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The Future of Living: Exploring Sustainable Residential Developments Through A Case Study Analysis of The Sustainable City Dubai

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EXPLORING SUSTAINABLE RESIDENTAL DEVELOPMENTS THROUGH A CASE STUDY ANALYSIS OF THE SUSTAINABLE CITY DUBAI

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Abstract

With population growth continuing on an upwards trend and urban living projected to increase in the coming years, a redesign of typical property development is required to ensure that housing demand not only has a lesser impact on the environment, but also meets the needs of communities. Through a combination of literature review, quantitative and qualitative data analysis, this paper presents a case study of The Sustainable City Dubai (TSC), a key sustainable development within the United Arab Emirates (UAE), taking into account its social, economic and environmental strategies and consequent impacts. Investigation has been conducted into the importance of such development models and the key benefits they provide to property owners, the environment and the related businesses. In addition, the unique role sustainable developments play to various segments within the international property market was scrutinized to determine their subsequent positioning. Discussion of the barriers to adopting sustainable property development/s, both for developers and property consumers was undertaken. The paper concludes that The Sustainable City Dubai is, for the most part, beneficial and positively impacts social, economic and environmental sustainability. The paper further concludes that sustainable developments are generally positioned as niche, premium priced properties in the current real estate market and that only with greater adoption will they move out of this position. Finally, the paper argues that policy change and legislature are driving forces behind uptake of sustainable development, both for developers and property consumers.

JEL Classification Codes: Q01, Q56, D01

Key Words: Sustainable Development, The Sustainable City Dubai, United Arab Emirates, Real Estate, Property Market

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1. Introduction

Sustainable development has become a buzz word in the real estate, property development and construction industries within recent years, and whilst the notion of sustainable building development may seem oxymoronic, there is no denying that the concept of sustainable development is of paramount importance (Reed & Wilkinson, 2007). The United Nations World Commission on the Environment and Development define sustainable development as "development that meets the needs of the present without compromising the ability of future generation to meet their own needs" (WCED, 1987:43; Sanguinetti et al, 2019). This is a concept that has particular pertinence in the property development and real estate sectors, two industries known to be largely unsustainable in the long run. In fact, "the construction industry is the world's largest consumer of energy and producer of greenhouse gases" (Mangialardo, Micelli& Saccani, 2018, p.1). Moreover, combined, commercial and residential buildings are responsible for over a third of total carbon emissions and consume approximately 40% of total energy used per year (Holness, 2009). Energy consumption and the emission of greenhouse gases are two major contributors to global warming; thus, it comes as no surprise that the Intergovernmental Panel on Climate Change (IPCC) has issued urgent calls to actions to the most energy intense sectors to significantly reduce their carbon emission by 2030 (Mangialardo, Micelli & Saccani, 2018). When considering these situations, it becomes strikingly obvious that there is - and why there is - a pressing need to make the real estate realm increasingly more sustainable (Goering, 2009). However, despite the seemingly evident benefits of sustainable development, the actual concentration of sustainable developments and/or sustainably developed green certified properties remain low (Feige, Mcallister &Wallbaum, 2013).

This paper comprehensively explores sustainable developments looking at their purpose, impacts and market positioning through consideration of price positioning and target

consumers. Additionally, this paper explores reasons for limited uptake and solutions for future permeability of such developments into the mainstream market. Specifically, this paper focuses on sustainable communities and the following research questions:

- Do sustainable communities produce a positive impact at the social, economic and environment levels of sustainability?
- How are sustainable developments currently positioned within the real estate market?
- How can greater acceptance, adoption and permeation of sustainable developments be encouraged?

In an attempt to answer these questions, this paper takes a case study approach, focusing specifically on The Sustainable City Dubai (TSC), a small sustainable development community located in the United Arab Emirates (UAE), a country not typically thought of when it comes to sustainability, instead usually a symbol of unsustainable luxury and opulence. The case explores how this one Dubai-based community is disrupting the local property market, demonstrating that sustainable cities can be born even in the most improbable places, and paving the way for more developing nations to follow suit in the implementation of such models. The case study examines the goals, strategies taken, impact and overall effectiveness of the community as it pertains to sustainability. This paper also explores more generally the market positioning of sustainable communities, including: their occupancy of a niche market, associated price premiums, and expected target consumers, with specific focus on and application to TSC. Discussion takes place concerning the barriers to adoption of sustainable development practices/property and of how this situation could potentially be improved in the future in order to achieve larger acceptance and market

penetration of sustainable residential developments. Finally, the paper concludes with a summary of research findings.

2. Case Study: The Sustainable City Dubai (TSC)

2.1 Methodology

2.1.1 Method

In order to develop knowledge regarding The Sustainable City in Dubai and learn more about its role as a sustainable development within the UAE, a number of methods were employed. Firstly, a review of current academic literature, as well as media publications pertaining to sustainable developments and TSC was undertaken. This was in order to gain greater understanding of the strategies used within the development to promote sustainability and why such developments are necessary, particularly as we move toward the future.

In addition to this, observational study was also undertaken. A guided tour followed by multiple site visits were carried out within the community, allowing for further and deeper exploration of not only the passive and active strategies employed within the development, but also of the resident's behaviors, their contribution to sustainability and the outward effectiveness of the community. During these visits, conversations were also had with tour guides, sales officers, and developers who provided valuable insight and information regarding the blueprint of the development, efficiency of renewable energy methods, occupancy of the development, and insight into previous research undertaken with TSC as a focus point.

Finally, a qualitative/quantitative survey was created and distributed to residents along with the help of Diamond Developers who manage the community. The survey consisted of 24-questions in total with the aim of responses aiding in better understanding the motivations people have for living in sustainable developments (in particular TSC), how value is added in such communities, how such estates contribute to behavioral changes of

residents, and the overall effectiveness of such communities in achieving triple bottom line sustainability through positive social, economic and environmental impact. To view a copy of the survey and questions, see Appendix B.

The survey was designed and intended to be completed on an individual basis rather than a household one, thus, the survey was able to be completed by multiple individuals aged 18 and above within any one unit. This was possible as the questions contained within focused on individuals thoughts, opinions and behaviors, rather than household patterns; the questions asked respondents about how they felt individually, and about their own personal sustainability efforts, not those of the whole family. Consequently, multiple individuals from the same villa were able to complete this survey, and it was hypothesized that in such cases, the responses would most likely be different/varying between the individuals anyway. It was also important to enable multiple individuals within one unit to complete the survey as many residents have live-in domestic staff who are typically not considered in any head of household responses, and house-sharing is common in Dubai too.

The survey was administered via the community management portal, ADDA, and was later also posted to the Facebook community group by a resident. All told, the survey was open for respondents to complete for a two-week period, in which time, a total of 71 responses were collected. More responses were submitted partially completed, however, only fully completed surveys were carried forward and included in the data analysis stage.

Throughout the process of examining sustainable developments, primary research was also undertaken concerning price premiums of sustainable real estate. The methodology and results of this data collection and analysis can be found in the price premium subsection.

2.1.2 Limitations & Scope of Further Research

2.1.2.1 Site Visits

Although the multiple site visits were informative and true to form of the development, providing an accurate picture of functionality, impact and effect, the timing of the research may have been an impediment in terms of witnessing the community at its best and most effective. Within the United Arab Emirates, the COVID-19 Pandemic has been met with strict rules and regulations to protect individuals and prevent transmission of the virus. Many such restrictions impact the mission of The Sustainable City, in particular the development's focus on social sustainability through interaction of community members, use of shared space, and event programming. As such, site visits may have shown a somewhat altered insight to the usual lifestyle of residents within TSC.

2.1.2.2 Survey

The survey results were used to deduce trends of residents' attitudes and opinion, evaluate the impact of TSC on the sustainability behaviors of its residents, and to evaluate the overall effectiveness of the development as it pertains to the community's goals of reaching social, economic, and environmental sustainability. However, the survey did have some notable limitations that could be improved in future studies, and with adaptations, allow for further scope of research.

Firstly, the survey is limited in that based off of the occupancy rate (˜99%) of The Sustainable City, respondent rate was fairly low with only 71 fully completed, submitted responses. Resultantly, while the results of the survey provide a good sample size, the level of generalizability of the conclusions is limited.

Additionally, one must be mindful of the presence of self-selection bias, a common problem in self-reporting surveys. As all of the survey respondents volunteered to take this survey, this may have caused a biased sample, perhaps through all of the respondents being

more focused on the topic of sustainability than the general population, or through respondents sharing another distinguishing group-characteristic that non-survey respondents may not have. This could further impact the generalizability of the survey results to the wider TSC population.

Furthermore, in addition to self-selection bias, it is wholly possible that demand bias was also present in the survey respondents answers. Although TSC management made it clear that the survey was not from them, which to some extent decreased the demand bias that would usually occur with residents answering management's questions, the survey also made it clear to respondents that the research focused on sustainable developments. Resultantly, this could have influenced respondents answers and made them answer in a way they perceived would satisfy the researcher or satisfy their interpretation of the research aims. As such answers may not be entirely representative of natural behavior and opinions.

Additionally, the survey and its responses are somewhat limited as a consequence of design flaws in the questionnaire itself. One such issue was raised by a survey respondent, and another identified by the researcher during analysis and evaluation of the data collected. The first flaw raised was that the survey, particularly question 15 (see Appendix B) was based on comparative statements of whether residents had increased their environmentally friendly behavior since becoming resident in TSC. The purpose of the question was to determine whether sustainable developments, such as The Sustainable City, had an impact on the promotion, fostering and adoption of green behaviors amongst residents, particularly, whether residence in a sustainable community has the potential to shift peoples habits. However, this comparative system proved problematic in that it did not account for individuals who already practiced environmentally friendly lifestyles before moving to TSC, and thus, demonstrated no significant increase in such behaviors. This is especially pertinent in places like TSC where residents hail from all corners of the globe and as one respondent

pointed out in their survey response, can oftentimes be coming from a country already well-versed and encouraging of sustainable living practices. Thus, as a consequence of the resident already being proficient in green living prior to residing in TSC, responses may be misleading and suggest that the individual has not improved on any sustainability habits since living in a sustainable community, but only because they had already adopted these previously, not necessarily because the development does not influence residents behavior.

The only other notable flaw in the survey that could provide additional insight and analysis opportunities if adapted for future research, was that the survey did not ask respondents to identity whether they resided in a TSC villa or an apartment block. It would be interesting to determine in further research whether the type of housing a resident lives in impacts their opinions and behaviors as they pertain to the community feel of the development, their economic savings from sustainability measures, and their involvement with the development's green-living practices. Although the lack of this distinction in the current survey did not impede conclusions drawn in any way, it would nevertheless be an interesting way to extend this research for future study.

2.1.3 Results

The survey was completed by a total of 71 residents within The Sustainable City. The overarching findings of the results were that overall, TSC is effective at meeting its goals based on the questions asked and the responses given. Of course, there were elements that the survey did not measure due to constraints, for example, city wide net-energy production, recycling etc., with results instead being gathered at the individual level and generalized to the wider population. Results will be discussed throughout the case study where applicable.

2.2 Introduction to the City

The Sustainable City[1] (also referred to as TSC for short) is a real estate development located in Dubai, United Arab Emirates. As its namesake suggests, the complex is considered a sustainable residential development and is the first of its kind to be fully operational in the Middle East region. The 'city' was the brainchild of Faris Saeed and Wassim Adlouni, business partners owning Diamond Developers, a company that had already produced many conventional residential developments within Dubai (Rogmans, 2018). The duo saw the necessity and beneficial business opportunity of venturing into sustainable developments, and so, The Sustainable City Dubai was brought to life. After the planning and building stages, the community came to fruition in 2015, with the first residents moving in that same year. The community is now in its third phase of development with only the innovation center - a center dedicated to further research, monitoring, and education on sustainability and sustainable development - left to be constructed.

The 113-acre community is made up of both residential and commercial units, with the former constituting the majority of the units on site. Within TSC there are 500 villas which are broken down into 10 signature villas, 40 four-bedroom garden villas and 450 three/four-bedroom courtyard villas. These units are broken down further into five clusters, each consisting of 2 signature villas, 8 garden villas, and 90 courtyard villas. Additionally, there are 89 apartments of various sizes (Rogmans, 2019). Presently, the occupancy rate of the community is at 95% which when broken down further produces an occupancy rate of 99.36% within the various villas available, and around 86% for apartments. [2] In terms of commercial units, occupancy of these currently stands at approximately 90%.[3] A range of

[1] https://www.thesustainablecity.ae
[2] Figure true as of March 14th, 2021, Received from the TSC Visitor's Center
[3] Figure true as of March 14th, 2021, Received from the TSC Visitor's Center

business offerings are available from these units ranging from supermarkets to gyms, to restaurants, to hairdressers and even gift shops.

Another important aspect within The Sustainable City - other than their residential and commercial units - is the community atmosphere and shared communal spaces of the compound. The community aims to provide a holistic environment in which residents can prosper socially, as well as environmentally and economically. The community aims to achieve this through providing an atmosphere conducive to wellbeing which includes shared and green spaces, programming for residents to engage in, and helping residents save money through renewable energy utility bill savings and consumer savings when utilizing the onsite business options. Further discussion of how TSC achieve this holistic environment will included in 2.4, passive and activity strategies.

In recent years, the community has been the recipient of countless awards and accolades recognizing the development's dedication to sustainability and the social wellbeing of residents. Examples awarded by the Gulf Real Estate Awards include the 'Happiest Community' award - which the community has won for multiple consecutive years running - 'Best Real Estate Project (Master Development)', 'Best Real Estate Research', and 'Best Real Estate Developer – Sustainable Green Development' (Diamond Developers, 2019).

On top of awards, the community has received international recognition and attention from a number of dignitaries such as Ruler of Dubai, Sheikh Mohammed bin Rashid, other notable figures, and academics. Despite the success it has already achieved, the development remains a working model or 'living laboratory' and has partnered with a number of renowned higher education institutions worldwide to continue its efforts to be at the forefront of sustainability as it pertains community development (Rogmans, 2018).

Image 1 below shows a masterplan of the development, including the innovation center which is still under construction. For an annotated copy of the TSC development plan, see Appendix A.

Image 1: TSC Development Plan (Source: The Sustainable City)

2.3 Sustainability Goals

The Sustainable City Dubai aims to follow the Triple Bottom Line (TBL) theory of sustainability. That is, the development aims to be sustainable not just environmentally, but socially and economically too. The TBL theory suggests that each of the aforementioned elements are interdependent and equal to one another, and to successfully achieve sustainability, all three must be present due to their interdependence (Elkington, 197 7). The Sustainable City appears to honor this necessity to focus on all three aspects equally by creating and implementing a number of active and passive strategies (further discussed in section 2.4) that specifically target all three factors equivalently within the community.

In addition to the overarching goal of being a sustainable community, TSC has more succinct goals that define the purpose of their areas in each of the three aforementioned areas. In terms of the environment, TSC aims to be net carbon neutral, which means producing little

to no carbon emissions (Rogmans, 2018). To do this, the city has been 'designed to reduce or avoid all sources of manmade carbon emissions under six categories: food, energy, water, products, mobility and waster. Optimizing these sectors enables TSC to bring forward the 1.5ºC Paris Agreement target'[4]. Socially, the city hopes to create a 'Live-Work-Thrive community where inclusivity and knowledge sharing are guiding principles in operation and management', all in all creating a community that provides residents the majority of what they need to function and lead meaningful lives. Finally, in terms of economic sustainability, TSC strives towards reducing 'living costs through energy and water savings' for residents, 'applies circular economy principles in operations, and creates job opportunities' in the community (TSC Visitors Center, 2021).[5] In order to achieve these goals, a number of passive and active strategies are employed within the community.

2.4 Passive & Active Strategies

2.4.1 Environmental Sustainability

One of the most obvious tenets of sustainability found within TSC is that of a focus on the environment. The very design of the 'city' is committed to being as noninvasive to the natural world as possible through use of eco-friendly components in residential units, incorporation of renewable energy, and encouragement of residents waste recycling, amongst other things. The development state they foster environmental sustainability 'through passive and active design strategies, as well as strategic partnerships' (The Sustainable City, 2020).

[4] The Paris Agreement is an international and legally binding treaty concerning climate change. The agreement was signed by 196 parties and came into effect on November 4th, 2016. The agreement's goal is to reduce greenhouse gas emission in order for the world to become climate neutral by mid-century and limit global warming to under 2ºC, preferably to no more than 1.5ºC above pre-industrial temperatures (Jayaraman & Kanitkar, 2016).

[5] Goals based on a plaque displayed in The Sustainable City Dubai's Visitor Center. Direct quotations accurate as of display wording on March 20th, 2021.

As The Sustainable City is located in the Middle East and thus experiences a considerably dry, hot and humid climate near year-round, an important element to guarantee the development is environmentally friendly (and affordable for residents) was ensuring that design elements prevented heat in both the living and commercial units, as well as the shared outdoor spaces. To achieve this, a number of design strategies were implemented. In terms of the villas, all were designed to be orientated north, away from the sun to avoid unnecessary heat, external walls were also covered with anti-reflective light-colored paint to further deflect the heat. Windows in the villas are thermal, equipped with ample glazing and are also anti-reflective for the same purpose. On top of efficient design, each unit within the city has been designed not just to deflect heat but to harness this through the presence of solar panels on the villa/building roofs (see image 2). This is a consistent and reliable source given the overall sunny climate of TSC's location.

IMAGE 2: Heat Preventative Villa Walls (Own Image)

Within the villas, climate is controlled through air conditioning but does utilize the more sustainable VRF (variable refrigerant flow) systems for the HVAC (heating, ventilation and air conditioning) which reduce energy consumption[6]. This can make a significant difference to energy consumption levels in a country in which many households utilize AC systems year-round. Like cooling systems, water consumption within the villas is reduced

[6] VRF systems utilize smaller ducts and optimized technology as opposed to regular systems, thus enabling better efficiency and reduced energy consumption.

through faucet aerators and low-flow shower heads. Each villa is equipped with all kitchen and lighting appliances pre-selected and installed in line with the environmentally friendly nature of the development. Kitchen appliances (including oven, stove, fridge, freezer, microwave, dishwasher, sink, garbage disposal, and washer/dryer machine) are all Energy Star Siemens appliances, designed with the purpose of conserving energy use without compromising the performance of the products. Lighting is energy efficient LED, in line with LEED ND (neighborhood development) standards in order to reduce light pollution (El Jisr, 2018). Upon move in, every unit is also provided with a set of recycling bins, as the community uses communal waste bins located on each street, which are separated into the various recyclable materials (see image 3). This sorted waste is collected by an external waste management company (Tadweer) before being taken to a private waste disposal center that will recycle and re-use whenever possible, something that is not common practice in the UAE at present. There is also a community compost pile located on the spine where residents can dispose of their compostable food and garden waste. The resultant product is then available to be used by residents on the community gardens as fertilizer.

