BETTER WAYS TO WORK

HVAC MANAGEMENT, REPAIR AND MAINTENANCE IN THE MID-TIER COMMERCIAL OFFICE SECTOR

MARCH 2021

ABOUT THIS REPORT

Title: Better Ways to Work: HVAC management, repair and maintenance in the mid-tier commercial office sector

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1. EXECUTIVE SUMMARY

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THE UNIVERSITY OF WOLLONGONG WAS ENGAGED BY THE DEPARTMENT OF INDUSTRY, SCIENCE, ENERGY AND RESOURCES (DISER) TO UNDERTAKE AN INDUSTRY SURVEY LOOKING AT HEATING, VENTILATION AND AIR CONDITIONING (HVAC) MANAGEMENT AND MAINTENANCE PRACTICES IN MID-TIER OFFICE BUILDINGS.

The project was developed to progress commitments under the *Addendum to the Trajectory for Low Energy Buildings – Existing Buildings.*

HVAC is the largest end-use of energy in commercial buildings. The aim of the project was to better understand how energy productivity can be improved in HVAC systems in the mid-tier commercial building office sector.

This report presents the results of the largest national survey of facilities managers, HVAC contractors and associated design and systems specialists undertaken to date. It provides a new empirical data source for understanding how the HVAC repair and maintenance workforce engages with buildings and technologies, with building owners and tenants, with governance authorities and regulators, and with each other through formal institutions, and through informal, everyday working relationships.

This report provides a descriptive analysis of the results and identifies areas of interest for further investigation. Key empirical findings from this work include:

PEOPLE

- SMEs were the most common enterprise type for contractors and engineers/systems designers, whereas facilities managers were predominantly from multi-national enterprises, with strong representation from national business or enterprise. This has implications for targeted continuing professional development (CPD) and knowledge dissemination.
- Contractors are largely trade-qualified and experienced (>11 years).
- Facilities managers are variably qualified (trade/diploma/degree) but with high rates of on-job experience reported as qualification. High rates of trade qualifications indicates a career pathway from contractor to facilities manager.
- Responses indicated strong representation from members of professional associations, which may reflect recruitment channels and confirms anecdotal evidence of difficulty accessing non-members.
- Contractors and facilities managers may both be effective conduits to building owners but require different training and information dissemination strategies.

BUILDINGS AND SYSTEMS

- As reported in prior studies, the mid-tier sector is heterogenous and segmented. Multiple tenants per floor was the most common tenancy type observed, and there was a low penetration of owner-occupied buildings. This means tenants, commonly multiple different tenants, are key players in mid-tier upgrade and retrofits.
- All systems types were commonly encountered; central plant only was slightly more common than mix of central/splits, which may indicate substantial 'patching' over old and under-performing systems. There was a relatively high penetration of split systems only. System type was influenced by state and geographical context.
- Many (42.7%) report that most buildings have original HVAC system with no upgrade since installation, and few (22.3%) report that most buildings have been fully retrofitted.

MAINTENANCE PRACTICES

- Equipment suppliers and informal knowledge sharing networks (experienced colleagues) are a key source of information, at almost double the rate of more formal CPD training. This has significant implications for the delivery of energy efficiency training and information dissemination.
- Cost is overwhelmingly the deciding factor when choosing between repair and replacement of systems and components. However, there is a slight mismatch between contractors and facilities managers when asked about what matters when engaging/winning work. Facilities managers report lifecycle cost as more important than upfront cost, whereas contractors see upfront cost as more important.
- Preventative maintenance is a greater than expected activity in the sector. However, the prevalence of maintenance, and explicitly planned and preventative maintenance, as the 'number one action that could be taken to make HVAC systems perform better' suggests that there remains an unmet need for additional maintenance work.
- Responding to comfort complaints were the most frequent reactive maintenance task, and the most common fault types were also amenable to simple fixes – filters and thermostats.

The survey findings highlight the need for a mix of policy approaches in lifting the energy performance of mid-tier office buildings. These may include empowering stakeholders through better training, information and capacity building; carefully targeted incentive programs that recognise geographical disparities in building stock, ownership profiles and workforce characteristics; and lifting energy performance through a range of regulatory pathways.

Given this was the largest survey of its kind to date, there is substantial scope for further analysis of the responses to inform the design and development of policy options.

2. INTRODUCTION

2. INTRODUCTION

ABOUT THE PROJECT

This report presents the result of a large survey project conducted on behalf of the Australian Department of Industry, Science, Energy and Resources (DISER), by researchers from the School of Geography and Sustainable Communities (SGSC) and Sustainable Buildings Research Centre (SBRC) at the University of Wollongong.

The project was developed to progress commitments under the *Addendum to the Trajectory for Low Energy Buildings – Existing Buildings*. The Trajectory Addendum is the second stage of the national plan for a trajectory towards zero energy (and carbon) ready buildings for Australia.

The project aimed to understand how building services in mid-tier office buildings are currently managed and maintained, particularly with respect to implications for energy performance. The focus of the project was on service enterprises, building service technicians and facilities managers; that is, those directly responsible for the management and maintenance of HVAC in commercial office buildings. While significant previous work has been completed in this sector, the perspectives of those working on these buildings day-to-day have not been systematically collected in previous research on the mid-tier office sector.

CONTEXT

Buildings in Australia account for approximately 19% of total energy consumption and 23% of greenhouse gas (GHG) emissions.[1] More specifically, commercial buildings account for about 10% of the nation's overall energy consumption and commercial office buildings for approximately 2.5%.[2] Recent modelling suggests that the building sector can potentially deliver a 23% reduction in emissions by 2030, with reductions of 55% estimated by 2050.[3]

The National Australian Built Environment Rating System (NABERS) scheme, and the introduction of mandatory disclosure through the *Building Energy Efficiency Disclosure Act 2010* has been instrumental in driving energy transitions in the urban environment. However, this transition has been centred on high quality commercial buildings in central business districts; existing drivers have not to date had a transformative impact around less prestigious commercial building development.[4] There has been a number of recent studies that have focussed on this less prestigious segment of the market, known within the industry as the 'mid-tier', to understand the barriers to change. This report adds to the empirical evidence base by focusing on the insights of those directly responsible for the management and maintenance of mid-tier office buildings.

Mid-tier commercial buildings are generally defined as non-premium or A-grade[5] grade buildings. The mid-tier sector is substantial; it has been estimated that mid-tier office buildings make up over 80% of the overall net lettable area (NLA) in Australia's overall commercial office building stock.[6] Despite the prevalence of these buildings, research to date is largely limited to work by government and industry bodies (e.g. GBCA and ASBEC).

1. ASBEC. 2008. *The Second Plank – Building a Low Carbon Economy with Energy Efficient Buildings*. www.TheCIE.com.au
2. Green Building Council of Australia. 2015. *Mid-tier commercial office buildings in Australia: A national pathway to improving energy productivity* (Issue November).
3. ASBEC. 2016. *Low Carbon, High Performance – How buildings can make a major contribution to Australia's emissions and productivity goals: Summary Report* (Issue May).
4. Van der Heijden, J. 2016. The new governance for low-carbon buildings: mapping, exploring, interrogating. *Building Research and Information, 44*(5–6), 575–584. https://doi.org/10.1080/09613218.2016.1159394
5. Grading is in accordance with the voluntary office building quality grading provided by the Property Council of Australia, *A Guide to Office Building Quality*. This is widely accepted as an industry standard for assessing commercial office buildings. The grading includes environmental and building performance standards.
6. EY. 2015b. *Mid-tier commercial office buildings in Australia: Research into improving energy productivity (draft)*.

These studies tend to define the mid-tier in an inexact manner, as buildings with the following characteristics:

- smaller and older than premium buildings
- highly diverse ownership profile, including property groups, government, corporate ownership, foreign ownership, and private landlords ranging from private investors, family-owned and property syndicates
- diverse tenant profile, generally comprised of small-medium enterprises that are largely cost-focused, and less likely to respond to non-economic drivers
- operate in a commercial context where higher vacancy rates and shorter lease terms dominate.[7]

From an energy efficiency perspective, the building stock is typically outdated (weaker thermal performance), using inefficient technologies (e.g. HVAC and lighting), with the buildings being operated well below their potential in terms of energy efficiency.[8] These factors indicate that those responsible for operating, managing and maintaining mid-tier buildings may have a substantial role to play in improving their energy performance. Previous studies have also reported difficulties in engaging with owners and tenants of mid-tier buildings, largely resulting from the disaggregated and heterogeneous ownership profile.[9] These studies have typically either been small scale investigations of decision making at the managerial level (i.e. n<50), taken a small scale, case study, or innovative niche focussed approach, and many have not specifically focussed on the mid-tier, but may have included some B or C grade buildings.

There is a clear role for regulation and incentive measures to stimulate energy transitions in the mid-tier sector to address the numerous barriers and market failures, identified in many studies, which discourage energy efficiency improvements in this sector.[10] A summary of these barriers is provided in EY, 2015b and Green Building Council of Australia, 2015.

However, there is a pressing need for further research and, in particular, for additional empirical data to better characterise and specify the diversity in buildings, HVAC systems, workforce, management and maintenance practices and applicability of identified barriers at a national level. Indeed the need for targeted surveying of mechanical services contractors to explore HVAC operation nationally in mid-tier buildings has been suggested.[11] This project sought to commence the task of large-scale data collection required to allow the Federal government to understand the pathways available to stimulate improvements in energy efficiency in the commercial office sector. The project focuses on the intermediaries, such as facilities managers, service organisations and building services technicians, who are involved in decision-making around maintenance and upgrading in mid-tier buildings.

7. EY. 2015b; Green Building Council of Australia. 2015; *Sustainability Victoria. 2016. Energy efficient office buildings: Tranforming the mid-tier sector.* Sustainability Victoria.

8. EY. 2015b; Sustainability Victoria. 2016.

9. Savills. 2018. Mid-Tier Offices Investment Performance Study. www.sustainability.vic.gov.au

10. e.g. EY. 2015b; Green Building Council of Australia. 2015; Rock, S., Hosseini, M. R., Nikmehr, B., Martek, I., Abrishami, S., & Durdyev, S. 2019. Barriers to "green operation" of commercial office buildings: Perspectives of Australian facilities"green operation" of commercial office buildings: Perspectives of Australian facilities managers. *Facilities*, 37(13–14), 1048–1065. https://doi.org/10.1108/F-08-2018-0101; Savills. 2018; Sustainability Victoria. 2016.

11. Savills. 2018.

3. ABOUT THE RESEARCH

- Survey design
- Survey dissemination
- Survey analysis
- Survey reach and responses

3. ABOUT THE RESEARCH

The overarching aim of this project was to explore how energy productivity can be improved in heating, ventilation and air conditioning (HVAC) systems in the mid-tier commercial building office sector, by improving understanding of the knowledge, skills and practices of workers responsible for the management, repair and maintenance of HVAC systems. HVAC is the largest end-use of energy in commercial buildings (43%), followed by lighting (20%) and equipment (10%).[12] The data collected through this project will help to build a more comprehensive picture of how the HVAC management, repair and maintenance workforce engages with buildings and technologies, with the building owners and tenants they provide services to, with governance authorities and regulators who determine the parameters of their work, and with each other through formal institutions such as professional associations, and through informal, everyday working relationships.

The current research project involved three main activities:

- A targeted review of previous studies that had investigated building energy efficiency improvements, particularly in mid-tier buildings;
- Interviews with key stakeholders and identified experts on mid-tier energy efficiency, designed to supplement the literature review and develop survey focus areas;
- Development and distribution of an online survey to facilities managers and HVAC contractors to explore the status of building services management and maintenance practices in the mid-tier commercial office sector across Australia.

The current report presents the results and analysis from the nationwide survey. The survey design and dissemination strategy were reviewed and approved by the University of Wollongong Human Research Ethics Committee (ref: HREC 2020/171).

SURVEY DESIGN

The survey was designed to focus on heating, ventilation and air conditioning (HVAC) management, repair and maintenance practices in Australian mid-tier commercial office buildings. It was intended that the survey would target a large national sample of service organisations, building services technicians and facilities managers.

The first stage of the survey design involved a series of interviews with an advisory board of key industry experts identified as relevant by either DISER or the UOW project team. In total nine interviews were conducted, ranging in length from 43 to 85 minutes. The interviews explored the experts' knowledge and opinions relating to the mid-tier office market sector (e.g. experience, who are the key actors, what skills exist, what are the main barriers), policy opportunities in the sector (e.g. what policies are having an impact, what are the main unknowns in the sector, what are the gaps or best ways forward for regulation in the mid-tier sector), and specific advice regarding survey design (e.g. what, how and from whom should data be collected).

Following these interviews, survey questions were developed using an iterative process with regular collaboration from DISER and the advisory panel. Given the intent to achieve a large sample size, a priority was to ensure the survey was concise, pocket-device friendly, and user-friendly. The final survey consisted of 28 questions, organised into five sections designed to 'pull' participants through the entirety of the survey:

- Section 1: About the work that you do (basic demographics)
- Section 2: About the buildings that you work on
- Section 3: About maintenance practices
- Section 4: Finding a better way to work in commercial office buildings
- Section 5: About you and your experience in the industry.

The survey was implemented using Qualtrics software, with separate flow logics created for facility managers and HVAC contractors.

12. Department of Climate Change and Energy Efficiency. 2012. *Baseline Energy Assumptions and Greenhouse Gas Emissions in Commercial Buildings in Australia – Part 1 – Report*. Prepared by pitt&sherry with input from BIS Shrapnel and Exergy Ltd. ISBN: 978-1-922003-81-2

SURVEY DISSEMINATION

The survey was widely disseminated via a number of avenues, including partner organisations, electronic direct mail to a list of enterprises in key metropolitan and regional locations identified by the UOW project team, and an electronic direct mail by the Australian Refrigeration Council (ARC) to a sub-set of refrigeration licence holders via their database. A branded webpage was created with accessible text and animation to introduce the survey aims and target audience (www.betterwaystowork.com.au). Forty $100 gift vouchers were offered as an incentive for completing the survey.

The survey invitation was shared by industry partner organisations. The primary distribution partners included:

- Australian Institute of Refrigeration, Air Conditioning and Heating (AIRAH)
- Facilities Management Association (FMA)

Other organisations played a smaller, though no less valuable role in disseminating the survey as widely as possible including:

- Australian Mechanical Contractors Association (AMCA)
- Airconditioning and Refrigeration Equipment Manufacturers Association (AREMA)
- Refrigeration and Air Conditioning Contractors' Association (RACCA)

Additionally, the Australian Refrigeration Council (ARC) also emailed the survey link to a sub-set of members (i.e. refrigeration licence holders).

The advertisement from partner organisations included social media posts on organisational *Facebook* and *LinkedIn* pages, articles in newsletters or industry magazines, webinars conducted by AIRAH and FMA, and electronic direct mail outs to membership. A direct email invitation was also sent to 1539 HVAC service providers identified via desktop research by the UOW research team. Contact details were located through a targeted google search of key metropolitan and regional locations.

SURVEY ANALYSIS

The survey was predominantly comprised of closed response questions, with a mix of question types including multiple choice, ranking, rating and slider questions. These closed response questions were quantitatively analysed using the statistical analysis package SPSS[13]. For questions where an 'other' qualitative response was possible, the responses were iteratively coded into emergent categories as appropriate.

In the design phase a decision was taken to limit the number of open response questions because of the risk of participants clicking out of the survey, rather than typing out responses. Voice recording functionality was added to the survey to allow participant to record their responses to qualitative questions to minimise this risk, however, this functionality was not widely used. Two open response questions were included in the final survey, namely:

- In your view, what is the number one action that could be taken to make HVAC systems perform better?
- We understand that like-for-like replacements are often the quickest, cheapest option when upgrading equipment. Can you tell us about a time when you have taken a different decision? Talk us through the steps involved in coming to that decision.

In the analysis phase, responses to the qualitative questions were coded against emergent categories, using a two-stage coding process. Firstly, the substance of each responses was interpreted into one or more short descriptive codes, then a second pass was completed to group these descriptive codes into common grouping codes. The current report primarily presents a quantitative analysis of these grouping codes.

SURVEY REACH AND RESPONSES

- Total number of surveys opened: 1645
- Total number of surveys started: 1548

Figure 1: Survey Responses

*Survey responses recording <10% did not complete any questions.

PERCENTAGE COMPLETION	FREQUENCY	PROPORTION OF SURVEYS STARTED
100% complete	945	61%
45–90% complete	127	8.3%
10–44% complete*	476	30.7%

Input from key stakeholder organisations during the survey design phase suggested that the survey needed to be as short as possible to engage the primary target audience of busy facilities managers and contractors. A balance was sought between retaining participants throughout the entirety of the survey and the one-off opportunity to collect industry data across different role types. The 100% completion rate of 945 participants—who responded to all questions in all survey sections (outlined above) —was regarded by partner organisations as excellent, based on their experience of previous large-scale industry surveys of their membership bases. These have tended to be much shorter in length. A further 127 surveys were at least 45% complete, where participants answered at least four questions related to maintenance practices (along with all of Sections 1 and 2, which included demographic and building stock questions).

Because of the variation in respondent numbers across the length of the survey, throughout this report the number of participants who responded to each question is included in the figure title.

13. IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp

The table below outlines the key role of partner organisations in distributing the survey link and contributing to this large data collection exercise.

Figure 2: Where respondents received the link (n=893)

	FREQUENCY	PERCENTAGE%
AIRAH	409	46.0%
FMA	179	20.0%
AMCA	20	2.2%
AREMA	20	2.2%
RACCA	26	2.9%
Other	239	26.8%
TOTAL	**893**	**100.0%**

Preliminary breakdown of 'other' category:

- ARC – 94 respondents (100% complete)
- TEFMA – 4 respondents (100% complete)

The following three sections of this report contain a descriptive analysis of the survey results.

BETTER WAYS TO WORK

4. PEOPLE

- Demographics
- Skills and training
- Relationships

4. PEOPLE

KEY POINTS: PEOPLE

- The industry overall is dominated by Small–Medium Enterprises (42.9% overall).
- A substantial proportion of facilities managers (37.9%) work for multi–national enterprises.
- Most participants report working in CBD/suburban geographical context.
- Contractors are trade-qualified (87%) and experienced (73.8% >11 years).
- Facilities managers are variably qualified (trade/diploma/degree) but high rates (69%) of on-job experience reported as qualification.
- High rate of trade (45%) indicates a career pathway from contractor to facilities manager.
- AIRAH and FMA are key organisations in information sharing and training, but they are a long way from full coverage in mid-tier office buildings.
- Contractors and facilities managers may both be effective conduits to building owners, but require different training and information dissemination strategies.

The mid-tier office sector is highly fragmented in terms of both owners and tenants, which makes it difficult to systematically target pathways to better energy performance.[14] Mid-tier building owners are diverse in terms of enterprise structure, investment motivation, geographical distribution, and their level of interest in the day-to-day operation of the buildings they own. They are often difficult to locate and to engage in discussions around improving the energy performance of their buildings.

Tenants who occupy mid-tier office buildings are also difficult to engage in discussions around energy performance and decisions tend to be driven at least initially by lease costs, rather than utilities bills. Whereas multinational corporations occupying premium buildings are increasingly driven by corporate social responsibility around their environmental impact, mid-tier office tenants are often SMEs with no identifiable sustainability agenda.[15] Mid-tier tenants appear to show much less interest in the energy performance of the buildings they occupy, although evidence of this lack of motivation is anecdotal and limited.

With both owners and tenants persistently difficult to reach, this large-scale survey has taken a different entry point to understanding how HVAC maintenance can be linked to better energy performance in mid-tier office buildings. By targeting facilities managers and contractors, the survey sought to capture a 'coalface' view of the experiences of those working on the ground and in the plantroom, to better understand how mid-tier commercial office buildings are currently managed and maintained in Australia, and how this might inform different policy approaches.

In this section the report looks at survey participant characteristics as a lens through which to understand the constitution of the HVAC management, repair and maintenance workforce. It details the participants in terms of:

- Demographics, (role type, enterprise size, geography)
- Skills, training and professional networks (qualifications, years of experience, professional memberships, locating information to carry out work)
- Relationships (procuring management, repair and maintenance services).

14. Savills. 2018.

15. Van der Heijden, J. 2018. From leaders to majority: a frontrunner paradox in built-environment climate governance experimentation. *Journal of Environmental Planning and Management*, 61(08), 1383–1401. https://doi.org/10.1080/09640568.2017.1350147

DEMOGRAPHICS

This section characterises the workforce responsible for managing and maintaining the mid-tier office sector in terms of role type, enterprise size, experience in the industry, and the geographies of where participants undertake their work.

Clear data on the size of the workforce servicing the mid-tier office sector is not available. The 'Cold Hard Facts 3' report estimated direct employment in the Refrigeration and Air Conditioning Industry in Australia, for 2016.[16] Based on those figures, somewhere between 59,000 and 85,000 people are estimated to be directly employed in commercial air conditioning and split system air conditioning <18kWr.

Elsewhere, the Australian government Job Outlook combines results from the most recent ABS Labour Force Survey, National Skills Commission trend data, the ABS Survey of Employee Earnings and Hours (cat. no. 6306.0), and customised ABS data to determine that the number of people working as refrigeration and air conditioning mechanics as their main job was 33,600 in 2019.

