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A COMPARATIVE ANALYSIS OF COMMUNITY SUSTAINABLE DEVELOPMENT INDICATORS WITH APPLICATION TO BALTIMORE COUNTY, MARYLAND

by

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THESIS APPROVAL PAGE

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Abstract

A Comparative Analysis of Community Sustainable Development Indicators with Application to Baltimore County, Maryland

Ayla R. Haig

The concept of sustainability has some commonly understood definitions, but no single precise definition is used by all interested parties. Regardless, the three core components or pillars of sustainability include the environment, society, and economy. Some U.S. communities have developed indices, groupings of indicators, to measure and disseminate information about their overall sustainable development. However, there has been little coordination to ensure that valuable indicators are being used. This thesis evaluated sustainability indices in five U.S. communities, and identified the one considered most helpful (Santa Monica, CA), and the one least helpful (Minneapolis, MN). Relevant data from Baltimore County, Maryland were collected and applied to these two indices. The collected data revealed that indicators could be improved to better reflect sustainable development. Finally, productive directions for Baltimore County were outlined, should the county decide to utilize a sustainability index.

Table of Contents

List of Tables

List of Figures

1.0 Introduction

1.1 What is Sustainability and Sustainable Development?

Sustainability has both vernacular and academic usage incorporating a range of concepts and terminology. However, no single, precise definition is used by all interested parties. Core elements of sustainability include living within certain limits, understanding the connections among the society, environment, and economy, (also known as the three pillars of sustainability) and ensuring equitable distribution of resources. The general idea focuses on using resources in a way that does not deplete them for future generations to use (Hart, 2006).

Sustainability is often employed as a surrogate for the quality of life and overall human well-being in a community. There are some similarities as the quality of life typically encompasses the three pillars of sustainability. Many links exist among the pillars, which are important to recognize when planning, and implementing sustainability focused programs. However, when the three pillars of sustainability are considered as separate independent issues, progressing towards a sustainable community becomes difficult (Hart, 2006).

In addition to sustainability, there is a slightly different but interchangeable concept, sustainable development, which is frequently referred to as a definition of sustainability. Sustainable development was originally defined in 1980 by the International Union for the Conservation of Nature as “for development to be sustainable, it must take account of social and ecological factors, as well as economic ones; of the living and non-living

resource base; and of the long term as well as the short term advantages and disadvantages of alternative actions" (IUCN, UNEP, WWF, 1980). A few years later, the definition of sustainable development was expanded and popularized by the United Nations (U.N.) Brundtland Commission as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). It is a measure of how communities can develop and prosper while maintaining environmental quality. The three pillars of sustainability stem from the Brundtland Commission definition. This thesis focuses on the concept of sustainable development in communities, but the term "sustainability" is used freely and interchangeably with sustainable development.

At the 1992 U.N. Conference on Environment and Development in Rio de Janeiro, also referred to as the Earth Summit, the U.N. brought together governments from across the globe to focus on sustainable development, as well as other environmental issues. By the end of the summit, more than 130 nations signed a Convention on Climate Change and Convention on Biodiversity, and agreed on an action plan for sustainable development, also known as Agenda 21 (Meakin, 1992). The U.N. subsequently began working on sustainable development indicators for the Commission on Sustainable Development (Moran et al., 2008). In response to the Earth Summit, President Clinton formed the Presidential Council on Sustainable Development in 1993, which promoted the efforts for sustainable development in the U.S. From 1996 until 2000, the federal program, Sustainable Development Challenge grants, funded sustainability projects in the U.S., sparking even more national interest in sustainability (Schubert and Stormer, 2007). While this funding was discontinued in the U.S., in 2000, the U.N. Millennium

Development Goals were adopted which requested all countries integrate sustainable development concepts into their national programs and policies (Moran et al., 2008).

Historically, sustainability primarily focused on environmental issues such as conserving natural resources and understanding that many resources are finite. However, according to Moldan et al. (2012), economic sustainability has been included in defining sustainable development. In the World Banks' report, *Where is the Wealth of Nations? Measuring Capital for the 21st Century*, economists identify that capital in the form of synthetic, natural, human, and social aspects should all be sustained. Other sources have expanded the definition of sustainable development to focus on the use of renewable natural resources in a way not to diminish their use for future generations. Furthermore, some research highlights that the real incomes in the future should not be reduced because sustainability requires future generations to have equal access to resources (Moldan et al., 2012). A deep, precise, and rigorous definition of sustainable development is beyond the scope of this thesis (and of science, at the moment), so here the aim is to focus on existing community-level indicators already proposed to measure sustainable development.

1.2 How is Sustainability Being Utilized?

The concept of sustainability and sustainable development has been circulating for years and will certainly continue to evolve in the future. One of the interesting outcomes building in the global initiatives is that many local communities have created their own sustainable development indicators to provide a basis for sustainability related decision-making processes. Furthermore, these indicators were created with particular local

interests and expertise in mind to help gauge and assess performance. Although they nominally all address a balance among the three pillars of sustainability, to date little comparison across the community indicators has been completed.

Assessments of sets of community indicators, also known as community indices, is difficult since there is no universal template for a "sustainable community"; however, this thesis uses a variety of resources to analyze indicators in selected communities for their ability to accurately reflect the definition of sustainable development. After analyzing a selection of community-level sustainability indicators and selecting the strongest and weakest indices from the selection, Baltimore County, Maryland is used as a common case study to investigate systematically indices' strengths, and weaknesses. As a sub focus, this thesis outlines appropriately universally valuable indicators for Baltimore County, and for any community, using the highest rated indicators from the communities analyzed. In addition to the universally valuable indicators, Baltimore County would need to develop indicators relevant to local needs and priorities. While the intent of current sustainable development efforts by Baltimore County may be for the betterment of the community at large, without a clearly defined set of indicators and support from the community, moving towards sustainable development may not be effective.

2.0 Literature Review

2.1 The Three Pillars of Sustainability

As stated above, sustainable development encompasses the economic, societal, and environmental aspects of a community, also referred to as the three pillars. Figure 1 illustrates how the three pillars equally support the concept of sustainable development. If any single pillar is considered weak, then the quality of sustainability is compromised, as it is not properly supported. In the *Guide to Sustainable Community Indicators,* Hart (2006) provides a three-layered image to also illustrate how the three pillars of sustainability are considered in a sustainable community, but using a three layered circle instead. Figure 2 shows the environment surrounds society (and the economy), as it existed prior to a human based society. Society then is portrayed as existing entirely within the environment, as the environment provides basic requirements to society. Finally, the economy is shown as existing wholly within society (i.e., it only exists in the context of a society), while society has additional space not solely dependent on the economy (i.e., family, the arts, religion, etc.).

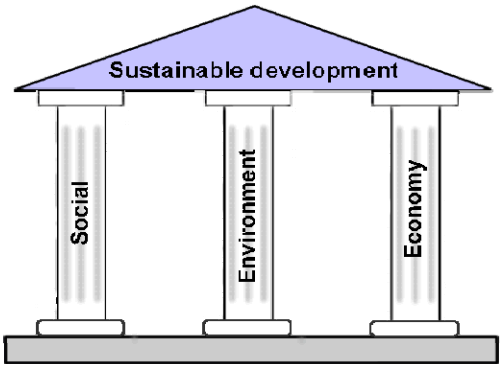


Figure 1: Three pillars of sustainable development (Sustainability-ED, 2005).

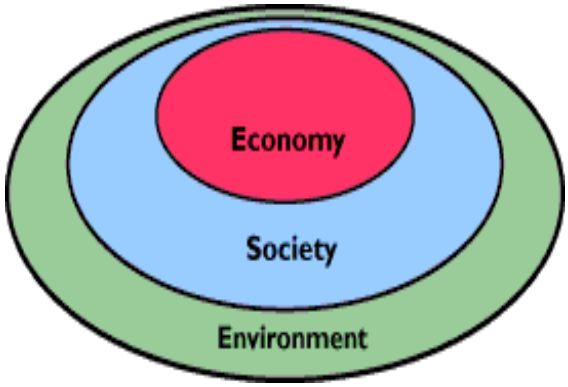


Figure 2. A sustainable community as three integrated entities (Sustainable Measures, 2010a).

2.2 Sustainability Indicators and Indices

2.2.1 Informative and Useful Indicators

As explained by Boyko et al. (2012), sustainability indicators are tools that can be used by a community for a variety of reasons including: identifying past trends, evaluating policy decisions, guiding future policy decisions, communicating to the public about current initiatives, influencing behaviors, and providing evidence and support to aid decision-makers. Indicators can be qualitative or quantitative in nature. They can also be directly tied to benchmarks, best management practices, or other existing projects. The selection of indicators is important because if the wrong ones are used, they may provide misinformation about the data they are tracking. Effective indicators, when monitored, are able to show current conditions and trends, both negative and positive, to allow a community to respond before problems arise (Hart, 2006).

An index is a collection of indicators, used to aggregate data into simpler forms to increase clarity for its intended audience. Frequently indices may weigh certain

components according to their relative importance and ultimately provide a number or rating for the index focus (Hart, 2006). For example, the percent of energy supplies by renewable energy sources may be weighted more than the total miles of bicycle paths for a given community.

The number of indicators in an index can affect the outcome and use of the index as a tool. Ideally, decision-makers make informed decisions based on a specific selection of indicators for the most relevant trends. For this reason, fewer indicators based on comprehensive up-to-date data are favored (Dahl 2012). Hart (2006) also believes that a small number of indicators, around ten to twenty total, are most effective if the indicators are primarily designed to inform the public. By condensing large quantities of data into simpler terms, indicators should provide usable key information about community sustainability to politicians, citizens, and decision-makers alike (Ramesteiner et al., 2011).

2.2.2 Indicator Development and Stakeholder Involvement

When a community decides to outline sustainability goals and track sustainability efforts using a sustainability index, it is important to consider which stakeholders are involved in the development process. Hart (2006) and Dahl (2012) both emphasize that people in a given community should be responsible for developing the needs for the community to move toward sustainable development. Hiring consultants to research and implement a sustainability plan (presumably for the short-term) is not as effective in the long run when a community is the element that remains and needs to be continuously evaluated (Hart, 2006). A community should take ownership of this process in order to see the changes

they want implemented. It is also important that a community envisions a long-term future based on the pillars of sustainability taking into account their specific regional and historical resources and economic conditions. When values of the target audience or community are properly aligned with the indicators, they become more effective as a catalyst for change (Hart, 2006).

While community involvement is important, the types of individuals selecting indicators are also crucial. There should be a well-balanced interest representation, while also considering the need for scientific knowledge and political and societal norms. Strictly science-based approaches to developing indicators are limiting as politics and policy-making pressures are not considered. On the contrary, developing indicators in a politically driven setting may skew indicators to favor policymakers. Furthermore, developing indicators while only considering local and community needs reduces the idea that sustainability is a concept greater than the community it's referencing. Therefore, finding a balance among the uses of science based information and that of political and societal norms is necessary (Ramesteiner et al., 2011).

2.3 Limitations with Sustainability Indices

Indices are being used at every level of government and at the community level to track sustainable development. The variety in the indices poses a problem for policy practices because there is no aggregate index used to interpret and communicate progress effectively to the public (Böhringer, C. & Jochem, P.E.P., 2007). Literature sources doubt that a direct relationship exists among changes in decision and policymaking and the use of indicators (Rinne et al., 2013). Therefore, there is a need for more consistent

sustainability indices that can be used as a turnkey for formulating, implementing, and assessing policy.

Dahl (2012) emphasizes that sustainable indicators have not had a significant impact to undo environmental damage or nullify unsustainable practices that affect the well-being of humanity. Indicators may convey scientific facts about irreversible damage or bring light to existing problems, but these alone may not be enough to act as catalysts for changes in the behavior of individual decision-making. This is important to consider as individual actions of every person in a community collectively affect sustainability (Dahl, 2012).

Fundamental change does not occur necessarily using indicators and facts alone. As Hart (2006) points out, indicators do not make a sustainable community. Instead, they report on progress and trends. A community must react in an appropriate and effective manner by way of changes in lifestyles, consumption patterns, use of resources, and the economy in order to see changes. Despite efforts to educate the public about sustainability, changes in behavior and governmental decision-making processes are lacking. This is important to realize when considering the need for positive feedback and reinforcement to encourage individual community members to make more sustainable decisions (Dahl, 2012).

Sustainability vs. Livability

Frequently, indices focused on sustainable development will include indicators geared towards the quality of life for its residents, also known as livability. As defined by the Victoria Institute for Transportation (2011), “livability refers to the subset of sustainability impacts that directly affect people in a community, such as economic

development, affordability, public health, social equity, and pollution exposure." While livability measurements may benefit the community, they are typically focused on local and short-term goals, such as reducing local air or noise pollution and increasing opportunities for recreation, entertainment, and aesthetics. By emphasizing local issues, indicators may exclude how the interactions within a given community affect the economy, society, and environment externally (which need to be taken into account, as a community's actions will ultimately affect outside communities as well). Furthermore, community indices with a strong focus on livability indicators become problematic if the true aims of the indices are to address sustainable development in the long-term.

2.4 Tools for Evaluating Sustainability Indicators

Several experts have developed tools to assess the value and utility of specific indicators that may be part of a community's sustainability index. For this thesis research, a selection of these tools is used to evaluate indicators in community-level indices. These tools include Maureen Hart's fourteen-question checklist to rate each indicator, Hart's list of pre-rated indicators, and the *U.S. Siemens Green City Index* to evaluate environmental indicators (Hart, 2006; Siemens AG, 2011).

2.4.1 Maureen Hart's Resources for Evaluating Indicators

Developed by sustainability expert Maureen Hart, *Guide to Sustainable Community Indicators* (2006) is a source of literature and research for evaluating indicators and indices. This book describes how to identify meaningful community sustainability indicators, provides a way to rate current indicators for their ability to represent sustainable development, and supplies a pre-rated list of over 700 commonly used

indicators. Hart has a fourteen-question checklist to rate an indicator to determine if it is a good measure of sustainability (see list below). An indicator earns a point for each positive answer for the first thirteen questions, meaning that the highest possible indicator rating is thirteen. An indicator may consist of multiple measurements that attribute to the overall status or trend of that indicator. For purposes of using Hart's checklist to rate indicators in this research, if at least one of the measurements for a given indicator meets the criteria for one of Hart's questions, the indicator earns a point. It is impossible for any indicator to have a rating of fourteen, as the last question, "Does the indicator measure sustainability at the expense of another community or at the expense of global sustainability," should always be answered "no." If the indicator does measure sustainability at the expense of another community, it is eliminated as a sustainability indicator (Hart, 2006).

An indicator with a rating of four or less is not considered useful for measuring sustainability, while an indicator with a rating equal to or greater than seven is considered a good measure of sustainability. However, few indicators will have a rating equal to or greater than ten, as it is difficult for an indicator to simultaneously link the economy, society, and environment and address the six types of community capital (listed in questions one through six below) (Hart, 2006).

Maureen Hart's Sustainable Community Indicator Checklist

1. Does the indicator address the carrying capacity of the natural resources - renewable and nonrenewable, local and nonlocal -- that the community relies on?

2. Does the indicator address the carrying capacity of the ecosystem services upon which the community relies, whether local, global, or from distant sources?
3. Does the indicator address the carrying capacity of esthetic qualities - the beauty and life-affirming qualities of nature -- that are important to the community?
4. Does the indicator address the carrying capacity of the community's human capital - the skills, abilities, health, and education of people in the community?
5. Does the indicator address the carrying capacity of a community's social capital - the connections between people in a community: the relationships of friends, families, neighborhoods, social groups, businesses, governments and their ability to cooperate, work together, and interact in positive, meaningful ways?
6. Does the indicator address the carrying capacity of a community's built capital - the human-made materials (buildings, parks, playgrounds, infrastructure, and information) that are needed for quality of life and the community's ability to maintain and enhance those materials with existing resources?
7. Does the indicator provide a long-term view of the community?
8. Does the indicator address the issue of economic, social, or biological diversity in the community?
9. Does the indicator address the issue of equity or fairness - either between current community residents (intra-generational equity) or between current and future residents (inter-generational equity)?
10. Is the indicator understandable to and useable by its intended audience?
11. Does the indicator measure a link between economy and environment?
12. Does the indicator measure a link between environment and society?

13. Does the indicator measure a link between society and economy?
14. Does the indicator measure sustainability that is at the expense of another community or at the expense of global sustainability? (Hart, 2006).

2.4.2 Siemens U.S. Green City Index

The *Siemens Green City Index* is the result of a research project initiated by the Siemens Corporation to assess the environmental performance of cities across the world. The index was developed by a panel of global experts in urban environmental sustainability in coordination with the Economist Intelligence Unit, an independent business providing research and analysis services. This index is currently used to rank the environmental performance of over 120 cities, including the twenty-seven most populous metropolitan areas in the U.S. and Canada. As one of the seven regional indices used by Siemens, the *U.S. Green City Index* consists of nine categories with thirty-one quantitative and qualitative indicators (see Table 1). While indicators focus on the environmental components of a community, they also address economic and societal issues, and in effect measure the sustainability of a community. For purposes of ranking the twenty-seven U.S. cities, Siemens normalizes its quantitative indicators from zero to ten. By doing so, the index transforms different scales of variables into one composite scale. Furthermore, each category score is equally weighted and summed for a possible high score of 100. Cities are ranked on this scale, making their environmental performances comparable (Siemens AG, 2011).

Table 1: Siemens U.S. Green City Index

Category	Siemens Indicator
CO_2	Carbon dioxide emissions per unit of gross domestic product (GDP) (metric tons/U.S. million dollars)
	Carbon dioxide emissions per person (metric tons)
	Carbon dioxide reduction strategy
Energy	Electricity consumption per unit of GDP
	Electricity consumption per person (gigajoules per person)
	Clean and efficient energy policies
Land use	Green spaces as percent of total city area
	Population density (persons per square miles)
	Green land use policies/Tree planting policy
	Urban sprawl/Brownfield reuse
Buildings	Number of LEED certified buildings (silver, gold or platinum) (buildings per 100,000 persons)
	Energy efficient building standards
	Energy efficient building incentives
Transport	Share of workers traveling by public transit, bicycle or foot
	Public transit supply
	Average commute time from residence to work
	Green transport promotion
	Congestion reduction policies
Water	Water consumption per capita
	Water system leakages
	Water quality policy
	Stormwater management policy
Waste	Percent of municipal solid waste recycled
	Waste reduction policies
Air	Nitrogen oxides emissions per year (pounds per person)
	Sulfur dioxide emissions per year (pounds per person)
	Particulate matter $(PM)_{10}$ emissions per year (pounds per person)
	Clean air policy
Environmental governance	Green action plan
	Green management plan
	Public participation in green policy

2.5 Objectives of Sustainability Indicator and Index Analyzes

Literature review and research are available to evaluate indicators and indices for their ability to accurately reflect and focus on sustainable development. However, there has been little coordination across communities to ensure that valuable indicators are being used to measure progress towards sustainability. In Part One of this research, the focus is to evaluate a selection of U.S. community-level indices using a quantitative and qualitative approach for their ability to measure sustainable development. As outlined above, methods of evaluation include utilizing Hart's list of pre-rated indicators, Hart's fourteen-question checklist, the *Siemens U.S. Green City Index*, and additional research from literature review. In Part Two, interpretations of these results lead to the selection of the strongest and weakest community indices. Furthermore, in Part Two an application of Baltimore County data to the strongest and weakest indices provides more insight about the utilization of the two indices selected. Conclusions in Part Three outline potentially valuable ways in which Baltimore County could develop a sustainability index.

3.0 Methodology

3.1 Part One: Selecting U.S. Sustainability Indices

As stated in the introduction, a set of community-level sustainability indices was chosen to examine their ability to represent the definition of sustainable development. While sustainability indices are used globally, this research uses indices for communities in the U.S. As a starting point, U.S. communities with sustainability indices listed by the *2013 State of the World's* chapter "Measuring U.S. Sustainable Urban Development" were reviewed. This literature source reviewed twenty-two indices focused on sustainable development. The twenty-two indices, listed in Appendix A, fall into four broad categories including institutional, non-governmental organization, private, and governmental indices. Six of the twenty-two indices were community-level indices in the U.S. and were used for further review (see list below) (Birch & Lynch, 2012).

2013 State of the World U.S. Sustainable Development Indices

- Sustainable Seattle: Seattle, WA,
- Portland Planning and Sustainability: Portland, OR,
- Santa Monica Sustainability Plan: Santa Monica, CA,
- Central Texas Sustainability Indicators Project: Central Texas, TX,
- Minneapolis Sustainability Indicators: Minneapolis, MN, and
- Houston Sustainability Indicators: Houston, TX (Birch & Lynch, 2012).

As a second source of indices, communities frequently cited in literature for using sustainability indicators were also reviewed (Portney, 2001; Hart, 2006). A literature

review identified over thirty additional indices used by U.S. communities, which are also listed in Appendix A. Collectively, these two sources of indices were narrowed down based on the indices' focus on sustainability, data availability and how recently the latest index report was published. This was primarily done by searching for indices' availability online. Indices no longer actively managed, with outdated websites, or with reports older than five years were eliminated. Based on this filtering, the following five communities were selected for further evaluation: San Mateo, CA; Santa Monica, CA; Minneapolis, MN; Houston, TX; and the Central Texas Project, TX.

3.2 Part One: Evaluating Sustainability Indices

As previously mentioned, there is no universal template to describe an ideal sustainable community. Communities are developing their own indices, consisting of indicators, to track and report on sustainability issues they deem to be important. However, there has been little research across communities to ensure that the indicators being used are valuable and effective at measuring progress towards sustainability. This research aims to evaluate the selected community indices by using the sustainability tools described above (Hart's resources and Siemens *U.S. Green City Index*) and by using best practices identified from research (Dahl, 2012 and Ramesteiner et al., 2011). For this thesis research, it is assumed that if the concept of sustainability were defined in a universal way, then indicators in different communities would generally focus on similar topics important to the sustainable development of a community. Variations in indices are expected, as indicators focused on local issues are sometimes necessary, and may not be relevant for another community; however, variations in indicators and their measurements should not be substantial.

3.2.1 Utilizing Maureen Hart's Checklist and Resources

Individual indicators in each community index were rated for their ability to measure sustainability by using Hart's list of previously rated indicators, and/or by determining a rating using Hart's fourteen-question checklist. As previously mentioned, Hart (2006) has a comprehensive list of indicators that are either frequently used by communities or have been proposed for use as sustainability indicators. The indicators consist of good to poor measurements of sustainability, and address topics relating to the environment, economy, and society. Each indicator already has its own rating from one to thirteen based the criteria outlined in Hart's fourteen-question checklist (see list below). For example, the indicator *Population Growth* is listed with a rating of eight because this indicator addresses eight of the fourteen questions in Hart's checklist. As another example, the indicator *Age Trends in Population* is also listed, with a rating of two for addressing only two of the fourteen questions (Hart, 2006).

For purposes of evaluating the five community indices, if a community indicator (or one of its measurements) matched an indicator in Hart's list of pre-rated indicators, it was given the same rating. If a community indicator was listed in Hart's list of pre-rated indicators, but had measurements that could possibly alter its pre-determined rating, it was evaluated separately. For instance, Central Texas's indicator *Mental Health* has four measurements to describe the community's status including Suicide Rate, Youth Substance Abuse, Clients Served by Public Providers, and Support (CTSIP, 2012). The first two measurements, Suicide Rate and Youth Substance Abuse, are included in Hart's list of indicators, each with a rating of three (Hart, 2006). However, because the last two measurements are not included in Hart's list, this indicator was evaluated separately

using the fourteen-question checklist. Its final rating was six because the last two measurements collectively met the sustainability criteria for three of Hart's questions where the first two did not. Finally, any community indicator not included in Hart's list was also evaluated separately to determine a rating. As an example, an indicator and its corresponding measurements are evaluated below using Hart's fourteen-question checklist.

Indicator: Water Consumption

Measurements for Indicator: Current Demand for Water, Groundwater Availability, Water Knowledge, Concern about Water, and Conservation Effort Awareness.

Hart's Fourteen-Question Checklist:

1. Does the indicator address the carrying capacity of the natural resources that the community relies on? **Yes.**
2. Does the indicator address the carrying capacity of the ecosystem services upon which the community relies? **Yes.**
3. Does the indicator address the carrying capacity of esthetic qualities that are important to the community? **No.**
4. Does the indicator address the carrying capacity of the community's human capital? **Yes.**
5. Does the indicator address the carrying capacity of a community's social capital? **No.**
6. Does the indicator address the carrying capacity of a community's built capital? **Yes.**
7. Does the indicator provide a long-term view of the community? **Yes.**

8. Does the indicator address the issue of economic, social, or biological diversity in the community? **No.**
9. Does the indicator address the issue of equity or fairness? **Yes.**
10. Is the indicator understandable to and useable by its intended audience? **Yes.**
11. Does the indicator measure a link between economy and environment? **Yes.**
12. Does the indicator measure a link between environment and society? **Yes.**
13. Does the indicator measure a link between society and economy? **Yes.**
14. Does the indicator measure sustainability that is at the expense of another community or at the expense of global sustainability? **No.**

For every question that was answered "yes," the indicator earned a "point" towards its final rating. Therefore, its rating was ten out of a possible rating of thirteen as the final question should always be answered "no" if it is to be considered an indicator of sustainability (recall that indicators with a rating of four or lower are not considered good measurements of sustainability, while indicators with a rating of seven or higher are considered good measurements). As a visual example, Appendix B shows how indicators were rated in a table for mass purposes of determining the average ratings by section and of the index.

Final indicator ratings were noted with caution as Hart (2006) points out that a rating is not always applicable based on different community needs. While a highly rated indicator may be important for one community, another may not consider it as useful. Likewise, a lower rated indicator may be important for a community to track, but not be important to another community. Additionally, just because an index consists of all high rated indicators does not mean all important issues in that community are addressed (Hart,

2006). To the extent possible, each index was assessed for incorporating indicators relevant to local issues, regardless of the indicator rating. As an example, local issues or local based indicators may focus on a unique geographical feature, goods or services provided in the region, or a strong cultural presence.

After each indicator had a rating from either Hart's list of pre-rated indicators or using the fourteen-question checklist, indicator ratings were then aggregated to determine an average indicator rating for each community index. For additional analysis, average indicator ratings for each section of an index were also calculated. By calculating average ratings by section, the strongest and weakest sections could be determined, implying that the community may be measuring sustainability accurately in one area, and not as well in another.

3.2.2 Siemens Green City Index

As a secondary means for evaluating the community indices, the *U.S. Green City Index* was used to evaluate environmental indicators in each index. As stated previously, the *U.S. Green City Index* consists of thirty-one qualitative and quantitative indicators, focused on evaluating the environmental performance of cities, while also integrating social and economic performance. The thirty-one indicators are separated into one of nine categories, with categories consisting of two to five indicators. The category, Environmental Governance, was not included for analysis since it is more qualitative in nature, and its "indicators" are not typical indicators. Two of the three indicators, a "Green Action Plan," and a "Green Management Plan," are essentially what is being analyzed for each community. The third indicator "Public Participation in Green Policy,"

is a measure of a city's efforts to involve the public in monitoring its environmental performance, and was not able to be measured using the indices alone. The remaining eight categories and twenty-eight indicators were used to evaluate the selected indices (Siemens AG, 2011).

