed services - need to clarify that this is 10% improvement comparing model 1) to model 3). Can't just have blanket 10% improvement on the Section J DTS criteria - won't work. Particularly because the Section J DTS Glazing Calculator is flawed.

For Resi NatHERS system is based on ABSA model - which focuses on thermal envelope performance - which is good. 6.5 stars is probably ok for the conditional requirement, but for the main energy credit you need a NatHERS target, plus a list of other requirements to address minimum lighting power efficiency, HVAC efficiency, and consideration of solar thermal hot water, BIPV etc.

In terms of equity between building types: 6.5 star NatHERS for resi is probably harder than NABERS 4.5 Star for offices.

4 Star NABERS Energy for Offices. A 10% improvement on NCC BCA baseline for all other building types including residential (the mandated star ratings change and can be different in each state). Referring to previous comments, what would be better however is for buildings other than offices to have the baseline benchmark specified by the GBCA, rather than asking for the project to measure itself against a dumber version of itself.

I believe the conditional requirement should step up for 5- and 6- star ratings. For 5-star: 5-star NABERS, 20% improvement on BCA, 1-star improvement on NatHERS. For 6-star: 5.5-star NABERS, 30% BCA, 1.5 star+ NatHERS. What would be ideal is an absolute energy demand benchmark per m2 for each building type but we don't currently have the data to support this approach. We should move away from using CO2 as a benchmark as the grid will eventually decarbonise and energy efficiency will become exposed.

We believe relating the pass mark to local benchmarking systems is important. We do not believe that successful correlation with NABERS Energy benchmark would be possible. With the move lately by NABERS and CBD to isolate export to tenants or assess precincts energy exchange properly, we do not believe that it has a place in the proposed Green Star approach at the moment.

Are There Any Other Frameworks That Could Be Applied for Residential Buildings?

Specific comments were provided by respondents as follows:

This is an accepted framework nationally, that is regulated and provides consistency of the approach to modeling. Remember all that is needed for the Residential Energy credit is results from the NatHERS modelling process not a NatHERS certificate as this becomes complicated in terms of what constitutes a NatHERS certificate in different states or at least in Queensland compared to NSW.

NatHERS is only for heating/cooling load. It doesn't cover all the other components - like equipment and lighting efficiency, renewable energy etc. So, if NATHERS is used, there must still be a way for the benefit of these other initiatives to be recognised.

A NatHERS rating does not provide enough information to demonstrate compliance. A NatHERS rating provides only results of a thermal assessment (energy transfer), it does not account for additional energy uses, and does not account for energy utilized throughout common areas. Therefore, a NatHERS rating can only be used for a DTS approach.

NatHERS is not an operational energy metric.

Currently in the MURT tool, the NatHERS rating forms only a part of the energy assessment, projects are still required to add all other energy uses to receive an overall result. This methodology should be retained.

Need NatHERS plus a checklist of best practice measures (like BASIX, but better). NatHERS only deals with fabric, whereas the energy credit needs to provide criteria for lighting power, HVAC and equipment efficiency.

In fact, assessing the thermal fabric under a NatHERS-like framework for more asset types would be ideal - as it would favour passive design rather than just plant efficiency and add-ons like trigeneration and PV cells.

I've ticked "No" only to flag that a NatHERS rating is not a measure of the energy efficiency or energy use of a residential unit. It is a measure of its thermal load. This is recognised by the current MURT tool which requires all other energy uses to be calculated and taken into account, measured against GBCA set benchmarks (my preferred approach as mentioned previously). It can be used as a starting point from which to estimate a comparable air con energy number, but not as a whole measure of energy for a building.

NatHERS should be the basis for calculating the HVAC energy but other energy uses as per current MUR tool. It should be noted that the NatHERS modelling currently contains known faults - these will be corrected/updated (eventually) and this will require the benchmarks to be corrected/updated.

Residential - NatHERS is insufficient on its own. A dwelling with a high NatHERS star rating can still have a very poor energy performance with appliances, overconditioning, etc. At a minimum something like the BASIX approach should be used.

Generally - ideally a real absolute energy consumption benchmark should be used, and a predicted energy consumption model used. I also believe Green Star ratings should be a 'live' rating such that if performance drops in certain areas, points are lost and the rating is downgraded. Is there a plan to move every building to Green Star Performance? Why not do this and use design and as-built milestones as checkpoints? After all, we should be trying to drive performance outcomes.

Which Points Scale Should Be Used to Award Points?

- Linear: 53%
- Non-linear: 47%

Specific comments were provided by respondents as follows:

I believe it is a good change. Projects that are pushing the envelope in terms of the energy efficiency and reduced operational GHG emissions should be rewarded and not be reliant upon targeting some innovation credits in order to boost their weighted points.

Slight preference for Linear, but would be comfortable with non-linear (but no option to select 'either' in this survey). A 5kg/m2 saving has the same environmental benefit regardless if it reduces the buildings emissions from 100 down to 95, or from 10 down to 5. however, I do recognise it is much harder to make reductions when building is already down at the 10 level, so could accept that extra encouragement (more points) to be worthwhile (as this pioneering effort will improve rest of industry over time).

The proposed approach will result in a substantial change in the points available to most projects, and in many cases disadvantage many current and past projects. Many Green Star projects do not have the scale, space, budget or energy use profile to include the use of low-carbon energy (i.e. cogen/trigen) or onsite renewables. Therefore, too many projects will be capped in terms of points. I agree Green Star should continue to push the boundaries of what is being achieved today, however, I am unsure of what the Green Star tool is trying to achieve with this stretch target? It will add unnecessary complexity to the category. Because of the skewed weighting, is achieving 5 stars under this non linear method possible without implementing significant energy saving measures??

Should be awarding small steps of improvement.

Not sure about this idea.

The focus of GS 2014 should not be on incentivising zero carbon or restorative buildings. The focus must be on making it simpler, cheaper and more accessible to smaller projects and non-office building types.

The non-linear scale further skews the rating tool to reward exemplar zero carbon type buildings, which are rare, and tend to have generous budgets. The non-linear scale discussion is not an important area to focus effort on. Unless it helps smaller projects and makes the tool simpler and clearer - leave it as it is. The non-linear scale brings more complexity to the tool, and I don't think it adds that much value. So leave it linear.

While a non-linear scale would seem to reward projects better that undertake more bold designs such as Natural Ventilation, the concern I would have would be that rather than implementing this, it would seem projects would have further incentives to provide more favorable energy consumption (and GHG emissions) calculations instead.

This is commensurate with all other recognised energy rating schemes. If a non-linear scale is adopted how will this be reconciled with pathway 2?

Achieving points in this credit become harder as you move up the scale so non-linear points are appropriate reward for the additional effort.

I agree that more points should be awarded the closer you get to a net-zero energy building. The scale will need to be selected to ensure that 4 Star ratings still are typically available for 'Australian Best Practice' buildings etc and not mean that a typcial building cannot achieve enough points in ENE to get a suitable rating.

I agree that there should be more incentive for projects to make the investment to achieve better energy outcomes and as the cost increases on a non linear scale the points should too.

This is an excellent idea. However, I believe the current scale will result in the bulk of projects targeting fewer energy points. I believe the curve should be more of an 'S' curve such that a group of points (e.g. 10) are available for passive design performance on a steep rise falling away (similar to a log curve) for the next group of points for efficient services and then rising exponentially towards and beyond carbon neutrality. This will incentivise passive design, which the proposed scheme fails to do.

We believe that promoting positive energy reduction before industry has developed achieving carbon neutral performance properly is a step too far. There are already many examples where Green Star has rewarded large CHP plant in its rating system that doesn't work in practice and this is a negative outcome. A non linear scale would introduce a rush of dubious design practice rather than supporting more robustness in design.

Non-Linear scale is not necessary. This also distorts the energy category, should there be more than one credit, negating the effect of other initiatives.

