

# Changes to Household Practices Pre- and Post-Occupancy in an Australian Low-Carbon Development

## Abstract

Limiting study to a narrow range of energy and water using activities is insufficient to provide a holistic understanding of household resource flows. Consideration of a wide range of social practices is needed. With the rise of low-carbon developments featuring energy or water efficient technology and design around the world, the way residents interact with the design and technology and community is vital to understanding if these households and developments will meet their intended design goals. The opportunity to study resident's pre- and post-occupancy resource consumption is a unique opportunity to examine how design, technology and community influence household practices. This article studied 13 Australian household's practices of waste management, food shopping, item purchasing, travel and laundry practices for two weeks before and after moving into a low-carbon development, while the home system of practice is in a stable phase. This provides an opportunity to comment on the state of interlocking of resident's home system, from lightly interlocked to highly. Post-occupancy, the presence of solar panels influenced when some residents put the washing machine and tumble drier on, however only when the resident was home. Many residents are conscious of putting these on during the day or use timers where they had not previously. Changes to resident's travel practices were not as broad as they anticipated before the move, while recycling rates increased, influenced by a supportive community and shopping practices became more localised through the use of smaller food retailers. Results show that resident's resource use is heavily influenced by their work and socialising routines, which are not commonly focused on when attempting to change household resource use behaviours. A traditional focus on psychological approaches targeting values and attitudes fails to adequately address these factors, whereby a social practice theory approach allows for their consideration in influencing resource use in the home.

**Keywords:** Household resource use; Social Practice Theory; home system of practice; Australia; Post-occupancy evaluation, Low-carbon development

## 1. Introduction

Resource use and waste generation around the world have increased as a result of population growth and rising consumption levels (Harder et al., 2014). Household consumption levels are affected through daily practices which involve those actions undertaken by individuals as part of their routine lives, which have varying impacts on the environment (Halkier, 2009; Kennedy, 2011; Terragni et al., 2009). The term sustainable consumption refers to the consumption of more efficiently or ethically produced goods and where consumers consider environmental and social aspects before purchase (Seyfang, 2005). Many studies have been completed on how household resources such as energy, water, waste and food are consumed and how these could be more sustainable (Delaney and Fam, 2015; Eon et al., 2018b, 2018a; Friis and Christensen, 2016; Gram-Hanssen and Bech-Danielsen, 2004; Hand et al., 2005; Hansen, 2016; Harder et al., 2014; Hess et al., 2018; Rathnayaka et al., 2015; Sahakian and Wilhite, 2014; Twine, 2015). These studies however, have not focused on residents of low-carbon developments (LCD).

LCDs have been designed to enable residents to consume less energy and water than the standard dwelling due to innovative design features. The residents of LCDs have been described as a special segment of the population with different lifestyles and consumption practices (Mlecnik et al., 2012). This paper is based on the concept that consumption occurs during the performance of social practices (Gram-Hanssen, 2008; Shove et al., 2009; Warde, 2005). Understanding the dynamics of everyday consumption practices allows for a comprehensive perspective on altering consumption practices (Greene and Rau, 2018).

. House, townhouse and apartment sizes in Australia are beginning to decline in floor size, indicating that a change may be occurring in preferences for house size (Australian Bureau of Statistics, 2019). As advancements in building codes require stricter building regulations of designs to increase energy efficiency and incorporate passive solar design principles, houses with low-carbon design features will become more prominent in the Australian market (Berry et al., 2019). This study aims to track whether resident's possessions and the related household practices may change too. Knowledge of how residents routines relating to various domestic practises emerge, develop and change provides an insight into sustainable consumption (Gram-Hanssen, 2008).

This paper will analyse domestic consumption practices through empirical evidence collected from resident's pre-and post-occupancy in an Australian LCD, located in Western Australia.

This addresses the research question: “What changes occur to individual domestic practices and the home system of practice (HSOP) when residents’ move into a LCD?” Pre-occupancy and post-occupancy studies are important to examine how residents engage with the design, technology and community aspects of LCDs (Meir et al., 2009). The focus on social practices in the space of the home has allowed for multiple practices to be studied, however there have been few studies that focus on these as a holistic study, rather most focus on one or two practices at a time. Understanding the dynamics of everyday consumption practices through a holistic study of household practices, therefore, allows for a comprehensive perspective on altering household resource metabolism (Fam et al., 2015; Greene and Rau, 2018). This paper will explore the routines of travel, waste management, food and item purchasing and laundry practices of residents for two weeks pre- and post-occupancy in the LCD. A discussion on how the practices interlock, or link together in a daily routine, in the HSOP, and the policy implications for sustainable household practices conclude the paper.

## **2. Theoretical overview: routines in domestic practices**

This section outlines the theoretical overview of relevant topics to this paper as found through a snowball narrative literature review using keywords relating to the topics and from references from key literature in the area. This includes social practice theory which provides the framework for analysing the practices, and a summary of the practices themselves: travel, waste management, item purchasing, food purchasing and laundry practices. These practices all involve the use of resources of one form or another and are centred around the home as a place of performance or of influence on their performance in the case of travel or purchasing. These practices were chosen based on practices previously studied in isolation and in other studies of household resource consumption which will be outlined below. The intention was to cover the majority of household practices performed outside of the traditionally studied showering and thermal comfort practices that have dominated the social practice theory literature, to provide an understanding of their performance that may influence attempts to reduce individual’s resource consumption to limit environmental impacts (Gram-Hanssen, 2008; Higginson et al., 2015).

### ***2.1 Social Practice Theory***

Traditional economic and psychological approaches view consumption as an isolated event and the consumer to be rational, thoughtful and responsible for their decisions and actions (Wahlen, 2011). However, researchers have increasingly demonstrated that consumers, whilst

being rational, thoughtful and responsible for their decisions and actions, are also part of on-going practices that are bundled up in other daily practices, not a one off event segmented in time (Halkier and Jensen, 2011; Sahakian and Wilhite, 2014; Schatzki, 2019; Spaargaren and Mol, 2008). People do not use resources such as water or energy directly, but rather with the objective of achieving a desired outcome and consumption occurs at the time of the performance of the practice (Shove et al., 2010; Wahlen, 2011).

Social Practice Theory focuses on the study of practices, a collection of doings and sayings that form the basis of lifestyles and are made up of three elements: meaning, technology and skill (Breadsell et al., 2019a; Breadsell et al., 2019; Eon et al., 2019, 2018a). Meanings are the understanding, assumptions and values associated with the practice; technology is the artefacts used in the performance of the practice and skill is the required knowledge and competency to execute the practice. These have been described under various names by previous social practice theorist (Gram-Hanssen, 2010; Reckwitz, 2002; Schatzki, 2002; Scott et al., 2012; Shove et al., 2012; Warde, 2005). These elements can change for each performance of the practice, particularly as skill or meaning alters but they are often routinely performed and inconspicuous in their performance (Wahlen, 2011). Routine practices form the basis for everyday life and reduce complexity, save time and energy (Wahlen, 2011).

When routine practices are performed with little change over a long period of time, they form into habits that do not require much engagement in the active performance of them (Sahakian and Wilhite, 2014). These habits can be connected to places such as the home, shopping centres or transport routines where they are most commonly performed (Breadsell et al., 2019a; Eon et al., 2019; Eriksson et al., 2008; Foulds et al., 2016; Gram-Hanssen and Darby, 2018; Hampton, 2017; Khalid and Sunikka-Blank, 2017; Pooley et al., 2011). The study of what happens to these habitual practices when the context they are performed in changes, such as when people move houses, is rarely studied (Plessz et al., 2016). Longitudinal studies can identify any changes that occur, such as through diary studies, however these have only previously been studied in situ in the home environment (Wahlen, 2011). However, researching only one practice and the consumption of resources related to this practice does not provide the whole picture (Sahakian and Wilhite, 2014). Practices do not exist in isolation from other practices, or be performed in a bubble from contextual factors, they are influenced by other members of a household, neighbourhood and technological changes (Bartiaux and Reátegui Salmón, 2014; Kennedy, 2011). Practices also interlock with each other, forming a system of practice (Watson, 2012), influencing when and how a practice can be performed

based on time and resource commitments (Breadsell et al., 2019a; Spurling et al., 2013; Spurling and McMeekin, 2015). This may take the form of a morning routine where the practices of showering, eating breakfast and driving to work are interlocked (Eon et al., 2019). Reconfiguring one aspect of daily practices forces other interlocking practices to be reconfigured as well (Shove and Walker, 2010; Spurling and McMeekin, 2015). Therefore, examining a broader system of practice, such as those found in the home, or a Home System of Practice (HSOP), is required (Breadsell et al., 2019a; Eon et al., 2018a, 2018b; Strengers, 2011).

