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Smart Cities in Asia

Paper

Can Smart Be Green? The Challenge of Being a Smart City in Asia

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ABSTRACT

South Korea has an intelligence problem. In its rush to become a regional leader in urban technologies, the national government has poured investment into cutting edge technologies underlying urban infrastructure, to develop smart, ubiquitous cities that blend real-time information with a wide range of public services, from transportation networks to garbage disposal and energy provision. Nowhere is this investment more evident than in Songdo International City, sited off the western edge of Incheon Metropolitan City, and at the far reaches of the greater Seoul Metropolitan Area. At its core, it is a real estate gamble, with high rise residential clusters and state-of-the-art schools, intending to attract those who can pay from anywhere and everywhere. But South Korea's famed growth machine has come at a high environmental cost, with air quality at dangerously poor levels in many urban areas throughout the country, leading to a reverse trend in urban growth for the first time in sixty years in 2015. Songdo has been marketed as many things: a smart city; a ubiquitous city; and a green city. But can it really be all of these things, especially with not-so-green neighbors? We present a case study of Songdo focusing on its unique infrastructure and the perceptions of residents as to what constitutes "green". We present the results of an original survey conducted among residents and visitors to Songdo, and we examine some of the contradictions presented in citizen perceptions when cities attempt to "leapfrog" over the environmental challenges presented by traditional industrial approaches to growth. We summarize Songdo's attempts to use technology as a means to promote "cleaner" development, and we offer lessons from Songdo's attempts to marry smart and green. We conclude that smart can be green, but not in isolation, and herein lies the challenge for smart cities in Asia.

Key words: green growth, green cities, smart cities, sustainability, renewable energy, green perceptions

1.1 Introduction

In 1956, Charles Tiebout offered a simple yet elegant solution to the problem of local governments trying to “read the minds” of citizens when providing goods and services at the local level. From an economist’s perspective, citizens always have an incentive to conceal their preferences for the particular mix of goods and services that they desire, so governments have difficulty determining how much of a particular good should be provided. Tiebout concluded that political mechanisms, therefore, would be highly inefficient predictors of how local governments spend their budgets, and that another mechanism should be used to determine voters’ true preferences for public goods. He argued that when local governments could offer a range of goods and services, at differing levels, citizens could match their preferences with their desired level of taxation by “voting with their feet”, as Paul Peterson (1981) put it, and move to a locale where the citizen can match the level and mix of service provision with his or her willingness to pay the local tax necessary for such provision. In this way, local governments might “reveal” the preferences of their citizens and provide services at more efficient levels than possible through a centralized national government.

In South Korea, with its unitary approach to government, Tiebout’s thesis has never gained traction, since the conditions necessary to satisfy the competitive model of local government offered by Tiebout did not exist. But in the last decade, the central government has embarked on what might be considered an experiment in local autonomy that goes beyond the local political freedoms first offered in the 1990s. The South Korean government has decided that “going green” is a useful policy premise, and as such, has embarked on a series of national projects meant to promote development in sustainable ways. Long before the recent agreement at the 2015 United Nations Climate Change Conference in Paris, the desire to develop a green growth model that is cost-effective and useable for developing countries has long been coveted. The South Korean government has created from scratch New Songdo City (hereafter referred to as Songdo) to fulfill this desire by providing an exportable green growth model for other nations to follow (Shwayri, 2013).

By allowing Songdo certain development experiments not pursued in other local governments, South Korea has created an opportunity to see whether, indeed, Tiebout’s thesis may have some relevance for unitary governments toying with the idea of more decentralization. Although not the intended purpose of the national government, Songdo’s distinctive characteristics have allowed it to differentiate itself from other new developments in South Korea. Thus there is the potential to see whether Korean citizens do, indeed, “vote with their feet”, and if so, what might prompt them to relocate.

In this paper, we examine the creation of Songdo and its association with “green growth” as a national policy construct. We then establish the premise for investigating how current residents, those interested in moving to Songdo, and those not interested in relocating view the “green” characteristics

of the city. We test the premise using a survey of a representative sample of these groups, administered in person at two separate locales where such people are likely to be. We find significant differences in level of preference for “green” characteristics between those who live in Songdo and those who have no desire to relocate, holding other characteristics constant. However, we find that despite consistency in resident and non-resident conceptions of “green”, these do not match the national government’s policy components, indicating a mismatch between service provision and citizen perceptions. We then re-examine Tiebout’s suggestions and provide policy recommendations for the national government.