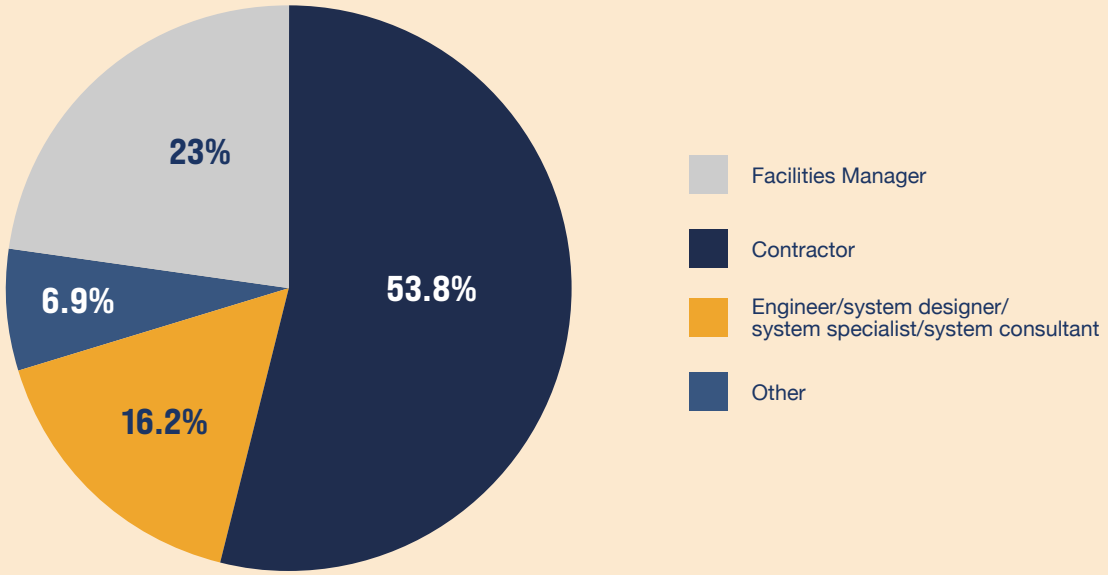
None of these figures give a precise count of those working on commercial buildings or, more specifically, the mid-tier office sector. However, they suggest that the commercial buildings HVAC industry is substantial and has a clear role as a stakeholder in improving the energy performance of Australia's commercial building stock.

ROLE TYPE

Reflecting the target audience for the survey, building services contractors accounted for the highest response rate by role type (53.8%; n=847), followed by facilities managers (23%; n=362). This sample represents those who are primarily responsible for the management and maintenance of commercial office buildings. The HVAC&R engineering, design and consulting industry was also well represented in the sample (16.2%; n=255).

Building services contractors included those who identified as refrigeration mechanics, in addition to other trades such as electrical (3.0%; n=47) and those holding dual trade qualifications. Within the 'other' category most participants identified as holding a role associated with business services, such as sales and marketing, finance and accounting, or general management.

Figure 3: Survey participants, by role type (n=1,573)



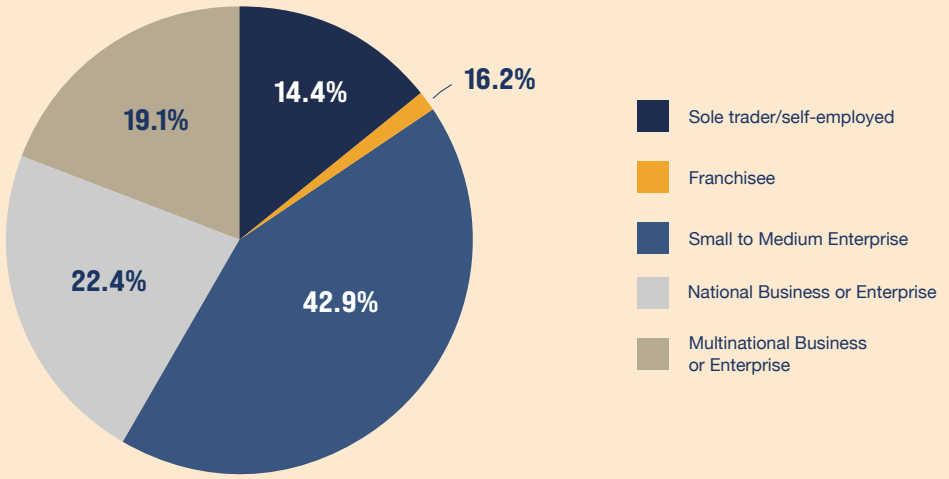
16. Expert Group. 2018. *Cold Hard Facts 3*. Prepared for the Department of the Environment and Energy.

ENTERPRISE SIZE

Anecdotally it has been reported for some time that the segment of the HVAC industry that services mid-tier commercial office buildings is predominantly comprised of Small–Medium Enterprises (SMEs). This was confirmed in data collected in this survey, where overall 42.9% (n=554) of participants reporting working for an SME.

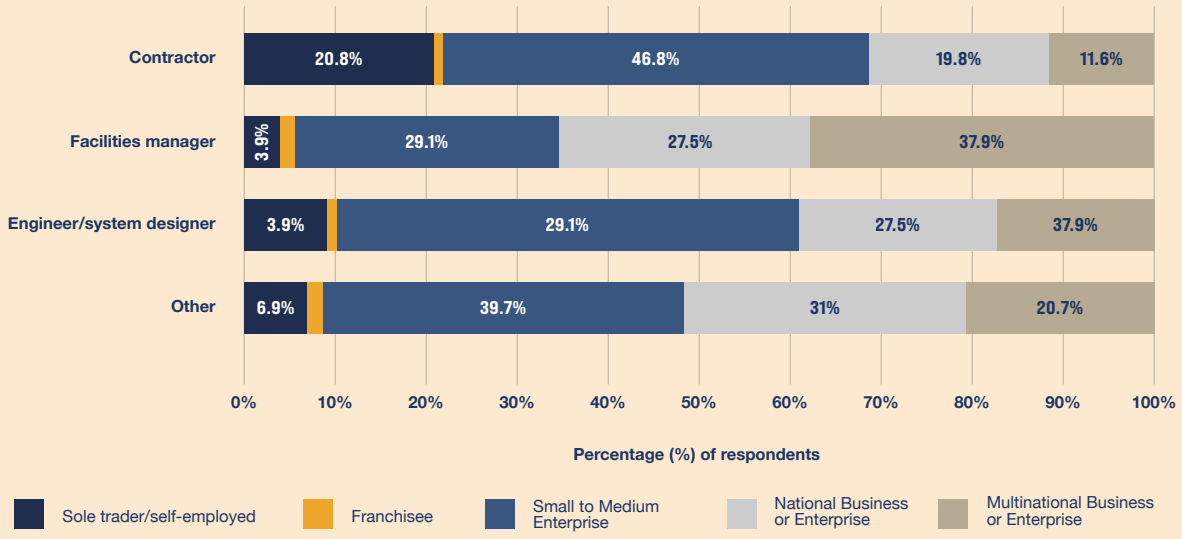
A sector dominated by SMEs provides both challenges and opportunities for targeting energy transitions, especially in terms of time-intensive activities that may support better maintenance practices, such as education and training. In an industry where lowest cost contracting is an identified issue (see Section 8), SMEs already experience both time and financial constraints in carrying out their work. Without additional support, their capacities for investing in further training for employees may be limited. The current government emphasis on supporting small business, jobs growth and skills training as part of COVID-19 recovery programmes may provide opportunity to leverage targeted support to address this.

Figure 4: Enterprise size (n=1,292)



The survey cohort also provides an opportunity to understand how enterprise size differs across the industry, by looking at how these figures vary by role type. A higher proportion of contractors who responded to the survey report that their enterprise is an SME, when compared to participants working as facilities managers, who tended to work for national and multinational enterprises.

Figure 5: Enterprise size, by role type (n=1,292)



GEOGRAPHY

Geography is a key variable in analysing how building stock, regulatory regime, climatic zone, and urban context all come together to shape the provision of HVAC services across Australia. In the survey, participants were asked to identify all the states they worked in, rather than where they were personally located. The responses to this question reflect Australia's urban geography of employment and population, with the highest numbers of participants reporting they work in the major east coast urban centres.

Also of note here is that 35 participants report working across all states, and 150 report working in multiple states[17]. From the less populated states, such as Northern Territory and Tasmania, more responses were received from those who worked across multiple states encompassing the smaller states, than from those exclusively working in those states. Recent moves toward reciprocal licence recognition across all states and territories will open further opportunities for mobility between states.

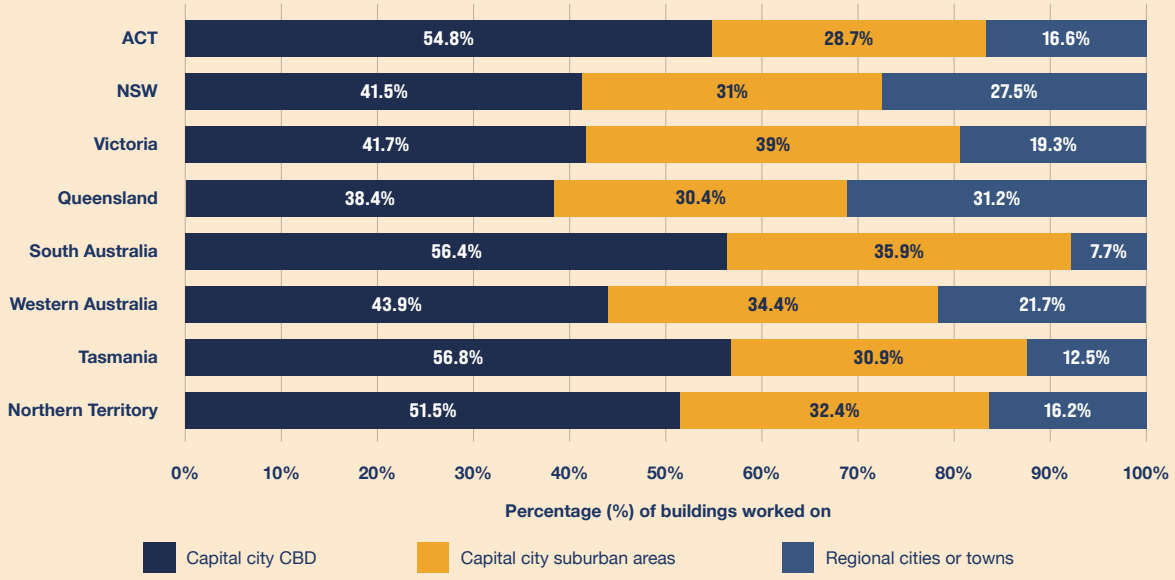
Figure 6: Participants by state

	ACT	NSW	VIC	QLD	SA	WA	TAS	NT
Number of participants who reported working in each state	157	436	363	363	142	245	82	70

Looking more closely at the breakdown of work within each state, it is evident that in all states at least 75% of work done by participants occurs in metropolitan CBD and suburban contexts, with a much lower proportion occurring in regional urban contexts. Again, this is reflective of Australia's urban population and employment distribution and the related distribution of commercial building stock.

When geographical questions are further cross-tabulated against role types, it is apparent that participants working in facilities management and engineering and systems specialist roles report that their work is concentrated in the major east coast metropolitan centres.

Figure 7: Where is your work based (state), by geographical context (n=1,274)



17. This includes those working in just ACT plus NSW, as well as those working in all states except Tasmania, and the multitude of combinations in between.

SKILLS AND TRAINING

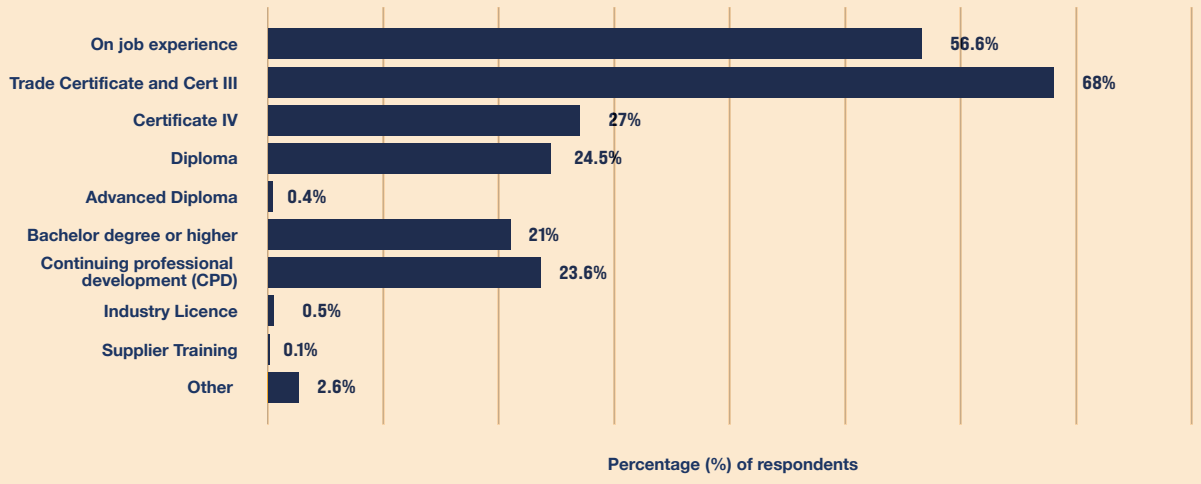
This section reports on the skills and training status of the participant cohort. It looks specifically at qualifications, experience in the commercial property industry, and professional memberships.

QUALIFICATIONS

The Australian HVAC industry has long advocated for better recognition of specialist refrigeration trade qualifications through its peak membership organisations. The nationally accredited Certificate III in Air Conditioning and Refrigeration provides the deep trades training required to install, maintain and repair complex electro-mechanical systems. This qualification currently includes both a Restricted Electrical Licence for disconnecting and reconnecting HVAC systems, and a Refrigerant Handling Licence, for handling what have historically been fluorocarbons, otherwise known as potent greenhouse gases.

The introduction of a Certificate II qualification has caused some consternation in the industry. This qualification was introduced to meet market demand for the installation of more straightforward split air conditioning systems, most commonly in residential settings. This background is relevant to the mid-tier office sector since the survey provides evidence of split systems proliferating in mid-tier buildings where older central plant and equipment may be under-performing (see Section 5). The implications for maintenance practices are that the cheaper and more straightforward installation of multiple split systems to overcome poorly performing central equipment may become more widespread. This in turn has implications for the energy performance of mid-tier buildings. Notably, no participants in the survey reported holding Certificate II qualifications. This reflects the distribution strategy used in the survey and existing anecdotal evidence that split system installers are not highly engaged in professional networks. Nevertheless, there are likely to be Certificate II-qualified installers working in mid-tier office buildings.

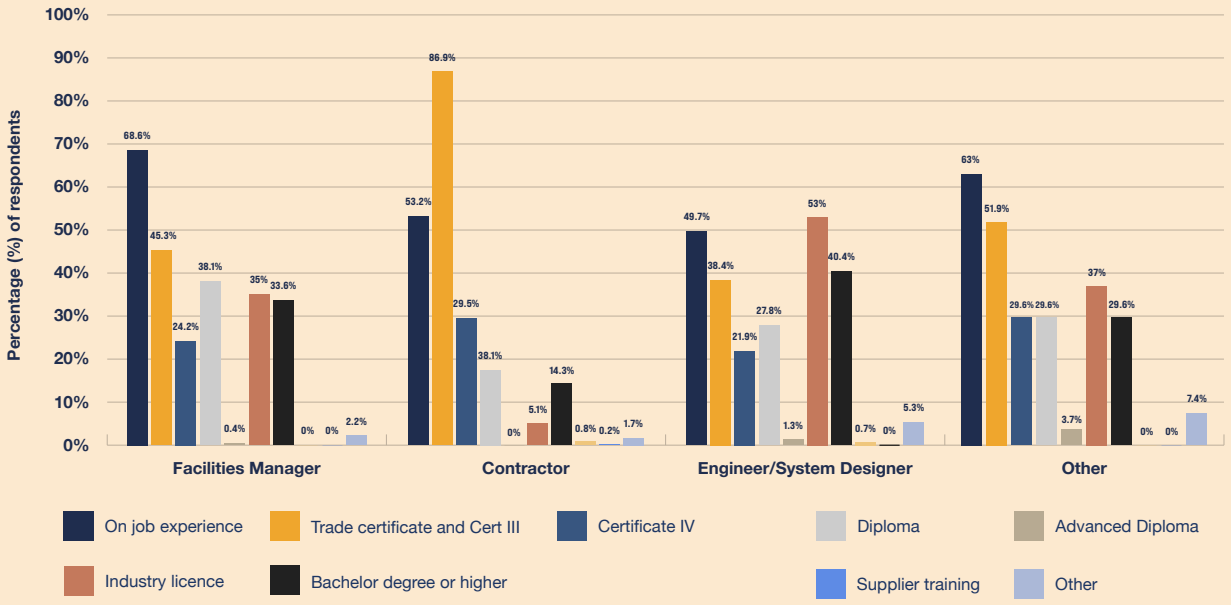
Figure 8: Qualifications (n=927)



The dominant qualification currently held across the entire participant cohort in this study is a trade certificate (Certificate III), with 68% (n=630) of participants overall holding this qualification. When this is broken down by role type, unsurprisingly the vast majority (86.9%, n=457) of those working as contractors hold a trade qualification (these are predominantly in refrigeration and air conditioning; however, small numbers reported their role type as electrician (n=47), or dual trade (n=12) so clearly other trade qualifications also feature).

Trade qualifications are also held by 45.3% (n=101) of those participants working as facilities managers, and 38.4% (n=58) of those participants working as engineering or systems specialists. This indicates that there is significant career mobility both horizontally (moving from a contracting to a facilities management role) and vertically (gaining further qualifications and/or experience to become an engineering/systems specialist). Further research into career trajectories across the industry would shed light on the drivers and motivations for this career mobility, and where opportunities exist to capitalise on it to advance and proliferate skills for energy performance.

Figure 9: Qualifications, by role type (n=972)

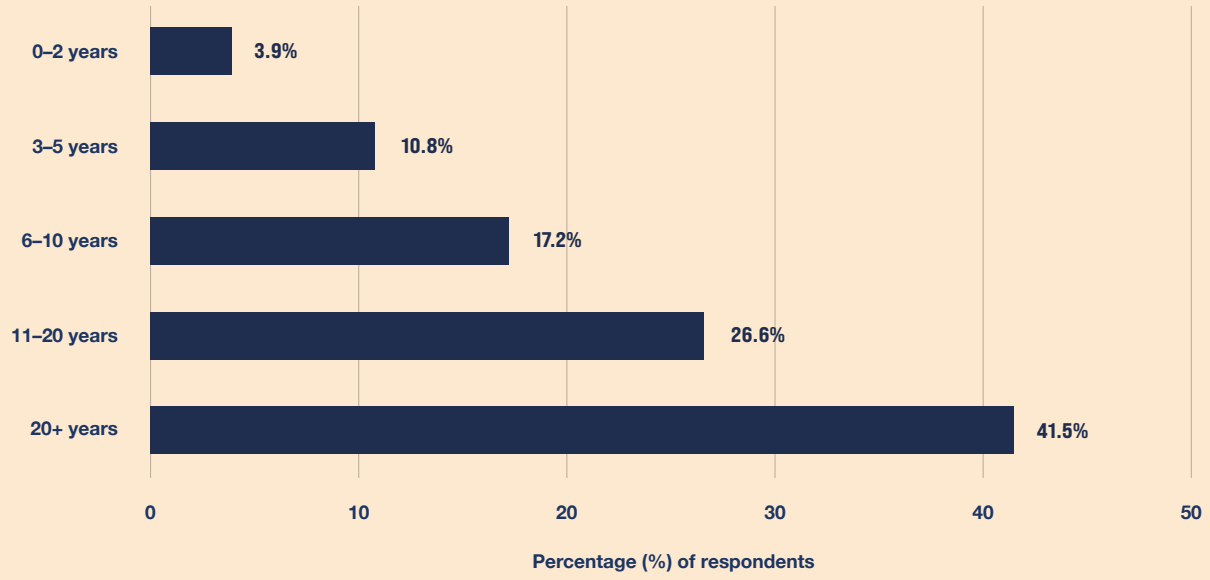


YEARS OF EXPERIENCE IN THE INDUSTRY

Alongside formal education credentials and training qualifications, management, repair and maintenance work benefits from depth and breadth of experience, particularly when it comes to resolving faults efficiently and determining when a system is not running optimally. Experience in the HVAC industry is especially crucial in the mid-tier office sector where there are lower rates of automation, installation of data-capable equipment and 'smart' maintenance (see Section 5 on Building Management Systems) than is apparent in other parts of the commercial property sector.

More than 40% of the respondents reported having 20 years or more experience in the commercial property industry. The depth of experience amongst the workforce responsible for managing and maintaining mid-tier buildings is a key strength that could be further leveraged in terms of improving maintenance practices. Creative problem-solving and the exercise of judgement are innately human qualities that are difficult to automate. This is especially the case in the mid-tier given the highly variant configurations of buildings and systems. With more than two-thirds of participants reporting at least 11 years of experience in the commercial property industry, there are likely to be untapped opportunities to build deeper knowledge-sharing networks across the industry.

