Design for Performance not compliance: making measured energy in-use the objective for new office buildings

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Abstract

The paper describes the transformation that has taken place over the last 15 years in the energy efficiency of new office buildings constructed in Australia and considers if and how countries across Europe could follow suit. The success in Australia has been greatest for the **'base building'**: the energy used by the heating, ventilation, air-conditioning (HVAC) and hot water supplies serving the whole building, together with all other energy uses in the common parts, including the lifts. Base building performance is determined by the building's design, its construction, HVAC services, controls, commissioning and management - all things the developer, designer, procurement and delivery team and operations and maintenance people can be responsible for. The Australian approach embraces a '*design for performance*' culture, supported by the NABERS[1] 'Commitment Agreement', where developers and their teams sign up to an in-use performance target. The process is underpinned by advanced simulation, strategic sub-metering and fine-tuning post occupation to help eliminate wasteful deviations.

The requirement of the EU Energy Performance of Buildings Directive for a non-residential building to be given an energy performance certificate when it is constructed, sold or let has stimulated a robust debate in all European countries about the relative merits of calculated asset ratings and measured operational ratings. For new buildings and major refurbishments, the paramount objective of a Commitment Agreement is to bring the two together. It requires the design process to predict how much energy the base building is expected to use when occupied. This then becomes the target for in-use performance (subject to codified adjustments for weather and the hours of occupancy of each tenant) and is verified by the direct measurements of sub-meters.

Introduction

In the 1990s, the Property Environment Group[2] in the UK identified a vicious circle of blame that conspired to undermine the environmental performance of the UK's prime office buildings. Since then, the energy efficiency of new rented office buildings in Australia has been transformed, while problems persist in the UK, and we suspect elsewhere in Europe. At the turn of the century, new office base buildings in Australia were no more energy efficient than typical existing ones. Over the last fifteen years, there has been a remarkable transformation in their energy efficiency, while existing building performance has also improved markedly.

In 1999, New South Wales introduced a voluntary system (the Australian Building Greenhouse Rating, ABGR), to measure and benchmark the CO_2 emissions arising from the energy use of office buildings. The system included procedures and benchmarks for 1). whole buildings, 2). "base buildings" (the landlord's services), and 3). tenancies. Over the years, this developed into a national rating scheme and became part of NABERS (www.nabers.gov.au/public/WebPages/Home.aspx).

A Base Building Rating

Base building performance is determined by the building's design, its construction, and its HVAC services, controls, commissioning and management - all things the developer, designer, procurement

[1] NABERS (the National Australian Built Environment Rating System) covers energy, water, indoor environment and waste. It is based 100% on measured performance outcomes. The **NABERS Energy** rating scheme has enjoyed particular success in driving improvement in energy performance of larger prime office **base buildings** in Australia, for which it is now mandated (on sale or let) by the Building Energy Efficiency Disclosure Act 2010. NABERS is also available, but less widely used, for office tenant ratings, whole office buildings, and for shopping centres, hotels and data centres.

[2] The Property Environment Group was set up in London by the consultancy Environmental Governance in 1998 to bring together investors, developers, contractors and occupiers to share sustainability-related information and support and break down the vicious circles obstructing development of more sustainable buildings.

and delivery team and operations and maintenance people can be responsible for. It has been demonstrated that, provided occupancy hours are taken into account, other aspects of tenant activity have a relatively small influence on measured base building performance. By providing information where the agency exists to improve it, the base building rating allows landlords to demonstrate how good and well-managed their buildings are. Today, most new prime office buildings in Australia have what Europeans would call excellent energy efficiency, as measured by their operational base building energy use. This is now reflected in property values, creating a virtuous circle where landlords compete to offer lettable space with a better operational rating. Observers in Europe can draw two conclusions:

1. First, it is remarkable that we actually know this situation to be true. This is because Australia has a robust and credible way to measure and verify the base building operational energy performance of all large commercial offices. And these outcomes are publicly disclosed.
2. Second, it has proved possible to make dramatic improvements in the in-use energy efficiency of new office buildings over this 15 year period.

New office buildings across Europe have not followed the same trajectory, though we cannot be precise about this, because base buildings are not clearly defined, nor is their in-use energy performance routinely benchmarked. However, evidence suggests that base building services in recently-completed UK prime offices use typically twice as much energy per m^2 as their Australian counterparts, and possibly up to four times as much as the market-leading Australian buildings.

Design for Compliance vs Design for Performance

There are no intrinsic physical reasons why base building energy performance in new European offices cannot be as good as it is in Australia. However, the absence of a disclosure culture has contributed to Europe falling behind (1); while the design of new offices is rarely informed by feedback from real-world measurements. Instead, although the '*design for compliance'* regime that is the norm across Europe largely targets the energy performance of the same "regulated loads" as the base building metric, it focuses on modelled theoretical results, not predicting and then achieving in-use performance outcomes.

By contrast, Australia has pioneered a '*design for performance*' culture. Developers and their teams sign up to – and then follow - a "Commitment Agreement" protocol[3] to design, construct and manage new office buildings to agreed levels of actual in-use energy performance, at least for the base building. By using the process, and learning from the experience, Australian teams can now design, build, commission and operate office buildings that routinely achieve measured performance in line with design intent, albeit after some (essential) fine-tuning. How can Europe catch up?

How Australia Achieved Market Transformation

Measurement and verification standard for base building energy use

In Australia, metering generally follows the landlord/tenant split in responsibility for management and control (see Figure 1); an arrangement that the base building rating has reinforced[4]. One set of utility meters measures the landlord's services: energy used by the heating, hot water, ventilation and air-conditioning serving the whole building, together with all other services in the common parts, and so directly feeds into the **base building rating.** Separate utility meters measure energy used by each tenant (typically for their lighting, small power and ICT), feeding into **tenant ratings**[5]. Whole building ratings can be used to meet mandatory disclosure requirements where base building performance cannot itself be measured. In addition to the base building rating, the Building Energy Efficiency Certificate required by the Building Energy Efficiency Disclosure Act[1] requires a tenancy lighting assessment[6]. In practice, it is the base building rating that has enjoyed stellar success and attracted much international attention.

[3] http://www.nabers.gov.au/public/WebPages/DocumentHandler.ashx?docType=2&id=26&attId=0

[4] When Australia was looking for an office building energy performance rating system in the late 1990s, this was the situation in two major States: New South Wales and Victoria. With hindsight, it is fair to say that they struck lucky: the metering coincides with the agency of the landlord to influence and control energy efficiency.