2.1 Characteristics of Songdo

South Korea’s ambitious concept city was designed to attract foreign investors to the Korean market. The uniqueness of Songdo is exemplified in its marketing where the following slogans have been utilized: “Tomorrow’s City,” “Green Eco City,” “Smart City,” and “International Business Hub” (Manning, 2016). Amenities provided reflect each of the aforementioned slogans in various ways. The city’s attraction is in its technologically advanced features and stunning, high-rise architecture. Throughout the city, evidence of amenities-driven growth initiatives are apparent, with seemingly constant construction of shopping malls, restaurants with ethnic foods from various countries, an excellent transportation infrastructure that includes wide, unobstructed bike paths that extend throughout the city, and well-designed parks for recreational use. The development of the aforementioned amenities are an alluring force designed to attract both domestic and international citizens which are critical to the city’s success (Clark, Lloyd, Wong, & Jain, 2002). Due to the acknowledge that cities themselves are in constant competition for locales (Molotch, 1976). innovative growth models predicated on amenities driven growth are critical (Clark, Lloyd, Wong, & Jain, 2002).

The city structure of Songdo exhibits smart city characteristics emphasizing energy efficiency and sustainability. Smart city characteristics, which overlap with green city features due to an emphasis on sustainability and energy efficiency among other things (Angelidou, 2015), were included in the design of the city. Although the energy efficiency standards enforced in Songdo’s construction come at an increased economic cost, the measures help ensure energy sustainability in the case of rapidly increasing energy prices (Copiello & Bonifaci, 2015). Energy efficiency is significant because Songdo represents the green growth model that Korea wishes to export (Shwayri, 2013). Smart green features of the city include an advanced recycling system (approx. 75% of building waste), storm water collection centers that feed into the Central Park canal, extensive open spaces which are enhanced by underground parking structures, an advanced transportation systems that includes various bus lines, 5 subway stations, extensive bike paths, LED traffic lights as the primary green features. LEED standard buildings have been constructed in an area of Songdo, and a 100-acre

Central Park which serves as a landmark symbol of the city (Kamal-Chaoui, Grazi, Joo, & Plouin, 2011; Anderson, 2015).



Figure 1: An overview of the harbor located in Songdo's Central Park

Anthopoulos (2016) asserts that Songdo's smart waste system, which acts a renewable energy source, is the main "smart" sustainability amenity provided by the city (Anthopoulos, 2016). However, as Anthopoulos' study was comparative in nature, he noted that "smart" features of Songdo are minimal when compared to other "smart" cities. Songdo provides high speed internet accessibility, "integrated building and facility management, security and hazard management, e-learning, remote healthcare facilities, and automated traffic control" which are additional smart city features (Kim, 2010).

3.1 Defining "Green"

The definition of "green" is not something that is universally agreed upon (Ko, Schubert, & Hester, 2011). Defining "green" through a political lens presents numerous problems due to both its wide-ranging policy scope and its relative isolation to the industrialized democracies in the 1980s and 1990s. Green political parties first surfaced in the 1970s in the United Kingdom (UK) and New Zealand, but were not called "green" until much later (Frankland, Lucardie, Rihoux, 2008). The early parties were the outcomes of grassroots movements, incorporating many different concerns that members saw as interrelated. Environmental groups have addressed "green" issues by pressuring businesses to decrease carbon emissions, focusing on conservation efforts related to excess lumber extraction and maintaining natural habitat, and monitoring the contamination of water commons (Kleiner, 1991). Given the breadth of policy goals, the shift from political to administrative structures for implementation reduced the apparent necessity for political movements, and the focus on "green" political parties deintensified over the early part of the 21st century (Frankland, Lucardie, Riboux, 2008).

Other examples of government approaches to defining “green” can be found in the early embracers of green political movements. The Finnish organization [Sitra](#), for example, was first created by the Bank of Finland as a fund in 1967 to promote “stable and balanced development, economic growth and international competitiveness and co-operation”. Its mission has changed over time, as Finland’s economy has grown and developed, and in 2012, its focus is on building a model that incorporates social, political, and private sector changes to enhance renewable energy usage and reduce carbon output among all countries. The initiatives being promoted by this organization provide additional context for defining green because they identify successful environmental policies utilized in different countries, and encourage adaption of these policies internationally. The carbon saving solutions encouraged by Sitra in their Green to Scale campaign are listed in Table 1. The policies shown cover the dimensions of Agriculture and Forestry, Industry, Buildings and Households, Transportation, and Renewable Energy (SITRA, 2017).