Should Restorative Performance be Awarded in the Credit or in Innovation?

- Credit: 40%
- Innovation: 60%

Specific comments were provided by respondents as follows:

It is important to keep some consistency and start to award projects within the main credits for pushing the boundaries and not having it as an outside credit. We are at a point now where we know that most building with a good design can achieve a 5 Star rating, Green Star should readjust the bar and sometimes this means dropping some credits and introducing new ones.

Restorative within Ene provides too much incentive for user to Game the model - so it predicts outcomes far in excess of real capability. It can also encourage 'creative accounting', where a benefit is demonstrated but only because of the way the numbers are reported. For example, some projects arrange energy/co2 summary so that effectively the CO2 is exported from the building...

This should be in the Innovation category, but listed as a Challenge with credits guaranteed.

The Energy category should be capped at carbon neutrality only. As mentioned above, such a large amount of onsite energy generation is only possible on certain projects. They should receive Innovation credit, but all other projects should not be disadvantaged with lower weighted Energy credits.

The focus needs to be on bringing standard practice up to good and best practice, not so much on pushing clients and project teams to zero carbon and beyond. That kind of client is rare. Focus on the bulk of the market, and what we can realistically push them to do. Innovation is fine for restorative idea for now.

It is still an innovation for most projects to be carbon neutral in operation - which is recognised by a maximum score in the current energy credit. Restorative energy generation should be rewarded via innovation credits. An inflated scale of points will encourage investment in generation technologies only, rather then the building or other more holistic design approaches, as "dollars for points" will win out every time for energy technology approaches. Example: a 3-bed residential dwelling with 3kW of PV, built to basic NCC standards, would achieve 34 points. Is this appropriate?

An energy-positive building should be rewarded if it using currently-available technology. Additional points could also be accrued on the sole basis of innovation.

Having Restorative in the actual credit signals strongly the vision for the future. Having it as an innovation challenge could be seen as making it a 'special case' rather than seeing it as the future mainstream.

I think restorative points should be included as an Innovation option (exceeding the benchmark) as it is still very uncommon to even achieve net-zero energy.

I agree that awarding in the credit takes out the uncertainty of whether it is innovation or not.

I believe this should be rewarded in the credit as it is not an innovation - if you allow offsite renewable energy credits to be purchased (which I support). The Innovation category should be reserved for true innovation.

Commonly some energy export is already necessary to achieve net carbon neutral status. Building clean energy export buildings is still a way off and should be approached very carefully. It should reside as an innovation provision only to protect the robustness of the Green Star rating system.

Restorative is so far advanced in the market that it is still innovation. Perhaps in the next version of the tool!

Should Green Power Be Recognised in the GHG Emission Credit, and How Should It Be Included?

Specific comments were provided by respondents as follows:

No, the purchase of Green Power is not linked to the design of a building or built form of a building. It should be awarded possibly in Green Star Performance.

No, should not be considered. It is not a characteristic of building - if it was implemented, projects will be discouraged from improving a building. And the organisation purchasing a building may expect that because it is GS rated it should have low running costs and high comfort, but the reality could be the opposite. This would open GBCA up to criticism in the future.

IF external Green Power had to be considered, then either the benefit would have to be limited to one or two points (out of 30-40 points in Energy), OR the points could only be achieved if the building had already achieved (say) a 70% reduction in energy usage (and even then, the number of points available should be limited. Of course the project would need to advance purchase say 20 years of this power (not just commit to it, but pay the $) to ensure it actually happens (commitments, and even contracts can be changed to easily - for example a contract between Building A and Supplier X to purchase 5kWh of Green Power for the next 20 years can be negotiated out when (a year later) Building A signs a new contract to purchase all their power (not just Greenpower) from Company X for the next 2 years.

Also, the amount of Green Power would need to be related to the reference case (ie 20% of reference case buildings annual energy consumption (20 years worth)), and not related to the buildings modeled energy

performance. Otherwise model will show that the building uses negligible energy, and therefore very little Green Power would need to be purchased.

No. The use of off-site certified renewable energy does not promote building solutions, the premise the Green Star tool was developed on.

Off-site low carbon energy has been approved by the GBCA in many cases as a physical connection exists (i.e. HHW line) between the generation facility and building. However, even the signing of a long term contract for off-site renewable energy purchase to gain Energy credits goes against the purposes of the Green Star tools.

Not a fan of 'buying' points by signing up to Green Power.

Yes. Absolutely. Have a separate credit for renewable energy. This would replace the Peak Energy Demand Reduction credit.

The renewable energy credit would reward both on-site and off-site renewable energy systems. It should reward 1 point for doing a renewable energy feasibility study. Then it should reward small increments of % renewables against annual building energy demand. e.g. 0.5 points for 1%, 1 points for 2%, 1.5 points for 3%, 2 points for 4%, 2.5 points for 5% etc...

The current PEDR credit thresholds of 15% and 30% of peak demand create perverse incentives leading to oversized trigen systems. Need to avoid this.

However, to get credit for purchasing certified off-site renewable energy (green power) the project team should have to buy enough certificates for the building's expected service life (e.g. 60 years). So to use RECs to show 1% of building annual energy demand, you would have to calculate annual energy demand times by 60 years, then buy certificates to offset 1% of that 60 year kWh figure. This will ensure that on-site systems will still be considered by project teams.

Purchase of LGCs and STCs should be allowed to be recognised with a few caveats. Abatement should be sourced upfront (even for the design rating) and the credits are effectively taken off market and "destroyed" through some process. A couple of things are suggested:

- *Abatement is purchased upfront for a period of (say) 50 years. This effectively raises the hurdle to purchase RECs, inviting projects to undertake more energy efficient design considerations rather than just buying certificates*
- *RECs are "surrendered" at that point to prevent them being re-sold.*

Associated considerations include:

- *Linear vs non-linear should be examined in this context*
- *Points should be 'smooth' rather than lumpy to prevent projects buying up small amounts to get to the next point.*
- *It may be that state-based coefficients should be abandoned altogether, otherwise buying RECs would be more valuable in VIC rather than TAS.*

Yes, 100% Green Power should be included in the GHG credit or energy category.

One point should be available to buildings using DTS compliance and achieving a low number of points e.g. less than 20% improvement on the baseline, and NA for projects which install renewables.

No it should not. This is not a building design feature.

Yes, but only if an appropriate agreement is in place and/or a dedicated generation facility is associated with the development, e.g. a windfarm supplying a development.

No - unless the building developer is putting up offsite renewable specifically for this building and that it is linked in some way directly to this building. As this is such an uncommon situation it should be treated as an Innovation.

Any sort of grid connected offsite supply should be considered in the Performance tool. It is too easy to change the operation of this power supply i.e. change the contract to remove the renewable energy component, in which case the environmental benefits are not met for the lifetime of the building.

No. While projects may be required to provide a contract with an energy supplier demonstrating the provision of Green Power for a set amount of time there is no way of ensuring that this would continue past the expiration of the contract. This would seem more appropriate for inclusion in the Performance rating not Design and As Built.

Absolutely. I believe we should be trying to incentivise the decarbonisation of the grid. At the same time, we should be incentivising energy efficient building design and in particular good passive design, which the tool does not currently do. Therefore, I think the GHG emissions credit needs to firstly reward a number of points (say max 10) for excellent passive design (and ideally link this to IEQ so we don't get dark boxes), a number of points for energy efficiency (say max 10) and a number of points for offsetting that energy consumption. The question is, how far do you go and how many points do you offer? Why not offer 30 points? Every project would target these points, and we would start to see restorative buildings emerge. I strongly support doing this, but there should be a healthy debate on how many points to offer.

