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What are Microunits and can this new Housing Typology Help Solve the Housing Affordability Crisis? A review of the literature.

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Introduction

In the United States, Australia and other developed countries, the continued trend of re-urbanisation is driven by young professionals and pensioners (the largest group of single-occupier households) moving back to the cities for medical, professional, lifestyle choice motivations. During the 2012 Cambridge Science Fest Harvard economist Edward Glaeser commented:

“At the start of the 19th century we were leaving our dense enclave place to populate the empty spaces of America. In the start of the 21st century, we [are] increasingly moving to be close to one another, to the areas where there are already lot of people. Far from spreading out, we are clustering in.”

The combination of rapid urbanisation of the world's cities and the increasing international phenomenon of urban singletons, people living alone, has prompted urban planners and developers to consider densification strategies to meet the growing housing demand within their geographic boundaries. To increase density whilst also catering for an increasing number of smaller households, many global cities have adopted new regulatory standards enabling building smaller units for one and two person households. Many of these standards aim to ensure that residents of these smaller units can capitalise on the advantages of small space living without compromising all the advantages of larger apartments. Micro-units meet this objective by aiming to providing efficient living spaces for small households in metropolitan areas through novel design while including an array of shared amenities.

Several cities in American and Europe are currently assessing the feasibility of modifying their regulatory controls and associated requirements to enable micro-unit development with the intent that these may help address housing supply and affordability issues in their city. However,

there has been some resistance to including this housing typology within established communities. As noted in a survey of San Francisco residents, where singletons were perceived as less-desirable residents¹, neighbours and community groups in some cities are opposed to the development of micro-units (Djukic, 2017). Furthermore, the liveability and valuation impacts of micro-units have not yet been researched, making it difficult for urban planners to successfully argue for their inclusion as an approved housing typology.

From a sustainability perspective, it is important to note that buildings contribute significantly to energy consumption and other environmental impacts, such as air emissions and solid waste generation (Pérez-Lombard, Ortiz, & Pout, 2008). Moreover, emerging health-related problems have increased awareness of the role that buildings play in the well-being of our living environment. While certain attempts are underway to regulate and handle various aspects of buildings' impact on the environment, there still is no holistic approach which includes the impact of the early phases of the building's life span (Jönsson, 2000). Although methods have been developed to view buildings as a linked network of environmental effects (Chevalier & Le Téo, 1996), it is essential to recall that buildings are complex systems with a lifetime of decades. Therefore, it is vital to not only consider buildings' environmental impacts through their operational phase, but also investigate the impact that the material production, physical waste and recurring embodied energy and environmental impacts associated with them have on the environment throughout a building's lifespan. One of the well-known methods for environmental analysis of different products throughout their lifetime is the Life Cycle Assessment (LCA), which is discussed more in the context of micro-unit assessment below.

Literature Review

Changing Demographics

Since 2010, more than 50% of the global population has lived in urban areas. In Australia and the United States, this percentage is significantly higher at 89% and 80%, respectively. These

¹ Opponents in San Francisco (in particular SOMACAN) associated an increase in singletons with a decrease of family-oriented living and therefore considered singletons as less desirable as compared to couples or families (Djukic, 2017).

percentages equate to approximately 20 million urban dwellers in Australia and 273 million urban dwellers in the United States (175 million in its suburbs and small metros + 98 million in its urban core counties) (Australian Bureau of Statistics 2012, U.S. Census Bureau's [American Community Survey](#) 2016). While the population is aging in all three county types (rural, suburban and small metro, urban), reflecting the increasing age of the Baby Boomer generation, this is happening more rapidly in U.S. suburban and small metro counties where the 65-and-older population grew by 39% in the suburbs between 2000-2016, compared with 26% in urban and 22% in rural counties (2000 decennial census SF3 data, 2012-2016 American Community Survey data).

According to the U.S. Census Bureau, the number of single-person households in the United States is increasing, while the average number of people per family has been declining slightly since the 1960s. In 2018, approximately 35.74 million people were living in single-person households in the United States, with the District of Columbia having the highest share of single-family households (45.2%) in major metropolitan areas, and Gainesville, FL having the highest share of single-family households (50.2%). Similar proportions were found in other US cities (such as Atlanta, Denver, Minneapolis, San Francisco), where singletons represent more than 40% of all households (Statistica, 2018). These figures seem to be an exceptionally high proportion of total households; however, similar rates were found other global cities such as London and Paris – with Stockholm reporting even higher rates of 60% (Djukic, 2017).

The trend is similar in Australia where the proportion of family households has declined from 77% in the 1986 census to 71% of Australia's households in the 2016 Census. Over this same period, the number of single-person households increased from 19% to 24%. According to the 2016 census (ABS 2016), more than 2 million Australians live in lone-person households, representing about 24% of households. This trend is expected to continue. By 2041, there are projected to be between 12.6 million and 13.2 million households in Australia (up from 9.2 million in 2016). Family households are projected to remain the most common household type in Australia, estimated between 69% to 71% of all households, with lone-person households projected to make up between 24% to 27% of all Australian households. In addition, single-parent households are forecast to make up between 16.5% to 18% of households, indicating that at least 40% of all households would have single adult residents (3236.0 - Household and Family

Projections, Australia, 2016 to 2040). Figure 1 presents the current and 2040 projected single-occupant household percentages by state.

Internationally, the story is much the same. In Germany, researchers estimate that despite a declining total population, the number of households will increase by more than 1 million until 2020. In England, 70% of new households established between 1996 and 2016 are expected to be single households, with half of these occupied by pensioners (Boardman et al 2005). The United Kingdom Treasury report on future housing anticipates a continuation of this trend with approximately 9 million single-person households by 2021, noting that “The number of households will grow at a faster rate than the population” (Palmer 2006). This is underlined by the fact that the area per person increased to 42.6m² in Germany (in 2008) and 44m² in England (in 2001) from previous years, possibly reflecting the lack of housing supply targeted toward this population group.

