Chapter 2

Environmental Impacts of Tiny Home Downsizers: A Call for Research

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Abstract

This paper is an exploration into the relationship between people who downsize to tiny homes (dwellings under 400 square feet) and their resulting environmental impacts. Issues of sustainability in the built environment are also explored, and tiny homes are introduced as a potentially viable housing solution to negate current unsustainable impacts of large homes. The review of literature indicates that there is a strong relationship between living in a tiny home and lowered ecological footprints, though no studies currently exist to support this in any measurable way. The paper concludes with a call for research to explore this relationship, suggesting that there are numerous positive implications of such research. Implications include improving practice within the tiny home field itself, potential policy changes, and an academic contribution to the relatively unexplored field of tiny homes.

Keywords: tiny homes, environmental impacts, ecological footprints, occupant behaviors, residential sector, build environment

Introduction

Sustainability can be applied to a variety of contexts, particularly within the building industry. Buildings account for 40% of carbon dioxide emissions and 70% of the electricity load in the United States, which is more than any other sector (EIA, 2017; Negat, Jomehhzadeh, Taheri, Gohari, & Majid, 2015; USGBC, 2004). Furthermore, three-quarters of total energy consumption in buildings is in the residential sector (IEA, 2013; Friedman, 2007; Negat et al., 2015). Carbon dioxide (CO_2) emissions in homes generally are a by-product of energy used for heating and cooling, lighting, appliances, and other electric equipment. The environmental impacts from buildings are even greater when one considers the CO_2 emissions generated from the manufacturing and transportation of building materials, demolition, and other building activities are considered (USGBC, 2004).

In recent decades, the building trend has been to "go big" (Foreman & Lee, 2005; Vail, 2016), resulting in newly constructed homes in the United States generally having the largest average square footage compared to any other country in the world (Palmeri, 2012). Large homes are often considered a symbol of status (Wilson & Boehland, 2005) and single-family homes comprise 63% of residential dwellings in the United States (Wilson & Boehland, 2005; Withers, 2012). The drastic increase in home size is evident through comparisons across decades; in 1973, the average square footage of a newly constructed home in the U.S. was 1,660 square feet (US Census Bureau, 2017), and in 2017, the average was 2,631 square feet (Mitchell, 2014; US Census Bureau, 2017; Vail, 2016) - - a 63% increase. This substantial increase in home size is associated with a number of detrimental environmental impacts, including loss of land, greater air pollution and energy consumption, and ecosystem fragmentation which leads to reduced diversity of species, and many other negative impacts (Johnson, 2001; Parrott, 1997; Wilson & Boehland, 2005; Withers, 2012). The current "go big" building trend can have major negative implications for the environment, since building size is one of the largest predictors of energy consumption for a building (Huebner & Shipworth, 2017; Sandberg, 2018; Wilson & Boehland, 2005).

In addition to building size, studies have shown that occupant behavior greatly influences the energy consumption in a building (Haas, Auer, & Biermayr, 1998; Sandberg, 2018; Santin, Itard, & Visscher, 2009; Steg & Vlek, 2009). This is especially evident in the United States, as research indicates if people from every country were to consume as much energy as the average American, we would need almost five Earths to provide enough resources to accommodate for these behaviors (Global Footprint Network, 2018a). To reduce an individual's environmental impact, the built environment would need to be designed more efficiently. This underscores the importance of encouraging the residential sector to begin adopting innovative solutions and approaches to address both housing size and occupant behaviors (Friedman, 2007; Sandberg, 2018; Withers, 2012). One innovative solution to address these issues is the construction of tiny homes.

Tiny Homes

Tiny homes are developing as a potentially viable solution to reduce building material waste and excessive consumption within the residential industry. Tiny homes counter housing trends of recent decades by emphasizing the value of quality over quantity (American Chemistry Council, 2015; Ford & Gomez-Lanier, 2017; Turner, 2017; Withers, 2012). There is no one universally accepted definition for a tiny home, though in general a tiny home is defined as a small efficient space typically under 400 square feet that often enables homeowners to live a more environmentally conscious, financially stable, and minimalist lifestyle (Campbell, 2015; Small House Society, 2014; Turner, 2017; Vail, 2016). Tumbleweed Tiny Homes, perhaps the most popular tiny home building company in the United States, builds homes that are 200 square feet on average (Tumbleweed Tiny Homes, 2018), which is about the size of two parking spaces. A common range for a tiny home is between 60 and 400 square feet (Waldman, 2017; Wu & Hyatt, 2016). Specifically, the 2018 International Building Code states that tiny homes are "400 square feet in area or less". Tiny homes are also substantially less expensive than single-family homes (Turner, 2017).