A renewable energy measure designed for the explicit use of the Green Star rated building/precinct and provided with a robust transfer accountancy system (Virtual Power Network or similar managed by a registered energy retailer held accountable to existing statutory metering accuracy requirements) could be considered. This might include a solar PV array (or portion of) installed on an adjoining building with optimal solar resource reticulating energy to the Green Star building. Purchasing Green Power is generally non descriptive and generally non specific energy pool provided. Where a measure is not specifically provided for a building it is unlikely to be able to be considered as a project emission reduction measure.

Yes - but only where supply agreements/contracts are in place for a minimum of two years, and the renewable technology is either in operation or contracted to be provided. The Design rating would expire within this time.

How Should Points Be Apportioned for Mixed-Use Projects?

- Area-Weighted: 47%
- Impact-Weighted: 40%
- Did not respond: 13%

Specific comments were provided by respondents as follows:

This is a tricky one as if the MUR GHG credit is given different weighting or number of points available how do you account for that. In the end if the aim is to assess the total GHG emissions from a project then really that should be the metric used for apportioning impact?

Can't use Area weighted, as some buildings have significantly higher energy needs than others. So, if there was a large industrial building, with a small laboratory in it, then all the points would be awarded for improvements in the industrial building, even though the environmental impact would be in the laboratory.

However, can't use the modeled GHG impact, because the better a building was, the lower its emissions would be and therefore the less points it would achieve.

Recommend using the GHG impact of the reference case building.

If following a DTS approach, then will need to apportion based on the number of weighted points available to each building class AND the size of each space (ie every building class could achieve 10 points for DTS initiatives, but energy points for industrial were weighted at 5% whereas laboratory were weighted at 20%, then in a building where the industrial facility was 70% of building size and laboratory was 30% then the overall points the project should achieve should be based on 0.7x1/5 industrial DTS points and 0.3 x 4/5 laboratory. NOTE: this is only quick thought -need time to consider and discuss further

An area weighted assessment will not work due to the different energy intensities of the two building types. Therefore, only an impact weighted assessment would be applicable. In this case, all building types would have to be modelled to determine energy intensity, with the modelling results determining how the GHG emissions are to be apportioned.

I don't really understand what you're getting at with the second option above [impact-weighted].

We believe that it should be calculated accurately for each building and awarded based on each building's emissions efficiency.

How Should the Interdependence of GHG Emissions and Other Green Star Outcomes be Addressed for Naturally-Ventilated and Mixed-Mode Buildings?

Specific comments were provided by respondents as follows:

Mixed Mode or Naturally Ventilated buildings do not mean that windows are always open: for energy and thermal comfort the opening and closing of windows is based on controls strategies within the model which should be consistent (this does not mean the project has to have automated controls, but what the agreed design operation of these windows should be).

For Quality of Internal Air a naturally ventilated building should be treated separately to mixed mode. Essentially a naturally ventilated building, users have ultimate control over their air quality so they should qualify for these credit points by demonstrating that they are achieving the compliant number of air changes through the space when windows are open.

Mixed Mode buildings will need to demonstrate compliance with Quality of Internal Air in both modes.

As for internal noise, natural ventilation buildings should have different compliance requirements to that of an 100% conditioned building or a mixed mode building. Occupants moving into a natural ventilated building will have a different expectation of internal noise requirements and it would be silly to make them comply with the same standards as an air conditioned building.

No. Mixed-mode buildings are harshly penalised in Green Star - basically the project has to consider the 'worst case' for every component. This has discouraged many projects from pursuing mixed mode, and others to implement mixed-mode but to then go through certification as if they were fully air-conditioned.

Mixed mode is actually better than both a purely naturally ventilated building and a purely air conditioned building - but Green Star recognises it as significantly worse (ie for IEQ1 if either the NV or mech system doesn't achieve a point, then the project gets zero points - even when one system might be used the majority of the time (and therefore provide the majority of the benefit). As such, mixed mode buildings should be able to choose if they wish to submit based on purely NV or purely mech (this is effectively what is happening anyway). This simplifies documentation, and because a consistent approach would be used

across the entire submission, the benefits of (say) MechVent in one area (acoustics) would be balanced by the disadvantage of MechVent in another area (energy).

Yes, this approach should continue to be taken. A project should not be allowed to claim the energy and IEQ benefits of a mixed mode system but not accept acoustic impacts or limitation. Consistency is required throughout the rating and submission.

Kept as it was.

Makes some sense for IEQ and Acoustics.

Does not make sense for Thermal Comfort - the whole point of mixed-mode is that when it's hot outside you have windows closed and use AC, when it's cold, you have windows closed and use heating, and only when ambient conditions are just right, you have the windows open.

Green Star should be actively incentivising mixed-mode systems, not creating barriers against it.

While it does reduce the incentives to implement NV/MM, IEQ should always be considered as balance between impacts is a fundamental of Green Star.

Energy modelling should be allowed to take into account mixed mode and natural strategies, rather than being required to be modelled for the worst case. This then aligns with all other credits.

Yes - it is disingenuous to do otherwise where the components in question have an impact on the outcome of different credits.

Yes - the modelling should be consistent between credits and should represent the actual conditions that will be experienced as far as possible.

No. Natural ventilation should be encouraged and not be penalised in other other credits such as acoustic comfort. I'm not sure how this should be addressed in future.

I think the current approach fails to reward mixed mode buildings sufficiently. It becomes difficult to achieve acoustics points, comfort points and air quality points, which is really frustrating when trying to push for a mixed mode solution. There should be concessions given for each of these negatively impacted points. Comfort should move to a an adaptive comfort model. Acoustic requirements should recognise the anomalies of things like garbage trucks - people with windows that are open for ventilation will close them when noise becomes a disturbance. We need to build in more flexibility to promote and reward mixed mode buildings - in our climates it should be a no brainer.

The robustness of the methodology for opening windows needs to be clearly defined, but should be able to be incorporated into energy efficiency assessments. The approach should continue.

How Should Shared Services Be Included in the Energy Category?

Specific comments were provided by respondents as follows:

Must be really careful here. Problems with creating accounting/gaming exist at the moment. For example buildings with cogen can use all the energy themselves, but transfer the carbon emissions associated with it to the tenants in the building - all through creative accounting. So, rules need to be developed that apply to all scenarios - not just when systems are offsite.

NABERS Ruling in this area is pretty good - provides a good methodology/framework.

The NABERS framework for GHG emissions apportioning should be adopted. This has been clearly laid out and accepted by industry.

NABERS has developed a methodology for the treatment of Co-generation and shared services. Line up with that. Work together. Make it consistent.

Using a mock "certificate" system would be preferable - i.e. a methodology deems an energy output of that generator, which can be allocated to certain projects.

Only an issue where "selling" energy to others. Should require a commitment or demand based agreement over several years with external party so there is an easily identified exported energy quantity.

As per the current NABERS Protocol.

Model the proposed building with a service matching the peak requirement for this building with performance characteristics of the shared services.

The proposed approach is excellent. Although it is probably simplest to limit this to cases where the assets are owned by the same entity, where the owner can provide proof of how the shared system will work, and the amounts of energy. Otherwise make it NA.

Each building should be energy modeled through computer simulation and the summation of these dynamic energy profiles used to assess shared energy systems. Single fuel systems, such as boilers, chillers, pumps can be easily proportionally allocated according to dynamic thermal load variations. Cogen and Trigeneration is much more complex and the move to follow research being carried out by EEC would seem to be a robust process to follow. Option 3 in the EEC paper appears to be the most robust methodology. In the interim (whilst EEC develop research), one of the several existing methodologies in use around the world are referenced in the EEC paper, could be adopted.

The NABERS methodology is simple to use and understand, however their treatment of energy across ownership or site boundaries negates any benefits of utilising cogen. This should be corrected to enable benefits to be recognised, but agreements that stretch across the life of the rating (e.g. Design being two years) should be required.

Shared systems must be established as being beneficial to each building using predictive energy modelling. District systems are not necessarily the most efficient solution.