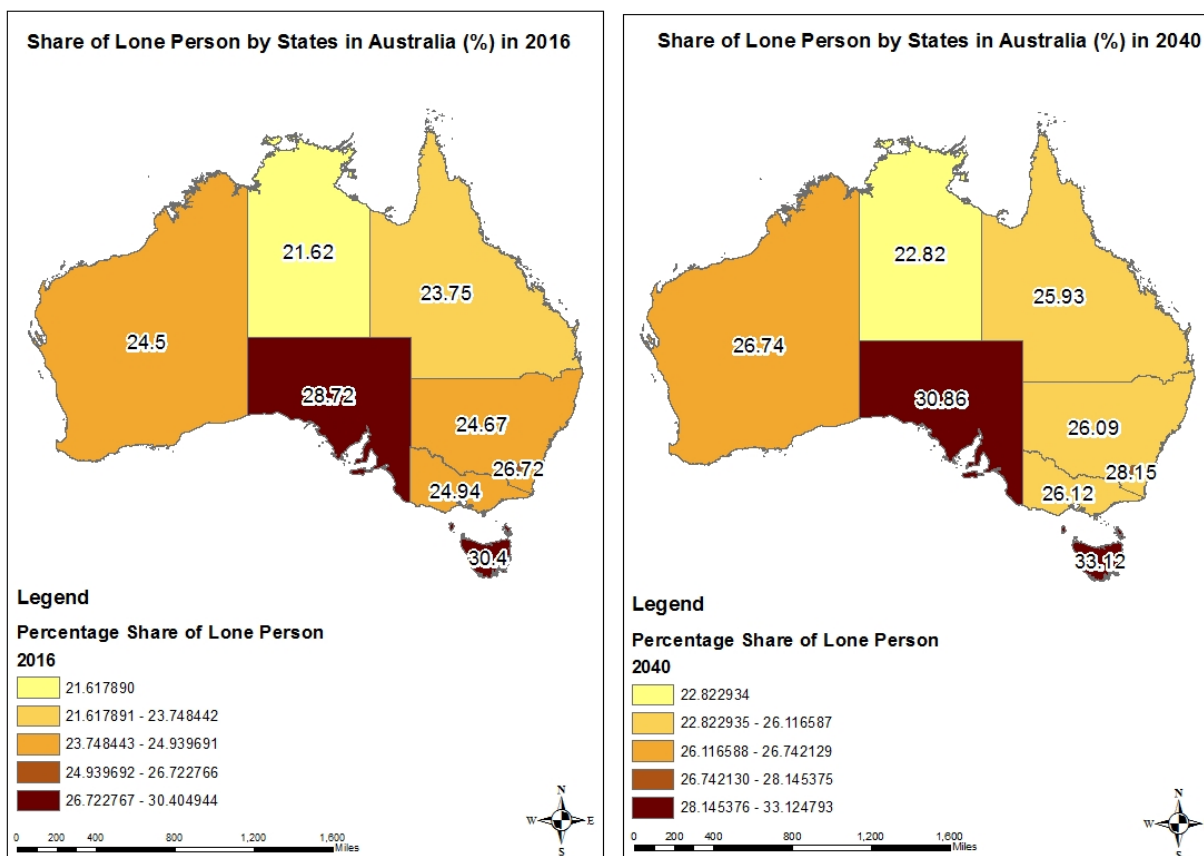


Figure 1: Percentage of Single-Person Households, by State, 2016 vs. 2040

The change in living arrangements over the past few decades has had a significant impact on the demand side of apartments. However, the supply side has not yet adjusted to meet this changing demand, with many new housing units still “designed for nuclear families in which the mother stayed at home to do domestic work while the father laboured elsewhere; so, too were most residential units, both apartments and stand-alone houses” (Hayden 2002). Klinenberg (2012, p. 186) notes that traditional forms of housing no longer meet today’s requirements and that the mismatch of supply and demand is impacting housing affordability across urban areas globally because of a lack in appropriate supply:

“Metropolitan areas were not built for them [singletons], and we have failed to redesign cities and suburbs to meet the needs of a singleton society. [Singletons need] compact residential units in apartment buildings, not single-family homes. [They need] walkable and densely populated neighbourhoods and proximity to a range of commercial goods and services, attractive public spaces, and restaurants, bars, and cafes where residents can meet.” (Klinenberg 2012, p. 207)

De Vaus & Richardson (2009) note that “(t)he steady rise in one person households is barely understood”, arguing that singletons are a large, growing and diverse group that is hard to characterize. Singletons represent all age groups, with one-third younger than 50 years of age, one third between 50-60 years of age, and the last third over 70 years of age. Furthermore, the authors note that singletons have a variety of marital histories and represent the full social-economic spectrum.

The results of a Met Life survey of people 55 and over investigating motivations for relocating in the United States are presented in (Figure 1). Although 14% indicate that they moved be farther away from crowded cities, the majority of responses fall in categories that support the idea that people in this age-group are relocating with the idea of down-sizing into an urban apartment (lower living costs, a desire for a maintenance-free life-style, move closer to amenities and activities).