A HSOP can be lightly or more highly interlocked depending on how routine the performance of practices are and the constraining factors influencing when practices can be undertaken (Breadsell et al., 2019a). A household of adults who work full-time off-site would be more highly interlocked than a household of a retiree who has few constraining factors on the performance of household practices. Households with highly interlocked HSOPs may find it difficult to change their practices as there are many influences on why they and how they perform practices, at particular times and with particular technology. For instance, a lightly interlocked household has more options to dry their laundry outside during winter when they are home during the day more than a highly interlocked household who are away from the home more frequently and who may have to resort to a tumble drier instead as their clothes would not be dry in time to be used again. The pre-occupancy interlocking status of the residents in this case study has been studied and discussed further in Breadsell et al., (2019a).

Previous studies on practices relating to household consumption have been undertaken on mobility practices (Cass and Faulconbridge, 2016; Greene and Rau, 2018), recycling (Wonneck and Hobson, 2017), food purchasing and meal times (Molander, 2011; Pfeiffer et al., 2017; Wahlen, 2011; Yates and Warde, 2017), appliance purchasing (Foulds et al., 2016), laundry (Hand et al., 2007; Higginson et al., 2015; Pink, 2005) and showering (Pink and Mackley, 2015a; Seebauer et al., 2016; Shove, 2003; Shove and Walker, 2010). The work undertaken by Foulds and colleagues has formed the basis for the pre- and post-occupancy studies of practices and also influenced the formation of this research (Foulds, 2013; Foulds et al., 2016). These practices and related studies will be discussed below, with reference to related social practice research with occasional inputs by other disciplines where relevant.

## ***2.2 Travel practices***

Travel practices have been defined as a consumption of distance practice, however there has been a lack of temporal and contextual studies into travel practices (Greene and Rau, 2018; Heisserer and Rau, 2017; Urry, 2007). People's travel practices, and the elements associated with that practice, change based on their stages of life, place and type of residence, and career (Urry, 2007). Travel behaviours or practices are largely habitual, embedded within daily routines and dependent on particular structural and locational factors (Barr and Prillwitz, 2011). Changes in these practices require subsequent changes in many daily practices that are interlocked with travel such as shopping, work and social interaction (Laakso, 2017). For many, the car is the dominant mode of transport for many activities, leisure, work and holidays (Kent, 2015; Urry, 2007). Travel practices are entwined with other practices and have powerful time and space dependent interactions (Urry, 2007). This encourages social networks to overlap, with quick, casual meetings. However many factors influence one's choice of travel method, such as being able to have multiple stops in a trip via a car, safety whilst walking or being sweaty after cycling (Cass and Faulconbridge, 2016; Harries and Rettie, 2016; Pooley et al., 2011).

## ***2.3 Waste management practices***

Each household in Australia is estimated to produce almost 1.5 tonnes of waste each year (Australian Bureau of Statistics, 2013). In Western Australia, this is slightly higher at 1.6 tonnes of waste per capita, with state targets to increase recycling rates by 15% by 2020 (ASK Waste Management, 2019). Household waste consists of organics (46%), paper and cardboard (27%), metals (14%), glass (10%), plastic (2%), and rubber, textiles and other (less than 1% each) (ASK Waste Management, 2019). Recycling rates are high for households, with 97% recycling paper, cardboard, metal, plastic and glass through curbside collections (Australian Bureau of Statistics, 2013). Despite 23% of Australian households always composting food waste, the average Australia household throws out approximately AU\$616 worth of food each year and over 80% report this as a concern leading to feelings of guilt (Australian Bureau of Statistics, 2013; Denniss and Bater, 2011). This equates to 15.9Mt of CO<sub>2</sub> emissions annually (Denniss and Bater, 2011). There are many benefits to composting including extending the lifetime of landfill sites, mitigating greenhouse gases and creating a useable product (Seng et al., 2013).

Larger scale studies at a neighbourhood or city scale reveals differences in recycling behaviours at a household level (Barr, 2007; Hayles and Dean, 2015). This is driven by differences in household practices through perceptions and social norms of convenience, disgust, cleanliness and environmental and health concerns; the skills to perform waste management practices including knowing what can be recycled or composted and how; and the technology to do so through indoor and outdoor garbage bins, and associated curbside collections or uses for composted materials (Harder et al., 2014; Wonneck and Hobson, 2017). Vague goals such as saving the planet, do not engage with relevant social practices or give people a chance to perform new practices, unless they also take account of the practices skills and technology in the performance (Sahakian and Wilhite, 2014; Wonneck and Hobson, 2017). Structured recycling systems and other members of one's social or neighbourhood circle recycling have been found to increase recycling rates in both behaviour and social practice based research (Barr, 2007; Sahakian and Wilhite, 2014).

#### ***2.4 Purchasing practices***

Previous studies have examined purchasing practices through tracking individual items such as light bulbs (Schleich et al., 2014), single-use spoons, reusable water bottles and washing machines in a behaviour based study (Goucher-Lambert and Cagan, 2015). These studies have found that consumers with environmental impact or efficiency information available for a product at the time of purchase will have this influence their purchasing decision (Goucher-Lambert and Cagan, 2015), and that many low-income households will use goods for as long as possible before replacement and will often buy products second-hand, particularly clothing (Lettenmeier et al., 2012). Moving home often coincides with purchasing new modern appliances, influenced by the size of the home, spatial layout and beliefs around moving home being a fresh start requiring new items (Corrigan, 2011; Foulds et al., 2016; Gregson et al., 2007).

#### ***2.5 Food practices***

Food consumption is responsible for significant environmental impacts and greater understanding about the meaning around food practices is needed (Halkier, 2009; Leray et al., 2016). One's relationship with food can change due to having a new kitchen, resulting in new skills, technology or meaning being applied for cooking and eating. This influences the practices and can increase their frequency if this is positive, or decrease if people are not satisfied with the kitchen or dislike some appliances (Foulds et al., 2016). The food practices

based in the home also influence how often, where and why people eat out, which can be spontaneous or conscious decisions to streamline their daily lives and for convenience or reward (Pfeiffer et al., 2017; Yates and Warde, 2017). The food practices of bulk shopping and cooking are popular household food practices but depend on many other factors such as time, money, transport options, other events and the technology and skills to do so (Ozaki and Shaw, 2013). Bulk shopping and cooking are popular in households with highly interlocked practices and where the households have other time-competing practices requiring their attention such as work, children or social events (Plessz et al., 2016). However, households that only have small fridges or freezers to store food are restricted in their food practices and when a change occurs in a practice element, such as purchasing a larger fridge to store more food in it, this can free up time for other practices in the day and week (Shove and Southerton, 2000).

## ***2.6 Laundry practices***

After water use in the bathroom, laundry practices use the largest amount of water in household practices across Australia (Sapkota et al., 2018). Laundry practices are made up of a series of dispersed actions throughout the day: from gathering laundry that needs washing, allowing this to run a cycle in the washing machine, drying on the clothes line or tumble drier, to collecting and storing the clean laundry (Pink and Mackley, 2015b). This makes laundry practices similar to travel practices in that they are linked together and coordinated with other activities but are also highly energy and water intensive practices, strongly influenced by changes in technology over the decades (O'dell, 2009). Laundry practices are time and effort consuming as well as water, chemical and energy consuming (Gram-Hanssen, 2008). There are many influences on the performance of laundry practices: the weather, availability of clothes or linen that can be washed together, and the available time to undertake the practice (Wahlen, 2011).

Over the past few decades, there has been an increase in the number of washing loads households perform each week due to the types of clothes people wear, the number of, and the type of, fabrics of which they are made (Hobman et al., 2017; Elizabeth Shove, 2003). There are also a number of studies of household laundry practices in the social practice theory literature as it was one of the first practices to be examined in the household by theorists (Higginson et al., 2015; Pink, 2005; Shove, 2003; Shove, 2003). The change in technology used in laundry practice has made it easier to wash sheets and towels more



frequently for hygiene reasons, while wanting to wear fresh clothes every day has been found to be positively associated with the number of wash and dry cycles that occur (Hess et al., 2018). There is a need to understand why people wash their clothes before policies or technologies that influence laundry water or energy use should be implemented (Strengers, 2011). If people are washing clothes for hygiene reasons or presentation reasons, there may be other ways that these results can be achieved without the traditional washing machine approach to laundry (Strengers, 2011). One study in the UK found that most residents do not use a tumble dryer as they perceived it to be wasteful, however when they moved into a passive house, they were not able to dry their clothes on clothes racks inside because it influenced the relative humidity of the house and they instead had to purchase a tumble drier (Foulds et al., 2016). As work participation rates by women and men in society rise, laundry practices have moved from being performed on weekdays to mostly being performed on weekends (Anderson, 2016). There has also been an increase in laundry being performed in the early morning due to the demand for other practices such as children's sporting activities, shopping or visiting friends during the day (Anderson, 2016). Laundry practices were traditionally tightly interlocked together (Mylan, 2015), however there has been some loosening in the time an individual actually performs the laundry practice due to technology, and therefore they can engage in other practices while the clothes are being cleaned. The same applies to drying practices, both on a clothes line and with a tumble drier (Friis and Christensen, 2016). Using automatic timers can assist in displacing or dis-interlocking these practices in time even further (Eon et al., 2019; Friis and Christensen, 2016).