[5] In Australia, there is currently no drive from Government at any level to make tenancy ratings mandatory; the voluntary CitySwitch program is driving activity in this area: www.cityswitch.net.au

[6] The mandatory tenancy lighting assessment is not part of NABERS. It reflects the energy efficiency potential of the installation - not its actual energy use, as this is not under the control of the landlord.

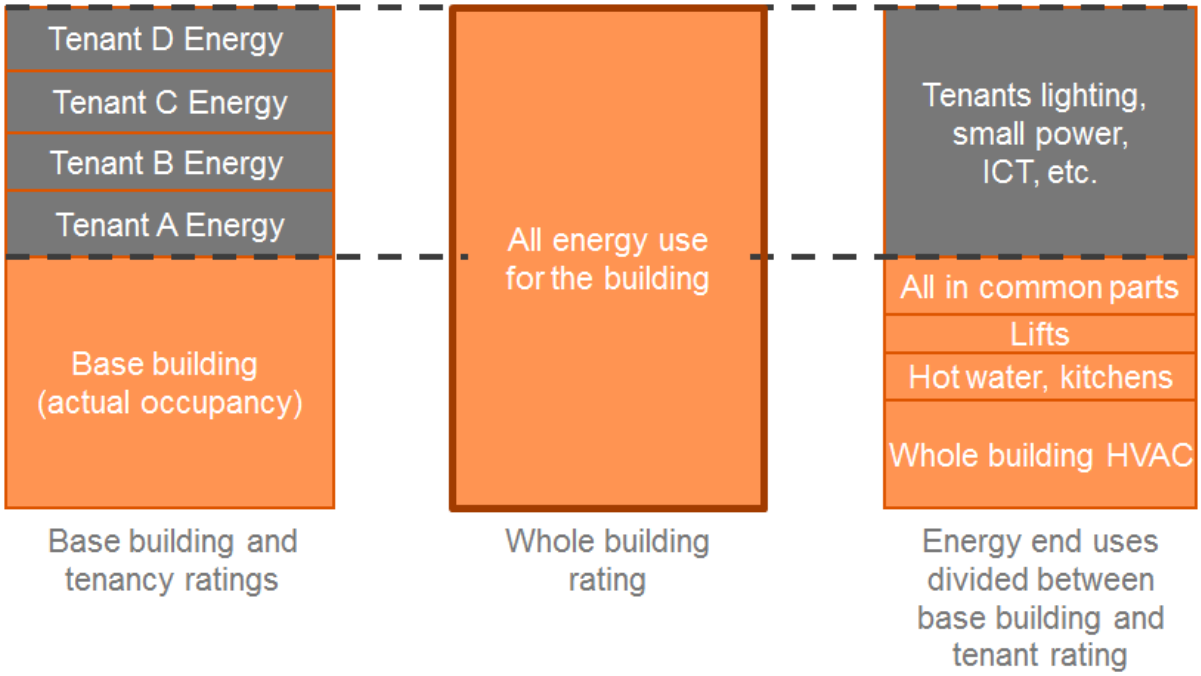

Figure 1 – Different scopes of different energy performance ratings

NABERS Energy motivates performance improvement by using a star scale. When first introduced, 2.5 stars was median performance and 5 stars was the highest possible rating. Recently the scale was extended to 6 stars[7]. The market transformation made possible by metering arrangements has actually come about because major office occupiers can now specify the performance they want. Federal and State governments set the ball rolling, saying they would only rent buildings that rated 4.5 stars or better. Some corporates followed suit. In 2006, the imperative for new build to be energy efficient was sealed when the Property Council of Australia stated that, to qualify for the Prime or grade A office categories, a minimum 4.5 star base building energy rating would be required (increased to 5 stars in 2012 for new build). The equivalent, for example in the UK, would be for the BCO specification (2) to require excellent energy efficiency, based on measured in-use performance.

The fact that market credibility of energy efficiency was now being driven by investment-grade measured in-use outcomes created a challenge for developers of new office buildings: how to attract pre-lets and underwrite their investment? Clearly, they needed to promise a guaranteed level of base building operational performance to investors and tenants. This implied two things: first an ability to deliver energy efficient base buildings and secondly an independent process to authorise developers to make their claims and give them credibility in the market.

Necessity was the mother of invention. In 2002, the NABERS Commitment Agreement was conceived, a process to help ensure that new offices could operate at their target energy efficiency level. Now virtually all new offices in Australia achieve at least 4.5 stars, with developers starting to target 5.5 and 6 stars. Commitment Agreements must take a substantial part of the credit for this transformation, not just for the individual projects, but perhaps more importantly for helping to educate the industry generally.

In summary, whilst the Australian process was assisted by the prevalence of base building metering at the outset, the market transformation in Australia has occurred through a virtuous circle of drivers:

- Commitment Agreements, empowering developers to deliver good performance
- the promise of a guaranteed level of base building performance enabling developers to attract prospective tenants and investors
- major office occupiers becoming inspired to specify the performance they want
- market credibility, resulting from investment-grade measurements of in-use energy performance, summarised in a simple star rating.

[7] 6 stars is half-way from 5 stars to net zero carbon. It is important to recognise that an absolute scale like this would enable Europe's nearly zero energy new buildings ambition to be realised in reality as well as theory.

What does a Commitment Agreement entail?

The Commitment Agreement requires the developer to:

- design and construct and commission the premises to operate at the target energy performance level
- provide written notice of the Commitment Agreement to all consultants and contractors involved in the design, construction, commissioning and management of the premises
- include in agreements to lease and in leases with all tenants a clause that discloses the Commitment Agreement
- provide data to allow the operational performance to be verified after 12 months of full occupation (if the commitment rating is not achieved by then, a 12-month extension is allowed for further fine tuning before the rating is published)
- use best endeavours to achieve and maintain the commitment rating for the duration of the lease
- provide the tenants with annual updates of the performance rating for the premises.

It also has some technical requirements:

- advanced simulation of the design, which can reliably predict actual operational energy use for individual sub-meters
- design reviews by independent experts
- the rating must be reported to the scheme administrator once it has been measured.

Extended commissioning and post occupancy fine tuning against expected performance is invariably necessary to achieve target performance.

Although commitment agreements manifest in contracts between the developer and the New South Wales Government (which manages NABERS on behalf of the Australian government), the intention is to use transparency and reputational pressure to encourage fulfilment of the agreement rather than legal enforcement. All commitment agreements are published on the NABERS web site, together with their status (achieved, pending, overdue, not achieved, terminated).