Young urban professionals and students represent most of the remaining third. Benfield (2012) notes that the “influx of Generation Y, now in their teens through to early thirties, will change

housing demand, and many do not even pursue the ‘Australian Dream’ of having your own house and a lot of land any longer. Generation Y is comfortable with smaller homes and will happily trade living space for an easier commute and ‘better lifestyle.’” They will drive up the number of single households and prompt a surge in demand for rentals, causing rents to escalate.” Ross (2012) agrees with this conclusion, noting that “Developers are betting that young professionals will trade personal space for proximity to urban life.” One example of this is New York-based property developer Related Companies, who built a 63-story, high-end, singleton-targeted

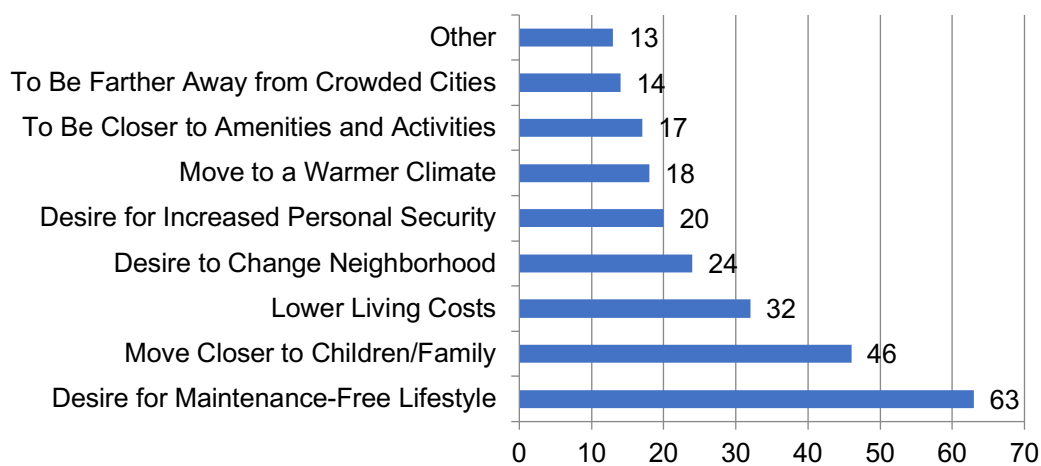


Figure 2: Motivation of 55+ age group for Relocating (in %) Source: Met Life Mature Market Institute (2009)

apartment tower named ‘MIMA.’ MIMA includes 44,000 square feet of amenities, including sundecks, private screening rooms, an indoor lap pool, full-size indoor basketball and volleyball court, and digital café (Related Companies 2012). The chairman and founder of Related Companies, Stephen Ross emphasized that the project has been “well received because of the amenity package” (Marino 2011 in Djukic, 2017).

Challenges of a new generation and the need for housing 'experience'

Real estate, whether commercial or residential, is all about the location, location and location. Now whilst this old adage continues to play a role; the next generation are identified as seeing work, leisure and life, from a very different perspective compared to previous generations (Anderson et al 2017; Lyons and Kuron, 2014; Twenge and Kasser, 2013; Ng et al.2010). The next generation, the millennials (broadly born between 1980 and 2000 (KPMG, 2017)), are focused on a lifestyle rather than work with a personal focus on their lives as a priority. They are looking for a workplace that is nurturing and provides fulfilment – a change from previous generations who have set the standard of living for work rather than working to live (Ng et al. 2010). This is being reflected not only in their choice of employers, but also in their engagement and desire to be situated in central cities where a 'playground for young professionals' is available (Moos et al.2017) and provides the hedonistic experience and entertainment desired by this generation (Holbrook, 2000). The need to "keep up with the Jones" has become a phenomenon of the millennial mindset; although the desire for experiences is evident over material possessions, the challenges of affording multi-faceted experiences ranging from travel (Siegel and Wang, 2018) to the café culture, visiting new restaurants and nightclubs are at increasing odds to affordability and ability to live in a location with central access to these environments.

The Millennials are driving the resurgence and regeneration of central business districts and the inner city (Lee, 2018), driven by their more focused commitment to location-orientated workplaces and residences. However, many of this generation are struggling with the balance of location versus affordability. Living in central locations where entertainment, nightlife, shopping and close proximity to work is desirable, particularly to young professionals, comes with a price tag. This is particularly true in Australia with Melbourne (5th) and Sydney (2nd) listed as in the top 10 least affordable cities in the world in the 14th Demographia International Housing Affordability Survey (Rider, 2018).

Regardless of country, in many of the large cities locating oneself close to the centre comes with the costly price tag for either renting or owning. Once the shine has gone off university digs and share housing; the cost of living on your own within the central city is almost prohibitive as a single-person household. Further, in Australia, you are perceived to have 'succeeded' at life, when you become a homeowner (Doyle, 2017). Millennials will soon make up 50% of the workforce; and by 2025 they will make up 75% (Economy 2019); companies are realizing the need to radically change their recruitment approach and strategies for enticing this growing generation (KPMG, 2017). In addition, cities and developers are realising that these millennials will soon require somewhere to live that caters to their growing needs and lifestyle choices.

The overlapping trends of desires for the millennial generation comprising community, engagement and collaboration experience at work - common termed as the growing co-working trend - and the increasing need to have this at home as part of a co-living community, suggests that the cultural shift in work-life preferences will also drive a change to the perceptive norm of housing (Howe 2016). The desire for community is also driving new-age perspectives of what a 'home' should be (Doyle, 2017). Another factor of increasing consideration is the social and environmental responsibility that millennials are demanding (Hwang and Griffiths, 2017), from their workplaces, the organisations they work for (McGlone et al., 2012), where they live (Kleber and Associates, 2009) and what they eat (Allen and Spialek, 2017).

The microunit potentially provides a new avenue of opportunity for creating spaces that appeal to the next generation - being well-located (for both work and play), providing the latest and most technology savvy spaces, collaborative open spaces internally and externally, and providing a more socially responsible approach to living on an affordable budget. However, the questions is how to ensure the micro-apartment charge doesn't result in 'tiny apartments in toaster buildings only suitable for students, singles and short stayers' (Doyle 2017) as developers seek to reap greater yield from existing development plots. Will this be the panacea for affordable living for the millennials or the creation of yet another investment product for others to attain reward?