Figure 10: Years of experience in the commercial property industry (n=927)



A caveat here is that the depth of experience evident in the participant cohort may reflect AIRAH and FMA membership (given that these were the primary distribution channels for this study), and thus suggest higher levels of experience than is characteristic industry wide. However, some additional context for the data collected in this survey is provided in previous industry studies. Expert Group reports that the average age of a refrigeration handling license holder in 2017 was 39 years.[18] In this age range, most contractors are likely to have between 15 and 20 years of experience, depending on the age at which they commenced an apprenticeship.

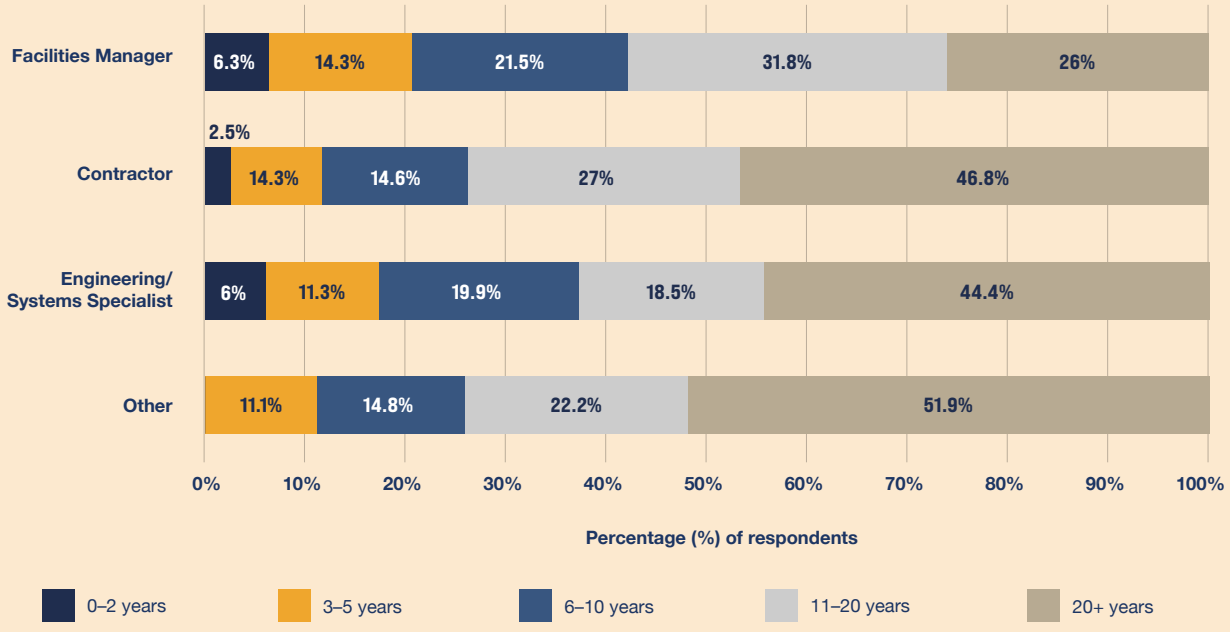
Further context is provided by the Facilities Management Association (FMA), who reported in their 2017 industry census that more than 60% of the workforce was over 30 years old.[19] It is more difficult to ascertain how age correlates with depth of experience amongst facilities managers, given the more diverse pathways into the profession. Nevertheless, it appears that the facilities management industry is also characterised by substantial levels of experience, and this is reflected in the results from this survey.

18. Expert Group. 2018.
19. Facilities Management Association. 2018. *Facilities Management Industry Census*. Trends and Insights 2016–2017.

While experience should be viewed as a strength, it does raise two concerns. First is succession planning and the recruitment of new talent into the sector. Second is the capacities of an older workforce to overcome entrenched work practices and incorporate new technologies, including those with increased capability to address energy performance, into their building management and maintenance routines.

The HVAC industry overall has experienced strong employment growth, jumping from 23,700 in 2014 to 33,600 in 2019.[20] There is widespread acknowledgement of a skills shortage, and difficulties in recruiting newcomers into the industry. Findings reported in Section 6 outline limited engagement with formal continuing professional development, suggesting that capacity to introduce change within the industry will be limited if the workforce continues to age.

Figure 11: Years of experience, by role type (n=927)



20. ABS Labour Force Survey National Skills Commission Trend Data, available at https://joboutlook.gov.au/occupations/airconditioning-and-refrigeration-mechanics?occupationCode=3421

PROFESSIONAL MEMBERSHIPS

Professional organisations play an important role in training, establishing and maintaining professional networks, advocating at a policy level on behalf of the industry, and providing resources such as the highly regarded DA19 maintenance guide produced by AIRAH. As these organisations provided the primary channel for distributing the survey through their networks, a higher rate of membership was to be expected amongst survey respondents than might be the case across the industry.

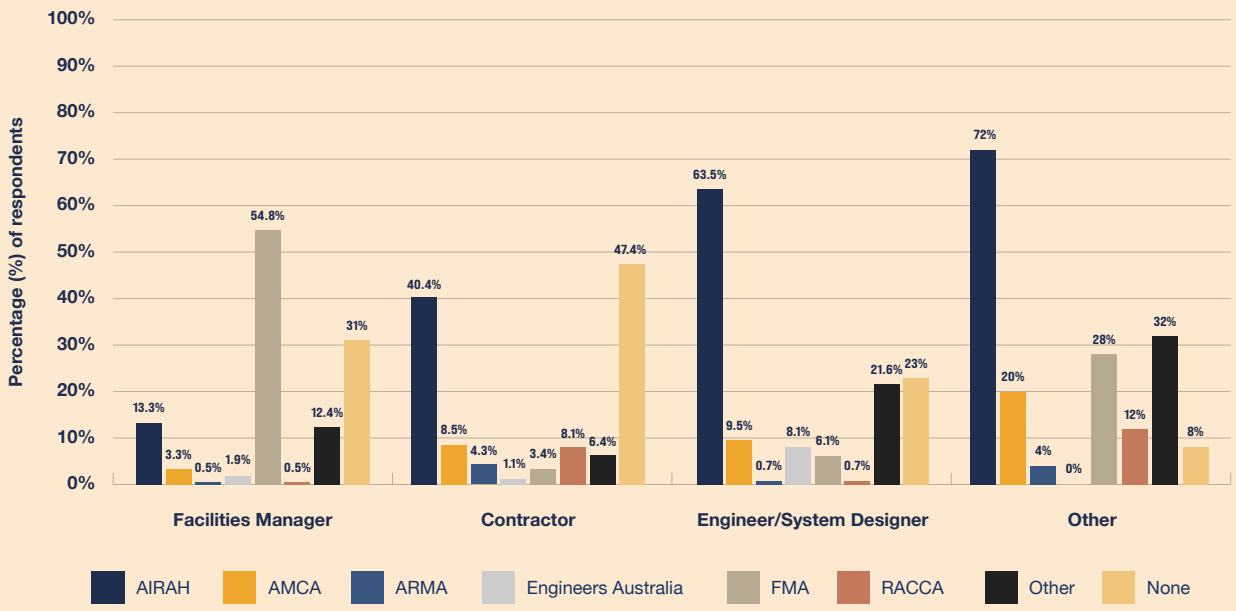
The Australian Institute of Refrigeration, Air Conditioning and Heating (AIRAH) and the Facilities Management Association (FMA) showed the highest rates of membership amongst the participant cohort. Amongst facilities managers, 54.8% (n=115) reported membership of the FMA. Contractors (40.4%; n=189), engineering/systems specialists (63.5%; n=94) and those in the 'other' category (72%; n=18) all reported high rates of membership of AIRAH.

AIRAH and the FMA are the most well-resourced and therefore the most active professional organisations working in the property sector. AIRAH, in particular, is a 'broad church' in terms of its reach, with a wide range of contractors, consultants and other key industry stakeholders forming its membership base.

The presence of several smaller organisations operating in the same sphere is indicative of a fragmented and somewhat politicised context for the HVAC industry. These organisations include the Australian Refrigeration Mechanics Association (ARMA), the Air Conditioning and Mechanical Contractors Association (AMCA) and the Refrigeration and Air Conditioning Contractors Association (RACCA). HVAC equipment manufacturers are also represented by the Australian Refrigeration Equipment Manufacturers Association (AREMA). Collectively, the range of organisations represents an opportunity that can be leveraged, as each has a slightly different remit and thus captures varying scopes of interest and coverage across this fragmented industry sector. However, the diversity and segmentation across the industry does need to be accounted for in the design of education and training frameworks, the provision of resources, and the design of information outreach and dissemination.

Finally, there is a notable proportion of participants who reported not being a member of any professional organisation, despite these organisations being the primary distribution channel for the survey. For example, 47.4% (n=222) of contractors reported holding no professional memberships. Distribution of the survey through direct mailout and via the Australian Refrigeration Council (ARC) database may account for some of these non-aligned participants. However, the figures support anecdotal industry knowledge that those working in the mid-tier office sector have limited engagement with the services provided by professional industry organisations. This represents a further significant challenge when it comes the design of outreach and information dissemination approaches.

Figure 12: Professional memberships, by role type (n=851)



RELATIONSHIPS

Building and maintaining relationships is important in any service-oriented sector, and this remains true for the provision of building management and HVAC repair and maintenance services. This section outlines the key relationships involved in procuring building management and maintenance services.

Who engages facilities managers for mid-tier buildings?

The survey question on the engagement of facilities management services was targeted only to those who identified as facilities managers. These respondents were to rank the options in order of who most commonly engages them. Within this participant cohort, 59.8% (n=155) reported that they were engaged most frequently by building owners.

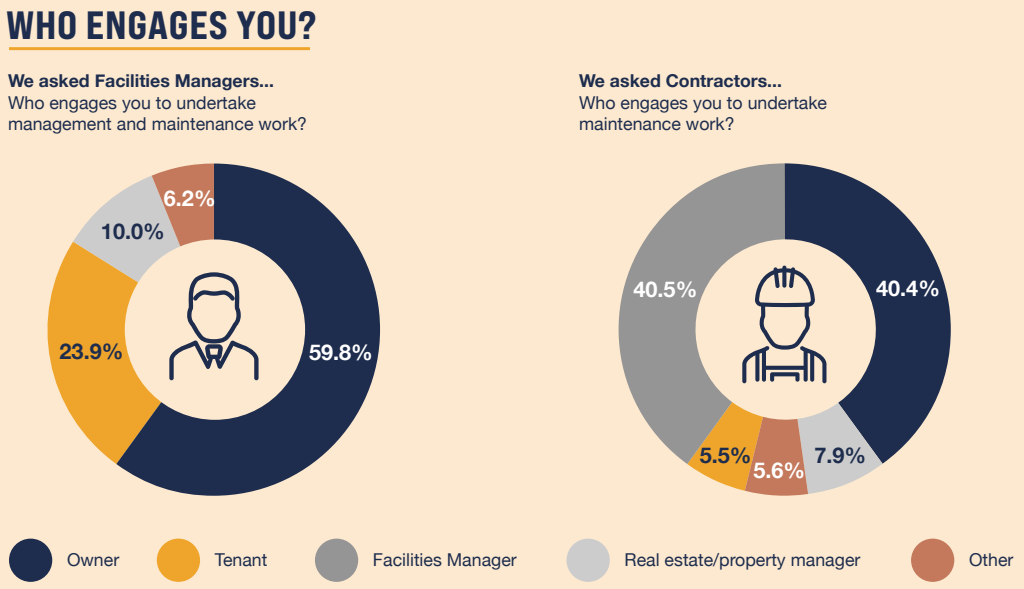
This places facilities managers in a key position when it comes to promoting the value proposition of better maintenance to building owners. This is key in mid-tier buildings that are more likely to be owned by smaller, less sophisticated or absent owners, lacking awareness regarding the benefits of HVAC maintenance and improved energy efficiency.[21] However, not all buildings – especially in the mid-tier – have dedicated facilities managers. Further research is needed to confirm where facilities managers are working in the mid-tier office sector (findings reported above indicate they may be concentrated in the major east coast metropolitan centres), to tailor further training and information resources specifically for this audience.

Who engages repair and maintenance contractors for mid-tier buildings?

The survey question on the engagement of repair and maintenance contracting services was targeted only at those who identified as contractors. Again, respondents were to rank options in order of who most commonly engages them to undertake maintenance and repair work. Within this cohort, an almost equal number of participants reported that they were most frequently engaged by facilities managers (40.5%; n=374) and owners (40.4%; n=373). Though facilities managers appear to be in a better position to educate owners about the value proposition of good maintenance practices, these findings demonstrate that contractors may also find themselves in this position, potentially in contexts where no facilities managers exist.

These finding are particularly relevant regarding tailoring programs and information resources and effectively targeting their dissemination to appropriate audiences.

Figure 13: Who engages you to undertake work in mid-tier office buildings?



21. Wilkinson, S. (2011). Sustainable retrofit potential in lower quality office stock in the central business district. In *MISBE 2011: Proceedings of the International Conference on Management and Innovation for a Sustainable Built Environment* (pp. 1–13). Delft University of Technology; EY. (2015a). *Mid-tier commercial office buildings in Australia: Research into improving energy productivity.*

BETTER WAYS TO WORK

5. BUILDINGS AND SYSTEMS

5. BUILDINGS AND SYSTEMS

KEY POINTS: BUILDINGS AND SYSTEMS

- Participants working in ACT report highest rates of single-tenant buildings (to be expected – govt owners). Multi-tenant, multi-floor is most common configuration across other states.
- Owner-occupied rate is very low, so tenants are always a key consideration in policy responses targeting upgrade and retrofits.
- Central plant only slightly dominant. Mix of central/splits indicates a fair amount of 'patching' over old and under-performing systems.
- Relatively high rate (23.7%) of splits only (state dependent; highest in WA 24.6%).
- Just over half (mean 56.6%) reporting that most buildings they work on have a functional building management system (BMS). Significant room for improvement in controls.
- High proportions (42.7%) report most buildings have original HVAC system with no upgrade since installation.

One of the challenges in lifting energy performance in the mid-tier office sector through policies targeting maintenance and upgrades relates to substantial gaps in data. First, there are significant data gaps around the configuration of the building stock. Second, there is a lack of substantive knowledge of how buildings are configured internally, including how this varies across Australia. Relatively little is currently known about key components that have significant implications for the opportunities to enhance mid-tier office building energy performance, for instance variations in tenancy structures, the most common configurations of HVAC systems and equipment, its condition, and levels of automation. This survey begins to address these questions.

For the diverse and hard-to-reach mid-tier office building sector, the HVAC management, repair and maintenance workforce are well positioned to provide insights into the building systems and tenancies they most commonly encounter. It is important to emphasise here that participants were asked to identify the most common configurations of buildings across their entire workload, with a particular focus on older, poorer quality buildings. This relates to the acknowledged challenges that no commonly accepted definition of the mid-tier exists across the industry. The data reported in this section, thus, needs to be interpreted carefully to extract key implications for understanding the mid-tier.

In this section the report examines responses to survey questions aimed to unpack building configurations and HVAC systems and equipment. It offers revealing insights into the most common tenant structures, equipment configurations, level of automation (i.e. BMS use) and general condition and upgrade status of HVAC systems and variation by geography (state and urban/suburban/regional context).

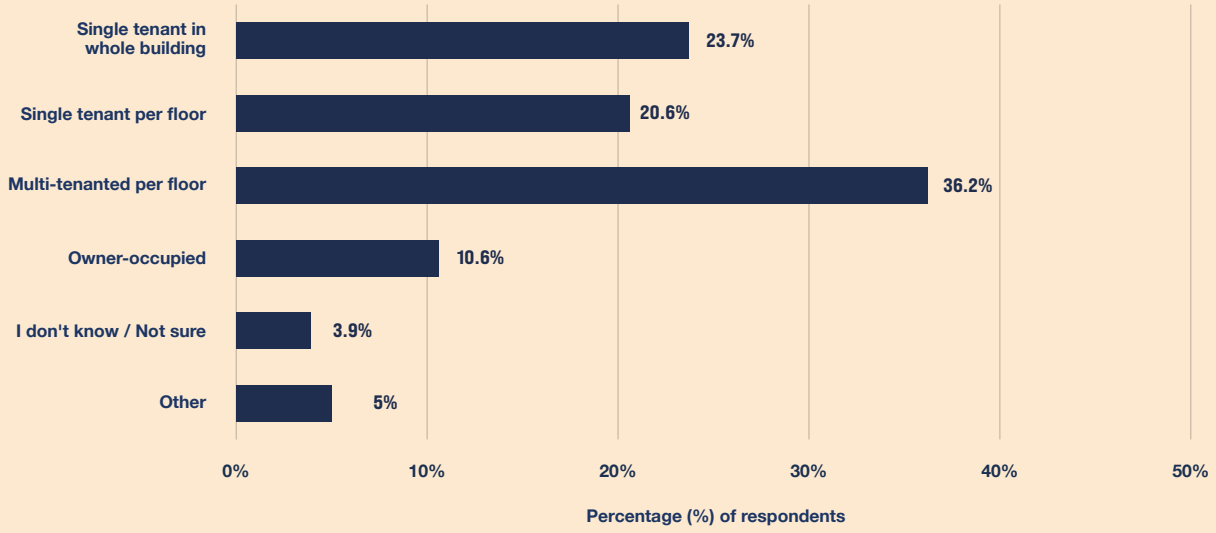
TENANT STRUCTURE

The number of tenants in an office building has a significant impact on how building services updates are planned for and carried out, as well as potentially limiting access to system components. The risk of disruption to tenants is a recognised barrier to major HVAC upgrades[22] (see Section 6), and this becomes more complex when multiple tenants are involved.

Across Australia, the most common tenant structure reported by participants was multiple tenants per floor, which has implications for designing policy or incentive programs targeting major equipment upgrades.

Major occupancy changes in a building are recognised as a key opportunity for improving HVAC and building energy efficiency,[23] as the upgrade of major HVAC equipment such as chillers may require whole buildings to be vacated for a period. Whereas in single-tenant buildings this can be accommodated during lease changes, the often-overlapping leases of multiple tenants make large-scale upgrades in multi-tenanted buildings a difficult proposition for owners looking to minimise vacancy rates. [24]

Figure 14: Most commonly encountered tenant structure (n=1,166)

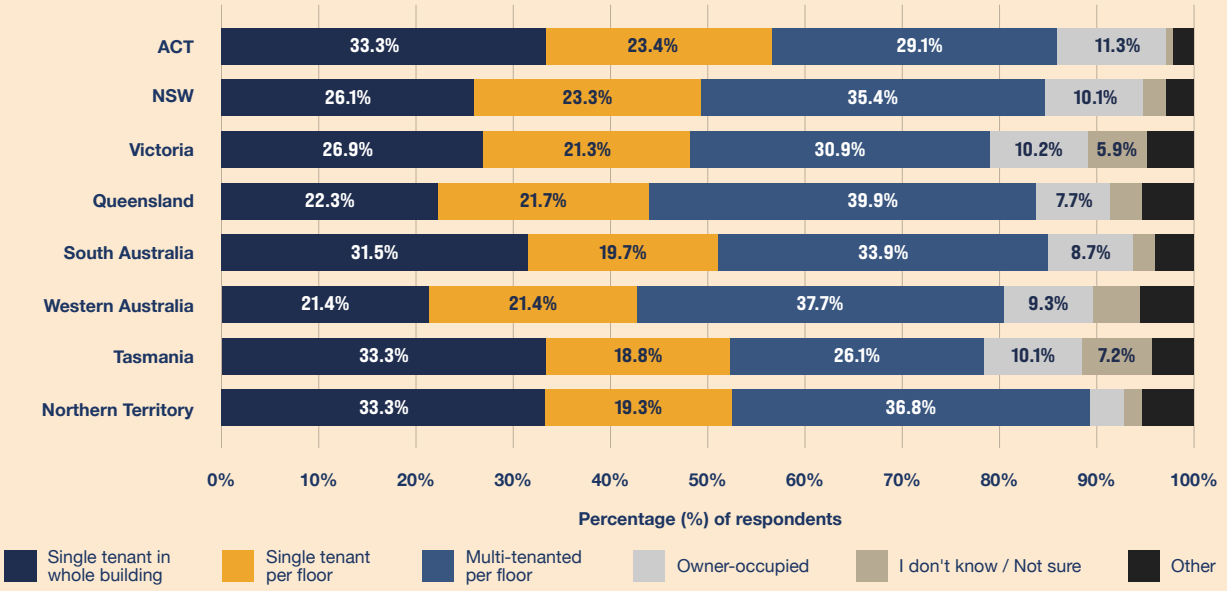


When the responses on tenancy structures are broken down by state and geographical context, minor variations become evident in the data that warrant further investigation, particularly to support the development of tailored incentive-based policy programs that might target specific locations. Survey participants reported higher rates of single tenant/occupant buildings in ACT, SA, TAS and NT. This is likely to reflect the dominance amongst larger tenancies/occupancies of government entities, occupying buildings either as owners or tenants. Single tenancy buildings were also more prevalent in regional geographical contexts (34.9%).