The concept of minimalist living has existed for centuries; however, the modern tiny house movement has only been gaining momentum since the early 2000s when one of the first tiny home building companies was founded. The original founder of Tumbleweed Tiny Homes, Jay Shafer, is often considered the inventor of this modern movement. The core principles behind this movement have been evident for centuries. This increasingly popular movement (Campbell, 2015; Dickinson et al., 2016) is largely based on the 20th century mindset that "less is more" (Anson, 2014; Bozorg & Miller, 2014; Ford & Gomez-Lanier, 2017; Heben, 2014), but has roots in the 19th century movements of romanticism and transcendentalism associated with Ralph Emerson and Henry Thoreau (American Chemistry Council, 2015; Anson, 2014; Ford & Gomez-Lanier, 2017). In recent years, there has been an architectural movement exploring stand-alone homes that mimic a modern home on a smaller scale. This movement has been gaining momentum as tiny home festivals, conferences, workshops, television shows, and more have become commonplace. This movement is not only becoming popular in the United States; other countries such as Australia have witnessed a recent surge of interest in tiny homes (Boyd & Clouston, 2004; Campbell, 2015).

Tiny homes are not only smaller than conventional homes, but are often built on mobile foundations, which allows them to be transported to various locations (Byram, 2017; Ford & Gomez-Lanier, 2017; Heben, 2014; Murphy, 2014; Priesnitz, 2014; Wheeler, 2015). However, unlike recreational vehicles tiny homes are generally meant to be permanent residences for their occupants and built to mimic the modern American house (Bozorg & Miller, 2014; Foreman & Lee, 2005). Additionally, tiny homes are often built with high quality, local materials and often implement green technologies such as solar power and greywater harvesting into their designs, enabling them to function off-grid (Anson, 2014; Boyd & Clouston, 2004; Bozorg & Miller, 2014; Calluari & Alonso-Marroquín, 2017; Vail, 2016; Wheeler, 2015).

Tiny homes are architecturally unique, customized homes where the homeowners often have an entrepreneurial, do-it-yourself attitude (Susanka & Obolensky, 2001). Furthermore, they have been popularized by television and are typically fully functional and independent from other homes (Bozorg & Miller, 2014; Foreman & Lee, 2005; Vail, 2016). Tiny homes often have a kitchen, bathroom, bedroom area, living space, and porch (Turner, 2017), and tend to be made of higher quality materials, and with more functions than typical mobile homes or trailers (Heben, 2014). Tiny homes are either built by an individual themselves or purchased from a building company. The cost of a tiny home can vary greatly depending on who builds it and what amenities it provides (Turner, 2017). Currently, there are over 60 tiny home building companies in the United States, ranging in services that can fully customize and build a home, to those that simply provide do-it-yourself kits and plans (Anson, 2014; Kahn, 2012).

The two main demographics of people who downsize (downsizers) to tiny homes are millennials (young adults under 30) who want the freedom of not being tied down by a mortgage, and recently retired baby boomers (over 50 years of age) who are seeking a more simplistic lifestyle. Literature reviews have supported these findings, but also found that these categories are neither exhaustive nor mutually exclusive (Bozorg & Miller, 2014; Foreman & Lee, 2005; Heben, 2014; Murphy, 2014). The literature makes it clear that downsizers choosing to build and live in tiny homes do it for many reasons, including the desire to reduce their environmental impact, live with fewer debts, and have more time and freedom to focus on families, hobbies, and travels (Byram, 2017; The Tiny Life, 2017; Vail, 2016; Wilkinson, 2011). Overall, individuals who are making a conscious decision to downsize to tiny homes are all making a conscious decision towards simpler living (Bozorg & Miller, 2014).