Figure 2 is a schematic representation of how Design for Performance differs from Design for Compliance. The two columns on the left represent compliance predictions of base building energy use, assuming respectively standard and expected occupancy and activities. The middle column shows a more realistic prediction of the same metric using advanced simulation and assuming realistic levels of occupancy and hours of use. A key attribute of the advanced simulation is to model HVAC plant and controls simultaneously with dynamic thermal modelling of heating and cooling loads. The two columns on the right of Figure 2 represent metered energy use, before and after fine tuning, illustrating how fine tuning can bring the measured energy use more into line with the predictions of the advanced modelling.

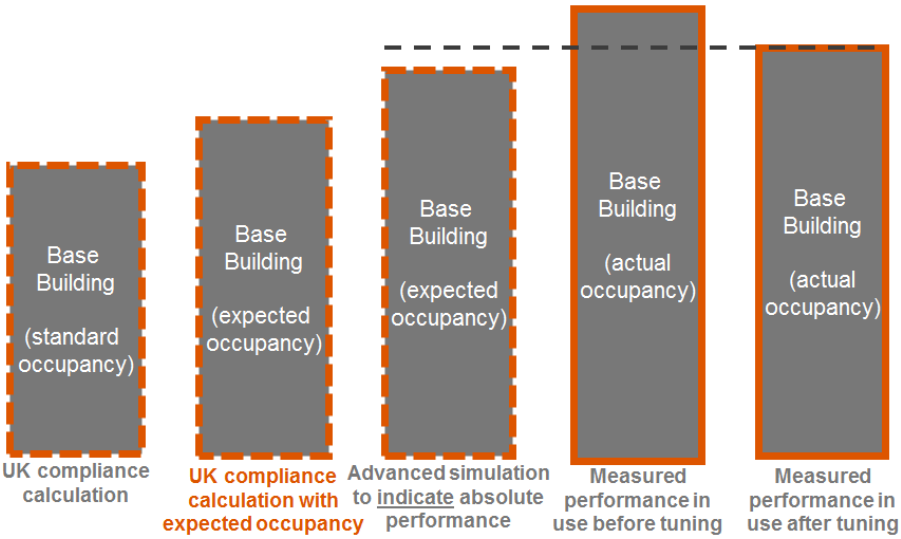

Figure 2 – Base building energy use: predicted vs measured (illustrative)

Figure 3 illustrates how strategically located sub-meters can capture the energy consumption of each significant end use and allow it to be compared with the predictions of the simulation model. Deviations may be due to inappropriate assumptions in the model or unexpectedly poor plant efficiency, control or management. The process enables engineers to identify the causes and to fine tune the plant, the controls, or the model, to allow any wasteful deviations to be addressed.

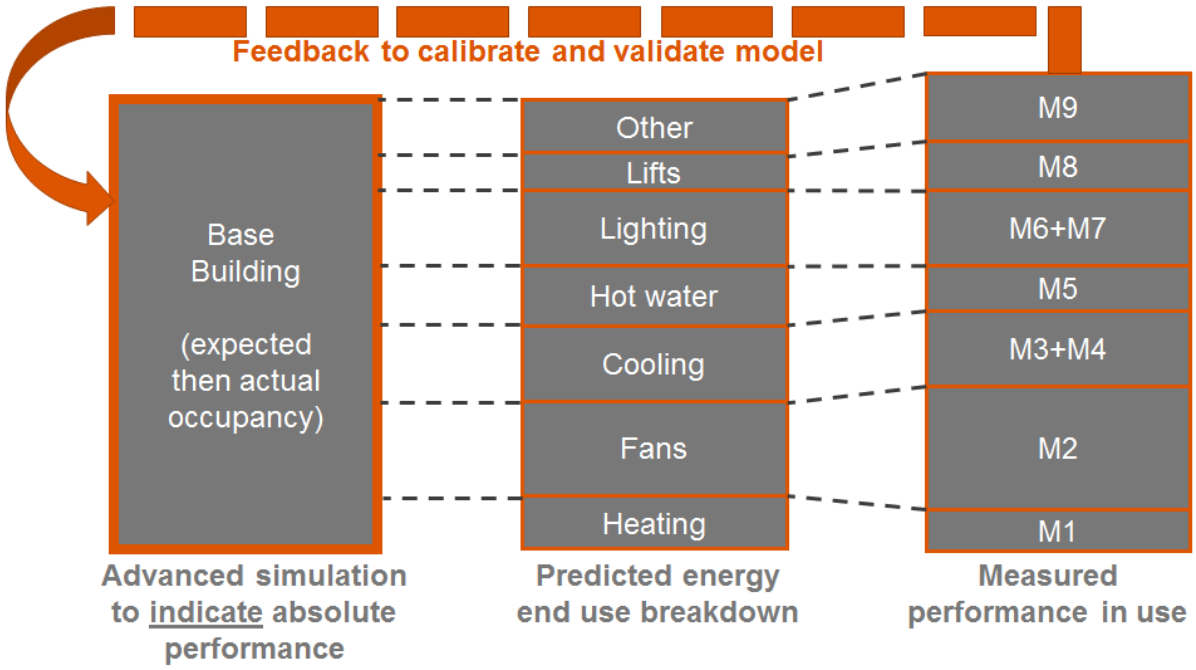

Figure 3 – Base building energy use: setting targets for individual sub-meters

For successful delivery of NABERS outcomes, monitoring and tuning during the Defects Liability Period (DLP), and beyond until full occupancy, has been found to be essential. Typically this includes:

- establishment of building and subsystem targets based on simulation
- monthly monitoring reports comparing sub-metered performance to simulated predictions
- at least 4 tuning exercises during DLP, each including a detailed review of BMS operation
- continued commissioning activity to identify and rectify commissioning defects
- contractual retentions on the builder and mechanical contractor based on NABERS performance (i.e. NABERS performance failure is treated as a defect)
- end-of-period formal assessment of NABERS Rating prior to contractual release.

History of Commitment Agreements in Australia

Since starting in 2002, a total of 147 Commitment Agreements have been signed for base buildings. Annual totals have fluctuated significantly over this period, peaking between 2008 and 2013; and with fewer just recently, see Figure 4. This probably relates to changes in construction activity, together with increased confidence by the industry that it can build high performing buildings that can achieve good NABERS ratings without oversight.