22. Sustainability Victoria. 2016.
23. EEC. (2016). *Building Retrofit Toolkit – scoping study* (Issue May). NSW Office of Environment & Heritage.
24. Savills. 2018.

Also of note here is the relatively small number of owner-occupied buildings, consistent across all states. This underscores the importance of tenants in advocating for better energy performance in mid-tier buildings (see Section 8). Tenants are clearly already playing a role in the demand for better maintenance, through the frequent registering of comfort complaints (identified in Section 6 as a major reason for reactive maintenance). Relatively little is known about mid-tier tenants, so further research is required to develop information resources and innovative distribution channels that could target this key group, improving their capacities to advocate for more energy efficient and thermally comfortable buildings.

Figure 15: Most commonly encountered tenant structure, by state (n=1,156)



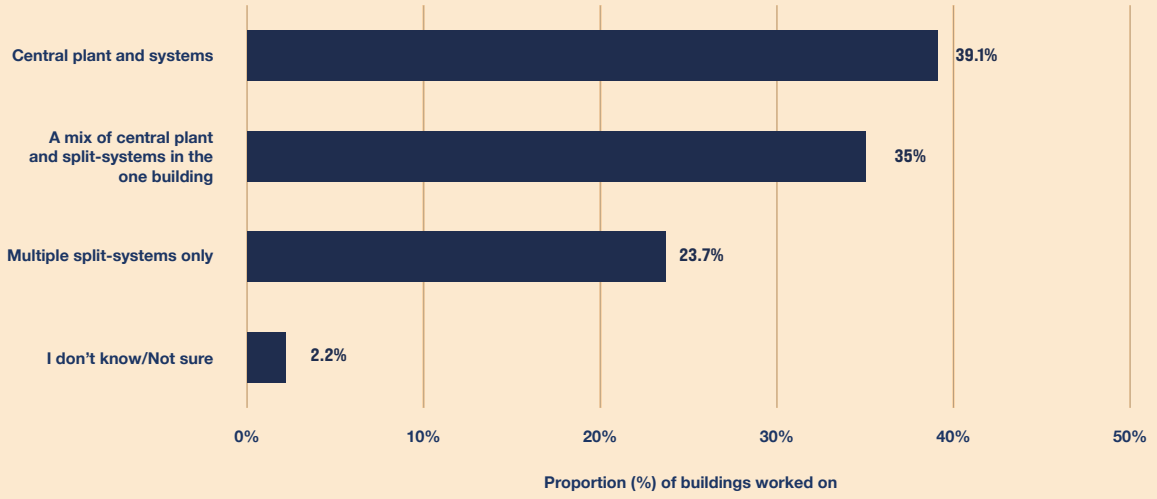
EQUIPMENT CONFIGURATION

The management, building repair and maintenance workforce is well positioned to identify common equipment configurations in mid-tier office buildings. Participants were asked to identify what proportions of their workload related to three different equipment types installed in the buildings they worked on: central plant and systems, split systems, and a mix of the two. While central plant and systems was the most commonly encountered configuration overall (39.1%; n=1,146), this was only slightly ahead of a mix of central plant and split systems in a single building (35%; n=1,146). The high rate of split system installations in buildings where central plant is already present indicates that 'patching' of old and low-performing central systems is common.

The proportion of buildings identified as running only split systems is relatively high at 23.7% (n=1,146). The discussion of 'Qualifications' above outlines the different skill sets and procurement processes at play in installing split systems. Central to the concern of this report is that repair is less likely to occur with split systems, given that they can be replaced much more easily than more complex and expensive central plant systems.

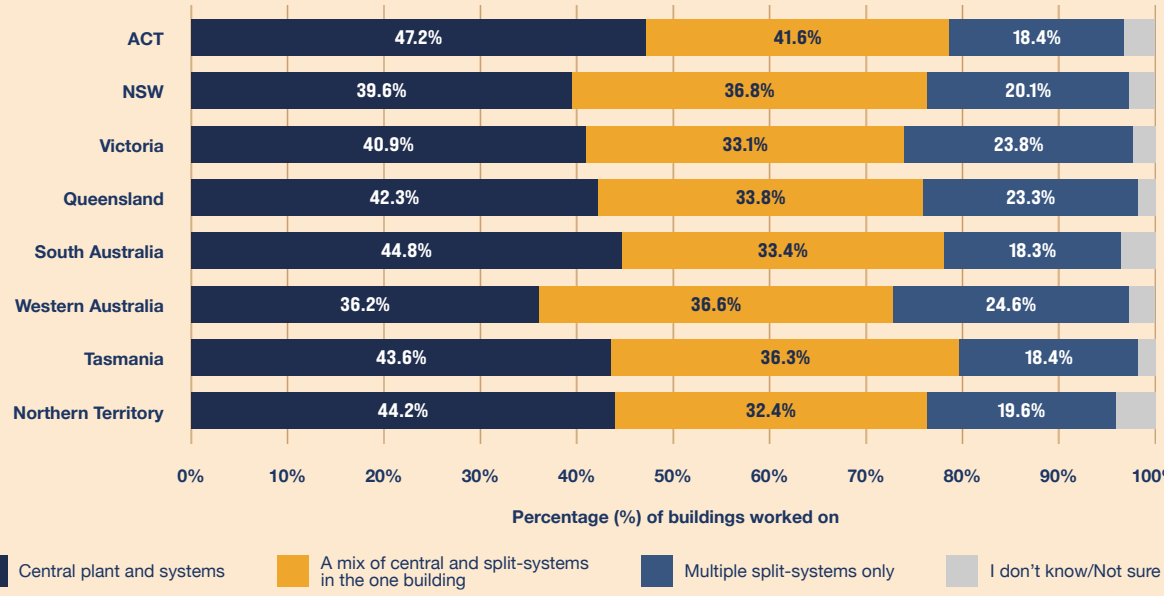
It is important to note then that while split systems do not maximise building energy performance of themselves, their prevalence offers an opportunity to leverage equipment upgrade at the point of replacement. As tenants turn over, the installation and/or upgrade to new split systems may result in improved energy performance due to more efficient sizing for the space, and the impact of technology advances (such as inverter technology) over time. Further research is needed to understand how decisions are made to add split systems into a building, how these decisions impact on overall building performance, and where possibilities exist for intervening in this specific procurement process to secure better energy outcomes.

Figure 16: Mean proportion (%) of equipment type (n=1,173)



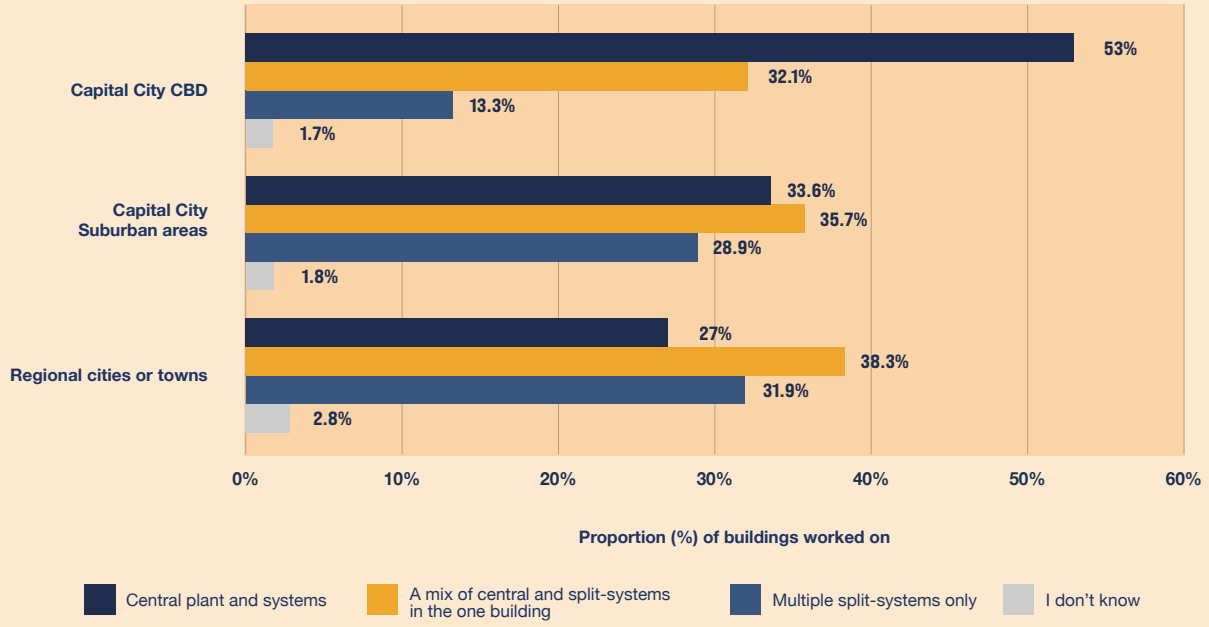
When the data on equipment configuration is broken down by state, again potential significant variations in the data become evident. Participants working in the ACT for example report a higher rate of central plant and systems (47.2%; n=141) than other states. When combined with higher rates of single tenant buildings as reported previously, this suggests that a geographically targeted approach to incentivising plant upgrades in localities such as the ACT may be productive. This also aligns with policy approaches that suggest governments can and should lead by example in setting minimum performance standards for the buildings they own and lease (GBCA et al 2017).

Figure 17: Mean proportion (%) of equipment type, by state



When this data is further broken down by geographical context, participants report that they encounter central plant and systems most often in capital city CBDs (53%; n=436). A mix of central plant and split systems in a single building is most commonly encountered in the suburban areas of capital cities. This equipment configuration is suggestive of underperforming central plant and systems 'patched' by the installation of additional split-systems. The higher proportion of this configuration in suburban settings indicates that under-performance of central systems could be targeted through geographically targeted information dissemination and policy initiatives. Significantly, the suburban concentration of mixed central plant and split systems corresponds with participants encountering lower rates of functional building management systems in suburban areas, reported directly below. This suggests that HVAC system configurations in suburban contexts are worthy of particular focus for improvement.

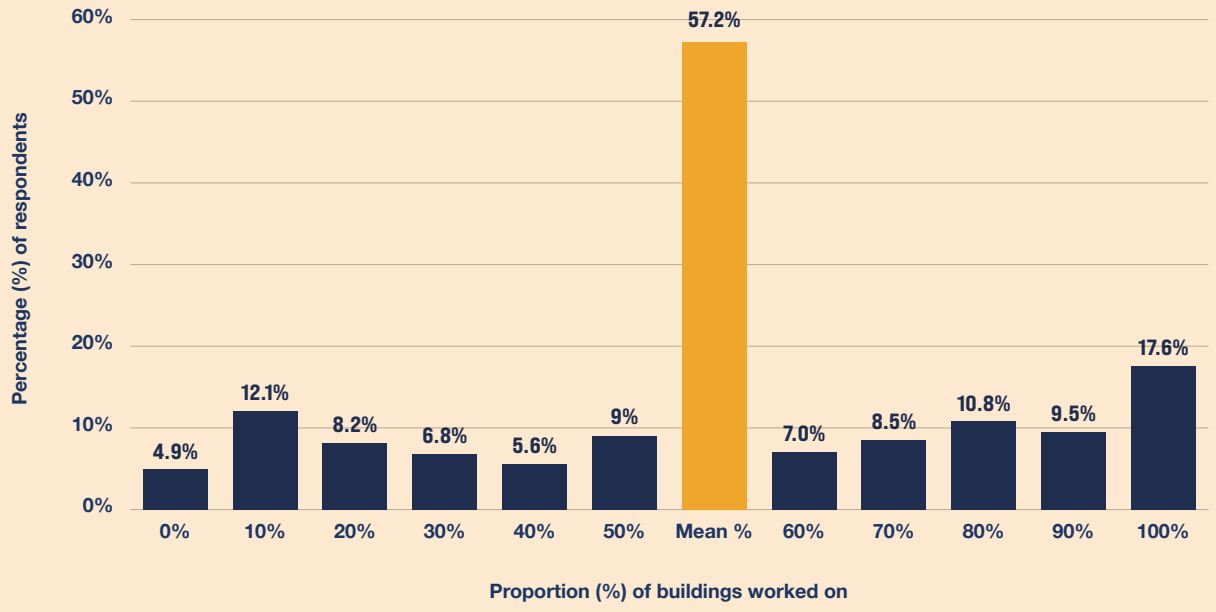
Figure 18: Mean proportion (%) of equipment type, by geographical context (n=1,160)



FUNCTIONAL BUILDING MANAGEMENT SYSTEMS

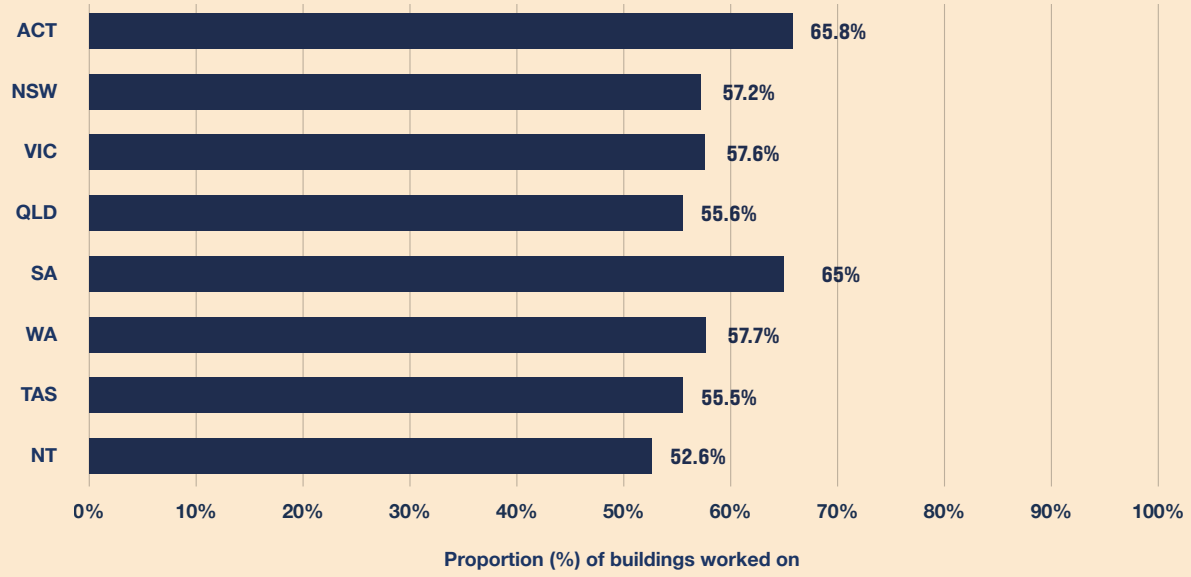
A functional building management system (BMS) provides the building owner, facilities manager and contractors with a higher degree of control and monitoring capability over building systems, including HVAC, lighting and equipment power. Participants were asked to identify the proportion of buildings they work in that have a functional BMS. The mean response of 56.6% confirms anecdotal knowledge indicating that there is significant scope for improvement in the control and monitoring capacity of Australia's mid-tier building stock. Unpacking this further to understand the frequency distribution, a high proportion of respondents (47%) reported that less than half the buildings they work on have a functional BMS. Previous small-scale research with facilities managers identified the availability or limitations of the BMS as a barrier to implementing new energy-efficiency measures in commercial office buildings (Rock et al 2019). Policies targeting control or tuning need to account for the relatively low penetration of functional BMS in mid-tier buildings, before performance standards can be met.

Figure 19: Proportion (%) of buildings with a functional Building Management System (BMS) (n=1,091)



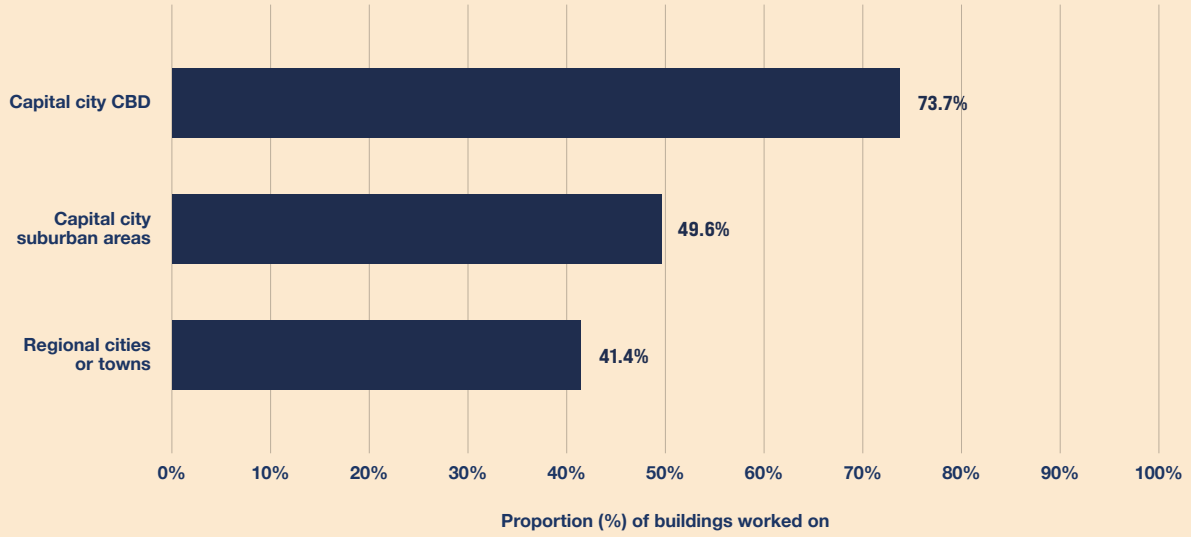
When disaggregated by state, participants working in the ACT again report the highest proportion of buildings with a functional BMS (65.8%). This is likely to be consistent with the prevalence of government owners and tenants with more established proactive maintenance programs, and the prevalence of central plant and equipment that requires regular maintenance. The lowest proportion of buildings with a functional BMS was reported in the Northern Territory, where a locationally targeted incentive program may have some traction in lifting the control and monitoring capacity of commercial office building stock.

Figure 20: Proportion (%) of buildings with a functional BMS, by state



Drilling down further into the geographical context, participants report substantially higher rates of functional building management systems in capital city CBD locations (73.7%), but much lower rates in capital city suburban areas (49.6%). When combined with the data on the prevalence of a mix of central and split systems in a single building, this suggests that further research is needed to understand how performance can be lifted through a combination of policies that empower building owners and tenants in suburban areas via information and capacity building, to drive better decisions around building maintenance and energy performance.

Figure 21: Mean proportion (%) of buildings with a functional BMS, by geographical context (n=1,083)



BMS USE

In addition to specifying the proportion of buildings participants engage with that have a functional building management system (BMS), participants were asked to identify what they use the BMS for and the system status in relation to installation and upgrade. The purpose of this question was to unpack how contractors and facilities managers engaged with building controls for the purposes of understanding, monitoring or controlling the energy performance of building systems. Where a BMS is installed, 79.3% (n=843) of participants reported using it for monitoring the performance of building systems (such as HVAC). Less frequent uses of the BMS included diagnosing problems (60.5%, n=643), control of building systems such as timed lighting (50.8%, n=540) and remote access of building systems (47.9%, n=509). These figures seem generally higher than anecdotal industry knowledge suggests for mid-tier buildings, and provide evidence that if building management systems are installed they are used in a manner that can be leveraged to drive building energy performance improvements. Education is key to ensuring contractors and facilities managers are able to utilise existing BMS in mid-tier buildings to improve energy efficiency.

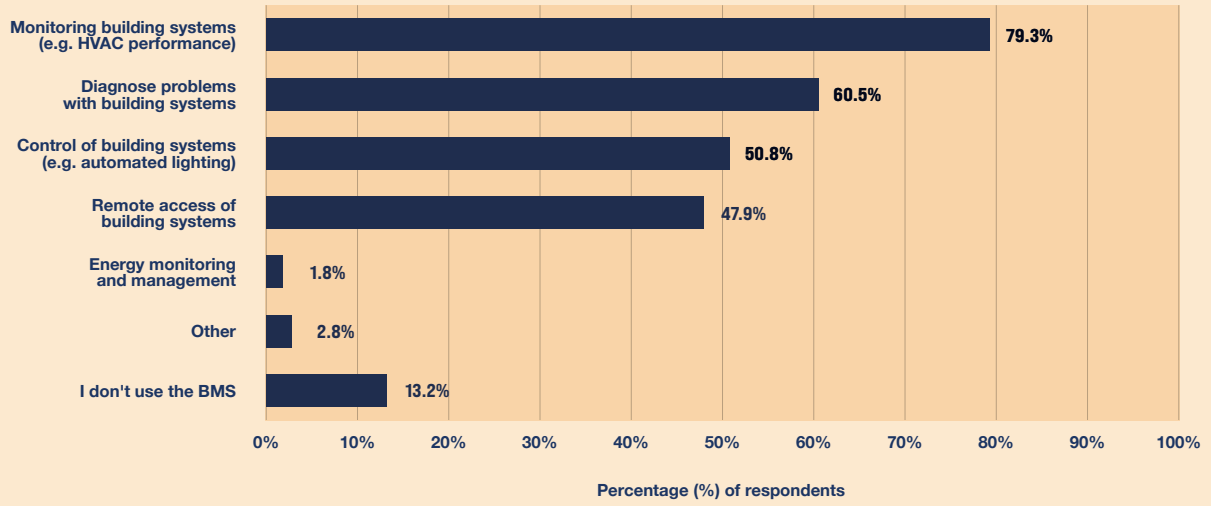
Of note here, however, is that 13.2% (n=140) of participants report that they do not use the BMS at all, indicative of potential problems either with training, access or equipment failures. Given the relatively significant proportion providing this response, this is worthy of further research.