### **3. Methods**

#### ***3.1 Research design***

This research is based on pre- and post-occupancy evaluation which is a form of research to assess the resident reactions and practice changes to building occupancy (Grijp et al., 2019; Meir et al., 2009; Mlecnik et al., 2012). Previous post-occupancy studies of low-energy buildings in Australia have focused on occupants comfort and interaction with technologies in the dwelling (Berry et al., 2014; Berry and Davidson, 2015; Moore et al., 2017; Sherriff et al., 2019). These studies have found that many occupants of low-energy buildings have little or no experience of the new technologies and how to effectively use them to remain comfortable in their homes (Whaley et al., 2019). However, individual user experiences are highly variable (Berry et al., 2019). The pre-occupancy study was included in this research to

make this a longitudinal study to complement the post-occupancy evaluation and examine any changes occurring to practices in the LCD.

Practices are the mediator and carrier of implicit or tacit knowledge and as such, they can be studied to unveil the resources utilised in their performance (Røpke, 2009; Shove et al., 2007; Warde, 2005). This can be through observation of the practice and discussion with the practitioners themselves to understand and interpret the implicit background knowledge and meanings (Shove et al., 2007). A time of change is ideal for studying practices because participants are more actively aware of how the new situation can be accommodated into existing practices (Higginson et al., 2013). Studying a situation of change can allow learnings of old practices and newly emerging practices to occur (Bueger, 2014). Studying practices in real-life settings and over multiple performances allows us to capture real motivations and needs of users (Dell’Era and Landoni, 2014; Higginson et al., 2015). It also acknowledges that practices are not performed in isolation, they are influenced by other practices. The discussion relating to the interlocking of practices in the home addresses this. This paper will follow the practices of daily travel, waste management, food and appliance purchasing and laundry practices, as well as using meal times as an example to study the interlocking of the HSOP, building on the work previously published (Breadsell et al., 2019a).

### ***3.2 Project participants***

This research is utilising residents of the LCD, titled “WGV”, located in Fremantle, Western Australia as case study participants. A cohort study of 13 homes, with 14 residents participated in the research for two week before and after they moved into the development, with time allowed for the practices to settle back into normal routines. Focusing on user experiences allows this research to study residents on both an individual and household level to track resource consumption changes (Harder et al., 2014). Therefore some of the results have been presented per household (out of 13), others have been presented per resident (out of 14), depending on the practice studied. Practices are presented together to allow for comparison across the cohort, with some individual changes highlighted where relevant. This shows the common elements that many social practices have and provide insights into targeted changes that would be relevant for policy approaches. Some questions were not answered by all participants and as such do not have a full cohort in their response. Although this study has a small cohort, the resident practices have been studied in great detail, leading to a richer understanding of the influences on them (Hargreaves, 2011). The residents are

from three different dwelling types in WGV, which comprised of apartments, semi-detached houses and detached houses. The first cohort are house owner/occupiers, where there are three residents in two semi-detached houses and one resident in a detached house. The second cohort are five owner/occupiers of apartments in a complex called Evermore. These apartments were sold at market rates with not concessions for homebuyers. sold at market rates, called Evermore. The final cohort are five renters of apartments and members of a housing co-operative in a government subsidized, low-income apartment complex called Sustainable Housing for Artists and Creatives (SHAC). The participants and their lifestyles are outlined in Table 1. Their pre-occupancy interlocking status of practices is also stated, this is discussed further in ( Breadsell et al., 2019a) For households with children, the children did not participate in the research due to uncertainties if they would be moving into the WGV development. A more detailed discussion of the resident’s pre-occupancy housing is discussed in ( Breadsell et al., 2019a).

**Table 1:** Resident’s dwelling, house and occupancy lifestyle at WGV, and pre-occupancy HSOP interlocked status as determined in (Breadsell et al., 2019a).

<b>Dwelling</b>	<b>House</b>	<b>Occupancy lifestyle</b>	<b>Pre-occupancy interlocking status</b>
<b>Evermore Apartments</b>	A	Works full-time off-site	Highly interlocked
	B	Works 4 days a week off-site; daughter is a student home most days	Highly interlocked
	C	Works 4 days a week off-site	Highly interlocked
	I	Retiree	Lightly interlocked
	O	Works full-time off-site; son is a student home most days	Highly interlocked
<b>SHAC Apartments</b>	D	Works part-time off-site, part-time on site; son works part-time off site	Lightly interlocked
	H	Works part-time off-site, part-time on-site	Lightly interlocked
	J	Works part-time off-site	Lightly interlocked
	L	Works part-time off-site, part-time on-site; 5 year old part-time school student	Lightly interlocked
	N	Works part-time on-site	Lightly interlocked
<b>Semi-Detached House</b>	F	Both residents work full-time off-site	Highly interlocked
<b>Semi-Detached House</b>	M	Both residents work full-time off-site	Lightly interlocked
<b>Detached House</b>	G	Shift work full-time off-site; daughter is a student home most days	Lightly interlocked

The WGV development is located in the City of Fremantle, a suburb near Perth, Western Australia. The area has a Mediterranean climate with regular summer sea breezes and average temperatures between 10°C and 27.3°C (Bureau of Meteorology, 2019). The dwellings studied have sustainability features including passive solar design principles to allow for airflow and sunlight levels to regular the thermal temperature; solar photovoltaic panels for on-site energy generation and Lithium-ion batteries for communal storage of energy in the SHAC and Evermore apartments; low-flow water fixtures; LED lights; and rainwater tanks with dual plumbing to use recycled water in the laundry, toilets and on gardens (Breadsell et al., 2019a; Wiktorowicz et al., 2018).

### ***3.3 Mixed methods***

Mixed methods were employed pre-and post-occupancy for data collection (Browne et al., 2015; Creswell et al., 2003; Creswell and Plano Clark, 2011, 2007; Liedtke et al., 2015). The data collection focused on the themes of energy, water, waste, food, transport and social network practices. This paper addresses the waste, food, transport and laundry practices and social network influences. Other papers have published the data on energy and water practices (Breadsell et al., 2019) and the social network and sense of community (Breadsell et al., 2019b) . Data was collected through three methods replicated both pre- and post-occupancy in WGV. Firstly, a one-hour semi-structured interview<sup>1</sup> was undertaken to gain an overview of the different ways the participant’s daily lives are structured. Secondly, a workbook was then completed over two weeks, allowing residents to respond to short-answer questions about their resource use<sup>2</sup> along with 5<sup>3</sup> point Likert scale survey questions (Bratt et al., 2015; Browne et al., 2015) Not all of the Likert scale data has been presented in this paper, only those with relevant answers to the focus of this paper. Thirdly, travel practices were provided through a travel diary over this time which noted time, duration, purpose and form of travel (Urry, 2007). The authors decided not to examine the tourism travel practices of the residents as these occur outside the HSOP (Verbeek and Mommaas, 2008). Finally, short answer questions were asked through text message during the workbook completion phase such as “can you tell me or send me a picture of how you got around today?” The

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<sup>1</sup> Questions in the semi-structured interview ask residents how they keep warm and cool, the routines they go through each day and how their lives have changed since moving to the LCD.

<sup>2</sup> An example of a short answer question is: Where do you get your knowledge about recycling?

<sup>3</sup> 5-scale Likert question examples: How important is it to you to eat home cooked meals every day? Extremely important, very important, somewhat important, not so important, not at all important. How often do you buy from a local store (non-supermarket chain)? Very often, often, sometimes, rarely, very rarely.

range of data collection methods enabled the strengths and weakness of each one to be compensated by others (Liedtke et al., 2015). For instance, interviewees may not accurately self-report frequency of practices, therefore the diaries were a way to capture data this way. Alternatively, the text message questions enable real-time data collection to compare to the responses from the interviews and diaries. The methods chosen were deliberately more intensive than the traditional observations and questions from psychology methods that are usually utilised to understand domestic behaviours and practices. This was in an attempt to understand the complex formation of the social practices and allow them to be contrasted to those that are present post-occupancy in WGV (Keller et al., 2016; Schelly, 2016).

Interviewees self-selected through an open invitation sent to households who had purchased property in the LCD or were intending to become a tenant through SHAC (n=27). Pre-occupancy data collection was conducted for a period of two week each household between April and June 2017 for SHAC residents and between December 2017 and March 2018 for Evermore and single house residents. Post-occupancy data collection was conducted once residents had moved into WGV, between December 2018 and March 2019. The long period of time for data collection pre-occupancy was intended to allow for a greater sample size of residents to self-select, however there is a bias towards those who post-occupancy are in SHAC or Evermore due to the requirement of the resident residing in the LCD during 2018 to allow for post-occupancy data collection to occur within the research time constraints. The period during which the households were studied was selected to be during a stable phase of their routines, not immediately before or after the residents had moved into WGV. This was to ensure the resident's systems of practice was represented at a 'normal' stage and not influenced by the process of moving to a new house.