Urban level Life Cycle Assessment (LCA) analysis

One of the well-known methods for environmental analysis of different products throughout their lifetime is the Life Cycle Assessment (LCA). LCA is a set of methods, tools, and data designed to estimate material flows and assess environmental impacts over the life cycle of a product or service (Matthews, Hendrickson, & Matthews, 2013). This technique has been widely used for the life cycle impact assessment of the buildings all over the world. More recently, Life Cycle Energy Analysis (LCEA) and Life Cycle Cost Analysis (LCCA) are starting to be used also for similar purposes (Cabeza, Rincón, Vilariño, Pérez, & Castell, 2014). As an example, researchers in Australia have conducted a life cycle energy analysis of a local residential building to optimize the building's energy consumption using alternative design strategies (Schmidt, 2018; Crawford, 2013; Stephan, 2013, Fay, Treloar, & Iyer-Raniga, 2000). In looking at higher density options studies include: Stefan and Stefan (2017) life-cycle analysis for apartment buildings and Junnila and Hovath, 2003 who examined life cycle environmental effects of a new high-end office building in Finland was analyzed.

Cities and their building stocks significant energy consumption and have environmental impacts that are critical to reduce. Although much of the academic literature in this area focuses on the operational phase of the building, studies have shown that both materials and construction can also play a large role in reducing both energy consumption and broader environmental impacts, with energy-efficient homes one example particularly relevant for this research. There is an urgent need for an urban-level action to improve and correctly monitor building construction trends to identify the trade-offs between the use of embodied and operational energy consumption rates for analysis and evaluating the life cycle energy and emissions of future development plans.

To date, very few studies have quantified embodied environmental requirements of building stocks and spatialized them in cities (Stephan & Athanassiadis, 2017). The goal of this section of the literature review is to review the related previous literature, to investigate the potential environmental impacts of high-density neighborhoods (as micro-units which will contribute to increased densification in cities) in comparison to more conventionally developed medium- and low-density areas.

International Review of Urban-level LCA analysis Case Examples

One of the first urban-level LCA analysis was a study conducted on the city of Toronto. The goal of this study was to compare two different high- and low-density residential areas of the city of Toronto focusing on their energy usage and greenhouse gas (GHG) emissions. For this purpose, building materials, infrastructures (roads), utilities, and transportation data were collected, analyzed and compared. The paper concluded that GHG emissions are highest for transportation sector and that energy usage is highest for building operations, in both “per person” and “per square meter” functional units. It also showed that the total energy usage is higher within low-density areas of the City when compared to the high-density areas of City (Norman, MacLean, & Kennedy, 2006).

Another urban-level LCA analysis studied four different regions of the central city and suburban areas in and around Phoenix, AZ, including both high- and low-density structured neighborhoods. The goal of this study was to analyze the impact of different urban forms on infrastructure energy demand. The results indicated that the suburban, high-density residential development was the most energy and GHG intensive area among the four case study areas (Guhathakurta & Williams, 2015).

A preliminary case study in Adelaide, South Australia, identified key characteristics that affect the overall carbon performance of urban precincts (Huang, Xing, & Pullen, 2017). Although the study extrapolated that outer-suburban occupants have higher embodied and travelling carbon in comparison to the inner-suburb counterparts, it also showed that their operational carbon is lower. Therefore, the final conclusion indicated only a slight increase in total per capita emissions for the outer, compared with inner, suburban areas.

There appears to be a general consensus in the literature indicating that urban planners generally believe that the development of high population-density regions of using high-density residential areas are favorable for reducing the total energy usage in the City. This theory has been validated in several cities all over the world, including Melbourne in Australia (Næss, 1997). However, some urban planners believe in the compensatory mechanism hypothesis, which indicates that those living in densely populated urban regions tend to travel longer for recreation, as they experience

restricted access to green fields (Næss, 2005). Additionally, a study which investigated the relationships between urban form and household consumption revealed that while high-density living reduced energy use related to everyday travel, the opposite applies to energy use for leisure-time travel (Holden & Norland, 2005). This study further showed that up to a certain extent, per-capita energy use declines with increasing density; however, this energy usage begins to increase again after the certain point.

Given that high-density inner suburbs are generally assumed to be more sustainable than low-density outer suburbs, these provisional results indicate further studies are needed to validate the initial findings. Therefore, a system-level research inquiry (e.g. systematic urban-level LCA analysis) is highly suggested to further investigate the accuracy and correctness of the analysis.

LCA of Micro-units

In recent decades, household sizes have shrunk and more people are living alone (Infranca, 2014). Although one person households are the biggest consumers of energy, land, and household goods (Olds & Schwartz, 2009), these impacts will decrease by switching to micro-units from traditional 1-bedroom apartments. From a theoretical perspective, lower floor plan per person results in more energy efficiency buildings. For example, literature showed that single-family housing is less efficient than multifamily housing while semi-detached houses fall in between (Owens, 1992). Additionally, a recent study on 100 metropolitan areas in the US determined that compact metros have lower per capita residential carbon footprints (Brown & Logan, 2008).

On the other hand, new studies claimed that moving towards green buildings, net-zero energy, and high performance buildings will further reduce the environmental footprints of buildings, including micro-units, in near future (Sartori & Hestnes, 2007). Particularly in terms of high-rises, Lotfabadi (2014) showed some potential and available renewable energy sources and environmental factors to be embedded in high-rise buildings (Lotfabadi, 2014). Another study, investigated the environmental advantages of micro-apartments in San Francisco (Gabbe, 2015). This study claimed that the combination of small unit sizes, on-site parking and transit-rich areas can reduce the energy use of buildings and transport and reduce greenhouse gas emissions of micro-units.

Even though the general results from the literature is in favour of the micro-units and high-density areas in terms of environmental impacts, it is still critical to conduct a standard LCA comparison between micro-units and conventional 1-bedroom apartments from a building's life cycle perspective. Particularly, because of the contradictory application of micro-units in occupying one household in comparison to multi-household 1-bedroom apartments, it is crucial to select the correct system boundary and functional unit in order to conduct a well-structured LCA and obtain meaningful outcomes, not only considering the buildings and materials impacts but also take into account the average transport impacts of the household.