Image 3: Recycling Bin System

(Own Image)

Other than the design of the villas, the blueprint of the overall community is set to be considerate and respectful of the environment. Similar to how the homes are designed to minimize heat absorption, the entire design of TSC is founded on this principle. Residential

areas are split into five clusters; each having a cooling wind tower system, and many shaded pedestrian ‘sikkas’ (streets) designed to provide shade and coolness from their narrow paths and added protection from the tall villa walls (see image 4). Moreover, the outer perimeter of The Sustainable City is marked with a triple layer of native trees, which aids in creating a breeze within the community, in addition to purifying the air – an important task considering the community is positioned between two of the major expressways.

Image 4: The View Down a Sikkas at Dusk (Own Image)

One area of the development however that is not designed with the goal of shade in mind is that of the community car parks. A unique aspect of The Sustainable City is the absence of cars inside the community. Only the 50 signature and garden villas, located on the outer most sikkas of the community are permitted to have garages and cars attached to their

homes, the rest of the residents must park their cars in their allocated parking spots (strategically positioned at the top and bottom of each cluster) and then walk to their villas, or take one of the convenient communal use electric buggies. Each of these spaces are covered by solar panels, which transform the heat of the day into solar energy to power the grid, the city's own personal electricity supply. Not only does having the car parks thus produce significant energy – so much so that this electricity directly powers the street lights year-round - but it also reduces danger to pedestrians and CO_2 emissions within The Sustainable City.

Image 5: A Lucious Green Section of the Spine (Own Image)

In addition to the peripheral trees, the community is brimming with green spaces throughout the development, especially when considering the complex is located in a desert climate. Through the center of TSC runs a 'central green spine' also known as 'The Farm'

(see image 5). This area runs the length of the community and contains many green spaces, a running stream, two ponds, community gardens, walking paths, an animal sanctuary, a bee hive, and ten biodomes - temperature-controlled artificial ecosystems which enable the urban farming of plants, herbs and vegetables that otherwise would not be possible due to the hot climate of the UAE (see image 6). The gym, community pools and main playpark can also all be found along this central spine and even these components contribute to the environmental friendliness of the community, with the gym equipment providing kinetic energy to the grid (the more people move the more energy produced) and the children's play area being made from recyclable materials including clay rubber, repurposed wood and tires. The greenery doesn't hurt the environment as one would expect in a desert climate either; the planted trees and shrubbery are all native to the region to help conservation efforts, and in addition, only re-purposed water is used as irrigation.

Image 6: The External of a Biodome at Dusk (Own Image)

2.4.2 Social Sustainability

Social sustainability is evident throughout the city's design, components, and governance. The Sustainable City is unique in that it is a developer led community, meaning

that the developers- in this case Diamond Developers - remain after project completion and manage the day to day running of the community. The management team employed by Diamond are responsible for overseeing the neighborhood notice and communication board (managed through the ADDA app), the social events calendar and the general wellbeing, maintenance and upkeep of the complex. Social events are a frequent happening in the complex and the team celebrate all kinds of occasions including horse shows hosted by the onsite equestrian center, Ramadan Iftar potlucks, and Halloween and Christmas celebrations for the children. The Sustainable Plaza also hosts regular market days known as 'Origins' to which various stall vendors, children's entertainers and the wider Dubai community are invited to attend. Other than events, Diamond also assist in maintaining community social media pages along with residents, namely the neighborhood Facebook page and the buy, sell, borrow, exchange page also hosted on Facebook.

Other than social events, the design of the city is structured in such a way that it encourages social interaction and wellbeing throughout. Villas are arranged in one of five clusters, with each cluster being composed of many sikkas (streets), shared spaces, a wind cooling tower and a children's play area. All residents have access to a breadth of shared spaces including gyms, playgrounds, football fields, basketball and tennis courts, swimming pools, jogging tracks, cycle tracks and more. There are frequently resident led classes for community members to partake in and socialize with their neighbors through these amenities. In the past, the community have also hosted their own friendly sporting competitions and community led initiatives to foster community engagement and neighborly interaction. There is even a community sports team for triathletes of all ages, led by residents of the community. In addition to leisure spaces, amenities such as the allotments and the Sustainable Plaza (and it's many encompassing amenities including art studios, cafes, shops, etc.) provide another space for residents to interact and access all that they may need (see image 7).

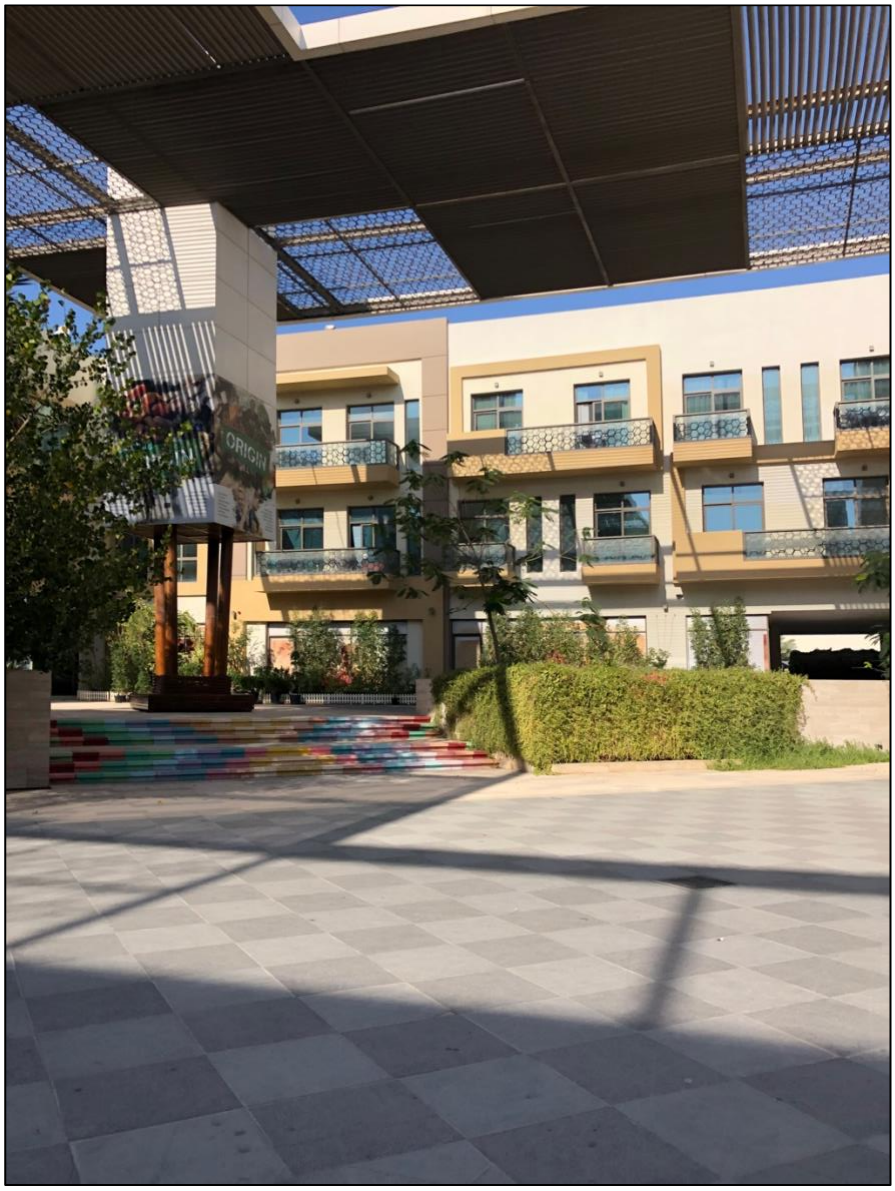

Image 7: A small section of The Sustainable Plaza (Own Image).

There truly is everything an individual may need within the community, including a children's nursery and a Kindergarten through 10th grade school, both of which also encompass the development's commitment to sustainability and 'green' education. The 'city' is also home to the region's first and the world's largest rehabilitation center for people with disabilities, Sanad Village, which in itself has won property development awards (Diamond Developers, 2020). Perhaps more important than such awards is the point that through having such a facility within a predominantly mainstream community, inclusion is being witnessed

at its finest, again, reinforcing that TSC really does pave the way in caring for its residents, leading positive social change in the region and ensuring true social sustainability. Inclusion is a must to achieve this in any community or society. In the case of TSC, the presence of an inclusion center is especially impactful as the development swayed from their initial plan of placing a hotel on the property, instead, welcoming Sanad Village.

2.4.3 Economic Sustainability

Another key focus within The Sustainable City is economic sustainability, which the complex states they achieve through 'taking advantage of operational efficiencies and passing on the savings to [their] residents, in addition to various offerings designed to give back to [their] community' (The Sustainable City, 2020).

The operational efficiencies are intertwined with the environmental aspects of the developments, which directly provide economic savings to the residents and the complex as a whole. The use of the renewable energy sources throughout the community (solar energy through solar panels and kinetic energy through gym equipment) significantly decreases energy consumption - and thus cost - through a grid-based system. Within villas in particular, electricity bills can be expected to be noticeably less expensive because much of a home's electricity consumption is supplied through the villa's personal solar panel powered energy. It is in fact, theoretically plausible that net energy in the month could be completely supplied from the solar panels, thus, incurring no additional charges, although, this is somewhat difficult to consistently attain. Additionally, energy and cost savings are achieved through the solar paneled water heaters, efficient lighting, AC and efficient appliances used within the units. A maintenance contract is also usually provided by the developers and savings can be found this way also.

Other than through savings based economic sustainability, the development also works towards economic sustainability through their own business ventures located within

the community, one such example being MyHive, a small honey shop located within the city's Sustainable Plaza that produce their own honey from hives within TSC. Home grown herbs are also available to residents within the community, who may come and go from the biodomes as they please. Residents are provided with vouchers each month which they may then exchange for free herbs/vegetables from the TSC farm. Similarly, during date season, the community harvest dates from their many on-site palm trees and distribute, gifting some to residents free of charge and selling the remainder to local supermarkets.

In addition to their farming efforts, the developers (Diamond) also own and operate an additional three businesses within the community; Beitfann, a sustainable art studio, Bedayat, a business incubator, and SEED/Mindspace, an educational enrichment program (which stands for sustainability and environmental education) with an accompanying dedicated educational space. These initiatives again help to ensure money is being retained and brought back into the community in such a way that keeps it economically viable for the future. Rent collected from business units generates the community income, and in turn, the presence of such business units increase the range of amenities within TSC, making the development attractive to more consumers, which continues to ensure economic success through high occupancy rates.

Economic success is further aided through the commercial and public area of the city known as the Sustainable Plaza, in which a wide variety of businesses and services are located including medical clinics, supermarkets, schools, gyms, restaurants and so much more (see table 1 for breakdown). This model appears to model/mimic that of JC Nichols' shopping plaza creation many years ago in Kansas City, USA, only with the addition of outside space (Worley, 1993).

The Chiron Clinic Holistsic Medicine	Core Care Poly Clinic	Fitzrovia Pathology Laboratory	Life Pharmacy	Sea Salt Spa	FTG – Functional Training Gym
KHBZ & ZAAD Restaurant	Bagels & More Cafe	Tuk Tuk Thai Cuisine	800 Pizza	Spill The Bean Cafe	Maria Bonita Restaurant
Zoom Market	Star Veterinary Clinic	The Artisans Tailors	Hair Touch Gents Salon	Eternity Beauty Salon	Volt
Borda Stationery & Gifts	Playpoint Soft Play	Creakids Nursery	My Hive	Beitfann Art & Music Studio	Fairgreen International School
Public Mosque	Sustainable City Equestrian Center	SEED/Mindspace Education Center	Visitor's Center & Sales Office	Public Transport Link (Bus Station)	& More

Table 1: Commercial Businesses & Services within The Sustainable City (own table) (as of December, 2020)

The Sustainable Plaza also contains a section dedicated to commercial office spaces. Diamond Developers are situated in this office block along with other companies and businesses that rent the space. Some notable and relevant offices located in the city that embody the mission of sustainability include the conservation charity WWF (Worldwide Wildlife Foundation) and Green Touches, a sustainable cleaning company specializing in eco-friendly products founded by a resident of the community.

2.5 Impact & Effectiveness

2.5.1 Environmental Sustainability

TSC appears to produce positive results when it comes to environmental sustainability; the development is active and successful in its efforts to recycle and reuse waste (as part of a circular economy), reduce carbon emissions generally (through renewable energy sources) and more specifically within the community (lack of cars), to ensure continued presence and preservation of native plants, and through its many other features incorporated in villa design in order to alleviate pressure on the environment. Data estimates that solar panels alone reduce 50% of energy usage as compared to conventional Dubai villas (Sanguinetti et al, 2019). The development also fulfills its goal of being environmentally sustainable through maintaining a low carbon economy with has low energy consumption, low emissions, and low pollution (Zhang, 2010).

Not only does TSC achieve results through the development's design, but it also achieves environmental results through the education and influence of residents personal environmental behaviors, in line with Meltzer's (2000) community empowerment model (CEM). As displayed in Figure 1, over 71% of residents agree or strongly agree that they have adopted more environmentally friendly behaviors since living in TSC, such as recycling and conscious conservation of utilities.

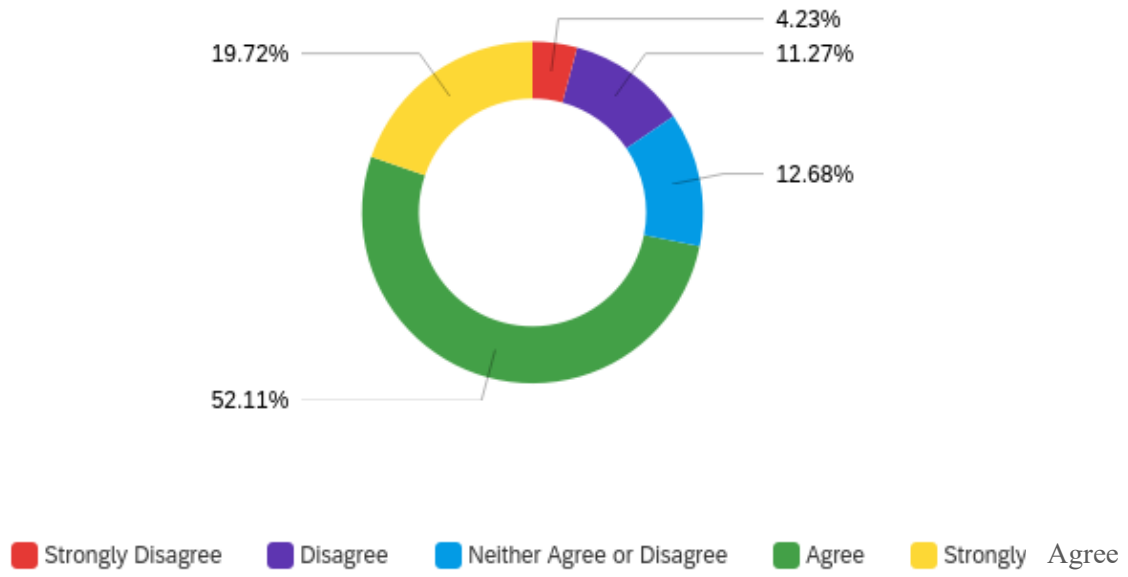

Figure 1: percentage of respondents who agree they have adopted more environmentally sustainable behaviors since living in TSC (Qualtrics Survey Results)

This is important to ensure continued success of the development because as one resident rightly pointed out in their survey, the development is only as strong as its residents, so if residents are not on-board and committed to the sustainable ethos, effectiveness of TSC would decrease. Figure 2 below further breaks down the environmentally conscious behaviors TSC residents actively pursue.

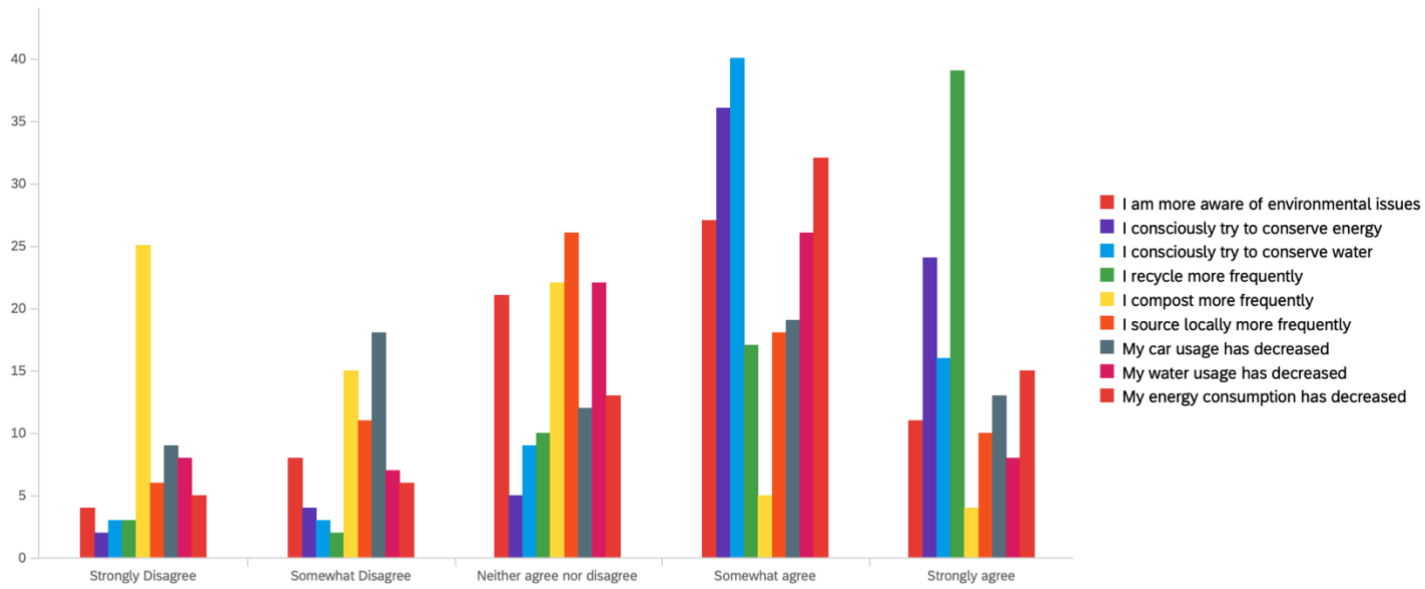

Figure 2: Areas of Sustainability Residents Have Improved in Since Living in TSC (Qualtrics Survey Results)

Notably, environmental behaviors residents generally engage more with within TSC include recycling and conservation of energy and water, apparently to some success as Figure 2 also indicates that many residents have reduced their overall water and energy consumption whilst living in the compound.