Should Projects Be Able to Use a Valid NABERS Energy Certificate as Evidence of Compliance at As Built Stage?

- YES: 60%
- NO: 40%

Specific comments were provided by respondents as follows:

This needs to be kept separate and reserved for the Performance tool.

This will improve industry perception of relationship between NABERS and GBCA, and by reducing criticism of the tools incompatibility/differences will help encourage the use of both tools. However, in reality do not expect anyone to use this approach because they would receive far less points than would be achieved via a model - and I expect it would also be less than achieved using DTS (this is where the real problem occurs!).

AECOM approve of this option. However, this would only apply to projects receiving a very late As Built certification, and is also unlikely to achieve a better result for the project than a modelling assessment and report. A favorable NABERS rating during the first year is difficult to achieve.

A NABERS Energy Certificate is more applicable to be used as part of a Green Star Performance rating.

No. This doesn't make sense. We're talking about GS Design & As Built, which covers the design process through to construction completion and then possibly also a few months into the post commissioning 1 year defects liability period. A formal NABERS rating can't be obtained until 1) 75% occupancy is reached and 2) there is 1 year of energy data. This timeframe is beyond the scope of the GS 2014 D&AB rating.

Using a NABERS Commitment Agreement makes sense, but not the formal rating.

Only if it were rewarded more favourably than just estimation at a design stage. Also this presents timing issues (NABERS needs 15 months post-PC, As-Built sunset is less than 24 months after PC).

Because this is a reflection on how well the building has been operated, and how a number of actual variables have affected the building energy use. It is also affected by occupation and vacancy profiles and so on. It does not establish a level playing field for all projects. Design or As-Built ratings should be based upon the same, comparable approaches using the same benchmarks and criteria. Actual NABERS ratings are applicable for Performance ratings only.

This minimizes effort for the applicant and avoids double work.

My only caution is that GBCA ensure that any changes to NABERS in the future are in line with the objectives/ targets of Green Star.

As projects are already performing these analysis, it seems like a waste of time/effort to replicate the process just to account for slightly different requirements. However, the problem is obviously that the benchmarks are not controllable by GBCA. GBCA will need to make corrections to the requirements when the framework is modified to ensure that all project teams continue to operate in a consistent manner. This did not occur when NABERS made the last change to the protocol and it has caused confusion and differences in the way projects are awarded points.

They should not be able to use operational certificates - this would allow project teams to pick and choose based on which gives the best results. Leave the operational ratings to Performance and stick to theoretical benchmarks/modellng for Design and Construction.

It makes sense to be able to utilise modelling that is already being done for the same project however there needs to be checks and balances in place to make sure that the modelling tools used are equivalent and generate the same results. Using actual certificates could be allowed but the timing of provision of energy certificates may not align with the timing requirements for As Built submissions.

Absolutely.

The NABERS Energy rating methodology is incompatible with the proposals being made by Green Star (which we generally support) using the reference building improvement methodology. We do not think a comparable metric is possible with the proposed reference building improvement methodology and the current fixed performance benchmark criteria used by NABERS Energy.

Exception being NABER for buildings with cogen. The national methodology for this should be examined in line with the intent of the credit(s).

Other frameworks should be examined on a CIR basis, and added to a list of 'accepted standards'. Examples might include LEED, BREEAM and Passivhaus. Points achieved should be established in a fair and equitable manner and each tool's shortcomings identified and adjusted for.

Appendix B: Issues and Responses

Issues raised, project team responses, and final actions are summarised in the following section. Where actions are recommended for future consideration/implementation, these are indicated in *red italic text*.

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Issue Raised	Project Response	Action Taken/Recommendation
Although implied by the credit title, it is not explicitly stated that the credit metric is generally to remain as kgCO2e. This requires clarification. (Note that ASHRAE and NatHERS use alternative metrics.)	Both energy and GHG emissions are proposed to be assessed within the credit.	***Two options for addressing energy and GHG emissions separately have been proposed:*** ***- Ring-fencing points for energy and GHG emissions*** ***- Including a minimum compliance performance for energy***
If kgCO2e remains the metric, given the discussions around the retention or otherwise of the state-specific weighting factors, is it intended that this credit continues to use the state-specific GHG intensity factors (rather than Australian average values)?	The credit has been drafted to make provision for project-specific GHG emissions factors to take local grid and procurement factors into account (for electrical and thermal energy).	
It is noted that projects following method 1 or 2 which wish to take account of features not otherwise assessed must use Method 3. In the case of multi-unit residential, does the potentially large disparity in outputs from NatHERS-approved software and other building energy performance modelling software risk compromising the validity of one or other method?	NatHERS is problematic from a consistency perspective, but it is embedded within the building code. The team propose assessing MUR under the reference building method as though it were class 3 (hotel).	
NABERS is an operational rating assessment. At design stage no such information will exist. What is the applicable quality standard? Is only a formal Commitment Agreement sufficient, or would any 3rd-party peer design review be adequate (both based on application of the NABERS Energy Guide to Building Energy Estimation)?	A NABERS commitment agreement (at design) and evidence of the peer review (at As-built stage) will mitigate the risks relating to NABERS performance. ultimately, the performance rating will be the test of design and construction.	
At As Built stage, would an actual NABERS Energy rating be valid evidence; or should it even be the only acceptable evidence (where obtainable)?	At as-built stage an actual NABERS rating would be valid, but not required. A commitment agreement with peer review and as-built documentation to support the assessment will be considered sufficient.	
The removal of some of the existing credits may result in some gaps. For example, an office building using Method 2 would now receive no (significant) reward for improved office lighting efficacy (not assessed as part of NABERS Energy for base building). Is this considered to now be standard practice?	Supplementary requirements for office lighting have been added to the NABERS requirement for the Existing Frameworks pathway for office buildings.	

Issue Raised	Project Response	Action Taken/Recommendation
How are mixed use buildings to be assessed when using Methods 1 and/or 2? If area-weighted what the applicable area measurements to be used?	GFA-weighted points. Different uses in the building can use different compliance pathways to determine their points, with only the points being weighted (not the energy). Where integrated systems are proposed, the building could be assessed as a whole.	
How are common areas in residential buildings to be assessed? They do not form part of the NatHERS assessment, and there is no applicable ASHRAE guidance, meaning that only the variable performance approach can be used when this may not be the Section J compliance path adopted by the project.	Common areas are to be treated in nison with the class 2 areas of the buidling and not calculated seperately.	
As an alternative to the proposed pathways, the use of actual operational benchmarks should be considered (i.e. comparison to an absolute benchmark), or at least for those building types for which adequate data sets exist. For buildings without data sets, or which cannot be equitably compared, the reference building can be applied. (Over time, Green Star Performance could be used to expand and update these benchmarks.)	This approach has been excluded based on due to poor data sets in non-office sectors (with office operational performance benchmarked with NABERS).	***Emerging operational data should inform the Green Star Performance rating tool, which in turn should be reflected in updated targets for Design and As-built.***
Energy should be rated as energy (the metric being the amount of energy/resource being consumed by the building) so that it recognises energy efficiency. GHG emissions should be rated separately as emissions. Currently the use of GHG emissions as an energy metric is encouraging energy-inefficient solutions and the inappropriate use of tri-gen. Energy and emissions should be dealt with on equal merit but separately.	The current approach is to address energy and GHG emissions separately.	
The impact of passive design and natural ventilation techniques are not effectively recognised, particularly by the BCA approach to determining a standard reference building.		