Table 1: Green to Scale - Successful low-carbon policies

Country of Origin	Policy	Benefits
Costa Rica	<ul style="list-style-type: none"> Afforestation and reforestation 	<ul style="list-style-type: none"> Encourages forest growth to cut carbon emission through government funding
Brazil	<ul style="list-style-type: none"> Reduction of deforestation 	<ul style="list-style-type: none"> Extends the life of forests to conserve biodiversity and help fight carbon emissions
Denmark	<ul style="list-style-type: none"> Reduction of food waste 	<ul style="list-style-type: none"> Lowers food demand, eases burden on low income families, and lowers carbon emissions
Brazil	<ul style="list-style-type: none"> Low-carbon agriculture 	<ul style="list-style-type: none"> Preserves ecosystem and lower carbon emissions
United States	<ul style="list-style-type: none"> Reduction of methane from oil and gas production 	<ul style="list-style-type: none"> Maximizes resources, saves money, lowers carbon emissions
United States	<ul style="list-style-type: none"> Industrial electric motors 	<ul style="list-style-type: none"> Reduces energy costs, need for imported fuel, decreases fossil fuel emissions
China	<ul style="list-style-type: none"> Industry energy efficiency through increased government standards 	<ul style="list-style-type: none"> Job creation, reduced carbon emissions and energy consumption
Japan	<ul style="list-style-type: none"> Appliance efficiency through increased government standards 	<ul style="list-style-type: none"> Cuts utility expenses for households and businesses, reduces energy consumption and fossil fuel imports
China	<ul style="list-style-type: none"> Improved cook stoves 	<ul style="list-style-type: none"> Reduces fuel consumption, increased safety, reduces need for firewood, charcoal and other biomass
Mexico and Germany	<ul style="list-style-type: none"> Building efficiency 	<ul style="list-style-type: none"> Reduces fuel imports, lessens utility costs, improves air quality
Colombia	<ul style="list-style-type: none"> Bus rapid transit 	<ul style="list-style-type: none"> Reduces travel times, traffic congestion and carbon emissions, increases property value on bus lines, and improves air quality
European Union	<ul style="list-style-type: none"> Vehicle fuel efficiency 	<ul style="list-style-type: none"> Improves air quality, enhances energy security, reduces demand for fossil fuels
Finland	<ul style="list-style-type: none"> Bioenergy for heating 	<ul style="list-style-type: none"> Creates employment opportunities, reduces import of fossil fuels, enhances energy security
Denmark and Brazil	<ul style="list-style-type: none"> Wind power 	<ul style="list-style-type: none"> Reduces reliance on fossil fuels, creates employment opportunities, provides a source of income for landowners
Bangladesh	<ul style="list-style-type: none"> Off-grid solar power 	<ul style="list-style-type: none"> Provides a modern electrical energy source for citizens living in rural, developing areas
Germany	<ul style="list-style-type: none"> Grid solar power 	<ul style="list-style-type: none"> Reduces reliance of fuel imports, potentially cuts energy costs for consumers, creates and secures employment, and improves air quality

China	<ul style="list-style-type: none"> • Solar water heating 	<ul style="list-style-type: none"> • Low-cost implementation, improves air quality in dense areas
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*Source: greentoscale.net

Finally, private sector adaptations to green issues and concerns include implementing waste reduction strategies, such as switching to paper bags from plastic, promoting energy conservation, and pollution reduction (Kleiner, 1991). Companies like Tesco, Wal-Mart and other large supply chains have made strong commitments to significantly decrease carbon emissions. However, the underlying cause of such changes are not necessarily due to environmental concerns but due to the realization that the changes required to reduce emissions have the additional benefit of lowering operating costs (Zokaei, 2013).

These descriptions of environmental policies and approaches demonstrate how wide the range of categories considered “green” can be; however, the conclusion drawn is that green is synonymous with ecological protection. Therefore, for the purpose of this study, green is defined as the protection of nature pertaining to air quality, water commons, forestry, and protection of endangered species.