Costs and benefits of Micro-Units of stakeholders

Housing costs are expensive globally, in particular the locations close to the central business districts. For example, in Sydney, the median established house prices were \$847,000 on March 2019, which have come down by around 15% from peak levels in December 2017. The common types of units or apartments in Sydney are studios, one to three beds apartments. The smallest size of housing type is studio that is around 50-70 square meters, with median prices are around \$500,000 to \$950,000, depending on the locations and the sizes of units or apartments. Given the prices and the availability of lending, a minimum of at least \$100,000 to \$200,000 as a deposit is required for purchasing the properties. Young people who have just entered into the workforce find this amount prohibitive to ownership, and consequently not affordable, as they are struggle to save enough for the required down payment.

Micro-units may be able to address this issue, as they are a smaller type of unit, most commonly less than 50 square meters, with a a small kitchen, a full bath, and a convertible area for sleeping and living. Micro-units in Singapore are among the largest at approximately 50 square meters, whereas micro-unit in New York and Boston were 37 and 42 square meters, respectively. San Francisco is embracing the micro-unit typology, with recent regulatory changes now allowing minimum apartment to be as small as 20 square meters.

Micro-units as an option to meet housing supply and affordability needs

Housing demand

With population growth, aging with baby-boomer era, many senior households have to stay in their home and often find themselves unable to downsize. Many young singles have to share with unrelated roommates in apartments to reduce their costs of living. Infranca (2014) identified that there is a mismatch between demographic changes and exiting housing due to changes of household compositions render the existing housing stock inadequate for many households. He found that the share of households consisting of one-person living alone had dramatically increased from around 7% in 1940 to 27% in 2010. The Australian government has projected that the one-person households are expected to increase from 2.3 million in 2016 to 3.5 million in 2041, or the share of one-person household from 25% to 27% the same period (Figure 3).

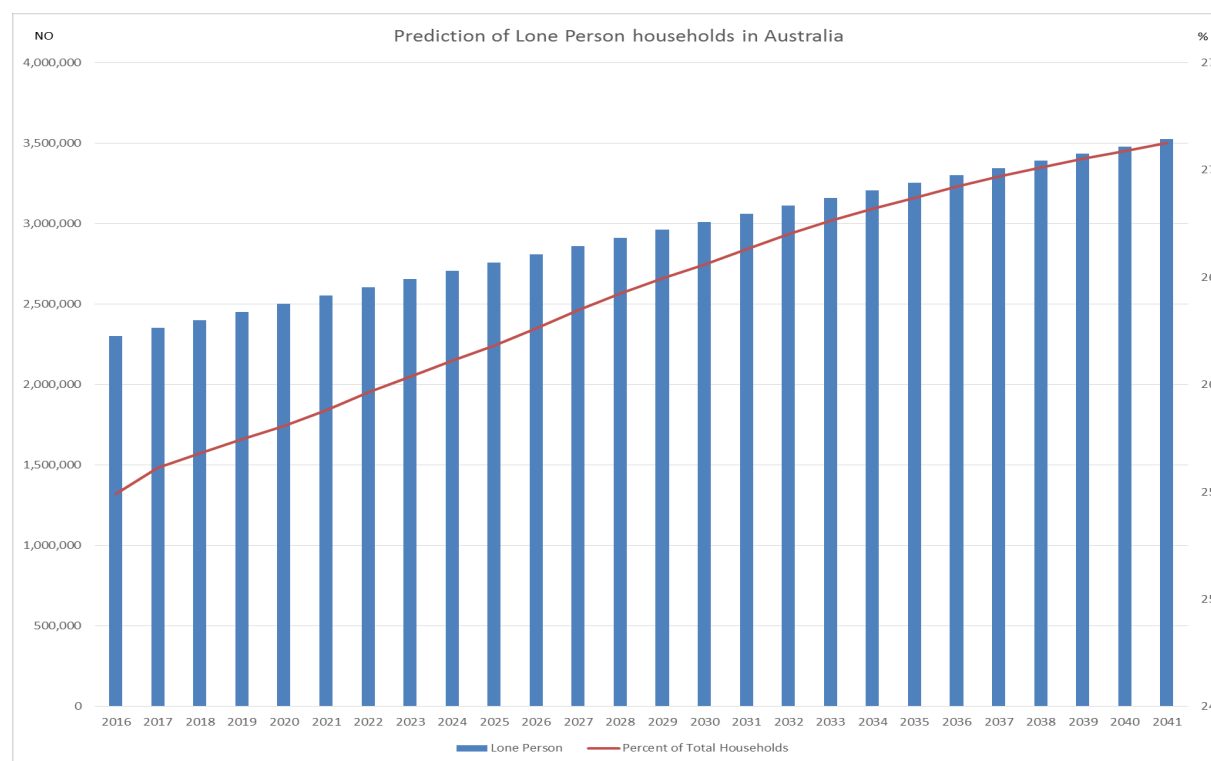


Figure 3: Prediction of lone person households in Australia (Source: Australian Bureau of Statistics, Projected number of households, Household type 2016 to 2041 Australia)

When we break down single-occupant households by gender, a consistent trend of more female single -person households than male single-households becomes evident. This may be related to the significantly higher ratio of female-led, single-parent households (Figure 4).

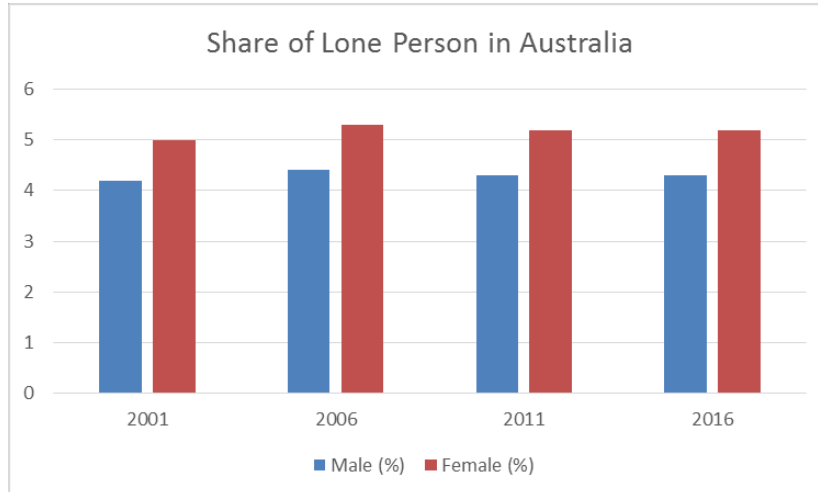


Figure 4: Share male and female of one-person households in Australia (Source: Author derived from the Living arrangement propensities, Australia, 2001-2016 Census)