While Siemens uses the index to designate a final score for cities assessed (Siemens AG, 2011), for this thesis, the index was used differently to evaluate indicators. Each set of community indicators, or each index, was evaluated separately. First, the number of community indicators in each index that matched the twenty-eight *U.S. Green City Index* indicator was determined. For instance, if a community had an indicator for Greenhouse Gasses and measured the CO_2 per capita, the measurement would match Siemens' indicator for CO_2 per capita. The community index would then be credited as having a matching measurement. Secondly, the number of Siemens' indicators that was referenced in a community's index, but not necessarily listed as an indicator, was also determined. This second measurement was necessary to calculate due to the variability of the structure of the reports and indicators (indicators consisted of targets, measurements, and general discussion points). This number was inclusive of the first number determined (direct measurements) because if a community's indicator matched one of Siemens' indicators, it was automatically assumed to be "referenced" in an index. A sample of this type of analysis is displayed in Table 2.

As a final measurement for each community, the number of Siemens' categories addressed by a community's indicators was calculated. For several of Siemens' categories, many indicators within a category were similar, but had different units of measurement (i.e., CO_2 per unit of GDP and CO_2 per person; and electricity consumption

per unit of GDP and electricity consumption per unit of GDP per person, etc.) (Siemens AG, 2011). Therefore, it was not expected that a community index would have each of Siemens' indicators included as an individual indicator (otherwise, the indicators would be repetitive instead of having multiple similar measurements contributing to one indicator). It was possible that a community index had more than one of Siemens' indicators within a given category included as measurements contributing to a single indicator's data. Overall, it was expected that a well-rounded index addressing the three tiers of sustainability would include at least one indicator from each category.

Table 2: Sample Chart for Siemens Indicator Analysis

	Number of Indicators in Community Index	Number of Community Indicators Matching Siemens *	Number of Siemens' Indicators Mentioned in Index **	Number of Categories Addressed by Community Indicators***
Community	#	Possible value of 0 to 28	Possible value of 0 to 28	Possible value of 0 to 8

*This number reflects community indicators with the exact measurement as Siemens.

**This number is inclusive of the number of community indicators matching Siemens in the previous column.

*** Siemens has eight categories used for indicator analysis.

The number of community indicators matching Siemens was weighted slightly more than the number of indicators mentioned. If an index was using the precise measurements of Siemens' indicators, then it was automatically known that the measurement is comparable and inferred something about the sustainability of the community. Meanwhile, if the Siemens indicator was simply mentioned within the index, it may have meant the data were not as important to that community to track. Furthermore, an index

with higher values for any of the Siemens based measurements was considered to be using a well-rounded set of environmental focused indicators since each category is strongly related to a community's sustainability.

3.2.3 Additional Indicator and Index Analysis

In addition to evaluating the indicators using the criteria above, each community was examined for how the community updated its index to keep it an evolving planning and policy tool. The concept of sustainability must be seen as a constant process; therefore, governments or those in charge of creating indices must provide data in a timely manner, and continue to reevaluate current conditions. The role of stakeholders was also examined in this ongoing process. Setting and achieving a goal does not make something sustainable unless the goal is maintained, or reevaluated in a way to reflect the current state of the external factors affecting that goal. In order to make sound policy decisions, the indicators should be assessed at some frequency to provide recent data.

Additionally, in order to understand the structures and use of each index, literature developed to help classify and evaluate indicators was used (Hart, 2006; Singh, 2009). Singh (2009) emphasizes the need for clarity and simplicity of indicators in their content, purpose, method, and comparative application. An indicator must be based on valid and reliable data, and the data must be available across time. Hart (2006) also describes the benefits and shortcomings of common index structures (categories, goal-indicators matrix, and driving force-state-response matrix) which are referenced when needed.

3.3 Part Two: Selection of Strongest and Weakest Indices

After each index was fully evaluated in Part One using Hart's resources, the *U.S. Green City Index*, and by additional personal analysis, the strongest and weakest indices were selected for their ability to measure sustainability in a community. Reasons for selecting the two indices are briefly discussed, as the second focus of Part Two evaluates the two indices further.

3.4 Part Two: Analyzing and Utilizing the Strongest and Weakest Indices

Part Two elaborates on why the two indices were selected as the strongest and weakest indices and also explains why they differed in performance in ways that were not discussed in Part One. To complete this analysis, the two indices were utilized as if Baltimore County, MD decided to select each index to assess its own sustainability performance. Therefore, Baltimore County data relevant to the information tracked by each index's indicators were collected as two separate data sets (one for each index). The purpose of collecting the two data sets was not to compare the sustainability performance of Baltimore County to the communities' baselines. Rather, the nature of the Baltimore County data sets shed further light on the value of the indices as tools for evaluating and measuring sustainability. A selection of indicators from both indices is compared in relation to the Baltimore County data collected. Furthermore, suggestions for improving the indicators for potential use by Baltimore County are included.

Collecting Baltimore County Data for the Strongest and Weakest Indices

Baltimore County, Maryland was selected due to this research being completed within the county, and due to access to local government records as a Baltimore County government employee. Data for Baltimore County were collected based on each indicator's specific measurement(s). For instance, if an index had an indicator that measured violent crimes by type, data for Baltimore County's violent crimes by type were collected. Data were collected primarily from county government resources, personal communications with county agencies, and from U.S. Census studies. Information not available for the county was collected from regional data or state data when necessary. In some cases, no data were available or they were not tracked by the county, region, or state. Frequently, measurements in the two indices were based on surveys only conducted by the community using the index. In those cases, Baltimore County did not have data available.

Many demographic, social, housing, and economic statistics used by the two community indices were available for Baltimore County through the three-year estimates from the 2010-2012 American Community Survey. This nationwide survey is designed to provide communities information by collecting long form type information throughout the decade, publishing statistics yearly rather than only once every 10 years (U.S. Census Bureau, September 24, 2014). Other U.S. Census studies were often used as well.

3.5 Part Three: Developing Suggestions for a Baltimore County Index

The additional analysis from the collection and application of Baltimore County data to each index is then used to construct suggestions for a hypothetical sustainability index for

Baltimore County. Should the county decide to develop and implement a sustainability initiative, it would be imperative to ensure the indicators selected would be good measures of sustainability while also addressing local issues important to the county.

4.0 Part One Results: Analysis of Sustainability Indices

Part One of this research focuses on analyzing the indicators in the five communities selected. The primary purpose of Part One is to assess the strengths and weaknesses of the indices using the selected evaluative criteria. Each community has a profile in Table 3 below that includes details about the formation of its indicator project, stakeholder involvement, how its report is structured, and how the information has been used as a policy-making tool. Siemen's Green City Index analysis results are described, followed by results from Hart's pre-rated list of indicators and fourteen-question checklist. Finally, a general overview is given for each index, identifying any additional strengths and weaknesses not already discussed.

Table 3: U.S. Community Profiles

Community	Population, 2013	Land Area (sq. mi.)	Number of Indicators in Index
Central Texas, TX	1,926,874	5,214.2	40
Houston, TX	2,195,914	599.6	25
Minneapolis, MN	400,070	57.4	26
San Mateo, CA	747,373	448.0	45
Santa Monica, CA	92,472	8.40	54
Baltimore County, MD (case study)	823,015	682.0	No index used

(U.S. Census Bureau, July 2014a, July 2014b, July 2014c, July 2014d, July 2014e).

4.1 Central Texas Project

4.1.1 Central Texas Sustainability Indicators Project

In Texas, a group of residents shared a vision that in order to enhance the quality of life in Central Texas with consideration to current and future generations, the environment, economy, and society needed to be addressed as interconnected issues. The development of the Central Texas Sustainability Indicators Project (CTSIP) was the response to this vision. Focused on increasing sustainability awareness, in 1999 the residents began developing an indicator report. Over the years, a CTSIP Board was created, which continues to guide current project efforts. Currently, the CTSIP is collaborating with the Center for Sustainable Development at the University of Texas at Austin School of Architecture, and the city of Hahn, Texas. Additionally, the CTSIP is participating in a regional planning initiative called the Sustainable Places Project. Unlike the other communities examined in this report, the CTSIP addresses sustainability across multiple jurisdictions (CTSIP, 2012).

4.1.2 Stakeholder Involvement

Using input from board meetings, resident concerns, phone surveys, and education and outreach, the CTSIP Board has provided active leadership while incorporating the public's concerns and needs. In the 2012 Report, the list of Board Members (and now co-directors) consists of three citizens and representatives from the following organizations:

- University of Texas-Austin School of Architecture, Dean,
- University of Texas- Austin, Director of Sustainability, and
- University of Texas-Austin Center for Sustainable Development (CTSIP, 2012).

4.1.3 Central Texas Indicator Reports

The CTSIP Board explicitly states that their purpose is not to provide specific solutions or strategies to problems, but to provide sound data for regional leaders and citizens to see the impact of actions on the region's sustainability. Reports are intended to be a diagnostic tool to help decision-makers create public policy and encourage discussion for solutions that address current issues (CTSIP, 2012).

The CTSIP released its first sustainability indicator report in 2000. The first five reports were produced annually, and beginning in 2004 the reports became biennial. Initial reports addressed sustainability issues throughout five central Texas counties including Bastrop, Caldwell, Hays, Travis, and Williamson. In 2009, Burnet County was added to the project area. The most recent data report, released in 2012, is used for this analysis (CTSIP, 2012).

In March 2013, an online portal for the indicator report was launched to provide an interactive website in place of a biennial report. The website has the indicators, data, and methods of assessment available to the public. The online portal is the means of continuously updating the forty indicators as information becomes available (CTSIP, March 2013).

Indicator data have been collected from multiple sources including academic, government, nonprofit and private sector information. Additionally, feedback and comments from previous report users and a phone survey have contributed to the indicator results. In 2000, the CTSIP designed a phone survey to collect measurements and data where there was little to no public data available. The 2000 survey, designed by

a consultant, consisted of twenty-one questions covering seven topics. In the following years, additional modules covering issues about Workforce Training, Child Care, Civic Engagement, Health Status and Health Insurance, and Reactions to Race/Ethnicity were added. In 2006, Opinion Analysts, Inc. helped design new questions regarding Land Use and Sustainability. Modules for Water Awareness, Climate Change, and questions related to Social Equity and Local Business have also been added in recent years. The current survey now consists of nineteen modules (CTSIP, 2012).

From 2000 to 2004, the phone survey was conducted annually. In 2004, the survey became a biennial Community Survey, the latest completed in 2010. Its content serves as a primary data source for eight indicators, and as a secondary data for five indicators. In order to improve the quality of indicators and to meet the survey needs of community partners, the CTSIP adds new or revised questions to the Community Survey as needed (CTSIP, 2012).

4.1.4 Central Texas Indicators

The CTSIP describes good indicators as easy to communicate, derived from reliable data, connected to other indicators, and able to identify where action is need most before trends become irreversible (CTSIP, 2012). These descriptions are parallel to Hart's (2006) descriptions of effective indicators. The 2012 report has forty indicators, separated into eight categories (see Appendix C). The report does include demographic data, but does not consider the measurements to be indicators, and therefore are excluded from the categories below.

Each indicator is assigned with a trend (unchanged, improving, or worsening) to provide the reader with a sense of progress over the past several years. Additionally, each indicator has a "status flag" to clarify what an appropriate response should be to improve the trend. The status flags include Action Needed, Keep Watch, and Doing Well. Additionally, the current state, ideal state, context, and additional measures are listed. The data sources that contributed to the indicator assessment are then visualized using maps and graphs, depicting trends over time (CTSIP, 2012).

Data are presented in various periods, including decadal, biennial, and annual. Some data date back to 1994, while other data rely on Community Survey responses in recent years. Maps are used to depict local data trends in addition to community-wide trends (which cover all counties affected). Issues, such as water availability and air quality, are described on a larger geographic scale, while other issues, such as community safety, are focused at a local scale (CTSIP, 2012).

There is an "Ideal State" described for each indicator; however, there are no goals or targets associated with each. Some indicators mention targets set by other organizations (i.e., Austin Chamber of Commerce and Austin Energy). Benchmarks are used sparingly, and typically reference state or federal benchmarks (i.e., Fair Market Rent for Affordability of Local Rental Units). There is not a pre-determined baseline to measure results against. Additionally, there are neither solutions nor strategies discussed to address indicators that need improvement (CTSIP, 2012).

4.1.5 Hart Indicator Analysis for Central Texas

After Hart's fourteen-question checklist was applied to the forty indicators, Central Texas had an average indicator rating of 6.53, the median of the five communities. The percent of indicators with a rating of seven or higher was also the median at 47.5% (see Figure 3 for a distribution of indicator ratings).

Four of the forty indicators had a rating of four, the lowest rating in the report. These indicators included *Home Loans*, *Participation in the Arts*, *Civic Participation*, and *Exporting Industries*. The highest rated indicators included *Density of New Development* and *Rural Land*, each with a rating of eleven. Table 4 lists the highest and lowest rated indicators by section.

As mentioned previously, Hart considers a good indicator of sustainability to have a rating of seven or higher. Of Central Texas's eight categories of indicators, only two had average indicator ratings of seven or higher (Environment and Land Use and Mobility). Of the six indicators in the Environment section, five of them had connections to the environment, economy, and society. Additionally, four of the five indicators in Land Use and Mobility had indicators with connections to the three pillars of sustainability.

From Hart's checklist, over one-half of the indicators addressed the Carrying Capacity of Human Capital and Equity or Fairness. Additionally, almost all of the indicators focused on a long-term view of the community, were understandable, and had a link between the economy and society. Less than twenty percent of the indicators had a link between the economy and the environment or addressed the carrying capacity of ecosystem services,

esthetic qualities, or built capital. Four of the forty indicators had no links between the environment, society, or economy.

Table 4: Central Texas's Highest and Lowest Rated Indicators by Section

Section	Average Indicator Rating	Highest Rated Indicator(s)	Lowest Rated Indicator(s)
Land Use and Mobility	9.2	Density of New Development and Rural Land (11)	Commuting and Vehicle Miles Traveled (9)
Environment	8.0	Water Consumption (10)	Hazardous Waste (6)
Education and Children	6.7	Child Care: Quality, Child Care: Access, Schools: Quality, Schools: Equity, and Schools: Performance (6)	Child Care: Access and Higher Education (5)
Social Equity	6.4	Housing: Ownership (8)	Home Loans (4)
Economy	5.5	Household Income, Diversity of Economy, Exporting Industries, Labor Availability and Job Availability (6)	Exporting Industries (4)
Public Safety	5.3	Equity in Law Enforcement (6)	Safe Families (5)
Health	5.3	Mental Health (6)	Health Access and Physical Health (5)
Engagement	4.5	Philanthropy and Volunteerism and Neighborliness (5)	Participation in the Arts and Civic Participation (4)

4.1.6 Siemens Indicator Analysis

Based on the Siemens indicator analysis, Central Texas had seven indicators that matched Siemens' indicators exactly. Twelve indicators were mentioned or included in the index (see Tables 5 and 6). Central Texas has the third highest value for number of exact indicators, while the lowest for the overall exact indicators and indicators discussed.

Table 5: Siemens Indicator Analysis Results for Central Texas

Community	Number of Indicators in Community Index	Number of Community Indicators Matching Siemens*	Number of Siemens' Indicators Mentioned in Index **	Number of Categories Addressed by Community Indicators***
Central Texas	40	7	12	7

*This number reflects indicators with the exact measurement as Siemens.

**This number is inclusive of the number of community indicators matching Siemens.

***Siemens has eight categories used for indicator analysis.

Overall, Central Texas indicators addressed seven of the eight categories. Central Texas had no indicators that measured LEED or energy efficient buildings or green building policies CTSIP, 2012).

4.1.7 Additional Analysis

One of the strong points of the CTSIP was the transparency of the data sources, and how they were used to construct trends. The appendix of the 2012 report stated that public data from regulatory agencies, available quantitative sources, and subjective data from the Community Survey and opinion surveys were all major inputs for assessing indicators. Each indicator was listed with the source(s) used, in addition to web links. Credible sources such as the Environmental Protection Agency, U.S. Energy Information Administration, Texas Comptroller's Office, and more were referenced. Additionally, the Community Survey results were included in the Appendix and are available by request (CTSIP, 2012).

Table 6: Siemens Green City Index and Central Texas Indicators

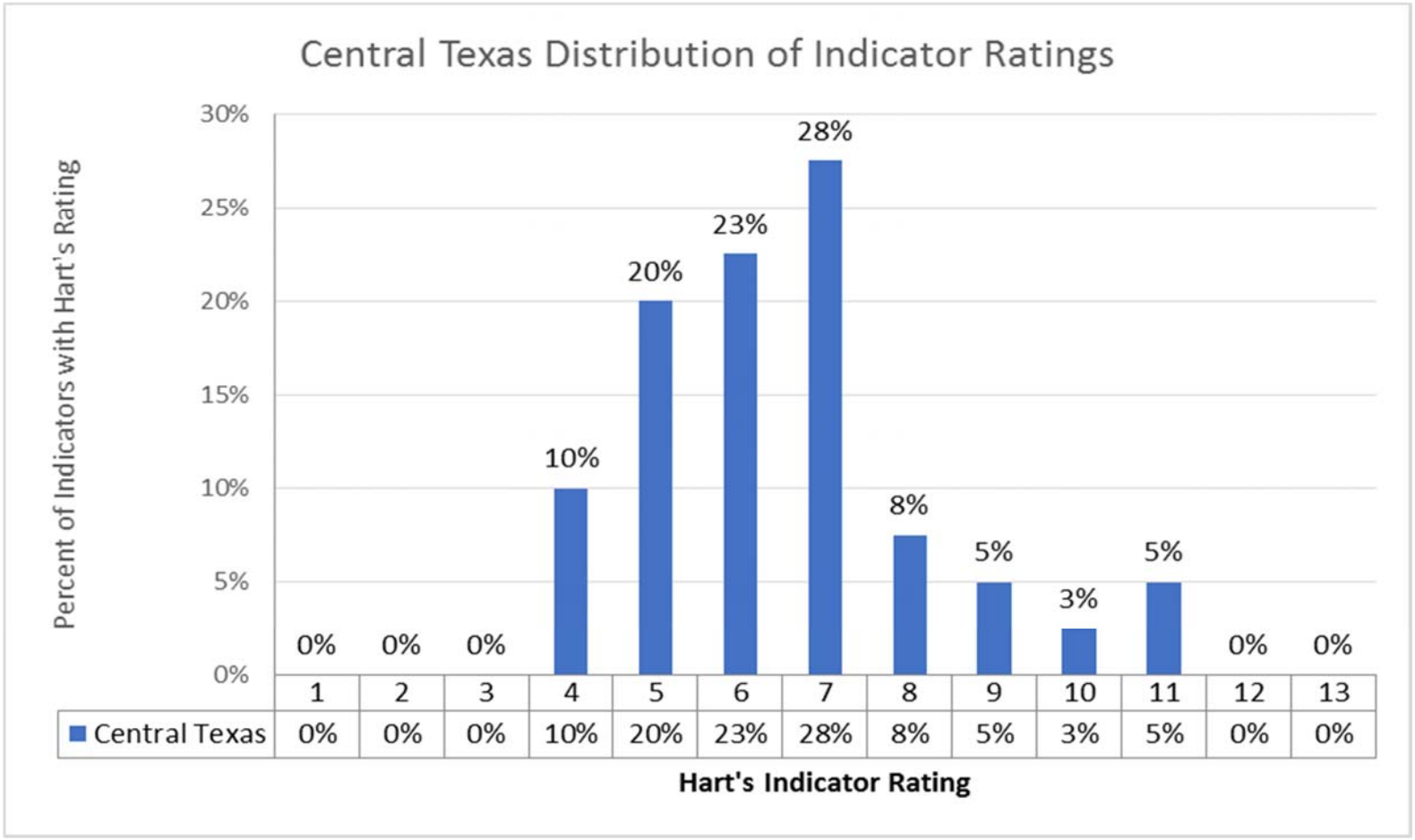
Category	Siemens Green City Indicator	Community Indicator Matching Siemens Indicator	Siemens' Indicators Mentioned in Index
CO_2	CO_2 emissions per unit of GDP	No	No
	CO_2 emissions per person	No	No
	CO_2 reduction strategy	No	**Yes**
Energy	Electricity consumption per unit of GDP	No	No
	Electricity consumption per person	No	No
	Clean and efficient energy policies	No	**Yes**
Land use	**Green spaces as % of total area (%)**	**Yes**	**Yes**
	Population density (persons/miles^2)	No	**Yes**
	Green land use policies/Tree planting policy	No	No
	Urban sprawl/Brownfield Reuse	**Yes**	**Yes**
Buildings	Number of LEED certified buildings per 100,000 persons	No	No
	Energy efficient building standards	No	No
	Energy efficient building incentives	No	No
Transport	**Share of workers traveling by public transit, bicycle or foot**	**Yes**	**Yes**
	Public transit supply	**Yes**	**Yes**
	Average commute time from residence to work	**Yes**	**Yes**
	Green transport promotion	No	No
	Congestion reduction policies	No	No
Water	**Water consumption per capita**	**Yes**	**Yes**
	Water system leakages	No	No
	Water quality policy	No	No
	Stormwater management policy	No	No
Waste	**Municipal solid waste recycled (%)**	**Yes**	**Yes**
	Waste reduction policies	No	**Yes**
Air	Nitrogen oxides emissions per year (pounds per person)	No	**Yes**
	Sulfur dioxide emissions per year (pounds per person)	No	No
	PM_{10} emissions per year (pounds per person)	No	No
	Clean air policy	No	No
	Total Number of Indicators Matched/Mentioned	**7**	**12**

Central Texas did not track some of the highly rated indicators frequently tracked by other communities. There was no mention of greenhouse gasses or climate change, despite adding climate change as a module for the Community Survey. Central Texas did track a few locally important and unique indicators, including *English Proficiency*, *Diversity of Leadership,* and *Race Relations* (CTSIP, 2012).

4.1.8 Conclusions

Central Texas covers a variety of sustainability issues and includes those of local importance. Data are displayed in easy and understandable formats, and there is a strong sense of data transparency. Based on the Siemens analysis, the Central Texas indicators performed averagely compared to the other communities. For Hart's analysis, the Central Texas indicators performed averagely as well. At 28%, the most frequent indicator rating was seven, while only 21% of indicators had ratings higher than seven. While some indicators were rated lower due to an emphasis on local issues, Central Texas did not perform as well as the other communities.

Figure 3: Central Texas Distribution of Indicator Ratings



4.2 Houston, Texas

4.2.1 Houston Sustainability Indicators Program

Houston, Texas has a population of 2,195,914 people in a city of 599.59 square miles (U.S. Census, July 8, 2014b). Currently, Rice University in Houston and Shell Oil Company are responsible for tracking sustainability efforts through the Houston Sustainability Indicators Program (HSI). In 2002, Rice University collaborated with Shell Oil Company to announce the formation of the Shell Center for Sustainability (SCS). As part of Rice University, the SCS is included under the School of Social Sciences. The SCS collaborates with schools and organizations to promote sustainability research and education in Texas, with a focus on the Houston and Galveston Regions. Some of these groups include Rice's Environmental and Energy Systems Institute, the Center for the Study of Environment and Society, and the James A. Baker III Institute for Public Policy (Rice University, 2013a).

The SCS Operation Committee is responsible for leading the group, and meeting the SCS's objectives and mission. The sixteen-member committee includes representatives from Shell Oil Company and faculty and staff from Rice University. The committee holds monthly meetings open to the public (Rice University, 2013b).

4.2.2 Houston Sustainable Indicator Report

As a part of the SCS research, the HSI was developed to better address sustainable development in Houston. In 2010, the SCS released a document, *Measuring City Sustainability: Project Houston*, which evaluated the most frequently cited indicators of city sustainability at that time. Using the report as a basis for further research, the SCS

designed the HSI Report to allow for a better balance of indicators from the three pillars of sustainability, provide a better structure to present the data, collect additional data missing previously, and describe methods for data collection. Additionally, when possible, data were added from the years 1990, 2000, and 2010 to allow for long-term comparisons (King, November 2012d).

Indicators were developed using the help of experts in sustainability related fields, while also incorporating issues important to the region. Because the city of Houston has no formalized goals or visions for sustainability, indicators were developed with an emphasis on what was considered most important to the local community. In total, twenty-four indicators were tracked through three on-going reports for different levels of the community. The first report for the city of Houston (and the focus for the following review on indicators) was released in 2012 (see Appendix D for a list of indicators). The second report, released in 2013, addressed sustainability issues at the Council District level. The third report (to be released in late 2014) will address sustainability at the "super-neighborhood" level (Rice University, 2013c).

The HSI Report has three main sub-reports corresponding to the three pillars of sustainability. The sub-reports, Social Development, Economic Development, and Environmental Development, are presented in a theme and sub-theme structure. Indicators are used to explain the themes, accompanied by metrics and a description of what the metrics conclude. A brief description is also given as to why each indicator is important in a "Sustainability Issue" section. Finally, each sub-report has brief recommendations that outline steps for policy or program changes to improve the condition of each indicator (King, November 2012d). An appendix is also included to list

sources of data, related agencies and reports, and the relevance of each indicator (if applicable) to the following:

- Sustainable/ Unsustainable Development,
- International Conventions and Agreements,
- National, State or Local Conventions and Agreements,
- International Targets/ Recommended Standards,
- National, State or Local Recommended Standards, and
- Linkages to other indicators (King, November 2012a).

4.2.3 Indicators by Section

Environmental Development Indicators

The Environmental Development indicators are categorized into three themes including Atmosphere, Freshwater, and Land. Indicators use metrics to present data over time, frequently using the year 1990 or 2000 as a baseline year with data until 2010. Indicators for water use and water availability include projections to the year 2060. Some national standards, such as water pollution limits set by the Environmental Protection Agency, are used as a reference point; however, there are no goals or targets set for any of the indicators (King, November 2012c).

Economic Development Indicators

Indicators listed under the Economic Development pillar are separated into two themes including Economic Development and Transportation. Indicators in these themes were similar to other communities, measuring the unemployment rate, distribution of the primary jobs, income levels, and transportation (King, November 2012b).

Social Development Indicators

Within the Social Development pillar, there are three main themes including Social Demography, Poverty, and Livability. Indicators in these themes were similar to other communities, measuring the education, community involvement, cost of living, and food deserts. Indicators are supported with charts and graphs depicting data over time. Frequently, 1990 is used as a baseline, with data displayed by decade. Informative graphics are used to display changes and patterns over time. For instance, the indicator, Accessibility of Public Spaces, includes a map that demonstrates areas that are within a quarter mile access to parks, and those that are not for the year 2000. A second map depicts the changes in access to parks for the year 2010 (King, November 2012e).

4.2.4 Hart's Indicator Analysis

After using Hart's resources to determine individual indicator ratings, Houston had the highest average indicator rating of 7.16 and the highest percent of indicators equal to or greater than seven (72%) (See Figure 4 for a distribution of indicator ratings). The highest rated indicator included *Land Cover Change* with a rating of eleven. Other highly rated indicators included *Water Use*, *Water Availability*, *Greenhouse Gas Emissions*, and *Access to Public Transportation*, each with a rating of nine. Some of the poorly rated indicators included *Voter Participation* and *Income*, each with a rating of four (see Table 7 for more details).