4.1 Korea’s Green Growth Model

The green growth models being promoted by the Korean government are described as being uniquely Korean by the government (Shwayri, 2013); however, questions are raised due to the apparent paradox between economic growth and green city theory. Korea’s focus is on growth due to per capita income being lower than desired. Consequently, per capita income has increased immensely in recent years; therefore, environmental variables must be added to growth policy due to belief that a demand for a cleaner environment accompanies increased wealth of a nation (J. Lee, 2010). Research into levels of environmental concern and economic growth show that Korean citizens place emphasis on the latter; therefore, this model addresses both areas (Kim and Kim 2010).

Green growth is an urbanization strategy that counters population growth and increased energy demands by increasing population density to decrease transportation impacts, while simultaneously investing in renewable energies and enforcing energy efficient building standards (J. Lee, 2010). Green growth that is favorable to the environment requires the preservation of natural resources, use of renewable energy sources, and, ideally, low carbon output (Lim, 2011). These desired outcomes, as outlined by the United Nations, only help mitigate the effects of climate change as opposed to more aggressive sustainable green city models. Arguments favoring green growth models are based on their necessity due to the continuing need to improve living standards in many parts of the world through growth while emphasizing sustainability (J. Lee, 2010). The problem with sustainability prioritization is that it is ambiguous with no standardized consensus of which elements need to be “sustained” (i.e. energy expenditures, quality of life, environmental conditions) (Mori & Christodoulou, 2011).

Green city models contain varying degree of each of these approaches. One of the more notable green cities in the United States, for example, is Boulder, Colorado. Green features of Boulder have been outlined on Table 2.

Table 2: Green City Features: Boulder, Colorado

Areas of Environmental Policy	Policy Description
Energy	<ul style="list-style-type: none"> • Usage of local renewable energy sources (i.e. solar panels on public buildings) • Regulations requiring specified energy consumption standards be met • Regular energy assessment standards of building complexes
Ecosystem	<ul style="list-style-type: none"> • Bus transportation • Construction of extensive bike paths • City organized car pooling programs • Promotion of local food source • Animal protection training • Regulation of pesticides to mitigate the decline of pollinators
Waste	<ul style="list-style-type: none"> • Reuse, recycle, compost discarded waste (required recycling) • Implementation of mandatory disposable bag fees to deter plastic bag usage
Water	<ul style="list-style-type: none"> • Regular quality assessment and treatment of drinking water • Collection and reuse of storm water and waste water • Water rebate programs to promote efficient use of water

*Source: <https://bouldercolorado.gov/environment>

5.1. Methodology

In response to the research detailing the Korean government’s view of what constitutes a green city (i.e. Songdo), the purpose of this study is to identify the prevailing view of Korean citizens as to how they define a green city. Lee and Kim (2015) identified community participation as a key variable leading to the varying degrees of success of green initiatives nationwide. Lack of citizen involvement in green initiatives is due to the absence/ineffectiveness of outreach programs or failures of the central government to enact initiatives that are consistent with community views. The inconsistencies of local governments to fully invest in green growth initiatives are linked to a lack of grassroots support (J.-S. Lee & Kim, 2015). Literature detailing the perceptions of South Korean citizenry’s concept of green is absent; however, research shows that gender, age, and level of education all play a role in level of environmental concern (Kim & Kim, 2010). This study aims to extend existing research by identifying the features that Korean citizens consider critical elements of green city models. Variables identified by Kim and Kim (2010) are tested in relation to level of environmental knowledge.

A survey method was used to collect data from Korean citizens. The survey was administered to participants within Songdo city to ensure that respondents had some knowledge of the city. Responses were collected at two shopping centers (Hyundai Premium Outlet and Canal Walk Shopping Center) and at Incheon National University. The respondents were targeted randomly on location. Each location was chosen due to its ability to offer a sample size representative of Songdo's population.

Using characteristics of Songdo's green city model, a survey was constructed requiring Korean citizens to describe their vision of a green city. In order to do this, respondents were required to choose from a list of green city attributes. The attributes consisted of green characteristics of Songdo, green characteristics of Boulder, Colorado, and red herrings used to check participants' knowledge of green cities. Background information detailing gender, age, income bracket, and level of education were obtained.

Practical assessment of survey results provide the data necessary to determine whether a consensus as to what the Korean population considers a green city matches the viewpoint of the government exists. Furthermore, due to the comparative structure of the survey, green city traits identified by participants allows for the analysis to determine whether Korean citizenry identifies more with "mainstream" green city features or green features highlighted by the South Korean government.