### ***3.4 Data analysis***

The qualitative data was analysed through thematic analysis of interviews, short answer questions and text probes focusing on the elements of the practices and changes to them pre- and post-occupancy. In total, 43 overarching themes were identified, highlighting the different ways of performing practices and resident's lifestyle at WGV. The themes related to this paper include convenience, transport, waste, cleaning, food, shopping, habit, routine, recycling, family, friends and local. The Likert scale data were analysed through tabulating and graphing the results to view trends, which were then compared with the qualitative data. The results are presented in this paper focusing on the performance of the practices and how

these change post-occupancy in WGV. Analysis begins on the practices of the cohort as a whole and focuses on dwelling cohorts and individuals where relevant.

## **4. Results**

### ***4.1 Travel practices***

The need for changes in transport practices to include those with less carbon emissions is well understood in the literature and the idea was supported by the residents in this study both pre-and post-occupancy, but is performed with varying success (Hickman and Vecia, 2016; Newman and Kenworthy, 2015). Table 2 shows the reported travel practices of residents pre-and post-occupancy. Residents across all the cohorts pre-occupancy anticipated change in their travel practices to reduce car use, with nine out of fourteen residents intending to alter their practice of getting to work, socialising or running errands. Five residents specifically identified that they wanted to ride bicycles to nearby amenities and activities more, despite the hilly landscape around the LCD, while others were not specific to how they wished to change their travel practices. The intention of changing a practice may be related to the meaning of the travel practice as people are living in a LCD and the desire to use the opportunity to make low-carbon choices in other practices. There is an electric vehicle on site that residents could book to use through a local share-car system, with three respondents indicating they would want to use this. This number may be below because most residents already own a car and would not want to pay for using another one. Those who do not own a car were enthusiastic to have access to one if needed. For residents who already lived within 2 km of the WGV development (five out of 13 households), no change in their travel practices was anticipated because they are expecting to use the same local shops and parks and continue the same travel practices to work. However, the average distance residents lived from WGV pre-occupancy was 10km, ranging from 0.6km to 50km away, so travel practices were anticipated to change for most residents.

As shown in Table 2, the daily routine use of transport has not changed with the exception of Resident D who walks to work now instead of driving:

“Living here made it easy for me to not use my car and my work has moved to Fremantle in late last year. So instead of commuting 40 kilometres one way, twice a week...I walk or ride my bike”

Some residents have replaced some local trips to shops with walking or biking instead but otherwise shopping and work practices have remained the same. Those who reported using public transport (bus or train) in WGV are only those who were already using these forms of transport before they moved in.

Many of the residents reported being disappointed about the onsite electric vehicle at WGV. This was installed in partnership with the developer and a local car share company, with the residents of WGV receiving free membership. However, to use the electric vehicle a AU\$500 deposit is held for up to one week on the resident's credit card as bond. This is too high a cost for many of the residents, particularly those in the low-income housing, SHAC. In addition, residents who reported expecting to use the electric vehicle have not used it either at all or regularly due to the flexibility in using their own car in not feeling restricted by the amount of time they spend outside of WGV. These residents all still own their own car, although some had plans to get sell their vehicle but have not done so yet. There was a suggestion by one resident that a community utility vehicle (as opposed to the current electric hatchback) may be more useful for residents to use to transport larger items from shops, to the recycling centre or people and luggage to the airport.

Three residents were expecting to either purchase or convert their current bicycles into an electric bike. At the time of the interviews post-occupancy, none of these residents had done this, citing being too busy settling in as the reason why. Two residents still want to make this conversion when they have time. Four residents wanted to cycle more once they moved into WGV. There has been an increase in the use of personal bicycles however the hills around WGV are a deterrent to the older residents who are more car dependent, especially for shopping trips, as Resident I and A stated:

Resident I: "Well, I'm 73 and I do have a few physical problems that kind of make it hard to walk long distances."

Resident A: "I just haven't got around to it and the hills here are actually quite steep. I've been a bit put off about "will I make it?""

The two apartment complexes, SHAC and Evermore have dedicated bicycle racks for residents to store their bicycles in. In Evermore, these are behind the gates to the complex, along with a bicycle repair station with tools, which is regularly used by residents who already own bicycles and with the inclusion of two communal bicycles, are now encouraging other residents to change their travel practises as highlighted by Resident C:

“I’m not a big bike rider, but...the complex has now got two communal bikes so I did actually have a bit of a trial run the other day...I can ride a bike, it’s just that I haven’t really done it very much – or certainly not in the recent years, so I am trying to build my confidence that I will use it to go in and out of Fremantle.”

In SHAC however, the communal bicycle space is open to the public and there have been reports of some theft of bicycles. This has deterred members from storing their bicycles outside, which results in them being moved inside the apartment or into the small storage shed adjacent to the carpark.

**Table 2:** Travel modes for practices of 14 residents’ pre- and post-occupancy in WGV. Question allowed for multiple answers for journey and travel option to capture the multiple ways residents may undertake the journey.

Travel mode	Study period	Purpose of journey and number of residents who use the travel mode for each journey type				
		Work	Shops	Local leisure journeys	Local social visits	Taking children to school
Car	Pre-occupancy	10	12	8	10	2
	Post-occupancy	9	13	7	9	2
Bus	Pre-occupancy	2	1	2	1	0
	Post-occupancy	2	0	0	1	0
Train	Pre-occupancy	4	1	2	1	0
	Post-occupancy	4	0	2	0	0
Walk	Pre-occupancy	3	7	5	4	1
	Post-occupancy	3	3	6	3	1
Bicycle	Pre-occupancy	3	1	5	5	0
	Post-occupancy	5	1	6	6	2

#### 4.2 Waste management practices

The waste management practices were studied, including recycling of aluminium, cardboard, glass, paper, steel and some plastics through the local council roadside recycling bins, soft plastics *via* dedicated disposal points and composting of food waste. The results are shown in Table 3. Pre-occupancy, all households recycled through the local council managed roadside recycling bins with either weekly or fortnight collections. This practice has continued post-occupancy in WGV. One detached house had multiple bin spaces installed in her kitchen cupboard to separate the waste and recycling at the source and cites this as assisting her to recycle. In regards to recycling of soft plastics which are unable to be placed in the roadside



recycling bins, no households pre-occupancy reported recycling these. Post-occupancy, SHAC and Evermore residents independently implemented a soft plastics recycling system for each development that is then taken to a local drop off point by a volunteer. This resulted in all apartment households now recycling soft plastics. All apartments and semi-detached households also compost through a shared compost system in each apartment complex and shared between the two semi-detached houses. The remaining detached house resident had not implemented a compost system at the time of interviewing but was planning to in the future. Those who composted pre-occupancy are continuing this practice but appreciate the scheme set up, as highlighted by Resident I from Evermore who said that:

“It's been really great to have somewhere to put it and to know what to do with it.”

Having a recycling system implemented by other residents who were more invested and motivated to do so has allowed residents who would not normally pursue this practice to participate, as Resident C reports:

“I'm not, you know, to be honest, I'm not as actively engaged with that [recycling] as a lot of the other people are, but I'm very happy to abide by...they know what they're doing, and as long as I know what to do, I'm happy to do it, you know?”

**Table 3:** Pre- and post-occupancy recycling practices of 13 households.

<b>Recycling practices</b>	<b>Number of household's pre-occupancy</b>	<b>Number of household's post-occupancy</b>
<b>Recycling</b>	13	13
<b>Soft plastics</b>	0	9
<b>Compost</b>	6	11

These results highlight that residents are willing to change their waste management practices if there is community support and adequate facilities in place for them to do so. Figure 1 shows the waste management stations at Evermore and SHAC, with containers for soft plastics, composting, cardboard, aluminium and garden waste. The provision of the space for this to occur has enable the residents to participate in recycling these items post-occupancy, and they have been purposely thorough, as highlighted by Resident N:

“boxes for cartridges, batteries, tin lids, soft plastics. We're really quite militant about it, the sustainability aspects.”



**Figure 1:** Left photo: The waste management station at Evermore. Right photo: Part of the SHAC waste management station

### ***4.3 Food shopping practices***

The practice of food shopping was examined to discover the frequency and location of where food was purchased for the household. Pre- and post-occupancy changes occurred to the shopping frequency and location. The frequency of shops increased for most household's post-occupancy. This is due to the households either decreasing in size with children not moving into WGV, therefore reducing the food required each week or by residents making a conscious effort to only buy what they need for a few days at each shop. This change in practice has been supported by an increase in the use of local stores and markets post-occupancy as shown in Table 4. The local stores are closer to WGV and residents report enjoying shopping there more and the convenience of the location and smaller stores. Residents who have lived further away from WGV pre-occupancy previously shopped at their local large supermarket but have now changed to the smaller supermarket or fresh food market due to the close proximity to WGV while still stocking the required items. A resident who shops at a local fresh food market 16km from WGV does so because it is close to her work and it is part of her weekly practice to do the shopping before or after work. This is a long-term practice she has performed and did not want to change when moving into WGV. Another long-term practice continued by 3 households in WGV is the delivery of food through weekly boxes. These residents enjoy the high quality food provided and this reduces the amount of time they spend shopping elsewhere during the week. Resident O from

Evermore was also involved in bringing a local business into WGV to sell some speciality produce to the residents:

“...twice now, [we] have sold some goat's milk products from [a local] goat farm. And that's growing out of the fact that those products used to be sold at the farmer's market... [so we] contacted him and this arrangement was made. And it's happened twice so, it's involved contacting people throughout the whole eco village [WGV] and they could come in and buy things.”