By looking at the share of one-person households by age group in Figure 5, we have identified a number of features including:

- A reduction of one-person households between age 15 to 44 for male and 15 to 29 for female from 2001 to 2016. For example, it was 5.5% in 2001 down to 4.3% in 2016 for the male age group of 30-40. For female, it was 2.9% in 2001 down to 2.1% in 2016 for the age group of 20-24.
- From age group 45 or above, there were more male-led single -person households in 2016 when compared to 2001. Similarly, female-led, single-person households between the ages of 30 to 64 from 2001 to 2016. However, a reduction of one-person households from 2001 to 2016 for female one-person households from ages of 65 or above.
- For both male and female group, the single-person households increased by age from 45-year old or above. For example, males in 2016 had a 0.5% share of one-person households for age group of 15-19, this increased to 9.1% for the age group of 85-year old or above. Similarly, for female there was a 3.2% share at the age of 35 which increased to 25.6% for age 85 or above.

- The one-person households of female age from 45-year old were much higher than the male groups for the same ages. This may explain that female has longer the life than male.

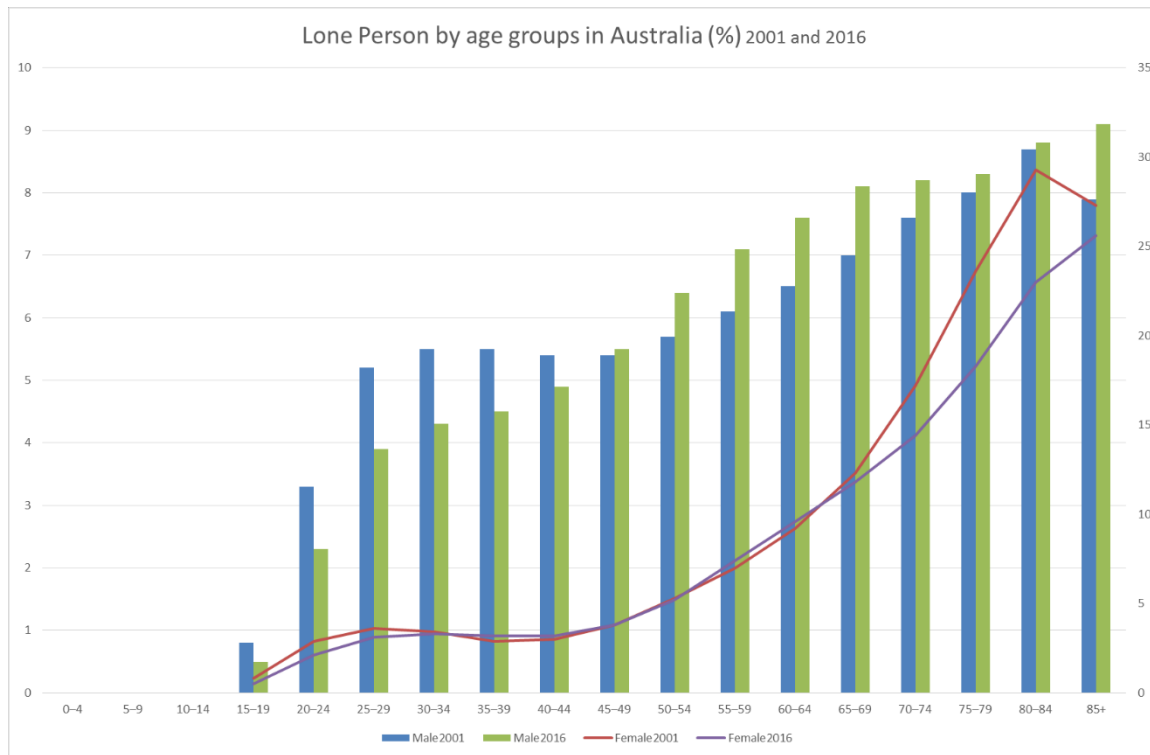


Figure 5: Comparison of One-person household from 2001 to 2016 (Source: Australian Bureau of Statistics, Living arrangement propensities, Australia 2001 & 2016 Census)

The change in composition of one-person households indicates increased demand for one-person smaller housing units at an affordable level, as claimed by (Disbrow, 2013) that singletons mostly live in urban areas of medium to high density and normally require less living space than families. On the other hand, the type of housing supply may not match the need for demand of small units. Renn and Armlovich (2016) provided evidence that there were 1.9 million one or two-person households in New York with only 2.15 million studio and one-bedroom apartments.

Improving Housing Affordability

With sky-rocky prices or rents, many households are unaffordable, in particular the young generation. Micro-units may increase density but they can provide affordable rate at the high cost urban market to the single households. Though there is criticism that per square meter price

may be higher than the large size of units, micro-unit allow households entry into the housing market at lower prices (Disbrow, 2010), relative to one- or two-bedrooms apartments due to the size of units are smaller. There is an argument that micro-units do not provide affordable housing and may exacerbate high rents in a community (Infranca, 2014) due to lack of housing supply.

The Share Economy

Infranca (2016) proposed a concept of sharing economy in urban areas by changing the perception of *ownership* to *access* of housing. Similar as sharing cars, like Uber, bikes, parks and infrastructure; micro-units may provide an opportunity to share land resources by increasing density and reducing living spaces. In addition, micro-units promote community and enhances amenity and services improvements. Though there are drawbacks of high-density living spaces - such as potential increase of crime rate, increased costs to homeowner for the maintenance of centralised facilities, limited private open space, and concerns that microunit may provide less human living conditions and at present the lack of regulations - the nature of share economy may improve households' opportunity to 'get out' more often from the small living space to engage more with society.