2.5.2 Social Sustainability

Social sustainability can be a difficult concept to measure due to the widespread ambiguity of what exactly social sustainability actually incorporates. This is only worsened by the many varying, inconsistent definitions that are used in academia (Davidson, 2010). One academic paper defines social sustainability as "development (and/or growth) that is compatible with the harmonious evolution of civil society, fostering an environment conducive to the compatible cohabitation of culturally and socially diverse groups while at the same time encouraging social integration, with improvements in the quality of life for all

segments of the population" (Stren & Polese, 2000, pp. 16-17). More recent literature states that "social sustainability is a process for creating sustainable, successful places that promote wellbeing, by understanding what people need from the places in which they live and work. Social sustainability combines design of the physical realm, with design of the social world – infrastructure to support social and cultural life, social amenities, systems for citizen engagement, and space for people and places to evolve" (Woodcraft, 2011, p.16).

TSC appear to follow the latter, more recent definition more closely. With regards to being socially sustainable in terms of infrastructure and amenities as specified by Woodcraft (2011), TSC really does have everything, and it is safe to say that nearly all human needs, and even wants, can be met within The Sustainable City Dubai, including the need of community and relationship building. This is evident in the overwhelming majority of residents who either agree or strongly agree that there is a strong sense of community in TSC Dubai (see Figure 3).

Percentage of Respondents That Agree TSC has a Strong Sense of Community

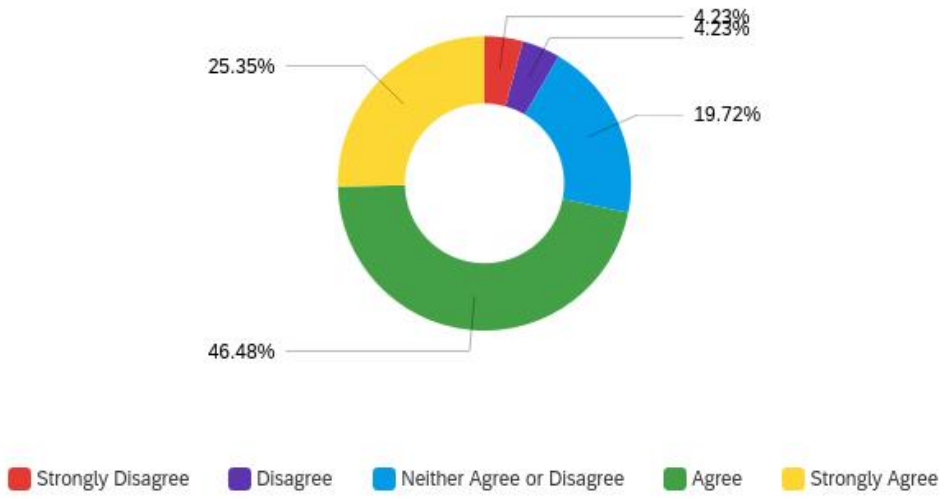

Figure 3: Percentage of Respondents That Agree TSC has a Strong Sense of Community (Qualtrics Survey Results)

Less than 9% of respondents disagree with this statement whilst 72% agree or strongly agree, thus indicating that overall, Diamond Developers have succeeded in their mission to create a community atmosphere within TSC. This trend of overall success in achieving goals remains consistent when looking at Figure 4 located below.

Figure 4: Use of Shared Spaces & Neighbor Interaction (Qualtrics Survey Results)

The graph demonstrates that the vast majority of residents agree to some extent that they make frequent use of shared spaces within the community (93%), and also, that they regularly interact with their neighbors (68%), suggesting the development is successful in achieving its goal of having people interact with one another in the communal spaces located around the community. The graph also demonstrates many residents attend events and programs held within the community, although, only 45% of residents agree with this

statement, which is considerably lower than the other metrics, perhaps indicating that events are not as pertinent to residents as other social aspects of the community. It could also indicate that the events offered are not appealing to residents. Further research on this would be needed to determine why events and programming are less successful.

To determine the impact of all that TSC offers socially on residents wellbeing and their standard of living, the residents survey asked respondents to identify the extent to which they agreed to the following statements titling Figures 5 and 6.

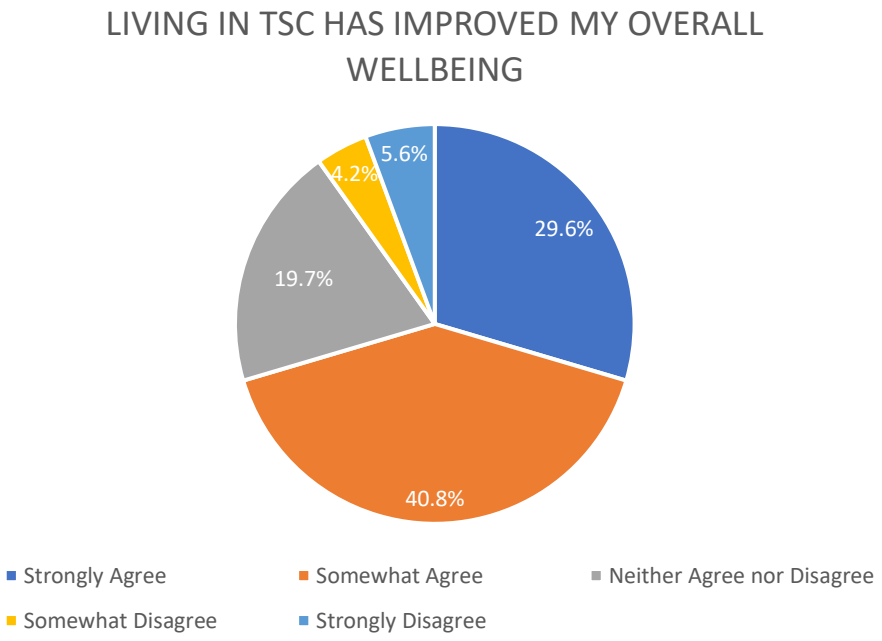

Figure 5: Percentage of respondents who feel TSC has improved their wellbeing (Own Chart)

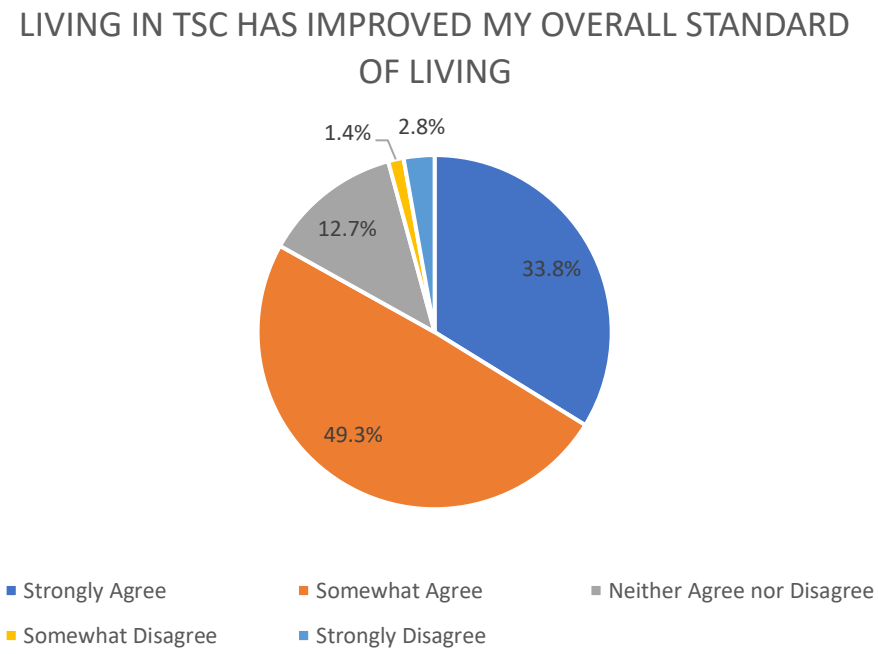

Figure 6: Percentage of respondents who feel TSC has improved their standard of living (Own Chart)

Again, the data from respondents indicates that for the majority of residents, their wellbeing and standard of living has improved since living in TSC, a great indicator that the community is providing a quality, meaningful lifestyle that is akin to social sustainability.

What's more, TSC provides such a unique, community-based lifestyle for residents that is seemingly difficult to replicate this experience elsewhere in other residential communities in Dubai (Figure 7). Over half of survey respondents (56%) stated that they did not feel they could experience the same standard of community living that they experience in TSC in any other residential estate in Dubai, just another indicator that overwhelmingly implies the success of the TSC's social sustainability initiatives and the benefits adopting a policy of 'live-work-thrive' can bring to a community.

Do you believe you could experience the same standard of community living offered in TSC elsewhere?

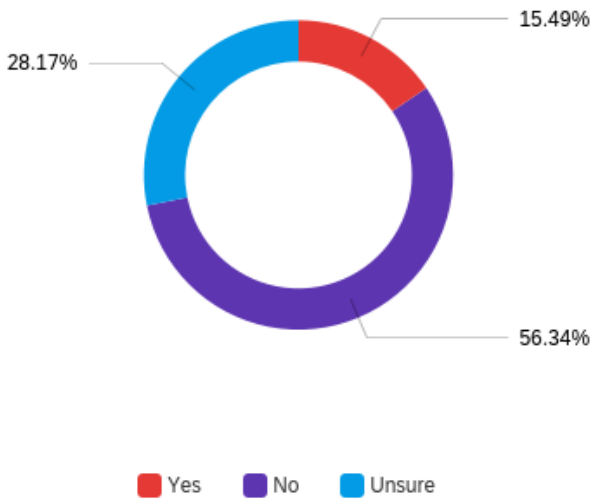

Figure 7: Percentage of Respondents Who Feel They Could Experience The Same Standard of Community Living Offered in TSC in Another Dubai Community (Qualtrics Survey Results)

Now, whilst there is no denying from survey data that TSC is immensely successful when it comes to achieving social sustainability, one criticism of the community is that true social sustainability often does not come in the form of gated communities (El-Bana, Selim & Taleb, 2015) and whilst this may be true in other parts of the world, or when examining TSC through other green standards (which has already been deemed problematic), this is not a fair criticism to make in the UAE, and Dubai in particular. The vast majority of premium developments within the UAE are gated for safety and security reasons, and as such, a precedent is set that quality residential estates be gated; thus, this is something many individuals look for in their property search. Simply put, if TSC was not gated, a considerable portion of the market would likely lose interest in the development or struggle to justify prices. The community would likely also have higher expenses (economic impact) in order to maintain security. Although TSC is gated, this does not dimmish the freedom and access to

the compound, with visitors to the area able to access all communal spaces without needing to enter through the gates, and bus routes being provided to connect The Sustainable City to the larger city of Dubai.

That said, one of the tenets of social sustainability is the integration of neighborhoods and areas, and in the case of sustainable developments, the overall connectedness and integration of the development to the wider community (Stren & Polese, 2000). Whilst TSC being a gated community does not limit this aspect significantly, the overall lack of integration of TSC into the wider Dubai community is noticeable. Even between TSC and its neighboring residential developments only mere minutes walking distance away, there are no available public footpaths allowing access. In fact, car reliance remains a large issue for many TSC residents as it is virtually impossible to get elsewhere without using this form of transport or taking the public bus. The overall impact of TSC's lack of integration is that the community appears an island unto itself, with limited opportunity for ease of connectivity to other outside communities and reduced social sustainability. As a consequence, this also impedes attainment of securing maximum positive effect when it comes to environmental sustainability and the reduction of carbon footprint as neither reduced vehicular transportation usage or the use of shared public transport options are wholly possible for TSC residents. Furthermore, this integration dilemma produces sustainable 'bubbles' within the UAE, with TSC becoming its own little entity within the larger community. In order to make the development increasingly socially sustainable and reduce this island-effect, TSC would need to be better connected to the city through an integrated approach utilizing multimodal transportation options. However, it must also be recognized that to achieve this, a change in public policy regarding city planning and public transportation would need to be implemented. TSC would therefore only be able to fully integrate its community with the

wider city of Dubai if higher level authorities were to implement the aforementioned changes that would enable better inter-neighborhood connectedness at the public policy level.

An additional critique regarding the social sustainability of TSC is the lack of presence of affordable housing within the development. Whilst this is to some extent also more of a systemic issue than an isolated TSC one[7], this does have notable limitations on the mission of the community to be socially sustainable that TSC could have avoided by implementing such a policy. The lack of affordable housing for the most part means that only a certain type of property purchaser/renter can live in the community, reducing the diversity and mixing of individuals from different classes and of various income levels. The lack of affordable housing also limits the overall permeability of the community meaning that individuals invested in sustainability who possess lower income levels are not able to adopt sustainable residential property. Moreover, making such developments unaffordable does nothing to solve social issues in communities or provide a platform to enhance the standard of living and wellbeing of less economically prosperous individuals. Overall, the lack of affordable housing limits the potential for inclusion of and access of a wide demographic, a tenet of social sustainability, thus, restricting the potential of TSC to be 100% effective when it comes to this area (Woodcraft, 2015).

Overall, Diamond Developers and the TSC management seem to achieve their goal of social sustainability through 'an abundance of amenities and community outreach programs' well (The Sustainable City, 2020) and there is little doubt if any that the developers have achieved their mission of building a community, not just a property estate. Nevertheless, the community remains lacking in this area when considering the wider, more generally used definition of social sustainability, looking beyond just amenities, community engagement and

[7] In some parts of the world, it is necessary by law to have a percentage of new residential developments be labeled as affordable housing. There is no such policy or concept within the UAE at present. There is also a more general gap between sustainable housing and affordable housing that will be later discussed in this paper.

wellbeing. In particular, the development is lacking in terms of its integration with the wider Dubai community and being exclusive through lack of affordable housing.

Additionally, it also remains questionable whether such a community could continue to flourish on its own as an intentional community run by residents, not a development management team. This is an important question because typically, long-term community facilitation that is developer-driven and continued by a management team, whilst socially sustainable, is not inherently economically sustainable. This is because developer management requires and relies on constant inflow and outflow of capital to cover employee salaries and other expenses involved with community management processes and event facilitation. Sanguinetti et.al (2019) found this to the case in earlier research within TSC, stating that activities led by management "did not seem economically sustainable, as indicated by a decline in such activities and the introduction of small fees for participation in organized events or rental of community spaces" (p.10). The presence of community management can also be unsustainable socially in that it can limit the possibility for community/resident empowerment and make the sense of community felt by residents reliant on the management's efforts (Sanguinetti et al. 2019). That being said TSC does have multiple resident-led community initiatives including a triathlon team, bootcamp fitness classes, instructor led yoga, a sewing group that use repurposed fabrics to great reusable shopping bags, and most recently, a resident council. All of these are in addition to community initiatives carried out by the management, perhaps providing some indication that the development would continue to prosper – and economically benefit – even without the presence of a hands-on community management as residents are seemingly beginning to foster their own management. Thus, whilst the ability of residents to create an intentional community and sustain the accustomed social functioning has previously been questioned in research as a result of there being seemingly low community empowerment (Sanguinetti et

al., 2019), it would appear since then, residents have become more engaged with the running of their community, demonstrating social sustainability is now driven by both the onsite developers and the residents themselves. It should also be noted that although somewhat limited in terms of economic sustainability, developer driven models, such as planned communities like TSC, have been deemed by sustainable community researchers as necessary, particularly in order to make such housing developments more mainstream in the property market, and more accessible for people to adopt (Boyer, 2015; Maguire 2017). In doing so, this creates more diverse, occupied, communities, which in turn, increases social sustainability, and helps to create the first stepping stone of positive sustainable change.

2.5.4 Economic Sustainability

The main economic goals of TSC are to reduce cost of living for residents, and apply circular economy principles, both of which, the development does fairly successfully. In terms of reducing cost of living for its residents, over half of survey respondents (59%) selected 'yes' to the statement 'do you believe that you benefit from economic savings by living in TSC?', thus indicating that they do believe that they save money. This is displayed visually in Figure 8.

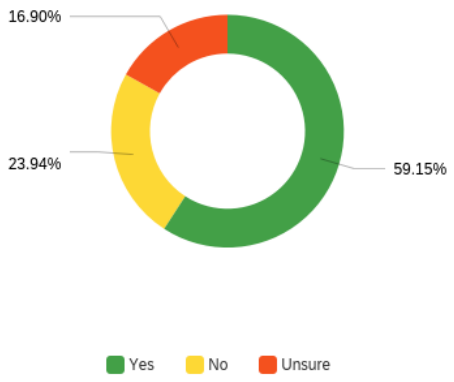

Figure 8: Percentage of Survey Respondents Who Believe They Experience Economic Savings by Living in TSC (Qualtrics Survey Results)

The 59% of residents who expressed that they believed they benefited from economic savings by living in TSC were also asked to identify which aspects of the community they felt these savings resulted from. A summary of results can be found in Table 2 below.

	" I experience economic savings on this aspect by living in TSC" - % of Respondents				
Community Aspect	**Strongly Disagree**	**Somewhat Disagree**	**Neither Agree nor Disagree**	**Somewhat Agree**	**Strongly Agree**
Energy Bills	0.00%	1.85%	9.26%	38.89%	**50.00%**
Water Bills	0.00%	3.70%	**37.04%**	35.19%	24.07%
Gym Membership	0.00%	5.56%	27.78%	27.78%	**38.89%**
Car Fuel	5.56%	12.96%	**46.30%**	22.22%	12.96%
Property Maintenance	0.00%	1.85%	16.67%	37.04%	**44.44%**
Public Transport	9.26%	9.26%	**72.22%**	9.26%	0.00%
Borrowing & Exchanging with Neighbours	5.56%	1.85%	**51.85%**	31.48%	9.26%
Using the Shops in the Community	5.56%	12.96%	**33.33%**	29.63%	18.52%

Table 2: Percentage of Respondents Experiencing Economic Savings

This table provides insight into which aspects of the community residents feel are most economically beneficial in terms of cost reduction. Unsurprisingly, 50% of respondents strongly agreed that as residents of TSC, they saved money on their energy bills. In total, over 88% of respondents agreed with this statement to some extent, supporting claims made by the development that the properties solar panels significantly reduce energy costs by producing off-grid power for consumption. Apart from energy bill savings, other top aspects

of the community that residents felt they save on include gym memberships and property maintenance, with 67% and 81% or respondents respectively agreeing at least somewhat with the statements. Factors the majority of residents are unsure about in terms of the economic savings or lack of they provide include water bills, car fuel (suspected to be decreased due to lack of cars internally), public transport, the shared economy of borrowing and exchanging with neighbors, and use of the shops within the community.