Residents in Households F and M are using the shared garden produce extensively and enjoy the seasonality of the produce. This has also reduced the amount of food they need to buy at the shops weekly. When they have excess, they are sharing it with others they know in the WGV precinct. The residents in Evermore have also started a produce garden with new plants and existing plants moved in pots to WGV. This allows residents to pick produce at their own leisure and have access to specialty plants that they did not have before in their gardens, as Residents B and O highlight:

Resident O: “Residents [of Evermore] have got a vegetable garden going and they just call everybody to harvest at will. And we've harvested lots of greens and zucchinis cucumbers and kale”

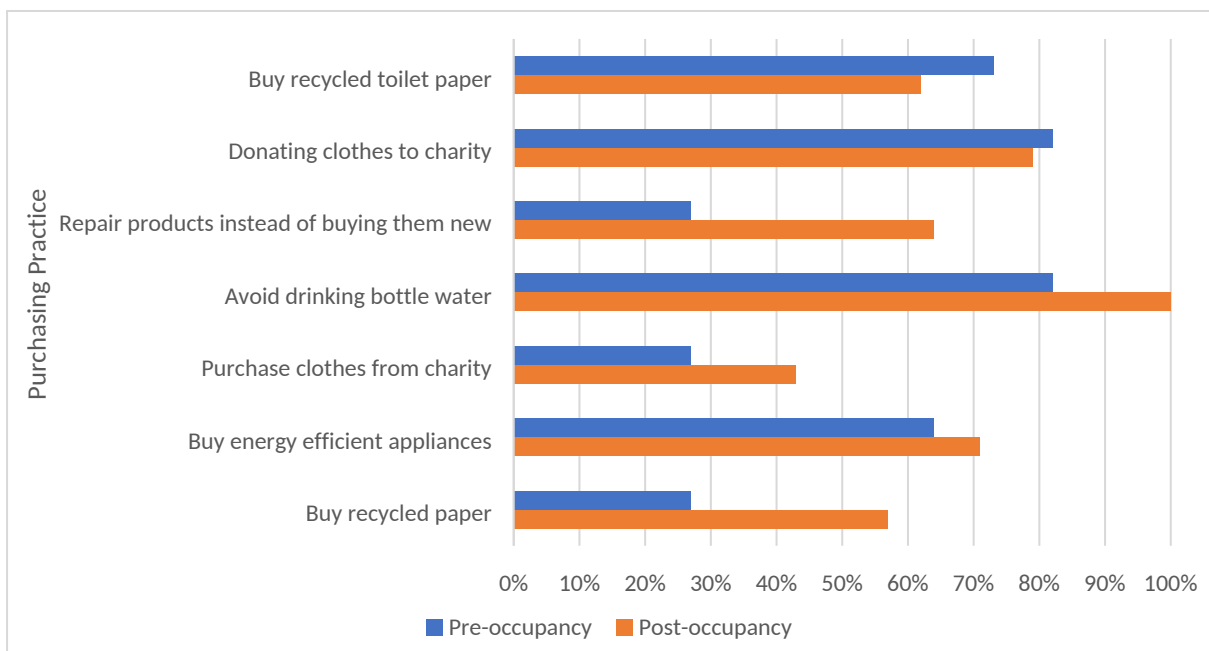
Resident B: “People giving grapes and we get mangoes”

**Table 4:** Food shopping location pre- and post-occupancy of 13 households

<b>Food shop (distance from WGV)</b>	<b>Number of households pre-occupancy</b>	<b>Number of households post-occupancy</b>
Large supermarkets (3km)	6	4
Smaller supermarket (1.6km)	3	6
Local fresh food market (1.6km)	3	8
Local fresh food market (16km)	1	1
Local farmers markets (2.4km)	7	6
Speciality food shop in Fremantle (3km)	5	5
Speciality stores in surrounding area (2-5km)	1	3
Food delivery box	3	3

#### 4.4 Practice of purchasing household items

As Figure 2 shows, post-occupancy practices of buying recycled toilet paper and donating clothes to charity decreased. The other practices reported all indicated an increase in performance post-occupancy. This includes an increase of over 50% for repairing products instead of buying new ones, as well as buying recycled paper when needed. An increase in purchasing energy efficient appliances and purchasing clothes from charity stores was also noted. Finally, all residents report that they have avoided purchasing drinking water in plastic bottles post-occupancy.



**Figure 2:** Purchasing practice of resident's pre and post-occupancy per household. These results are shown as percentages due to the variance in the number of completed surveys by household's pre-occupancy (11 out of 14) and post-occupancy (14 out of 14).

In the pre-occupancy interviews it was discussed with residents if they planned to purchase new furniture and appliances for their new homes and this was followed up on in the post-occupancy interviews. Most residents did not purchase large items for their households, although there were a few exceptions. Household B and O pre-occupancy lived in the same house pre-occupancy, so post-occupancy they purchased an additional fridge and washing machine for the second apartment. They were able to divide the rest of their household items for use between the two apartments post-occupancy to prevent buying anything else. A similar situation occurred in Household C, where the adult children moved into a different

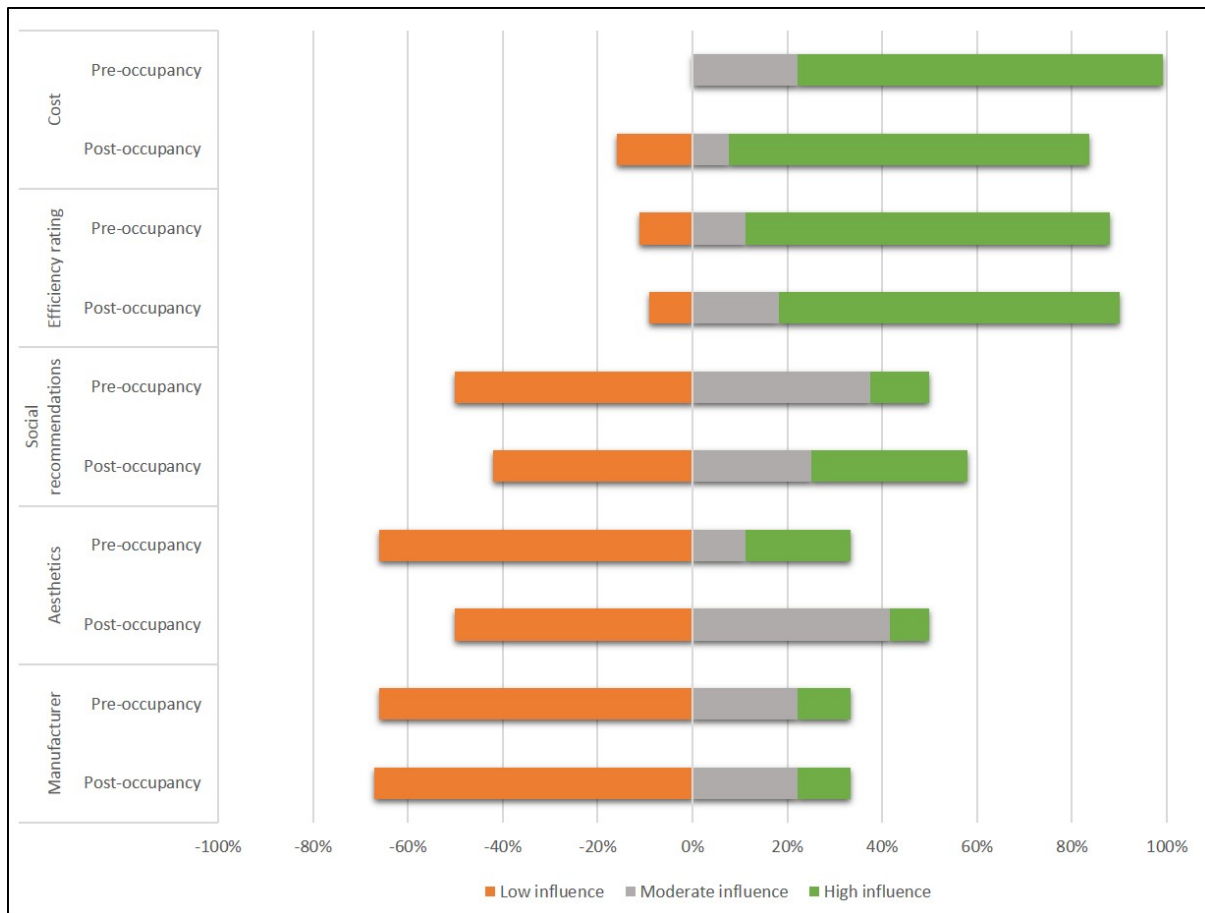
Evermore apartment post-occupancy (not included in this study) and purchased additional items for this. The residents from households B and O reported selling or bartering many household items pre-occupancy that they did not need including books, bikes, furniture and garden plants. Some other households purchased a new or second-hand couch or dining table to suit the aesthesis or size of the new household. Resident C was unsure in the pre-occupancy move what to do with her worm farm but found a solution before the move to WGV, while Resident N has sourced all of his furniture second-hand:

“Interviewer: What happened to your worm farm?”