The Environmental Development indicators had the highest average rating of 8.1, ranging from six to eleven. The Economic Development indicators had an average rating of 7.3,

ranging from four to nine. Finally, the Social Development indicators had the lowest average rating of 6.2, ranging from four to eight.

Table 7: Houston's Highest and Lowest Rated Indicators by Section

Section	Average Indicator Rating	Highest Rated Indicator(s) and Rating	Lowest Rated Indicator(s) and Rating
Environmental Development Pillar	8.1	Land Cover Change (11)	Flood Plain Expansion (6)
Economic Development Pillar	7.3	Primary Jobs & Green Jobs and Access to Public Transportation (9)	Income (4)
Social Development Pillar	6.2	Population Growth Rate and Affordability (8)	Voter Participation (4)

Only two of the indicators had no links between the economy, environment or society, including *Voter Participation* and *Travel Choice*. Six of the eight Economic Development indicators only had one link between the economy, environment, and society. Additionally, eight of the nine Social Development indicators only had one link between the economy, environment, and society. The predominant link was between society and the economy. However, seven of the eight Environmental Development indicators had two or more links between the environment, society, and economy.

4.2.5 Siemens Indicator Analysis

After using Siemens Green City Index to review the Houston indicators, it was found that Houston only had one indicator measurement that matched a Siemens indicator (water consumption per capita). For the remaining twenty-four indicators, sixteen of them mentioned or had measurements similar to Siemens' indicators, but were not indicators

themselves (see Tables 8 and 9). Houston, along with Santa Monica and San Mateo, had the highest number of indicators (seventeen) that matched or included similar measurements to the Siemens' indicators. However, Houston had the lowest number of Siemens categories addressed (six out of eight), along with Central Texas. The two Siemens categories not addressed by Houston's indicators included Waste and Energy. Instead of measuring waste generation by the amount of municipal waste recycled or discussing possible waste reduction strategies, Houston only measured the total amount of waste landfilled (tons) and the disposal rate (pounds per person per day). Furthermore, while Siemens Energy indicators address energy use per capita and per GDP, Houston measured total residential energy use by kilowatt-hours per year, and the total energy consumption for city of Houston facilities (King, November 2012b).

Table 8: Siemens Indicator Analysis Results for Houston

Community	Number of Indicators in Community Index	Number of Community Indicators Matching Siemens*	Number of Siemens' Indicators Mentioned in Index **	Number of Categories Addressed by Community Indicators***
Houston	25	1	17	6

*This number reflects indicators with the exact measurement as Siemens.

**This number is inclusive of the number of community indicators matching Siemens.

***Siemens has eight categories used for indicator analysis.

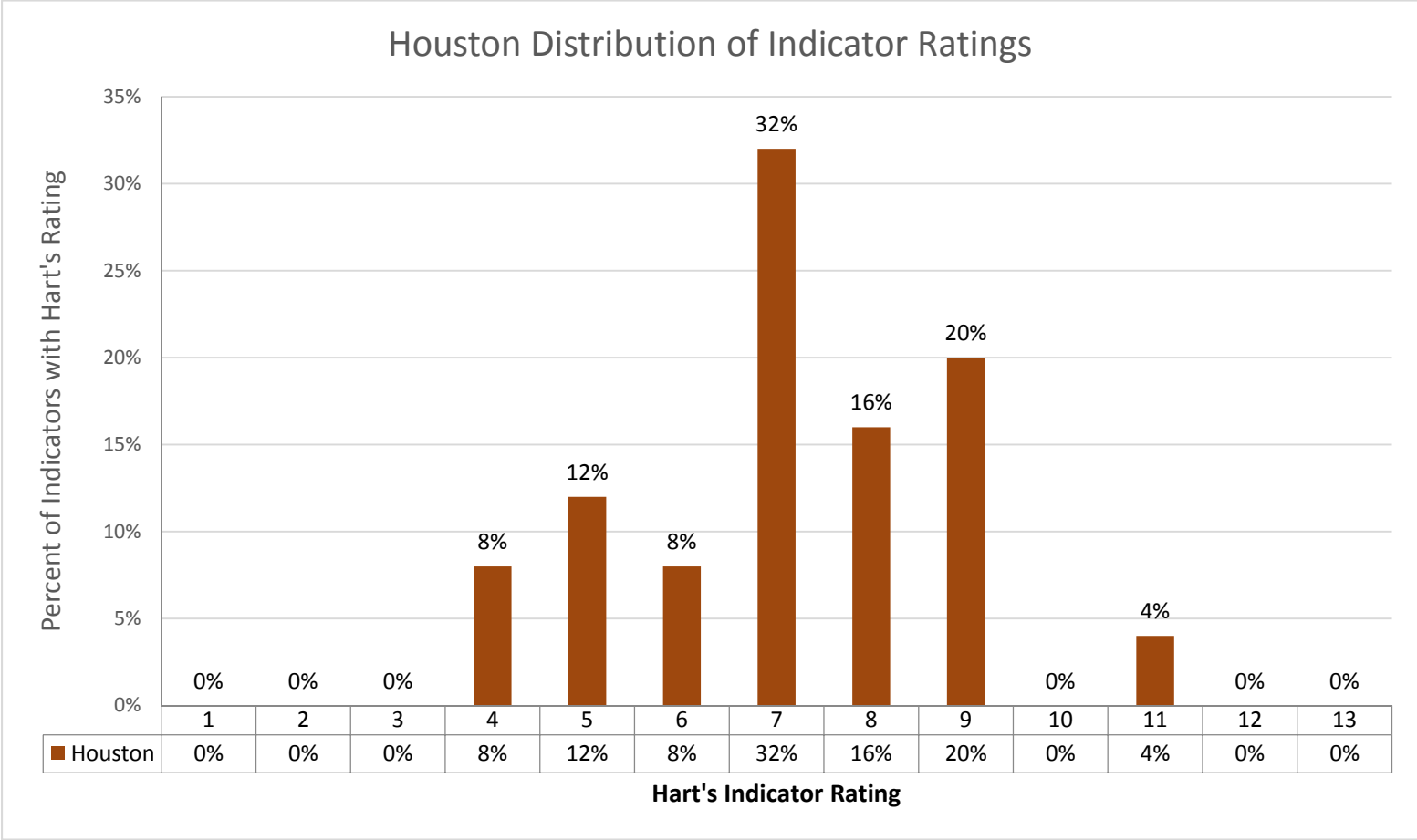
Table 9: Siemens Green City Index and Houston Indicators

Category	Siemens Indicator	Community Indicator Matching Siemens Indicator	Siemens' Indicators Mentioned In Index
CO_2	CO_2 emissions per unit of GDP	No	No
	CO_2 emissions per person	No	No
	CO_2 reduction strategy	No	**Yes**
Energy	Electricity consumption per unit of GDP	No	No
	Electricity consumption per person (GJ)	No	No
	Clean and efficient energy policies	No	No
Land use	**Green spaces as % of total area (%)**	No	**Yes**
	Population density (persons/miles^2)	No	**Yes**
	Green land use policies/Tree planting policy	No	**Yes**
	Urban sprawl/Brownfield Reuse	No	**Yes**
Buildings	Number of LEED certified buildings per 100,000 persons	No	No
	Energy efficient building standards	No	**Yes**
	Energy efficient building incentives	No	**Yes**
Transport	Share of workers traveling by public transit, bicycle or foot	No	No
	Public transit supply	No	**Yes**
	Average commute time from residence to work	No	No
	Green transport promotion	No	**Yes**
	Congestion reduction policies	No	**Yes**
Water	**Water consumption per capita**	**Yes**	**Yes**
	Water system leakages	No	No
	Water quality policy	No	**Yes**
	Stormwater management policy	No	No
Waste	Municipal solid waste recycled (%)	No	No
	Waste reduction policies	No	No
Air	**Nitrogen oxides emissions per year (pounds per person)**	No	**Yes**
	Sulfur dioxide emissions per year (pounds per person)	No	**Yes**
	PM_{10} emissions per year (pounds per person)	No	**Yes**
	Clean air policy	No	**Yes**
	Total Number of Indicators Matched/Mentioned	1	**16**

4.2.6 Additional Analysis

In comparison to other communities' environmentally related indicators, Houston had similar indicators and measurements. Local issues important to the Texas community were included, such as floodplain expansion and water use. However, in some instances, an indicator's description would identify a problem, but it would not include relevant metrics. For instance, for the indicator *Water Pollution*, the report stated that nonpoint source pollution has become a major focus for Houston due to wastewater treatment plants discharging into waterways and that "source protection of reservoirs should be priority" (King, November 2012c, p. 68). However, the only metric used for *Water Pollution* was the city of Houston's Drinking Water Quality from 2000 to 2010 (King, November 2012c). This disconnection between the sustainability focus and the metrics was misleading. The other indicators for water, *Water Availability* and *Water Use*, did emphasize the impact that local industries have on the water supply as large companies hold manufacturing water rights (King, November 2012c). However, without supporting metrics to describe reasons for water pollution issues, the indicator is less valuable than one that would provide those metrics. In the Social Development Pillar, stronger indicators included *Population Growth*, *Income Inequality*, and *Cost of Living*. However, other indicators had lower ratings due to the one-dimensional nature of their metrics. For instance, the indicator *Educational Attainment* measured the high school graduation rate overtime and by race. However, this was the only metric used to describe the education of the Houston population (King, November 2012e). All the other communities (except Minneapolis) included one or more supplemental metrics such as the dropout rate, college preparedness, school performance, and average class size. As another example,

Figure 4: Houston Distribution of Indicator Ratings



the indicator *Health Coverage* measured the percent of insured and uninsured people in the city of Houston and Harris County for 2000 and 2010. In the indicator's description, there was little explanation for the percentage other than noting that unemployed people are more likely not to have healthcare (King, November 2012e). Central Texas had a similar indicator, *Health Access*, which not only measured the percent of uninsured residents by county compared to the state and national rates, but also broke down the uninsured by income level, the percent of population enrolled in Medicaid, and incorporated reasons for no coverage from a local community survey (CTSIP, 2012).

The Economic Development indicator, *Waste Generation*, measured municipal solid waste in tons and in pounds per person per day for metrics. Although these metrics indicated that disposal rates are decreasing in the region, there was no connection in the indicator analysis to indicate why this may be happening (King, November 2012e). There was no speculation whether there has been a reduction in resource use or an increase in recycling, if the region had expanded or promoted recycling efforts better, or if a poor economy had led to less purchased and therefore less waste. In comparison, Santa Monica's indicator, *Solid Waste Generation*, measured total citywide generation (per capita and by sector), the amount landfilled, and the amount diverted (recycled composted, etc.) from the landfill (City of Santa Monica, 2006).

Furthermore, measurements for transportation indicators were not as extensive compared to other communities, nor did they always focus on a sustainable alternative to the current situation. Houston's theme, Transportation, measured *Access to Public Transportation*, *Vehicle Miles Traveled (VMTs),* and *Travel Choice*. The first indicator, *Access to Public Transportation*, measured the percent of the population and housing within a quarter of a

mile to transit stops. The indicator description stated that congestion time, frequency of bus routes and proximity to destinations contribute to accessibility, yet none were measured to demonstrate how Houston is performing in these areas. Additionally, in the "Sustainability Issue" section, poor street connectivity and a lack of proximity of work/school to neighborhoods were both listed as issues to be addressed. However, no metrics were provided to show a status. Furthermore, the indicator, *Vehicle Miles Traveled*, measured the annual VMTs per capita. While the description of the indicator stated that VMT reductions are difficult with an increasing population and economic development, there was no discussion about the environmental effect of the VMTs, or the need to reduce them. Under the "Sustainability Benefit" section, it stated, "High VMT is an indicator of a robust economy" (King, November 2012b, p. 52). This is clearly not a good indicator of sustainability where conservation is key.

The complementary indicator, *Travel Choice*, measured the percent of people traveling alone to demonstrate the alternative means of transportation. There was no discussion about the types of alternative travel available, how the environment is affected by an increase in private automobile use, or the cost to society (King, November 2012b). Even though Hart's (2006) rating for *Alternative Modes of Transportation* is seven, this metric alone did not demonstrate the types of alternative means of travel being used in the Houston region. Additionally, the indicator did not discuss the opportunity for residents to use alternative travel. Recommendations for travel choice included expanding the pedestrian and bicycle network as a counterpart to the existing bus and rail network and increasing coordination of transit operations through technology and ride share programs. While these recommendations may be important, the indicator provided no information

that would allow a reader to gain insight into the type of alternative transportation modes available. No other indicators discuss the existing conditions of bicycle pathways, the extent of the bus and rail lines, etc. (King, November 2012b). In contrast, Santa Monica had indicators that measured the percent of total miles of city arterial streets with bike lanes, total miles of bike paths, average bus ridership, residents' choice of sustainable transit, and perception of availability of sustainable modes of transit and average number of vehicles per employee, and the modal split of those employee-trips (City of Santa Monica, 2006).

4.2.7 Conclusions

While the intent of Houston's indicators may have been to measure community sustainability, many metrics and supporting information did not support the indicators, nor the sustainability issues described. Houston performed poorly for the Siemens indicator analysis, and was the only community to not address or include indicators related to recycling or energy use per capita. Even though Houston had the highest average indicator rating of 7.16, Houston's indicators and goals were not always aligned with sustainability. For instance, the suggestion that higher VMTs is a sign of a good economy may infer that private interests (such as Shell Oil's) may have influenced some of the content development. Overall, Houston's index lacks in many ways where other sustainability indices excel.

4.3 Minneapolis, Minnesota

4.3.1 Minneapolis Sustainability Program

At 57.4 square miles, Minneapolis is the largest city in Minnesota, with an estimated 2013 population of 400,070 (U.S. Census, July 7, 2014c). Minneapolis was recognized by SustainLane.com in 2008 for its sustainability efforts, rating as the seventh most sustainable city in the United States (City of Minneapolis, 2012). Additionally, using data from the U.S. Census Bureau and the National Geographic Society's Green Guide, *Popular Science* listed Minneapolis as the 11th most sustainable U.S. city with a population over 100,000 people (Svoboda, 2008).

Since 2003, Minneapolis has been actively progressing towards a more sustainable city through legislative actions. The mayor created Resolution 2003R-133, which began the development of the Minneapolis Sustainability Program in 2003. The resolution announced that through involvement of citizen, business, and environmental organizations, a Sustainability Plan would be developed, and furthermore integrated into the city's Comprehensive Plan. Resolution 2003R-133 also called for the development of a program to track sustainability indicators, set ten-year sustainability targets, and to measure progress on an on-going basis. Initially, the Department of Planning was tasked with determining a plan of action and identifying the necessary staff/stakeholders to develop the Sustainability Plan. Additionally, they were also asked to develop interim broad goals for the City Council to adopt until a final Sustainability Plan was adopted (Johnson and Schiff, 2003).

In 2004, the city held two public roundtable meetings where environmental organizations, citizens, and city staff helped draft sustainability indicators. Through a $66,000 grant from the Minnesota Office of Environmental Assistance, Minneapolis was able to develop a sustainability plan (City of Minneapolis, MN, 2003).

Two resolutions passed in 2005 further solidified the city's commitment to sustainability. The resolutions adopted key sustainability indicators to be included in the city's Comprehensive Plan. Furthermore, the city's Council was required to adopt ten-year targets for the indicators, with a baseline starting in 2006. The resolutions also made it a requirement for government departments to integrate the indicators in all business planning activities and to provide annual reports charting progress (City of Minneapolis, MN, April 2012). Furthermore, the resolutions specifically stated that minimal changes should be made to the indicators over time unless significant progress is made, or if the city finds it necessary to shift priorities (Schiff, 2005).

In March 2006, after a series of public input meetings, roundtable discussions, and expert testimony, the City Council formally adopted twenty-four sustainability indicators (City of Minneapolis, MN, June 2006). Over the years, two additional indicators were added for twenty-six indicators (listed in Appendix E).

4.3.2 Stakeholder Involvement

The Minneapolis Sustainability Plan is updated annually with the assistance of two working environmental groups. The first, the Environmental Coordinating Team (ECT), consists of representatives from city government departments involved in environmental issues. When the group was formed in 1994, it addressed the city's industrial and land

use issues. Since then, it has evolved to address environmental issues Citywide and now provides feedback for the established targets, baselines, annual reporting, and business planning functions of the Sustainability Indicators Program. Quarterly meetings are open to the public, and frequently attended by the Mayor, City Council Members, and the counterpart to the ECT, the Community Environmental Advisory Commission (City of Minneapolis, MN, November 2013).

The Community Environmental Advisory Commission (CEAC) provides support on environmental issues for the city, including the Sustainability Indicators Project. The CEAC consists of sixteen members with two-year terms. Members appointed by the City Council or the Mayor include environmental advocates, environmental and technical experts, and community and business representatives. Additionally, representatives with expertise in environmental curriculum and environmental matters in general are invited from local school boards. The group meets monthly and reports directly to the ECT. For instance, the CEAC encouraged the ECT to adopt a new indicator and target for air quality in the Sustainability Indicator Report (City of Minneapolis, MN, February 2013).

4.3.3 Minneapolis Sustainability Plan

In 2011, Minneapolis released their sixth and final published Sustainability Plan. Starting in 2012, the city began tracking indicator progress through an interactive website. The report is structured with three main sections including A Healthy Life, Greenprint, and A Vital Community. Each section consists of indicators with one to three associated targets. The website explains the importance of the indicators, targets, and lists related city and community activities. This index structure places each indicator into one of three broad

categories that reflect the three pillars of sustainability. While A Healthy Life (Society) and A Vital Community (Economy) have six and seven indicators respectively, the number of environmental indicators (twelve) dominates in the Greenprint section (City of Minneapolis, MN, June 2014).

4.3.4 Hart's Indicator Results

Of the five communities examined, Minneapolis had the second lowest average indicator rating of 6.23. The highest rated indicator was rated at nine while all of the other communities had their highest indicators equal to or greater than eleven. At 46.2%, Minneapolis had the second lowest percent of indicators with a rating equal to or greater than seven. The most frequent indicator rating was eight at 23%. Among the five communities, Minneapolis had the second highest percent of indicators with ratings equal to or less than four, indicating that almost 16% of its indicators are not useful for measuring sustainability (see Figure 5 for a distribution of indicator ratings).

Table 10: Minneapolis's Highest and Lowest Rated Indicators by Section

Section	Number of Indicators	Average Indicator Rating	Highest Rated Indicator(s) and Rating	Lowest Rated Indicator(s) and Rating
A Healthy Life	6	5.0	Asthma and Lead Poisoning (6)	HIV & Gonorrhea and Healthy Weight (4)
Vital Economy	7	5.8	Brownfield Sites (8)	Community Engagement (3)
Greenprint	12	7.2	Climate Change (9)	Transportation Alternatives and Airport Noise (5)

Indicators in A Healthy Life and a Vital Economy had lower average indicator ratings of 5.0 and 5.8 respectively while the indicators in the Greenprint section had an average

rating of 7.2. Some of the lowest rated indicators included *Community Engagement*, *Violent Crimes*, *HIV and Gonorrhea Rates*, and *Healthy Weight*. The highest rated indicator was *Climate Change* with a rating of nine (see Table 10).

4.3.5 Siemens Indicator Analysis

The Minneapolis's Sustainability Plan had only one indicator (municipal solid waste recycled) directly matching the indicators from Siemens Green City Index. Minneapolis, along with Houston, had the least number of exact matching indicators. Twelve additional Siemens' indicators were mentioned within the sustainability plan for a total of thirteen matching or mentioned indicators (see Tables 11 and 12). Additionally, Minneapolis indicators covered seven of the eight Siemens categories. Siemens' indicators for the "Air" category were not measured, however, Minneapolis measured PM 2.5 and ozone levels in their *Air Quality* indicator.

Table 11: Siemens Indicator Analysis Results for Minneapolis

Community	Number of Indicators in Community Index	Number of Community Indicators Matching Siemens*	Number of Siemens' Indicators Mentioned in Index **	Number of Categories Addressed by Community Indicators***
Minneapolis	26	1	13	7

*This number reflects indicators with the exact measurement as Siemens.

**This number is inclusive of the number of community indicators matching Siemens.

***Siemens has eight categories used for indicator analysis.

Table 12: Siemens Green City Index and Minneapolis Indicators

Category	Indicator	Community Indicator Matching Siemens Indicator	Siemens' Indicators Mentioned In Index
CO_2	CO_2 emissions per unit of GDP	No	No
	CO_2 emissions per person	No	No
	CO_2 reduction strategy	No	**Yes**
Energy	Electricity consumption per unit of GDP	No	No
	Electricity consumption per person (GJ)	No	No
	Clean and efficient energy policies	No	**Yes**
Land use	Green spaces as % of total area (%)	No	No
	Population density (persons/miles^2)	No	No
	Green land use policies/Tree Planting Policy	No	**Yes**
	Urban sprawl/Brownfield Reuse	No	**Yes**
Buildings	Number of LEED certified buildings per 100,000 persons	No	No
	Energy efficient building standards	No	**Yes**
	Energy efficient building incentives	No	**Yes**
Transport	**Share of workers traveling by public transit, bicycle or foot**	No	**Yes**
	Public transit supply	No	**Yes**
	Average commute time from residence to work	No	No
	Green transport promotion	No	**Yes**
	Congestion reduction policies	No	No
Water	Water consumption per capita	No	No
	Water system leakages	No	No
	Water quality policy	No	**Yes**
	Stormwater management policy	No	**Yes**
Waste	**Municipal solid waste recycled (%)**	**Yes**	**Yes**
	Waste reduction policies	No	**Yes**
Air	Nitrogen oxides emissions per year (pounds per person)	No	No
	Sulphur dioxide emissions per year (pounds per person)	No	No
	PM_{10} emissions per year (pounds per person)	No	No
	Clean air policy	No	No
	Total Number of Indicators Matched/Mentioned	**1**	**13**

4.3.6 Additional Analysis

In addition to the results for Hart's resources and Siemens' indicators, there were other weaknesses and strengths in the Minneapolis Sustainability Plan worth noting. According to Hart (2006), the framework of indicators emphasizes that the economy, environment, and society are separate community matters rather than interrelated. Furthermore, Minneapolis's indicators were not structured as some of the other community indicators reviewed. Each indicator was supplemented with a short description of broad goals or themes with one to three specific targets. Many targets were updated annually, with a focus of meeting a goal for the following year. Frequently data were supplied to show trends in data from the past, but long-term goals were rarely mentioned. For instance, the description for the indicator *Renewable Energy* described the need for more renewable energy to provide energy security, lessen the impact of climate change, and so on. While targets for *Renewable Energy* included increasing renewable electricity to one megawatt by 2015 and permitting seventy renewable energy projects annually by 2015, these measurements did not have a comparable unit measurement (i.e., per capita, per acre of usable space, etc.) (City of Minneapolis, MN, February 2013). Another community with ten times more usable land space than Minneapolis could use Minneapolis's indicator to report the same amount of sites and kilowatts installed, and appear on par with Minneapolis' efforts.

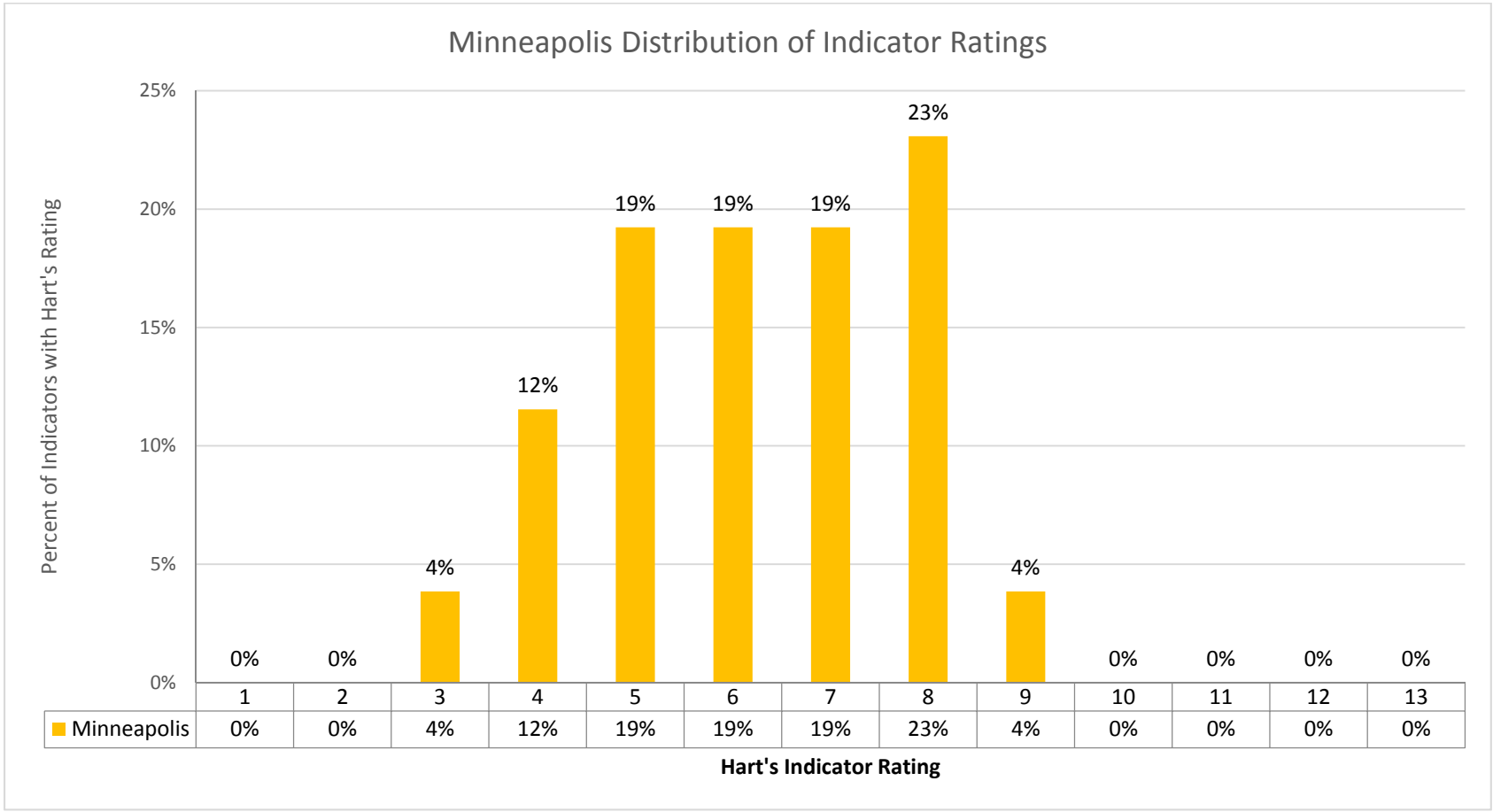
As another weakness, the indicator, *Transportation Alternatives* lacked extensive measurements. Although Minneapolis stated it is making alternative transit modes more accessible and affordable, the two targets (and essentially measurements) focused on reducing the percentage of residents and percentage of workers driving alone to work.

Recent city and community activities described efforts to expand light rail services and enhance current bus routes; however, no metrics were provided to describe the use of alternative transit (City of Minneapolis, MN, December 2013).