Figure 5 shows that the vast majority of buildings with Commitment Agreements have targeted 4.5 or 5 stars. This reflects a number of factors:

- 4.5 stars is still the benchmark requirement for Government departments, so many projects aim to reach this rating, and no more. However, it should be noted that when Commitment Agreements started, 4.5 stars was genuinely a “stretch” rating, with no track record of it ever having been achieved in use.
- 5 stars has in recent years become the new informal benchmark for “high performance”, but only in the past 3-4 years has it been achieved regularly.
- 5.5 stars (and higher) is relatively uncommon today, with industry knowledge of how to deliver it not well established, so making it a greater risk as a commitment. Nevertheless, several projects that committed to 5 stars have gone on to achieve 5.5 stars, indicating some conservatism and risk management on the part of developers and designers.

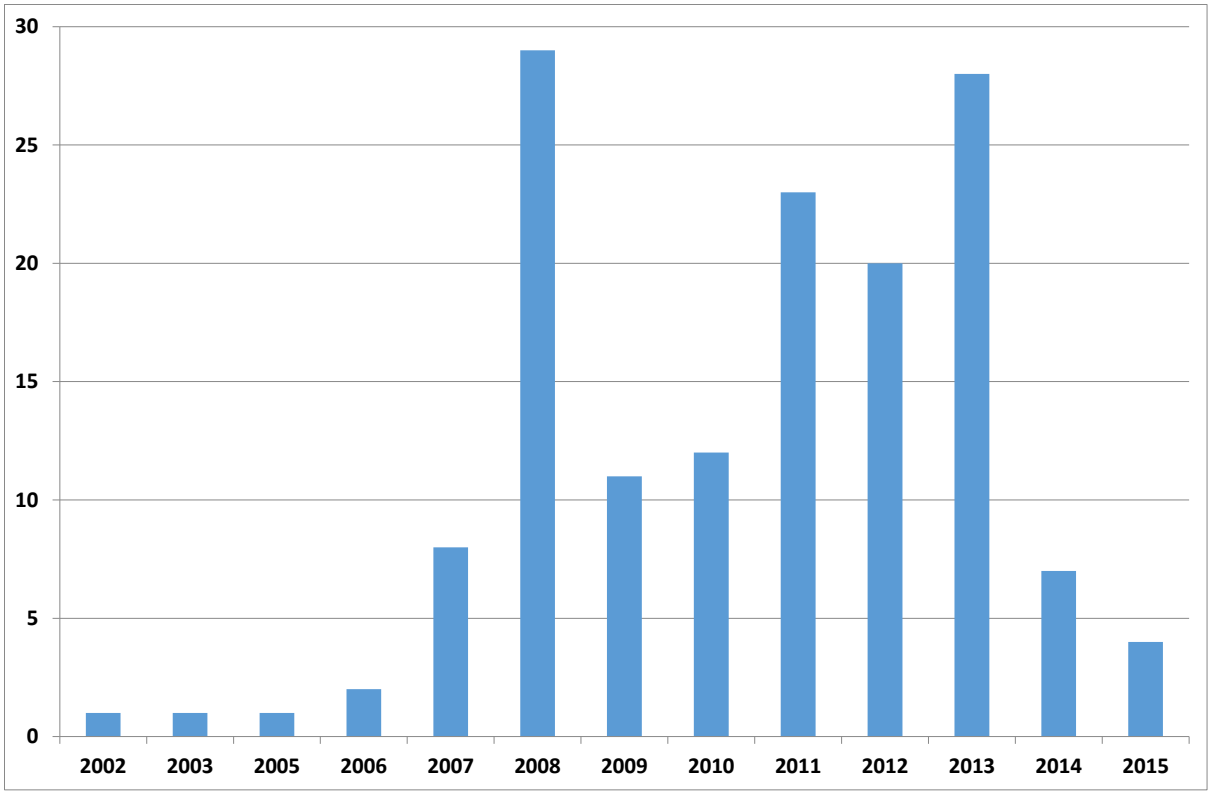

Figure 4 – Numbers of office base building Commitment Agreements by year

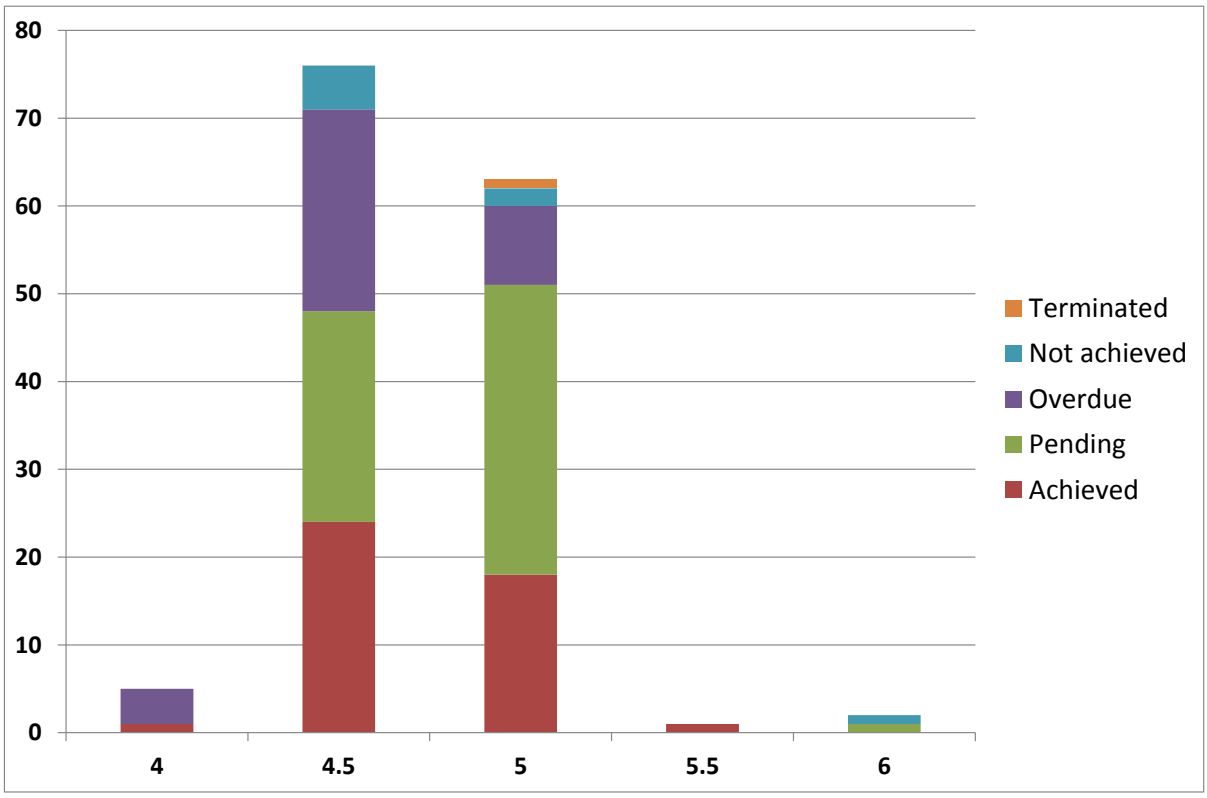

Figure 5 – Number of office base building Commitment Agreements by target

As Figure 5 shows, one new building has achieved 5.5 stars. This is significant in that 5.5 star performance requires almost four times less energy than 2.5 stars, the average performance of

Australian office buildings in 1998. In other words, a 5.5 star building is now achieving the "Factor 4" hypothesised as possible by Amory Lovins et al back in 1998 (3).