Issue Raised	Project Response	Action Taken/Recommendation
In some tools (e.g. office) Green Star needs to place more importance on improving the envelope performance beyond the NCC minimum. Part of the conditional energy credit should be establishing a higher envelope thermal performance than that in deemed-to-satisfy J1 and J2 or a JV3 Reference Building. Achievement above this new conditional minimum could also be rewarded with energy points in the Design rating, as could pressure testing and confirmation of insulation and glazing installed in the As Built rating. These are yet to be adequately addressed in the BCA	The credit allows for the separate assessment of passive performance and systems.	***Two options for addressing passive and active emissions separately have been proposed:*** ***- Ring-fencing points for passive design and service energy emissions*** ***- Including a minimum compliance performance for passive design***
Whatever is provided by way of a credit within the rating system should be assessed in terms of clear benefits and how these are derived and measured (i.e. deemed to satisfy otherwise you have significant variance in outcomes which results from the alternative drivers from some developers.	A degree of variance between compliance paths is inevitable. This approach has sought to include flexibility, even if it means that approach are not 100% aligned. Every effort has been made to align the reward for different approaches.	
Green Power – refer LEED.	Green Power has been accounted for in the project-specific GHG Emissions factors for energy. A minimum of a three year energy contract is required to be rewarded with Green power (or any other renewable energy)	
Strongly recommend separating Energy from CO2. Both components have an environmental benefit - CO2 from a global warming perspective, and Energy from a Resource use perspective. Whilst one solution can achieve both goals, this is not necessarily the case. For example if trying to improve a buildings Energy (energy efficiency), then projects would purse electric solutions. If pursuing low CO2, they will pursue natural gas solutions. At present, only focusing on CO2 means there is a significant bias towards systems like cogeneration that can be very energy intensive. Energy and CO2 have been used almost interchangeably in the industry, and this has lead to confusion. Remember, BCA Section J is about Energy (not CO2) whereas NABERS is about CO2 (not energy) - so this becomes a fundamental problem when trying to align Green Star with both NABERS and BCA.	Energy and CO2 have been addressed separately.	***Two options for addressing energy and GHG emissions separately have been proposed:*** ***- Ring-fencing points for energy and GHG emissions*** ***- Including a minimum compliance performance for energy***

Issue Raised	Project Response	Action Taken/Recommendation
Strongly recommend separating a buildings need for energy to its use of energy. At the moment, Green Star focuses on a buildings use of energy rather than its need for energy. This is biasing the solutions that are being implemented - effectively encouraging technology intensive solutions. This has been criticised by industry (bolt-on green-bling), and also can lead to buildings not performing as expected for the life of the building (e.g. cogeneration system is only used 1 hour per week rather than the 50 hours modelled, or systems aren't maintained so don't achieve the expected performance). Whilst there is definitely a place for technology and the efficient use of energy, I suggest it is more important to reduce a buildings need for energy to be used in the first place (less heating/cooling, more natural light). I believe this should be prioritised because solutions that achieve this are generally part of a building for its life - so outlive many technology solutions.	The credit allows for the separate assessment of passive performance and systems.	***Two options for addressing passive and active emissions separately have been proposed:*** ***- Ring-fencing points for passive design and service energy emissions*** ***- Including a minimum compliance performance for passive design***
The WSP report states that Green Star is targeting the top 25% of the industry, and therefore makes particular recommendations. The 25% targets was an original premise of Green Star, however this was removed a number of years ago as it was observed many buildings (not just top 25%) were targeting Green Star. Therefore need to consider which (if any) recommendations were influenced by this 25% target as it no longer applies. Maybe restructure GBCA target so that 6 Star is targeting top 10% of buildings, 5 Star is top 25% and 4 star is for everyone???	The alignment of Green Star broadly is beyond the scope of this assessment.	
At a high level, please find below AECOM's proposed assessment framework: ■ Method 1 (DTS): Implemented once an NCC BCA / ASHRAE methodology can be developed. ■ Method 2 (Comparison to Existing Framework): NABERS Energy for Office buildings (class 5), NCC BCA JV3 modelling to be used for all other building types.	This is broadly reflective of the approach that has been adopted.	

Issue Raised	Project Response	Action Taken/Recommendation
■ Method 3 (Performance): To utilise the Green Star Public Building methodology as the starting point.		
Although other international rating tools have been discussed, there does not seem to be any lessons learns or application of their credits towards the new Green Star tool. For example, the BREEAM energy credit uses the Part L (or Section J equivalent) model as evidence for the credit. A BREEAM rating has been awarded on thousands of buildings world-wide which would have been critiqued by international peers - they surely must be doing something right!	The proposed credit structure reference the NCC BCA (Australian equivalent of part L) in two of the three compliance pathways.	
We should consider avoiding modelling for energy consumption estimation altogether. I do have concerns that the current system is seeing more instances of gaming rather than improving design overall. Perhaps a more DTS-style approach would be to identify key energy impacts and implement good strategies in the building (Natural Ventilation, low-pressure pumping systems etc.) that are often underestimated in their energy impact if they were modelled.	A flexible approach has been proposed. Energy modelling is embedded within all major green building rating tools globally and Green Star will retain a modelling compliance path at this stage.	
Energy and GHG emissions should be separately measured, benchmarked and separately rewarded.	This has been taken into account.	

Issue Raised	Project Response	Action Taken/Recommendation
I believe the current approach fails to reward passive design - this should be addressed. One way would be to use the second model in JV3 that assesses fabric only - look at the % reduction in energy against the DTS model and award points on a sliding scale. Another approach could be to use the Green Mark ETTV/RTTV method of calculating thermal gain through the building envelope. Imagine the impact on facade design this would have! Also another sensible approach would be similar to the NatHERS approach - run a thermal model for a year and work out the MJ/m2 per year it would take to create comfort conditions. Green Star has instead produced too many sealed boxes with expensive and in many cases oversized equipment chasing points. Now is the time to make a significant change and start allocating points to well designed architecture.	The credit allows for the separate assessment of passive performance and systems.	***Two options for addressing passive and active emissions separately have been proposed:*** ***- Ring-fencing points for passive design and service energy emissions*** ***- Including a minimum compliance performance for passive design***
I believe that we should be looking at the entire life cycle of GHG emissions - at the moment this credit should be called "Operational GHG Emissions". Exploration should be done to develop a holistic approach to all GHG emissions associated with our buildings. This would have significant impacts through the supply chain, not only into materials but into efficient construction practices, logistics, procurement and product recycling.	This is beyind the scope of the current review.	***Whole-building whole of life may be subject to future development pending the success of lifecycle assessment of material impacts in Green Star 2014***
The ENE credits should be split into 3 as follows: ENE1 Carbon emissions intensity, linear scale to carbon neutral. (Beyond should be innovation)		

Issue Raised	Project Response	Action Taken/Recommendation
ENE2 Demand reduction should be revised and expanded in both point score and coverage. Currently assessing electricity demand reduction only, skews buildings towards CHP plant solutions using gas (or non electricity fuel). Total energy demand reduction would create a credit that instead would change focus of the credit more onto facade insulation and optimisation to reduce total peak energy demand of the building. Building technology efficiency would still have a role to play, but the credit would rely much more on architectural elements. This would be a much better result for Green Star buildings. ENE3 Renewable energy reward. Australian uptake of renewable in the built environment is extremely poor compared to other countries. A specific credit that rewards renewable energy measures in building designs would help promote greater uptake of these technologies. BREEAM probably has the best example of this approach to energy efficiency and it would appear to be a natural refinement of the direction taken for the Public Building tool.	Energy and GHG emissions are both being assessed. For ENE-2, total energy demand is being assessed (not just electrical demand). The current proposal supports renewable energy through a double reward system for on-site renewable energy points within the Ene-1 structure.	
Clear boundaries for carbon emission scope assessment must be provided and Green Star must indicate what these accepted methodologies are, particularly for any Scope 3 emissions where benchmarking is very difficult and subjective.	Scope 3 emissions have been included where docmemented in the national greenhouse factors.	
ASHRAE Advanced Energy Design Guides reference climate zone definitions adopted by the US Department of Energy and use IP units of measurement. These need to be converted to readily understandable equivalents for Australia.	The DTS approach rewards an improvement on the BCA DTS requirements.	
It is not evident that the prescribed glazing design parameters will necessarily be compliant with NCC Part J2. Compliance will need to be reviewed.	The glazing calculators will be used as the baseline for demonstrating the level of fabric performance required.	
ASHRAE Standard 90.1 uses the metric of energy cost, not raw energy or GHG emissions. How does 30% or 50% improvement translate to overall GHG emission reduction?	The proposed credit makes use of the NCC BCA Section J as an assessment framework, based on energy and GHG emissions not cost.	

