June 2014

NABERS algorithms review

AIRAH submission

Prepared and coordinated by

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About AIRAH

AIRAH is the recognised voice of the Australian air conditioning, refrigeration and heating industry. We aim to minimise the environmental footprint of our vital sector through communication, education and encouraging best practice.

AIRAH – Strategic Aims

Claim the sustainability space

Through its conferences, publications, manuals and training, AIRAH will educate and motivate the HVAC&R industry and related fields about achieving sustainability. Our aim is to be the HVAC&R organisation whose values are aligned with sustainability in a practical sense

Close the skills gaps

At a time of rapid change of new technology and standards, and a shifting regulatory landscape, AIRAH will provide relevant professional development for HVAC&R industry personnel, and work alongside government and providers to ensure the voids in formal training are filled.

Inform regulation and policy decisions

As the key industry organisation representing HVAC&R in Australia, it is essential AIRAH collaborate with government at both the state and federal levels. The collective skills and specialist knowledge of the Institute can better inform decisions that affect society and the HVAC&R industry.

Build and engage membership

AIRAH will become the institute of choice for HVAC&R professionals in Australia. This means ensuring that formal connection with AIRAH provides benefits – actual and intangible – that are valuable, worthwhile and attractive to our members throughout their professional lives.

Disclaimer

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1. INTRODUCTION

This document summarises AIRAH's response to the NABERS Algorithms review.

In March 2014 AIRAH distributed a circular to its members that the NSW Office of Environment and Heritage (OEH) had invited participation from stakeholders in the NABERS Rating System to review, in confidence, and comment on the algorithms used in the rating system. Comment was required to be submitted to OEH by 30 June 2014.

A panel of AIRAH members volunteered to participate in this review as attached in Appendix A.

All of the review group members are actively involved in the Building Services industry and are regular users of the NABERS Rating Tools, either in the preparation of rating assessments and/or in the design, commissioning and tuning of building services systems.

AIRAH and the review group members all hold a high regard for the NABERS Rating Scheme, and believe in its future potential, both within Australia and overseas. AIRAH are grateful to the NABERS administrator for the opportunity to provide this feedback.

2. SCOPE OF REVIEW

The Rating Tools which were referenced by the AIRAH review group related predominately to the NABERS Energy for Offices algorithms, with a focus on Base Building Ratings.

Additional comments have been included in relation to the Tenancy Ratings vs Base Building ratings, the treatment of supplementary cooling systems and data collection / sampling for NABERS IE Ratings.

In this submission a commentary is provided for each issue brought up by the review group and recommendations are put forward on potential ways to address the issue.

3. NORMALISED HOURS

Commentary

It is the common experience of many NABERS Assessors that extended operating hours, whether core hours only or core hours + after hours, often enhances the base building star rating. This has been anecdotally quantified as approximately ½ star improvement for each 10 hours per week of extended operation.

The rating tool currently has a single basis for assessing normalised hours which does not allow for the variety of predominant extended hours or after hours scenarios including:

i. Operation prior to commencement of core hours
ii. Operation after the end of core hours
iii. Weekend operation, including six-day or seven-day per week

The impact of each of these scenarios varies widely, both throughout the day and throughout the year, in relation to thermal loadings and the availability of economy cycle options. As a result the impact of a block of, say, one month of after-hours usage during summer could have an adverse

effect on the rating compared to an identical block of after-hours usage during the winter, depending on the climatic region.

In addition the algorithms allow for at least 10 hours per week, or two hours per day, of start-up time which is for many combinations of location and season an unnecessarily long start-up time. While two hours per day may be required in peak summer or peak winter conditions after a weekend shutdown, it would commonly be no more than one hour per day in many locations.

Whilst this review recommends potential changes to the algorithm and possibly consequent changes to the data entry procedures, it is acknowledged that a balance needs to be maintained to between simplicity of use and accuracy of outcomes.

Recommendations

That the algorithm to determine $f_{basebldg}$ be checked to ensure that it achieves a balanced outcome including compensation for:

i. Time of day
ii. Time of year
iii. Climatic region
iv. Reduced start-up time in mid-seasons

4. CLIMATE CORRECTION FACTORS

Commentary

It is difficult to comment definitively about this area because the reviewers do not have much detail on how the climate correction factors were evaluated. But these factors are critical in the benchmarking process between localities and even more so if rating tools are developed for other countries and benchmarking across countries is desired, which we understand is the case.

The algorithm presented appears to be based on heating/cooling degree days (HDD18DB and CDD15WB) and the electric/gas GHG Coefficients for a 'correctly operating VAV system with gas heating'. The correction given is a single number for each locality. Comments and queries expressed by the reviewers include the following:

i. The reviewers would like more detail on how these factors were developed. For example, are these factors based on statistical analysis of actual consumption data or were they developed from energy modelling of the same building in each locality? Did the building have an economy cycle operating with after-hours consumption?
ii. Overall this correction seems overly simplified. For instance while the literature suggests the base temperature for HDD could be considered a constant over a full 12 months, the base temperature for CDD is known to vary considerably throughout the seasons. Also both base temperatures for HDD and CDD can vary substantially depending on the building construction materials used, extent of glazing and orientation of the building.
iii. Is the climate factor based on heating and cooling load calculation differences for the 'default building with VAV/gas heating system' in each location? And then the relevant GHG Coefficients used for each location to calculate the kgCO2/m2 adjustment?
iv. It appears that a building with the same consumption and fuel mix can have a rating of anywhere between 2.6 to 4 stars depending on the locality. Is this reasonable?

v. Similarly it has been reported that it is easier to achieve a high star rating in Queensland, particularly FNQ, than in other parts of Australia.