In sum, micro-units fill an unmet housing need, could potentially provide lower cost housing for one-person households, increase density and relieve pressure from other parts of the market as singles vacate apartments better suited for families (Potikyan, 2017).

What are the benefits and costs of stakeholders on micro-unit development?

Micro-unit developments started in the US many years ago. Table 1 provides some examples of precedence of micro-unit developments in the US. Those micro-units were built less than 38 square meters and were considered as affordable units. The young one-person households could save 20 to 30 percent of rent and of course, the developers found this would be more profitable than other the developments.

To promote micro-unit development, government regulations are required, and developers need to be encouraged. In Australia, there is a requirement of minimum size of a unit in the state of

New South Wale. According to SEPP 65, 48 square meters is the minimum apartment size. One-bedroom units can be no smaller than 50 square meters, but studio apartments can go down to 35 square meters. However, there is not a requirement in the state of Victoria, although recent legislation has required all 'living' rooms (bedrooms included) to have access to direct natural light and ventilation. Further, many of the major four banks in Australia are reluctant to provide loans for apartments less than 50 square metres at an loan to value ratio of 80:20.

Table 1: Examples of Micro-unit development in the US

Name	Location	Number of Units	Developers	sqm
38 Harriet	San Francisco	23	Panoramic Interests	27.4
My Nicro NY	New York City	55	Monadnock Development	
2221 S Clark St	Arlington VA	252	Vornado and WeWork	
Flats No. 800	Chicago		Cedar Street	32.5 - 37.2
Turntable Studios	Denver	179	Nichols Partnership	30.65
The Wharf	Washington DC	180	Hoffman Madison Waterfront	30.65
286 Varick	Jersey City, NJ	87	Rushmon-Dillon Projects	37.2
Patterson Mansion	Washington DC	90	SB-Urban	

Why would developers like to be involved in micro-unit development? What are the costs and benefits for the consumers and governments? To demonstrate the benefits, a hypothetical development project is used to demonstrate the costs and benefits of the developments.

The development site of 1,075 square meters was acquired located at 16 kilometre from Sydney CBD in 2016. The approved development is a medium rise and medium density apartment that

consists of 35 mixed-use commercial, one and two-bedroom units and penthouses. The total of project was 4,848 square meters and completed in 2 years with a fixed price construction cost of \$10.8 million and generate a gross revenue of \$25.6 million (GST excluded). The average price per unit was \$752,941 or \$5,291 per square meter. The feasibility study suggests that the development is profitable for the developers.

Assume that micro-units are developed and development approval was granted by the local council. Could the development be feasible? Given all assumptions the same, except 161 micro-units are developed instead of 34 units. Additional \$1,909,000 construction costs are occurred due to additional partition, fittings and fixture. Average size of micro-units is 30 square meters. The completed micro-units are priced \$6,000 per square meter and the average price per unit for sale is \$180,000. Table 2 compares the different unit built, costs and sales price of the two types of developments.

Table 2: A comparison between a conventional vs. micro-unit hypothetical development in Sydney

	Original	Microunit	Difference	Measurement
Construction site	4838	4838	0	square meters
Residential Units	34	161	127	number
Shop	1	1	0	number
Average price per square meter	\$ 5,291	\$ 6,000	\$ 709	dollars/per sqm
Average price per unit	\$752,941	\$180,000	-\$ 572,941	dollars
Revenue	\$ 25,600,000	\$ 30,086,289	\$ 4,486,289	dollars
Construction Costs	\$ 10,800,000	\$ 12,709,000	\$ 1,909,000	dollars

The benefits and costs of the developers

The discounted cash flow shows that the micro-unit development proposal is feasible. The developers could generate \$30.08 million revenue instead of the original \$25.6 million, or an additional \$4.48 million. As the price of the unit (\$180,000) is very low and affordable for many households and investors, the units should be sold easier than the bigger sized units. Since the developers provide affordable housing to the lower income households, some development benefit could be received from the government. The developers will also gain a reputation of contribution to the society.

The benefits and costs of government

The development of micro-units have the potential to increase supply of affordable housing, as housing affordability is always a concern of governments. The cost to government with this type of scheme, is mostly focused on the the time and human capital for processing the development approval and inspections, which is generally required anyway. The efforts of making and revising regulations and building code for micro-unit developments are probably the main cost factor for government. As pointed out by Potikyan (2017) micro-unit developments only benefit developers when they can charge premium rents in a build to rent model; whilst examining it from a sales perceptive scale is required if costs to the purchaser is to be kept low. There may also be overcrowding issues and other factors associated with low income unit living. In an open market, when demand is higher than supply of micro-units, the sales or rental prices could be pushed up, which will put the one-person and low-income households in a disadvantaged position. Thus, government plays a vital role in regulating and monitoring the sales and rental for the micro-unit market.

The benefits and costs of one-person households

The availability of micro-units have the potential to make the one-person household, in particular the young generation, to achieve home ownership earlier. It would also enable seniors to downsize to smaller well located areas providing greater convenience to facilities and amenities required. Assuming there is 20% minimum deposit required, i.e., \$36,000, and lending of 80% is available. Given the cost of micro-unit is \$180,000 per unit, the younger generation will require less than two years to accumulate the required deposit, when considering for median weekly disposable income of \$1,195 for 15-24 year olds. Whilst, only about one-year of saving would be needed for 35-44 year olds to achieve home ownership of a microunit. Figure 3 shows the household average and median disposable income per week in Australia for all age groups in 2016.