The additional qualitative comments contributed by respondents who selected the 'other' response category provide further insight into the use of building management systems with an energy management agenda. Fifteen qualitative responses were recorded that specifically mentioned the use of the BMS to monitor and manage energy consumption, such as:

> *For the purposes of maintenance, I will use a BMS to monitor overall performance of central energy systems and to rotate lead/lag chillers.*
>
> *[I use it to] implement energy saving initiatives e.g. seasonal controls.*

While these numbers are relatively low, the fact that participants made the effort to draw attention to their energy management practices is arguably promising. These responses demonstrate the wide range of perspectives on energy performance held amongst those servicing mid-tier buildings, and the value in segmenting approaches to information and capacity building amongst the workforce. Further research would help to locate and build on these existing capacities.

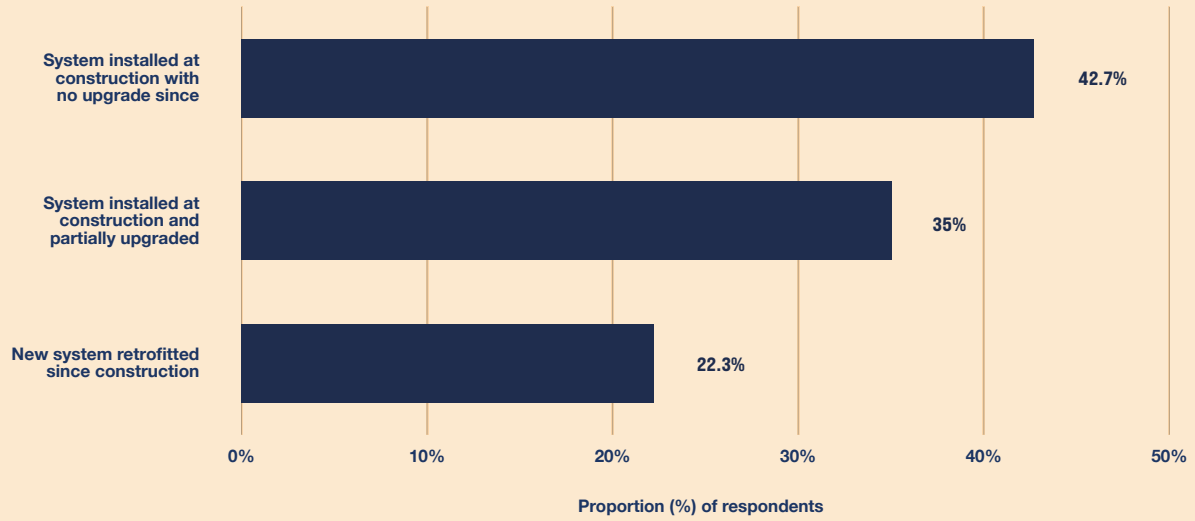
Figure 22: What is the BMS used for? (n=1,063)



STATUS OF HVAC SYSTEM

The final question that was asked about buildings and systems addressed the upgrade status of the HVAC system that participants most commonly encounter. Again, participants were asked to identify the status they most commonly encountered: that is, what they found in the majority of buildings they work on. Participants reported that most often the systems they encounter were installed at the time of building construction, with no upgrade since that point (42.7%, n=1,146). This was nearly double the proportion for new systems that had been retrofitted since construction (22.3%, n=1,146), with partial upgrades falling between these figures (35.0%, n=1,146). These findings confirm anecdotal knowledge that mid-tier office buildings are dominated by older and under-performing HVAC systems. It also suggests the scale of the opportunity to achieve building energy performance through HVAC upgrades.

Figure 23: Mean proportion (%) of HVAC system status most commonly encountered (n=1,146)



Disaggregating responses by state reveals slight difference across Australia, which indicates that the issue of older and underperforming HVAC systems is widespread. This study therefore confirms that comprehensive programs are needed to lift the performance of mid-tier commercial office buildings. Further research should target priority areas including the upgrade of older equipment, and the installation of building management systems that build capacity to control and monitor building energy use, and the potential for locationally focused programs to address poorly performing suburban buildings.

Figure 24: Mean proportion (%) of HVAC system status most commonly encountered, by state

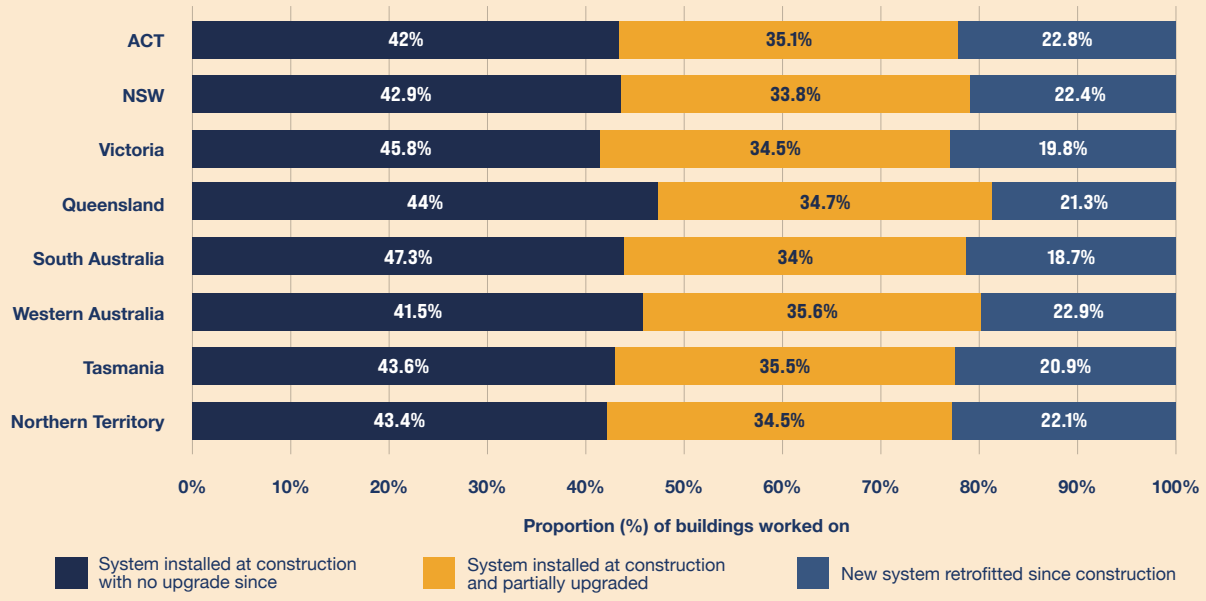
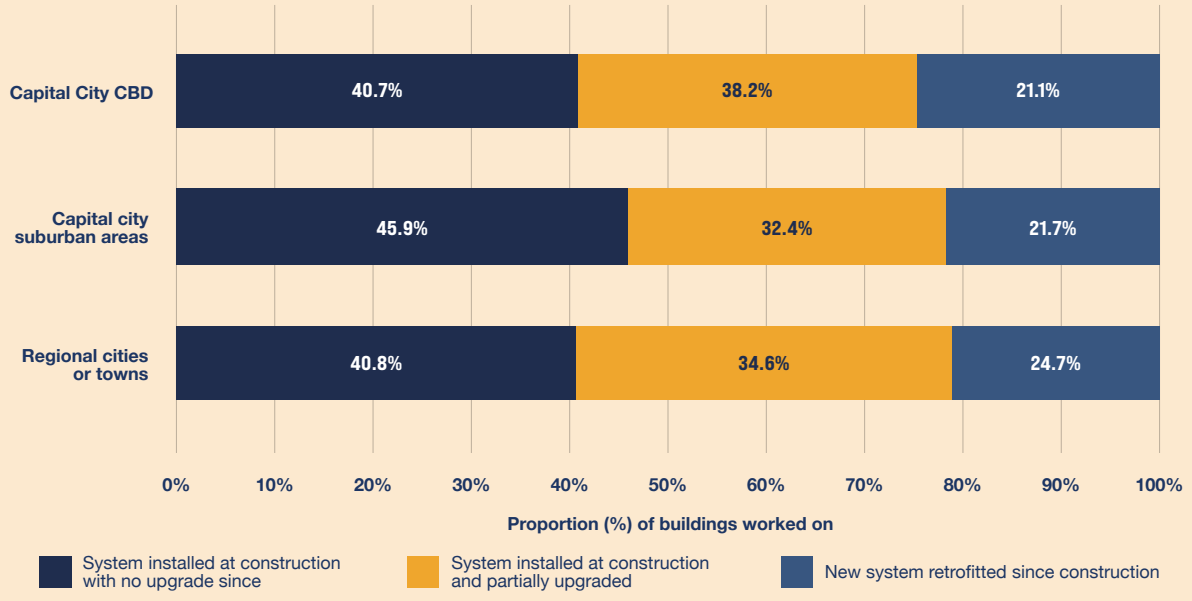


Figure 25: Mean proportion (%) of HVAC system status most commonly encountered, by geographical context (n=1,134)



6. MAINTENANCE PRACTICES

- Routines of HVAC management, repair and maintenance work
- Relationships involved in procuring repair and maintenance services
- Gaps and barriers to better maintenance practices
- Responses to qualitative questions

6. MAINTENANCE PRACTICES

KEY POINTS: MAINTENANCE PRACTICES

- Workload levels suggest that where maintenance is being done there is adequate time to do it. This supports the need to promote maintenance as a value proposition.
- Equipment suppliers and informal knowledge sharing networks (experienced colleagues) are a key source of information, at almost double the rate of more formal CPD training.
- Where BMS is functional it is more frequently used for monitoring building systems (79.3% rather than control (50.8%).
- Higher rates (~70%) of preventative maintenance are undertaken than expected
- The most frequent reactive maintenance task was responding to comfort complaints
- The most common fault types are also those amenable to simple fixes – filters and thermostats (see point above about comfort complaints).

In this section the report looks at the maintenance work practices that are undertaken by participants. Discussion is structured under four key areas:

- routines of HVAC management, repair and maintenance work;
- relationships involved in procuring building maintenance services;
- gaps and barriers to good maintenance;
- respondents' identification of key actions to improve energy performance (qualitative).

Specifically, this section examines the breakdown between reactive and scheduled maintenance, underlying reasons for callouts, fault types, and the role of cost, standards, reputation and relationships in procuring management, repair and maintenance services.

25. AIRAH 2020. Maintenance for Low Emissions HVAC&R. Unpublished document authored by Vincent Aherne.

ROUTINES OF HVAC MANAGEMENT, REPAIR AND MAINTENANCE WORK

Good maintenance is based on routine. Regular preventative maintenance ensures equipment is operating safely, is reliable, able to offer consistent thermal comfort to building occupants, and primed to operate as energy and cost efficiently as possible. While the value proposition for preventative maintenance routines is clear, it is widely acknowledged within the industry that the mid-tier office building sector is dominated by a higher proportion of reactive maintenance. Equipment is generally run to fail, and contractors are called on only when things go wrong.[25]

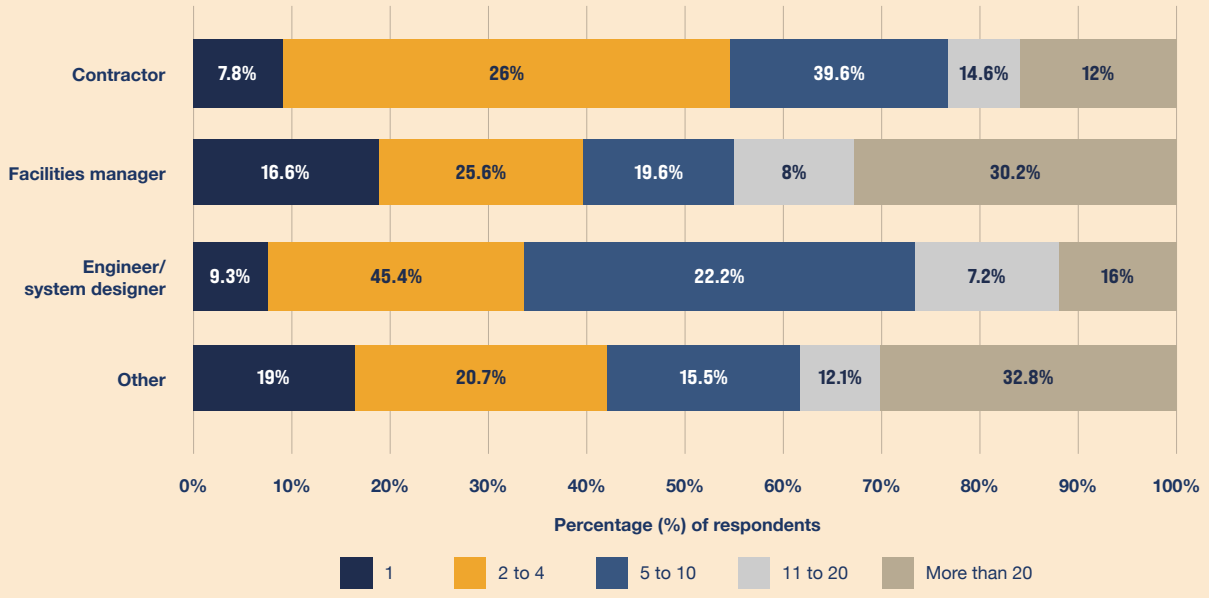
This section looks at the routines involved in undertaking HVAC management, repair and maintenance work. It includes data emerging from questions about workload, the networks through which participants source information to do support their work, the frequency with which they perform preventative and reactive maintenance, the prevalence of commissioning, reasons for callouts, commonly encountered fault types, key factors when replacing or repairing components, and the presence of energy efficiency or performance in work orders.

WORKLOAD

The number of buildings serviced in a standard week acts as a proxy for workload, and there were notable variations in the data by role type. Participants working as contractors most commonly reported working on between 5 and 10 buildings per week (39.6%, n=288). Facilities managers most commonly reported working across a much wider array of more than 20 buildings per week (30.2%, n=91).

Anecdotal knowledge about the prevalence of lowest cost contracting and cost-minimisation in mid-tier building maintenance points to budget and price constraints (i.e. needing to bid low to win the job and minimise both up-front and life cycle costs) on the level and quality of maintenance undertaken. This is borne out by responses to the qualitative questions in this survey (see Section 6) and suggests that more work is needed to educate both building owners and facilities managers on the value proposition for regular maintenance. This will have an effect on the time constraints experienced by facilities managers and contractors, the capacity to consider alternatives to 'keeping it running', and ultimately on workload and its implications for constraining work to reactive maintenance. Further research is required to empower facilities managers and building owners to compare services on equal terms.

Figure 26: Number of buildings serviced in a standard week, by role type (n=1,280)



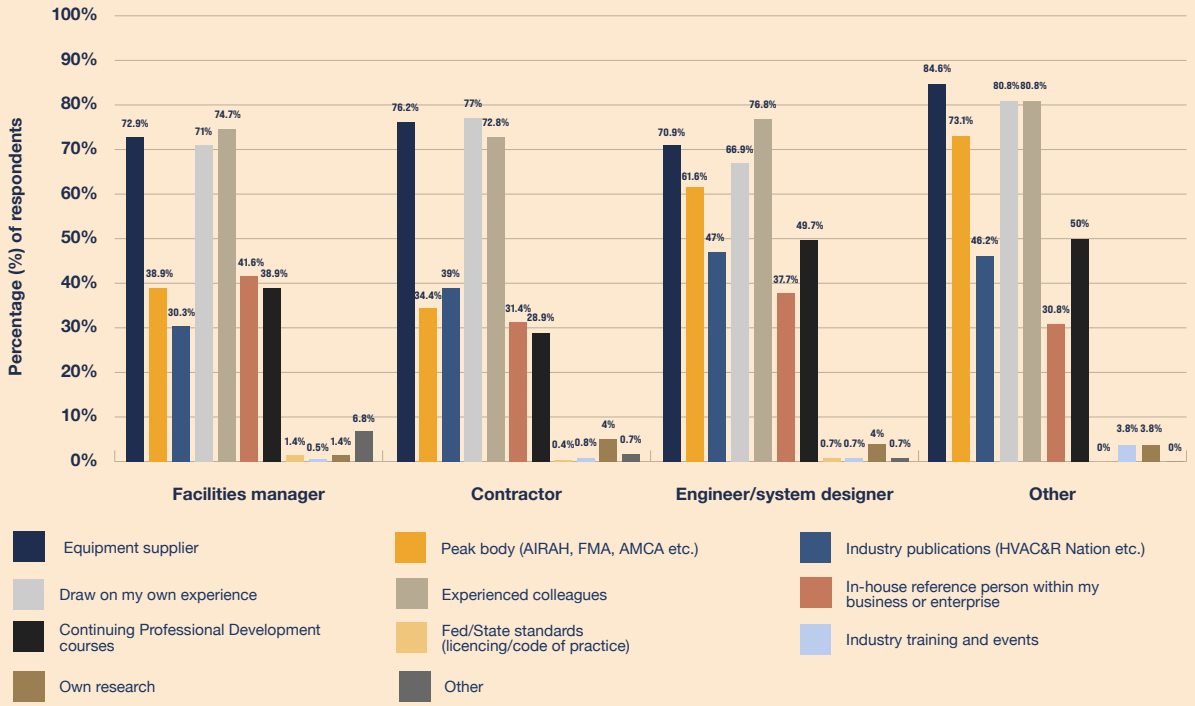
25. AIRAH 2020. Maintenance for Low Emissions HVAC&R. Unpublished document authored by Vincent Aherne.

INFORMATION SOURCES

Access to information is crucial to the way in which sectors transform, adapt new practices or adopt new technologies. Understanding how the HVAC workforce sources information is thus central to any concerted effort to uplift building energy performance.

Participants across all role types report that knowledge sharing is an important part of being able to carry out their jobs. Obtaining information from equipment suppliers rated as the most frequent source of information in carrying out work, with 76.3% of participants across all role types identifying this as a key source of information. This is almost double the rate of Continuing Professional Development (CPD) (42% across all role types). More research is needed to understand the supplier training and information dissemination landscape, in order to make best use of these existing networks in lifting the skills base of the industry around energy efficiency.

Figure 27: Information sources, by role type (n=924)



In this highly experienced industry (see Section 4), a high proportion of participants rely on their own experience (74% across all role types) and that of their colleagues (76.5% across all role types) to carry out their job. The strong presence of these informal networks points to how good maintenance practices can be shaped by social learning processes such as cultivating knowledge sharing communities of practice.[26]

So too, professional organisations such as AIRAH provide evidence of a social learning culture around bad maintenance practices and how to avoid them. On their social media pages, the organisation posts 'Monday muck-ups' – photos of bad installations and repairs that have been shared by members. These posts usually invite multiple comments and show the strength of social learning processes within the industry.

International studies have found similar outcomes amongst other trades professions, including heating engineers in the UK[27]. Understanding how contractors, facilities managers and other HVAC professionals already operate as communities of practice will ensure policies targeting skills and capacity building are designed to work in concert with the way the industry is organised, rather than against it. The professional organisations clearly have a role to play here (also noting that 52% of all participants use them as a source of information) and should be supported in fostering both formal and informal training networks further.

26. McGuirk, P.M., Dowling, R., Carr, C. (2019). The material politics of smart building energy management: a view from Sydney's commercial office space, *Political Geography* doi.org/10.1016/j.polgeo.2019.102034; Wade, F. Hitchings, R. & Shipworth, M. (2016) Understanding the missing middlemen of domestic heating: Installers as a community of professional practice in the United Kingdom. *Energy Research & Social Science* 19: 39–47.
27. Wade, Hitchings & Shipworth. 2016.