In contrast, Central Texas's indicator *Commuting* used multiple measurements to describe transportation patterns by comparing five commuting modes (carpool, vanpool, walking, public transportation, and working at home) over the past ten years. Additionally, it measured the average one way commute time in minutes by sections of Central Texas over the past 10 years, and included survey responses about perspectives on travel modes. Furthermore, the complementary indicator, *Vehicle Miles Traveled*, tracked the daily miles per capita traveled over the past 10 years, measured the travel time index, the cost of congestion, and the annual congestion cost savings by public transit. While Minneapolis attempted to address alternative transportation, in comparison to other communities, its indicator did not consider other factors contributing to the use of alternative transportation (CTSIP, 2012).

Furthermore, Minneapolis's indicators included a mix of understandable and incomprehensive measurements. For instance, the indicator *Air Quality* measured the number of days with air pollutant concentrations exceeding standards set by the Environmental Protection Agency and the average benzene and formaldehyde concentrations compared to state benchmarks (City of Minneapolis, MN, June 2014a and June 2014b). While the first measurement was informative and easy to understand, the later may be difficult for the average citizen to use. Hart (2006) emphasizes that effective indicators must be understandable and usable by its intended audience, not just by experts. Measuring air toxins may be important, but without a formal explanation, this

Figure 5: Minneapolis Distribution of Indicator Ratings



information can be considered difficult to interpret. One of the weaker parts of the index overall was the structure of the indicators, targets, and measurements. For instance, the indicator *Waste Reduction and Recycling* was structured as follows:

Indicator: Waste Reduction and Recycling

Targets for Indicator:

- Increase recovery of residential source-separated organics from 0.30% of municipal solid waste to 7% annually by 2015.
- Recover 67% of all recyclable materials from the residential waste stream by 2014.
- Recover 2,750 tons annually of residential recycled materials at a Hennepin County-Minneapolis facility by 2015 (City of Minneapolis, MN, March 2013).

If the targets were developed into explicit measurements for each indicator, it would be easier to apply and compare data. Furthermore, targets focused on short-term goals did not seem to consider long-term sustainability efforts/goals.

4.3.7 Conclusions

Of all the communities, Minneapolis performed the worst for the Siemens analysis, and performed poorly for Hart's analysis. Additionally, even though data presented trends over the long-term, many targets focused on short-term sustainability goals. Reviewing indicator measurements in more detail showed that a more in-depth approach is needed for specific issues. Minneapolis was not only missing key indicators measured by other communities, but the indicators they did measure were not comprehensive. Some of the

key missing indicators included energy use, water use and availability, land use and development, and vehicle miles traveled. These indicators were measured in three to four of the other communities and either considered important to the community or highly rated by Hart.

4.4 San Mateo County, CA

4.4.1 Sustainable San Mateo County

San Mateo County, California covers 448 square miles of land and is one of the most ethnically diverse counties in the nation. With a population of 747,373, it has one of the highest per capita incomes in the state, and one of the highest household incomes in the nation (SSMC, 2013a, U.S. Census Bureau, July 2014 e). In 1992, Sustainable San Mateo County (SSMC) was established by county citizens seeking to increase sustainability awareness among the public. Their efforts led to the operation of SSMC as a non-profit in 1996. By 2002, SSMC was conducting educational programs as a 501 (c) (3) non-profit public benefit corporation (SSMC, 2014b). SSMC efforts are funded by donations from businesses, individuals, government agencies, and foundations (SSMC, 2014c).

SSMC is guided by four main goals listed below. Of importance, the first and third goals recognize the three pillars of sustainability. Additionally, the four goals listed below recognize the need for long-term work towards creating a more sustainable county.

- Provide fact-based information about San Mateo County's economy, environment, and society.
- Educate the community about sustainability.

- Bring the concepts of sustainability into the process of countywide decision-making.
- Contribute to the long-term improvement of our economy, environment, and society (SSMC, 2014b).

4.4.2 Stakeholder Involvement

Sustainable San Mateo County has two paid staff members, including an Executive Director and an Indicators Program Coordinator, and is governed by a Board of Directors (SSMC, 2014c). Members include individuals with experience in local public utilities, law, education, environmental engineering, and more (SSMC, no date). Additionally, an advisory council exists to assist and guide efforts of the Board of Directors when needed (SSMC 2014e).

Overall, the community-based organization relies largely on the support of volunteers to develop and implement multiple programs. Volunteer efforts contribute to outreach of more than 10,000 San Mateo County and Bay Area residents annually (SSMC 2014c). Newsletters are sent out two to four times a month to engage community members in events and notify them of reports.

The current indicators report is largely based on indicators developed in previous reports. However, a large team of staff and volunteers contributed to the research, editing, and publication of the latest report. In the 2014 acknowledgements page, the following groups are recognized for their work: Indicators Production Team, Indicators Committee, 18th Annual Report Advisory Council, Researchers, San Jose State University GIS Team,

External Experts, Founders, Board of Directors, SSMC Advisory Council, and SSMC Staff (SSMC, 2014f).

4.4.3 Indicators for a Sustainable San Mateo County

Since 1997, SSMC has produced an annual indicators report, *Indicators for a Sustainable San Mateo County*. The reports are issued to all parts of the county's community, including local government, environmental groups, businesses, residents, and more**.** The county released its 18th annual report in 2014 **(**SSMC, 2014b).

The most recent report categorizes forty-five indicators under three main areas including the economy, equity, and environment. Each main area is subdivided into three broad topics with a subset of indicators. Each broad topic includes an explanation for why it is important to the sustainability of the county, what an ideal sustainable state would be, and key findings from the past year. Each indicator is assigned a trend (no clear trend, positive, or negative), which is displayed using charts and graphs. The SSMC report is unique because it is intended to provide information about trends in the community, and therefore does not outline specific goals or targets. Instead, governments, businesses, and local groups are expected to utilize the report as a guide to creating their own goals or targets and measure them (SSMC, 2014d).

4.4.4 San Mateo Indicators

Indicators relating to the economy are categorized into three topics including Employment, Housing, and Innovation and Economic Growth. Equity issues are broken into three topics as well, including Community Cohesion and Safety, Community Health, and Education. Finally, the environment is represented by three themes including Climate

and Energy, Land Use, and Natural Resources. Recently, an additional key indicator was featured as a topical issue important to long-term sustainability efforts. The 2014 key indicator was Transportation in San Mateo County. Indicators from the 2014 report can be found in Appendix F.

4.4.5 Hart Indicator Analysis

With an average Hart rating of 5.98, San Mateo's forty-five indicators had the lowest average indicator rating of the five communities, and had the lowest percent of indicators with a rating equal to or greater than seven (35.6%). Additionally, San Mateo was the only community other than Minneapolis to have its lowest rated indicators starting with a rating of three, while other communities had lowest rated indicators starting at four. The most frequent indicator rating was four, and almost a third of indicators had a rating of four or lower, inferring that almost a third of their indicators are not very useful for measuring sustainability.

Table 13 displays the average indicator rating by San Mateo's report sections, along with the highest and lowest indicator ratings within each section. The Environmental section had the highest average indicator rating of 8.3, followed by the Key Indicators for Transportation with a rating of 6.1. The highest rated indicators were frequently within the Environmental section including *Land Use Breakdown*, with a rating of eleven and *Land Use Policies* with a rating of ten. The lowest rated sections, *Equity* and *Economy*, had average ratings of 5.0 and 4.7 respectively. The distribution of indicator ratings can be found in Figure 6.

Table 13: San Mateo's Highest and Lowest Rated Indicators by Section

Indicator Section	Number of Indicators	Average Indicator Rating	Highest Rated Indicator(s)	Lowest Rated Indicator(s)
Environment	12	8.3	Land Use Breakdown (11)	Green Buildings and Bay & Ocean Water Quality (6)
Transportation	7	6.1	Environmental Impacts from Transportation (9)	Infrastructure (3)
Equity	15	5.0	Prenatal & Maternal Care and Homelessness (7)	Voter Participation, Causes of Death, Average Class Size, Public School Funding, and 3rd Grade Reading Proficiency (4)
Economy	11	4.7	Housing Supply (7)	Total Taxable Sales (3)

4.4.6 Siemens Indicator Analysis

The structure of San Mateo's indicator report required indicators and their measurements to be considered differently than the other communities for purposes of the Siemens indicator analysis. In the report, each indicator has a trend listed and includes a few tables and graphs measuring progress in the indicator area. In addition, bullet points identify other measurements towards the indicator status. This structure was quite different from other communities' indicator-measurement structures, which made it hard to distinguish between a measurement towards an indicator status or simply discussion about a given topic. The following Siemens analysis considered most of the San Mateo measurements to be counted towards the number of indicators matching Siemens indicators. As an example, the indicator *Energy Use* has two graphs showing the total county energy use over the past ten years and the energy use by sector in 2012 (SSMC, 2014g). Bullet

points below these graphs discuss the two trends, but also include reference the per capita energy usage. For the Siemens analysis, these bullet points, when appropriate, count towards the exact indicators matching and indicators mentioned counts.

San Mateo had nine indicators/measurements match a Siemens indicator, the second highest of the communities. Of the remaining thirty-six indicators, seven of them mentioned or had measurements similar to Siemens' indicators (see Tables 14 and 15). San Mateo had the second highest number of indicators that matched or included similar measurements to the Siemens' indicators. Furthermore, San Mateo was the only community to have indicators address all eight of Siemens categories.

Table 14: Siemens Indicator Analysis Results for San Mateo

Community	Number of Indicators in Community Index	Number of Community Indicators Matching Siemens*	Number of Siemens' Indicators Mentioned in Index **	Number of Categories Addressed by Community Indicators***
San Mateo	45	9	16	8

*This number reflects indicators with the exact measurement as Siemens.

**This number is inclusive of the number of community indicators matching Siemens.

***Siemens has eight categories used for indicator analysis.

Table 15: Siemens Green City Index and San Mateo Indicators

Category	Siemens Green City Indicator	Community Indicator Matching Siemens Indicator	Siemens' Indicators Mentioned in Index
CO_2	CO_2 emissions per unit of GDP	No	No
	CO_2 emissions per person	**Yes**	**Yes**
	CO_2 reduction strategy	No	**Yes**
Energy	Electricity consumption per unit of GDP	No	No
	Electricity consumption per person (GJ)	**Yes**	**Yes**
	Clean and efficient energy policies	**Yes**	**Yes**
Land use	**Green spaces as % of total area (%)**	**Yes**	**Yes**
	Population density (persons/miles^2)	No	No
	Green land use policies/Tree planting policy	**Yes**	**Yes**
	Urban sprawl/Brownfield Reuse	No	**Yes**
Buildings	Number of LEED certified buildings per 100,000 persons	No	No
	Energy efficient building standards	**Yes**	**Yes**
	Energy efficient building incentives	No	No
Transport	**Share of workers traveling by public transit, bicycle or foot**	**Yes**	**Yes**
	Public transit supply	No	**Yes**
	Average commute time from residence to work	**Yes**	**Yes**
	Green transport promotion	No	**Yes**
	Congestion reduction policies	No	**Yes**
Water	**Water consumption per capita**	**Yes**	**Yes**
	Water system leakages	No	No
	Water quality policy	No	No
	Stormwater management policy	No	No
Waste	Municipal solid waste recycled (%)	No	No
	Waste reduction policies	No	**Yes**
Air	Nitrogen oxides emissions per year (pounds per person)	No	No
	Sulfur dioxide emissions per year (pounds per person)	No	No
	PM_{10} emissions per year (pounds per person)	No	No
	Clean air policy	No	**Yes**
	Total Number of Indicators Matched/Mentioned	**9**	**16**

4.4.7 Additional Analysis

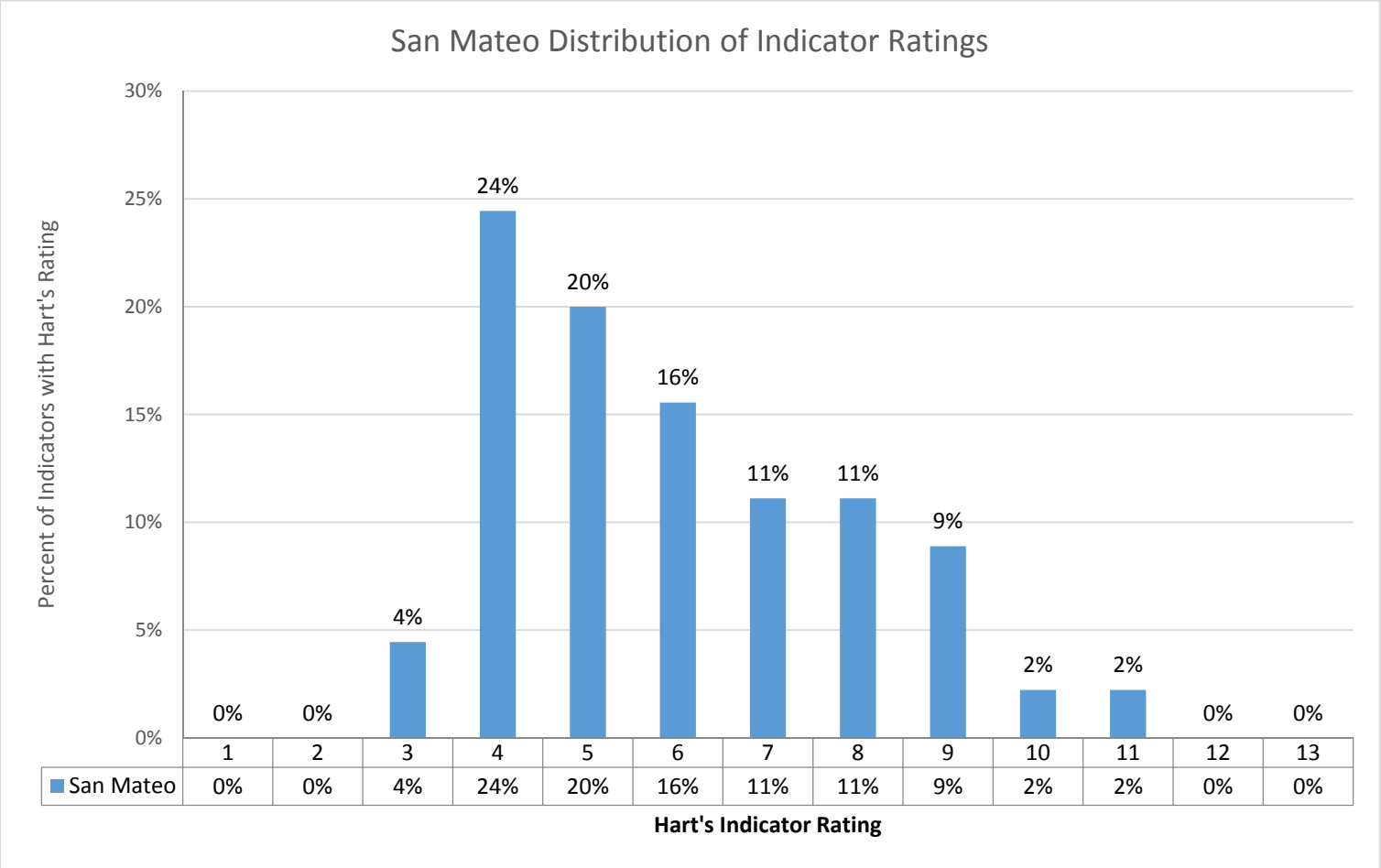
Overall, the San Mateo index was an informative tool, covering the different aspects of sustainability. Indicators were detail oriented, predominately focused on the long-term, and were understandable. Over 62% of their indicators were able to make a connection between the society and economy. The structure and outlay of the report was easy to use, and the use of trends for each indicator allowed for a quick interpretation of the results.

Despite being a highly informative and detailed index, San Mateo had the lowest average indicator rating of the communities. Almost one third of the indicators had a rating of four or less. Only 31% of indicators had a link between the economy and environment, and only 38% had a link between the environment and society. Additionally, seven out of the fifteen indicators in the Equity section had no connections among the three tiers of sustainability. Furthermore, ten of the eleven indicators in the Economy section had no links to the environment.

Research shows that ten to twenty indicators is ideal for communities using indices (Hart 2013; Dahl 2012). While San Mateo had the second highest number of indicators, each indicator had multiple measurements, some complex, some not related to sustainability at all. For instance, the indicator *3rd Grade LA Proficiency* measured the following:

- Percent of 3rd Graders Scoring Proficient or Higher on English Language Arts/CST,
- Regional Benchmark 3rd Grade LA Proficiency, and
- Third Grade LA Proficiency by Parents' Educational Attainment and Socio-Economic Status (SSMC, 2014h).

Figure 6: San Mateo Distribution of Indicator Ratings



Each of these measurements had no direct connection to the sustainability of the community. While a well-educated population is important for a sustainable society, tracking and connecting third graders' reading score to their parents' education infers little about the community's sustainability. As an example of a complex indicator, the indicator *Housing Affordability* measured the following:

- Median Sales Price,
- Market Average Rent,
- Household Income Needed to Afford Annual Housing Costs,
- First time Buyer Affordability Index, and
- Percent of Households Paying more than 35% of Household Income on Monthly Owner Housing Costs (SSMC, 2014i).

Three of the measurements compared San Mateo data to a mix of local counties, state, and national data. While these data may be informative, the purpose of a sustainability indicator is to summarize and condense complex data into a manageable amount of information (Singh, 2009). Because many other indicators had multiple measurements as well, the index as a whole may not be welcomed as a tool for decision-makers to base policy. Additionally, with too many indicators or measurements, it becomes difficult to extract the most important information from the overall product.

4.4.8 Conclusions

Despite performing well for the Siemens analysis, San Mateo's index performed poorly for other reasons. Hart's indicator rating analysis revealed that their indicators had an average rating of 5.98, and almost a third of indicators had a rating of four or less. While

environmental and transportation related indicators covered a wide range of sustainable development issues, measurements were frequently too complex, and lacked robust connections to sustainability. The high number of indicators also increases difficulty to track information overtime, as each indicator had multiple measurements.

4.5 Santa Monica, California

4.5.1 Santa Monica Sustainable City Program

Located within Los Angeles County, California, the city of Santa Monica is situated along the Santa Monica Bay. This beachfront city has a population of 91,812, and covers 8.42 square miles (U.S. Census, 2012). In 1991, Santa Monica City Council established the Task Force on the Environment (TFE) to address environmental issues within the city. The seven members were appointed by the council, each with expertise in environmental and sustainability matters. Over the years, the group's efforts, including the development of a set of sustainability indicators, have contributed to Santa Monica's sustainability efforts (City of Santa Monica, May 2014).

4.5.2 Stakeholder Involvement

In September 1994, the Council formally adopted the Sustainable City Program (SCP). Originally proposed by the TFE in 1992, the SCP focused on long-term impacts and sustainability issues. The program consisted of goals and strategies for the government and community centered on the environment, economy, and society. Numerical indicators and targets were established for the year 2000 in four goal areas including: 1) Resource Conservation, 2) Transportation, 3) Pollution Prevention and Public Health Protection, and 4) Community and Economic Development. In order to reflect a more

comprehensive approach to sustainability, new indicator targets were later developed to be completed by the year 2010. Community stakeholders began meeting in July 2001, and over the course of 15 months, they used the three pillars of sustainability to organize the new indicator targets. The set of new indicators are currently incorporated into the Santa Monica Sustainable City Plan (Sustainability Plan), which replaced the Sustainable City Program in 2003 to better demonstrate the need for long-term efforts (City of Santa Monica, 2006).

In response to an expanding Sustainability Plan, the TFE suggested the creation of a broader group to better represent the city government's sustainability initiatives. Thus, in 2003, the Sustainability City Task Force (SCTF) was initiated by City Council. The SCFT is a group of community stakeholders with expertise in the specific goal areas of the Sustainability Plan, tasked with leading the efforts of future development and implementation of the Sustainability Plan. Additionally, in order to ensure the goals of the Sustainability Plan are incorporated into local government policies, an interdepartmental Sustainability Advisory Team (SAT) was created. Staff involved in the SAT serves as liaisons between their respective city department and the SCTF. Together, the SAT and SCTF are responsible for researching and updating the Sustainability Plan, along with implementation of policies and activities which support the Plan's goals (City of Santa Monica, 2006).

4.5.3 Santa Monica Sustainability Plan

The latest full Sustainability City Plan was revised in January 2014, with new goals, targets, and indicators. Updates to the plan are now through an interactive website

described as the Sustainability City Progress Report. Most recently, Santa Monica announced that new goals, indicators, and targets for 2020 are to be included in an updated Sustainable City Plan. Using updated information and trends, Santa Monica anticipates releasing results in 2015. In the meantime, they are currently updating the Progress Report as new data and trends become available (City of Santa Monica, 2014).

The Sustainability Plan organizes its indicators in a Goal-Indicator Matrix format. This allows indicators not to be limited to one category (as in the Minneapolis Plan), but instead to be considered as interconnected to other parts of the community. The Plan consists of eight goal areas, each with its own goals and indicators to track progress. Two types of indicators are used including system level indicators and program level indicators. The difference between these is as follows: "System level indicators measure the state, condition, or pressures on a community-wide basis for each respective goal area. Program level indicators measure the performance or effectiveness of specific programs, policies, or actions taken by the city government or other stakeholders in the community" (City of Santa Monica, January 2014). Indicators from the 2014 report have specific targets for the year 2020 using the year 2000 as a baseline. Some targets are not numerical due to the type or limited availability of data. Frequently, a trend direction is used in place of a numerical target (i.e., upward trend, increasing trend, downward trend, no trend, etc.) (City of Santa Monica, January 2014).

The eight goal areas include the following: 1) Resource Conservation, 2) Environmental and Public Health, 3) Transportation, 4) Economic Development, 5) Open Space and Land Use, 6) Housing, 7) Community Education and Civic Participation, and, 8) Human Dignity (City of Santa Monica, January 2014). According to the updated website, the

sixty-six indicators previously reported in the 2006 Sustainability Plan have been reduced to sixty indicators for the 2014 update (City of Santa Monica, January 2014). Six indicators from 2006 report did not have data available. These are italicized in the list of Santa Monica indicators (see Appendix G). Because research and analysis on the indicators began prior to the January 2014 update, all analysis is based on the indicators and measurements presented in the 2006 report. The eight goal areas remained the same between the two reports.

Currently, two tools are used to present progress on indicators and targets to the City Council, staff and the community at large. The first tool, mentioned previously, is the Sustainable City Progress Report, which provides an up-to-date in-depth look at each indicator through an interactive website. The second tool, the Sustainable City Report Card, provides an executive summary of progress bi-annually. Most recently, the city created a position for a Community Sustainability Liaison to inform organizations and residents about updates and strategies for the Sustainability Plan (City of Santa Monica, June 2014).

4.5.4 Hart's Indicator Analysis

Santa Monica had an average indicator rating of 6.78, the second highest after Houston's rating. Additionally, Santa Monica had the second highest percent of indicators with a rating equal to or greater than seven (57.4%). The most frequent indicator rating was seven. There were no indicators with a rating lower than four (see Figure 7 for a distribution of indicator ratings).

The indicator *Ecological Footprint* had the highest indicator rating of thirteen. The next highest rated indicators (all with a rating of nine) included *Water Use*, *Greenhouse Gas Emissions*, *Air Quality*, *Urban Runoff Reduction*, *Average Vehicle Ridership*, *Land Use and Development*, and *Livable Housing*. Some of the lowest rated indicators (rating of four) included *Pedestrian and Bicycle Safety*, *Voter Participation*, and *Traffic Impacts to Emergency Response*. Table 16 lists the highest and lowest rated indicators by section.

4.5.5 Siemens Indicator Analysis

After using the Siemens Green City Index to analyze Santa Monica's indicators, Santa Monica had eleven indicators match Siemens' indicators, the highest of the five communities (see Table 17). Additionally, Santa Monica tied with Houston for having the most indicators mentioned in their Sustainability City Plan (seventeen). Additionally, Santa Monica had the second most number of Siemens categories addressed by their indicators. The only category not addressed was Air, which consists of three specific measurements for nitrogen oxides, SO_2 emissions, and PM_{10} emissions (see Table 18). However, Santa Monica's indicator *Air Quality* addressed residents' proximity to significant emissions sources (City of Santa Monica, 2006).

Table 16: Santa Monica's Highest and Lowest Rated Indicators by Section

Indicator Section	Number of Indicators	Average Indicator Rating	Highest Rated Indicator	Lowest Rated Indicator
Resource Conservation	8	8.8	Ecological Footprint (13)	Sustainable Procurement (7)
Housing	5	7.4	Livable Housing (9)	Affordable Housing, Distribution of affordable housing, Affordable housing for special needs groups and Green Housing (7)
Environmental and Public Health	12	7.4	Air Quality and Urban runoff reduction (9)	Toxic Air Contaminant Releases (4)
Open Space and Land Use	5	7.2	Land Use and Development (9)	Parks – Accessibility, and Regionally Appropriate Vegetation (6)
Economic Development	6	7.0	Jobs/Housing Balance (8)	Local Employment of City Staff (4)
Transportation	9	6.2	Average Vehicle Ridership (9)	Pedestrian & Bicycle Safety and Traffic Impacts to Emergency Response (4)
Human Dignity	6	5.5	Homelessness (7)	Education & Youth, Perception of Personal Safety, Ability to meet basic needs, and Crime Rate (4)
Community Education and Civic Participation	3	4.7	Civic Participation and Sustainable community involvement (5)	Voter participation (4)

Table 17: Siemens Indicator Analysis Results for Santa Monica

Community	Number of Indicators in Community Index	Number of Community Indicators Matching Siemens*	Number of Siemens' Indicators Mentioned in Index **	Number of Categories Addressed by Community Indicators***
Santa Monica	54	11	17	7

*This number reflects indicators with the exact measurement as Siemens.

**This number is inclusive of the number of community indicators matching Siemens.

***Siemens has eight categories used for indicator analysis.

4.5.6 Additional Analysis

The two strongest sections included Resource Conservation and Open Space and Land Use, both primarily focused on the environment. On average, the Resource Conservation indicators had an average indicator rating of 8.8, the highest of the eight goal areas. The Resource Conservation goals incorporated the three pillars of sustainability and the role of city government to meet those goals. Each of the indicators had links between the environment and society and the environment and economy. Three of the indicators included links among all pillars of sustainability. The highest rated indicator, *Ecological Footprint*, measured the use of natural resources, which was then converted into a footprint of the city (City of Santa Monica, 2006).