In 2013 survey research was conducted by The Tiny Life, an online resource for tiny living. This survey was sent to tiny home households to gather basic demographic information on tiny home occupants, including age, gender, income, and educational levels. Survey results found that approximately two out of five tiny home owners are over 50 years of age, with the age breakdown as follows: 21% under 30 years of age; 21% between 30 and 40 years of age; 18% between 40 and 50 years of age; and 38% over 50 years of age. It was also found that more women (55%) own tiny houses than men (45%), and the average income of tiny home occupants is $42,038, which is $478 more than the average American. Additionally, tiny home occupants are twice as likely to have a master's degree as the average American (The Tiny Life, 2013).

As presented in this section, tiny homes provide sustainable, affordable, and innovative housing solutions to accommodate a variety of needs and populations. Tiny homes offer the opportunity for homeowners to value quality of space over quantity of square footage. The next section will explore how tiny homes relate to issues of sustainability within our built environment.

Tiny Homes and the Environment

To offset the environmental impacts of conventional homes, many have purposefully downsized to tiny homes to seek a more sustainable lifestyle. With a smaller physical footprint, tiny homes users can potentially reduce their ecological footprint associated with heating and cooling while at the same time purchasing fewer material possessions (Askham, 2014; Susanka & Obolensky, 2001; Vail, 2016; Wu & Hyatt, 2016). One study that interviewed tiny home occupants found that the primary motivations for downsizing included interest in a simpler life, sustainability and environmentalism, cost, freedom and mobility, a sense of community, and an interest in design (Mutter, 2013). Tiny homes are a fundamentally different approach to housing than the traditionally larger homes which have dominated development patterns in America for decades (Foreman & Lee, 2005; Mitchell, 2014; Murphy, 2014; Susanka & Obolensky, 2001; Withers, 2012).

Tiny homes are well-known for promoting a lower ecological footprint by generally reducing their consumption through smaller building square footage, less material possessions, and alternative sources of energy such as solar (Anson, 2014; Bozorg & Miller, 2014; Turner, 2017; Vail, 2016; Wu & Hyatt, 2016). However, no formal studies have been found to confirm this. In fact, some literature even hints that tiny homes can unintentionally prevent some elements of sustainable living. Some examples of this include eating out more often due to small kitchens, driving longer distances due to remote locations, relying on others for storage due to lack of space to store personal belongings, inability to can foods and store bulk items due to small fridges and storage space, and lots of energy needed to heat and cool a tiny home in extreme weather due to a lack of foundation to regulate temperature (Anson, 2014; Murphy, 2014; Williams, 2014).

The Oregon Department of Environmental Quality (DEQ) released a study in 2010 which found that reducing the square footage of one's home is the single most effective measure for reducing one's impact on the environment (DEQ, 2010; Palmeri, 2012). In fact, reducing home size is likely more environmentally beneficial than many green home certifications (DEQ, 2010). By conducting a life cycle assessment (LCA) of a 2,262 square foot medium home and an "extra-small home" of 1,149 square feet, one study found that across all categories (including energy use, materials production, construction phase, maintenance phase, demolition phase, and transportation of materials), the environmental impact of the "extra-small home" was significantly lower-- nearly 40%-- than that of the medium standard home (DEQ, 2010). While the average square footage of a new home built in America in 2017 was about 2,600 square feet, the average size of a tiny home size is about 300 square feet (Mitchell, 2014; US Census Bureau, 2017). Additionally, homes that use recycled materials also have substantially reduced environmental impacts (DEQ, 2010). Therefore, with the DEQ study findings in mind, tiny homes can potentially have even more significant environmental savings than a 1,149 "extra-small home", considering their smaller sizes and tendency for recycled materials (Campbell, 2015; Murphy, 2014; Withers, 2012).

Because of the negative environmental impacts of traditionally larger homes within the residential sector, research in the tiny home field could potentially inform our understanding of how downsizing into a tiny home influences one's environmental impact. Though limited, the academic literature on tiny homes has expressed that tiny homes promote lower environmental impacts for their occupants (American Chemistry Council, 2015; Bozorg & Miller, 2014; Ford & Gomez-Lanier, 2017; Kahn, 2012; Mitchell, 2014; Susanka & Obolensky, 2001; Turner, 2017; Vail, 2016). However, the lack of sufficient literature on this topic indicates an important gap in scholarly research that formally examines how the environmental impact and behaviors of tiny home occupants change after downsizing to a tiny home (Anson, 2014). The significance of this gap is explored in the next section.