Existing Buildings

Energy performance ratings for Australia's existing stock of larger office buildings have also improved markedly since the ABGR was introduced. Figure 6 shows data from IPD (4) covering the period 2006-14. The right hand axis and filled area show how the use of NABERS for existing buildings has grown enormously, with total area rated annually increasing from 1.5 million m^2 in 2006 to 7 million m^2 in 2014. National data collected by Government (5) states that over 77% of the national office building market has now been rated with NABERS Energy for offices at some point – about 18 million out of 23 million m^2.

The average base building rating is shown by the thick blue line and left hand axis of Figure 6. When introduced in 1999, the average rating was 2.5 stars and excellent practice 5 stars (at the time deemed unattainable). The average rating had risen to 2.9 stars in 2006 and 3.6 stars by 2010, so transparency about energy performance was clearly driving significant activity to improve efficiency. This evidence led to the federal government introducing in 2010 the Building Energy Efficiency Disclosure Act, to mandate disclosure of base building ratings on sale or let of premises over 2,000 m^2. With poorer performers forced to declare their ratings, the area-weighted average dipped from 3.6 to 3.3 stars, but recovered within two years. The NABERS Administrator then introduced the 6 star level (categorised as "market leading performance"), challenging the industry to be yet more ambitious. The average rating has since continued to rise, reaching 4.2 stars by June 2014 - equivalent to a 32% reduction in emissions for the whole stock over the 8 years of this graph.

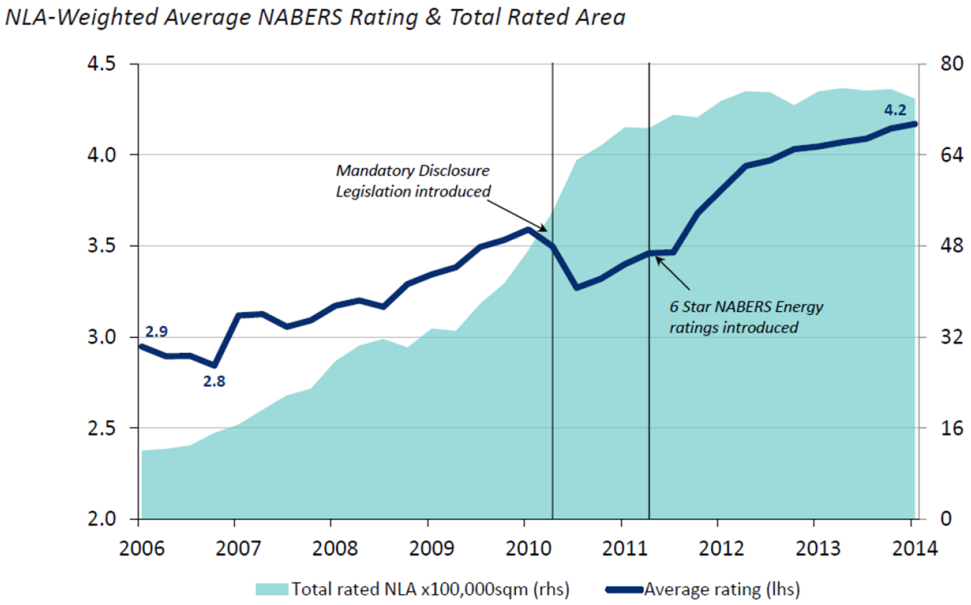

Figure 6 – Office base building ratings: improving penetration and outcomes

Figure 7 shows the current number of base building ratings at each star level for the 921 existing offices held in NABERS' database at November 2015. Over half the ratings are 4.5 star or better, with the mode rating (203 buildings) 5 stars ("Excellent performance"). Although 70 buildings are rated 5.5 stars and 12 are 6 stars, these numbers reduce to 60 and 4 respectively without GreenPower[8].

[8] GreenPower is certified zero carbon electricity. Buildings that use it get a better NABERS Rating due to the zero emission supply, but they also have to declare their ratings ignoring the impact of this supply choice.

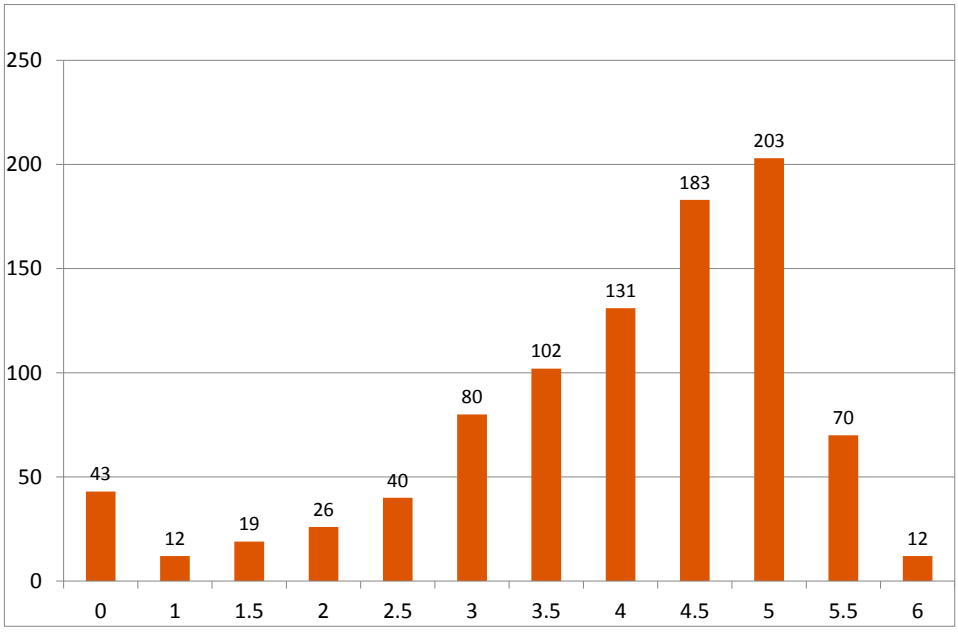

Figure 7 – Number of base building ratings by star rating (November 2015)

How Does the Energy Efficiency of European Offices Compare?