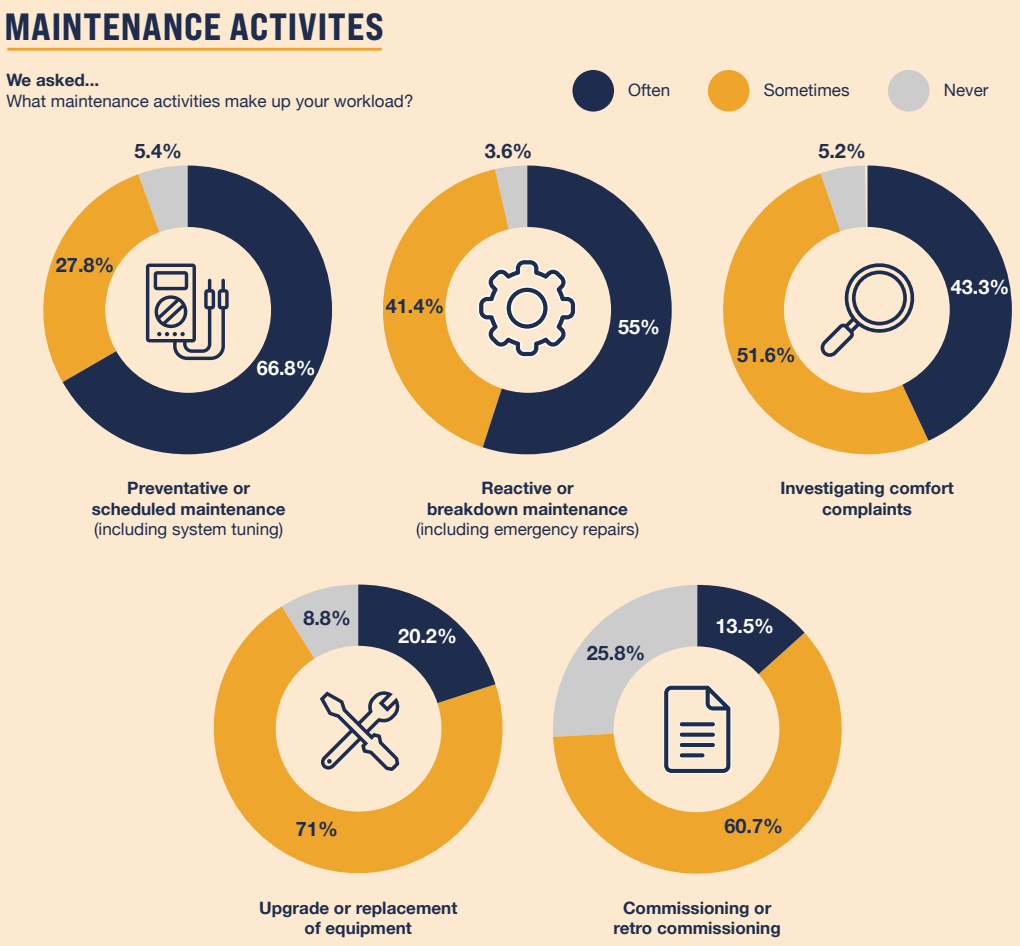
FREQUENCY OF ACTIVITIES

To obtain a more detailed breakdown of the management, repair and maintenance workload for mid-tier building HVAC systems, participants were asked to rate how frequently they performed a range of activities on a 3-point Likert scale of 'often', 'sometimes' and 'never'. Preventative and scheduled maintenance was rated as the activity most participants (69%) identified as doing often. This was consistent across all role types, with facilities managers (75.3%; n=189) and contractors (70.2%; n=426) reporting most frequently that they undertook preventative maintenance 'often'.

However, as has been suggested is characteristic of mid-tier maintenance,[28] reactive maintenance (55%) and investigating comfort complaints (42%) make up a substantial proportion of the workload overall. Breaking this down by role type, contractors report doing reactive maintenance 'often' (59.4%; n=361) more frequently than facilities managers (49.4%; n=124). They also report responding to comfort complaints 'often' (46.4%; n=281) more frequently than facilities managers (35.6%; n=88). This may reflect the fact that contractors are engaged directly by both building owners and facilities managers to provide technical repair services and does confirm the prevalence of reactive responses in the day-to-day maintenance workload.

The upgrade or replacement of equipment was identified as being undertaken 'sometimes' by 70% of participants overall. When broken down by role type there was little variation across roles, with facilities managers (76.2%; n=189) and contractors (71.4%; n=431) most frequently citing that they do this work 'sometimes'. In line with expectations, engineering/system specialists were involved in the upgrade and replacement of equipment more frequently, with 31.1% reporting that they do this work 'often'. These figures point to some significant capability in the mid-tier building workforce around retrofitting and upgrades.

Figure 28: Frequency of activities within mid-tier office building workload (n=1042–1053)



28. AIRAH. 2014. PRIME Strategy.

Less encouragingly, the majority of participants (61%) reported that commissioning or retro-commissioning is an activity undertaken only 'sometimes'. Only 12% reported undertaking this activity 'often' (12%), while a full 25% reported that they 'never' do commissioning or retro-commissioning work. There is value in breaking these findings down by role type, as a larger proportion (32.7%; n=80) of facilities managers reported 'never' being involved in commissioning or retro-commissioning compared to contractors (23.6%; n=142). To some extent, this is to be expected given the nature of their role. Crucially, however, in a separate question that specifically addressed commissioning and retro-commissioning, 76% of all participants reported that they had at some point undertaken this work to ensure building systems were operating as intended. Again, this points to significant capability in the workforce and the capacity to service increased demand if the value proposition of commissioning/retro-commissioning can be effectively promoted amongst building owners.

The wider implication is that there is a tendency in mid-tier buildings to keep existing systems ticking over and run systems until they fail, rather than a push towards optimising plant and equipment through retro-commissioning. This has significant implications for optimisation in terms of building energy performance. Moreover, it confirms industry reports that estimate reactive maintenance is the maintenance strategy used by at least 60% of owners, preventative (or scheduled) maintenance is estimated to be used by at most 30% of owners, with at most 10% using predictive maintenance.[29]

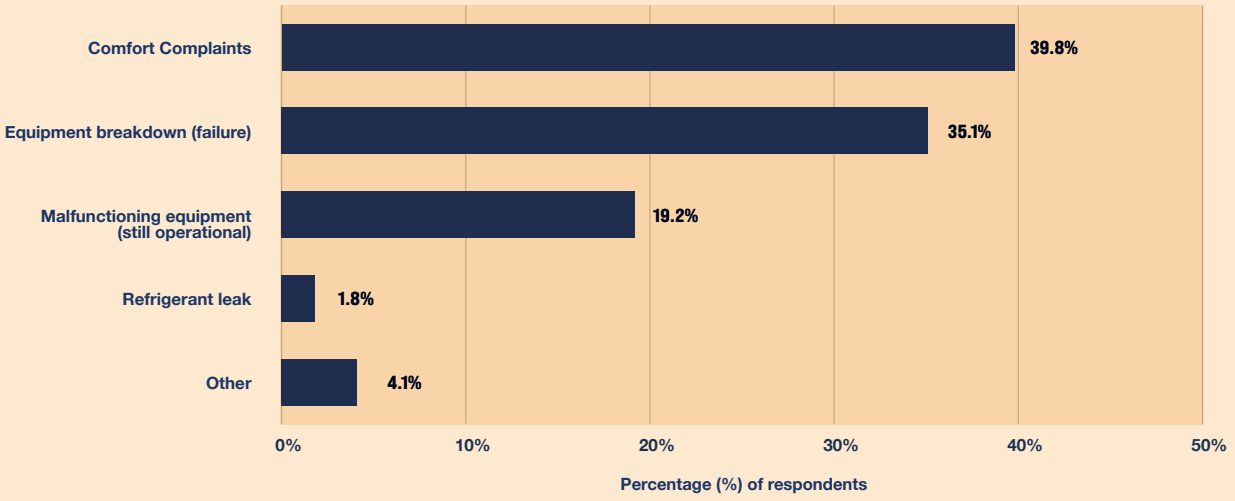
29. AIRAH. 2020.

REACTIVE MAINTENANCE

Given the importance of reactive maintenance in the workload of the sector, and the potential benefits for energy performance of shifting the model towards preventative or scheduled maintenance, it is valuable to understand the triggers for reactive maintenance. Participants ranked the most common reasons for an emergency callout across five options, including an 'other' option where they could nominate additional triggers. The most frequently cited reason for callouts was comfort complaints, with 39.8% (n=336) of participants reporting that these complaints constituted the most trigger of their reactive maintenance workload. This points to the direct nature of the relationship facilities managers and contractors have with tenants (given that the vast majority (81%) of buildings were tenanted). It reiterates the significant role of the tenant in identifying under-performing HVAC systems and advocating for long term solutions such as regular maintenance programs that sustain reliable thermal comfort.

The second most common reason (35.1%; n=297) for callouts was identified as complete equipment breakdown and failure. This provides evidence to support anecdotal industry knowledge that HVAC equipment is commonly run to the point of failure in mid-tier buildings, and the expertise of contractors is only sought when systems are no longer operational and require 'breakdown maintenance'.[30] Malfunctioning equipment is reported less frequently (19.2%; n=162), and refrigerant leaks are least likely to be reported (1.8%; n=15), emphasising that HVAC systems are largely 'out-of-sight, out-of-mind' until they fail. This points strongly to the need to and potential of effective information campaigns to build awareness around HVAC, especially to owners.

Figure 29: Most common reasons for callout – reactive maintenance or emergencies (n=845)

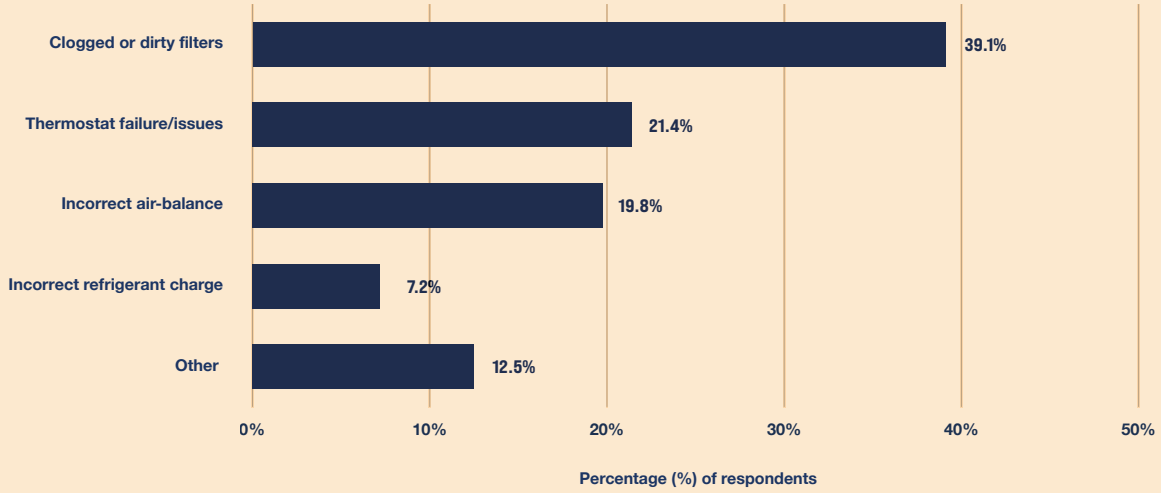


FAULT TYPES

Delving further into reactive maintenance practices and triggers, participants were asked to rank the most common fault types they encounter when they are called out, in order of frequency. The responses point to a series of routine and avoidable causes, the most commonly identified fault type being clogged or dirty filters (39.1%; n=394), followed by thermostat failure/issues (21.4%; n=215). The key observation here is that these faults are amenable to relatively simple fixes, they are largely avoidable through relatively simple preventative maintenance. This point suggests the prevalence of the belief amongst building owners that a practice of running to failure and breakdown maintenance presents a better value proposition than budgeting for preventative and scheduled maintenance. Targeting awareness campaigns and incentives on preventative maintenance to avoid common faults – such as the comfort complaints that inevitably result from poor air flow and a lack of temperature control – could be an effective strategy in rebalancing service demands away from purely reactive maintenance.

30. AIRAH. 2020.

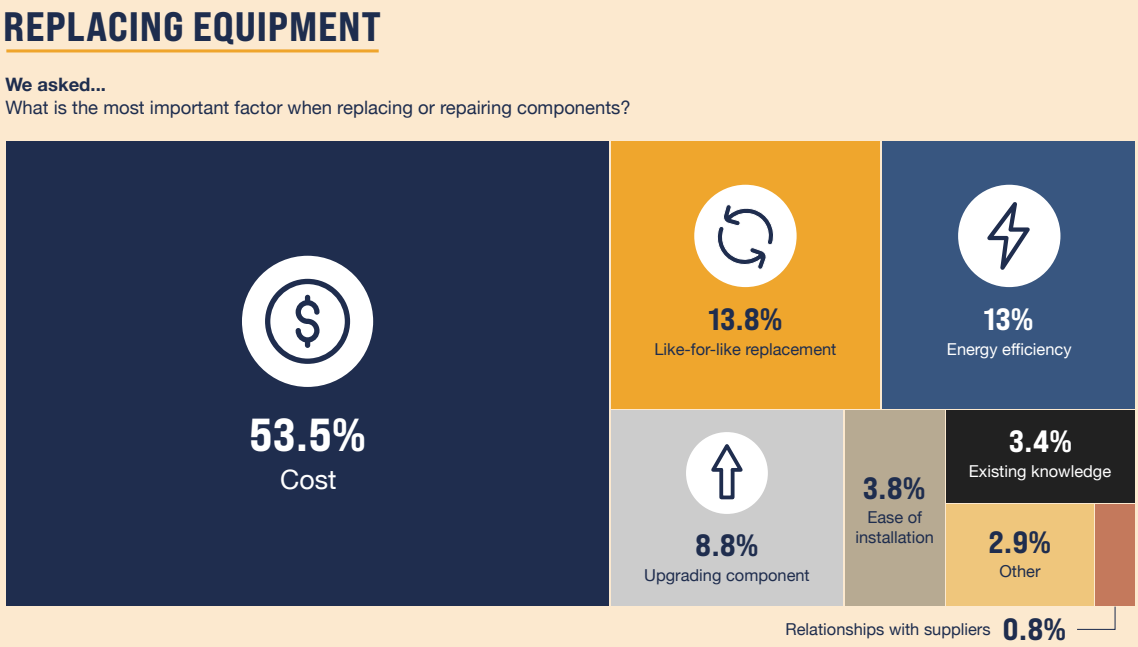
Figure 30: Most common fault types encountered (n=1,007)



FACTORS WHEN REPLACING/REPAIRING COMPONENTS

Significant enhancements can be attained in mid-tier building energy performance through the replacement of components, wherein equipment technological advances can lift energy efficiency. Thus, unpacking the drivers of decisions to replace rather than repair existing system components is worthwhile. Participants were asked to rank a list of eight factors that guide the repair and replacement of components in order, including the option to choose and specify 'other' factors not amongst the eight. There was a clear indication that the issue of cost drives repair and replacement decisions, with 53.5% (n=538) of participants rating this as most important. This outweighed the second ranked most important factor, like-for-like replacement (13.5%, n=131), more than threefold. Like-for-like replacement suggests that ease of replacement and, potentially, time constraints are also key drivers of decisions to repair or replace components of a HVAC system. The repair option is unlikely to trigger re-design issues that might be encountered if upgraded replacement equipment is specified. Again, this confirms suspicions held widely across the sector that mid-tier owners are looking for the lowest cost and least disruptive solutions to managing and maintaining buildings, rather than seeking to optimise building performance to ensure performance, reliability, and comfort.

Figure 31: Importance of key factors when replacing or repairing components

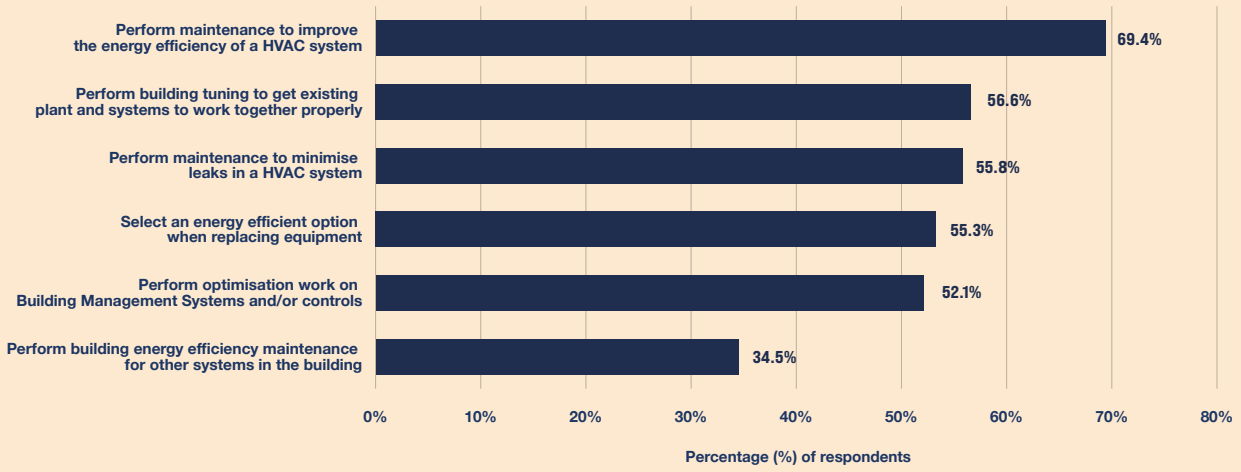


WORK ORDERS

Finally, to understand how energy performance currently features in work being undertaken in mid-tier buildings, participants were asked to identify whether they had received a work order in the previous two years that specified a range of activities specifically focused on energy. Just under 70% (69.4%; n=666) of participants reported that they had received a work order requiring them to perform maintenance to improve the energy efficiency of a HVAC system. Building tuning (56.6%; n=543) and leak minimisation (55.8%; n=536) were also commonly specified in work orders, followed by selecting energy efficient options for replacement (53.3%; n=512) and optimisation of BMS/controls (52.1%; n=500). Participants were least likely to have been asked to perform maintenance relating to the energy efficiency of other systems such as lighting, although this still featured in recent work orders for 34.5% (n=331) of participants.

These findings demonstrate that energy performance is being specified in the mid-tier, though further research is required to understand who is driving these requirements, how specifically they address quantifiable performance improvements, and how equipped the workforce is to carry out the diagnostic work to fulfil them. This research is a necessary precursor to understanding how to scale up this activity across the mid-tier sector.

Figure 32: Specification of energy efficiency activities in work orders (n=331–666)



RELATIONSHIPS INVOLVED IN PROCURING REPAIR AND MAINTENANCE SERVICES

In Section 4 the key relationships involved in procuring management, repair and maintenance services were outlined by role type. Participants working as facilities managers reported that they were predominantly engaged by building owners. Those working as contractors reported that they were engaged in almost equal proportions by facilities managers and building owners. The implication is that both facilities managers and contractors are well positioned to raise awareness amongst building owners of the value proposition of preventative maintenance.

This section adds further detail to these findings, by exploring the factors that impact on the engagement of contractors by facilities managers and that contractors view as important in winning work.

IMPORTANT FACTORS FOR ENGAGING CONTRACTORS

Facilities managers were asked to rate factors on a five-point Likert scale from 'extremely important' to 'not at all important' when engaging a building services contractor. The factor most frequently rated as extremely important (68.8%; n=161) was 'ensuring that standards would be met', followed by 'minimising lifecycle cost' (35.6%; n=83). This implies that facilities managers are attuned to the value proposition inherent in high quality work that meets standards (though these were not defined, and could be read broadly to include safety, regulatory and/or professional standards that influence the firm's reputation and brand). It also demonstrates that facilities managers are aware of the role of building services contractors in minimising lifecycle costs when replacing, repairing or maintaining equipment, and of owners' sensitivities to these costs.

Also of note are the factors rated as 'not at all important' by facilities managers when engaging building services contractors. Participants tended to rate all five factors as moderately to extremely important, so very low numbers were recorded. However, 'existing relationship with contractor' was ranked most frequently as only 'moderately important' by 33% (n=77), and as 'slightly important' or 'not at all important' by a further 12.3% (n=33) combined. This suggests that that facilities managers are not strongly motivated by loyalty around an existing relationship with contractors in procuring maintenance services for mid-tier building, pointing again to the importance of lowest cost contracting as a driver in the industry.

IMPORTANT FACTORS FOR WINNING WORK

Contractors were similarly asked to rate the importance of the same factors on a five-point Likert scale from 'extremely important' to 'not at all important' when bidding competitively for work. The factor that was rated as 'extremely important' most frequently was, again, 'ensuring standards will be met' (48.5%; n=385). This indicates that both parties understand the commercial reality that meeting standards is the most important factor in determining the work of contractor. Given that contractors are frequently engaged by building owners, this also suggests that owners are also motivated to ensure the maintenance of standards. Where facilities managers and contractors diverge however, is around the value of existing relationships in awarding new work. Almost half (45.8%; n=364) of contractors rated their relationships with owners and/or agents as 'extremely important', whereas most facilities managers ranked relationships as only moderately important or less.

Looking at the factors that contractors deemed less important in winning work, negligible figures were recorded against all factors for 'not at all important', indicating that contractors were responsive to each of these factors to some degree when bidding for work. Most notably, minimising lifecycle cost was deemed 'slightly important (9%, n=71) and 'moderately important' (28.5%; n=226) more often. Contractors were also more attuned to the importance of minimising up-front costs as a key component of winning work in a context dominated by lowest cost contracting.