On average, the five indicators for Open Space and Land Use had a rating of 7.2. Goals for the Open Space and Land Use section emphasized the need for mixed land use in a way that preserves open space for environmental values and to service multiple purposes

Table 18: Siemens Green City Index and Santa Monica Indicators

Category	Siemens Green City Index Indicator	Community Indicator Matching Siemens Indicator	Siemens' Indicators Mentioned in Index
CO2	CO_2 emissions per unit of GDP	No	No
	CO_2 emissions per person	**Yes**	**Yes**
	CO_2 reduction strategy	No	**Yes**
Energy	Electricity consumption per unit of GDP	No	No
	Electricity consumption per person (GJ)	**Yes**	**Yes**
	Clean and efficient energy policies	No	**Yes**
Land use	**Green spaces as % of total area (%)**	**Yes**	**Yes**
	Population density (persons/miles^2)	No	No
	Green land use policies/Tree planting policy	**Yes**	**Yes**
	Urban sprawl/Brownfield Reuse	No	No
Buildings	**Number of LEED certified buildings (silver, gold or platinum) (buildings/100,000 persons)**	No	No
	Energy efficient building standards	**Yes**	**Yes**
	Energy efficient building incentives	**Yes**	**Yes**
Transport	**Share of workers traveling by public transit, bicycle or foot**	**Yes**	**Yes**
	Public transit supply	**Yes**	**Yes**
	Average commute time from residence to work	No	No
	Green transport promotion	No	**Yes**
	Congestion reduction policies	**Yes**	**Yes**
Water	**Water consumption per capita**	**Yes**	**Yes**
	Water system leakages	No	No
	Water quality policy	No	**Yes**
	Stormwater management policy	No	No
Waste	**Municipal solid waste recycled (%)**	**Yes**	**Yes**
	Waste reduction policies	No	**Yes**
Air	Nitrogen oxides emissions per year (pounds per person)	No	No
	SO_2 emissions per year (pounds per person)	No	No
	PM_{10} emissions per year (pounds per person)	No	No
	Clean air policy	No	No
	Total Number of Indicators Matched/Mentioned	11	16

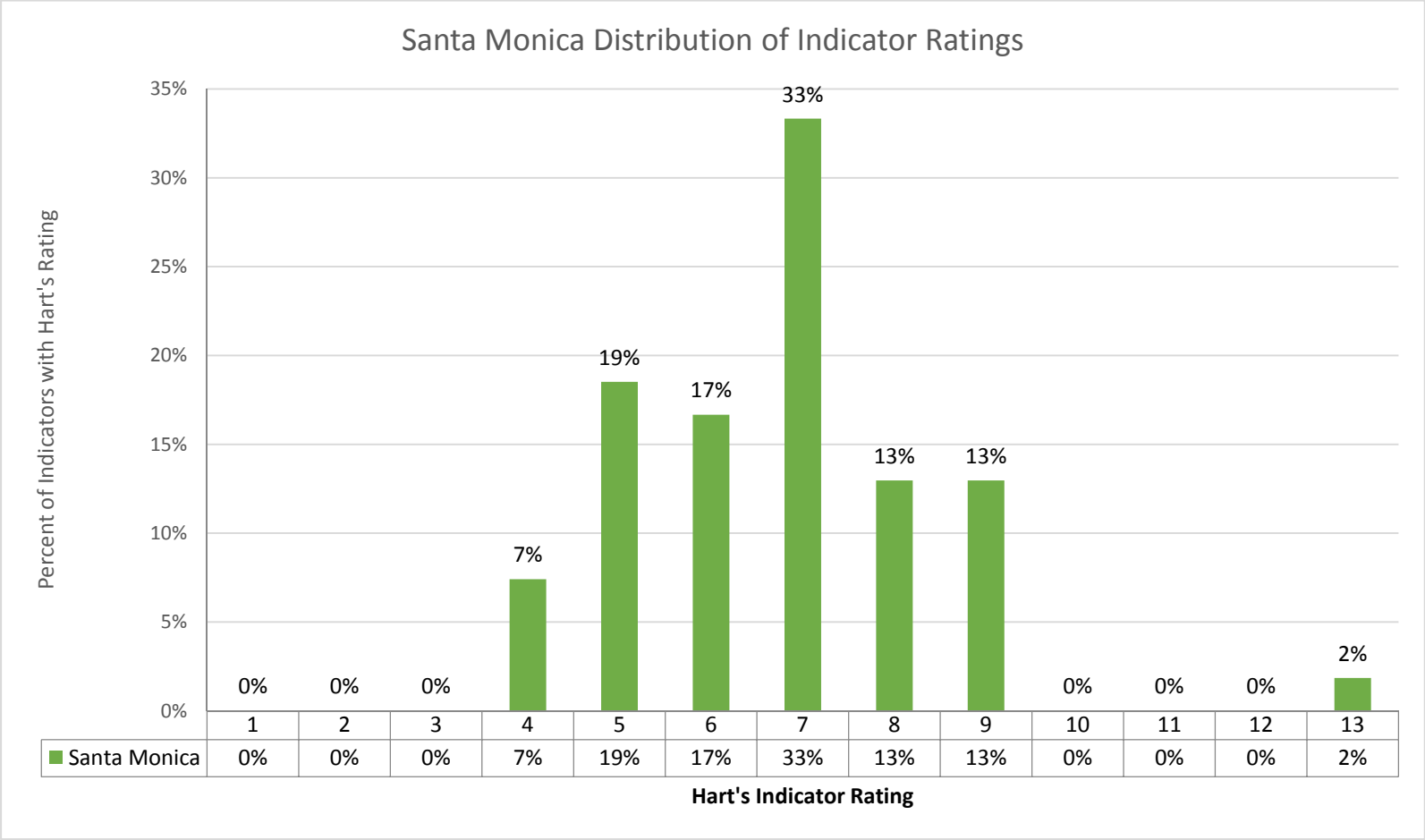
for the community. The goals also addressed the need to plan for multimodal transportation with consideration of proximity to housing.

The weakest sections of Santa Monica's index included Human Dignity and Community Education and Civic Participation. Both sections had average indicator ratings below six, with metrics focused strongly on societal impacts, and without connection to environmental aspects. Another weakness of the index was the repetitiveness of some indicators. For instance, four indicators from the Environmental and Public Health section addressed local and healthy food availability for the community including *Fresh, Local, Organic Produce*, *Organic Produce – Farmers Markets*, *Restaurant Produce Purchases*, and *Food Choices*. Because Santa Monica had three times the number of indicators suggested by Hart (2006) or Dahl (2012) to include in an index, it would be beneficial if these were condensed into one indicator. Furthermore, while the first three indicators addressed sustainable sources of food for the region, the indicator *Food Choices* may be seen as a livability indicator, promoting a lifestyle choice instead of measuring the sustainability of a region.

4.5.7 Conclusions

Overall, Santa Monica had one of the strongest approaches for incorporating sustainability into the community and city government operations. The combination of the TFE and SAT created a much-needed support system for incorporating sustainability. For instance, when needed, either of these groups may bring formal recommendations to city council, city manager, and/or planning commission. Together these interactions with the public and city staff and officials are a strong strategy to increase sustainability efforts

Figure 7: Santa Monica Distribution of Indicator Ratings



in the city (City of Santa Monica, May 2014). Santa Monica performed well for the Siemens indicator analysis and for Hart's analysis. The presence of indicators that were more informative, better addressed all three sustainability pillars, included measurements by capita, sector, and addressed the role of government all contributed to the index's performance. Some of Santa Monica's weaknesses were due to complex indicators, frequently outdated information and statistics, and a lack of connection between the environment or economy to society-focused indicators.

4.6 Part One Summary of Results

From the summaries above, it is apparent that great efforts are being made by communities to incorporate sustainability in every aspect. However, these indicators may tell something about a community, but in terms of being sustainability indicators, they can be considered average. According to Hart's indicator analysis, each community index only had an average indicator rating of roughly six to seven. While an average rating of seven may indicate an index has "good" measurements of sustainability, they are not necessarily "great" measurements. If communities are going great lengths to develop and report this information, they need to reevaluate their indicators if they want to measure their development as a sustainable community.

4.7 Hart's Indicator Analysis Results

Overall, Hart's indicator analysis revealed that the five communities had an average indicator rating of 6.52, just below a good indicator rating of seven. This infers that each of the indices could be improved to better encompass the three tiers of sustainability. Houston had the highest average indicator rating of 7.16, while San Mateo had the lowest

at 5.98. Tables 19 and 20 display the average indicator rating and the distribution of indicator ratings by community. Furthermore, Figure 8 charts the distribution of indicator ratings across all communities.

Table 19: Hart's Average Indicator Ratings by Community

Community	Number of Indicators in Index	Average Indicator Rating
Central Texas	40	6.53
Houston	25	7.16
Minneapolis	26	6.23
San Mateo	45	5.98
Santa Monica	54	6.78
Average Indicator Rating	**38**	**6.52**

Table 20: Distribution of Indicator Ratings by Community

Indicator Rating	Central Texas	Houston	Minneapolis	San Mateo	Santa Monica
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	1	2	0
4	4	2	3	11	4
5	8	3	5	9	10
6	9	2	5	7	9
7	11	8	5	5	18
8	3	4	6	5	7
9	2	5	1	4	7
10	1	0	0	1	0
11	2	1	0	1	0
12	0	0	0	0	0
13	0	0	0	0	**1**
Number of Indicators	40	25	26	45	56
Number of Indicators ≥ 7	19	18	12	16	33
Percent of Indicators ≥ 7	47.5%	**72.0%**	46.2%	35.6%	58.9%

4.8 Siemens Green City Index Results

Overall, each community addressed a variety of environmental indicators, although some more than the others. Results in Table 21 show that Santa Monica had the most number of indicators exactly matching the Siemens' indicators, while Houston and Minneapolis had the least. Houston had the highest number of Siemens' indicators mentioned in their index, while Minneapolis still had the least. However, although Houston had the highest number of Siemens' indicators mentioned, it was only one more than San Mateo and Santa Monica. Emphasis should be placed on the number of exact indicators, as these measurements are more informative as indicators. Furthermore, San Mateo was the only community to address all eight categories, while Central Texas and Houston addressed only six. Overall, Minneapolis performed the poorest for the Siemens indicator analysis.

Table 21: Siemens Green City Index: Analysis by Community

Community	Number of Indicators in Community Index	Number of Community Indicators Matching Siemens*	Number of Siemens' Indicators Mentioned in Index **	Number of Categories Addressed by Community Indicators***
Central Texas	40	7	11	6
Houston	25	1	17	6
Minneapolis	26	1	13	7
San Mateo	45	9	16	8
Santa Monica	54	11	16	7

*This number reflects indicators with the exact measurement as Siemens.

**This number is inclusive of the number of community indicators matching Siemens.

***Siemens has eight categories.

A few of Siemens' indicators were neither tracked nor mentioned in all community indices. These included CO_2 emissions per unit of GDP, electricity consumption per unit of GDP, water system leakages, and number of LEED buildings per 100,000 people (see Table 22). However, many indices measured either the total number of LEED buildings, or the number built as a percent of new construction in a given year. Additionally, very few communities had indicators matching or mentioned from Siemens' Air category, which measured nitrous oxide emissions, sulphur dioxide emissions, and PM_{10} emissions per person, and a clean air policy. However, air quality was addressed in many indices, but more frequently for ozone pollution, or $PM_{2.5}$. Perhaps these indicators are too complex for the public to understand or uninformative to the sustainability of communities.

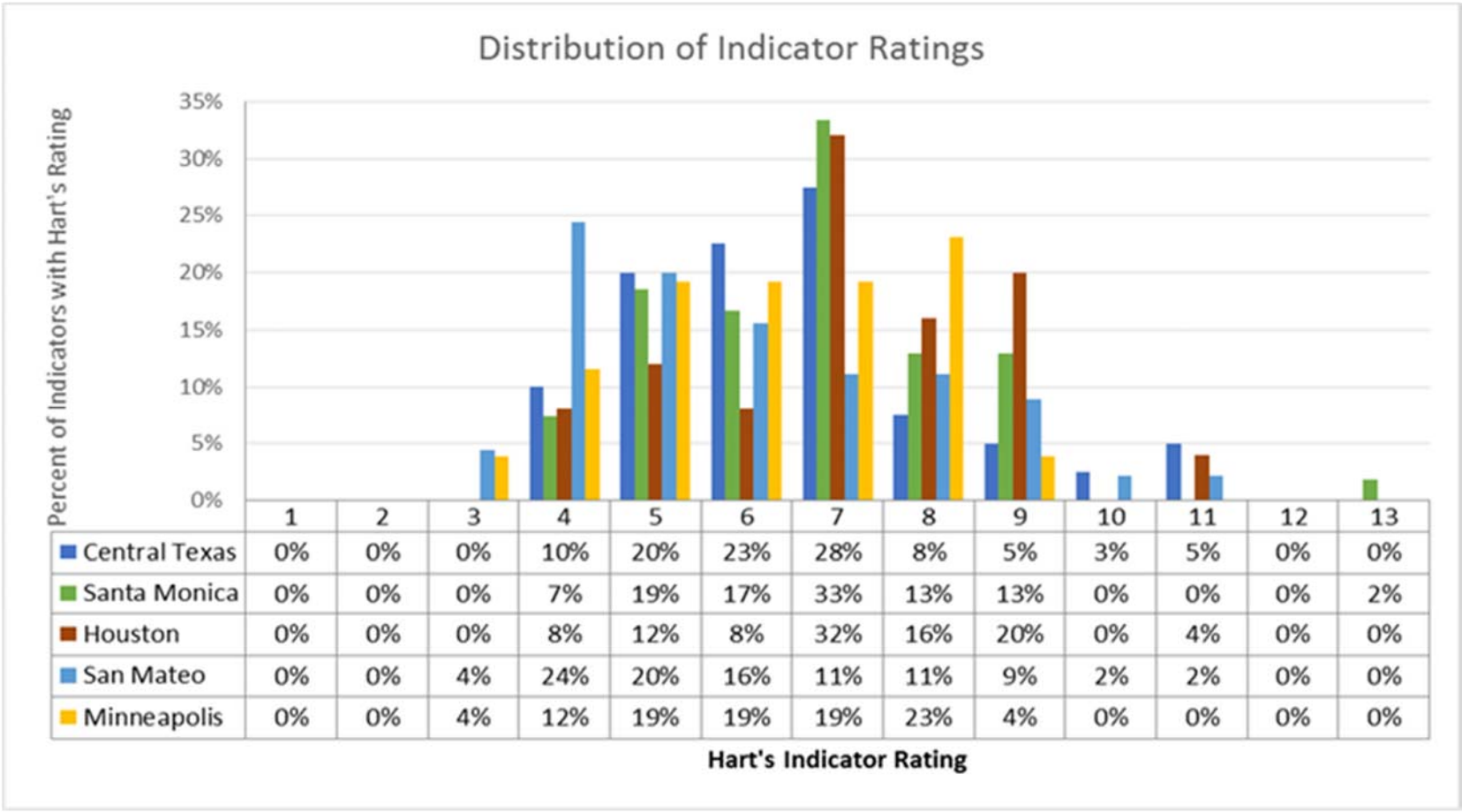
On the contrary, indicators tracked by all communities included a CO_2 reduction strategy, public transit supply and the share of workers traveling by public transit, bicycle, or foot. Indicators tracked in four of the five communities included clean and energy efficient energy policies, green land use policies, energy efficient building standards, green transport promotion, and waste reduction policies.

Table 22: Siemens' Indicators Measured and Mentioned in Community Indices

Category	Siemens Indicator	Texas	Houston	Minneapolis	San Mateo	Santa Monica
CO_2	CO_2 emissions per unit of GDP	No	No	No	No	No
	CO_2 emissions per person	No	No	No	**Yes**	**Yes**
	CO_2 reduction strategy	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Energy	Electricity consumption per unit of GDP	No	No	No	No	No
	Electricity consumption per person	No	No	No	**Yes**	**Yes**
	Clean and efficient energy policies	**Yes**	No	**Yes**	**Yes**	**Yes**
Land use	Green spaces as % of total area	**Yes**	**Yes**	No	**Yes**	**Yes**
	Population density	**Yes**	**Yes**	No	No	No
	Green land use policies/Tree Planting Policy	No	**Yes**	**Yes**	**Yes**	**Yes**
	Urban sprawl/Brownfield Reuse	**Yes**	**Yes**	**Yes**	**Yes**	No
Buildings	Number of LEED certified buildings per 100,000 persons	No	No	No	No	No
	Energy efficient building standards	No	**Yes**	**Yes**	**Yes**	**Yes**
	Energy efficient building incentives	No	**Yes**	**Yes**	No	**Yes**
Transport	Share of workers traveling by public transit, bicycle or foot	**Yes**	**Yes**	No	**Yes**	**Yes**
	Public transit supply	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
	Average commute time from residence to work	**Yes**	No	No	**Yes**	No
	Green transport promotion	No	**Yes**	**Yes**	**Yes**	**Yes**
	Congestion reduction policies	No	**Yes**	No	**Yes**	**Yes**
Water	Water consumption per capita	**Yes**	**Yes**	No	**Yes**	**Yes**
	Water system leakages	No	No	No	No	No
	Water quality policy	No	**Yes**	**Yes**	No	**Yes**
	Stormwater management policy	No	No	**Yes**	No	No
Waste	Municipal solid waste recycled	**Yes**	No	**Yes**	No	**Yes**
	Waste reduction policies	**Yes**	No	**Yes**	**Yes**	**Yes**

Air	Nitrogen oxides emissions per year	No	**Yes**	No	No	No
	Sulphur dioxide emissions per year	No	**Yes**	No	No	No
	PM_{10} emissions per year	No	**Yes**	No	No	No
	Clean air policy	No	**Yes**	No	**Yes**	No
	Number of Siemens' Indicators in Community Index	**11**	**17**	**13**	**16**	**16**

Figure 8: Distribution of Indicator Ratings by Community



	1	2	3	4	5	6	7	8	9	10	11	12	13
Central Texas	0%	0%	0%	10%	20%	23%	28%	8%	5%	3%	5%	0%	0%
Santa Monica	0%	0%	0%	7%	19%	17%	33%	13%	13%	0%	0%	0%	2%
Houston	0%	0%	0%	8%	12%	8%	32%	16%	20%	0%	4%	0%	0%
San Mateo	0%	0%	4%	24%	20%	16%	11%	11%	9%	2%	2%	0%	0%
Minneapolis	0%	0%	4%	12%	19%	19%	19%	23%	4%	0%	0%	0%	0%

5.0 Part Two: Analyzing and Utilizing the Strongest and Weakest Indices with Baltimore County, MD Data

Part Two of this thesis identifies and uses the strongest and weakest indices analyzed in Part One in two primary ways. First, the following provides an explanation for why the two indices were the strongest and weakest at measuring community-level sustainability. Second, to emphasize the differences in the indices (i.e., highlight why one index was considered the strongest and the other the weakest) a common set of data (Baltimore County) is collected based on the indicators' measurements in each index, the result being two data sets for Baltimore County. Selections of indicators from each data set (and in turn from each of the indices) are compared for their ability to measure sustainability of Baltimore County. The purpose of this is not to evaluate Baltimore County's performance, but rather comment on whether the data (and ultimately their original indicators) are useful at measuring sustainability for a community other than the one for which they were developed. Secondly, applying Baltimore County data allows for an understanding of how a potential sustainability index could be crafted ensuring the County would use highly rated and effective indicators.

5.1 Selection of Strongest and Weakest Indices

Of the five communities examined in Part One, Minneapolis's index was selected as the weakest due to the indicators' poor performance in the Siemens evaluation, and the low average indicator rating of 6.23. Weaknesses of the index prevailed, as measurements for a majority of indicators were not geared towards sustainability. Frequently indicators focused on livability standards for community residents and lacked vital connections

among the three pillars of sustainability. Additionally, many measurements were not usable for a comparable analysis, and were focused on short-term goals instead of the long term.

Meanwhile, Santa Monica's indicators performed well for the Siemens analysis and had an average indicator rating of 6.78. While the rating was the second highest of the group (as Houston had an average rating of 7.16), Santa Monica was selected as the strongest index due to the informative and comprehensive indicators that better addressed the three sustainability pillars. Furthermore, Santa Monica's measurements frequently held all individuals in a community responsible for their actions (i.e., by capita, by sector and the role of government).

5.2: Using Baltimore County, MD Data to Further Evaluate the Strongest and Weakest Indices

While the communities had average indicator ratings of 6.78 and 6.23, both sets of indicators could be better framed to measure the components of a sustainable community. The following analysis looks at the Minneapolis and Santa Monica indices for additional critique as Baltimore County data were collected for each (see Appendices L and M for the full sets of Baltimore County data collected). Based on the high number of indicators, a few indicators from each index's sections are selected for analysis and categorized into economy, environment, and society. Suggestions are included for how these indicators could be improved prior to being included in a hypothetical index for Baltimore County.

Baltimore County, MD Sustainability Efforts Overview

Baltimore County sits in the heart of Maryland, with roughly 682 square miles and a population just over 800,000 people (U.S. Census, 2014a). The county is home to urban, suburban, and rural neighborhoods, and has over 200 miles of shoreline. Historically, Baltimore County has been recognized as an environmental leader for its initiatives and policies geared towards protecting the environment. For instance, in 1967, the county created an Urban Rural Demarcation Line (URDL), Maryland's first formal urban growth boundary. The line separates the county's urban and rural land management areas, and allows infrastructure investments and land developments to be concentrated in urban areas while preserving agricultural and natural areas (Baltimore County MD, 2013a). This is just one of the many ways Baltimore County has tried to incorporate sustainability into its planning and policy-making.

The county is also recognized for its Master Plan 2020, a guiding document for decision-makers to utilize (i.e., County Executive, county council, and government agencies). Mandates made by the state require items outlined in the plan to be consistent with regulations and ordinances passed by the county. Baltimore County is required to prepare and adopt a new master plan every 10 years. Currently, the Annotated Code of Maryland requires the plan to include 12 visions focused on sustainability for inclusion in all of Maryland's jurisdictional plans (Baltimore County MD, 2013a).

5.3 Baltimore County Application to Santa Monica and Minneapolis Indices

5.3.1 Society Related Indicators

Society related indicators typically focus on the following parts of a community: education, government, volunteerism, health, housing, and public safety (Hart, 2006). Minneapolis measured ten society-focused indicators in their "A Healthy Life" and "A Vital Economy" sections, with an average indicator rating of 5.1. Santa Monica tracked fourteen society-focused indicators in their "Housing," "Community Education and Civic Participation," and "Human Dignity" sections, with an average indicator rating of 6.0. With average indicator ratings below 7.0 for both communities, this suggests that societal indicators in general need to be strengthened to better connect to a community's sustainable development. In Table 23, a selection of society related indicators for both communities are listed with their Hart rating, and are further discussed below.

Table 23: Selection of Minneapolis and Santa Monica Society Indicators

Minneapolis Indicator	**Indicator Rating**	**Santa Monica Indicator**	**Indicator Rating**
Cost-burdened households	7	Distribution of affordable housing	7
No similar indicator		Affordable Housing	7
No similar indicator		Affordable housing for special needs groups	7
No similar indicator		Green Housing	7
No similar indicator		Livable Housing	9
Violent Crimes	4	Crime Rate	5
No similar indicator		Perception of Personal Safety	5
No similar indicator		Ability to meet basic needs	5
Healthy Infants	5	No similar indicator	
Healthy Weight	4	No similar indicator	
Teen Pregnancy	5	No similar indicator	

Hart (2006) explains that a healthy and well-educated community is important for a community to be sustainable. Prevention of health problems is vital, as a healthy community is able to work effectively, learn efficiently, and contribute to the overall community. Minneapolis's index measured teen pregnancy, asthma rates, healthy infants, healthy weight, and the sexual health of its community. Collecting Baltimore County data for these indicators shows that in the past five years, Baltimore County's teen pregnancy has dropped by 10 percent (see Table 24) and average infant mortality rates have declined as well (DHMH, August 2013). Asthma rates are highest among children up to four years old, and exceed the Maryland state average (DHMH, August 2011). Furthermore, in 2011, only 33.5 percent of residents were considered a healthy weight, while 28 percent of residents were considered obese (Governing, 2011).

Table 24: Baltimore County Teen Pregnancy Rate (Live Births per 1,000 Females 15-19 year olds):

Year	2008	2009	2010	2011	2012
Teen Pregnancy Rate	27.0	25.2	22.5	21.5	17.2

(DHMH, August 2013).

Table 25: Baltimore County Average Infant Mortality Rates (deaths per 1,000 live births):

Year	Average Infant Mortality Rate
2003-2007	7.7
2008-2012	6.6

(DHMH, August 2013).

Table 26: Baltimore County Infant Mortality Rates by Race/Ethnicity (deaths per 1,000 live births):

Baltimore County Infant Mortality Rates	Infant Mortality Rate All Races	Infant Mortality Rate Caucasian	Infant Mortality Rate African American
2011	6.3	3.6	12.7
2012	5.3	3.3	9.5

(DHMH, August 2013).

Collectively, what this tells a reader about Baltimore County's sustainability is sparse. While Hart (2006) considers the teen pregnancy rate an indicator of sustainability as it relates to issues such as education, health, and poverty, the Minneapolis index did not provide cross-sectional indicators that corresponded to it. The other indicators' connections among the economy, society, and the environment were weak, as there were no corresponding indicators to show the economic impact of the healthcare system, the cost to residents, or equal access to healthcare services. Aside from asthma rates, which may be attributed to poor air quality, there was little connection to the environment as well. It is questionable if these indicators should be included in an index measuring community sustainability. Santa Monica did not include health related indicators, suggesting they are not as important to a sustainable community.

If Baltimore County were to include indicators about community health, then it would be imperative to include socio-economic factors such as the cost for and equal access to adequate healthcare, geographic information such as the proximity to adequate healthcare, and demographic information. Measuring the percent of population that is physically active, while also the proximity to local parks (by Census Designated Places (CDPs), race/ethnicity, and socioeconomic status) may also reveal more about why only

one third of residents are a healthy weight. To incorporate environmental factors, it may be important to identify sources of local pollution, or proximity of residents to those sources.

Housing characteristics are also frequently measured in sustainability indices, and can be categorized as societal indicators. Housing indicators should address both the built capital and social capital, as a sustainable community will have affordable, safe, and sustainably built housing, in proximity to places of work, school, and recreation (Hart, 2006). Both communities used a housing indicator to measure the overall availability of affordable housing. While this measurement may connect society, the economy, and the built environment, Minneapolis did not consider equity issues, or the environment in their measurement. Meanwhile, Santa Monica measured housing availability by neighborhood, by income, and for special needs groups. Furthermore, other housing indicators addressed the carrying capacity of natural resources and the environment by measuring the percent of new housing close to open space, and built to green standards (both considered good sustainability indicators by Hart) (2006).

While Baltimore County data were not available for some of the housing indicators, in a theoretical sustainability index, it would be useful for Baltimore County to use Santa Monica's indicators. Collectively, Santa Monica's indicators addressed the carrying capacity of human and built capital, the diversity of housing by price, location, and building standards, and measured links between the environment and society and between the economy and society.

As another example of a society related indicator, public safety typically addresses the number and types of crimes in a community. However, Hart (2006) states that public

safety indicators must measure more than just the level of crime by additionally addressing the relations among people (social capital), and the connections among society and the economy and the environment. Minneapolis' indicators measured homicide rates and violent crimes on a per capita basis. While Baltimore County has a homicide rate of 2.43 homicides per 100,000 residents and violent crimes have decreased by five percent since 2008, the metrics used do not have an explicit connection to economic, social, or environmental issues in the community (Baltimore County, MD 2013c). Santa Monica measured crime rate, but also the percent of people who feel they are able to meet various basic needs. However, as Table 23 shows above, these indicators only had ratings of five. Hart (2006) states the ability to afford basic needs, along with proper education, are both directly connected to public safety. If Baltimore County were to measure public safety as part of an index, then it would be necessary to include the types and number of crimes by economic and educational status of the population, and to possibly consider the number of convicted criminals who receive educational assistance (both considered a sustainability indicator by Hart) (2006).