Resident C: I bequeathed it to my neighbour.”

Resident N “A friend gave me a table. I got a second-hand fridge...everything is either given or second-hand or found at [WGV]. So I [have been] recycling furniture.

The influence of various factors on purchasing practices was also studied pre- and post-occupancy in the survey through a 5- point Likert scale. These results are summarised in Figure 3 and show that pre-occupancy, the cost of energy and water efficiency of an item were the main influencing factors on item purchase. The manufacturer and aesthetics were of the least influence, while recommendations from friends and family were of moderate influence. Post-occupancy, these influences remained in that order, however the recommendations from friends and family increased from pre-occupancy, as did the aesthetics of the item. The efficiency of an item remained at a similar level of influence; however it overtook cost as the driving factor of item purchase.



**Figure 3:** Graph showing the influence of various factors on resident purchasing practices, These results are shown as percentages due to the variance in the number of completed surveys by household’s pre-occupancy (nine responses out of nine), and post-occupancy (13 out of 14).

#### ***4.5 Laundry practices***

The study of laundry practices in this research highlights the influence of design and technology features on the performance of a practice. There were no changes to the meaning element of the practice, with residents reporting similar reasons for washing clothes as pre-occupancy, mostly around cleaning dirty clothes, the social expectation of having clean clothes and the comfort that comes with that, as highlighted by Resident J:

“I feel better about myself out in the world with clean clothes.”

There were unexpected changes to resident’s laundry practices in both the volume of laundry washed and the way the practice is performed that were not anticipated in the pre-occupancy interview. Most residents performed a similar number of loads of washing and drying as they had in their previous dwelling, with changes occurring only in households that had changes in

the number of residents in the house, decreasing the volume of washing. The majority of residents pre-occupancy (12 out of 14) did not use a tumble drier to dry their clothes due to environmental or energy conscious preferences (Breadsell et al., 2019a). Post-occupancy, some residents have begun to use a tumble drier due to the reduction in clothesline space in WGV and for convenience, while others retain their previous practices, such as Resident A: “I just don't [use a tumble drier]. I think I like the freshness the air on the clothes and sheets. I like that smell in preference to the hot tumble dry kind of smell. I guess if it was [raining heavily] for days on end and I couldn't dry anything, yes. Then I would use it but it came with the apartment and I prefer not to use it.”

All the residents in Evermore had a tumble drier included in the apartment on purchase due to there being no permanent clothesline in the complex. Residents report only running the tumble drier during the day to make use of the solar energy provided by the solar panels and battery to offset the additional energy usage. Other Evermore apartments have purchased small collapsible clotheslines that are positioned on balconies or inside. The residents have reported difficulty with drying bed linen and towels on these and the parents of children who have moved into other apartments in Evermore (that were residing with them pre-occupancy) have reported the children using their tumble drier for convenience. This is highlighted by Resident I's comment:

“There is no clothesline here [in Evermore] which would be nice to have a clothesline, but I don't think they want the visuals of hanging clothes.”

In contrast to the apartment residents in Evermore, residents in SHAC do not own tumble driers and have a communal clothesline on the side of one of the apartment buildings (Figure 4). Some residents are cautious of using this line due to the public nature and close proximity to the edge of the WGV precinct where passers-by can see the line. There have also been a few items stolen from the line, resulting in residents not putting valuable or emotionally important items on the line. The communal clothesline does serve as a social space for residents, with informal social networking when residents are handling their laundry.



**Figure 4:** SHAC communal clothesline with linen and towels drying.

An alternative drying practice has occurred in SHAC post-occupancy by resident J. She has used the space above the heating pump in the kitchen to leave items that need to be freshened up or quickly dried by the residual heat of the pump. This design (shown in Figure 5), is present in all the SHAC apartments and the resident reported that she would tell her fellow residents of this new practice that they could incorporate.



**Figure 5:** Use of heating pump space as a drying or freshening cupboard by SHAC resident J with a blanket in the cupboard to freshen up and improve the smell.



Resident G in the detached house has also changed her drying practice from air drying to using a tumble drier post-occupancy. This is due to the installation of a heat pump drier that removes the water from the clothes and recycles the water on the garden. This appliance has a higher water and energy efficient rating than the standard tumble drier and so the resident is happy to use it regularly. She is also prevented from using a small outside drying court due to her neighbours still building their house next door and the dust contaminating the laundry.

#### ***4.6 Interlocking of practices***

Practices interlock together into systems of practices, and when these exist in the space of the home they are termed the HSOP (Eon et al., 2018a; Macrorie, 2016). Practices interlock and influence other practices through their use of resources and the timing and space that they are performed in (Friis and Christensen, 2016). HSOP can be lightly or highly interlocked depending on how routine the performance of practices are and the constraining factors influencing when practices can be undertaken (Breadsell et al., 2019a). The resident's daily routines are generally similar, especially when influenced by work, despite the move, as Resident A states:

“It's pretty much the same. I mean, you know, if you're working, you're doing the same stuff, aren't you?”

Some practices though have become influenced by the design and technology of WGV. The presence of solar panels influences when residents put the dishwasher, washing machine and drier on, whether for economic reasons or environmentally conscious reasons. Many residents are conscious of putting these on during the day where they had not previously, shifting or displacing the interlocking of practices with others. Otherwise, the use of automatic systems is minimal, a few houses reported using the timer settings on the washing machine, dishwasher or air-conditioner unit but most will use these only when they are home. This has changed for residents using their washing machine and dishwasher during times they can use the solar power but has not changed for air-conditioner use. These changes in practices have required residents to learn a new skill (the setting of a timer). It has not changed the demand for the practice or the intention of the practice (having clean dishes and clothes).

Residents who had automatic reticulation post-occupancy have now all moved into apartments and now only hand water pot plants. Those in single houses all have reticulation on their gardens, which is set to automatic, different to their post-occupancy dwellings. This has dis-interlocked the performance of watering the garden for some residents who now do not have to actively engage in the performance of the practice each time (Eon et al., 2018a). This reduces the influence of other practices preventing or altering the practice of watering the garden. For instance, when the irrigation is on a timer, a resident does not have to remember to turn it on, this ensures the reticular will run at the scheduled time regardless of if the resident is home or not.

An example of a practice that is often highly dependent upon other practices are the times that residents eat meals (Molander, 2011; Yates and Warde, 2017). Table 5 shows the resident's pre- and post-occupancy mealtimes and the reasons for this. The degree of interlocking of HSOP did not change for most resident's post-occupancy. Table 5 shows the pre-occupancy interlocking status and mealtimes, and the post-occupancy interlocking status and mealtimes. Only two residents changed their interlocking status from light to high post-occupancy and no residents changed from high to light. This was due to resident L's son starting school with fixed hours that allowed for her work to become more consistent and washing and cooking routines to become interlocked. The other resident who changed was resident M who was moving between a number of different houses pre-occupancy and he now has a stable residence in WGV. This has allowed him to standardise his travel times between work, shopping and leisure times and has then flowed on to interlocking his cooking, washing and showering practices also.

Regarding mealtimes, those residents who are highly interlocked and work full-time have structured mealtimes. Those who are lightly interlocked eat at different times of the day. Those who live in houses with other occupants are influenced particularly in the evening by the other occupant's movements, this is the case for Households B and D. The residents will vary their evening mealtime based on each other's movements and work schedules. The exceptions to the lightly interlocked/variable mealtimes is for households I and M. The residents in these households have lightly interlocked practices but enjoy eating meals at a consistent time each day, this supports the findings found in a previous study whereby those who live alone (as it the case in household I) prefer to eat at similar meal times (Yates and Warde, 2017). Household M is highly interlocked post-occupancy and has continued the practice of consistent mealtimes. The timing of meals highlights how this is a stable practice

that is linked with the HSOP and work and socialising practices, more than that of the home design or location.

**Table 5:** Relationship between mealtimes each day and WGV HSOP interlocking and occupation of households, pre and post-occupancy in WGV.