Literature on Tiny Homes

In the past decade formal academic literature on tiny homes has steadily emerged as interest in this innovative housing type has increased, although it is limited in terms of quantity according to Anson (2014) and Ford & Gomez-Lanier (2017). Much of the tiny home literature consists of news articles, blogs, personal narratives, and television shows-- rather than peer-reviewed, academically published literature (Ford & Gomez-Lanier, 2017). Most of the published literature that does exist is based on unpublished resources such as blogs, newspaper articles, and television shows, largely due to a lack of academic literature to start with. This presents a gap in the literature and a need for research to aid in the further advancement of the tiny home movement, and exploration of sustainable construction practices within the built environment.

The existing literature has claimed that individuals who downsize to tiny homes will have a significantly lower environmental impact, particularly because they are forced to reexamine their material consumption (American Chemistry Council, 2015; Anson, 2014; Bozorg & Miller, 2014; Ford & Gomez-Lanier, 2017; Kahn, 2012; Mitchell, 2014; Susanka & Obolensky, 2001; Vail, 2016). Conversely, some literature also hints that tiny home living can sometimes lend itself to unsustainable practices such as driving longer distances, dining out more often, and recycling less (Anson, 2014; Mitchell, 2014; Williams 2014).

Despite the common claims that tiny homes promote a smaller environmental impact, there are few academic discussions thus far that explore this concept in detail, posing a gap in the research (Anson, 2014; Ford & Gomez-Lanier, 2017). Upon a thorough review of published literature on tiny homes, it was found that, so far, no empirical research studies exist that comprehensively examine one's changing environmental impact with respect to downsizing to a tiny home. Additionally, no research exists identifying what behaviors influence this change. To comprehensively examine one's environmental impact, one has to not just look at their housing, but also consider other behavioral choices such as food, transportation, goods, and services.

Existing student research, including theses, dissertations, projects, and research presentations have begun to show a trend towards academic attention on tiny homes and their potential impacts on individual environmental impact. One particular student paper explores the theoretical potential for tiny homes to decrease the carbon footprint of their occupants, and in fact, makes a call to future researchers to explore the environmental benefits of downsizing to a tiny home (Carlin, 2014). Another student wrote their thesis on the motivation of downsizers' decisions to live in a tiny home, revealing environmental concerns being among the top reasons (Mutter, 2013). Another thesis offered an analysis of the tiny house movement (Hutchinson, 2016). And in an undergraduate research paper, it was proposed that tiny homes are a viable solution for those wanting to foster a stronger relationship with the environment and their communities (Kilman, 2016). Other student works discussed the trends of the tiny house movement and how they can be used as a sustainable and innovative housing approach (Bartlett, 2016; Beam, 2015; Calluari & Alonso-Marroquín, 2017; Dion, 2015; Hsiao, 2014; Mingoya, 2015; Schenk, 2015; Ubben, 2014; Wu & Hyatt, 2016; Wu, 2017). Although most of these student research efforts did not employ rigorous analytical methods, they do indicate there is interest among young scholars in the tiny home field, and that these scholars are curious about the relationship between tiny homes and the environmental impacts of their occupants. Needed still is research providing quantitative data to understand this relationship. The following section explores this relationship through the concept of an ecological footprint, which is one way to quantitatively measure an individual's impact after occupying a tiny home for a year or more.

Measuring Ecological Footprints

The term "footprint" refers to a measurement in area-based units (Gossling, Hansson, Horstmeier, & Saggel, 2002; Wiedmann & Minx, 2007) and offers a broader measure of environmental impact than other metrics that examine perceptions of environmental impact (Bleys, Defloor, Ootegem, & Verhofstadt, 2018). Specifically, an ecological footprint refers to the amount of biologically productive area that is required by an individual, population, or activity to accommodate for their resource consumption (Global Footprint Network, 2018a; Global Footprint Network, 2018b; Wackernagel & Rees, 1996). The point of calculating an ecological footprint is to determine if consumption is environmentally responsible (Gossling et al., 2002).

An ecological footprint is one way to measure an individual's environmental impact by calculating one's spatial footprint in terms of global hectares considering housing, transportation, food, goods, and services. An ecological footprint is a 3-dimensional metric, considering economic, environmental, and societal aspects of sustainability (Martins, Mata, & Costa, 2007). An ecological footprint converts many types of environmental impacts into a single unit of measure, allowing for meaningful comparisons to be made between different combinations of impacts that are otherwise not easily compared. Specifically, for tiny home occupants, previous lifestyles in prior housing can be compared to current lifestyles while living in a tiny home.