5.3.2 Economic Indicators

Economic indicators frequently focus on general business, industry, energy, and transportation issues. Indicators of a sustainable economy are able to demonstrate how economic activity affects and interrelates with the environment and society (Hart, 2006). Minneapolis only had five indicators relating to the economy with an average indicator rating of 5.8, while Santa Monica had fifteen with an average rating of 6.4. This section reviews the indicators in Table 27 below for their differences between indices and reflects on their usefulness in an index for Baltimore County.

Table 27: Selection of Minneapolis and Santa Monica Economic Indicators

Minneapolis Indicators	Indicator Rating	Santa Monica Indicators	Indicator Rating
Employment and poverty	6	Economic diversity	7
No similar indicator		Income disparity	7
No similar indicator		Jobs/Housing balance	8
Green Jobs	8	No similar indicator	
No similar indicator		Average Vehicle Ridership	9
No similar indicator		Vehicle Ownership	7
Transportation Alternatives	5	Sustainable Transportation Options	6
Biking	4	Bicycle Lanes and Paths	7
No similar indicator		Pedestrian & bicycle safety	4

While Minneapolis had few indicators related to the economy, Santa Monica had a diverse set, focused on the variety of jobs available, the number of jobs relative to housing opportunities, and local employment. A snapshot of Baltimore County's economy is shown by the data collection for Santa Monica's indicators. Baltimore County has diverse business sectors, with no individual sector making more than 25 percent of total wages, and the top three sectors making up just over 50 percent (see Table 28 below) (DLLR, June 13, 2014). The jobs-housing balance has dropped from 1.61 in 2010 to 1.35 in 2013, and there is roughly 40 percent of Baltimore County residents working in Baltimore County (DLLR, September 2014; U.S. Census Bureau, 2013b). Only 17 percent of the population earns less than $25,000 a year and the households earning more than $100,000 per year make up 28.6 percent of the population (U.S. Census, 2012).

Table 28: Baltimore County Percent of Total Economic Activity by Sectors, Proportion in Top Three Sections (by payroll)

Economic Sector	Percent of Total Economic Activity
Education and Health Services	15.9
Professional and Business Services	16.9
Government	19.2
Top Three Sectors Total	**52.0**

(DLLR, June 13, 2014).

Baltimore County Ratio of the number of jobs in Baltimore County to the amount of housing:

- 2013 Labor Force Average: 453,280
- 2013 Housing Units: 335,896
- 2013 Jobs-Housing Balance: 1.35 (DLLR, September 26, 2014).

Together Santa Monica's indicators had a strong connection between the economy and society, with an emphasis on the local economy and the importance of equity among all job sectors. They were able to present information about Baltimore County's economy in a way that would be useful to those responsible for economic development and equity in the county. However, few of these indicators addressed the environment or the carrying capacities of natural resources, the ecosystem, and esthetic qualities. If Baltimore County were to use similar indicators, then they would need to be altered first to reflect how the economy, and income affect the environment. For instance, Hart (2006) considers that it is important to measure the extent to which economic viability is dependent on unsustainable activity important. Baltimore County could consider measuring the availability of green jobs as a percent of total jobs, the percent growth of green jobs (as Minneapolis does), and the percent of businesses using renewable energy or using

resources in a sustainable manner. Green jobs typically produce goods or services that help conserve natural resources, or benefit the environment. The presence of green jobs indicates a greener economy, focused on energy efficiency, energy independence, sustainable use of resources, and more.

Furthermore, the economy is greatly tied to transportation, as producers and consumers require goods and services in different locations. Personal transportation is also important, as its impacts on the environment can be costly. Hart (2006) considers transportation in a sustainable community to conserve energy and materials to support transportation and the land that transportation systems are built on.

Although both communities measured alternative commutes and means of transportation, Santa Monica's indicators addressed the safety of alternative transportation, total vehicle miles traveled (not just percent driving alone as Minneapolis did), the types of vehicles owned, and public transportation use. Collectively these were able to provide more information about Baltimore County than Minneapolis's indicators alone. Collection of Baltimore County data showed that alternative transportation is an area of weakness for residents and workers alike. Only 4.8 percent of Baltimore County workers report using public transportation to travel to work, while 79.4 percent of workers drive alone (U.S. Census Bureau. 2013a). This high percentage may correspond to the high number of vehicles available per person of driving age measured in another indicator. Over 70 percent of Baltimore County residents have access to two or more vehicles (see Table 29 below) (U.S. Census Bureau, 2013b). I suggest that Baltimore County include similar transportation indicators as Santa Monica's. However, many of these indicators had a rating of seven, and could be improved by including economic, demographic, and

geographic information to better address economic impacts and equitable access to public transport.

Table 29: Baltimore County Average Number of Vehicles per Person of Driving Age:

Vehicles Available	Percent
No vehicle available	3.2
1 vehicle available	25.1
2 vehicles available	42.8
3 or more vehicles available	28.9

(U.S. Census Bureau, 2013b)

Table 30: Measures of Transportation to Work

Baltimore County, Maryland	Estimate	Percent
Total:	407,759	
Car, truck, or van - drove alone:	323,677	79.4
Worked in state of residence:	316,753	77.7
Worked in county of residence	160,515	39.4
Worked outside county of residence	156,238	38.3
Worked outside state of residence	6,924	1.7

(U.S. Census Bureau, 2013a).

Additionally, Santa Monica measured the miles of bicycle paths and the percent of commuters who ride bicycles (as does Minneapolis). However, Santa Monica also measured safety conditions for bicyclists and pedestrians. For the small percent of residents who commute to work via bicycle, only 8.28 miles of bike paths are available out of more than 2,600 miles of roads in the county (K. Schlabach, personal communication, October 1, 2014). Baltimore County expanded its bicycle paths in recent years, adding 4.23 miles of bicycle lanes for the recent Towson Bike Beltway (Waldman, 2014). Additionally, the county has developed two of three Pedestrian and Bicycle Access Plans, addressing pedestrian and bicycling access and safety issues in different

parts of the county (Baltimore County, MD, October 2014). Because the use of alternative transportation is relative to the environment, society, and economy, it would be imperative for Baltimore County to include indicators similar to Santa Monica's in an index. However, these indicators could be altered to better reflect the environment and the economy. For instance, the miles of bicycle paths could also measure miles by area (CDP), by demographics, and by income to address equity issues, links between society and the economy, and the economy and environment.

5.3.3 Environmental Indicators

Santa Monica's fourteen environmental indicators were primarily split among three sections including Resource Conservation, Environmental and Public Health, and Open Space and Land Use. Santa Monica included several indicators that focused on land use patterns, amount of open space, and public accessibility to parks. On average, the indicators had a rating of 7.4. Minneapolis had ten indicators related to the environment with an average rating of 7.5. Although very close in rating, Santa Monica's indicators revealed much more about the sustainability status of Baltimore County due to their ability to address the carrying capacity of the ecosystem, natural resource use, esthetics, and the links among the environment, society, and the economy. This section reviews the indicators in Table 31, below, for their differences between indices and if they should be considered for a Baltimore County index.

Table 31: Selection of Minneapolis and Santa Monica Environmental Indicators

Minneapolis Indicator	Indicator Rating	Santa Monica Indicator	Indicator Rating
Renewable Energy	8	Renewable energy use	8
No similar indicator	-	Energy Use	8
Tree Canopy	7	Trees	6
Waste Reduction and Recycling	8	Solid Waste Generation	8
No similar indicator	-	Water Use	9

Minneapolis and Santa Monica both included indicators to measure renewable energy use in their communities. However, utilizing Santa Monica's indicators revealed much more about the sustainability of Baltimore County than did Minneapolis's indicators. As previously mentioned, Minneapolis's indicator, *Renewable Energy*, measured the number of citywide permits for renewable energy projects annually and the total renewable electricity used by municipal operations. The first measurement did not account for the number of residents, businesses, nor the size of the community in the number of renewable energy projects issued annually. Furthermore, Minneapolis did not discuss the overall use of energy, per capita or by sector (City of Minneapolis, February 2013). In contrast, Santa Monica's indicator, *Renewable Energy Use*, measured the percent of citywide energy use from renewable and more efficient sources, total renewable energy use (percentage) and by sector, and total energy use from clean distributed generation sources in Santa Monica (also reported by sector). Additionally, Santa Monica's complementary indicator, *Energy Use*, measured the total energy use citywide, per capita, and by sector (City of Santa Monica, 2006). These measurements would allow decision-makers to understand sources of energy for their community and work towards energy independence from foreign sources.

While Baltimore County does not use local sources of energy, it is required to meet Maryland's Renewable Portfolio requirements by increasing the percent of renewable energy purchased each year. Renewable energy sources include a selection of solar, wind, qualifying biomass, methane from a landfill or wastewater treatment plant, geothermal, ocean, hydroelectric power, poultry litter, and waste-to-energy. In 2013, Baltimore County purchased 10.5% of their energy from renewable resources, and 0.2% from solar renewable energy credits. Because Santa Monica's indicators were highly rated by Hart and were more informative, they could be utilized by Baltimore County. To improve their ability to measure sustainability, they could be altered to address affordability for renewable energy by income and CDP to account for equity issues.

Water focused indicators are important to the sustainability of a community because the economy, environment, and members of society all depend on water in some way. Santa Monica addressed community water issues through its indicator *Water Use*, while Minneapolis did not track water use at all. Santa Monica's indicator measured total water use, the percent local versus imported, and the amount of potable water available (City of Santa Monica, 2006). In 2013, Baltimore County used 221 millions of gallons per day (MGD) (which does not take into account per capita measurements nor by sector) (Baltimore County, 2011). Baltimore County obtains all its water resources locally from three major sources. Baltimore County water is purchased from Baltimore City's Department of Public Works. Water provided to Baltimore County consumers comes locally from three reservoirs including Loch Raven, Liberty, and Prettyboy reservoirs (Baltimore City DPW, 2014). Having local water resources not only reduces the need to

use resources to import water and is cost effective, but it also enhances Baltimore County's resiliency to climate change, drought, or other possible natural disasters.

Trees in a community are also important to include in a sustainability index. Not only do trees directly benefit the environment by purifying the air and absorbing and treating stormwater, they benefit society in an economic sense by increasing property values and reducing energy costs when properly sited around buildings. Therefore, it is vital to account for trees in a sustainability community. Tree canopy by neighborhood was included as an environmental indicator measurement for both Minneapolis and Santa Monica. Baltimore County currently has a tree canopy of 48.9 percent and has set a goal to achieve and maintain a 50 percent tree canopy countywide and within the three drinking water reservoirs by the year 2025. The county also has a goal to maintain 40 percent tree coverage within more populated areas inside the URDL and for each of the CDPs (Baltimore County, MD, November 2013). Minneapolis also measured the total number of trees planted and lost annually, without accounting for the size of a community, nor their current tree canopy cover. To improve this indicator for use by Baltimore County, it could incorporate socioeconomic data to show where trees are being planted (not just by CDP), and if they are planted in a strategic manner, for example to protect drinking water or reduce energy costs. This would add a link between the economy and the environment and address issues of equity as well.

As a final example, recycling and waste reduction efforts are important to the sustainability of a community. Both indices address waste reduction policies. Minneapolis's indicator *Waste Reduction and Recycling* measured the annual tonnage of source-separated organics and the volume and percent of residential recyclable materials

recovered. In 2012, Baltimore County's compostables made up 5.6 percent of its waste stream and in 2013, the residential recycling rate was 16.3 percent (50,090 tons) (MDE, 2013). While this demonstrates a weakness in Baltimore County's residential recycling rate, the measurement does not account for the county's overall recycling rate of 41.52 percent (Baltimore County, MD, 2014). By focusing on the residential sector only, it excludes vital information about the county. Santa Monica's indicator, *Solid Waste Generation*, had an equitable indicator rating of eight. The indicator measured the citywide generation and presented the residential waste data on a per capita basis, accounting for any changes in population overtime. Additionally, a corresponding indicator measured residential household hazardous waste (City of Santa Monica, 2006). Collectively, Santa Monica's measurements were more informative for waste generation and recycling patterns in the county. Similar indicators should be included in an index; however, it would be useful to also include waste generation and recycling rates by sector to compare residential, business, and government rates.

5.3.4 Part Two Conclusions

The application of a community's set of data to two separate indices revealed information about the usability of the indicators and their ability to demonstrate the sustainability of a community. Additionally, it provided insight into the current sustainability status of Baltimore County, identifying strengths and weaknesses.

The Minneapolis index was selected for further review based on its weak performance in the Part One analysis. While some of Baltimore County's sustainability efforts (or lack thereof) were presented from the collection of data for Minneapolis measurements, many

efforts were left out. If decision-makers in Baltimore County, such as the county council, were to use the data set presented by the Minneapolis indicator application, then information would be unclear regarding where additional sustainability efforts would be needed. Meanwhile, Santa Monica's indicators were better able to show information about Baltimore County's economy, environment, and housing. However, the sheer number of indicators in the Santa Monica index could become time consuming to update on a frequent basis. Furthermore, the types of data measured were not always directly related to the sustainability of the county. Therefore, it is suggested that Baltimore County pursue a sustainability index based on the Santa Monica index, but with changes to strengthen the indicators and to remove irrelevant measurements.

6.0 Part Three: Suggestions for a Sustainability Index for Baltimore County

6.1 Introduction

As stated previously, Baltimore County does not use an index to track sustainability efforts despite having multiple government agencies working towards sustainable community goals. Should the county decide to develop a sustainability index, it would be imperative to make sure the indicators are strong measurements of sustainability and able to comprehensively address the ecological, social and economic trends in a concise form. It would be most beneficial for Baltimore County to use a universally applicable framework of indicators, which addresses the core concepts of sustainability for any given community. A universal framework would allow for comparison of sustainable development efforts among communities in a uniform manner. However, this framework should allow for adjustments to take into account local needs and priorities of Baltimore County and for any community using it. The following analysis outlines indicators and concepts for a theoretical index for Baltimore County.

6.2 Incorporating Highest Rated Indicators

While Baltimore County would need to develop indicators specific to the needs of the community, a foundation of highly rated indicators would be the first step to developing an index. Table 32 lists indicators from all communities that rated higher than seven using Hart's checklist. These indicators predominately focus on the environmental sector, with only a few economic and social indicators. While it may be clear which indicators to

select for environmental purposes, Baltimore County would need to spend time selecting and developing strong economic and societal indicators.

Table 32: Highest Rated Indicators from Five Community Indices

Indicator	Indicator Rating	Category	Community Measured In
Solid Waste Generation	8	Environment/Consumption and Production/Natural Resources/ Resource Conservation	Central Texas, Houston, San Mateo, Santa Monica
Energy Use	8	Environment/Consumption and Production/ Resource Conservation	Central Texas, Houston, San Mateo, Santa Monica
Energy Supply	8	Climate and Energy	San Mateo
Waste Reduction and Recycling	8	Greenprint	Minneapolis
Renewable Energy	8	Greenprint/Resource Conservation	Minneapolis, Santa Monica
Green Construction	8	Resource Conservation	Santa Monica
Brownfield Sites	8	Greenprint	Minneapolis
Organic Produce - Farmers Markets	8	Environmental & Public Health	Santa Monica
Local Food	8	Greenprint	Minneapolis
Food and Agriculture	9	Land Use	San Mateo
Water Use/Demand	9	Freshwater/Resource Conservation	Houston, Santa Monica
Water: Supply and Demand	9	Natural Resources	San Mateo
Water Consumption	10	Environment	Central Texas
Water Quality	9	Environment	Central Texas
Water Availability	9	Freshwater	Houston
Stormwater	8	Greenprint	Minneapolis
GHG Emissions/ Climate Change	9	Atmosphere/Greenprint/ Climate & Energy/Resource Conservation	Houston, Minneapolis, San Mateo, Santa Monica
Air Quality	9	Environmental & Public Health	Santa Monica
Urban Runoff Reduction	9	Environmental & Public Health	Santa Monica

Indicator	Indicator Rating	Category	Community Measured In
Land Use and Development	9	Open Space & Land Use	Santa Monica
Land Use Policies	10	Land Use	San Mateo
Land Cover Change/Land Use Breakdown	11	Land/Land Use	Houston, San Mateo
Density of New Development	11	Land Use and Mobility	Central Texas
Public Open Space	10	Land Use and Mobility	Central Texas
Rural Land	11	Land Use and Mobility	Central Texas
Open Space	8	Open Space & Land Use	Santa Monica
Parks and Open Space	10	Land Use	San Mateo
Ecological Footprint	13	Resource Conservation	Santa Monica
Jobs/Housing Balance	8	Economic Development	Santa Monica
Population Growth Rate	8	Social Demography	Houston
Affordability	8	Livability	Houston
Housing: Ownership	8	Social Equity	Central Texas
Livable Housing	9	Housing	Santa Monica
Commute Profiles	8	Transportation	San Mateo
Primary Jobs & Green Jobs	9	Economic Development	Houston
Green Jobs	8	Greenprint	Minneapolis
Environmental Impacts from Transportation	9	Transportation	San Mateo
Access to Public Transportation	9	Transportation	Houston
Average Vehicle Ridership	9	Transportation	Santa Monica

6.3 Initial Suggestions

- Establish and determine motivation for the indicator initiative by approaching government leaders and community members alike. Ensure that government

leaders support the development of the index through a resolution or proclamation. Establish one to two working groups to develop indicators and take responsibility for collecting and updating data on an annual basis. One group may be solely government representatives, while the other may be a supporting group of community members.

- Design indicators with consideration for how the information they track will be used by the public and for input in policymaking.

- Work with internal government departments to extract data and request updates on an annual basis.

- For data not currently tracked, institutionalize regular surveys to track community data to identify local trends and issues.

- For each indicator, minimize the number of measurements used as more measurements make it difficult to interpret the overall status.

- Multiple measurements may also be time consuming to track on an annual basis.

- Make sure data are readily available and able to be updated on a frequent basis.

- Ensure indicators address the impact of different sectors whenever possible, including government, businesses, and residents to address all parts of community sustainability.

- Although Hart (2006) and others suggest using ten to twenty indicators to condense information into a manageable amount, I suggest that Baltimore County use more than twenty to best account for the diversity of sustainability efforts.

6.4 Societal Indicators

- Include indicators on the availability of affordable, livable, and green housing for all incomes while also emphasizing the need for equal access to housing.

- Measure the proximity of housing (by type) to open spaces and local services to address equality issues.

- Incorporate socio-economic factors (health care costs, and availability by CDP, income, race and age) for all health indicators to better identify problem areas.

- Connect the environment when appropriate to health related problems or solutions (i.e., local pollution sources, proximity to the pollution, and potential effects on health).

- Include only the most important health indicators for residents in Baltimore County, if needed at all, as they are frequently rated low by Hart.

- Include fewer public safety indicators, also frequently rated low by Hart, unless deemed an issue by the county.

- Ensure that public safety indicators address the type and number of crimes, by location (CDPs), and measure the economic and educational status of those committing crimes.

- Briefly focus on civic and voting participation, as both are frequently rated low by Hart. Ensure that indicators address the diversity of participators and voters (demographics, economics, and education) and by area (CDP).

- Briefly focus on government related indicators, as they are frequently rated low by Hart. Address issues of diversity, equity, education, and interactions with the public.

6.5 Economic Indicators

- Measure the availability and diversity of jobs, while highlighting the percent of and growth of green jobs.

- Measure the impact of the business sector in relation to environmental issues (i.e., energy use, use of renewable energy, participation rates in green business programs, etc.).

- Include transportation indicators that address the affordability, availability, distribution, and safety of alternative transportation options (walking, public transit, bicycling, etc.).

- Measure the modal split of employee commutes and availability of carpooling and other commuting programs designed to reduce VMTs.

6.6 Environmental Indicators

- Include indicators focused on land use and development patterns as the County has strived to protect open space through the URDL. Measure the different types

of open space as a percent of overall land, and access to local space by CDP, income, demographics, etc.

- Measure the tree canopy cover for county, by CDP, and by income of CDPs.
- Agriculture and local food issues should be incorporated for their environmental impacts (amount of land sustainably managed), the local economic impact, and the availability of local food to all residents (i.e. location of community food gardens).
- Water needs to be included as multiple indicators to address water use (by sector and per capita), water availability (local resources, equitable access), and water quality (as it relates to public health).
- Energy use, supply, and demand should be included as multiple indicators to address consumption patterns by sector and per capita, and to address the supply of renewable energy. Incentives for alternative energy for businesses and residents should also be considered for discussion as more incentives may encourage an increased use in alternative energy.
- An indicator geared towards climate change should measure greenhouse gas emissions per capita and by sector (transportation, businesses, residential, governmental, manufacturing), and address strategies in place to reduce greenhouse gases.
- Waste and recycling rates need to be measured to address the economic impacts on local government (as landfills have finite space), total waste generated and

percent of waste recycled by sector and per capita. Because the county tracks recycling rates on a CDP basis already, it would be important to incorporate the data as well.

6.7 Conclusions

As stated throughout this paper, the selection of good sustainability indicators alone does not make a community sustainable. Rather, it is the use of the solid data and trends from the indicators that will help a community develop in sustainable ways. Few studies have focused on the usability of indicators and their direct influence on communities and in policymaking (Rinne et al., 2013). For best results, Baltimore County would need a robust indicator development process to set up a framework for indicators to achieve more than just reporting data. It is crucial that the county avoid a process by which the indicators are used mostly by the developers and the small spheres of influence outside of the developers. The development of the indicators must take account for their potential use and role in policymaking (i.e., the county council, County Executive, and other governmental policymakers). Indicator developers must consider the value of the indicators' data beyond their own use by accounting for the use by and interpretation by private citizens, journalists, lobbyists, government policymakers (Rinne et al., 2013). It cannot be assumed that the development of an index will trigger changes unless effective communication is deployed for each of these potential users. Collectively, an integrated approach to develop sustainable development indicators, including their end use, their connection to the pillars of sustainability, and ability of users to aggregate information into an understandable form, would help Baltimore County progress toward becoming a sustainable community.

Appendices

Appendix A: Sustainable Development Indices Reviewed

2013 State of the World U.S. Sustainable Development Indices

Institutional

Columbia University and Yale University: 2010 Environmental Performance Index

Non-Profits / NGOs (9)

STAR Community Index (ICLEI - International Council for Local Environmental Initiatives)

Green Building Council of Australia – Green Star

Global Reporting Initiative – Sustainability Reporting Guidelines

International Institute for Sustainable Development

Urban Ecology Coalition – Neighborhood Sustainability Indicators Guidebook

U.S. Green Building Council – LEED Neighborhood Development

The World Bank – Global City Indicators Facility

American Society of Civil Engineers – Sustainability Action Plan

International Sustainability Indicators Network

The World Bank – Sustainable Development

Private Organizations (3)

The American Society of Landscape Architects and Lady Bird Johnson Wildflower Center – Sustainable Sites Initiative

PricewaterhouseCoopers – Cities of Opportunity

Siemens – European Green City Index

National / Municipal Governments (9)

Abu Dhabi – Estidama

European Foundation – Urban Sustainability Indicators

Central Texas – Central Texas Sustainability Indicators Project

Houston, Texas - Houston Sustainability Indicators

Minneapolis, Minnesota - Minneapolis Sustainability Indicators

Portland, Oregon – Portland Planning and Sustainability

Santa Monica, California – Santa Monica Sustainability Plan

Seattle, Washington – Sustainable Seattle

Whistler, British Columbia – Whistler Monitor Program

Additional Indices Reviewed (Portney, 2001 and Hart, 2006)

Boston, MA – Sustainable Boston Initiative

Boulder, CO – The Sustainability Program

Brookline, MA – Comprehensive Plan

Brownsville, TX – Eco-Industrial Park

Cambridge, MA – Sustainable Cambridge, Cambridge Civic Forum

Cape Cod, MA – The Pulse of Cape Cod: Measuring Progress for a Sustainable Community

Chattanooga, TN – Sustainable Chattanooga

Cincinnati, OH – Sustainable Cincinnati Project

Cleveland, OH – Sustainable Cleveland Partnership, EcoCity Cleveland

East Lansing, MI – Sustainable Lansing

Euegen, OR – Eugene

Indianapolis, IN – IndyEcology

Jacksonville, FL – Jacksonville Indicators Project, Jacksonville Community Council

Milwaukee, WI – Campaign for Sustainable Milwaukee

New Haven, CT – Vision for a Greater New Haven

Olympia, WA – Sustainable City Indicators/Sustainable Community Roundtable

Orlando, FL – Sustainable Communities

Phoenix, AZ – Comprehensive Plan, Environmental Element

Pittsburgh, PA – Sustainable Pittsburgh

San Francisco, CA – The Sustainability Plan

San Jose, CA – Sustainable City Programs (Sustainable City Major Strategy, part of San Jose 2020)

Santa Barbara, CA – The South Coast Community Indicators Project

Scottsdale, AZ – Scottsdale Seeks Sustainability

Tampa, FL – The Tampa/Hillsborough Sustainable Communities Demonstration Project

Appendix B: Sample of Indicator Analysis Using Hart's Resources

Each indicator and its measurements are used to respond to Hart's 14-question checklist (each question is designated as Q# across the top row). If one or more of the measurements was listed in Hart's pre-rated list of indicators, it was recorded. A final rating was given for each indicator.