To further ascertain the extent of these reported savings, a question was posed to residents asking them to self-report a best estimate of how much money they save per month in AED, taking into consideration utility bills, as well as all of the aforementioned aspects too. Only 21 respondents chose to input a value for this question. A summary of data collected is presented in Table 3 below.

Estimated Savings of Residents Per Month By Living in TSC (AED) (1 AED = 0.27 USD)[8]						
# of Inputs	**Mean**	**Mode**	**Median**	**Min**	**Max**	**Range**
21	2121.42857	2000	2000	500	5000	4500

Table 3: Summary of Estimated Savings of Residents Per Month in AED

A wide range of estimated savings per month were reported, ranging from as a little as 500 AED, all the way up to 5000 AED, with the mean, median, and mode of the data all sitting around the 2000 AED a month mark. Whilst a range of 4500 AED seems large, such a difference in estimated savings is entirely plausible, and will primarily vary based on which aspects of the community's value creation residents choose to capitalize upon. For example, a resident with one individual living in a unit has the ability to experience greater savings than another unit with four individuals living in it because both units produce similar energy from

[8] Currency exchange rate true as of April 29th, 2021 using https://www.xe.com/currencyconverter/convert/?Amount=1&From=AED&To=USD

the solar panels, but their usage would likely vary. Likewise, even though all residents have access to the same amenities, this does not mean they use them all; residents who make greater use of facilities can be expected to believe they have greater savings by living in the community than residents who do not.

Regardless, all in all, it appears many residents are reaping the benefits of TSC's success in achieving its economic goal of reducing the cost of living for residents, although, the extent to which a resident's cost of living is reduced by ultimately varies and is dependent on numerous factors, including but not limited to, whether the property occupant rents or buys, average energy consumption, utilization of community facilities, and family-size. One notable comment on economic sustainability from the residents survey stated that those who purchased property as rental investments are excluded from the development's economic savings, because cheaper rents than expected have meant they have been unable to achieve sufficient return on investment (ROI) to even cover mortgage payments. Thus, it would appear that economic savings are not obtainable or accessible for all stakeholders within the development.

2.6 TSC Summary

Overall, The Sustainable City Dubai is a successful model of a sustainable development, not only because over 94% of residents regard the development to be a somewhat or extremely effective model (see Appendix C), but also because the development achieves what it set out and intended to. Net energy consumption and carbon emissions are reduced within the 'city', residents are thriving thanks to the excellent social sustainability and value creation from various community/property characteristics, and for now, the economic aspects of the development appear to go being going well. In fact, the 'city' has been such a success that Diamond Developers are replicating the model – with some

adaptations[9] – in Sharjah, another Emirate in the UAE, thus demonstrating the success of the model based not only on attainment of its sustainability goals, but also in terms of its successful market penetration leading to high consumer demand (Diamond Developers, 2019).

The 'city' also provides a solid blueprint for other real estate developers to themselves replicate, not only in the UAE but worldwide, although, adaptations of passive and active strategies would need to be implemented based on the culture of a host nation, the climate, the most likely renewable energy capability, and the policies and legislature already in place. Nonetheless, the ability for developers to witness TSC, and share in the knowledge of how the development was specifically planned, designed, and implemented for success can be incredibly utile, particularly in the research and development stages.

Of course, whilst TSC as a development is for the most part highly successful, future developments could also benefit from certain adaptations rather than simply reproducing TSC, for example, through creating a more socially connected community using multimodal transportation integration or implementing affordable housing - affordability being one of the key issues residents raised in their surveys – the overall effectiveness and impact of future developments could be improved. Likewise, TSC residents noted that fostering more community education and empowerment surrounding sustainability practices would be beneficial, as would be the implementation of more options for greater solar panels savings or greater renewable energy production for individuals homes. As a working model TSC work

[9] Adaptations in TSC Sharjah to date include: the internal community not being car free, residents will be able to park their vehicles directly outside of their property rather than in car parks, villas no longer having a third floor or a roof terrace, each home will only have two liveable floors, a fully autonomous vehicle will be utilized within the grounds, no apartments will be available, but there will 1,200 villas available as opposed to 500, and the Sustainable Plaza will instead be a community mall (The Sustainable City Sharjah, 2021). Other features for now present in TSC Dubai, such as the community facilities/spaces, EV charging ports and renewable energy generation from solar panels are being replicated. The adaptations are in part due to improving sustainability and are in part about appealing to the target market for this new development, which sales advisors in TSC Dubai shared is slightly different as the development want to attract local citizens as opposed to expatriates.

on actively improving their development and future developments as a result of resident feedback and critiques. Any future developments should also adopt this strategy.

3. Market Positioning of Sustainable Developments

3.1 Niche Market

A niche market is a highly specialized, typically limited market that appeals to a narrow group of potential consumers (Goering, 2009). More specifically, consumers of a niche market are "a more narrowly defined group seeking a distinctive mix of benefits" (Kotler, 2003, p. 280). At present, sustainable 'cities' and developments can be classified as such; there has been limited market penetration and also limited supply, largely due to the unique and small target market. However, in recent years there has been an increase in intentional green consumerism as buyers have become more aware of the impact of their purchasing choices. With the trend in green consumerism set to continue increasing in coming years, and as more policies are put in place to encourage greater investment in sustainable development, as well as uptake of sustainable residential options, it can be assumed that eventually, sustainable real estate developments will become mainstream, rather than remaining green housing niches. In fact, it can be argued that in recent years, this has already been occurring and that such sustainable developments are cropping up more frequently, slightly lowering the disjunction caused by excess demand as more green-living units become available for consumers. However, whilst this is a positive step towards future uptake and adoption, it will not be before such developments become ubiquitous that sustainable real estate, particularly that of the residential kind, will move out of its current niche positioning and into the mainstream market (Nelson, Rakau, & Dörrenburg, 2010).

3.1.1 Application to TSC & Dubai

In terms of the property market in the United Arab Emirates, and in particular, Dubai, The Sustainable City certainly occupies a niche market. At present, it is the only mixed-usage sustainable development within the Emirate, and only one of two fully operational sustainable residential developments within the UAE as a whole – the other development being MASDAR City in Abu Dhabi[10] .As a result, not only is TSC a differentiated real estate product through its sustainable focus and unique community features that, generally, attract specific niche consumers (e.g. – those willing to have a no car estate, those interested in sustainable living, etc.), but it is also a community that attracts more demand than it can meet. Moreover, as a consequence of this excess demand and niche market position, evident not just within TSC but across many sustainable housing markets worldwide, developers and property brokers have the power to charge a price premium for such properties, although there is no requirement to do so.

When a product, in this case sustainable residential real estate, holds a niche market position, this also calls for the use of niche marketing, an approach that varies from traditional market segmentation in that it is a bottom-up approach rather than top-down approach traditional with segmentation (Parrish, Cassill & Oxenham, 2006). What this means is that the customer base is gradually built up from a small starting base. In this case of TSC, it began predominantly for those interested in sustainability, but as will be discussed in the coming section, it expanded to attract a wider consumer market, who not only those who sought a sustainable home, but also a community that had many unique offerings. Interestingly, TSC now have very little need for marketing, if any, but in the beginning, they utilized social media campaigns, websites, and events to showcase their development and

[10] Masdar City, like TSC is mixed-usage sustainable development, but unlike TSC, Masdar city has had far less success with their residential units as a result of their focus being the development's commercial units. The development focuses on smart technology to pioneer and innovate sustainability strategies. Masdar City also follows the TBL theory of sustainability. The City is LEED green building certified in addition to being certified by Estidama, the local Abu Dhabi sustainable building certification (MASDAR, 2021). More information can be found at the development's website: https://masdarcity.ae

attract residents. Nowadays, the development's reputation speaks for itself, so much so, that as of April 2021, there are waitlists for those hoping to secure a residence in the community.

3.2 Price Premiums

Sustainable real estate developments often come with a price premium, that is, a higher price of purchase and/or rent than comparable, non-sustainable properties, otherwise equal in terms of unit size and product quality. It is approximated that prices for sustainable residential properties typically run at 2-5% premiums for rentals, and similar for sales (Feige, Mcallister &Wallbaum, 2013). This trend appears to be a global pattern, with research having been carried out in multiple countries with multiple sets of results supporting the conclusion of there being an existence of premium prices for properties with eco-certifications and sustainable design (Robinson & McAllister, 2015). Reasons for such price premium can be attributed to a number of factors, namely the higher costs of construction and purchase of materials associated with sustainable development (Feige, Mcallister &Wallbaum, 2013) and shortages in the supply and demand of sustainable real-estate. The latter can further drive-up prices through making such properties seem 'exclusive', unique, hard to come by and niche.

As a result, such price premiums that occur in sustainable developments position sustainable real estate options as more costly for consumers than comparable non-green developments. To some extent, the higher costs associated with this type of real estate make the ownership of eco homes somewhat exclusive to those in the upper-middle and upper classes who can afford to pay the premium. This is further suggested in a study conducted by Zhang (2010) which indicates that income levels are the "most important factor" in a consumer's decision of whether they adopt sustainable real estate or not (p.177). This conclusion is further backed up by research carried out in the United States and China that also indicated that an individual's income typically must reach over a certain threshold per month (respectively over 5000 USD in the USA and 1000 Yuan in China) before consumer

pragmatism comes to a cease and concern with contributing to the environment through eco-property consumption is seriously considered by or a viable option for a property purchaser or renter (Zhang, 2010).

However, price premiums of green real estate do not always occur. Some studies indicate that in areas of high market penetration/diffusion of sustainable property, both residential and commercial, the usual elevated costs of eco-property can somewhat be diminished (Robinson & McAllister, 2015). This is supported by findings from a Japanese study undertaken by Yoshida and Sugiura (2011) in which it was discovered that eco-condominiums in Tokyo actually sell at a price discount of 5.5% compared to non-eco-certified properties in the same area. The researchers attributed this to the fact that the market was already focused on many sustainable practices and use of innovative technologies, not to mention, the already forward-thinking culture present in Japan that encourages green consumerism, keeps demand for such offerings constant, and in turn, helps to maintain lower prices. Whilst this is completely plausible, it must also be noted that the area had an abundance of eco-buildings (a total of 34,862 condominiums over 1,154 green buildings) meaning there was no shortage in supply and demand, thus, also supporting the theory that high market penetration reduces the effects of price premiums on sustainable developments (Feige, Mcallister &Wallbaum, 2013).

In addition to the exceptions to the price premium noted above, there has also been criticism of the reliability and thoroughness of using hedonic analysis to confirm the presence of price premiums, despite this being the most common method for investigating price relationships in the real estate sector. Some researchers worry that the inevitable omission of variables in this type of analysis can at times mis-attribute the reasons for price premiums within the green real estate sector (Robinson & McAllister, 2015). It is argued that the isolation of variables in hedonic modelling to determine effect of environmental features on

real estate price can leave other pertinent price determinants (such as location of property, design, quality, and other factors that affect price in non-sustainable real estate) unconsidered and thus, wrongly attribute price premiums to sustainability features (Feige, Mcallister &Wallbaum, 2013). That said, hedonic regression remains the most widely used technique in real estate pricing, so, whilst a logical argument, it remains plausible that sustainable features result in a price premium; multiple studies have reached the same conclusion cementing the reliability of this fact and as a whole, sustainable properties are often more expensive than their equal non-eco counterparts that otherwise, possess identical price determinants. The validity of price premium as a consequence of eco-certification is also supported by Feige, Mcallister &Wallbaum's (2013) study into the effect of various elements of building sustainability on price premiums. Their research found that certain features of sustainability (energy and water efficiency, safety, security, health and wellbeing) had more notable impacts on price, thus indicating that green features can and do increase property prices. It also suggests that price premiums are incremental and increase as the number of sustainability features present in the property's design increase, thus supporting a positive relationship between price of a house and its sustainability.

3.2.1 Application to TSC

3.2.1.1 Method & Data Collection

To apply this principle to The Sustainable City in Dubai, secondary data was collected on both sale and rental prices of properties from TSC and three other residential developments within Dubai. The three other residential communities incorporated into the data include Arabian Ranches 2, Mudon, and Mira. These developments were selected for meeting a strict criteria below that outlined the property characteristics that were required for a valid comparisons. Such a system was put in place in order to decrease dissimilarity between the

estates and increase the homogeneity of the houses and communities, thus reducing - as much as possible - the potential for misattribution of factors other than sustainability when considering the presence, or lack thereof, of a price premium (Sopranzetti, 2015). The criteria used are outlined below:

1) The development of comparison must offer similar types of property: villas, ranging in size but at least offering up to four bedrooms.
2) The development of comparison must offer the same level of security: gated community
3) The development of comparison must have similar amenities within their boundaries: communal green spaces, play parks, shops, pools, etc.
4) The development of comparison must be located within a similar location or within near proximity to TSC: this will remove location bias and effect on price as much as possible

Table 4 demonstrates the property characteristics and community features of each of the communities chosen.

Residential Development	Property Characteristics	Community Features
The Sustainable City in Dubai	3 & 4 Bed Villas / Apartments / Kitchen Appliances Built-In / Solar-Panels / Energy Monitoring Appliances / Gardens / Balconies / Roof Terraces / Two Car Parking Spaces or Car Port / Terraced	Gym / Exercise Pool / Leisure Pool / Tennis Courts / Basketball Court / Green Playing Field/ Play-Areas / Running Track / Cycling Track / Biodomes / Animal Sanctuary / Shops / Schools / Equestrian Center / Allotments / Eateries / Outdoor Gym Trail / Gated
Arabian Ranches 2	3, 4 & 5 Bed Villas/ Gardens / All Villas with Car Ports or Garages / Balconies / Terraced or Stand-alone	Gym (additional charge) / Pools / Communal Gardens / Shops / School / Eateries / Play Areas / Outdoor Gym Trail / Gated
Mudon	3, 4 & 5 Bed Villas / Apartments / Terraced or Stand-alone / Gardens /	Gym (additional charge) / Pools / Play Areas / Walking Route / Community Gardens / Community Barbeque Areas / Shops / Eateries / Nursery / Outdoor Gym Trail / Gated
Mira	2, 3 & 4 Bed Villas / Two Space Car Port / Gardens / Terraced / Gardens /	Pools / Shops / Eateries / Community Gardens / Play Areas / Walking Paths / Cycling Paths / Outdoor Gym Trails /

Table 4: Comparison of Property & Community Characteristics (Own Table)

For each of the communities mentioned above, the aim was to collect data on the price per year/sale price, total square-footage of the property plot, and total square-footage of the properties build-up-area (BUA), which is the livable area of a property. For each developments, the goal was to collate data on at least ten property prices, however, due to differences in occupancy rates and availability of properties from each development, it was not possible to achieve this goal, and in some cases, as few as five property details were available at the time of data collection. Rental listings in particular were difficult to attain, and so for rentals, only five properties for each development were collected as data. This also ensured that weighting was similar for each development, rather than one development having ten pieces of data available, and another only five. To increase validity of results as much as possible, data collection on property prices was completed within a two-week period, in the same calendar month (15th -29th March 2021) in order to hedge against the constantly fluctuating property market and subsequent pricing variations over time.

Property details were sourced from listings posted on Property Finder[11], a popular and widely used property rental and sale website within the UAE. The site also displays helpful insights such as size and price trends within a particular area and compares these to the average price of a similar sized property. Whilst it can be argued that this is not the most reliable place to collect data from due to the occasional occurrence of falsified listings and property duplications (a ramification of the easy access to postings from multiple real estate agents), the site also offers a 'verified' listing badge awarded to property listings that have undergone additional scrutiny to confirm their validity. Consequently, such verified listings are considerably more reliable; the postings are confirmed to be true, the property is currently available, and the property's description is true to form, both in terms of images supplied, size of property mentioned, and all other details mentioned. In order to improve the

[11] propertyfinder.ae

reliability and validity of the data, only verified listings were included in the data collection. There was no particular method for data collection after this stage; the first ten verified listings (provided they included details on plot and BUA size) shown after searching were chosen. It should be noted however that plot size and BUA was not available for every property included in the data. Plot size especially was lacking for The Sustainable City when looking at rental listings and so to counter this, residents of the development provided the plot size for the various property options as stated on their tenancy deed to enable analysis to continue.

After collection, data was then analyzed to determine the mean and median of the price per square foot of the property, both in terms of total plot size and the BUA (built-up-area) size of the property. The reason behind comparing both price per plot square-foot, and price per BUA square-foot was to examine whether this varied, and if so, to attempt to explain why. In addition, this gave a more well-rounded, detailed picture of potential price premiums than simply considering one measurement whilst ignoring the other. It also allowed a better understanding of how to potentially market villas more successfully, for example, by advertising based on plot size or BUA based on whichever seemingly holds better value for money.

Lastly, a difference of means test was employed to garner knowledge on whether any difference in the mean prices of the various communities were in fact statistically significant or otherwise, with H_0 being that prices for TSC are not greater than comparable communities, and H_a being that prices for TSC are greater than comparable Dubai communities.

3.2.1.1 Results

When looking at The Sustainable City in Dubai, it is somewhat difficult to determine if a price premium exists as is typically expected amongst sustainable developments. This is

in part due to limited availability of market price data as a consequence of the presently high occupancy rate, seemingly low rate of resident turnover, and the lack of verified listings on PropertyFinder, especially with regards to TSC. Further discussion concerning limitations of results is provided in section 3.2.3.3.

When it comes to determining if a price premium is present, many discrepancies occurred as to whether this was the case or not, not only between quantitative data of various measurements (plot size vs BUA and buy vs rent), but also between the quantitative data provided and the qualitative data reported in residents' survey answers. Nevertheless, there are a few general trends and main conclusions that can be ascertained with regards to TSC, comparable Dubai-based developments and property prices.