Figure 33: Importance of key factors when awarding/winning work, by role type (n=233–796)

BUDGET PRIOR TO CONSULTATION

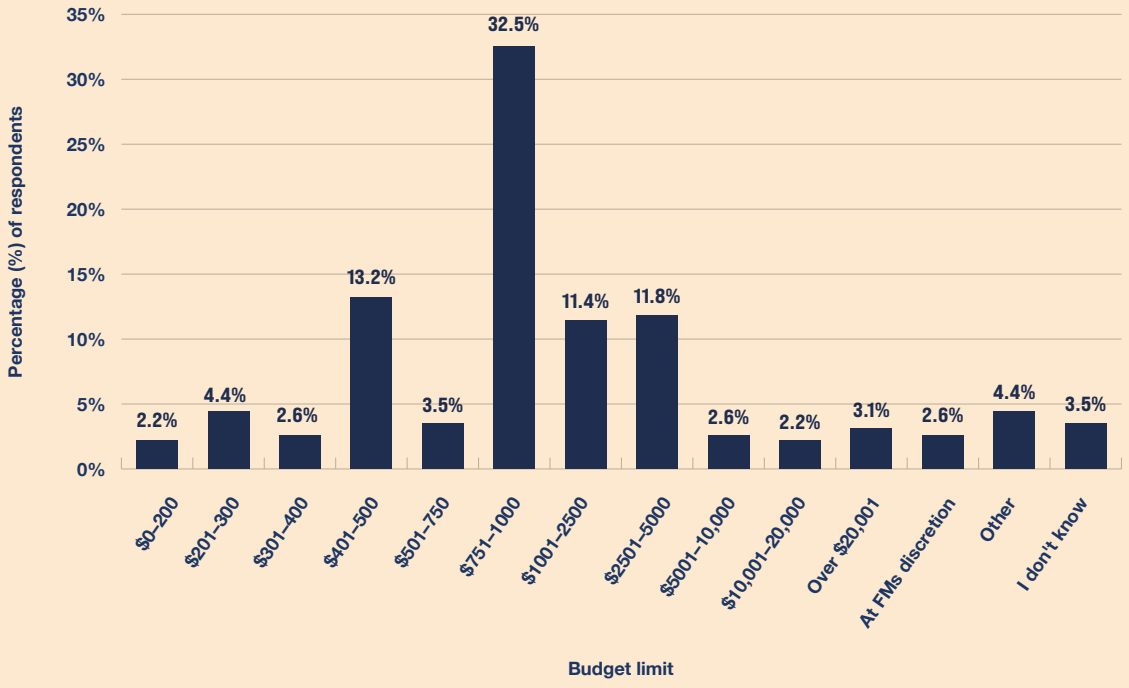
Owner sensitivity to operational costs associated with maintenance was probed by investigating the discretion that facilities managers and contractors have with budget, before being obliged to consult the client. Specifically the question asked:

What is your usual budget limit for operational expenses before you need to consult with the building owner/client?

Responses were analysed separately for facilities managers and contractors.

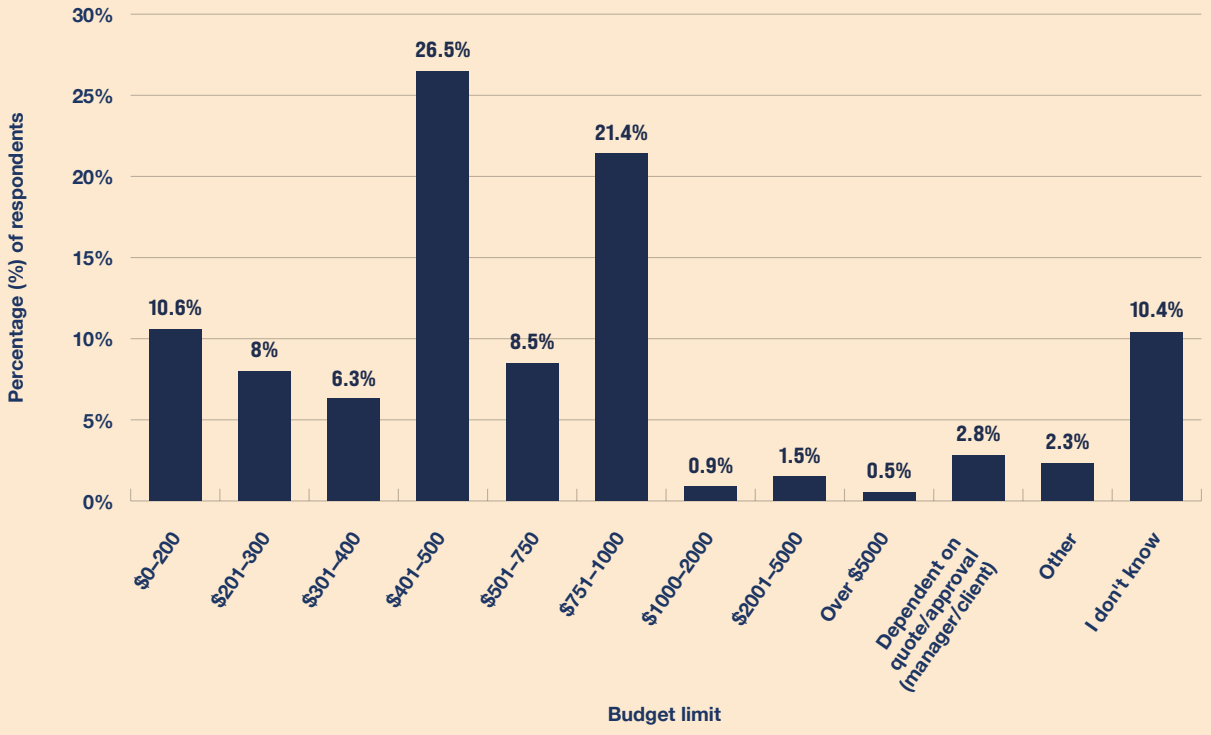
The response ranges in this multiple-choice question were designed in consultation with the professional organisations, based on their industry knowledge of budgetary norms. Because a wide range of responses were received including some outliers, using frequency counts is the best way to analyse this data. Facilities managers reported that their budget was most frequently in the range $751–1,000 (32.5%; n=74). Outside of this clear majority, higher frequencies were recorded for ranges between $401–500, $1,001–2,500 and $2,501–5,000. Taken together as a range, 72.4% (n=165) of participants working as facilities managers reported that their budget was between $401 and $5,000. However, over half (58.45%) reported their most frequently encountered limit as <$1,000. Further research is needed to understand the implications of this for the level of discretion facilities managers have around maintenance budgets, especially in light of the of the relatively 'simple fixes' required for the most commonly encountered faults outlined earlier.

Figure 34: Usual operational expenses budget before consultation with building owner/client – facilities managers (n=228)



Data generated from contractors responding to the same question demonstrated considerable difference in the level of discretionary operational expense budgets. Contractors reported that their budgets were most frequently in the range $401–500 (26.5%; n=211), followed closely by $751–1,000 (21.4%; n=170). Averaging out this range, 56.4% (n=449) of contractors reported that their operational expense budget before consulting a facilities manager, owner or client was between $401 and $1,000. The key point across both cohorts is that a generally low operational expense budget is available to both facilities managers and contractors before consultation with client is required, although facilities managers generally greater latitude here. These findings reinforce the perception of widespread sensitivity to cost across the industry and provided a grounded sense of the tight budget constraints this creates for the industry.

Figure 35: Usual operational expenses budget before consultation with facilities manager / building owner / client – contractors (n=796)



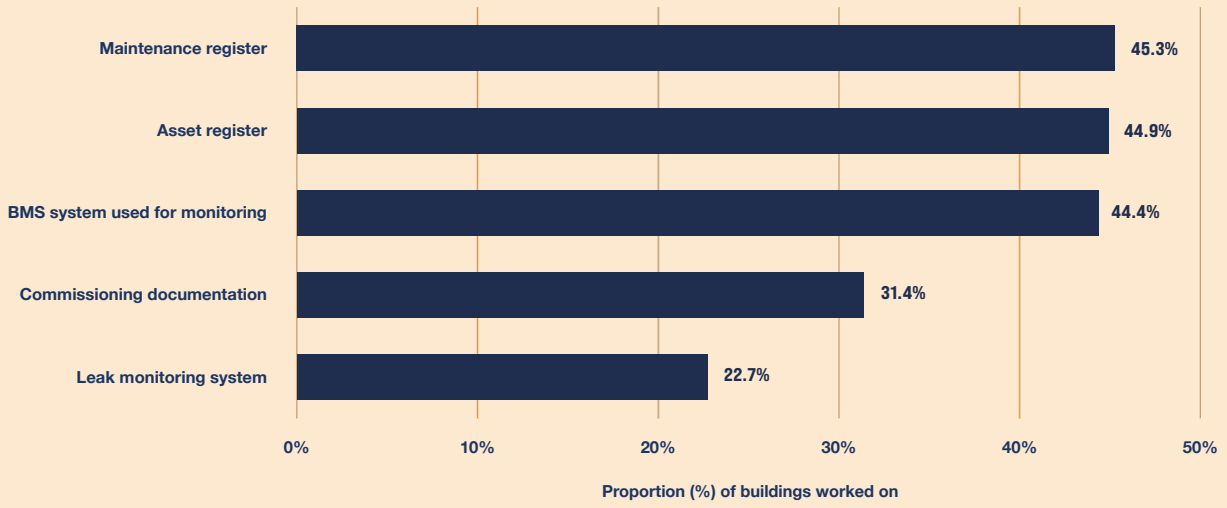
GAPS AND BARRIERS TO BETTER MAINTENANCE PRACTICES

This section of the report looks at the barriers participants encounter in carrying out their work and, consequently, in achieving better maintained, more efficient buildings. The section begins by looking at the prevalence of documentation systems and detailed specifications that enable effective management, repair and maintenance. This is followed by an analysis of twelve barriers that were adapted from a range of industry and academic literature. This analysis unpacks how these barriers take effect in shaping maintenance practices in the sector. The section ends with an analysis of two qualitative questions posed of respondents about the key actions likely to effective to addressing barriers and about steps likely to encourage equipment upgrades and reconfigurations.

DOCUMENTATION/ASSET REGISTERS

Documentation systems are key to the development of more proactive maintenance regimes. Poor record keeping makes it difficult to understand what maintenance has previously been done, which assets require maintenance and when. It poses a significant impediment to opportunities for preventative maintenance. Participants reported that less than half the buildings they work on in the mid-tier kept a maintenance register (45.28%) or asset register (44.9%). Even less had access to commissioning documentation (31.36%). This limits the efficiency of contractors undertaking repair and maintenance, and makes it difficult to ascertain whether a HVAC system is operating as it was designed or operating an optimal level. Without documentation systems in place, building owners and managers have limited records of previous work on their building to guide decisions around what is necessary and appropriate maintenance work, especially when comparing quotes.

Figure 36: Mean proportion (%) of buildings with documentation and maintenance systems in place



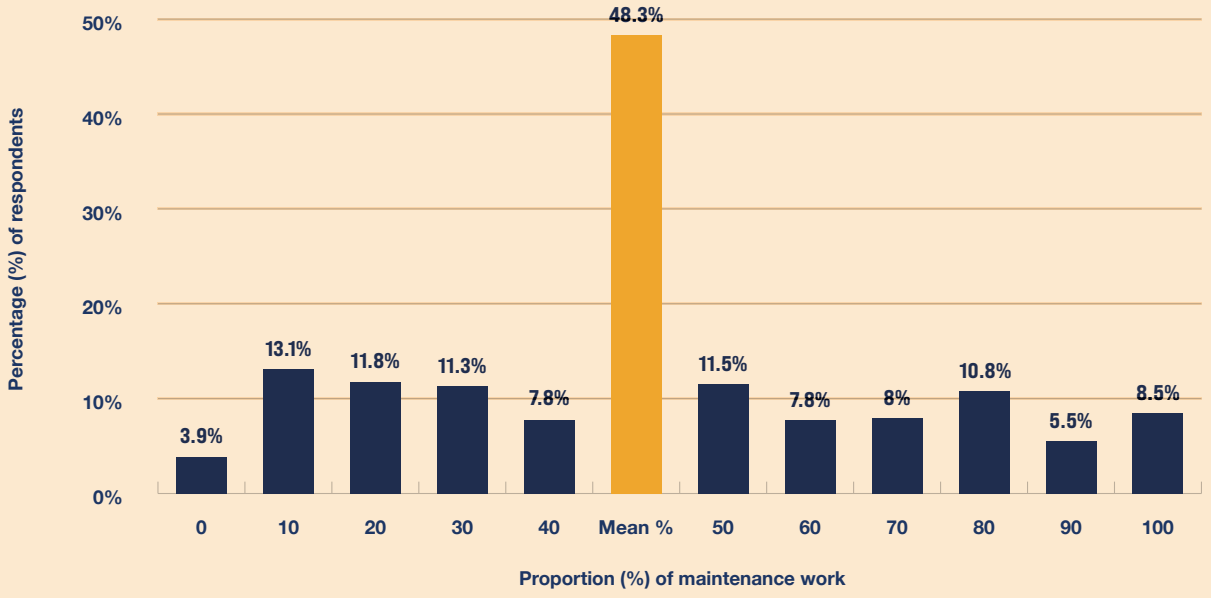
DETAILED SPECIFICATIONS

A detailed specification of work to be performed also contributes to effective maintenance. Participants reported that 48.3% of work that they do is in response to detailed specifications. Drilling further down into the frequency of responses the majority of participants (59%) were providing maintenance work in response to a detailed specification of work less than half the time.

Viewing this data through a geographical lens, relatively minor variation was observed on a state-by-state basis. A higher proportion of work in capital city CBDs used detailed specifications (53.3%) than in capital city suburban areas (46.6%) and regional towns and cities (43.7%). These figures suggest that geographically targeted information dissemination could be effective in promoting the benefits to owners of developing specifications to support maintenance work.

The development of the DA19 maintenance manual by AIRAH is an important first step in setting out maintenance activities for each type of equipment, including activities and suggested frequencies for three different maintenance strategies. DA19 could be a useful tool in assisting mid-tier building owners and facilities managers to develop more detailed specifications for maintenance work in conversation with contractors.

Figure 37: Mean proportion (%) of maintenance work done in response to a detailed specification (n=823)



BARRIERS

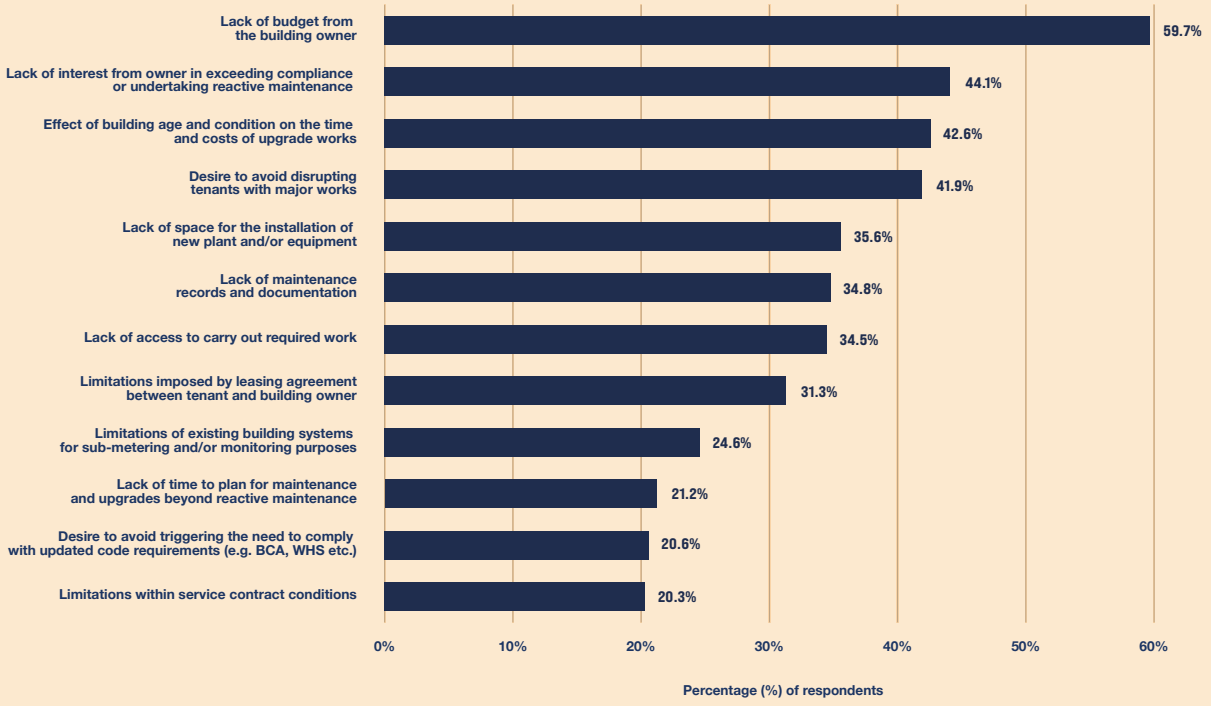
Multiple industry-commissioned studies have considered the barriers to energy efficiency improvements and upgrades in mid-tier office buildings.[31] Some additional barriers specific to facilities managers have also been identified.[32] In the survey design a consolidated list of twelve barriers was developed from this previous work, with respondents asked to rate the significance of each barrier on a three-point Likert scale ranging from 'highly significant barrier' to 'not a significant barrier', with an option for 'not appropriate'. The barriers covered issues such as disruption, budget, documentation, limitations of existing kit and building materiality, lack of time and interest on the part of owners.

Overall, the survey showed that all of the options were considered barriers to pursuing better maintenance practices, although some were more significant than others. Lack of budget is seen as a highly significant barrier across all participants (59.7%). Lack of interest from the owner (44.1%), effects of building age on the difficulty of upgrades (42.6%), and a desire to avoid disrupting tenants (41.9%) were comparable as the next three most significant barriers.

At least 20% of respondents rated each barrier as highly significant, so none should be discounted from consideration in the design of policy targeting the mid-tier buildings sector. However, limitations in service contracts (20.3%), desire to avoid triggering compliance upgrades (20.6%), and lack of time to plan beyond reactive maintenance (21.2%) were considered the least significant overall by respondents.

Breaking the data down by geographical context, the barriers were seen as more significant in capital city CBDs than in capital city suburban areas and regional cities and towns. This is indicative of several factors: the complexity of upgrades in a denser urban environment; the greater risk of disruption to multiple tenants occupying buildings; and, the higher opportunity cost of vacancy in a more competitive leasing context.

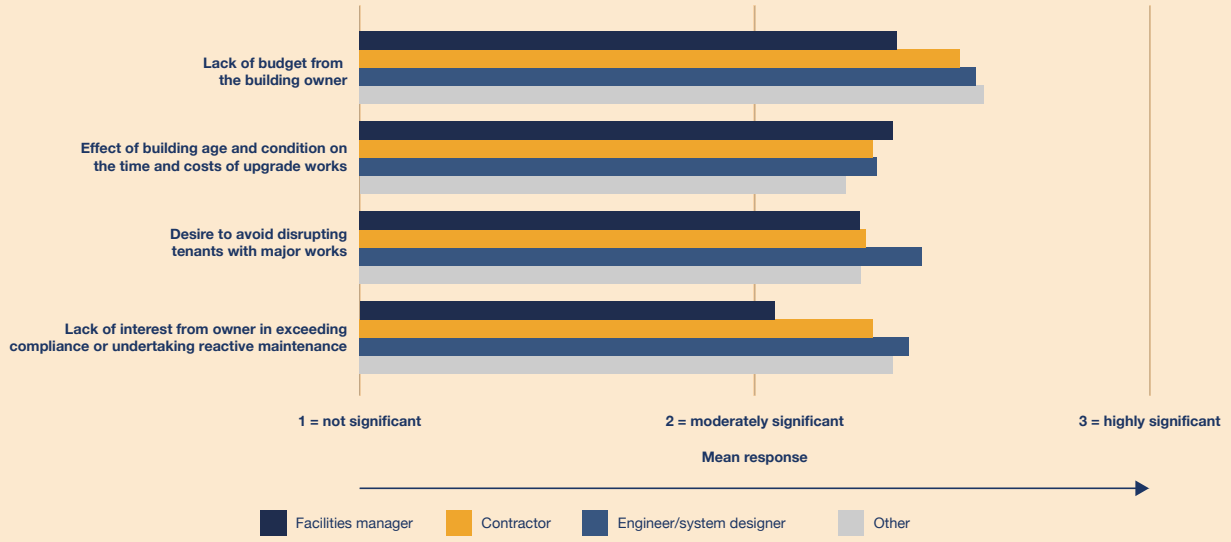
Figure 38: Highly significant barriers to work on mid-tier commercial office buildings



31. EY. 2015a; Green Building Council of Australia. 2015; Sustainability Victoria. 2016.
32. Rock et al. 2019.

There was a reasonable consistency of responses to the different barriers across the role types, although there are some deviations to note. For instance, a lack of interest from the owner is less likely to be seen as a barrier by facilities managers than other role types. In general, facilities managers see most of the barriers as less significant. Given facilities managers are likely to be engaging directly with building owners, this suggests they have a role to play in educating owners about the reality of these barriers to effective maintenance, and the value proposition maintenance presents.

Figure 39: Mean response to four most significant barriers, by role type



The following table summarises respondents' assessment and rating of the 12 barriers and draws out observable variations in this assessment across the key role types.