Indicator	Measurements	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Rating in Hart's List	Final Rating
Solid Waste Generation	Total citywide generation (per capita); Amount landfilled & diverted from landfill	Yes	Yes	No	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes	No	No	8-8-8	8
Water Use	Citywide Water Use, Percent Local vs. Imported; Potable vs. Non-potable	Yes	Yes	No	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes	No	No	9-9	9
Energy Use	Total citywide use (also per capita and by sector)	Yes	Yes	No	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	8	8

Appendix C: Central Texas Sustainability Indicators

Health

- Health Access
- Physical Health
- Mental Health

Education and Children

- Child Care: Quality
- Child Care: Access
- Schools: Quality
- Schools: Equity
- Schools: Performance
- Higher Education

Social Equity

- Cost of Living
- Housing: Ownership
- Housing: Rental
- Home Loans
- English Proficiency
- Diversity of Leadership
- Race Relations

Public Safety

- Community Safety
- Safe Families
- Equity in Law Enforcement

Engagement

- Philanthropy and Volunteerism
- Participation in the Arts
- Neighborliness
- Civic Participation

Economy

- Household Income
- Diversity of Economy
- Exporting Industries
- Labor Availability
- Job Availability
- Entrepreneurship and Innovation

Land Use and Mobility

- Density of New Development
- Rural Land
- Public Open Space
- Commuting
- Vehicle Miles Travel

Environment

- Water Consumption
- Water Quality
- Energy Use
- Air Quality
- Solid Waste/Recycling
- Hazardous Waste

Appendix D: Houston Sustainability Indicators

Social Development Pillar

- Population Growth Rate
- Education Attainment
- Voter Participation
- Income Inequality
- Poverty Rate
- Health Coverage
- Affordability
- Accessibility of Public Spaces
- Food Deserts

Economic Development Pillar

- Employment Status
- Primary Jobs and Green Jobs
- Income
- Waste Generation
- Energy Consumption
- Access to Public Transportation
- VMTs
- Travel Choice

Environmental Development Pillar

- Ambient concentrations of air pollutants
- GHG Emissions
- Water Pollution
- Water Use
- Water Availability
- Flood Plain Expansion
- Land Cover Change
- Jobs/Housing Balance

Appendix E: Minneapolis Sustainability Indicators

A Vital Community

- Brownfield sites
- Violent crimes
- Community engagement
- Homelessness
- Cost-burdened households
- Employment and poverty
- Graduation rate

A Healthy Life

- Healthy Infants
- Teen Pregnancy
- HIV and gonorrhea
- Healthy weight
- Asthma
- Lead poisoning
- Arts and the economy

Greenprint

- Climate change
- Renewable energy
- Air quality
- Tree canopy
- Biking
- Transportation alternatives
- Airport noise
- Stormwater
- Healthy lakes, streams, rivers
- Green jobs
- Local food
- Waste reduction and recycling

Appendix F: San Mateo Sustainability Indicators

Transportation

- Environmental Impacts from Transportation
- VMTs and Fuel Consumption
- Commute Patterns
- Commute Profiles
- Congestion
- Safety
- Infrastructure

Equity:

- Community Connectedness
- Healthy Families
- Voter Participation
- Library Use
- Crime and Safety
- Homelessness
- Poverty
- Access to Healthcare
- Cause of Death
- Prenatal and Maternal Care
- Healthy Behaviors and Risk Factors
- Average Class Size
- School Funding
- 3rd Grade Reading Proficiency
- Graduation and Dropout Rates
- College Preparedness

Economy

- Jobs
- Unemployment
- Wages
- Housing Affordability
- Housing Stock
- Housing Supply
- Skilled Workforce
- Venture Capital Funding
- Location Quotient
- Growth: Total Taxable Sales
- Green Business

Environment

- Greenhouse Gas Emissions
- Energy Use
- Energy Supply
- Green Buildings
- Land Use Breakdown
- Land Use Policies
- Parks and Open Space
- Food and Agriculture
- Air Quality
- Water: Supply and Demand
- Water: Bay and Ocean Water Quality
- Solid Waste

Appendix G: Santa Monica Sustainability Indicators

Resource Conservation

- Solid waste generation
- Water use
- Energy use
- Renewable energy use
- GHG emissions
- Ecological Footprint for Santa Monica
- Sustainable Procurement
- "Green" construction

Environmental and Public Health

- Santa Monica Bay – beach closures
- Wastewater generation
- Vehicle miles traveled
- Air quality
- Residential household hazardous waste
- City purchases of hazardous materials
- Toxic air contaminant releases
- Urban runoff reduction
- Local Produce at City Facilities
- Organic produce – Farmer's markets
- Restaurant produce purchases
- Food choices

Transportation

- Average Vehicle Ridership
- Sustainable Transportation Options
- Bicycle Lanes and Paths
- Vehicle Ownership
- Bus Ridership
- Alternative Fueled Vehicles
- Traffic congestion
- Pedestrian and bicycle safety
- Traffic impacts to emergency response

Economic Development

- *Business reinvestment*
- Cost of living
- Economic diversity
- Income disparity
- Jobs/Housing balance
- Local employment of City staff
- Quality Job Creation
- *Resource efficiency of local businesses*

Open Space & Land Use

- Open Space
- Trees

- Parks - Accessibility
- Land Use & Development
- Regionally appropriate vegetation

Housing

- Affordable housing
- Distribution of affordable housing
- Affordable housing for special needs groups
- Livable Housing
- Green housing

Community Education & Civic Participation

- Voter participation
- Civic Participation
- Sustainable community involvement

Human Dignity

- Ability to meet basic needs
- *Basic Health Insurance*
- Crime Rate
- Economic Opportunity
- Education and Youth
- *Empowerment of Minorities*
- *Incidents of abuse*
- *Incidents of discrimination*
- Perception of Personal Safety

Appendix H: Central Texas Sustainability Indicators Ratings

Section	Indicator	Final Rating
Environment	Water Consumption	**10**
	Water Quality	**9**
	Energy Use	**8**
	Air Quality	**7**
	Solid Waste	**8**
	Hazardous Waste	**6**
Health	Health Access	**5**
	Physical Health	**5**
	Mental Health	**6**
Land Use and Mobility	Density of New Development	**11**
	Rural Land	**11**
	Public Open Space	**10**
	Commuting	**7**
	Vehicle Miles Traveled	**7**
Public Safety	Community Safety	**5**
	Safe Families	**5**
	Equity in Law Enforcement	**6**
Education and Children	Child Care: Quality	**7**
	Child Care: Access	**6**
	Schools: Quality	**7**
	Schools: Equity	**7**
	Schools: Performance	**7**
	Higher Education	**6**
Social Equity	Cost of Living	**7**
	Housing: Ownership	**8**
	Housing: Rental	**7**
	Home Loans	**4**
	English Proficiency	**7**
	Diversity of Leadership	**7**
	Race Relations	**5**
Engagement	Philanthropy and Volunteerism	**5**
	Participation in the Arts	**4**
	Neighborliness	**5**
	Civic Participation	**4**

Section	Indicator	Final Rating
Economy	Household Income	**6**
	Diversity of economy	**6**
	Exporting Industries	**4**
	Labor Availability	**6**
	Job Availability	**6**
	Entrepreneurship and Innovation	**5**
Average Indicator Rating		**6.53**

Appendix I: Houston Sustainability Indicators Ratings

Section	Indicator	Final Rating
Social Demography	Population Growth Rate	**8**
	Education Attainment	**5**
	Voter Participation	**4**
Poverty	Income Inequality	**7**
	Poverty Rate	**5**
	Health Coverage	**5**
Livability	Affordability	**8**
	Accessibility of Public Spaces	**7**
	Food Deserts	**7**
Economic Development	Employment Status	**6**
	Primary Jobs and Green Jobs	**9**
	Income	**4**
Consumption and Production	Waste Generation	**8**
	Energy Consumption	**8**
Transportation	Access to Public Transportation	**9**
	VMTs	**7**
	Travel Choice	**7**
Atmosphere	Ambient Concentrations of Air Pollutants	**7**
	GHG Emissions	**9**
Freshwater	Water Pollution	**7**
	Water Use	**9**
	Water Availability	**9**
Land	Flood Plain Expansion	**6**
	Land Cover Change	**11**
	Jobs/Housing Balance	**7**
Average Indicator Rating		**7.16**

Appendix J: Minneapolis Sustainability Indicators Ratings

Section	Indicator	Final Rating
A Healthy Society	Healthy Infants	**5**
	Teen Pregnancy	**5**
	HIV and Gonorrhea	**4**
	Healthy Weight	**4**
	Asthma	**6**
	Lead Poisoning	**6**
Greenprint	Climate Change	**9**
	Renewable Energy	**8**
	Air Quality	**7**
	Tree Canopy	**7**
	Biking	**6**
	Transportation Alternatives	**5**
	Airport Noise	**5**
	Stormwater	**8**
	Healthy Lakes, Streams, and Rivers	**7**
	Green Jobs	**8**
	Local Food	**8**
	Waste Reduction and Recycling	**8**
A Vital Economy	Brownfield Sites	**8**
	Violent Crimes	**4**
	Community Engagement	**3**
	Homelessness	**7**
	Cost-burdened households	**7**
	Employment and poverty	**6**
	Graduation Rates	**5**
	Arts and the Economy	**6**
Average Indicator Rating		**6.23**

Appendix K: San Mateo Sustainability Indicators Ratings

Section	Indicator	Final Rating
Employment	Jobs	**4**
	Unemployment	**4**
	Wages	**5**
Housing	Housing Affordability	**6**
	Housing Stock	**5**
	Housing Supply	**7**
Innovation and Economic Growth	Skilled Workforce	**5**
	Venture Capital Funding	**4**
	Location Quotient	**5**
	Total Taxable Sales	**3**
	Green Business	**4**
Community Cohesion and Safety	Healthy Families	**5**
	Poverty	**6**
	Crime and Safety	**5**
	Homelessness	**7**
	Voter Participation	**4**
	Library Use	**5**
Community Health	Access to Healthcare	**6**
	Causes of Death	**4**
	Prenatal and Maternal Care	**7**
	Healthy Behaviors and Risk Factors	**5**
Education	Average Class Size	**4**
	Public School Funding	**4**
	3rd Grade Reading Proficiency	**4**
	Graduation and Dropout Rates	**5**
	College Preparedness	**4**
Climate and Energy	Greenhouse Gas Emissions	**9**
	Energy Use	**8**
	Energy Supply	**8**
	Green Buildings	**6**
Land Use	Land Use Breakdown	**11**
	Land Use Policies	**10**
	Parks and Open Space	**8**
	Food and Agriculture	**9**

Section	Indicator	Final Rating
Natural Resources	Air Quality	**7**
	Water: Supply and Demand	**9**
	Water: Bay and Ocean Water Quality	**6**
	Solid Waste	**8**
Transportation *Key Indicator*	Environmental Impacts from Transportation	**9**
	Transportation: Vehicle Miles Traveled and Fuel Consumption	**7**
	Commute Patterns	**6**
	Commute Profiles	**8**
	Congestion	**6**
	Safety	**4**
	Infrastructure	**3**
Average Indicator Rating		**5.98**

Appendix L: Santa Monica Sustainability Indicators Ratings

Section	Indicator	Final Rating
Resource Conservation	Solid Waste Generation	**8**
	Water Use	**9**
	Energy Use	**8**
	Renewable energy use	**8**
	Greenhouse gas emissions	**9**
	Ecological Footprint for Santa Monica	**13**
	Sustainable Procurement	**7**
	"Green" construction	**8**
Environmental and Public Health	Santa Monica Bay – beach closures	**7**
	Wastewater (sewage) generation	**5**
	Vehicle miles traveled	**7**
	Air quality	**9**
	Residential household hazardous waste	**6**
	City purchases of hazardous materials	**5**
	Toxic air contaminant releases	**4**
	Urban runoff reduction	**9**
	Local Produce at City Facilities	**7**
	Organic produce – Farmer's markets	**8**
	Restaurant produce purchases	**6**
	Food choices	**7**
Transportation	Average Vehicle Ridership	**9**
	Sustainable Transportation Options	**6**
	Bicycle Lanes and Paths	**7**
	Vehicle Ownership	**7**
	Bus Ridership	**7**
	Alternative Fueled Vehicles	**7**
	Traffic congestion	**5**
	Pedestrian and bicycle safety	**4**
	Traffic impacts to emergency response	**4**
Economic Development	Cost of living	**6**
	Economic diversity	**7**
	Income disparity	**7**
	Jobs/Housing balance	**8**
	Local employment of City staff	**5**
	Quality Job Creation	**7**
Open Space and Land Use	Open Space	**8**
	Trees	**7**
	Parks - Accessibility	**6**
	Land Use and Development	**9**
	Regionally appropriate vegetation	**6**

Section	Indicator	Final Rating
Housing	Affordable Housing	**7**
	Distribution of affordable housing	**7**
	Affordable housing for special needs groups	**7**
	Livable Housing	**9**
	Green Housing	**7**
Community Education and Civic Participation	Voter participation	**4**
	Civic Participation	**5**
	Sustainable community involvement	**5**
Human Dignity	Homelessness	**7**
	Ability to meet basic needs	**5**
	Crime Rate	**5**
	Economic Opportunity	**6**
	Education and Youth	**5**
	Perception of Personal Safety	**5**
Average Indicator Rating		**6.78**

Appendix M: Baltimore County Data Collection for Minneapolis Indicators

Below are the data collected for Baltimore County, MD using the Minneapolis, MN index as a guide. The indicators are separated by the section in which they appeared in the Minneapolis index, and each indicator is bolded with its relevant measurements italicized below.

Section: A Healthy Life

Healthy Infants:

Baltimore County Average Infant Mortality Rates (deaths per 1,000 live births):

Year	Average Infant Mortality Rate
2003-2007	7.7
2008-2012	6.6

(DHMH, August 2013).

Baltimore County Average Infant Mortality Rates by Race/Ethnicity (deaths per 1,000 live births):

Baltimore County Infant Mortality Rates	All Races Infant Mortality Rate	Caucasian Infant Mortality Rate	African American Infant Mortality Rate
2011	6.3	3.6	12.7
2012	5.3	3.3	9.5

(DHMH, August 2013).

Baltimore County Live Births and Infant Birth Weight by Race in 2012: Percent less than 2500 grams:

All Births	White	White, Non-Hispanic	Black	Black, Non-Hispanic	Asian or Pacific Islander	Hispanic
9.0%	7.3%	7.3%	12.2%	12.2%	8.5%	7.5%

(DHMH, 2012).

Teen Pregnancy:

Baltimore County Live Births per 1,000 Females Aged 15-19:

Year	2008	2009	2010	2011	2012
Rate	27.0	25.2	22.5	21.5	17.2

(Kids Count Data Center, 2012).

HIV and Gonorrhea:

New HIV cases for 13 years and older:

Adult/Adolescent HIV Diagnoses during 7/1/2012-6/30/2013: 179 new cases*

*2013 population estimate of 823,015 equates to 21.74 per 100,000 residents

(DHMH, 2014).

Gonorrhea cases (ages 15 through 44):

There were 586 cases for the year 2013, for a rate of 71.2 per 100,000 (DHMH, 2011).

Healthy Weight:

Adults at Healthy Weight:

In 2010, Baltimore County had 28% of adults obese (body mass index >30) (County Health Rankings & Roadmaps, 2014).

In 2011, the CDC reported adults in the Baltimore-Towson Metropolitan Statistical Area at the following weights:

- Healthy Weight - 33.5%
- Overweight - 38.4%
- Obese - 28.0%

The Baltimore-Towson, MD Metropolitan Statistical Area includes

- Anne Arundel County, MD

- Baltimore City, MD
- Baltimore County, MD
- Carroll County, MD
- Harford County, MD
- Howard County, MD
- Queen Anne's County, MD

(Governing, 2011).

Asthma:

Asthma Emergency Department Visit Rates in 2009 (per 10,000 people):

Age	Baltimore County Rate	Maryland Rate
0-4 years	60.2	48.2
5-17 years	18.7	17.4
18-64 years	17	9.5
65+ years	28.6	30

(DHMH, August 2011).

Lead Poisoning:

Percent of children less than 6 years of age tested:

Maryland Department of the Environment (MDE) Childhood Blood Lead Surveillance

Population of Children (2010 Census)	# of Children Tested <6 yrs. old	Percent of Children Tested	# New Cases for Children with BLL 5-9 µg/dL	# New Cases for Children with BLL ≥10 µg/dL
68,408	16,549	24.2%	200 (1.2%)	25 (.02%)

(CDCP, March 1, 2012).

Percent of homes inspected with children with elevated blood-lead levels (equal to or greater than 10ug/dl):

According to the Maryland Department of the Environment's (MDE) Lead Poisoning Prevention Program, if a child under the age of six has an elevated blood level of 10

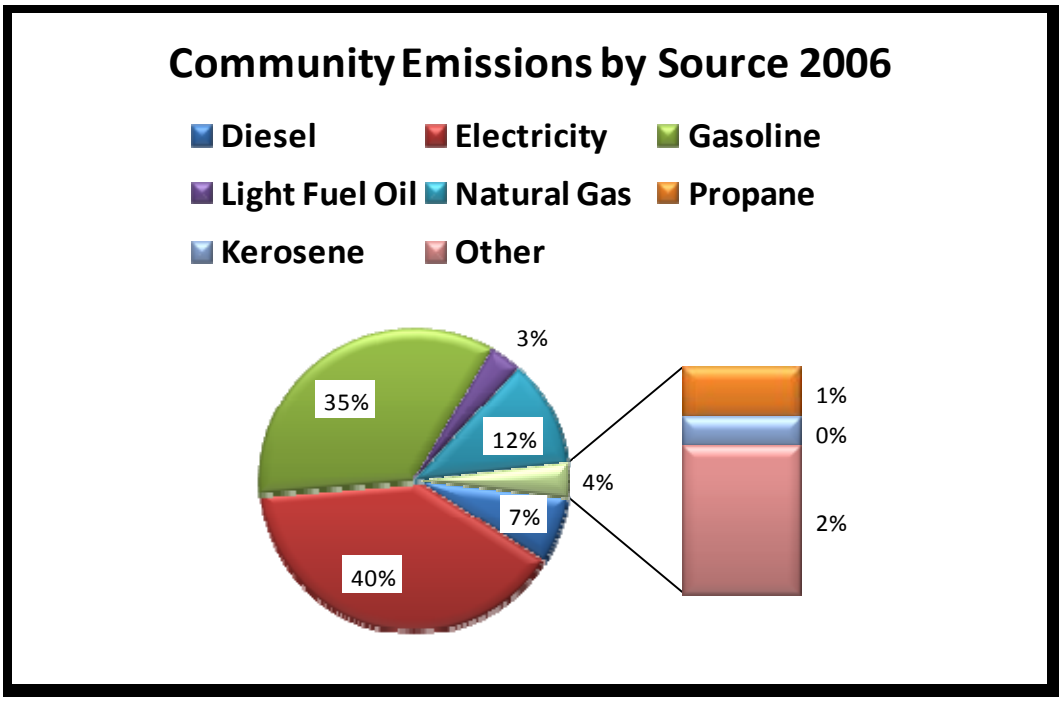
mg/dL or more, a Notice of Elevated Blood Lead Level is sent to the owner of a pre-1950 residential dwelling unit. The owner is required to prove that they temporarily relocated tenants to a lead free dwelling, or performed lead hazard reduction treatments, and submit a compliance report from an accredited contractor or worker to MDE stating the treatments passed inspection. MDE has the right to perform spot checks, but is not mandated to inspect homes, as Minnesota's law requires (MDE, September 2013).

Section: Greenprint

Climate Change:

Greenhouse Gas Emissions from Community-Wide Activities:

Baltimore County Community Greenhouse Gas Emissions by Source 2006



(Brady, November 2008).

Baltimore County Greenhouse Gas Emissions, 2002 – 2006

Year	2002	2003	2004	2005	2006
Residential	3,268,817	3,392,356	3,413,804	3,530,181	3,195,697
Commercial	2,296,482	2,235,746	2,415,026	2,477,361	2,331,496
Industrial	926,726	989,726	1,012,129	1,018,325	956,473
Transportation	4,765,753	4,892,024	4,876,428	4,905,985	4,897,796
Waste	165,712	177,180	174,389	159,402	166,805
Metric Tons eCO_2	**11,423,490**	**11,687,033**	**11,891,774**	**12,091,254**	**11,548,267**

(Brady, November 2008).

Estimated greenhouse gas emissions from municipal operations 2006:

Based on a 2006 greenhouse gas report from Patricia Brady, government related greenhouse gas emissions are at 142,701 metric tons of eCO_2 (Brady, November 2008).

Renewable Energy:

Number of renewable energy projects permitted citywide by year:

Based on solar permitting data from Baltimore Gas and Electric, in 2013, Baltimore County had the following:

- 116 Level 1 solar applications installed (<10kW maximum alternating current (AC) capacity)
- 76 Level 2 solar applications installed (>10kW maximum AC capacity).

  (E. Riesner, personal communication, September 24, 2014).

Renewable energy generated for municipal operations:

Zero renewable energy projects for municipal operations were listed on MEA's website. (MEA, 2014).

Air Quality:

Days exceeding Ozone standard of 0.12 ppm (1-hour), 0.075 ppm (8-hour):

- 2013: 1 day for ozone 8-hour at 0.076 ppm

Days exceeding PM2.5: 35 ug/m3 (24-hour), 12.0 ug/m3 (annual):

- 2013: 1 day for PM 2.5 at 35.2 ug/m3 (24-hour)

(EPA, 2014).

Average benzene & formaldehyde concentrations 2012

Parameter Name	Duration Description (Baltimore County only)	Baltimore County Mean µg/m3	Benchmark set by Minneapolis µg/m3
Benzene	24 Hours	0.73668	1.3
Benzene	24 Hours	0.85205	1.3
Benzene	1 Hour	0.48836	1.3
Formaldehyde	3 Hours	1.79481	2.0
Formaldehyde	24 Hours	1.15812	2.0

(EPA, October 8, 2014).

Tree Canopy:

Tree Canopy Coverage:

Baltimore County's current tree canopy coverage is 48.9% (Baltimore County, MD, August 2014).

Trees Lost and Planted:

In FY 2013, using funds from the implementation of the Baltimore County Forest Conservation regulations, the Department of Environmental Protection and Sustainability (EPS) planted 345 trees in rural and urban reforestation projects. In fiscal year 2013, EPS sold 705 trees through the Big Trees Sale (C. Oberholtzer, personal communication, October 1, 2014). Based on the EPS 2013 Application to Tree City USA, in fiscal year 2013, through the Department of Public Works, 1,608 trees were removed (P. Cornman, personal communication, October 6, 2014).

Biking

Miles of Bike Facilities:

- 8.28 miles of bike paths (K. Schlabach, personal communication, October 1, 2014)

Percent of Commuters Who Ride Bicycles:

- 0.1% of commuters ride bicycles in 2013 (U.S. Census Bureau, 2013a).

Estimated daily cyclists at all bike count locations:

- Baltimore County does not conduct bike counts (K. Schlabach, personal communication, October 1, 2014).

Transportation Alternatives:

Percent of Persons living in Baltimore driving alone to work:

- 79.4% in 2013

Percent of Persons working in Baltimore driving alone to work:

- Data not collected.

Baltimore County, Maryland	Estimate	Percent
Total:	407,759	
Car, truck, or van - drove alone:	323,677	79.4%
Worked in state of residence:	316,753	77.7%
Worked in county of residence	160,515	39.4%
Worked outside county of residence	156,238	38.3%
Worked outside state of residence	6,924	1.7%

(U.S. Census Bureau, 2013a).

Airport Noise:

Average noise levels:

- Twenty-five airports are in Baltimore County (private and public). Noise levels are not monitored in these locations (Toll Free Airline, 2014).

Stormwater:

Impaired Water Bodies:

As of November 2012, Baltimore County had the following water bodies listed as impaired:

Cycle First Listed	Basin Name	Listing Category	Pollutant
2012	Back River	5	Chlorides, Sulfates, and Total Suspended Solids
2002	Baltimore Harbor	5	Cause Unknown
2012	Baltimore Harbor Watershed	5	PCB in Fish Tissue
2008	Bird River	5	PCB in Fish Tissue
2006	CB3MH - Upper Chesapeake Bay Mesohaline	5	Cause Unknown
2006	Gunpowder River	5	PCB in Fish Tissue
2010	Gwynns Falls	5	Chlorides
2010	Jones Falls	5	Chlorides and Sulfates
2002	Jones Falls	5	PCB in Fish Tissue
2012	Liberty Reservoir	5	Chlorides
2002	Liberty Reservoir	5	Mercury in Fish Tissue
1996	Liberty Reservoir	5	Phosphorus (Total) & Sedimentation/siltation
2002	Loch Raven Reservoir	5	Cause Unknown
2012	Lower Gunpowder Falls	5	Chlorides, Sulfates, and Total Suspended Solids
2006	Middle River - Browns	5	PCB in Fish Tissue
2010	Patapsco River Lower North Branch	5	Chlorides and Sulfates
2004	Patapsco River Mesohaline	5	Cause Unknown
1998	Patapsco River Mesohaline	5	Chromium - sediments and Zinc - sediments
2008	Patapsco River Mesohaline	5	Debris/Floatables/Trash
1996	Patapsco River Mesohaline	4b	Copper
1996	Patapsco River Mesohaline	4b	Cyanide
1996	Patapsco River Mesohaline	4b	Nickel

4b* Expected to meet water quality standards by next monitoring cycle
5* Requires a TMDL
(MDE, November 9, 2012).

Rain gardens by land and use category:

- Since 2007, watershed groups in Baltimore County have reported 30 rain gardens installed. Information is not tracked by land and use category.

Rain Gardens in Baltimore County

Year	Number of Rain Gardens
2007	2
2008	2
2009	1
2010	5
2011	3
2012	4
2013	9
2014	4 to date

(N. Forand, personal communication, October 9, 2014).

Healthy Lakes, Streams, and Rivers:

Beach closings by lake:

In 2013, there were four beach closings and six alerts issued for rivers systems due to high bacteria levels and sanitary sewer overflows. In 2014, there were two beach closings and two alerts issues for similar issues (A. Sutherland, personal communication, October 8, 2014).

Lake Aesthetic & User Recreation Index Average:

This rating system is independent to Minneapolis and is not used by Baltimore County.

Known Present Aquatic Invasive Species:

Six species have been identified as causing, or having the potential to cause, significant degradation of the Chesapeake Bay ecosystem.

- Mute swans
- Nutria

- Phragmites australis (common reed)
- Purple loosestrife
- Water chestnut
- Zebra mussels (Maryland Sea Grant, 2014).

Green Jobs:

Net gain of green businesses (green manufacturing or service companies including renewable energy, energy efficiency, water filtration, and green building):

Information is not collected on for Baltimore County. For the State of Maryland, *Green Goods and Services* employment change from 2010 – 2011 was 14,143 new jobs.

Green Goods and Services employment:

2010: 77,346 jobs

2011: 91,489 jobs (BLS, March 13, 2013).

Number of green jobs by industry:

Information not collected by Baltimore County.

Jobs through building retrofits:

Information not collected by Baltimore County.

Local Food

Food Producing Community Gardens:

- Baltimore County has sixteen community gardens (UME, 2014).

Access to Healthy Food for Residents:

Population Living in a U.S. Department of Agriculture (USDA) Food Desert: 31.90%

USDA Food Deserts are defined as low-income census tracts where residents are greater than 0.5 miles (urban) or greater 10 miles (rural) from the nearest supermarket (USDA January 2014).

Waste Reduction and Recycling

Annual tonnage of source-separated organics:

- 109,103 tons of compostables in 2012, 5.6% of total waste generated (MDE, 2013).

Residential recyclable materials recovered:

- For 2013, 50,090 tons of residential recyclables were collected while 257,809 tons of residential trash were collected resulting in a recycling rate of 16.3% (Baltimore County, MD, 2014).

Section: A Vital Economy

Brownfield Sites:

MDE provides a list of active and inactive sites by County. Baltimore County had 91 active sites listed, and 102 archived sites listed (MDE, 2014).

Violent Crimes:

Violent crimes reported:

- As of 2013 data, Part I violent crimes are at 4,184, a 5.5% decrease since 2008 (Baltimore County, MD, 2013c).

Reported homicides per 100,000 residents:

- Total homicides in 2013: 20
- Total population in 2013: 823,015
- Average of 2.43 per 100,000 residents (Baltimore County, MD, 2013c).

Community Engagement:

Percent of Board and Commission members who are non-white (survey respondents):

- The survey is not conducted by Baltimore County.

Residents rating City government good to very good etc. from a survey:

- Baltimore-Towson, MD 81%

Satisfaction ratings are provided by the Gallup-Healthyways Well-Being Index survey, conducted in 2012 and 2013 (Maciag, 2014).

Homelessness:

Baltimore County completes an annual Point-in-Time Survey of the homeless. This one-day effort returned a count of 919 people on January 24 2013 (Baltimore County, MD, July 2014).

Cost Burdened Households:

Families who pay more than 30 percent of their income for housing are considered cost burdened.

Cost-burdened households (estimated rate):

Housing is considered affordable if it accounts for roughly 35 percent or less of a household's monthly budget.

Source: 2009-2011 American Community Survey

- Percent homeowners paying 35.0 percent or more of income for housing: 27.0%
- Percent renters paying 35.0% or more of income for rent: 41.9% (Maryland Department of Planning, 2013).

Affordable housing units produced through City programs:

Information was not available for by Baltimore County.