3.2.3.1 Buying Price

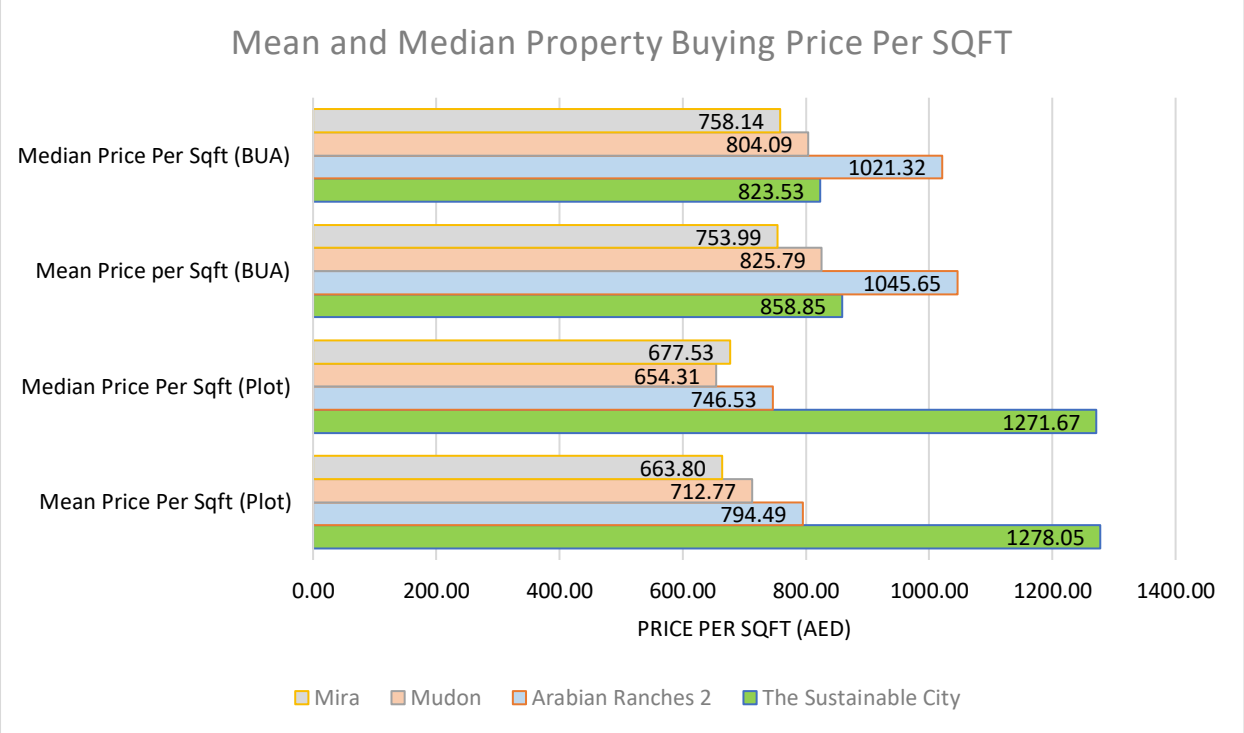

Figure 9: Mean and Median Property Sale Price Per SQFT (own figure)

In terms of sale prices of villas, the positioning of TSC's property pricing is variable. As seen in the Figure 9, based on the mean and median price per square foot of the total property plot, TSC is the highest priced development as opposed to the other comparable villas/communities in the area. This is indicative of a price premium because average property prices in TSC exceed that of the mean relative price (of the other three developments) by over 500 AED. This is particularly striking when considering that out of all of the developments, properties within TSC have a relatively small total plot size in comparison. By mean plot size in square-feet, TSC is smaller than Arabian Ranches 2 and Mudon, and when considering plot size based off of the median, TSC is shown to have the smallest of all plot sizes between the comparative communities (see Appendix G). Looking solely at this, concluding TSC does charge a price premium based on their sustainability seems plausible; more is being charged for less in terms of property plot.

However, when looking at data collected for the built-up-area (BUA) size of the properties in square-feet, a different story emerges. By both mean and median prices per square foot (BUA), TSC no longer has the costliest properties; Arabian Ranches 2 is higher priced based on price per square-foot. This is largely due to TSC having a higher BUA property size than total plot size. Unlike the other three developments that consist of only two-level villas, properties in TSC consist of three stories: two floors of living space, and a third floor with a useable roof terrace; the roof terrace being the element of TSC homes that make them the second largest sized villas according to mean BUA square-footage, and the largest based on the median. Based solely on BUA price per-square foot, the presence of a price premium for The Sustainable City becomes questionable. It also to some extent discredits the premium price found in plot price because it is well known that houses do typically increase in cost as their livable size increases, and as TSC homes are on average larger (whether the roofs are seen as utile or not by residents), it is plausible that they would

demand a higher price. Although on the contrary, one could argue that all homes within TSC are not larger than their comparatives, only the garden and signature villas, which made up multiple listings included in data analysis and thus, raised the mean in an unrepresentative manner. Such an argument – which is indeed valid – would once again align with price premiums and their existence in TSC.

That said, it must be remembered when considering the presence of price premiums per square-foot, both for total property plot and for BUA, that although one could make the argument that presence of a price premium indicates more is being charged for less (as previously stated), it can also be argued that more is not being charged for less in TSC, but rather that more is being charged for more, because when purchasing or renting property in TSC, residents also have access to copious shared communal spaces not as readily present in other communities. This argument is particularly pertinent as it relates to TSC and other sustainable developments because the trade-off of high density living requiring less personal space in order to allow for more communal space is imperative in TSC's goal of achieving social and environmental sustainability. Thus, recognizing the fact that less personal space welcomes more communal space, and that property purchasers are in part, paying for the privilege of said shared spaces, can refute the notion of more being charged for less, despite presence of price premiums.

3.2.3.2 Rental Price

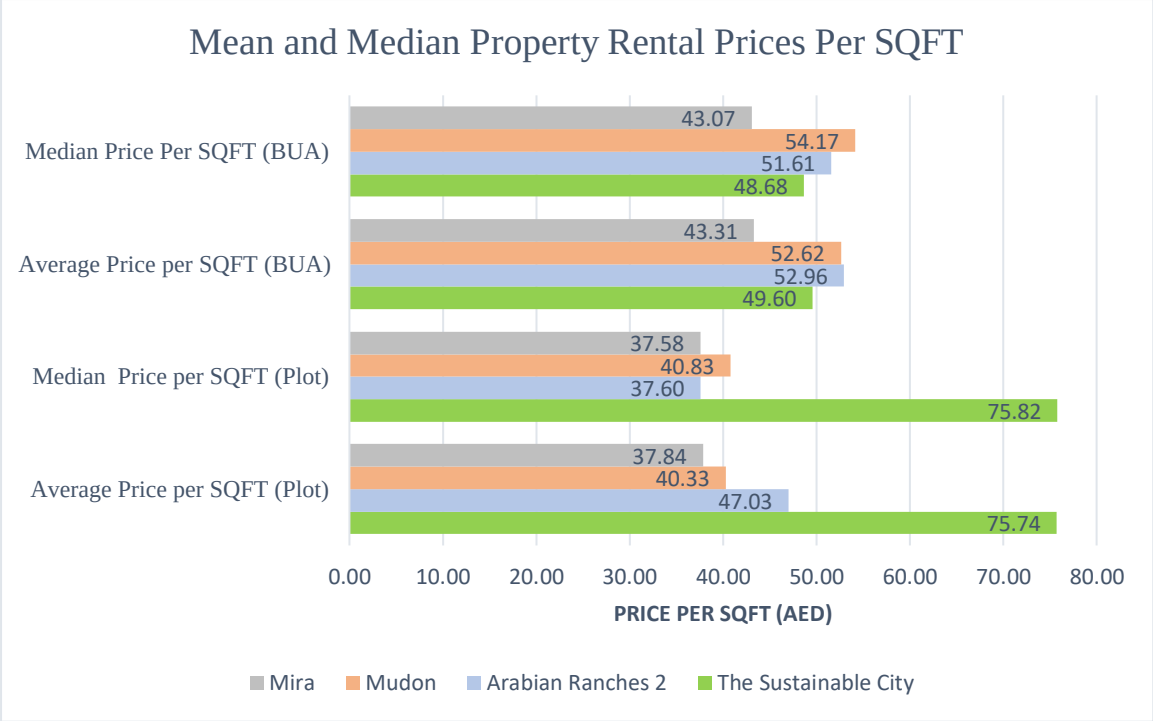

Figure 10: Rental Price of Properties Per SQFT (Own Figure)

Rental data for properties was considerably lacking, particularly for The Sustainable City; there was no available data on plot sizes on listings, and sales officers were unwilling to provide actual or approximate data for this metric, instead, residents provided this data. This seems indicative of a clever marketing tactic considering the BUA size of the villas in the community show more cost value and different price positioning in terms of comparable communities than when looking at price per total plottage. Unsurprisingly, the trend of the BUA size of TSC properties proving to have no evident price premium and instead appearing an economical choice, transcends the buying price and is also present when it comes to rental prices of property. Again, like with buying prices, despite TSC properties being the largest in size based on mean and median BUA square-footage (see Appendix I), they are not the costliest villas per square foot, implying no presence of price premium. However, like with the buying property of prices, when looking at property prices in TSC through the price per total plot in square foot, TSC appears to have a considerable price premium as opposed to other comparable communities. On average, villas in TSC cost 28.71 AED more per square

foot in terms of the property's total plot than the even the next most expensive development based on this metric, Arabian Ranches 2 (see Appendix H). Again, as discussed in the buying price section, this discrepancy between price per BUA and plot is most likely a result of the BUA taking into consideration the larger livable size of TSC villas (created by the third level roof terrace), despite the overall plot size of the villas being smaller on average than all of the other comparable properties (see Appendix I). In essence, what this means is that in TSC, livable space is greater, whilst outdoor land space of properties is less, however, this is arguably made up for by the abundance of shared communal spaces available to residents.

3.2.3.2 Difference of Means Test

	Buying Price		Rental Price	
	Price per Sqft (Plot)	Price Per Sqft (BUA)	Price per Sqft (Plot)	Price Per Sqft (BUA)
	The Sustainable City Dubai			
Arabian Ranches 2	H_0	H_a **	H_0	H_a **
Mudon	H_a **	H_0	H_a **	H_0
Mira	H_a **	H_0	H_a **	H_a **
	H_a ** = Statistically significant in difference of means test at $\alpha = 0.05$			

Table 5: T-Test Difference of Means Results Summary Table (Own Figure)

The pattern of inconclusiveness concerning whether a price premium exists in TSC remains a common trend when examining the statistical significance of the difference of means of the multiple communities. What the results of the multiple t-tests (see Appendices J – O) show is that not all of the means (those labelled H_0) are statistically different, suggesting instead the difference in prices between the property developments could be caused by sampling error. This may refute the notion that the difference exists because of a price premium, if the difference really exists at all. More specifically, when looking at the various Dubai communities, the results of the various t-tests (see Appendices J – O) indicate that compared to mean prices for TSC, there is only a significant difference in prices between

sales in Mudon and Mira (based on total plot), as well as Arabian Ranches 2 (based on BUA). Likewise, the differences of mean rental prices are also only significant between TSC, Arabian Ranches and Mira (based on BUA) and Mudon and Mira (based on total plot).

The discrepancies between whether the difference of means is statistically significant or not does not appear to follow any trend, with even the same developments having various significance results depending on the measurement used (BUA vs plot) and whether the property was a rental or a sale. Interestingly, only Mudon and Mira were consistent to any extent; both of these developments proved to have statistically significant pricing differences per square foot of total plot than TSC for both rental and sale prices, thus providing some indication that in comparison to these developments, a price premium for TSC does occur. The lack of consistency amongst other measurements and developments is perhaps insinuating that these results indicate that there is only a price premium between TSC and certain comparable estates, which is of cause an entirely plausible conclusion. However, this insinuation can be diminished as a result of the argument that no one development is statistically significant or statistically unsignificant across the board, thus, it seems more plausible that the results are, at least when considering short-term data, indeterminate. All in all, the measures of central tendency combined with the difference of means test clearly demonstrate that the data is varying and inconclusive. It is uncertain whether a price premium exists or otherwise within The Sustainable City Dubai. Long-term future data collection combined with a larger sample of verified data would help establish a conclusive relationship.

3.2.3.3 Price Perception

Whilst there is no clear indication of a price premium associated with property in The Sustainable City based off of quantitative data, multiple residents did note that they felt a price premium certainly is present when it comes to property prices in TSC as opposed to

other comparable communities in Dubai. Whilst answering their surveys, multiple residents stated in question 24, an open space provided for residents to mention anything they felt important to the research, that they believed TSC did carry a price premium. One respondent wrote, “I think that it is more expensive to live [in TSC] than other communities of comparable villa size”. Another stated, “house rent is higher compared to other communities”. Contrary to the inconclusiveness assumed from the quantitative data, this would suggest that, based on price perceptions, there appears to be - or at the very least there is perceived to be – a price premium associated with TSC properties.

The price perception of residents is important because to some extent, it can provide better insight than the limited quantitative data collected short-term. Many residents within TSC have resided in the community for numerous years, either as the renters or property owners of their inhabited unit, and so, their long-term experiences with pricing of TSC and its relation to Dubai can provide valid cognizance that the quantitative data could not. Interestingly, this price perception appears to be somewhat common in Dubai.

3.2.4 Limitations of Results

It must be recognized that the findings from this data collection and subsequent analysis are not comprehensive. As such, the results may not be able to be generalized beyond the specific dates and times of data collection. Specifically, three major issues lie in The Sustainable City and Dubai property price premiums analysis. Firstly, the data was only collected over a short period of time which is problematic because short term data collection does not provide a comprehensive picture of Dubai property prices (and potential premiums) as they fluctuate over time. Consequently, without the ability to view long-term data, the results of this price premium analysis are unable to show any form of pattern or trend that one would expect to see overtime that would allow confirmation or refutation of a price premium or lack of. This critique provides further scope of research that could be undertaken in the

future; prolonged data collection concerning rental and sale prices of properties in TSC versus comparable Dubai-based developments would enable trends to become visible and would also make the data more applicable to be analyzed using models such as hedonic, OLS and/or quantile regression in an attempt to isolate the independent variable of sustainability.

The second issue with this method was that the property transaction prices were not available, only the listed prices of the real estate, the two of which are not necessarily unvarying, and are in fact, quite frequently different. This is problematic as to truly confirm or refute whether a price premium exists or otherwise, not only is long term data required, but it is also necessary to know the actual price paid for the purchase and/or rent of the property, else, the data may not portray an accurate picture, instead, suggesting a potentially lower or higher listed price than what consumers verily paid in the buying transaction. Consequently, without this information, the conclusions drawn from this method can be argued to be unsound, although, for the purpose of this investigation the data used, and the succeeding results are suitable in providing time-specific conclusions concerning property prices.

Finally, the third notable limitation of the method used to determine price premiums of housing developments in Dubai is that the volume of data available for collection was sparse. This was less than ideal, however, due to not having access to data from previous years, only listings published at the time of research could be sourced, collected as data and used in analysis. In addition, being limited to the collection of only 'verified' property listings increased the sparsity of data available. While this is not tremendously problematic, the small scope of the data set does impede the generalizability of any conclusions drawn from the data, especially in data sets where there was missing information. The small scope of data also impedes descriptive statistics, particularly when calculating measures of central tendencies due to higher weighting/importance being placed on each individual piece of data collected. Consequently, it is imperative to recognize that the results would likely look very

different if using large data sets containing information on house prices in TSC versus comparable communities over time rather than short-term.

3.4 Target Market

3.4.1 Expected Consumer Profile of Sustainable Real Estate

The expected consumer profile of those looking to purchase and/or rent sustainable property has a few key features. As previously discussed, due to the typically high price of such properties, and the premiums associated with them, consumers are most likely to be upper-middle- or high-income earners who have the ability to make purchases for un-pragmatic reasons, because as Robinson & McAllister (2015) stated, there is a positive relationship between affluence and adoption in the consumer market for sustainable real estate. This indicates that consumers with higher opulence are the current target.

Due to the need for higher incomes, it can also be expected that consumers interested in sustainable developments will predominantly be older than the typical young and/or first-time property buyers, likely aged 30 years or older, although this does depend on expendable income because as Zhang (2010) stated, income level is the most prominent factor in determining the consumer profile. The reason for this assumption that more middle-aged individuals will fit the consumer profile for the sustainable real estate market is because often – although not always the case - people will typically acquire wealth and thus become more prosperous with age. This is often a consequence of a variety of factors including rising salaries, return on investments and financial savings to name but a few.

In addition to age and income levels, Zhang (2010) also implies that individuals with a higher education level are more aware of sustainability issues and more passionate/concerned about finding ways to rectify them. Oftentimes, this is materialized through a desire to be a ‘green’ or sustainable consumer. Consequently, individuals with

higher educational levels are attracted to the purchasing and/or renting of sustainable residential developments. However, that being said, green consumerism is not a consumer behavior linked perfectly to education level, and people of all backgrounds and educations, can be equally as concerned with environmental justice and the engagement of sustainable consumerism. That leads on to another expectation of the consumer profile for sustainable real estate developments: that the customer is to some extent, environmentally aware and concerned.

It is also important to note that in some instances, a consumers decision to purchase and/or rent sustainable property may be completely unrelated to the sustainability features of a residential development, and instead be related to other desirable aspects the community may offer such as location, style of homes, surroundings, facilities, amenities, etc.

3.4.2 Application to TSC

3.4.2.1. Consumer Motivation/Intention

Due to its location in Dubai, a host city to expatriates from across the globe, The Sustainable City attracts a wide range of individuals, hailing from various parts of the world, all looking for different features within the property market. As such, the typical consumer profile is particularly reliant on having a deep understanding of an individual's motivation to live within the community, perhaps even more so important than understanding the demographic. Information on this was gathered in question 4 of the residents survey (see Appendix B).