<b>Dwelling</b>	<b>House</b>	<b>Pre-occupancy meal time same each day?</b>	<b>Pre-occupancy reason</b>	<b>Pre-occupancy HSOP interlocking status</b>	<b>Post-occupancy meal time same each day?</b>	<b>Post-occupancy reason</b>	<b>Post-occupancy HSOP interlocked status</b>
<b>Evermore Apartments</b>	A	Yes	Work, eat simply	Highly	Yes	Work	Highly
	B	Mostly	Work, partner's movements	Highly	No	Work, evening activities, partner's movements	Highly
	C	Yes	Work and other household members	Highly	Yes	Work	Highly
	I	Yes	Hunger and convenience	Lightly	Yes	Hunger and habit	Lightly
	O	Yes	Work, evening activities and health	Highly	Yes	Work and evening activities	Highly
<b>SHAC Apartments</b>	D	Mostly	Work and other household members	Lightly	No	Work and other household members	Lightly
	H	No	Evening activities and hunger	Lightly	No	Depends on many factors	Lightly
	J	No	Depends on many factors	Lightly	No	Depends on many factors	Lightly
	L	No	Tries to have regular times with child when home	Lightly	Yes	Child	Highly
	N	No	Depends on many factors	Lightly	No	Depends on many factors	Lightly
<b>Semi-Detached House</b>	F	Mostly	Work and evening activities	Highly	Mostly	Work and evening activities	Highly
<b>Semi-Detached House</b>	M	Yes	Healthy to eat regularly	Lightly	Yes	Healthy to eat regularly	Highly
<b>Detached House</b>	G	No	Shift worker	Lightly	No	Shift worker	Lightly

## 5. Discussion

The purpose of this paper is to address the question: “What changes occur to individual domestic practices and the home system of practice (HSOP) when residents’ move into a LCD?” It utilised a longitudinal study of resident’s household and individual practices pre- and post-occupancy in WGV to track any changes that occurred as a result of the changing technology, social context or household composition changes.

The overall interlocking of a resident’s system of practice has not changed due to resident’s lifestyles not significantly altering post-occupancy, with household composition remaining the same for most residents. Resident’s still work the same each week and undertake most household chores, with some changes happening to clothes washing, and socialising at similar times and places compared to pre-occupancy in WGV. These are the factors in this real-life study that influenced practices and their timing, with some changes occurring to the timing of practices when the desire was to utilise energy from the solar PV system to be used in certain practices. This aligns with the literature that states that when practices that are interlocked shift, they force a reconfiguration of the system (Shove and Walker, 2010). These results show that because there was not a major shift in residents transport practices, along with no shift in work practices, the interlocking of their HSOP has not shifted similarly. The timing of making and eating meals each day is influenced by resident’s system of practice and how these interlock with others in their home. Those who have a highly interlocked HSOP are more likely to eat meals at the same time each day and do so due to work times, other household member’s practices and habit. Those who are lightly interlocked are more likely to eat when hungry or depending on fluctuating work times.

Post-occupancy design features have affected laundry practices but not the timing of them being performed. The increase use of a clothes drier by some residents, as compared to air drying pre-occupancy, will increase the energy used in the performance of the entire laundry practice. This may be offset somewhat if the practice is performed during the day when there is sufficient energy provided by the solar PV panels on the dwelling or through energy stored in the communal battery. Where the household size has changed post-occupancy, residents are performing less loads of laundry than pre-occupancy. This will influence the overall consumption of energy and water in the household as a whole. A more detailed analysis of household energy and water consumption levels can be found in (Breadsell et al., 2019).

The location of WGV close to food shops has resulted in local shops and markets being used more. Home grown fruit, vegetables and herbs are being used more in WGV also. The community has influenced recycling rates and increased self-reporting of other's recommendations influencing purchasing practices. This highlights the influence that community members have on resident practices, through providing the skills, technology or motivation (meaning) to change practices. The increased influence of family and friend recommendation on purchases post-occupancy could also be attributed to the sense of community developed in WGV. Less donation of clothes to charity may have been due to residents already donating enough before the move or wanting to purchase new items to fit the feel of a new house, or if they had additional money. The motivating factors, influencing the meaning behind the practice of purchasing, influenced product purchase and disposal should be explored further in future research, especially relating to a circular economy approach and the value that waste has in society (Van Vliet et al., 2005).

Pre-occupancy, residents expected their travel practices to change quite significantly, especially an increase in the use of bikes, the electric vehicle and walking. However, the use of transport post-occupancy did not change for the majority of residents with the exception of one resident who walks to work now instead of driving.

To have lasting change, previous studies have identified that influencing the routine use of resources has the largest benefit due to the long-lasting nature of the change (Eon et al., 2019, 2018b). Technological improvements also play a role, allowing practices to be performed easier or with less interlocking with other practices, or automatically negating the need for human interaction or decision making which may not be the more sustainable option (Eon et al., 2018a; Spurling et al., 2013; Van Vliet et al., 2005). Automation is useful for influencing highly interlocked practices as it reduces the influences of other practices and contextual factors on the timing and elements of the practice. For lightly interlocked practices, changing an individual element, technology, skill or meaning, is potentially more beneficial. In the absence of technology changes, cost-saving consumption choices have been observed to be subject to rebound effects when liberated income is used for additional consumption (Murray, 2013).

While individual consumption changes do little to drastically reduce the resource intensity of modern lifestyles (Connolly and Prothero, 2003), the results of this research show the influence that design, technology and community networks have in aiding daily household

practices changes. The need to engage with the consumer and their daily actions has been acknowledged in the policy sphere for some time now (Shove, 2010; Spaargaren and Van Vliet, 2000). A social practice theory approach acknowledges that humans have certain contexts they consume resources in and their power to change these actions depends on the resources being used for the practice, the meaning the practice which is being undertaken and the skills they have to alter the practice (Macrorie et al., 2015; Spaargaren and Van Vliet, 2000; Spurling and McMeekin, 2015). This has been assessed in this study through the comparison of practices pre- and post-occupancy and discussing changes in these practices with residents who have had to alter their skills and technology used in the practice and the meaning behind the practice being performed. An approach of this measure also enables the context and design features of a practice to be studied alongside the traditional behavioural aspects of values and attitudes (Breadsell et al., 2019; Whitmarsh et al., 2011). This adds depth to the understanding of the motivations and influences on a practice and hence resource use. This also allows for the refocusing of decision makers attention to different routes into these practices and practice bundles to explore other options to reframing them (Strengers et al., 2014). These include the reach and durability of existing practices and their elements and identifying what changes might have the greatest effect over time and space (Sahakian and Wilhite, 2014). For travel practices, policies that promote and enable non-car travel options to assist in promoting these and overcoming barriers to non-car travel options could be considered (Laakso, 2017). For recycling practices, creating supportive structures that can easily be incorporated into current practices will have more likelihood of creating lasting change (Cass and Faulconbridge, 2016). There is also a need to consider the other practices that are interlocked with each other such as bulk shopping trips, travelling with different ages and abilities of children and adults, location of schools, health care and entertainment centres to understand why and how people perform practices before they can be influenced (Cass and Faulconbridge, 2016).

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## **6. Conclusion**

This paper has considered daily household of practices that involve resources outside of thermal comfort and personal hygiene to gain a more holistic understanding of resource use in the home. The opportunity to study resident's pre-and post-occupancy in a LCD has been a unique situation to examine how design, technology and community influence household practices. These results show that community influences recycling and purchasing practices, the location of a LCD is vital for influencing shopping practices as most people will shop locally in the area. The timing of meals is influenced by the activities of others in the home and work practices. Since these have not changed for most resident's since moving in, their timing of meals also has not changed. Resident's resource use is heavily influenced by their work and socialising routines and must take these into consideration when designing LCD and influencing resource use in the home.

Although this was a small cohort study of LCD residents, the detailed investigation of household practices has led to a richer understanding of their performance motivations and influences. This should continue to be scaled up to include more residents to broaden the understandings to various contexts (Hargreaves, 2011). A similar post-occupancy, longitudinal study could also be undertaken once residents have resided in the LCD for a longer period of time. This would be able to examine the long-term influence of the design, technology and community and assess the stability of practices that had altered post-occupancy. Residents may have returned to pre-occupancy practices or other influences may have resulted in changes to practices Further research could be undertaken on what people dispose of in the compost, recycle and general waste bins (Evans, 2012; Quedsted et al., 2011) to understand more about why people are disposing these items to inform policy on how to reduce this (Kaipia et al., 2013). Other research could also examine some of the household practices in more detail, such as the temperature or water level of washing loads to see if residents are using the technology in the most efficient way. Finally, continuing the research undertaken on the spatial and temporal aspects of social practices is important to understand



how they connect to the home system and influence domestic resource use, enabling targeted approaches to reducing resource consumption to more sustainable levels (Friis and Christensen, 2016; Southerton, 2006; Torriti, 2017).