Figure 40: Barriers ranked by mean overall response with description of any observed differences in responses, by role type

OVERALL RANKING (MEAN OVERALL RESPONSE)	BARRIER	DESCRIPTION OF DIFFERENCES BETWEEN ROLE TYPES
1	B10. Lack of budget from the building owner	***Highly significant*** Strong agreement across role types that this is a highly significant barrier. Facilities managers were slightly more likely to see this as not significant.
2	B7. Effect of building age and condition on the time and costs of upgrade works	***Moderate–Highly significant*** Almost all respondents considered this to be a moderately or highly significant barrier, with close agreement across role types.
3	B2. Desire to avoid disrupting tenants with major works	***Moderate–Highly significant*** Almost all respondents considered this to be a moderately or highly significant barrier, with close agreement across role types. Engineering/systems specialists were more likely to consider this to be highly significant (52% compared with 42% overall)
4	B11. Lack of interest from owner in exceeding compliance or undertaking reactive maintenance	***Moderate–Highly significant*** All role types most frequently rated this as highly significant, slightly more often than moderately significant. Facilities managers differed from other roles, with more considering this not to be a significant barrier (30% compared with 20% overall)

OVERALL RANKING (MEAN OVERALL RESPONSE)	BARRIER	DESCRIPTION OF DIFFERENCES BETWEEN ROLE TYPES
5	B6. Lack of space for the installation of new plant and/or equipment	***Moderate–Highly significant*** Responses were relatively consistent between role types. Facilities managers were less likely to consider this barrier highly significant, while 'other' (e.g. business services or general managers) were more likely to see this as highly significant.
6	B8. Lack of access to carry out required work	***Moderately significant*** Greater variation in responses across role types than most barriers. Facilities managers were more likely to consider this not significant, while contractors and 'other' were more likely to consider this highly significant.
7	B1. Limitations imposed by leasing agreements between tenant and building owner	***Moderately significant*** This barrier was most frequently rated as moderately significant by all role types except 'other'. Facilities managers were more likely to consider this to not be a significant barrier (30% compared with 20% overall). 'Other' role types considered this a highly significant barrier.
8	B4. Lack of maintenance records and documentation	***Moderately significant*** Responses were relatively consistent between role types, and were spread across the spectrum from not significant to highly significant. Moderately significant was the most common response from all role types, except facilities managers who found this barrier highly significant.
9	B5. Limitations of existing building systems for sub-metering and/or monitoring purposes	***Moderately significant*** Responses were consistent between role types.
10	B12. Limitations within service contract conditions	***Moderately–Not significant*** Responses were relatively consistent between role types. Facilities managers were more likely to consider this barrier not significant (40% compared with 30% overall).
11	B9. Lack of time to plan for maintenance and upgrades beyond reactive maintenance	***Moderately–Not significant*** Larger variation in responses across role types. Majority of Facilities managers considered this not significant. Engineering/systems specialists and 'others' more likely to consider this moderately significant.
12	B3. Desire to avoid triggering need to comply with updated code requirements (e.g. NCC, WHS etc).	***Moderately–Not significant*** All role types rate this a moderately significant barrier, with a high proportion of responses considering it not to be significant (33% overall).[33]

33. Noting here that further targeted training around NCC Section J provisions amongst owners, contractors and facilities managers would help to alleviate this barrier.

RESPONSES TO QUALITATIVE QUESTIONS

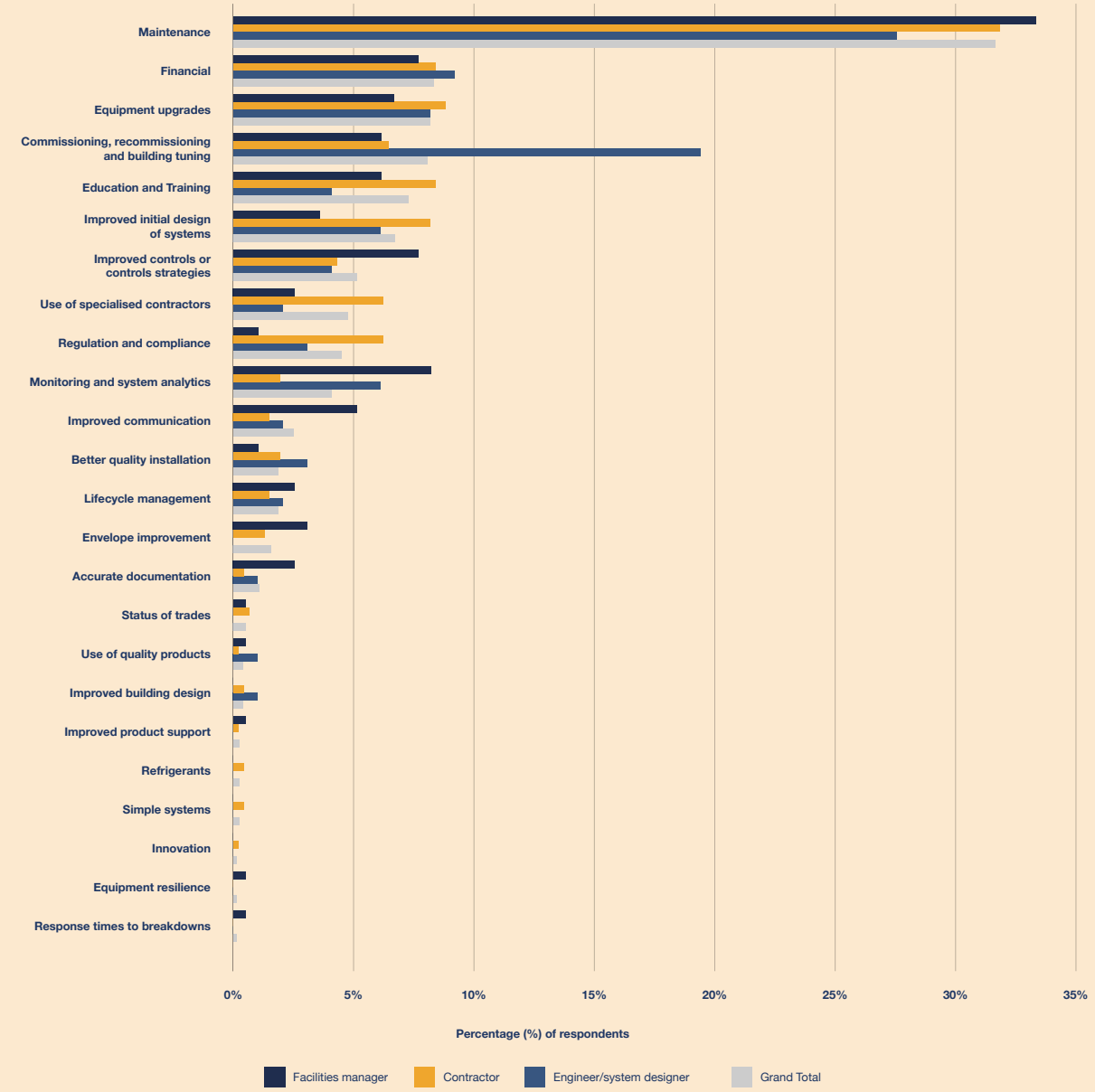
Two qualitative questions were asked at key points in the survey, to encourage a more liberal response from participants. A higher than anticipated rate of response was received for these questions. Participants provided detailed and specific comments on their experiences, indicating a willingness and enthusiasm in the industry to communicate on improving HVAC performance and upgrade processes.

THE NUMBER ONE ACTION TO MAKE HVAC SYSTEMS PERFORM BETTER

The first qualitative question asked respondents to identify the 'number one action' that could be taken to improve building performance. Just under half of all participants provided a response to this question (49%; n=762). Response rates were similar across the main role types, with slightly lower response rate for engineer/system designers (41%), and slightly higher for refrigeration and air conditioning mechanics (52%).

A summary of the coded responses (aggregates of a series of sub-codes) is provided below, showing the number of responses coded to the main categories disaggregated according to participant role type.

Figure 41: Coded responses (qualitative) to 'What is the number one action that could be taken to improve building performance in mid-tier office buildings?', by role type (n=762)



The vast majority of participants identified maintenance, and in particular the implementation of planned and preventative maintenance, as the number one action that can be taken to make HVAC systems perform better. This was true for the three main role types surveyed. While it is to be expected that maintenance is a dominant concern amongst the surveyed cohort, particularly those providing maintenance services, the broader responses to this question provide several useful insights.

- Almost four times as many respondents across each role type saw improved maintenance as a more important action than equipment upgrades. This indicates that in many cases the existing equipment may be able to meet the needs of the buildings if serviced appropriately.
- The second most commonly identified actions were financial. Across all role types, the most commonly identified kinds of financial actions related to needing to increase the budget available for management of HVAC systems (46% of responses related to financial issues). Financial incentives for HVAC maintenance and/or upgrading was the next most common financial action identified by Engineers/System designers and Facilities managers, whereas for refrigeration and air conditioning mechanics it was addressing lowest cost contracting. The problematic impact of lowest cost contracting was well summarised in the following quote:

  > *"[Too] often on small to medium buildings the FM just want to cheapest option which means we have to drop our maintenance hours to win buildings which mean only 50% of the required service is being done. If maintenance on buildings were a priority and FM or owners didn't just get the cheapest price you would limit service calls, and building performance issues"*
  >
  > – Refrigeration and air conditioning mechanic, NSW and Victoria

  It should be noted that across the variety of financial actions identified, the vast majority ultimately relate back to either increasing the budget available for maintenance or upgrading work, and thus could be coded back to financial actions and vice versa.
- The maintenance responses suggest that in many cases the existing equipment can be made to perform better. Nonetheless upgrades to existing equipment was a commonly identified action; it was the second most common sub-code behind planned and preventative maintenance, and was raised by 8% of contractors, and 5% of facilities managers who provided a response to this question.
- Neither Commercial Building Disclosure nor other forms of mandatory disclosure were identified by respondents as a useful action. Reducing the floor area threshold or otherwise expanding the applicability of this policy has been commonly recommended as an approach to improving energy efficiency in the mid-tier. However, it was not identified by any respondents to this question. Comparatively, 34 (4%) respondents identified regulation and compliance actions, with the majority of these (25 (3%)) identifying improved compliance. This could be an artefact of the target audience or could indicate that the mid-tier will not respond to CBD in the same manner as the higher quality office stock.

ALTERNATIVES TO LIKE-FOR-LIKE REPLACEMENTS

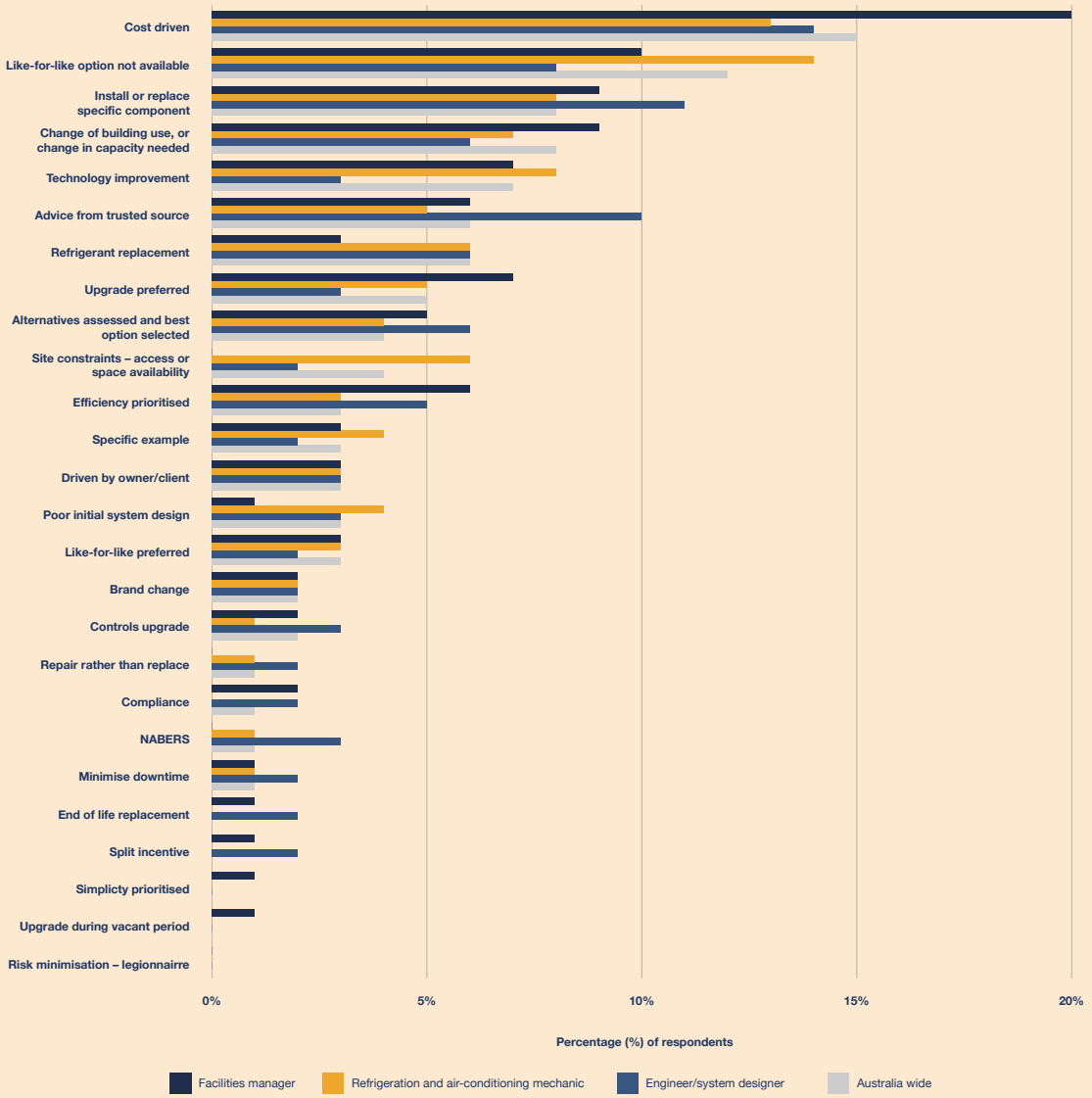
The second qualitative question asked respondents to identify a specific instance when they overlooked like-for-like replacement of equipment in favour of a different decision.

Like-for-like replacement overlooks the opportunity to leverage building performance improvements via equipment reconfigurations. In the design phase of the survey, this question was identified as a way of locating specific points of traction or opportunities to encourage upgrades in the mid-tier sector.

Well over one-third of respondents provided a response to this qualitative question (38%; n=602). Response rates were similar across the main role types, with slightly lower response rate for engineering/systems specialist (34%), and slightly higher for facilities managers (40%) and contractors (39%).

A summary of the coded responses (aggregates of a series of sub-codes) is again provided below, with the number of responses coded to the main categories disaggregated according to respondent role type.

Figure 42: Coded responses to (qualitative) question about alternatives to like-for-like replacement of equipment, by role type (n=602)



There was a much greater spread of responses across codes for this question, in comparison with the open response question on the number one action. However, the single most common reason given in deciding whether to undertake a like-for-like replacement was cost considerations (15%); another indication of the primacy of cost in driving maintenance decision making. Where specified, most commonly (6%) the cost assessment was based on life-cycle cost.

The second most common reason given for not undertaking like-for-like replacements was that the like-for-like replacement option was not available (12%). This was most commonly due to failure of a component that was no longer manufactured or sold, or the inability, difficulty, or high cost of accessing parts to maintain a component.

The next most common reason provided was that a specific new component or technology was replaced or installed (8%). This in large part reflects technology improvements in specific systems (i.e. variable refrigerant flow, variable speed drives and electronic expansion valves), as well as the acceptance of these technologies as cost-effective and sensible upgrades. Change of building use and/or a change in system capacity was also identified 8% of the time as a trigger for a system upgrade.

The next most commonly occurring code was 'technology improvement' (7%); this code was used to categorise those response that identified a situation where a similar, though updated and more efficient, component was installed. The diversity of responses is indicative of the diversity and segmentation of the mid-tier sector and of the building and system configurations to be found across the sector.

7. CONCLUSIONS

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THE SURVEY PRESENTED IN THE CURRENT REPORT WAS THE FIRST NATIONWIDE SURVEY OF FRONTLINE WORKERS RESPONSIBLE FOR MANAGING AND MAINTAINING HVAC SERVICES IN MID-TIER BUILDINGS.

Useable responses were collected from 1072 participants, predominantly building services contractors (n=847; 53.8%), facilities managers (n=362; 23%), and engineering/system specialists (n=255; 16.2%), with representation across all Australian states and territories. This represents a significant new empirical data source that can be used to test assumptions and anecdotal findings from prior studies, and as a basis from which to ground future research and policy development. The current report has provided a descriptive analysis of the results and identified areas of interest for further investigation. Some of the key empirical findings from this work include:

PEOPLE

- SMEs were the most common enterprise type for contractors (46.8%) and engineers/systems designers (50.8%), whereas facilities managers were predominantly (37.9%) from multi-national enterprises, with strong representation (27.5%) from national business or enterprise. This has implications for continuing professional development and knowledge dissemination.
- Contractors are trade-qualified (87%) and experienced (73.8% >11 years).
- Facilities managers are variably qualified (trade/diploma/degree) but with high rates (69%) of on-job experience reported as qualification. Their high rate of trade qualifications (45%) indicates a pathway from contractor to facilities managers
- Responses indicated strong representation from members of professional associations, which may reflect recruitment channels and confirms anecdotal evidence of difficulty accessing non-members (e.g. direct mail out had low response rate).
- Contractors and facilities managers may both be effective conduits to building owners.

BUILDINGS AND SYSTEMS

- As reported in prior studies, the mid-tier sector is heterogenous and segmented. Multiple tenants per floor was the most common tenancy type, and there was a low penetration of owner-occupied buildings, meaning tenants, commonly multiple different tenants, are key players in mid-tier upgrade and retrofits.
- All systems types were common; central plant only was slightly more common than mix of central/splits, which may indicate ‘patching’ over old and under-performing systems, and there was a relatively high penetration of splits only. System type was influenced by state and geographical context.
- Many (42.7%) report that most buildings have original HVAC system with no upgrade since installation, and few (22.3%) report that most buildings have been fully retrofitted.

MAINTENANCE PRACTICES

- Equipment suppliers and informal knowledge sharing networks (experienced colleagues) are a key source of information, at almost double the rate of more formal CPD training.
- Cost is overwhelmingly the deciding factor when choosing between repair and replace. However, there is a slight mismatch between contractors and facilities managers when asked about what matters when engaging/wining work. Facilities managers report lifecycle cost as more important than upfront cost, whereas contractors see upfront cost as more important.
- Preventative maintenance is a greater than expected activity in the sector. However, the prevalence of maintenance, and explicitly planned and preventative maintenance, as the 'number one action that could be taken to make HVAC systems perform better' suggests that there remains an unmet need for additional maintenance work.
- Responding to comfort complaints were the most frequent reactive maintenance task, and the most common fault types were also amenable to simple fixes – filters and thermostats.

BETTER WAYS TO WORK

8. FUTURE WORK

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The current report has presented a descriptive analysis of the survey results, along with an initial discussion of the implications for policy. Given this was the largest survey of its kind to date, there is substantial scope for further analysis of the responses that might inform the design and development of policy options. Key activities to be undertaken in the next phase of work being undertaken by UOW include:

1. **Breaking down the mid-tier:** Cluster analysis will be used to understand how the large and heterogeneous mid-tier sector can be broken up into smaller sub-sectors to better target policy interventions, information design and dissemination, and further research.

   Data will be grouped using two-step cluster analysis (SPSS), testing multiple variables based around:

   - People – Worker profiles,
   - Buildings and systems – Building profiles, Geography
   - Maintenance practices – Maintenance workload, Building maintenance profiles

Initial analysis is indicating clusters being driven by factors including: geographic context, tenancy profile, role type, HVAC system type. Other variables such as state location and common fault types encountered are not strong predictors of clustering.

Once meaningful clusters are identified, key systemic issues in the procurement of maintenance services, and the intervention points where policy change, incentives and/or the delivery of skills and training initiatives can affect repair and maintenance regime change will be explored through exploratory interviews and other qualitative investigative methods.

2. **Ground-truthing potential for extrapolation of findings beyond the mid-tier:** While this survey targeted building service contractors working in the mid-tier office sector, many of the identified issues have similarities with other sectors. Further work will explore to what extent the findings from the *Better Ways to Work* survey extend to sectors beyond mid-tier commercial office buildings; for example, aged care, schools, hospitals and local government facilities.
3. **Pathways to Enhancing Skills and Training:** The *Better Ways to Work* survey identified an under-utilisation of formal post-trade training in the Australian HVAC&R sector, which poses a problem for an industry on the front line of increasingly rapid environmental, technological and economic change. Further work will explore the existing licensing and training regime in the commercial building HVAC&R industry and identify opportunities for improving energy efficiency outcomes through skills and training. It is imperative that this work recognises the potential for social learning processes and the communities of practice that are *already* operational and functioning well to ensure policies targeting skills and capacity building are designed to work in concert with the way the industry is organised, rather than against it.

9. REFERENCE LIST

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BETTER
WAYS TO WORK