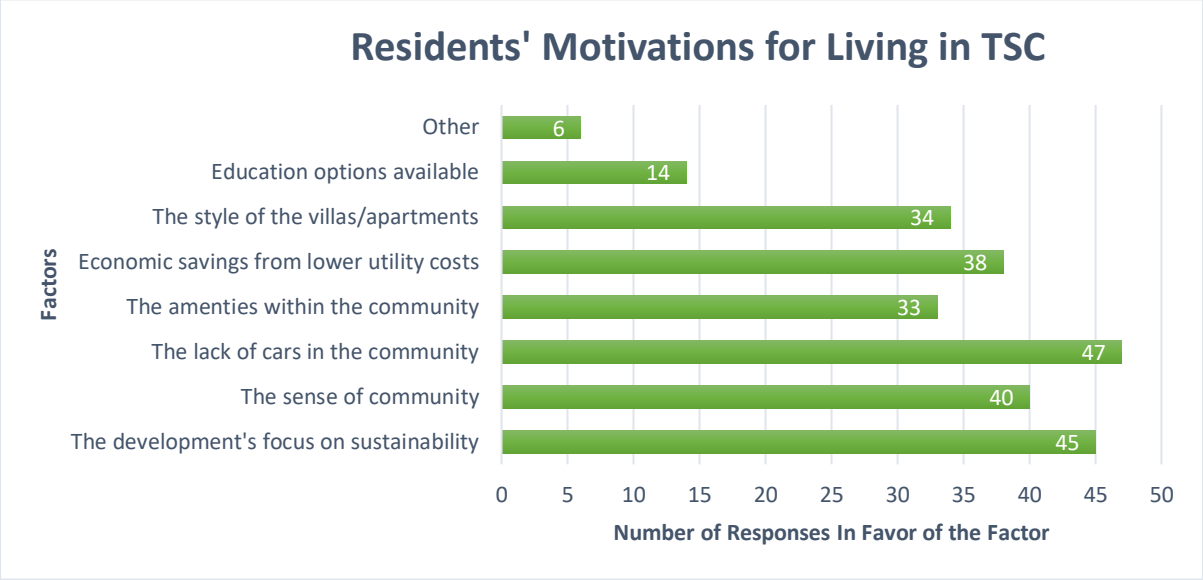

Figure 11: Motivations of Residents for Living in TSC

As Figure 11demonstrates, whilst sustainability is one of the most important motivations for TSC residents choosing to live in the development, it is not overwhelmingly so, and in fact, another factor, the lack of cars within the community had more respondents select this as a main motivator. This graph shows that based on respondent count alone, the three most commonly selected, thus arguably also the most important factors contributing to consumer intention of purchase and/or renting within TSC, are the development's no-car internal design, its focus on sustainability and its sense of community. Other highly selected factors include the economic savings the development provides through lower utility costs, the style of the properties, and the amenities within the compound. Considerably lower in importance when it comes to choosing to live in the development are the education options available and other options. Ultimately, what this graph demonstrates is that not only individuals looking to support green property consumerism choose to make TSC home, but also those who want to benefit from the many other features of the development. This graph also demonstrates that there is no one factor that is a universal motivator for all residents of TSC; 71 respondents answered the survey, but no one factor had 71 responses indicating it to

be motivator. Table 6 below shows a clearer picture of the percentage of total respondents who selected each factor as a motivator for them.

Community Factor	Percentage of Respondents Selecting Factor as Motivator
Lack of cars in community	66%
The development's focus on sustainability	63%
The sense of community	56%
Economic savings from lower utility costs	54%
The style of the villas/apartments	48%
The amenities within the community	46%
Education options available	18%
Other	8%

Table 6: Percentage of Total Respondents Selecting Each Factor as a Motivator for Choosing TSC (Own Table)

The breakdown of the 8% of other motivations stated by residents that were not included in the selection list can be seen in Figure 12 below and indicate that other reasons for choosing to live in TSC include the landscape of the community, its pet friendly and child friendly atmosphere, and the presence of work places located in the community too.

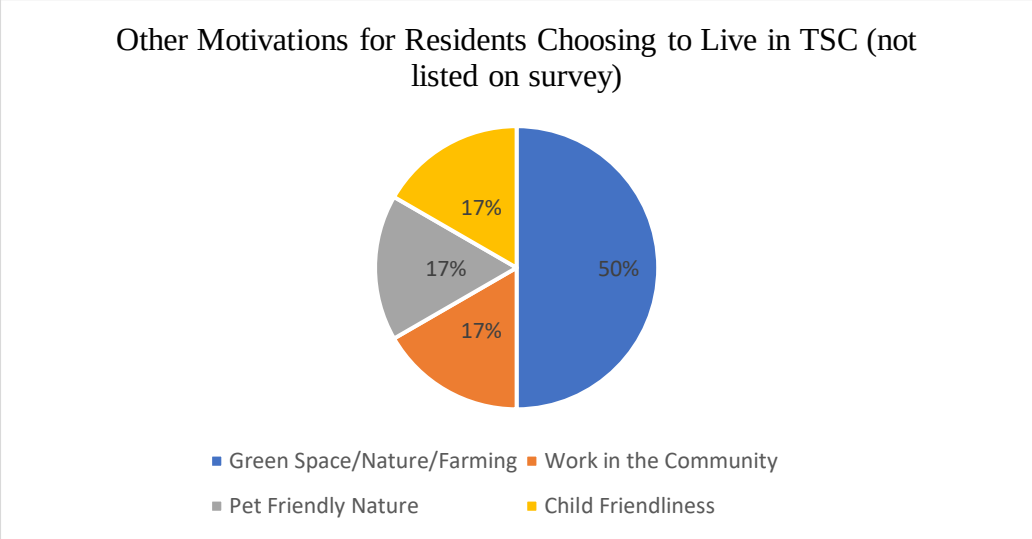

Figure 12: Other Motivators for Choosing to Live in TSC not listed in survey (Own Chart)

Furthermore, in addition to selecting which factors motivated residents to choose TSC, survey respondents were asked to then rank those they selected in order of importance, with 1 being the most important. Figure 13 below shows a summary of the results.

Ranking of Importance of Each Factor in Motivation for Living in TSC

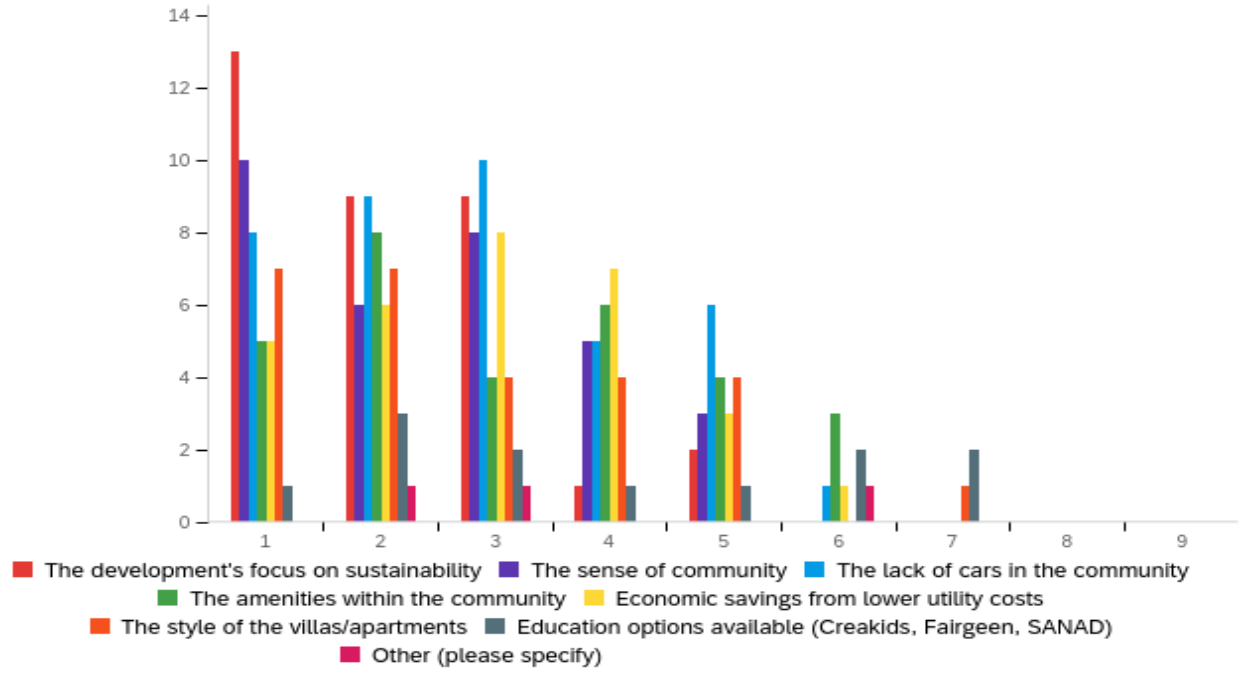

Figure 13: Ranking of Motivators for Living in TSC (Qualtrics Survey Results)

The graph indicates that when asked not only to select motivators, but to rank these in order of importance, the overall factor respondents most commonly ranked as having the highest level of importance in their decision to live in TSC was the development's focus on sustainability. This is followed by the sense of community being ranked as having the second highest importance overall, the lack of cars being ranked third most important, style of properties being fourth, and amenities, economic savings and education options respectively ranking joint fifth and sixth. 'Other' was not listed as the number one factor on any of the residents surveys; it was always ranked second most important or lower.

Of course, it must be recognized that each survey respondent potentially (and likely) had a different selection of motivations that were important to them, which consequently would have produced multiple various mixes of factors to then be ranked. To better understand how each factor is considered in line with importance, a table was constructed (Table 7) to show the various positioning of each factor, relative to where the majority of respondents (by percentage) placed it.

Factor	Percentage of Total Selected Factor Per Ranking (%)						
	1	2	3	4	5	6	7
The developments focus on sustainability	**38.24**	26.47	26.47	2.94	5.88	0.00	0.00
The sense of community	**31.25**	18.75	25.00	15.63	9.38	0.00	0.00
The lack of cars	20.51	23.08	**25.64**	12.82	15.38	2.56	0.00
The style of villas/apartments	**25.93**	**25.93**	14.81	14.81	14.81	0.00	3.70
Economic savings from lower utility costs	16.67	20.00	**26.67**	23.33	10.00	3.33	0.00
The amenities in the community	16.67	**26.67**	13.33	20.00	13.33	10.00	0.00
Education options	8.33	**25.00**	16.67	8.33	8.33	16.67	16.67
Other	0.00	**33.33**	**33.33**	0.00	0.00	**33.33**	0.00

Table 7: Ranking of Factors Based on Percentage (%) of Total Selected Per Factor (Own Table)

This table provides deeper insight into the factors residents find most pertinent. Whilst sustainability was not the factor with the highest count of respondent selections, this table demonstrates that those who did select sustainability as an important motivator for them choosing to live in TSC, typically consider this to be the most important factor for their choosing to live in TSC. If sustainability was not their top factor of pertinence, then respondents predominantly ranked this is in their top three motivations. This is seen by the fact 38.24% of respondents who selected sustainability as an important factor in their decision ranked it as the most important motivator, and only 8.82% of respondents who

selected sustainability of the development did not rank this in their top three motivators for choosing TSC over other comparable communities. This clearly demonstrates that, as with the expected consumer profile of sustainable development purchasers, many of the residents are aware of sustainability issues and wish to be green consumerism helping to combat such problems.[12]

Following this pattern, respondents who selected the sense of community in TSC as one of their main motivators to live there ranked this as extremely important factor, with the majority (31.25%) ranking this their top reason, and 75% of respondents ranking this in their top three motivators.

Interestingly, whilst the lack of cars in the community had the most respondents select this as a critical factor for moving to TSC in terms of total frequency, the majority of respondents by percentage placed this as third in the rankings of importance. Despite this, the factors importance cannot be mistaken as over half (69.23%) of respondents did place this as one of their top three motivators.

Similar results were shown for residents who selected economic savings from lower utility bills; overall, the majority placed this third, however, exactly half of respondents who selected this factor placed it in the top three factors of importance. A similar pattern is also found when looking at amenities within the community, education options and 'other'.

Another interesting pattern that emerged was that amongst those respondents who selected the style of the properties in TSC as a main motivator, over half ranked this as one of their three most important factors, indicating that style is perhaps a much more important motivator amongst residents who are looking for that, as opposed to other community features.

[12] It should be noted however that as this survey was on sustainable developments, there may have been some self-reporting bias when it came to this motivator as survey respondents were aware the survey concerned sustainable developments, and as such, may have felt pressurized into selecting that they felt sustainability of developments was an important decider in their decision-making process when in actual fact it was not.

All in all, what this table essentially demonstrates is the various extents to which respondents who selected each factor are concerned with them. The general trend would suggest that if a respondent selected the factor as a motivator, said factor is a large contributor to their decision to live in TSC, as demonstrated by the fact that most individual factors had all of their rankings clustered in the top three spots (1, 2 or 3). This table also demonstrates and supports previous data analysis throughout this paper that states that a range of consumer intentions exist in choosing to live in TSC, not just sustainability, although that is a large, and salient factor for many residents.

3.4.2.2. Consumer Age

The typical age of TSC resident survey respondents fell between 31-50 years of age, with the majority of survey respondents (46%) falling into the 41–50-year-old category, and the second majority of respondents (41%) falling into the 31-40 age bracket. Only 13% of respondents fell outside these two age brackets, with no respondents in the 18-20 category or the 60+ category, likely due to visa and residency rules within the UAE.[13] To some extent, the missing respondent age groups can be somewhat indicative of a lack of sustainability, particularly social sustainability, as the lack of elderly individuals creates a lack of age diversity in the community. Although amongst expatriate residents especially, this is more so a systemic issue than an isolated issue applicable to TSC. For the most part, this demographic pattern is consistent with the wider breakdown of the UAE population demographic.

[13] To be resident in the UAE, you typically need to have current employment in the country or a sizeable sum of money in savings to retire. Many residents choose to retire elsewhere accordingly. This provides explanation as to why it appears there is a small/nonexistent over 60 population in TSC, that transcends into the general UAE demographic. The 18-20 population is also somewhat lower than other demographics in the UAE as many expatriates return home after finishing secondary education and/or for further study.

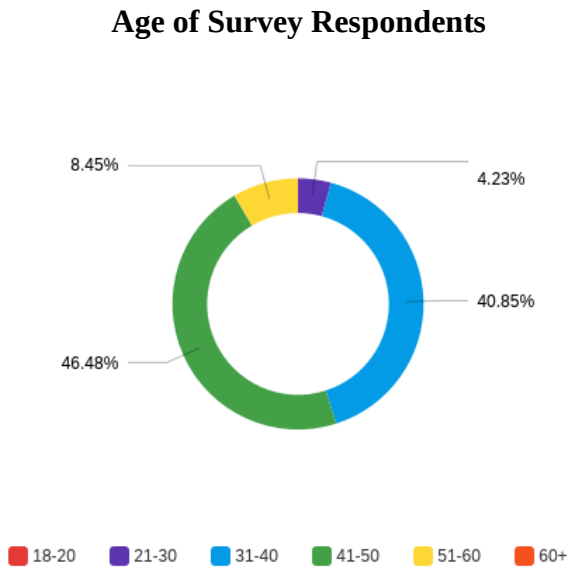

Figure 14: Percentage Breakdown of Age of Survey Respondents (Qualtrics Survey Results)

The generalization of the age breakdown of TSC resident survey respondents supports the expected consumer profile of sustainable property buyers/renters as being older and likely middle-aged. It is uncertain in the case of TSC though whether this age demographic is a result of higher income and/or savings by this point. The question of income levels was not asked due to its limited importance in the Dubai housing market. Income can oftentimes be unrelated to willingness to pay for property as many employers in the region will provide some or all of the cost of a home for the employee and so, income of an individual cannot guarantee any correlation.

4.4.2.3. Consumer Lifestyle

Whilst specific lifestyle preferences of residents were not determined within the residents survey, one major lifestyle factor was: whether or not respondents had children. According to question 13 of the survey, the vast majority of respondents do have children (see Figure 15).

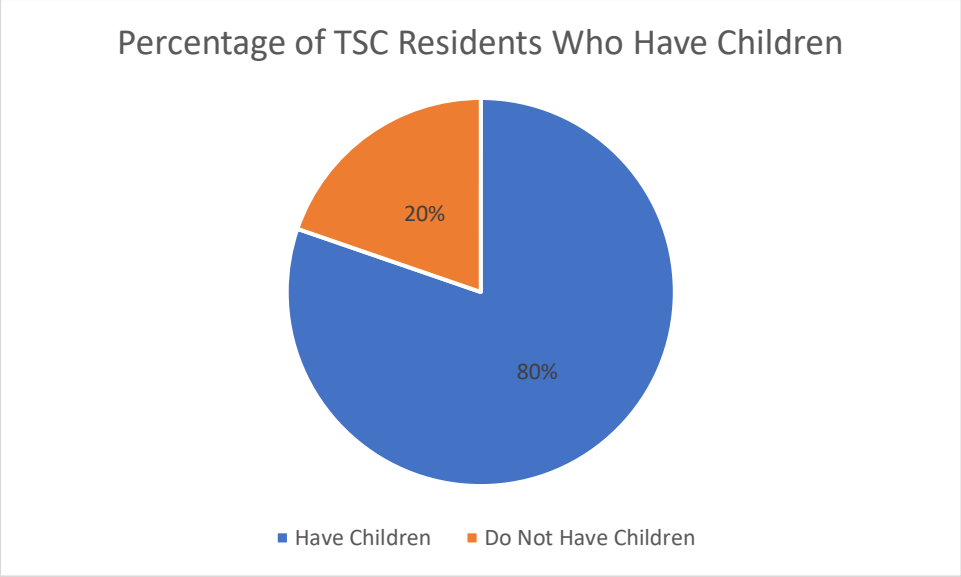

Figure 15: Percentage of Residents With & Without Children (Own Chart)

Oftentimes, individuals with children, especially those of a younger age, are likely to look for a place to live that can also cater for offspring, as well as adults. TSC has many advantages for those with children including on site educational facilities, playparks, children's clubs/classes, the animal farm, and children pools just to name a few. Thus, it provides an ideal environment for residents with children.

Other notable lifestyle-based consumer segments TSC may attract as a result of their facilities include athletes (as a result of the many on site facilities), gardeners (as a result of their being allotments), and of course, those aiming to follow a sustainable or eco-friendly lifestyle. Finally, The Sustainable City Dubai also attracts those individuals who want to enjoy the lifestyle TSC offers, with green spaces, community events, and amenities on site. As discussed earlier, it can be argued, to some extent, that TSC offers prospective consumers a unique lifestyle in Dubai, which itself attracts consumers.

3.4.2.4. Consumer Profile Summary

It is necessary to note that the unique nature of the property market in Dubai, and the UAE as a whole, can also mean that the typical sustainable development consumer profile is

somewhat diversified in this specific location. The Sustainable City Dubai offers so much more to residents than just sustainability, and when moving there, prospective residents are likely to consider far many more aspects of the community holistically than just its sustainability alone. This is especially true in the area, as TSC is not just differentiated by being a sustainable community, but also by its inclusion of multiple other features that are unique to TSC such as the car-free internal area, biodomes, the animal sanctuary, and the ability to urban farm. This means that whilst TSC certainly does attract many of its residents as a result of its sustainability goals, the development's consumer profile is exceptionally diversified and can draw people in who have no interest in sustainability, as demonstrated by the survey in which 26 (out of 71) respondents expressed sustainability was not one of their main motivations for moving to the community.

It is also important to note that the consumer profile of TSC varies in terms of ownership of the properties. Only approximately 250 residential units within the development are privately owned, by home owners living in their properties, or investors, using their properties for rental income. The remainder of the 500 units are owned by Diamond Developers and are occupied by either long- or short-term renters. This creates an interesting dynamic where the vast majority of residents in the community are renters, whilst only some are home owners.