Issue Raised	Project Response	Action Taken/Recommendation
It would seem reasonable that Deemed-to Satisfy criteria could be developed for Peak Energy Demand Reduction based on, say, AS3000 peak demand assessment (which is a standard design calculation) (similar to the existing credit). Why has this been omitted?	The DTS provisions are intended to be achievable without substantial additional calculations. A DTS approach to ENE-2 has been included on the basis of: - Installed generation to provide power to its capacity at all times (i.e. always 'on', not load lopping); and - Sized to provide 10% of the total building load.	***There is no consensus on the achievement of PEDR with DTS criteria. The consultants have proposed a possible approach. This must be confirmed with the TAG.***
We believe that PED cannot be targeted/achieved under a DTS method, it can only be demonstrated with modelling, as per the current GS Public Building methodology.	The DTS provisions are intended to be achievable without substantial additional calculations. A DTS approach to ENE-2 has been included on the basis of: - Installed generation to provide power to its capacity at all times (i.e. always 'on', not load lopping); and - Sized to provide 10% of the total building load.	***There is no consensus on the achievement of PEDR with DTS criteria. The consultants have proposed a possible approach. This must be confirmed with the TAG.***
It is not clear from the report how the ASHRAE Guidelines compare to Section J and whether they are comparable. How do the climate zones compare?	The DTS approach rewards an improvement on the BCA DTS requirements.	
ASHRAE 90.1 should not be used. NCC should be used for DTS.	The DTS approach rewards an improvement on the BCA DTS requirements.	
It is assumed that the NABERS Energy assessment to be applied to offices is base building (not whole building). This excludes office lighting, which would be included as part of a JV3 assessment. How are these disparities of scope of measurement to be addressed?	A supplementary requirement for office lighting has been included for the 'Existing Frameworks' pathway.	
It is assumed that the 6-star threshold rating for multi-unit residential buildings is based on the average rating across all apartments, as per BCA compliance assessments. Should the minimum individual apartment rating be specified at each increment as well?	The requirements will apply to both the average and minimum individual apartment rating.	

Issue Raised	Project Response	Action Taken/Recommendation
JV3 only requires that HVAC, lighting, DHW and lifts are included in the energy consumption. The scope of assessment required for Green Star will need to be specified for different building types, and reference loads specified where required. JV3 does not require that DHW and lifts are included where they are equal in design and reference buildings; Green Star will need to specify if these must be included for consistency of calculation of GHG reduction. There are other specialist loads (e.g. operating theatre lighting in healthcare) which are not regulated by Section J; Green Star will need to specify applicable benchmarks for these items.	The consultants have defined the scope of required inclusion for all building types.	
NABERS calculation for a commitment agreement (Method 2) will be underpinned by energy modelling comparable to that completed for Section J (Method 3). Should a mechanism therefore be included to allow supplementary information to be provided demonstrating that peak demand reduction has been achieved as part of the design?	The NABERS framework under the "Existing Frameworks" compliance path will only be used within its current scope (GHG emissions). There is no reference buidling in this proces, so PEDR cannot be calculated.	
Additional energy efficiency criteria for residential needs to include DHW system efficiency (including solar thermal heating).	The reference building approach includes incentives for renewable energy.	
Consider including additional criteria for residential with photovoltaic installations.	The reference building approach includes incentives for renewable energy.	
There is currently disparity in the definition of GHG emission factors used in NABERS, Green Star and as published in the National Australian Greenhouse Accounts. It would assist projects if these were better aligned.	Noted. Advocacy relating to GHG emission factor alignment is beyond the scope of this assessment. GHG factors for Green Star are not proposed to be changed for the performance approach. NABERS GHG factors will apply if NABERS is used to demonstrate compliance.	

Issue Raised	Project Response	Action Taken/Recommendation
How might future changes in these frameworks impact on the equivalence with Green Star benchmarks? In particular, Section J major changes are forecast for 2015 and 2020.	Green Star will be assessed relative the NCC BCA minimum requirements which are mandatory for all buildings. If the code changes, the Green Star benchmarks will shift accordingly. The credit has been structured to reflect current industry norms and standards rather than strict equivalency. Should one of the frameworks shown substantial shifts, the targets and benchmarks should be reviewed.	***Should either the NABERS, NatHERS or NCC BCA Section J requirements change substantially, the benchmarks of the energy category should be reviewed.***
NABERS Energy benchmark has been set at 4.5-star on basis of government office accommodation guidelines. What about PCA guidelines requiring 5-star for Premium grade, etc.?	The minimum NABERS benchmark of 4.5 star has been endorsed by the TAG. The choice of 4.5 stars as the minimum benchmark by the Commonwealth Government is an indication of the appropriateness of this baseline, rather than the final reason for its selection.	
Residential includes criteria for appliances, but what if these are not offered as part of the fit out? Would these then be NA in the calculation, or would the max points not be attainable? What if no air conditioning is installed?	If appliances are not provided, then projects will not be rewarded for the GHG and energy befits of efficient appliances. There is a ebnefit for naturally ventilated apartments.	
Is it intended that the reference building will be defined in accordance with the version of the BCA applicable to the development, or to a fixed reference standard (if the latter, this will not necessarily reduce workload, but may result in some projects being disproportionately rewarded if using BCA 2009 or earlier). This may need to be the subject of a case-by-case review.	The version applicable to the project will apply.	
As per current Public Buildings calculation methodology, will the design building DHW consumption be allowed to vary from that of the reference building according to the level of water-efficient fixtures and fittings specified, or will the Specification JV usage be applied to both?	Yes.	

Issue Raised	Project Response	Action Taken/Recommendation
We note that BASIX only seems to note energy efficiency requirements for air-conditioning systems that have an Energy Star rating, there are however a number of alternate air-conditioning approaches other than DX systems that do not come with an Energy Star rating that are used on MUR projects and very energy efficient.	Porjects in this situation must take the performance-based approach.	
It is unclear throughout the report which type of NABERS rating is to be targeted - Tenancy, Base Building, Whole Building. It is recommended that only a Whole Building rating be an acceptable compliance methodology as this will capture all of the required energy uses within a building to be rated.	The Green Star Design/As-built framework will allow the use of a NABERS base building rating to demonstrate compliance (with a supplementary lighting requirement).	
It is unclear throughout this report as to the extent of each assessment method. Which energy uses are to be captured? It is therefore recommended that regardless of which methodology is to be selected, the following applies:	The modelling guide identifies scope and all energy uses.	
n All methodologies capture the same energy consumers within the building to be rated; and	The modelling guide identifies the relevant users for each buidling type.	
n All methodologies capture the same area of the building to be rated.	The modelling guide identifies which areas must be considered for each buidling type.	
Currently, NCC BCA, NABERS, ASHRAE and NatHERS all capture different energy uses within a building. This will need to be standardised to ensure that compliance methodologies are not selected due to their favourable catchment of utilized energy within a building.	The proposed credits reference the existing frameworks and processes with the fewest possible additions or amendments to keep the process of demonstrating compliance as simple as possible. The consultants have attempted to align the points to the greatest degree possible, but flexibility has been prioritised over exacting consistency. Some buddling's will inevitably fare better under one methodology than another.	