Employment and Poverty:

Unemployment Rate by Race:

White	8.1%
African American	15.9%
American Indian and Alaska Native	15.5%
Asian	7.2%
Native Hawaiian and Other Pacific Islander	12.9%

(U.S. Census Bureau, no date).

Poverty Rate by Race 2009-2012

White	7.2%
African American	12.5%
American Indian and Alaska Native	16.2%
Asian	11.2%
Native Hawaiian and Other Pacific Islander	N

(U.S. Census Bureau, no date).

Graduation Rates:

Four-year graduation Rate:

- 85.99% in 2013 (Maryland State Department of Education, September 2014).

Arts and the Economy:

Occupational Title	Employment 2010	Employment 2012	Change
Arts, Design, Entertainment, Sports and Media Occupations	5,559	6,522	963 (17% increase)

(DLLR, October 2013).

Appendix N: Baltimore County Data Collection for Santa Monica Indicators

Below are the data collected for Baltimore County, MD using the Santa Monica, CA, index as a guide. The indicators are separated by the section in which they appeared in the Santa Monica index, and each indicator is bolded with its relevant measurements italicized below.

Santa Monica Indicators

Solid Waste Generation

Total citywide generation:

- 1,956,546 tons of waste was collected in 2012 for 13.11 pounds/person/day

Amount landfilled:

- 1,037,536 tons landfilled in 2012

Amount diverted from landfill:

- 919,010 tons recyclables collected in 2012 for recycling rate of 41.52%
- 2013 Total Residential Trash Collected: 257,809 tons
- 2013 Total Residential Recyclables Collected: 50,090 tons
- 2013 Baltimore County Residential Recycle Rate: 16.3%

Per Capita Residential Waste Disposal

Residential Waste Disposal in Pounds Per Person Per Day: 2.06 pounds/person/day (MDE, 2013).

Water Use:

Water Use:

In fiscal year 2005, Baltimore County was supplied 97.44 MGD from the Baltimore City system (City of Baltimore, August 2006). In fiscal year 2009, Baltimore County used about 89 MGD from the Baltimore City system.

- 14.34 MGD (16%) is used by commerce and industry.
- 53.74 MGD (84%) is used for residential consumption.
- 21.05 MGD is unaccounted for.

It is estimated that approximately 10% of the unaccountable water system wide is being lost through main breaks (Baltimore County, MD, 2011).

Percent local vs. imported

Baltimore County water is supplied through Baltimore City's Department of Public Works. Water provided to Baltimore County consumers comes locally from three major sources: the Gunpowder Falls, the North Branch Patapsco River and the Susquehanna River. Water collects and is stored in three reservoirs including Loch Raven, Liberty and Prettyboy reservoirs. On average, the three water filtration plants filter and distribute an average of 225 million gallons of drinking water daily to the Baltimore Metropolitan region. Water supplied by County impoundment reservoirs is sent to Baltimore City's filtration plants, where it is treated and returned to County consumers (Baltimore City Department of Public Works, 2014).

Percent Potable vs. Non potable:

Information not available for Baltimore County.

Energy Use:

Total Countywide Energy Use:

In 2013, Baltimore County government used 1,797,475 MWh of electricity. Countywide energy use was not available (M. Carpenter, personal communication, October 8, 2014).

Total Energy Use Per Capita:

Information not available for Baltimore County.

Renewable Energy Use:

Percent of County energy use from renewable and more efficient sources:

Baltimore County is required to meet Maryland's Renewable Portfolio requirements, increasing the percent of energy from Tier I and Tier 2 renewable energy sources each year. In 2013, Baltimore County purchased 8% of their energy from Tier I resources, 2.5% of energy from Tier II resources, and 0.2% from solar renewable energy credits. Tier 1 renewable energy sources include solar, wind, qualifying biomass, methane from a landfill or wastewater treatment plant, geothermal, and ocean, including energy from waves, tides, currents, and thermal differences, and hydroelectric power plants less than 30 megawatts in capacity. Tier 2 renewable energy sources include hydroelectric power other than pump storage generation, poultry litter, and waste-to-energy.

Estimates are bolded.

Tier I Resources			
Calendar Year of Compliance	Portfolio Usage (MWh)	Required % Amount	Total REC quantity requirement
2012	1,790,604	6.40%	114,599
2013	1,797,475	8.00%	143,798
2014	**1,797,475**	10.00%	**179,748**
2015	**1,797,475**	10.10%	**181,545**
2016	**1,797,475**	12.20%	**219,292**

Tier II Resources			
Calendar Year of Compliance	Portfolio Usage	Required % Amount	Total REC quantity requirement
2012	1,790,604	2.5%	44,765
2013	1,797,475	2.5%	44,937
2014	1,797,475	2.5%	44,937
2015	1,797,475	2.5%	44,937
2016	1,797,475	2.5%	44,937

Solar-SREC		
Required % Amount	Total REC quantity requirement	REC quantity Purchased to Date
0.10%	1,791	1,791
0.20%	3,595	3,595
0.30%	5,392	--
0.40%	7,190	--
0.50%	8,987	--

Total renewable energy use:

In 2013, Baltimore County government purchased 159,536 MWh of renewable energy, and 3,595 MWh of solar renewable energy credits.

Total energy from clean distributed generation sources in County:

No known clean distributed generation sources are known of in the County, being purchased by the County.

Greenhouse gas emissions:

Community GHG Emissions by Source 2006:

See data listed above for Minneapolis.

Baltimore County Per Capita Emissions, 2002-2006

Year	**2002**	**2003**	**2004**	**2005**	**2006**
Metric Tons eCO_2	11,423,490	11,687,033	11,891,774	12,091,254	11,548,267
Population	768,697	774,811	780,022	782,885	787,762
Per capita emissions	14.86	15.08	15.25	15.44	14.66

Estimated greenhouse gas emissions from municipal operations 2006:

See data listed above for Minneapolis.

Ecological Footprint for Santa Monica:

This indicator was developed using a licensed online quiz through Ecological Footprint: Center for Sustainable Economy. The license was not purchased to analyze Baltimore County data.

Sustainable Procurement:

Number of categories of purchased products that meet established criteria:

The County has contracts for environmental preferable purchasing including contracts to purchase Energy Star computer equipment and recycled toner cartridge. Additionally, the County has a contract for electronic recycling. The County also has a contract to purchase green cleaning supplies. Whenever possible, Building Operations under Property Management purchases cleaning products that are considered non-toxic, biodegradable, and made from renewable resources. These include green products such as vacuum cleaners with High-Efficiency Particulate Air filters, floor machines with dust return systems, recycled paper products, and micro-fiber cloths and mops. Additionally, County Code sections (with provisions) address the purchase of recycled and recyclable products by the Purchasing Agency (received through Baltimore County's online purchasing database, AMS, 2014).

"Green" construction:

In 2013, 10 buildings were certified through LEED in Baltimore County. Six of them were related to new construction or new homes, while the remaining four were for existing buildings, core and shell, or commercial interior.

Environmental and Public Health

Beach Closures:

Number of days beaches posted with health warnings/closed:

In 2013, there were four beach closings and six alerts issued for rivers systems due to high bacteria levels and sanitary sewer overflows. In 2014, there were two beach closings and two alerts issues for similar issues (A. Sutherland, personal communication, October 8, 2014).

Wastewater (sewage) generation:

Total citywide generation (also per capita, and by sector):

Back River Treatment plant and Patapsco Treatment Plant process Baltimore County wastewater. Baltimore County was invoiced for 37,521,910,000 gallons in FY13.

At a 2013 population of 823,015, this equates to 45,590.8 gallons per capita.

Information was not available by sector use.

Vehicle miles traveled:

Total vehicle miles traveled:

8.3 billion in 2006, or 28.8 VMT/person/day (Brady, November 2008).

Total VMTs for 2013: 8,339,000,000

VMT per person annually: (Divided by 2013 estimate of 823,015): 10,132 miles

VMT per person daily: 27.75 miles (MDOT, 2013)

Air quality:

Percent & demographic profile of residents who live within a ½-mile radius of significant emissions sources:

Information was not yet collected by Santa Monica, nor is it available for Baltimore County.

Residential household hazardous waste (HHW):

Total volume of HHW collected from residents:

4,058,390 pounds of liquid and solid hazardous waste were collected in FY 2013.

Number & Percent of households using HHW collection facility:

Information not collected by Baltimore County.

Cumulative number & percent of households using HHW facility since 2000:

Information not collected by Baltimore County.

City purchases of hazardous materials:

Volume & toxicity of hazardous material purchased by City:

Examples of products purchased or contracted to purchased by the county are provided below. This information was obtained from Baltimore County's online purchasing/contract database.

Cleaning Products: The County has incorporated Clean Greening specs in their Purchasing Code.

Herbicides: The county tracks its use of chemicals involved in vegetation maintenance (herbicides, pesticides, fertilizers) and deicing materials for winter weather conditions.

Graffiti removers: The county purchases graffiti removers from Green Seal Products Co. Inc.

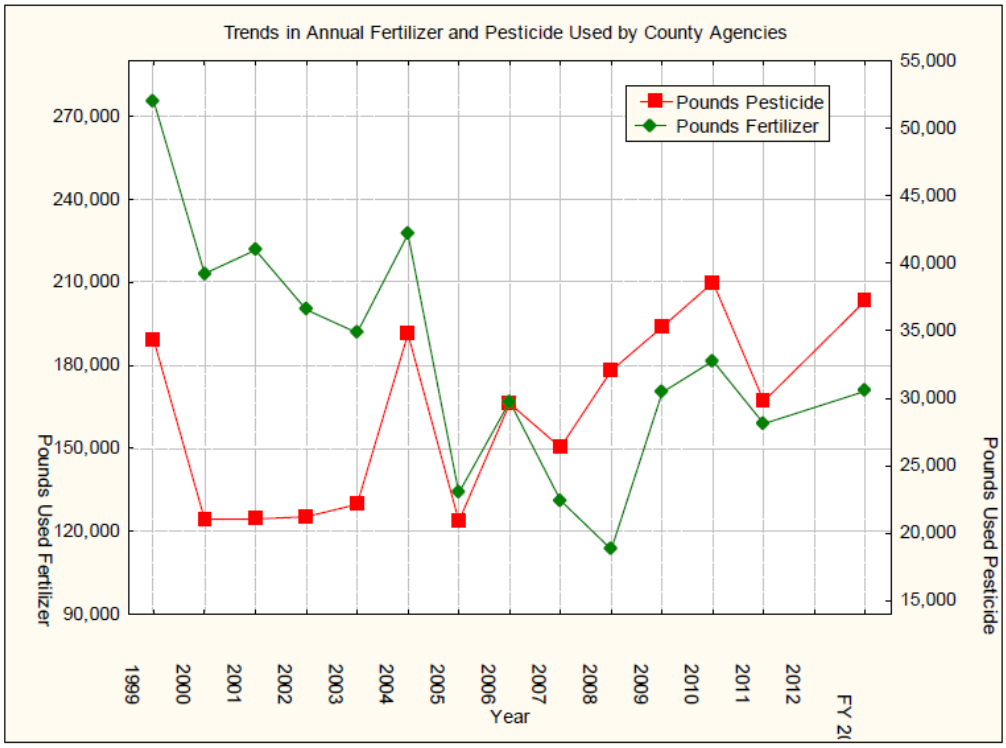
Stainless steel cleaner and polish: The county purchases stainless steel cleaner from EcoLab, an environmentally friendly company.

Hand soap: The county purchases handsoap from Ecolab, an environmentally friendly company.

Insecticides: The National Pollution Discharge Elimination System (NPDES) program requires Baltimore County, to have a discharge permit for storm drainpipes. Within the annual NPDES report, current permit conditions require Baltimore County Property Management to have a plan to reduce pollutants associated with road maintenance activities.

Table 7-9: Annual Fertilizer, Pesticide and Deicing Materials Used By County Agencies (in Pounds)

Year	Fertilizer	Pesticide	Deicing Mat.	Snowfall (in.)	Number of Winter Weather Events
1999	275,400	34,320	83,978,000	12.4	8
2000	213,114	21,028	94,467,750	27.2	7
2001	221,609	21,509	48,566,400	7.4	5
2002	200,060	21,229	100,437,859	12.0	7
2003	191,726	22,137	205,164,341	58.0	8
2004	227,309	34,762	147,537,040	8.7	5
2005	133,881	20,899	185,118,740	24.5	7
2006	166,870	29,607	23,888,950	13.1	1
2007	131,191	26,362	156,690,026	14.4	11
2008	113,435	32,059	65,456,420	4.3	15
2009	170,175	35,279	151,208,045	28.6	9
2010	181,573	38,587	162,724,620	58.1	7
2011	158,866	29,778	133,892,760	13.2	7
2012*	90,546	14,878	23,162,196	1.8	3
2013 FY	170,644	37,244	65,614,500	8.0	3
Totals	**2,646,399**	**382,434**	**1,582,293,147**		



*2012 data is for January – June only

Figure 7-6: Trends in Annual Fertilizer and Pesticide Used by County Agencies

(Baltimore County MD, 2013b).

Toxic air contaminant releases:

Number of facilities permitted to release TACs; Total volume of TACs emitted annually:

Information not yet collected by Santa Monica nor Baltimore County.

Urban runoff reduction:

Percent of permeable land area in County:

Information not available for Baltimore County.

Local Produce at City Facilities:

Percent of fresh, locally produced, organic produce served at County facilities and other County institutions:

Information not available for Baltimore County.

Organic Produce - Farmers Markets:

Total annual produce sales at farmers' markets:

Baltimore County has 18 farmers markets annually, the fourth highest in the state. Annual earnings were not provided for farmers markets (USMDA, August 2012).

Percent organically grown:

As of 2012, there were 12 farms in Baltimore County USDA Certified.

Of the 81 farms in Baltimore County that sell locally, seven are USDA Organic and 37 sell at farmers markets (USMDA, August 2012).

Percent grown using low-chemical methods:

Of the 81 farms in Baltimore County that sell locally, seven are USDA Organic and 37 sell at farmers markets.

Percent conventionally grown:

Of the 751 farms in Baltimore County, 14 farms are USDA Certified Organic Farms, while 13 are transitioning to USDA Certified Organic. This is the second highest and third highest rankings in the state.

Restaurant produce purchases:

Percent of SM restaurants that purchase ingredients at SM farmers' markets:

Information not available for Baltimore County.

Food choices:

Percent of residents who report vegetable-based protein is primary protein source for at least 1/2 of meals:

Information not available for Baltimore County.

Transportation Indicators

Average Vehicle Ridership:

Average number of vehicles per employee arriving at a worksite:

Information not available for Baltimore County.

Modal Split of Commuters:

16.7% of residents travel to work using an alternative mean of transportation (U.S. Census Bureau. 2013a).

Sustainable Transportation Options:

Residents' choice of sustainable transit:

16.7% of residents travel to work using an alternative mean of transportation (see Average Ridership Chart).

Residents' perception of the availability of sustainable modes of transit:

This information was based off a citywide survey by Santa Monica. Information not available for Baltimore County.

Bike Lanes and Paths

Total miles of bike paths:

See data listed above for Minneapolis.

Percent of total miles of city arterial streets with bike lanes:

- 40.71 miles of shared use paths (K. Schlabach, personal communication, October 1, 2014)

Vehicle Ownership

Average number of vehicles per person of driving age:

Vehicles Available	Percent
No vehicle available	3.2
1 vehicle available	25.1
2 vehicles available	42.8
3 or more vehicles available	28.9

(U.S. Census Bureau, 2013b).

Of the 4,782,657 vehicles registered in Maryland (2012), 295,531 were considered Alternative Fueled Vehicles (6.2%) (MVA, 2012).

Bus Ridership:

Annual ridership on public transportation:

4.8% of Baltimore County workers report using public transportation as travel means to work (U.S. Census Bureau, 2013b).

Alternative Fueled Vehicles:

Percent of non-emergency fleet vehicles using alternative fuels:

Information not available for Baltimore County.

Traffic congestion:

Number of congested intersections:

5.6% of intersections with level of service of D, E, or F.

Pedestrian & bicycle safety:

Number of bicycle and pedestrian collisions involving motor vehicles:

2013: 22 pedestrians killed by vehicles in Baltimore County

2009: 0 bicycle fatalities (Baltimore Sun, June 19, 2014).

There were five fatal bicyclist crashes in Maryland in 2011. The 5-year average for the state is seven fatalities per year (MHSO, 2013).

Traffic Impacts to Emergency Response:

Average emergency response times for public safety vehicles: Police & Fire

Information was requested through the Baltimore County Police Department. This information is considered confidential and is not available to the public.

Average response time to traffic accident:

Information not available for Baltimore County.

Economic Development Indicators

Economic Diversity:

Percent of total economic activity by business sector (expressed as percent of total wages)

Government	19%
Natural Resources and Mining	0.1%
Construction	7.2%
Manufacturing	6.0%
Trade, Transportation, and Utilities	13.6%
Information	2.0%
Financial Activities	12.9%
Professional and Business Services	16.9%
Education and Health Services	15.9%
Leisure and Hospitality	4.2%
Other Services	2.0%

(DLLR, June 13, 2014).

Percent of total economic activity by sectors, proportion in top three sections (by payroll)

Education and Health Services	15.9%
Professional and Business Services	16.9%
Government	19.2%
Top three total	52.0%

(DLLR, June 13, 2014).

Jobs/Housing Balance:

Ratio of the number of jobs to the amount of housing:

2013 Labor Force Average: 453,280

2013 Housing Units: 335,896

2013 Jobs-Housing Balance: 1.35 (DLLR, September 26, 2014; U.S. Census, 2013c).

Percent of Baltimore County residents employed in Baltimore County:

50.8% (U.S. Census Bureau, 2013b).

Cost of Living:

Average Household Income 2008-2012 $66,068

March 2012 cost of living index in Baltimore County: 107.1 (City-data, 2012)

Quality Job Creation:

Number of net new jobs created in SM that pay greater than or equal to the SMCOLI as a percent of total new jobs created:

Information not available for Baltimore County.

Income Disparity:

Percent of Households Earning Less than $25,000/year: 17% in 2012

Percent of Households Earning More than $100,000/year: 28.6% in 2012

(U.S. Census, 2012).

Local Employment of County Staff:

Percent of employees who live in the County:

Information collected by Santa Monica survey, not available for Baltimore County.

Distance City employees travel to work:

Information collected by Santa Monica survey, not available for Baltimore County.

Open Space and Land Use

Open Space

Number of acres of public open space by type:

Existing Land Use

Land Use Category	Acres	Percent of Total
Single Family Detached	42,567.01	11
Single Family Attached	5,061.39	1
Multi Family	5,162.18	1
Commercial	6,586.76	2
Office	1,322.73	0
Industrial	10,530.59	3
Mixed Use	834.15	0
Institutions	11,932.75	3
Open Space	13,463.60	3
Agricultural Preservation Area	142,786.19	37
Resource Conservation	81,238.70	21
Rural Residential	33,998.78	9
Transportation	20,519.54	5
Utilities/Drainage	3,181.70	1
Landfill	390.93	0
Vacant	7,909.18	2
Unbuildable	631.68	0
Water	1,301.91	0
Total	**389,419.77**	**100**

(Baltimore County, MD, May 6, 2014).

Trees:

Percent of tree canopy coverage by census-designated place (CDP):

Census-Designated Place	CDP Acres	Tree Canopy Acres	Percent Tree Canopy
Arbutus	4,193.50	1,499.30	36%
Bowleys Quarters	2,000.70	978.20	49%
Carney	4,489.70	2,129.90	47%
Catonsville	9,010.80	4,971.00	55%
Cockeysville	7,340.60	3,476.30	47%
Dundalk	8,402.70	1,746.70	21%
Edgemere	7,065.40	2,059.30	29%
Essex	5,898.30	2,502.30	42%
Garrison	2,010.50	848.10	42%

Census-Designated Place	CDP Acres	Tree Canopy Acres	Percent Tree Canopy
Hampstead	5.30	2.90	55%
Hampton	3,660.90	2,207.50	60%
Kingsville	6,450.90	3,796.50	59%
Lansdowne-Baltimore Highlands	2,749.70	842.90	31%
Lochearn	3,585.70	1,668.20	47%
Lutherville-Timonium	4,755.80	2,109.10	44%
Mays Chapel	2,396.60	1,101.60	46%
Middle River	4,998.80	1,871.70	37%
Milford Mill	4,463.30	1,650.80	37%
Overlea	1,937.90	708.20	37%
Owings Mills	6,144.10	2,443.10	40%
Parkville	2,742.80	868.40	32%
Perry Hall	4,453.80	1,873.40	42%
Pikesville	7,952.00	3,828.30	48%
Randallstown	6,618.30	2,832.40	43%
Reisterstown	3,297.60	1,279.90	39%
Rosedale	4,442.20	1,629.90	37%
Rossville	3,462.40	1,211.60	35%
Towson	9,100.90	4,508.90	50%
White Marsh	3,420.40	1,281.70	38%
Woodlawn	6,140.20	2,336.60	38%
Total CDPs	**143,192.00**	**60,264.90**	**42%**
Other than CDPs	**246,137.00**	**130,009.60**	**53%**
Total County	**389,329.00**	**190,274.50**	**49%**

Parks – Accessibility:

Percent of households & population within ¼ and ½ mile of a park by neighborhood:

Information not collected by Baltimore County.

Land Use and Development:

Percent of residential, mixed-use projects within ¼ mile of transit modes and consistent with Sustainable City Program goals:

Information not available by Santa Monica, and not measured by Baltimore County.

Regionally appropriate vegetation:

Percent of new or replaced, non-turf, public landscaped area & non-recreational turf area planted with regionally appropriate plants:

Information not tracked by Baltimore County.

Housing

Availability of Affordable Housing

Percent of all existing & new housing affordable to very low, low, moderate, and upper income households:

Information not available for Baltimore County.

Distribution of Affordable Housing

Distribution of low-income housing by neighborhood:

Information for the number of multifamily rental units by income band and by section of the county are presented in the table on the following page.

Affordable housing for special needs groups:

New or rehabilitated affordable housing units for families, seniors, disabled & other special needs groups as percentage of new or rehabilitated affordable housing development:

Information not available for Baltimore County.

TABLE 37 Penetration Rate Analysis

	Northeastern		Eastern		Northwestern		Western		North Central		Baltimore County	
Inventory of Affordable Rental Units												
Total Number of Multifamily Rental Units	**12,077**		**13,797**		**17,410**		**18,290**		**18,950**		**80,524**	
	#	%	#	%	#	%	#	%	#	%	#	%
Extremely Low Rent and Subsidized Units (<30%)	37	0.3%	693	5.0%	983	5.6%	905	4.9%	362	1.9%	2,980	3.7%
Very Low Rent Units (30-50%)	2,207	18.3%	7,938	57.5%	1,662	9.5%	3,956	21.6%	1,836	9.7%	17,599	21.9%
Low Rent Units (50-60%)	3,306	27.4%	4,157	30.1%	5,257	30.2%	7,487	40.9%	6,352	33.5%	26,559	33.0%
Moderate Rent Units (60-80%)	6,338	52.5%	1,009	7.3%	7,028	40.4%	5,354	29.3%	7,950	42.0%	27,679	34.4%
High Rent Units (80-100%)	189	1.6%	--	--	1,751	10.1%	466	2.5%	1,362	7.2%	3,768	4.7%
Very High and Extremely High Rent Units (>100%)	--	--	--	--	729	4.2%	122	0.7%	1,088	5.7%	1,939	2.4%

2011 Renter Households by Affordability Band		
Income Bands	*Min Income*	*Max Income*
Extremely Low Rent and Subsidized Units (<30%)	$0	$25,650
Very Low Rent Units (30-50%)	$17,280	$42,750
Low Rent Units (50-60%)	$28,800	$51,300
Moderate Rent Units (60-80%)	$34,560	$68,400
High Rent Units (80-100%)	$46,080	$85,500
Very High and Extremely High Rent Units (>100%)	$57,600	$128,250

(Real Property Research Group, June 2010).

Production of Livable Housing:

New housing units' proximity to grocery stores, parks, transit nodes:

Population in Designated Limited Supermarket Access Area: 6.47%

Population Living in a USDA Food Desert: 31.90%

USDA Food Deserts are defined as low-income census tracts where residents are >0.5 miles (urban) or >10 miles (rural) from the nearest supermarket (USDA January 2014).

Production of Green Housing:

Percent of new & substantially rehabilitated housing that complies with Green Building Ordinance #1995 as a percentage of total new and rehabilitated housing

In 2013, 10 buildings were certified through LEED in Baltimore County. Three of these were certified Homes.

Community Education and Participation

Voter Participation:

Voter Participation in local elections	58.78% for 2010 State and Local elections
Voter Participation in State elections	75.1% of registered voters participated in the 2012 Maryland general election
Voter Participation in Federal elections	75.0% for 2012 Presidential Election

Civic Participation:

Information is based off a survey of residents' level of community involvement. This information is not collected by Baltimore County.

Sustainable community involvement:

Information is based off a survey of residents' understanding of the community's ecological footprint and how they contribute to it. This information is not collected by Baltimore County.

Human Dignity

Homelessness:

Number of homeless living in Baltimore County:

Baltimore County completes an annual Point-in-Time Survey of the homeless. This one-day effort returned a count of 919 people on January 24 2013 (Baltimore County, MD, July 22, 2014).

Percent of homeless served by city shelter that transition to permanent housing:

Information not available for Baltimore County.

Economic Opportunity:

Percent of Baltimore County residents working over 40 hours/week to meet basic needs:

	Baltimore County, Maryland	
	Estimate	Margin of Error
Total:	38.6	+/-0.3
Male	40.7	+/-0.4
Female	36.7	+/-0.4

(U.S. Census Bureau, 2013d).

Public Safety:

Crime rate per capita – violent crime	4,184 total in 2013, .5% crime rate
Crime rate per capita – property crime	23,643 total in 2013, 2.9% crime rate
Incidence of Hate Crime	5 reported by Baltimore County Police Department in 2012 (5 race related, 2 sexual orientation related)

(Baltimore County Government, 2013c).

Perception of Safety:

Maryland students who did not go to school because they felt unsafe at school or on their way to or from school (on at least 1 day during the 30 days before the survey): 8.8% (CDCP, 2013)

Education and Youth:

Student Dropout Rates: 9.7% for class of 2013

Baltimore County Public School Enrollment in 2011-12 101,522 students

College Enrollment

- 83% overall: 33.7 % attend 2-year college, 49.3% attend 4-year college (Maryland State Department of Education, September 30, 2014).

Suspension Rates:

- Percentage of Students Suspended or Expelled from Maryland Public Schools: Out-of-School Suspensions and Expulsions: 8.0% for 2011-2012 (Maryland State Department of Education, November 2012).

Substance Abuse:

- Number of students suspended or expelled in Baltimore County for Dangerous Substances: 507 in 2011-2012 school year. Includes alcohol, inhalants, drugs, tobacco, sale or solicitation of controlled substance, possession or use of illegal drugs (Maryland State Department of Education, November 2012).
- 507/101,522= 0.5%

Advanced Placement Test Results:

- AP participation rate was 37.8 percent in 2011-2012 year (BCPS, February 14, 2012)

Ability to meet basic needs:

Baltimore-Towson Metro Area ranked 105 out of 189 in Basic Needs category from survey (Gallup-Healthways Well-Being Index, 2013).

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