Some Existing Initiatives

There are three main ways that market leaders in the UK attempt to achieve exemplary energy performance for new office buildings or major refurbishments:

1. setting targets "beyond Building Regulations compliance"
2. setting a target whole building operational rating[9]
3. signing up to the Low Carbon Workplace[10] (LCW)-ready scheme.

The first is clearly wedded to a design for compliance culture and never associated with explicit real outcomes. The second and third focus on operational outcomes, but for whole building energy use, which is likely to be a bigger challenge than base building energy (as more parties are involved), though it avoids any doubts about which energy is in scope (and casts the net wider), and suitable metering for verification is much more likely to be available.

Measuring and benchmarking base building energy use

The market transformation success for office base buildings in Australia led the Better Buildings Partnership (BBP) in 2012 to commission Verco and UBT to develop a Landlord Energy Rating[11] (LER), an investment-grade base building rating scheme for existing UK offices akin to the NABERS system in Australia. In 2013, prototype tests of the resulting Excel software on eighty of the BBP members' existing buildings exposed challenges with the configuration and sub-metering of building services systems in many existing UK office buildings[12]. Detailed case studies were then made of four of these buildings to understand these underlying issues in more depth, and to provide calibration checks on the simpler rating approach that had to be used on most of the sample (in order to keep costs down). We have no data on how the characteristics of prime office base buildings in Australia (size, type of construction, hours of operation, occupancy, etc.) compare with those in the UK market, although we suspect there are more similarities than differences.

[9] http://www.willmottdixon.co.uk/projects/building-a-prosperous-future-for-keynsham
[10] https://www.carbontrust.com/client-services/advice/business-advice/low-carbon-workplace/
[11] http://www.betterbuildingspartnership.co.uk/our-priorities/measuring-reporting/landlord-energy-rating
[12] In 2006-07, UBT had developed a Landlord's Energy Statement (LES) and an associated Tenant Energy Review (TER) with the British Property Federation, see http://www.les-ter.org. This low-cost method was intended to support the UK Government's proposed extension of Display Energy Certificates (DECs) to commercial buildings, which in the event never happened. The inconsistent boundary between landlord and tenant energy use in different buildings made simple benchmarking of the LES and TER impossible.

The findings caused the BBP to explore a different path towards the successful outcomes achieved in Australia: to focus on new buildings, where it was potentially possible to design out the obstacles of engineering services and sub-metering configurations encountered in the existing stock, and to:

- demonstrate that energy efficient operation can be achieved in new buildings
- ensure that new stock does not 'add to the existing problem'
- identify exemplar pathways for improving the existing stock.

Base Building Energy Performance of New Prime Offices in Europe

For the purposes of this paper, we have made a comparison between offices in London and Melbourne. London is typically cooler, both in summer and winter, so buildings require a little more heating and a little less cooling. Figure 8 makes direct comparison of base building energy performance ratings of offices in London and Melbourne. The line shows the relationship between kWhe/m^{2}NLA/yr[13] and the NABERS star level for Victoria. At the poor end of the scale, 1 star equates to over 200 kWhe/m^2, at the excellent end, 5 stars represents around 50 kWhe/m^2/yr. The ranges for each city indicate the spectrum of performance, from least to most energy efficient. Most new offices in Melbourne achieve 4.5 stars (70 kWhe/m^2/yr) or better, with the best at 5.5 stars (40 kWhe/m^2/yr).

Where do new UK offices sit on Figure 8? We cannot say precisely, because UK base building operational performance is not measured. However, the 2013 tests of the LER found that base building energy use averaged 160 kWhe/m^2/yr, four times as much as the best in Melbourne. The detailed case studies were scattered around that level, giving some confidence in the value.

The LER assessments were mostly for existing buildings. However, from this and other evidence, it seems likely that the range for new build stretches to at least 160 kWhe/m^2/yr, the average for existing buildings. From other confidential data sources, the best prime office base buildings in the UK currently seem to reach 60-80 kWhe/m^2/yr, similar to the 4.5 star minimum standard in Melbourne. So the best end of the UK new building range seems to need nearly twice as much energy as the best in Melbourne, and the poorer end four times as much.