Issue Raised	Project Response	Action Taken/Recommendation
Whilst many buildings are of the same type/class, not all buildings are the same (i.e. some office have car parks, some do not). NABERS has “rules” for their office assessment, whilst the energy simulation of a car park would be treated very differently when it is installed for a Multi-Unit Residential building. Is this fair when comparing the outcome under a single design tool? If Green Star is to pursue a common design tool, a common assessment approach is needed. This is another example of an “industry standard” approach that is needed.	A credit structure which allows a degree of flexibility (based on the nature of the project seeking certifiaiton), but with a common framework for assessing performance has been developed. The modelling guideincludes details particular to each buidling type.	
Based on the indicative points allocation for existing frameworks, the relative emissions reduction of a NABERS Energy rating does not appear to be equitably awarded. Additionally, this only considers the current maximum of 6-star, but the future 6.5- and 7-star ratings are already defined and should be incorporated into the credit definition. For projects achieving 6-stars prior to the formal implementation of these higher ratings, a workaround similar to that for projects achieving greater than 5-star in Office v2 assessments can be implemented. Owing to the scope of NABERS for Offices not necessarily including the whole building, the maximum available points should perhaps be capped at less than 100% improvement even though 7-star is defined as zero emissions.	The points under the "Existing Pathways" approach are based ont eh appropirate KGCO2 rather than the star rating resulting in a contiunous scale able to extend beyond 6 star.	
Does the current relative points award and proposed future points award fairly reflect the relative environmental benefit of emissions reduction versus peak demand reduction?	Final weighting of points for intitaives will be undertaken by the TAG in subsequent stages. At thsis tage, the relative assessment of energy/GHG emission and peak demand redution have been retained from existing tools.	

Issue Raised	Project Response	Action Taken/Recommendation
Should points be awarded on a continuous scale, rather than based on discrete steps? For example, in the current and proposed arrangement 54.5% improvement achieves no better score than 50% improvement, but can be reasonably considered to have provided benefit to the project and justify the award of 0.9 points. This may assist in reducing the likelihood of, for example, cogeneration units being oversized just for the sake of securing an extra point in the Peak Demand Reduction credit. (In this context, NABERS Energy would need to use the Benchmark Factor or raw GHG emissions values, rather than the absolute star rating.)	Points will be awarded on a continuous scale.	
If the GHG emission credit is to award restorative behavior, which will presumably result in substantial peak demand reduction as well, should additional points be available here as well (to a maximum of 100% reduction)?	The Tag and GBCA have indicated that nay points beyond the current allowance will be rewarded in the innovation category.	
It is not apparent whether it is proposed that the DTS approach requires all elements to be included to achieve the full points allocation only, or whether only some items can be implemented to achieve partial points. If the latter, would all initiatives be awarded equally or will some be more highly weighted than others?	Each section of the DTS category wil be worth 1 point. They can be targeted seperately.	
A 34 point emission score seems excessive.	The total is currntly proposed to be capped at 20 points. Final weighting of points for intitaives will be undertaken by the TAG in subsequent stages. At thsis tage, the relative assessment of energy/GHG emission and peak demand redution have been retained from existing tools.	
Linear scale required no export reward in energy credit (yet, to soon) - Promoting highly sceptical design practices that cannot be executed in reality should not be promoted or encouraged by Green Star. Building owners want robust workable solutions to be rewarded that produce real life measurable results.	A linear points scale has been included in the ENE-1 credit.	

Issue Raised	Project Response	Action Taken/Recommendation
Lifecycle cost reward should not be incorporated in carbon emissions - There are no government energy carbon emission intensity benchmarks for the future so this approach would be highly subjective and open to creative accountancy.	Lifecycle costing has not been included in the credit.	
Clarification required regarding the calculation methodology for solar hot water systems. Our understanding is that requirement for TRNSYS modelling applies only to the rating of the equipment, which would be undertaken by the manufacturer, not the project team. This information is to be used by the project team in assessment of the system contribution to hot water heating; refer to the Green Star Custom Pilot Solar Hot Water and Heat Pump Booster Energy Simple Calculation Methodology (Nov 2010).	This is addressed in the modeling guide.	
Section J uses the metric of energy consumption, and does not specifically consider energy source, e.g. cogeneration is not directly accounted for expect as a source of waste heat. Differences in approach applicable to Section J and Green Star will need to be clearly defined.	The methodoogy for modelling will be based on section J JV-3 approach. The final assessmetn of performance will be based on the mdoelling, but will include the assessment of GHG emissions.	
How should mixed-mode and naturally-ventilated buildings be modelled for consistency with credits Quality of Internal Air, Thermal Comfort and Acoustic Comfort? In particular, for naturally-ventilated buildings, should windows be assumed to be open at all times for ventilation amenity, even if occupants would be expected to close them in reality (at times of extreme high or low ambient temperature)?	The modelling guide includes an approach to mixed-mode and naturally ventilated buildings.	
Section J only requires the assessment of fabric R values based on the "centre" construction; thermal bridging effects are ignored. The use of R values equal to the DTS values, and to nominal specification values may therefore be inappropriate. Is there a better approach that can be taken?	While section J is imperfect, the consultants have propsoed a rfamework which reflects the code as it stands and nominate an improvement, rather than try and amend the requirements for better accuracy.	
Section J specifies very high infiltration rates for the reference building (and the actual building in the absence of pressure testing results). Are these appropriate for use here?	Infiltration as per the code.	***After practical comletion, if projects can demosntrate better perforance than code, the TAG should consider allowing them to use commissioned figures for the Proposed Building.***

Issue Raised	Project Response	Action Taken/Recommendation
Simple vs Realistic Models: The report talked about accrediting software, and I agree this is important. However, equally (if not more) important is ensuring the models submitted for Green Star reflect some level of reality. Whilst the Assessment process does review models, the current assessment process is significantly limited. At the moment there is a perverse incentive - Green Star rewards the most number of points for a building with the lowest CO2 emissions. The lowest CO2 emissions are shown when the model is most simple - therefore modelling fee is lowest. As such, clients can either select the cheapest fee that will achieve the highest number of GS points, or, a higher fee that achieves the lowest GS points.	By aligning Green Star with the existing buidling code proceses, the consistency in modelling is predicted to improve.	
Modelling Expertise. Modelled emissions can be reduced further when junior/inexperienced people complete the work (as they are on lower salaries). When models are created by people that don't actually understand how buildings are constructed or the systems that are being modelled, the model will not reflect reality. In some cases this will predict higher energy consumption, in other cases lower. If lower emissions are predicted, more green star points are achieved, and this could be the model submitted to GS (and even screen shots from the model will imply everything is OK when in reality they are not. Generally, when models/reports are reviewed by senior/experienced staff, the focus is on the areas that modelled using too much energy - not too little. As such, it is often only the 'high emission' problems that get resolved.	The assesment of modeller qualifications and expertise is beyond the scope of this assessment.	

Issue Raised	Project Response	Action Taken/Recommendation
No Ramifications. Green Star rewards more for Energy model than any other category or credit. This is fine, however it is an area that is most open to abuse/misuse/gaming. There can be a substantial difference between models created for Green Star, and ones that are developed to actually predict a buildings energy consumption. The difference (for the same building) between two different models can easily be 10-15 points - almost an entire Star. And this can be done in a way that is completely within Green Star Rules, and cannot be picked up in the current Assessment process. Strongly recommend that	The Green Star Perforance rating will liekly have the strongest role to play in mitigating gaming during design. Rewarding design and construction on the basis of analysis and modelling will always be open to gaming. The credit amendments have been made to mitigate this to the greatest degree possible by providing project teams the freedom to align modelling inputs to likely operation.	
(a) energy models have a more comprehensive review process than the rest of the submission,	The review process is beyond the scope of this analysis.	
(b) there should be ramifications if poor modelling is discovered,	The consideration of recourse for poor modelling is beyond the scope of this analysis.	
(c) Modelling Protocol should explicitly state that the model is to reflect reality, and	The modelling protocol instructs design team to bae their assesment on the likely performance parameters of the building.	
(d) Modelling Protocol should adapt some components so more in line with reality.	The modelling protocol instructs design team to base their assesment on the likely performance parameters of the building.	
Not addressing this issue is actually making the problem worse (as the good modellers have to start employing some of the approaches used by the other modellers in order to (a) keep their fee low and (b) achieve results that competitors are offering (and have achieved in the past). As such, the modelling industry is actually being de-skilled, and some models may actually be further from reality than they were in the past.	The consideration of recourse for poor modelling is beyond the scope of this analysis.	