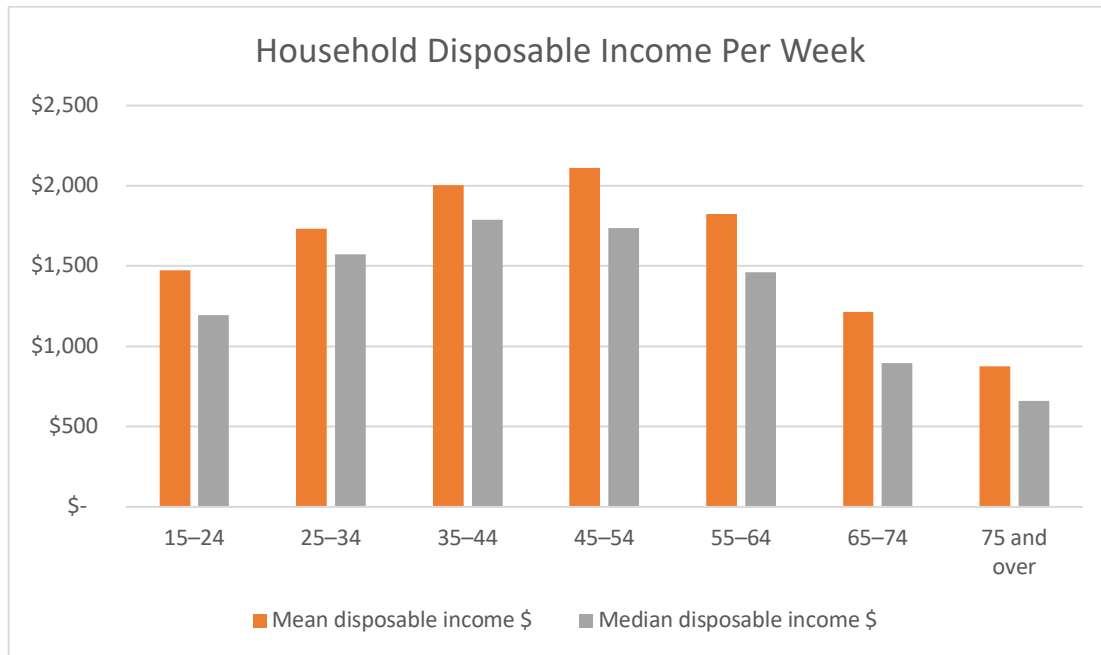


Figure 6: Household disposable income, per week (Source: ABS, Household characteristics, age of reference person, Released on 20 June 2018).

The calculation of number of years deposits include steps as follows by:

- deriving yearly income by weekly income times 52 weeks;
- Taking 30% of the disposable income for saving as a deposit of the micro-units;
- Estimating a number of years that need to accumulate \$36,000 for deposit of homeownership.
- Referring to Table 3, it is obvious that housing affordability could be greatly improved, if purchasing a micro-units rather than a standard apartment at market price. By contrast, to buy a standard units at a price of \$752,941. Its 20% deposit is \$150,588. It takes 8.08 and 5.39 years respectively for saving enough deposit to purchase the standard units for the group of 15-24 and 35-44 year old. They can pay off the loan within 5 to 8 years. By the time the young people reach to have a family, they have already accumulated equity to upgrade to the stand units or houses. For the senior people, they can easily down size at a minimum costs.

The possible disadvantage of the micro-units is small and limited space and living in a high-density environment. However, since micro-units are commonly built in the city center, they

offer a convenient location and easy access to employment and public transport which may make up for the smaller space.

Table 3: Comparison of number of years for saving of 20% deposits for micro-unit vs. conventional unit

					Micro-Units		Standard units	
	Yearly Disposable Income		30%	30%	\$30,000	\$30,000	\$ 150,588	\$ 150,588
	Mean	Median	Mean	Median	mean	Median	Mean	Median
15–24	\$ 76,648	\$ 62,140	\$ 22,994	\$ 18,642	1.30	1.61	6.55	8.08
25–34	\$ 90,168	\$ 81,744	\$ 27,050	\$ 24,523	1.11	1.22	5.57	6.14
35–44	\$ 104,104	\$ 93,080	\$ 31,231	\$ 27,924	0.96	1.07	4.82	5.39
45–54	\$ 109,772	\$ 90,272	\$ 32,932	\$ 27,082	0.91	1.11	4.57	5.56
55–64	\$ 94,900	\$ 76,024	\$ 28,470	\$ 22,807	1.05	1.32	5.29	6.60
65–74	\$ 63,232	\$ 46,644	\$ 18,970	\$ 13,993	1.58	2.14	7.94	10.76
75 and over	\$ 45,448	\$ 34,320	\$ 13,634	\$ 10,296	2.20	2.91	11.04	14.63

Conclusions

Micro units are smaller, denser apartments targeted to meet the changing demands for the growing population of urban singletons. While they offer a relatively small amount of space, rents and purchase prices are also less than those for average sized units. Despite having a higher \$/m2, micro-units could contribute to filling the demand both for more affordable apartments for residents, while also satisfying developer demands for return on investment.

Design becomes a key factor in the success of micro-unit development. The relatively small unit sizes can be made to feel larger when high ceilings, larger windows, balconies and built-in furniture are carefully included in the design. One way to potentially further reduce the cost of micro-units would be the use of prefabrication of entire units. This solution has the potential to also improve the sustainability performance of the units/development as well as reducing construction times and cost. As micro-units are a component of a larger ‘shared’ concept, the various communal spaces and amenities across the building would need to be carefully considered to compensate residents for reduced individual space by meeting the needs of the need generation for engagement. If carefully considered, the amenity package can become part of the brand the building. We believe that micro units can successfully meet the demands of the growing number of urban singletons if construction of this typology was not disincentivised, as it currently is by the existing regulatory framework.

As a large portion of singleton is in the 55 and over age category, consideration of appropriate design and furnishings for this age group should be considered. Although micro-units may be occupied by any age-group, existing case studies indicate that architects and developers seem to focused on targeting the young professionals and student group of singleton moreso than the baby boomers. This may be a missed opportunity to attract the stable, elderly, and often more financially reliable occupants into their projects.

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