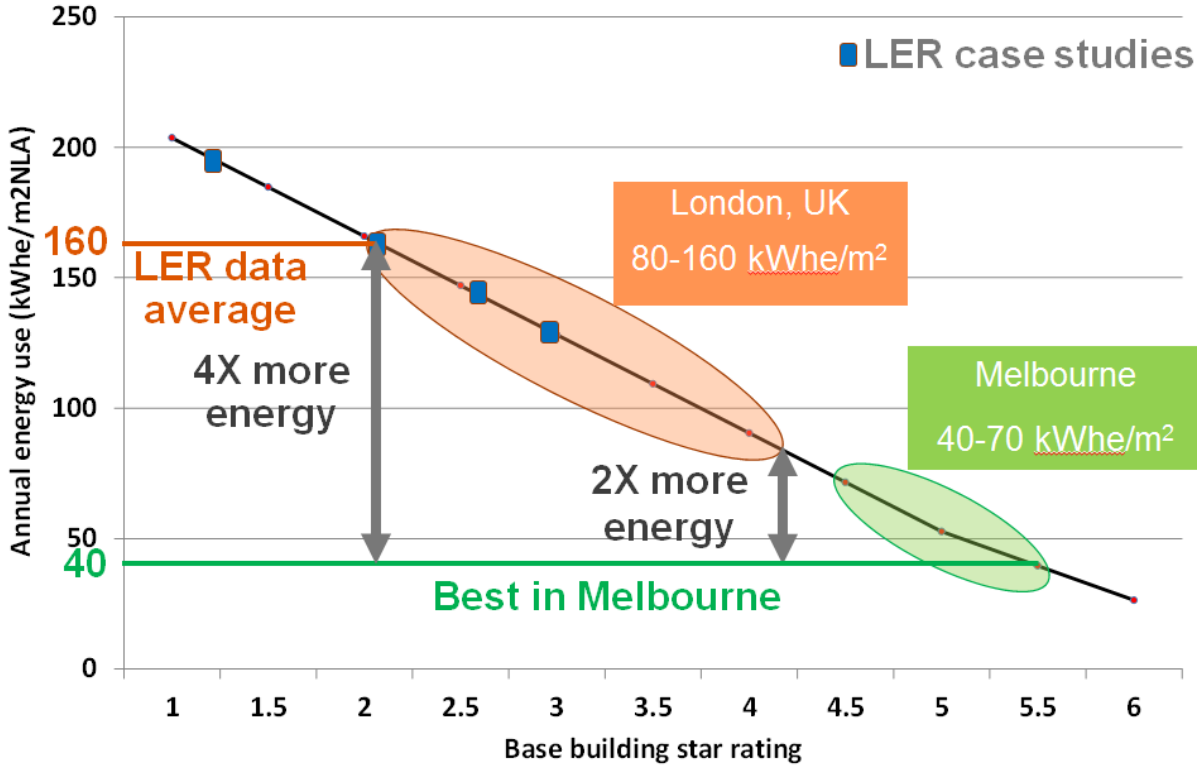

Figure 8 – Base building energy use for new offices in London and Melbourne

[13] kWhe is the "electricity equivalent" of total energy use: kWh of electricity are added to kWh of any fuel multiplied by 0.4 and kWh of hot or chilled water multiplied by 0.5. NLA is net lettable floor area.

Importance of single responsibility for base building services

An important reason for the Australian success is that the developer and then the landlord can "own" base building performance, and have authority of control over HVAC services in tenanted areas (apart from special equipment added by the tenants). In the UK this is not always technically possible, particularly in top end Central London offices. Why? Because developers and landlords are pushing onto tenants the installation, operation, maintenance, control and metering of what would be base building plant in Australia. This results in an apparent (but fictitious) saving in the cost of installation, operation and maintenance of landlord's services - perhaps with lower service charges, but with tenants incurring extra direct costs. More worryingly, the lack of a common control strategy and the division of responsibility for what should be managed as base building services can lead to highly inefficient energy use, with the landlord becoming a "dumb" provider of hot and chilled water (and sometimes primary air) to tenants. The differences can be enormous, at worst with landlord's services operating 24/7, whether or not they are really needed.

Some London tenants allegedly prefer these arrangements, taking in-house more control of the services in their spaces. However, this preference may be solely cultural: it seems unlikely that their technical requirements are much different from those in Sydney (indeed some of the occupiers and activities are identical). Some tenants may feel more secure under such arrangements, but may be unaware of the scale of the energy and carbon penalties; and the potential CSR embarrassment if evidence emerged that their base buildings used much more energy per m^2 than was demonstrably necessary in efficient and well-managed prime offices.

Feasibility of Commitment Agreements in the UK

An extensive group of industry stakeholders[14] is currently undertaking a study of the potential to introduce to the UK the '*design for performance*' concept and a Commitment Agreement protocol, supported by a base building rating method. There is a strong expectation that the Australian model can map directly onto second tier property here, where many tenants are happy to get on with their business and leave servicing the building to the landlord. Evidence from building performance studies (6) also suggests that energy efficient performance and high levels of occupant satisfaction are not in conflict, but can be achieved simultaneously as complementary outcomes of good briefing, design and management. Given the huge energy efficiency benefits arising from single-actor control of HVAC services in Australia, the top end of the UK office market might want to consider it too. UBT also hopes to promote Commitment Agreements in all sectors, and not just offices.

Compatibility of Base Building ratings with the EPBD

The EPBD recast (7) Annex 1 paragraph 1 says:

"The energy performance of a building shall be determined on the basis of the calculated ***or actual*** *annual energy that is consumed in order to meet the different needs associated with its* ***typical*** *use and shall reflect the heating energy needs and cooling energy needs (energy needed to avoid overheating) to maintain the envisaged temperature conditions of the building, and domestic hot water needs."*

The focus on 'heating energy needs and cooling energy needs' seems to have led EC lawyers to take the view that all energy certificates must be based on an asset rating, and to justify saying this disallows the use of whole building utility meter data to determine the energy performance.

It is apparent that the Annex 1.1 wording is compatible with the definition of the NABERS Base Building rating, which is closely based on the measured energy use for heating, cooling and hot water (or a prediction of the same until the building has been in operation for a year with at least 75% of full occupancy). It may therefore be tenable that EC lawyers can endorse a NABERS-style measured (and predicted) base building rating as being compliant with Annex 1.1. The key semantic challenge is

[14] The feasibility study is backed by the Better Buildings Partnership (BBP) and is being funded and overseen by: British Land, Legal & General Property, Stanhope, TH Real Estate, Laing O'Rourke, NG Bailey and the energy simulation company EDSL. UBT is co-funding the public interest aspects of the project. The study also has the support of DECC, BCO, BPF, UK-GBC and CIBSE. The study team is led by Verco and includes BSRIA, Arup and UBT. For the Australian review, and consideration of the feasibility of Commitment Agreements in the UK, the team is being assisted by Energy Action, Canberra.

to understand that a Base Building rating should be based on metered energy use once the building is occupied, ie it is a type of operational rating, but it is not the operational rating most people in Europe associate with the term ie based on the whole building energy use measured by utility meters. The latter can be deemed by lawyers to be inconsistent with Annex 1.1, whereas the former cannot.

The words 'typical use' in Annex 1.1 above can also sometimes be claimed to imply an asset rating, but a measured base building rating does effectively benchmark "typical use" by adjusting the benchmark 1) for the actual weather during the measured period (compared with typical weather) and 2) for the building's actual hours of use (compared with typical use).

So the EPBD recast seems to allow EU countries to deploy NABERS-style measured base building ratings, but Member States have not taken the opportunity to do so. This may be partly because the CEN Standards which relate to the EPBD do not explicitly offer this option, despite it being explicit in Annex 1.1. An extensive market study commissioned by the EC in the context of the common Voluntary Certification Scheme (VCS), which is required by Article 11.9 of the EPBD recast, highlighted stakeholder appetite for measured ratings and suggests that allowing a measured base building rating to be an option for the VCS would be strongly supported by stakeholders in the real estate market. For this to happen, the new CEN Standards for the EPBD recast need to recognise the measured base building rating option implied by Annex 1.1.