Issue Raised	Project Response	Action Taken/Recommendation
All green star credits (whether at design or as-built) stage focus on delivery on an environmental outcome. For the GHG credit, this is the process of energy simulation is to inform the building owner of the buildings estimated energy performance, prior to construction and occupation, such that they can adjust the design to achieve the desired outcome. This credit should reflect this intent, rather than just being a "benchmarking" or compliance exercise. For this reason, the credit should be expanded to include elements such as:-	The credit has been updated to align with existing approaches and frmeworks in the desing and construction industry; NCC BCA, NatHERS and NABERS among others. Additional requirements have been limited to the greatest degree possible.	
a. Completion of off-axis scenario testing for all buildings, to identify the sensitivity of key building attributes.	Off-axis testing has not been inluded in the proposed model.	
b. Design teams should need to demonstrate that they have completed the modelling, and learnt from the results.	The consideration of how modelling is used in design is beyond the scope of this analysis.	
c. Modelling protocols should best reflect the estimated performance profiles and inclusions of the proposed building, rather than being assessed on a generic basis. Perhaps, design teams should prepare their own site specific energy modelling protocol for peer review / GBCA review, prior to completion of the energy model.	The credit has been structured to allow deisgn teams the freedom to mdel buidlings as they are intended to be operated.	
A requirement for a qualified engineer sign off of energy modelling should be required. CIBSE ASHRAE of IEAUST qualified sign off, accreditation, CV should be evidenced. Modelling software accuracy is covered, but accuracy of modelling process is not, rubbish in rubbish out.	The consideration of modelling quality control is beyond the scope of this analysis.	
The question of being rewarded for displacing load from the national grid onto a shared utility should be discussed in further detail. On the one hand, the demand reduction on grid infrastructure is an important consideration. However, on the other hand, simply replacing one type of infrastructure with another (rather than reducing peak loads through efficiency of design) does not achieve the intended environmental goals of reduced impact on infrastructure.	The credit does not reward projects connecting to district utilities for reducing infrastructure.	

Issue Raised	Project Response	Action Taken/Recommendation
The proposed requirement for shared services infrastructure to be subject to the same standards for emissions, commissioning, etc., as the rated building appears to require that the utility is the subject of a mini-GS rating. It is suggested that this should be assessed independently and logged in the database, in order that later projects do not need to resubmit evidence.	The consultant team have proposed that shared services be addressed as current utility systems and not subject to the requirments of Green Star.	
For consistency, it is strongly recommended that the form of Green Star registration is based on the proposed NABERS/EEC framework (and registration on the latter should automatically satisfy the requirement of the former).	The consideration of Green Star registration processes is beyond the scope of this analysis.	
It is stated that the shared services approach is not compatible with the compliance pathway using existing frameworks. This is not true for NABERS which is adopting a similar approach to the inclusion of off-site embedded generation systems in ratings, and which will allow the benefit of such a system to be incorporated in the rating.	The Energy Efficiency Council approach to shared services will be used as the basis for apportioning GHG emissions from CHP procesess for both Green Star and NABERS.	
Precinct initiatives, such as precinct recycled water, precinct thermal solutions, precinct energy, should be easily rewarded for individual buildings within the precinct in the new Green Star tool without having to lodge CIR or TCs. Green Star should understand that the time to implement such initiatives is heavily dependent on load from the precinct - the first buildings in the precinct will typically not provide this load, therefore the precinct infrastructure is typically delayed. Recommend a period of 2 years be allowed for individual buildings to be connected to precinct infrastructure and still award the credit provided sufficient evidence can be provided demonstrating the initiatives intend on being implemented.	Precinct energy utilties will be rewarded through the assessment of a project specific GHG emission factor on the basis of electrical and thermal power purchase agreements.	
We support reference building methodology, we support watching the outcome of the EEC research into CHP as the basis of calculation of energy and emissions aportioning. There are international standards that are referenced in EEC papers that could form part of an interim methodology.	Precinct energy utilties will be rewarded through the assessment of a project specific GHG emission factor on the basis of electrical and thermal power purchase agreements.	

Issue Raised	Project Response	Action Taken/Recommendation
Export energy - Is a very difficult subject to get right and is open to double accountancy. We do not believe the register is workable. Mandating Virtual Power Network energy accountancy between buildings that share energy systems is a robust solution that allows accounting across utility meters and should be considered. However, it is possible to share without geographical constraints and precinct boundaries to these systems would need to be carefully considered.	Energy exports are currently excluded from the credit. Buidlings desinged to be energy positive will be assessed in the innvoation categroy.	
The proposed Design documentation references 'for construction' information only. It is assumed that this is indicative only, and could be 'tender' or 'contract' revision, according to the project stage and discipline. This should be consistent with current Green Star guidance.	Documentation will not be nominqted specifically, but must be: - relavent to the stage of deisgn or construction - contractually binding.	
NABERS Commitment Agreement will have been subject of peer review process, hence certificate is sufficient evidence of design integrity. However, this is not the case for NatHERS, and evidence of significant design and specification features should be provided.	The requirements for NatHERS will be of the same nature as the Referfence Buidling pathways; notably deisng or contruction docuemtnation that is stage-relavent and contractually binding.	
Evidence of installation of energy-efficient features will be required at As Built for residential.	Yes.	
As Built should require declaration from contractors that all system have been installed in accordance with design documentation; where this is not the case, updated energy modelling should be provided with any changes incorporated.	The inclusion of a declaration by contracts has been conisdered. The TAG should assess whether this is an approporiate form of docuemtnation.	***TAG to consder requiring contractor statements for as-built ratings.***
What is the scope of the report required by Method 1 for As Built?	As-buult docuemtnation that the claimed DTS provisions have bene achieved.	
Streamline evidence: if modelling process accuracy is supported by qualified engineers, the submission evidence volume could be reduced.	The certification of modellers and QA process for modelling is beyond the scope of this assessment.	
Testing the achieved level of building fabric thermal performance could be included, such as:	The DTS pathway includes the requirement for fabric commissioning with respect to infiltration.	
n thermographic analysis of insulation installation, and	This as not been included in the credit criteria.	
n degree of building sealing achieved to be measured through the use of blower door testing.	Buidling sealing has been included in the DTS pathway.	

Issue Raised	Project Response	Action Taken/Recommendation
There could be an option to feed this back into energy modelling to improve/validate energy credits.	This has not been included. The aim of this proces has been to simplify the modelling and assesment process with the Performance Tool providing the motivation to align modelling with actual performance.	
Whatever Green Star can do to force the hand of architects to adopt sustainable architectural responses at an early stage, these opportunities should be pursued. Currently Green Star is forcing the adoption of building services engineering technology solutions in the absence of willingness to adopt sustainable architectural design practice. Admittedly this could constrain developers (major financial backers of the GBCA) in the possible design responses at a particular site, but more needs to be done in Green Star to encourage real sustainable architecture. To use a car analogy the current situation is like manufacturing a car with a very high efficiency engine, while allowing the aerodynamics of the body's design to be pretty much ignored.	The credit allows for passive performance to be assessed independently of the buidling services perormance, supporting passive design.	