6.1 Results

The survey construction was organized to gather relevant background information about Korean residents as well as to identify green city characteristics that compare Songdo to other green cities throughout the world. As previously stated, the background information of the participants was gathered for the purpose of conducting a comparative analysis in relation to the Kim and Kim (2010) study citing gender, age, nationality, level of education, and income as variables contributing to an individual's level of environmental concern; however, weak levels of significance were found in our statistical analyses pertaining to background and perception of "green".

The focus of the ensuing sections is to provide a summary of answers elicited pertaining to perceptions of Songdo as an environmental city. Emphasis on location of residence of respondents enabled our analysis to relate conception of "green city" with prioritization on living in environmentally-friendly communities relating to Tiebout's study.

6.2 Survey Respondents

A total of 135 Korean citizens participated in our survey. Gender distribution shows a breakdown of 59 male respondents and 76 female respondents. A relatively equal distribution of participants regarding gender and age exists; however, the 26-35 age group was the most represented. Assortment of participants based on highest level of education achieved is largely representative of the Korean

population. Most of the survey respondents (93) have achieved a university degree. Only one of the survey respondents reported not obtaining a high school diploma.

Income distribution was evaluated based upon monthly earnings. Respondents were asked to report their family income. Aggregate totals of household income showed a majority of respondents (43) earning less than 1,999,999 KRW (Korean won) per month most of whom with residences outside of Songdo. The greatest variance among personal traits was due to income. Current residents of Songdo and desired residents reported higher average salaries than participants with no interest in relocating to the city. In particular, 33.3% of respondents living in Songdo reported a monthly household income of more than 6,000,000 KRW, which is well over the 3.98 KRW monthly income average according to 2015 Korean Statistical Information Service (KOSIS) records.

6.3 General Perceptions of Green

Anderson (2016) highlighted the attributes of Songdo which ranged from technological, smart city features to environmental features to infrastructure designed for alluring international businesses. The variances indicate that perceptions of Songdo as a “green city” could be skewed due to emphasis on multiple areas. The prominent Songdo environmental feature accentuated by Korean media outlets is the aforementioned Central Park (which is the background for various commercials and television programs). Other prominent visual symbols which embody the sleek, modern styling of Songdo are the #Sharp First World Apartments and Northeast Asian Trade (NEAT) Tower.

The prominence of Central Park as a key amenity of Songdo reflects the majority view regarding the image of a “green city”. Survey participants were asked to determine which image they most closely associate with a “green city”. Five options were provided: parks and natural spaces; clear air and clean environment; solar panels and renewable energy sources; vast public transit; and farms and gardens. Parks and natural spaces received 68 responses (50.4%). Coincidentally, farms and gardens were not chosen by any of the participants. The significance of this reflects altered perception between Korean and western environmental policies emphasizing local food growth (i.e. Boulder, Colorado). Solar panels and renewable energy sources (which are staples of the Green Growth Initiatives) only received 7.4% of the responses which supports Lee and Kim’s (2016) assertion that lack of community-level support affected the implementation of the Green Growth Initiatives due to lack of acceptance.

Table 3: Image of a Green City

Image Description	Frequency	Percentage
Parks and natural spaces	68	50.4
Clear air and a clean environment	47	34.8
Solar panels and renewable energy sources	10	7.4
Vast public transit	10	7.4
Farms and gardens	0	0
Total	135	100

In addition to identifying an “image of green” participants were required to list key characteristics desired in green city models. Participants were provided with a list of 15 characteristics. The characteristics listed were derived from literature highlighting “green” features of Songdo and Boulder, Colorado located in the United States. Boulder was chosen a counter model due to its contrary “green” elements and recognition as a progressive, environmental city. Additional red herrings were placed among the list to test the knowledge of participants. Comparative features allowed clarification as to whether the Korean government has implemented features conceptualized by Korean citizens. Survey participants were not notified of the comparative nature of the survey with location of identified “green” characteristics not provided on the original survey.

An overview of the results provided show a distinct connection with features present in Boulder and those envisioned by the Korean population. Parks and open spaces, which is emphasized in both cities, received an overwhelming majority of support by being selected by 81.5% of participants. Additional characteristics, “prioritization of renewable energy resources” and “building regulations requiring strict energy efficiency standards”, received strong support; however, both are characteristics more closely reflected in the Boulder model as opposed to the Songdo model.