4. Discussion

4.2 Barriers to Mainstream Market Penetration

One of the major problems in increasing the market penetration of sustainable developments, particularly of the residential real estate kind, is that there are many actual and perceived barriers to adoption, both for property developers, and for property consumers. Until these actual and perceived barriers are respectively broken down and distilled, it is unlikely that market penetration will increase significantly. This is unfortunate, because increased

penetration would not only reduce some of the actual barriers present (through the economics of supply and demand), but also increase visibility, and in doing do, erode some of the misconceptions of sustainable development that further prevent widespread adoption.

4.2.1 Deterrents for Developers

There is a great deal of concern amongst property developers that the cost of developing sustainable properties is higher than that associated with typical real estate. In particular, developers worry that their upfront costs for sustainable developments would be greater than those typical when producing non-sustainable real estate, predominantly as a result of sourcing sustainable materials and green technologies for construction (Turner, 2017; Feige, McAllister & Wallbaum, 2013). Additional costs associated with sustainable real estate further perturb developers who don't want to have to budget extra expenses for qualifying steps, such as permit and certification fees, not to mention the protracted timelines often linked to sustainable real estates as a consequence of low impact development and sustainable working conditions (Carter, 2009; Bowman & Thompson, 2000). Providing sustainable working conditions for laborers is a particular deterrent in developing countries where labor standards are often low, and workers can be sourced unsustainably to work longs days for cheap wages. As such, developers pursuing green real estate should avoid such labor, but in countries where this is the norm, sustainable construction and working conditions can seem an even greater cost to the developer.

The other main deterrent of developers when it comes to building sustainable real estate is that developers often face concern with such projects that return on investment (ROI) is less secure, especially because of increased forward costs. Many developers worry that property buyers may be unwilling to pay the necessary price premiums, that the benefits of sustainable real estate may not be reflected in property value, that there is a lack of consumer awareness and thus demand may not be ample (Gallupo & Tu, 2020). Ultimately,

the overarching concern is that the cost-benefit trade off will not be sufficient for developers to put their efforts into sustainable options, especially since at present, developers cannot benefit through economies of scale in this industry (Singh, Walsh & Mazza, 2019). However, for developers who can finance the upfront costs, there is evidence that consumer demand and willingness to pay generally does exist and that the lack of market interest is predominantly a misperception on the developers part (Gallupo & Tu, 2010).

Although this research was not carried in Dubai or the UAE, it is plausible that it would also be applicable within the borders of the country, especially considering the UAE's new focus on sustainability efforts and apparent popularity of already existing sustainable developments. The notion of Gallupo and Tu (2010) that consumers are willing to pay the price of sustainable developments is further supported by primary data findings from the TSC residents survey which indicates that over 60% of survey respondents would be willing to pay a premium to live in such a community.

Would you be willing to pay a higher price than for the average property to live in a sustainable property/community?

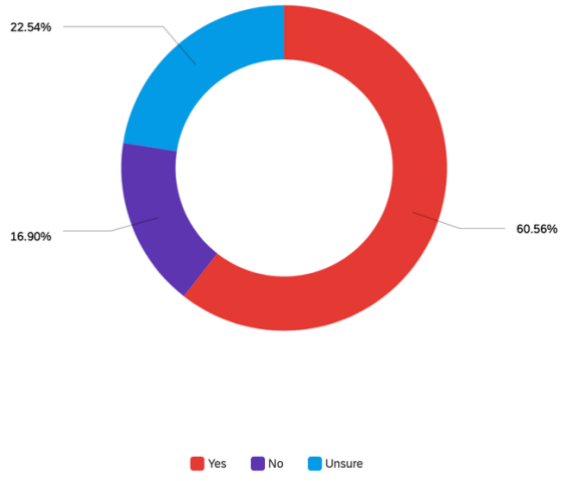

Figure 16: Percentage of survey respondents indicating they would be willing to pay a higher price than average for a sustainable property/community

This indicates that prior research undertaken in other markets concerning willingness to pay is generalizable to the UAE, although further research with a larger sample size of respondents would be needed to absolutely confirm this. Additionally, future research amongst non-sustainable development residents would be necessary to ensure that results were not skewed or made unrepresentative as a consequence of selection and demand bias of the respondents.

Interestingly, many of the perceived and actual barriers of sustainable property development can be removed if supply of such properties increases and such an increase in accompanied with the correct national collective culture and ample policies and legislature in place. However, developers and investors must also recognize that whilst rare, sustainable residential real estate does not always carry a price premium, and in such cases, developers may not reap any financial benefits at all, because it would be the property occupants who benefited from the sustainability features (Feige, Mcallister & Wallbaum, 2013).

4.2.2 Deterrents for Property Consumers

A major barrier that consumers face when considering whether or not to become residents of the sustainable real estate market is the presence of price premiums for such properties (Zhang, 2010). In some cases, this is a barrier of choice, but in many more cases, this is a barrier of unaffordability. Resultantly this limits the market for sustainable developments and prevents sustainable housing accepters from becoming adopters. It is also possible that even in instances where a price premium does not exist, a perceived price premium can be just as much of a barrier. Unfortunately, as per economic theory of supply and demand, only with increased uptake will price premiums fall, unless governments provide tax

breaks, subsidies, and other incentives to reduce the equity gap between those who can, and cannot, afford to consume sustainable residential real estate (Goering, 2009).

A further major barrier faced by consumers is lack of knowledge concerning the importance and benefits of sustainable residential developments, which in turn can lead to skepticism and reluctance to adopt sustainable housing, especially when cost is brought into the equation (Singh, Walsh & Mazza, 2019). Thus, this highlights the importance placed on the real estate industry and sustainability advocates to further educate people on the necessity, importance, and positive impacts that sustainable residential developments provide, not only to the Earth, but to the consumer/resident of such properties too.

4.3 Impact of Polices & Legislature

Collective culture, policies and legislature are also paramount considerations. This was made evident in the previously discussed example of Japan that demonstrated that when a focus on sustainable living and sustainable development is present, market acceptance and penetration is far more successful, not to mention that the resultant mainstream nature of such developments then drive down the associated premiums in price (Yoshida & Sugiura, 2011). What this example also demonstrate is that when a common culture and commitment of and to sustainability is established nationally, developers and consumers alike are more willing to adopt, barriers are reduced, and the overall impact of sustainable development is heightened as a consequence of increased occurrence.

Furthermore, it stands to reason that countries with a larger commitment to sustainability are more likely to facilitate the acceptance and penetration of sustainable developments into the housing market. For example, the United Arab Emirates has reaffirmed its commitment to sustainability in recent years through setting multiple nation-wide goals focused on improving the country's social, economic and environmental sustainability. It is no coincidence that in line with these goals, the UAE has made strides in becoming more

sustainable, opening up multiple renewable energy production plants (solar and nuclear), rolling out new national green building standards, and becoming home to multiple sustainable, and smart sustainable cities (MASDAR City, TSC, and TSC Sharjah). Had the UAE not had such a strong commitment to improving sustainability, it is unlikely such great leaps forward towards a more sustainable future would have been achieved in such a short period of time.

However, that said, a common culture alone will unlikely be as impactful as policy and legislature focused on improving sustainability, especially in the developed world. Policy and legislature have the power not only to encourage acceptance and adoption of sustainable residential developments, but also to incentivize greater development and purchasing of sustainable housing, both for the developers and property occupants. In fact, the impact of policy and legislature is so pertinent as it pertains to this topic that multiple academics in the field argue that without government backed support and regulations to encourage and incentivize sustainable housing, market acceptance and adoption will remain limited due to equity gaps in affordability, which in turn, continually limits market penetration/saturation (Goering, 2009). Jordan (2008) and Turnpenny (2009), both argue that momentous commitment from governments to increase acceptance and adoption of sustainable real estate is one of, if not, the most critical factor in creating change. Thus, it stands to reason that 'until governmental incentives, tax policy, and regulations act coherently to support both innovation and technological improvements…social equity gaps will remain, and green building will remain more fashion than necessity for longer than is necessary' (Goering, 2009, p. 192). Only with governmental commitment in the form of policy and legislature will there likely be a significant change in the current uptake of sustainable housing, despite the fact that many consumers are willing to pay, because regardless of that fact, many more developers and consumers alike are unable to afford the steeper forward costs.

4.4 Overall Impact of Sustainable Developments

It is evident just from considering the case study of The Sustainable City Dubai alone, that mixed usage and predominantly residential sustainable developments host a wealth of benefits, not only for the natural environment, but also for the individuals that live/work in them, and the economies they function within. Whilst sustainable property developments have a limited impact at the macro level, there is no denying their positive impact at the micro level, nor is there any denying that should sustainable real estate become part of the mainstream residential property market, the impact of said developments would significantly expand and have a far greater likelihood of positively impacting the macro level environment, economy, and social sphere too, however, we are currently far from this point. However, it must also be noted that this paper examined only one such residential sustainable development, and the impacts of other developments may not mirror the findings from this case study, particularly because of the uniqueness of this entity in blueprint design and as a planned community, in addition to its geographic positioning.

Nevertheless, the case study of TSC Dubai has demonstrated that residential sustainable developments have the ability to reduce energy/water consumption, waste, and carbon emissions all whilst protecting/safeguarding the natural environment. It has also demonstrated that through circular economy principles, economic stability can be improved, and individuals can benefit from reduced living costs, not to mention the benefits they also receive at the social level.

All in all, the case concreted the notion that sustainable cities/developments are advantageous and worthwhile projects that produce both tangible and intangible benefits that directly reduce pressure on some of the most pressing triple bottom line sustainability concerns of the 21st Century. Although of course, the extent of such a reduction is specific to each individual sustainable development and the effectiveness of it design.

5. Conclusion

Overall, there is no doubt that The Sustainable City Dubai provides many unique and positive impacts pertaining to the triple bottom line theory of sustainability. The comprehensive passive and active strategies that the development employ are for the most part, demonstrated as being highly effective and a major contributing factor to the attainment of the developments sustainability goals. This in turn positively impacts the micro and macro environment by reducing the pressure placed on natural resources and reducing the emission volumes of gases that actively contribute to global warming.

TSC already has a large impact on micro level sustainability; the development influences positive behavioral change as it concerns individuals environmental habits, directly impacts the environment by lessening many unsustainable natural pressures, and it helps create more positive, circular, and perhaps more important, sharing economies. The case study of The Sustainable City in Dubai has demonstrated that benefits of sustainable communities are not just the impacts that can be tangibly measured, such as reductions in energy consumption and greenhouse emissions, but that there are countless intangible impacts such developments produce too, which are conceivably more impactful in the long run. Consider the education, mindset and commitment to sustainable living that residents in such communities are exposed to, and how being equipped with such knowledge and skills concrete the importance of future sustainable real estate development into young minds, inspiring them to live their lives in sustainable manners. Communities such as TSC are beneficial not just for the planet, but for humans, social and economic prosperity too. The impacts of such developments that incorporate the triple bottom line (TBL) theory of sustainability are immense, and have an overall important, impactful role in combating the sustainability problems facing the 21st Century earth. Following on from TSC, it can be implied that sustainable developments more generally could also encompass these impactful

benefits, although, the extent to which each sustainable development is effective varies and may not necessarily reflect the findings from The Sustainable City Dubai, especially as this entity is unique in terms of design blueprint and geographic location.

Whilst the powerful impact of such developments is recognized, it is also important to be cognizant of the fact that presently, wider impact of sustainable developments is limited, largely due to lack of market acceptance and penetration of such projects within the real estate industry. Consequently, the TBL benefits of green developments fail to extend beyond the micro-level of sustainable impact into the macro-level. For the impacts of eco-communities to become macro, far greater market penetration, acceptance and uptake would need to occur, so much so that sustainable real estate options were no longer considered niche offerings, but mainstream options.

Whilst this could be achieved through widespread replication of existing models for sustainable residential development, or the creation and implementation of new ones, sustainable real estate development is unlikely to move up through the product lifecycle without support from decision-making entities, particularly in the form of policies and legislature designed to incentive both developers and property purchases to invest in the adoption of sustainable real estate. This is especially true in countries where there is not already a common culture and sizeable commitment towards a more sustainable national future as in these cultures, developers and consumers alike will be even more unwilling to pay any early price premiums occurring before widespread market penetration. Thus, if sustainable residential development is to have even a change of becoming mainstream in the marketplace, change must be implemented top-down in the form of governance, and also bottom-up, with conscious consumers and sustainability advocates pushing to educate individuals on the importance and value creation such communities possess.

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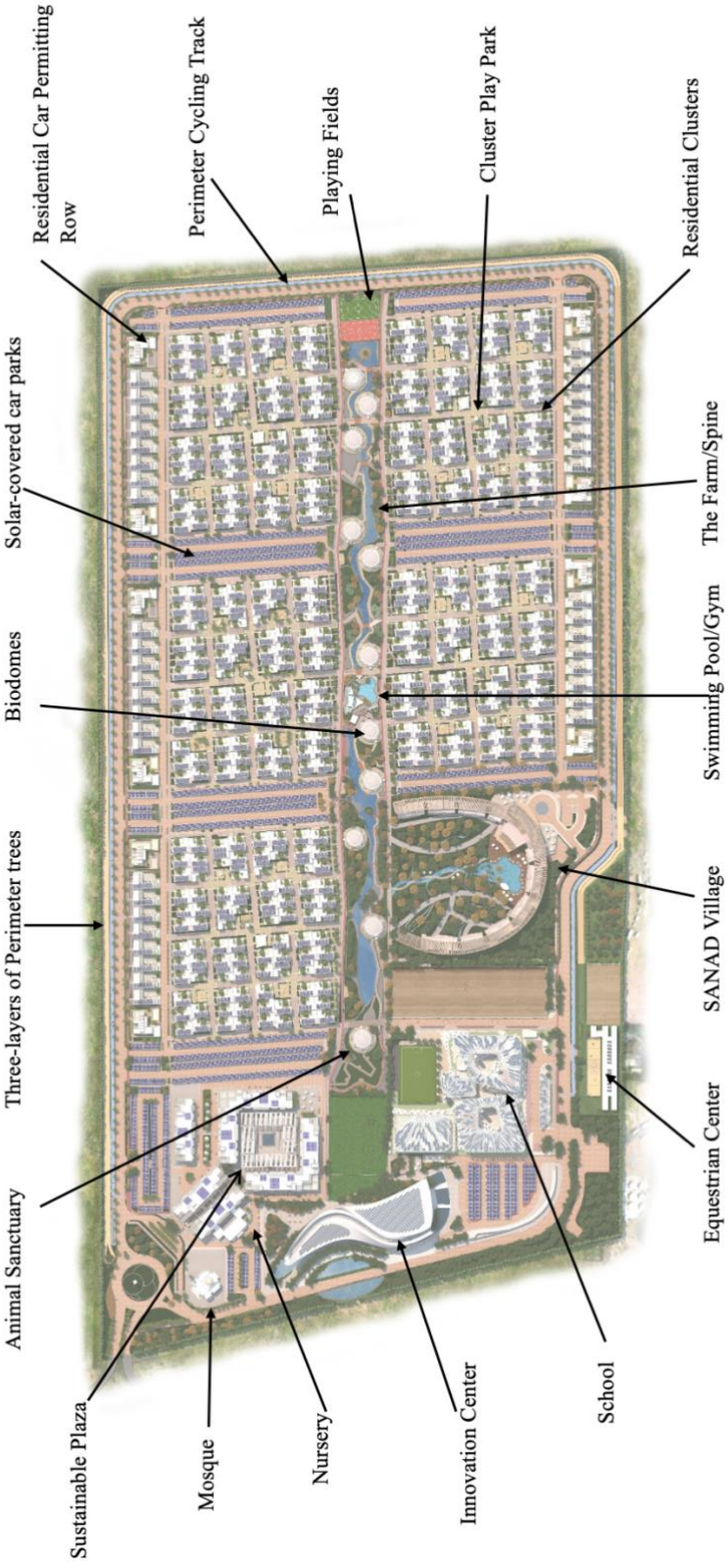
7. Appendices

Appendix A: Annotated Development Plan of The Sustainable City Dubai



Appendix B: Copy of TSC Resident's Survey Questions

Start of Block: Attitudes to Sustainable Developments

Q1 This survey is part of undergraduate student research towards a written thesis on the subject of sustainable real estate development within the UAE. The aim of the survey is to learn more about the opinions and behaviours of residents within sustainable developments such as TSC, and the impact they have on social, economic, and sustainable development.
Residents aged 18 and over are welcome to participate. The survey can be completed by multiple residents from the same household, including helpers. The more data the better, so please complete if you can.
This survey should take approximately 7 minutes to complete and is designed to be completed in one sitting. If you start a survey without completing, you may complete another one. Only fully completed surveys will be considered in data analysis.
Responses to this survey are anonymous. Respondents will be assigned a random ID number. You may remove your responses from the research at any time by emailing cdavidsonhuxley@rollins.edu and quoting your random identification number listed here: ${e://Field/Random%20ID}. Please take note of this number.
This survey has been approved by the Rollins College Institutional Review Board and has been deemed to meet all ethical requirements. You may contact the ethics approval head by contacting jhouston@rollins.edu .
If you have any further questions, please contact the research at cdavidsonhuxley@rollins.edu and include the subject "TSC Resident Survey".

1. I have read the above information, confirm I am over 18 years of age, and consent to participate in this survey (1)
2. I do not consent to participate in this survey (2)

Skip To: End of Survey If This survey is part of undergraduate student research towards a written thesis on the subject of... = I do not consent to participate in this survey

Q2
This first set of questions are about your motivations for choosing to live in TSC.

How long have you lived in TSC?

3. 0 - 1 year (1)
4. 1 - 3 years (2)
5. 3 - 5 years (3)
6. 5 + years (4)

Q3 What age bracket do you fall into?

7. 18-20 (1)
8. 21-30 (2)
9. 31-40 (3)
10. 41-50 (4)
11. 51-60 (5)
12. 60+ (6)

Q4 What motivated you to live in TSC?

1. The development's focus on sustainability (1)
2. The sense of community (2)
3. The lack of cars in the community (3)
4. The amenities within the community (4)
5. Economic savings from lower utility costs (5)
6. The style of the villas/apartments (6)
7. Education options available (Creakids, Fairgeen, SANAD) (7)
8. Other (please specify) (8)
   _____
9. Other (please specify) (9)
   _____

Carry Forward Selected Choices from "What motivated you to live in TSC?"

Q5 Please rank your main motivations for living in TSC. 1 being the most important. Drag and drop.