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### **Conflict of Interest**

The authors have no conflict of interest to declare

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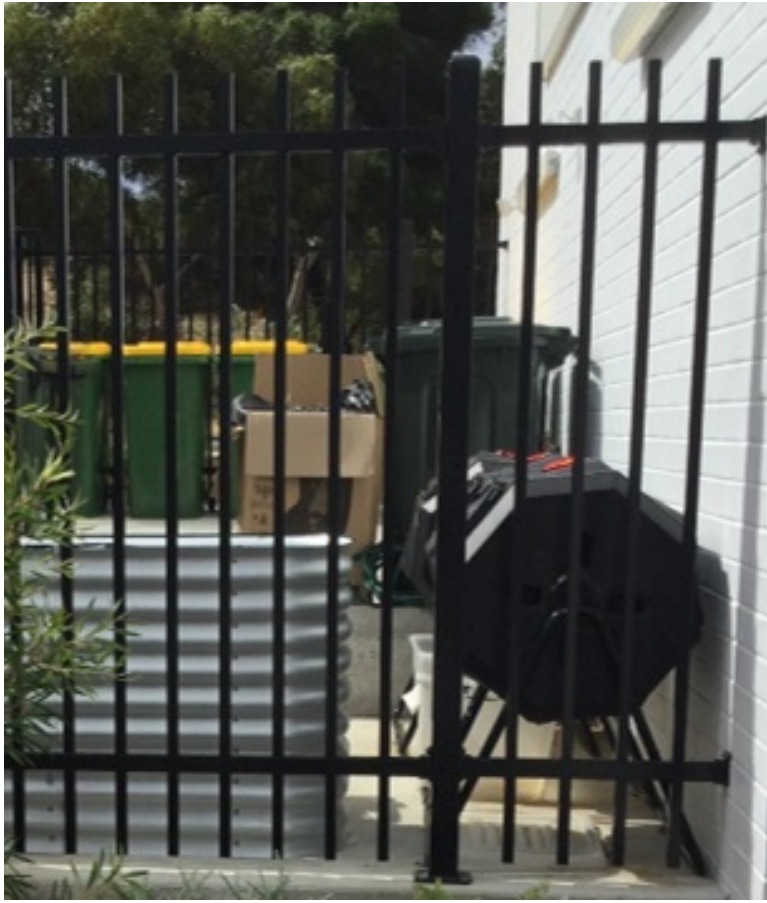
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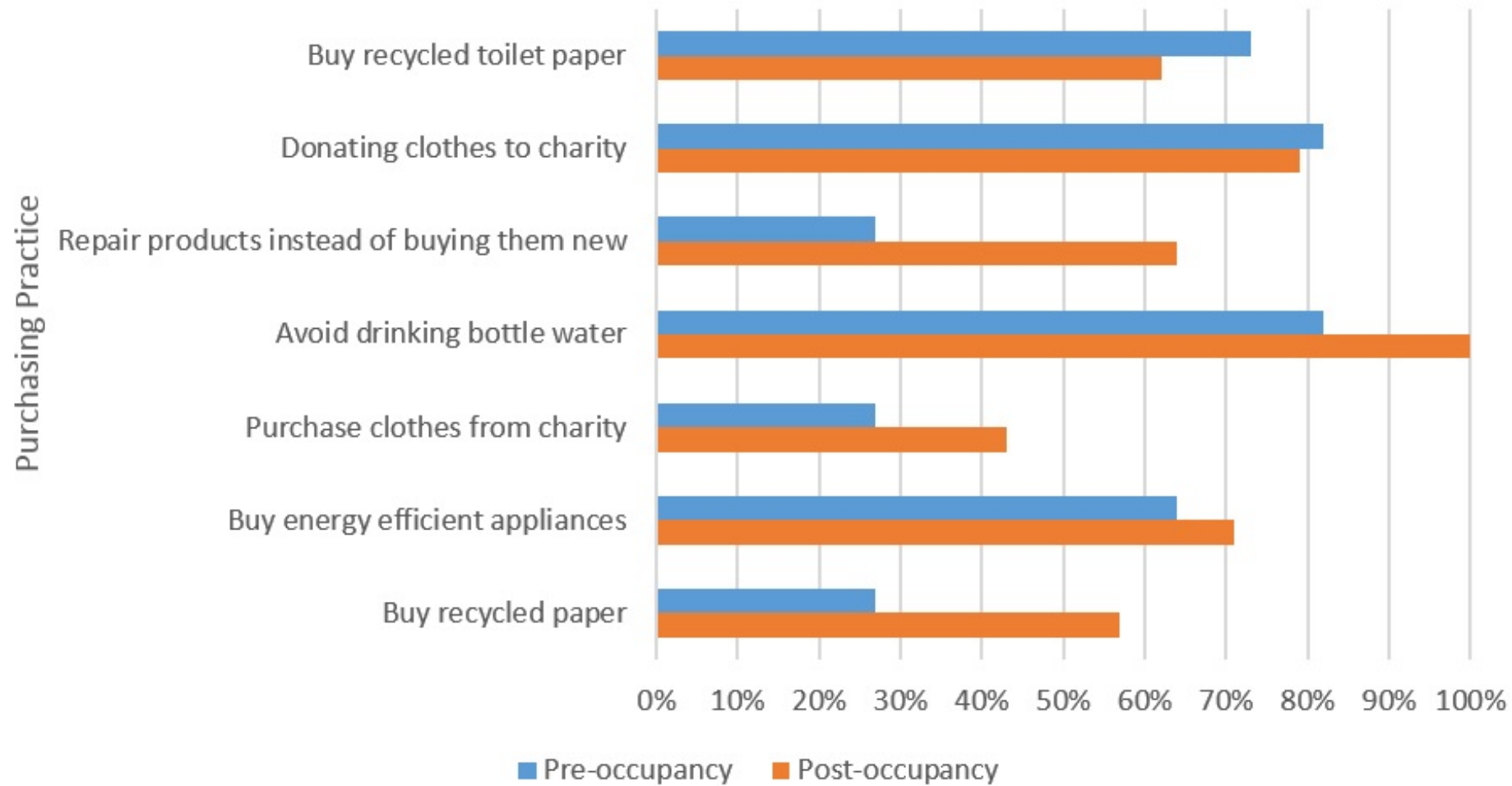
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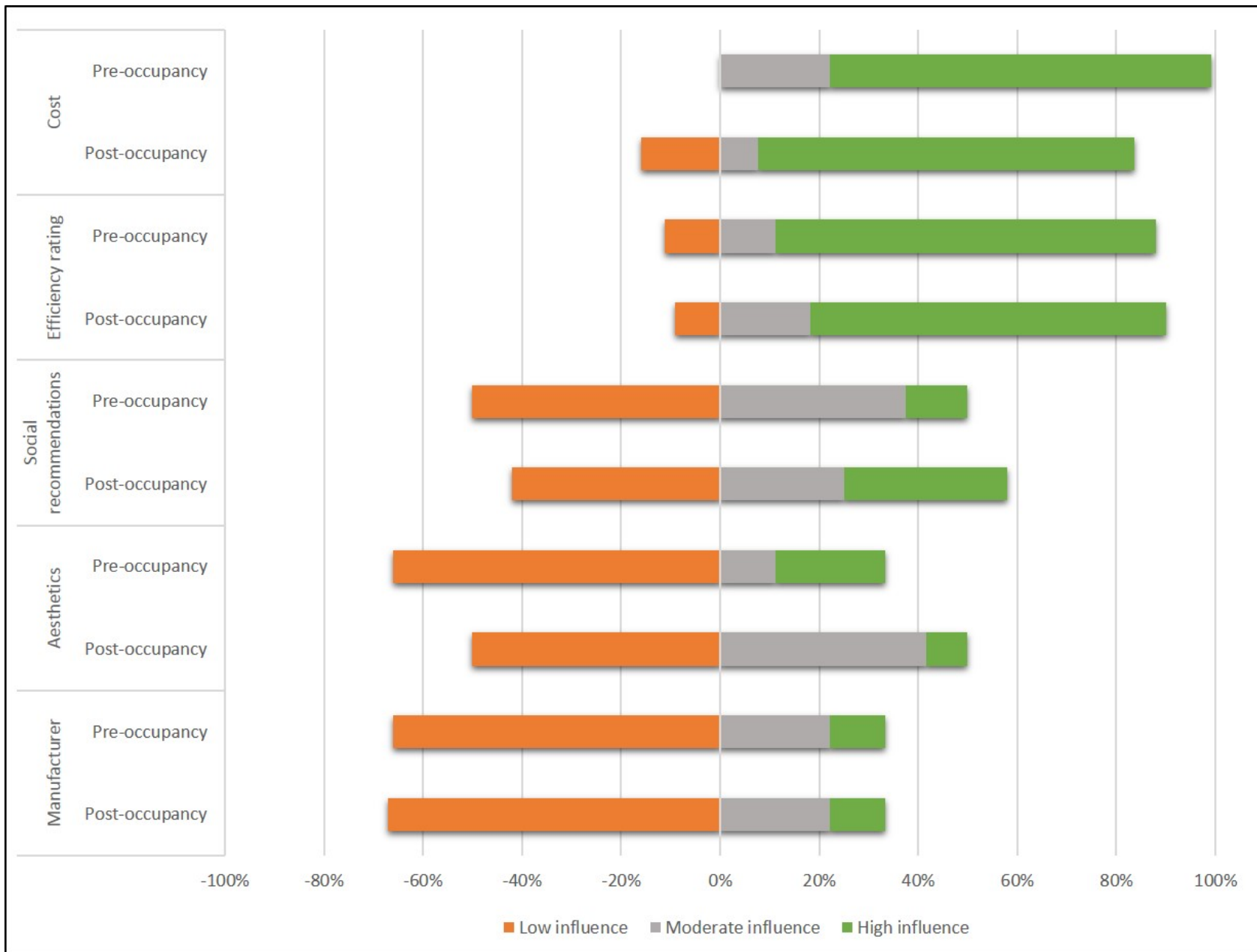
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## **Conflict of Interest**

The authors have no conflict of interest to declare