It should be noted that the variation of frequency of CCD and HDD days during different seasons throughout the year has previously been identified as an issue in Section 3 – Normalised hours – above.

Recommendation

That detailed analysis of actual case studies be carried out to validate the equitable comparison of buildings between different localities and climatic regions.

5. GHG EMISSION COEFFICIENTS

Commentary

The values shown in Energy for Office algorithms - Table 1 – *Specific greenhouse gas emission coefficients* - are not the values published by the National Greenhouse Office and are different to those shown for the other building types (e.g. Shopping Centres, Hotels, etc). It looks like these are the original values used when the system was first developed. The reviewers understood that these had been replaced by the NGO figures but it looks like they haven't.

In addition, the NGO figures change from year-to-year but the figures in Table 1 for the other building types are for the 2012 year period only. In the reviewers' view, the rating scheme needs to accurately reflect the GHG emissions for a building based on the specific location and year as well as benchmark it against buildings in other localities. For instance if Victoria cleans up its brown coal issue in the future (thereby improving its SGE_e) then Victorian buildings in that period will suddenly start to appear to perform better. Is this an intended outcome and if not, how should it be addressed?

Also, whilst Table 1 shows the kgCO2/kWh values for each fuel type, it should also include the calorific values to be applied for gas, coal and oil as the consumption of these fuels is commonly measured in volumetric and/or mass flow rate units.

Recommendations

i. Use the NGO GHG Emission Coefficients in the Energy for Offices algorithms.
ii. Consider using the year-based NGO GHG Emission Coefficients in all energy rating tools.
iii. Use the same GHG Emission Coefficients in all rating tools.
iv. Publish the calorific values used in the NABERS algorithms.

6. TENANCY RATINGS vs BASE BUILDING

Commentary

The following are a number of observations AIRAH reviewers have made regarding Tenancy Ratings in relation to Base Building Ratings as follows:

i. Tenancy NABERS Energy – location should not impact the benchmarks other than potentially a very minor adjustment for weather dependent supplementary cooling loads

ii. Tenant Intensity – Agile Working / Activity Based Working is an industry reality. Tenancy and Base Building ratings need to fully respond to the increase in workpoint density (some tenants aiming for or achieving 10 m2 NLA/workpoint) and the increase in workpoint utilisation (typically from 60% historically to 75% in Agile Working workplaces) leading to far greater occupancy levels and tenant loads.

iii. ICT intensification – it is fair to say that the internet is highly utilised in business today compared to 15 years ago and with Big Data upon us the server loads per person have grown since the benchmarks were set. Perhaps NABERs Energy needs to allow for a Data Centre adjustment within a Base Building and/or tenancy rating.

Recommendation

That the rules and algorithms for both Tenant ratings and Base Building ratings be reviewed in light of the above comments.

7. SUPPLEMENTARY COOLING SYSTEMS

Commentary

This commentary relates to the rules governing the NABERS Energy for Offices rather than to the specifics of the algorithms themselves.

There has been a significant level of frustration expressed by leasing agents and building managers at the extent, nature and cost of the supplementary cooling systems which tenants are required to install to safeguard the NABERS Energy base building rating of office buildings, particularly in that they cannot use the main chilled water systems to provide supplementary cooling (under the provisions of Rules for collecting and using data V3.0, section 6.2.5, Rule B2).

There have been remarkable advances in coefficient of performance (COP) of chillers and chilled water systems over the past few years which could offer much more energy-efficient options than the alternative tenant condenser water cooled options.

A holistic approach to energy efficiency in buildings should encourage the use of the most energy-efficient method of providing services to both tenant and base building applications and this should include connection to the main chilled water system. The NABERS rule currently disincentivises this potentially energy efficient arrangement.

Recommendation

i. That the rules governing NABERS Energy for Offices base building ratings be amended to allow and/or encourage connection of supplementary cooling systems to the central chilled water plant subject to approved thermal metering.

8. NABERS IE FOR OFFICES

Commentary

To date the measurements required for an IE rating are not based on a full 12-month cycle but on observations recorded over one or more short periods of time.

This obviously decreases the reliability of the data upon which the rating is based and may fail to identify abnormalities which occur at certain times of the year and/or times of day.

Most modern office buildings are equipped with extensive Building Management Systems (BMS) which have a large history database capable of storing well over a year's data for the measured variables within the building. These commonly include the following variables which are relevant to the NABERS IE assessment:

- Zone dry-bulb temperature
- Zone relative humidity
- Ambient dry-bulb temperature
- Ambient relative humidity
- Zone carbon dioxide ppm
- Ambient carbon dioxide ppm

Where such data is available, this could be statistically analysed within the period of tenancy occupation throughout the year as a part of the IE assessment.

This methodology would clearly provide an enhancement to the quality of IE Ratings.

Recommendations

i. That consideration be given to including a statistical analysis of BMS data into the IE Rating Tool
ii. That results obtained from such statistical analysis be awarded a "bonus" score subject to satisfactory calibration results in acknowledgement of the improved accuracy of assessment

APPENDIX A – AIRAH REVIEW GROUP MEMBERS

The following AIRAH members assisted with the NABERS Algorithm review and the development of this submission.

- Andrew Crabtree M.AIRAH **(Review Group Chair)**
- Gary James M.AIRAH
- Paul Graham M.AIRAH **(AIRAH ESD Chair)**
- Ania Hampton M.AIRAH **(AIRAH ESD Deputy Chair)**
- Lee Michael M.AIRAH
- Paul Dearlove M.AIRAH
- Graham Dyus M.AIRAH
- Vince Aherne M.AIRAH
- Graham Carter M.AIRAH

End of submission