_____ The development's focus on sustainability (1)
_____ The sense of community (2)
_____ The lack of cars in the community (3)
_____ The amenities within the community (4)
_____ Economic savings from lower utility costs (5)
_____ The style of the villas/apartments (6)
_____ Education options available (Creakids, Fairgeen, SANAD) (7)
_____ Other (please specify) (8)
_____ Other (please specify) (9)

Q6 When choosing a home/community, how important a factor is sustainability in your decision-making process?

13. Not at all important (1)
14. Unimportant (2)
15. Neither important or unimportant (3)
16. Important (4)
17. Extremely Important (5)

Q7 Do you believe that sustainable developments/communities are important for the future?

18. Yes (1)
19. No (2)
20. Unsure (3)

Q8 Would you be willing to pay a higher price than the average property to live in a sustainable property/community?

21. Yes (1)
22. No (2)
23. Unsure (3)

Q9 To what extent do you believe that TSC is an effective model for promoting sustainability?

24. Not at all effective (1)
25. Somewhat Ineffective (2)
26. Neither effective or ineffective (3)
27. Somewhat effective (4)
28. Extremely effective (5)

End of Block: Attitudes to Sustainable Developments

Start of Block: Social Sustainability

Q10 SOCIAL SUSTAINABILITY

Some responses will be different now due to the COVID-19 pandemic. If your answer has changed ONLY as a result of the pandemic restrictions, please answer as you would have done prior to this situation.

'There is a strong sense of community within The Sustainable City Dubai.'

29. Strongly Disagree (1)
30. Disagree (2)
31. Neither Agree or Disagree (3)
32. Agree (4)
33. Strongly Agree (5)

Q11 Living in TSC...

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
I regularly interact with my neighbors. (1)	34.	35.	36.	37.	38.
I regularly make use of shared social spaces (parks, pools, gym, the Plaza, etc.) (2)	39.	40.	41.	42.	43.
I regularly attend events and/or programs that are held in the community. (3)	44.	45.	46.	47.	48.
Has improved my overall wellbeing. (4)	49.	50.	51.	52.	53.
Has improved my overall standard of living. (5)	54.	55.	56.	57.	58.

Q12 Do you believe that you could experience the same standard of community living offered in TSC in another residential development in Dubai?

59. Yes (1)
60. No (2)
61. Unsure (3)

Q13 Do your children attend one of the educational facilities within the community? (Creakids Nursery, Fairgreen International School, SANAD)

62. Yes (1)
63. No (2)
64. I do not have children (3)

End of Block: Social Sustainability

Start of Block: Environmental Sustainability

Q14
ENVIRONMENTAL SUSTAINABILITY

'Since living in TSC, I have adopted more environmentally sustainable behaviours.' e.g. - recycling, energy & water conservation, etc.

65. Strongly Disagree (1)
66. Disagree (2)
67. Neither Agree or Disagree (3)
68. Agree (4)
69. Strongly (5)

Q15 Since living in TSC...

	Strongly Disagree (1)	Somewhat Disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
I am more aware of environmental issues (1)	70.	71.	72.	73.	74.
I consciously try to conserve energy (2)	75.	76.	77.	78.	79.
I consciously try to conserve water (3)	80.	81.	82.	83.	84.
I recycle more frequently (4)	85.	86.	87.	88.	89.
I compost more frequently (5)	90.	91.	92.	93.	94.
I source locally more frequently (6)	95.	96.	97.	98.	99.
My car usage has decreased (7)	100.	101.	102.	103.	104.
My water usage has decreased (8)	105.	106.	107.	108.	109.
My energy consumption has decreased (9)	110.	111.	112.	113.	114.

Q16 'I regularly make use of the re-use initiatives within the community', e.g. - borrowing from neighbours, making use of the community book swaps, using the buy-sell page, giving to Beitfann, etc.

115. Strongly Disagree (1)
116. Disagree (2)
117. Neither agree nor disagree (3)
118. Agree (4)
119. Strongly agree (5)

Q17 Do you grow your own produce?

120. Yes - in the community gardens/allotments (1)
121. Yes - on my own property (2)
122. Yes - both (3)
123. No (4)
124. No - but I have in the past (5)

Q18 Do you utilise the resident's herb/plant scheme?

125. Yes (1)
126. No (2)
127. No - but I have in the past (3)

Q19 Do you make use of the public transport bus route(s) available from TSC?

128. Yes (1)
129. No (2)

End of Block: Environmental Sustainability

Start of Block: Economic Sustainability

Q20 ECONOMIC SUSTAINABILITY

To what extent do you agree with the following statement. 'I am more likely to use the local amenities available within TSC as opposed to the same amenities located outside of the community', e.g. - Zoom, gyms, Play point, restaurants in the plaza, etc.

130. Strongly Disagree (1)
131. Somewhat Disagree (2)
132. Neither agree nor disagree (3)
133. Somewhat agree (4)
134. Strongly agree (5)

Q21 Do you believe that you benefit from economic savings by living in TSC?

135. Yes (1)
136. No (2)
137. Unsure (3)

Skip To: End of Block If Do you believe that you benefit from economic savings by living in TSC? = No

Q22 Please select how strongly you agree with the following statements. By living in TSC I save money on/through...

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
My energy bills (1)	138.	139.	140.	141.	142.
My water bills (2)	143.	144.	145.	146.	147.
Gym memberships (3)	148.	149.	150.	151.	152.
Car Fuel (4)	153.	154.	155.	156.	157.
Property Maintenance (5)	158.	159.	160.	161.	162.
Public Transport (6)	163.	164.	165.	166.	167.
Borrowing & Exchanging with neighbors (7)	168.	169.	170.	171.	172.
Using the shops in the community (8)	173.	174.	175.	176.	177.
Other (please specify) (9)	178.	179.	180.	181.	182.
Other (please specify) (10)	183.	184.	185.	186.	187.
Other (please specify) (11)	188.	189.	190.	191.	192.

Q23 Please provide a best estimate in AED of how much you save on average per month by living in TSC?

This estimate can include utility savings (which can be found on your green DEWA bill) and other saving opportunities as outlined above.

If you would prefer not to answer, please input N/A.

End of Block: Economic Sustainability

Start of Block: Additional Comments

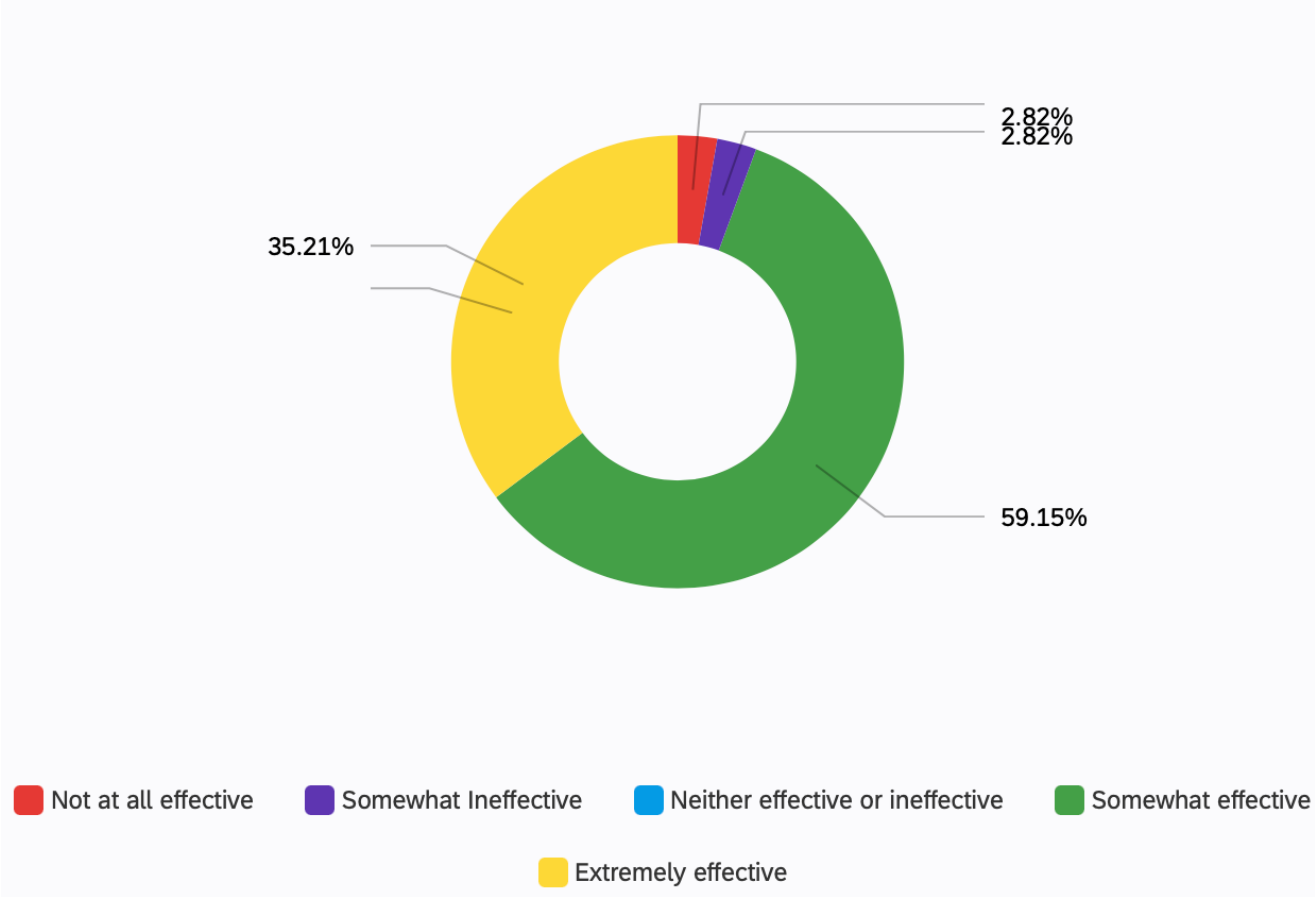
Q24 Please use the space below to add any additional comments that you think could be helpful relating to TSC & sustainable communities. Topics could include the amount of energy savings each month due to solar panels, ways you have personally increased sustainability within your home, or groups within the community I may not be aware of that support the development's mission (e.g. - sports clubs, social groups, anything you organise to share with residents etc.).

In particular, if you would be happy to share copies of your green savings DEWA bills (personal details can be omitted) that would be especially helpful in proving value creation from renewable energy.

You can send these via email to: cdavidsonhuxley@rollins.edu

Thank you so much for taking the time to complete this survey, it is greatly appreciated!

<u>Appendix C:</u> Chart to demonstrate the percentage of respondents who believe TSC is an effective model for promoting sustainability (Qualtrics Survey Results)



Appendix D: **Raw Data Table For Price Per Square Foot for Property Buys/Sales**

Residential Community	Price (AED)	Square-Footage (Plot)	Price per SQFT (Plot)	SQFT (BUA)	Price per SQFT (BUA)
The Sustainable City	3,090,000	2,323	1330.18	3,778	817.89
	2,800,000	2,308	1213.17	3,400	823.53
	4,200,000	4,858	864.55	5,400	777.78
	4,530,000	-	-	5,466	828.76
	4,000,000	2,347	1704.30	3,823	1046.30
Arabian Ranches 2	1,950,000	1,952	998.98	2,200	886.36
	4,700,000	6,888	682.35	4,354	1079.47
	1,950,000	2,195	888.38	1,963	993.38
	3,800,000	5,007	758.94	3,196	1188.99
	3,700,000	4,650	795.70	3,846	962.04
	4,100,000	6,528	628.06	3,383	1211.94
	2,050,000	1,900	1078.95	2,200	931.82
	3,200,000	4,359	734.11	3,168	1010.10
	5,050,000	7,540	669.76	4,354	1159.85
	3,300,000	4,650	709.68	3,196	1032.54
Mudon	3,000,000	3,330	900.90	3,800	789.47
	2,700,000	4,023	671.14	3,808	709.03
	2,999,999	3,206	935.75	3,786	792.39
	3,499,999	6,777	516.45	3,750	933.33
	3,100,000	3,300	939.39	3,800	815.79
	3,000,000	4,706	637.48	3,800	789.47
	1,600,000	2,890	553.63	2,071	772.57
	2,150,000	3,650	589.04	2,603	825.97
	1,550,000	1,950	794.87	1,544	1003.89
	2,150,000	3,650	589.04	2,603	825.97
Mira	1,900,000	3,000	633.33	2,524	752.77
	1,900,000	3,685	515.60	2,554	743.93
	1,600,000	2,325	688.17	2,180	733.94
	1,950,000	2,996	650.87	2,554	763.51
	1,600,000	2,200	727.27	2,180	733.94
	2,450,000	3,376	725.71	2,524	970.68
	1,700,000	2,190	776.26	2,180	779.82
	1,950,000	2,615	745.70	2,385	817.61
	2,000,000	2,999	666.89	2,554	783.09
	1,175,000	2,312	508.22	2,551	460.60

Appendix E: Raw Data Table For Price Per Square Foot for Property Rentals

Residential Community	Price (AED per year)	Plot Size (Sqft)	Price Per SQFT (Plot) (AED)	BUA Size (Sqft)	Price per Sqft (BUA) (AED)
The Sustainable City	185,000	2,347	78.82	3,800	48.68
	185,000	2,308	80.16	3,400	54.41
	175,000	2,347	74.56	3,800	46.05
	160,000	2,308	69.32	3,400	47.06
	175,000	2,308	75.82	3,378	51.81
Arabian Ranches 2	180,000	2,650	67.92	3,488	51.61
	155,000	4,359	35.56	3,146	49.27
	170,000	4,521	37.60	3,224	52.73
	130,000	1,948	66.74	2,202	59.04
	165,000	-	-	3,164	52.15
Mudon	139,850	3,330	42.00	3,800	36.80
	118,000	2,785	42.37	1,873	63.00
	120,000	3,247	36.96	1,872	64.10
	130,000	3,184	40.83	2,400	54.17
	150,000	3,800	39.47	3,330	45.05
Mira	110,000	2,325	47.31	2,385	46.12
	110,000	2,996	36.72	2,554	43.07
	115,000	3,060	37.58	3,059	37.59
	125,000	4,218	29.63	2,524	49.52
	90,000	2,370	37.97	2,236	40.25

Appendix F: **Mean & Median Price Per SQFT for Buy/Sale Properties**

Residential Community	Mean Price Per Sqft (Plot)	Median Price Per Sqft (Plot)	Mean Price per Sqft (BUA)	Median Price Per Sqft (BUA)
The Sustainable City	1278.05	1271.67	858.85	823.53
Arabian Ranches 2	794.49	746.53	1045.65	1021.32
Mudon	712.77	654.31	825.79	804.09
Mira	663.80	677.53	753.99	758.14

Appendix G: **Mean & Median Plot Size (SQFT) for Buy/Sale Properties**

Residential Community	Mean Plot Size (sqft)	Median Plot Size (sqft)	Mean BUA Size (sqft)	Median BUA Size (sqft)
The Sustainable City	2,959	2,335	4,373	3,823
Arabian Ranches 2	4,567	4,650	3,186	3,196
Mudon	3,748	3,490	5,157	3,768
Mira	2,770	2,806	2,419	2,524

Appendix H: **Mean & Median Price Per SQFT for Rental Properties**

Residential Community	Average Price per SQFT (Plot)	Median Price per SQFT (Plot)	Average Price per SQFT (BUA)	Median Price Per SQFT (BUA)
The Sustainable City	75.74	75.82	49.60	48.68
Arabian Ranches 2	47.03	37.60	52.96	51.61
Mudon	40.33	40.83	52.62	54.17
Mira	37.84	37.58	43.31	43.07

Appendix I: **Mean & Median Plot Size (SQFT) for Rental Properties**

Residential Community	Average Plot Size	Median Plot Size	Average BUA Size	Median BUA Size
The Sustainable City	2,324	2,308	3,556	3,400
Arabian Ranches 2	3,370	3,505	3,045	3,164
Mudon	3,269	3,247	2,655	2,400
Mira	2,994	2,996	2,552	2,524

Appendix J: **T-test of means assuming unequal variance between mean buy price of TSC & Arabian Ranches**

	TSC	*Arabian Ranches 2*
Mean	858.852	1045.649
Variance	11385.043	12430.330
Observations	5	10
Hypothesized Mean Difference	0	
df	8	
t Stat	-3.148	
P(T<=t) one-tail	0.007	
t Critical one-tail	1.860	
P(T<=t) two-tail	0.014	
t Critical two-tail	2.306	

Appendix K: **T-test of means assuming unequal variance between mean buy price of TSC & Mudon**

	TSC	*Mudon*
Mean	858.852	825.790
Variance	11385.043	7066.771
Observations	5	10
Hypothesized Mean Difference	0	
df	7	
t Stat	0.605	
P(T<=t) one-tail	0.282	
t Critical one-tail	1.895	
P(T<=t) two-tail	0.564	
t Critical two-tail	2.365	

Appendix L: **T-test of means assuming unequal variance between mean buy price of TSC & Mira**

	TSC	*Mira*
Mean	858.852	753.990
Variance	11385.043	15509.849
Observations	5	10
Hypothesized Mean Difference	0	
df	9	
t Stat	1.695	
P(T<=t) one-tail	0.062	
t Critical one-tail	1.833	
P(T<=t) two-tail	0.124	
t Critical two-tail	2.262	

Appendix M: **T-test of means assuming unequal variance between mean rental price of TSC & Arabian Ranches**

	TSC	*Arabian Ranches 2*
Mean	75.738	51.955
Variance	17.892	316.106
Observations	5	4
Hypothesized Mean Difference	0	
df	3	
t Stat	2.617	
P(T<=t) one-tail	0.040	
t Critical one-tail	2.353	
P(T<=t) two-tail	0.079	
t Critical two-tail	3.182	

Appendix N: **T-test of means assuming unequal variance between mean rental price of TSC & Mudon**

	TSC	*Mudon*
Mean	75.738	40.325
Variance	17.892	4.824
Observations	5	5
Hypothesized Mean Difference	0	
df	6	
t Stat	16.614	
P(T<=t) one-tail	0.000	
t Critical one-tail	1.943	
P(T<=t) two-tail	0.000	
t Critical two-tail	2.447	

<u>Appendix O:</u> T-test of means assuming unequal variance between mean buy price of TSC & Mira

	TSC	*Mira*
Mean	75.738	37.844
Variance	17.892	39.597
Observations	5	5
Hypothesized Mean Difference	0	
df	7	
t Stat	11.176	
P(T<=t) one-tail	0.000	
t Critical one-tail	1.895	
P(T<=t) two-tail	0.000	
t Critical two-tail	2.365	