Table 4: Characteristics of “Green Urban City”

Green City Characteristic	Location of Feature	Frequency	Percentage
Smart grid development	Songdo	25	18
Parks and open spaces	Songdo Boulder	110	81.5
Express trash collection	Red herring	24	17.8

Areas for farming and agriculture	Boulder	0	0
Conservation areas for indigenous animals	Boulder	20	14.8
LED lighting for traffic lights	Songdo	21	15.6
Recycling mandates	Songdo Boulder	23	17.0
Well-developed public transit system	Songdo Boulder	28	20.7
Prioritization of renewable energy resources	Boulder	46	34.1
Building regulations requiring strict energy efficiency standards to be met	Boulder	40	29.6
Solar panels on public buildings with incentives for citizens	Boulder	28	20.7
Broadband internet technology	Red herring	10	7.4
Promotion of local food consumption	Boulder	10	7.4
Animal protection training	Boulder	7	5.2
Collection and reuse of storm water and waste water	Boulder Songdo	24	17.8

6.4 Application of Tiebout's Framework

Tiebout (1956) outlined the difficulty of identifying citizen preferences for public goods through voting platforms. Tiebout hypothesized that citizen preferences can be identified based upon community choice. Therefore, in the case of this study, Korean residents keen on a blend of technological features and environmentally advanced city attributes would invest in Songdo as opposed to competing communities not offering these qualities. This study accounted for these features by permitting comparative analyses testing relationships between location of residents and conception of green cities.

The distribution of Songdo residents showed that 34 of the 135 participants currently reside in Songdo. The remaining non-residents were divided into two groups: non-residents interested in moving to Songdo and non-residents with no interest in residing in Songdo. A majority of non-residents (63) reported "no interest" in relocating to Songdo. The minority group of 38 respondents showing interest in moving to Songdo reported a more positive view a Songdo in regard its reflection of its "green city" ideals. Residents of Songdo reported the highest level of agreement in the statement that "Songdo is a green city". As indicated in the graph below, a majority of Songdo residents

indicated that they do indeed believe that Songdo is a “green city” with only a small minority of respondents disagreeing with the notion. This positive outlook of residents is in agreement with Tiebout’s theory that public amenities are drivers of community choice; therefore, the people with financial means to live in Songdo would choose to do so based upon city appeal. Desirable amenities and environmental policies have satisfied Korean residents to the extent that Koreans and international agencies (i.e. Green Climate Fund) have relocated to Songdo due to these features.

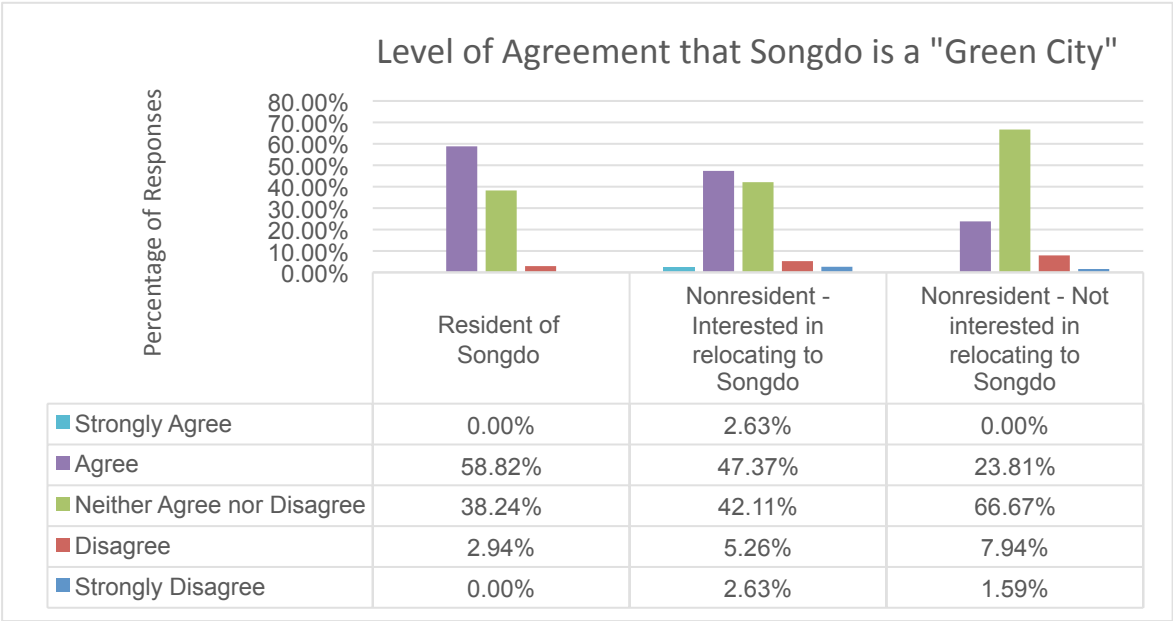


Figure 2: Crosstabulation consisting of place of residence and level of agreement that Songdo is a "green city"