Achieving 4.5 Stars in the UK: a Commitment Agreement Challenge

Given it is routine in Australia for new office base buildings to be 4.5 stars or better, what does 4.5 stars energy performance look like in a UK context? The most used benchmarks for offices in the UK are contained in Energy Consumption Guide 19 (8), known as ECON 19. Figure 9 shows the Good Practice benchmark for a Type 3 office (air-conditioned, open plan) base building. It equates to nearly 120 kWhe/m^2/yr, placing it at around 3.2 stars if in Melbourne. Figure 9 also shows the measured base building performance of one of the most energy efficient air-conditioned offices known to the authors, at just over 100 kWhe/m^2/yr, or 3.7 stars. To achieve the 4.5 stars target in the UK, base building energy use would need to be about 72 kWhe/m^2/yr. While this might appear daunting, the speculated improvement from the 3.7 star building in Figure 9 is almost all due to lower space heating, which seems more than feasible, given much evidence, e.g. (9), that the fuel needed for heating has decreased substantially since ECON 19 was published.

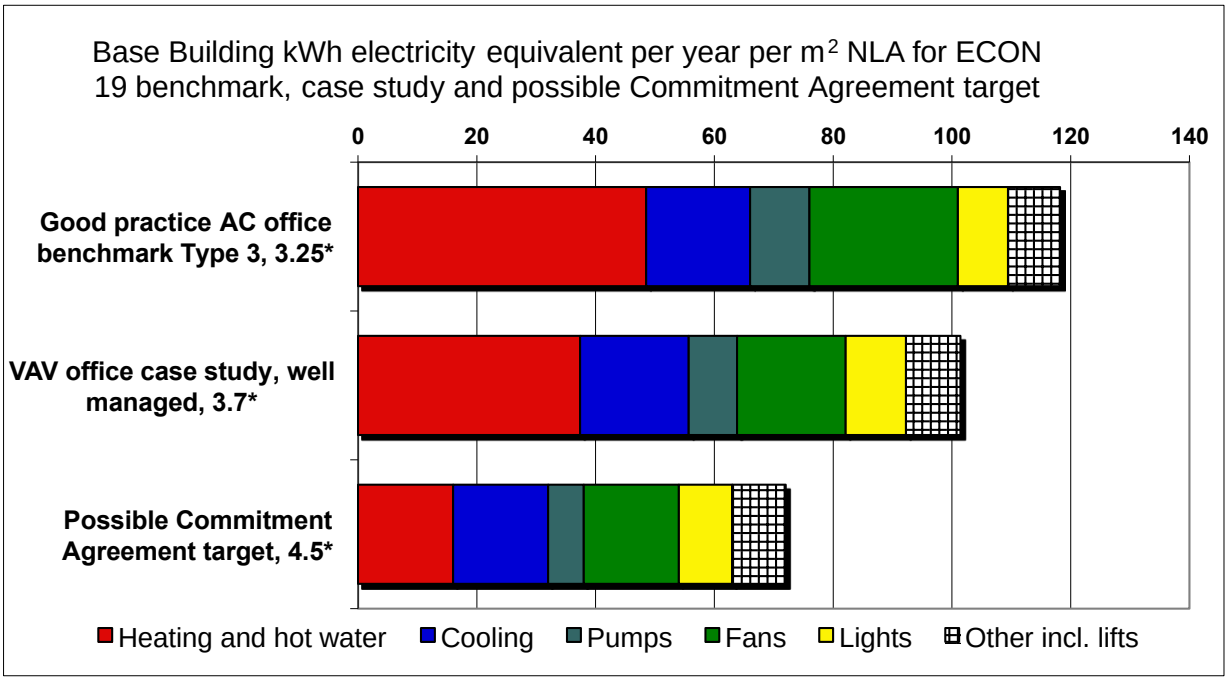

Figure 9 – Base building 4.5 star energy use vs ECON 19 Type 3 Good Practice

(Energy Consumption Guide 19 gives Typical and Good Practice benchmarks for 4 office building types: naturally ventilated cellular (1) and open plan (2), air-conditioned standard (3) and prestige (4))

Conclusions

The energy performance of new prime office base buildings in Australia has been transformed over the last 15 years. Primary drivers have been:

- a base building energy in-use measurement standard and rating system
- a Commitment Agreement process that has helped teams to target in-use performance realistically, and then deliver it
- major office occupiers deciding to specify the energy performance they want.

NABERS base building ratings and their mandatory disclosure are fundamental to the way commercial buildings are managed in Australia, strongly influence investment decisions for existing and new buildings and have a significant impact in the management of major investment property portfolios, including which buildings are bought and sold (5). Research indicates that higher NABERS Energy ratings enhance property values, reduce vacancy rates and increase yield (10).

As investors in property in Europe show ever more interest in sustainability as a driver of asset value, measured operational energy use is becoming increasingly material data (11). A key lesson here is that a government can effectively support the achievement of energy performance outcomes in the private sector by mandating transparency (which removes uncertainty and information asymmetries) and creating one independent, robust and authoritative system which enables credible information to be collected and communicated effectively.

In Australia, the alignment of operational energy efficiency with lettability and thereby shareholder value in commercial property has created a virtuous circle between policy objectives and market forces. In Europe, in spite of there being more energy-related legislation for buildings, data on the expected base building energy performance of new office buildings, in a form which could then be validated by in-use measurements, is not produced. It is not surprising therefore that markets in Europe are not driving the spectacular improvements in base building energy efficiency that are being witnessed by the Australian market.

There are no intrinsic physical reasons why new offices in Europe cannot perform as well as Australia's. However, base building energy in use is neither measured nor targeted; the design of energy efficient offices is rarely informed by feedback from real world measurements; and a design-for compliance culture, lack of energy performance disclosure, and confused responsibilities have contributed to the EU falling behind. As a result, it seems plausible that on average new prime offices across the EU may be using twice as much energy per m^2 for base building services as their Australian counterparts.

The Commitment Agreement process appears to be a promising avenue for European countries to explore further, probably with pilot studies that apply some key ingredients of the process to real building projects. Harking back to the Property Environment Group's circle of blame, developers may say they need tenants sufficiently committed to rent space in truly energy efficient buildings before it is worth their while creating them. But with the increasing interest of investors in operational energy use, market demand for an energy efficient 'product' can be established as soon as an investment-grade measurement and rating system is in place to prove it. The EU can get to that position quickly, by learning from Australia's experience. An ambitious but realistic goal would be for a scheme to be in place for the 2020 roll out of 'nearly zero energy' new buildings, as required by Article 9.1(a) of the EPBD recast (7). New offices could then begin to offer what the energy efficiency claim 'says on the tin'.

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