Mathis Wackernagel and William Reese were among the first individuals to systematically calculate an ecological footprint (Bicknell, Ball, Cullen, & Bigsby, 1998; Global Footprint Network, 2010; Kitzes et al., 2009; Wackernagel & Rees, 1996). Wackernagel, now the President of the Global Footprint Network, has worked towards developing and creating standards for the ecological footprint. Ecological footprint standards exist to provide guidelines to ensure the accuracy and transparency of ecological footprint calculators. Data sources, scopes, conversion factors, and communication processes are all outlined using the ecological footprint standards (Global Footprint Network, 2018a). Committees consisting of academics, government officials, and professionals review these standards, with the most recent revision developed in 2009 (Global Footprint Network, 2009; Global Footprint Network, 2018b).

To calculate the area required, ecological footprint calculators use yields of land types including cropland, forest, grazing land, fishing ground, built-up, and energy land to measure this in global hectares (gha) (Global Footprint Network, 2010; Global Footprint Network, 2018b; Kitzes et al., 2007; Moore, Cranston, Reed, & Galli, 2012; Wackernagel & Rees, 1996; Wiedmann & Minx, 2007; Zhao, Heinsch, Nemani, & Running, 2005). A global hectare equates to 10,000 square meters or 2.471 acres and is approximately the size of a soccer field (Global Footprint Network, 2018c). To measure in global hectares, the total amount of a resource is divided by the yield per hectare (Global Footprint Network, 2010). Global hectares (gha) are used as a unit of measure because they look at weight and physical area across various land use types (Borucke et al., 2012).

An ecological footprint calculator is the most comprehensive climate change metric available as it compares all human demands on nature, including food, housing, transportation, goods, and services (Bicknell et al., 1998; Global Footprint Network, 2017, World Wildlife Fund, 2017). Other types of sustainability metrics exist (such as the carbon footprint, water footprint, and the general ecological behavior scale), but the ecological footprint is the overarching metric to calculate human demand on our planet's ecosystem, and an ecological footprint calculator includes components of other popular sustainable metrics (Global Footprint Network, 2018a; Wackernagel & Rees, 1996). The ecological footprint calculator comprehensively examines human demand on the Earth (Borucke et al., 2012; Cucek, Klemes, & Kravanja, 2012; Global Footprint Network, 2010; Kitzes et al., 2007; Moore et al., 2012), and is the world's primary measurement of human demand (Cucek et al., 2012;). As a research tool, an ecological footprint calculator presents the potential for exploring the relationship between downsizing to a tiny home and changing environmental impacts.

Call for Research: Needs and Implications

There is a need for research to investigate tiny homes as a potentially effective way to reduce the environmental impacts in the residential building sector and provide empirical evidence behind the claim that tiny homes reduce one's ecological footprint. Such research could contribute to the relatively unexplored academic field of tiny homes by providing measurable results that may be used by future researchers in the tiny home field.

Findings from this type of research would add to the scholarly research and literature in the tiny home field, potentially improve practice within the field itself, and potentially improve policy related to tiny homes. Results might well lead to changes in current practice to improve the design and development of tiny homes, and to promote lower ecological footprints.

Additionally, these research findings may help current tiny home occupants understand the relationship between their behaviors and their resulting ecological footprint. This in turn may promote a sense of empowerment to intentionally further reduce their footprint.

Other potential implications from this research might include further development of policy allowing tiny homes to be legal in more jurisdictions, or perhaps nationally. Tiny homes are not allowed in many jurisdictions, and some tiny home downsizers occupy their homes illegally or are dissuaded to live in a tiny home because of the strict zoning laws and building codes. Research of this type could serve as a source of support for advocates of the tiny home movement who are urging their jurisdiction to allow tiny homes. The benefits of downsizing to tiny homes lacks the empirical evidence necessary to document such potentials. Tiny homes represent a viable housing solution to negate the current unsustainable impacts of large homes. However, to realize these potentials a body of empirical research is needed that can serve as a stepping stone for shifting the trend from large, excessive homes to smaller, more efficient ones.

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