The significance of residence on the perception of Songdo as a “green city” is consequential. According to the results, current residents of Songdo were in majority agreement with 58.8% agreeing with the notion that Songdo is indeed a green city. Less than 3% of residents disagreed that Songdo was a green city while the remaining 38.2% neither agreed nor disagreed. Levels of agreement varied between both categories of non-residents with neither showing significant levels of disagreement with the notion that Songdo is a green city; however, among those interesting in relocating to Songdo, a much higher level of agreement is indicated (47.3 to 23.8). A majority of respondents with no interest in moving to Songdo (66.6%) indicated a neutral opinion. The cumulative results indicate that the predominate images that Koreans first associate with a “green city” are parks, natural spaces, clean air, and a clean environment, which are all elements of Songdo in varying degrees.

7.1 Discussion

The designers of Songdo were the international real estate development group Gale International in association with POSCO Engineering and Construction and government officials. The primary focus in the initial plan for Songdo focused on ease of access to amenities (Whitman, Reid, von Klemperer, & Roy, 2008). Aside from conservation areas needed due to the displacement of indigenous animals,

the primary green initiatives focused on construction of a city that reduced dependency upon automobiles for transportation. Infrastructure systems linking buildings, bike paths connecting residential areas through the adherence of compact city principles, and interlinking amenities and residential areas all contribute to the energy efficiency. These features are favorably viewed by the Korean population due to increases in livability standards.

Energy efficiency was prioritized over renewable energy resource models. Initial designs showed that LEED standards would be used as a benchmark to ensure high energy efficient standards were met; however, the adherence to these standards is limited to few complexes within the city. Additionally, solar paneling, which was also highlighted in early promotions (Whitman, Reid, von Klemperer, & Roy, 2008), is largely absent throughout the city. Alternative energy investment was prioritized by former President Lee Myung-bak which was highlighted by the construction of the largest hydrogen-powered fuel cell power plant in the world; however, as the survey shows, citizens are not largely concerned with alternative energy sources and deem modernization efforts to decrease greenhouse gas emissions through urban planning models emphasizing energy efficiency more ideal.

Criticisms of Songdo emphasizing shortcomings based upon alternative green city models focusing more upon alternative fuel usage are relevant. Models outlined by Sitra embody aggressive strategies nations are using to address climate change concerns. When comparing Korea's Songdo model to more aggressive strategies it is clear that the exportable green growth model desired is not in itself a suitable model for universal use. Nevertheless, for a nation whose citizens are still primarily concerned with economic stability and growth (Kim & Kim, 2010); this model encapsulating a mixture of sustainability and job growth through an idealized international business district offers a solution deemed suitable by Korean citizens. Conclusions derived from the survey indicate that the implementation of Gale International's plan is largely representative of the Korean viewpoint of what constitutes a "green city".

8.1. Conclusion

The evolution of the planning of Songdo has been in constant flux since the initial stages. A shift from smart city features to an emphasis on green growth has allowed the incorporation of green growth characteristics envisioned by President Lee's administration to the detriment of earlier proposed smart city plans. The top-down manner in which the city was planned left the city with issues regarding the accurate representation of citizen desires. Our study has concluded that the vision for a green city represented by the Korean government does not represent views of the entire population. However, certain sectors of the population, particularly those who have chosen to relocate to Songdo, report approval for the green growth model of the city. Inclusion of green spaces (parks and recreation areas) and cleanliness (express trash removal) are the most commonly cited attributes of green cities by Korean citizens.

Validation of Tiebout's framework shows that citizens do relocate based upon the services and amenities provided in particular locales. Songdo's inclusion of ideal green features to its residents is evident; however, alternative amenities not associated with green cities are offered which causes additional motivation for relocation. This paper concludes that although residents of Songdo have confirmed that the city does, for the most part, represent their vision of a green city, many outside of the city have not had their views represented; therefore, additional citizen participation in the planning process is needed for a more inclusive vision for Korea's green future.

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