

Developing a Green Economy in Houston

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A practicum submitted in partial fulfillment
of the requirements for the degree of
Master of Science
(Natural Resources and Environment)
at the University of Michigan
April 2014

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Acknowledgements:

I would like to acknowledge Laurie Kaye Nijaki, Ph.D., a Postdoctoral Fellow at the Erb Institute at the University of Michigan for developing the rigorous and analytical framework that provides the basis of this practicum and in her role as primary advisor for the project. In addition, I would like to acknowledge all of the support I have received from the Erb Institute, the Ross School of Business, and the School of Natural Resources and the Environment at the University of Michigan throughout all of my terms at the university.

ABSTRACT:

This report uses a framework developed by Laurie Kaye Nijaki, Ph.D., a Postdoctoral Fellow at the Erb Institute at the University of Michigan to investigate the potential for developing a green economy in the city of Houston. She chose to divide the green economy into meaningful clusters that can help economic development professionals identify opportunities within the region. These clusters include: Green Building and Construction; Biofuels/ Farming/ Agriculture; Transportation/ Alternative Fuel Vehicles; Waste, Waste Management, and Recycling; Environmental Compliance, Sustainability Planning, and Pollution Prevention; and Energy Generation, Renewable Energy, and Energy Storage.

Under the framework she developed, I evaluated the overall economy of a Metropolitan Statistical Area – in this case the Houston-Sugar Land Baytown MSA – across a number of quantitative and qualitative characteristics. I perform economic analysis on industries and occupations to understand which ones are in high concentrations within the region that give it a comparative advantage. I then link them to each of the green clusters to determine which one has support from a large potential workforce. I then perform an institutional analysis to determine how support for a green economy is organized within the region. For this institutional analysis, I review of sustainability policies and programs of local governments and government agencies in the region – in this case the City of Houston, Harris County, the Port of Houston Authority, the Metropolitan Transit Authority of Harris County Houston, and the Houston-Galveston Area Council. I then link those policies to individual green economy clusters. I then identify local green business and nonprofit alliances and then link them to the green economy clusters. To supplement this data, I also interviewed a number of local green economy stakeholders to gain additional perspective on the current and future state of the green economy in the region. Once, I perform this analysis, I evaluate each green economy cluster across all dimensions to determine which one Houston has a comparative advantage in. I then identify strategies for local economic development stakeholders can use to develop a green economy in Houston. These strategies include: workforce development strategies, geographic and land-use strategies, financing mechanisms, business incubation, and government procurement.

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Introduction

In the opening of her dissertation, “Evergreen Economies: Institutions, Industries, And Issues in the Green Economy,” for her Doctor of Policy, Planning, and Development Dissertation, Laurie Kaye asks the following question: “Can economic growth and environmental preservation be supported through a workforce development and economic development approach focused on sustainable industries and occupations?”¹ The question is both intriguing and relevant to stakeholders interested in economic development and job growth. While the national unemployment rate has declined from its 2010 peak of 9.6 percent, at its current level of 6.7 percent², job creation and employment are still of vital interest to both the national and local economies.

Environmental preservation and economic growth have frequently been viewed as contradictory goals: many stakeholders view increased economic growth and increased environmental preservation as incompatible and as a zero sum game.³ In her dissertation, Kaye looks to challenge this notion. She cites a University of California Berkeley report to define the fundamental characteristics of a green economy:

*At its most basic level, the green economy consists of economic activity that reduces energy use and/or improves environmental quality. . . . The green economy is not just about the ability to produce clean energy, but also the growing market for products which consume less energy, from fluorescent light bulbs to organic and locally produced food. It also encompasses economic sectors that improve the environment, for instance through remediation of toxic sites or design of more compact cities.*⁴

The goal of her dissertation was to investigate the gap in research around a green economy and green job creation especially with respect to cities and to develop a framework to rigorously analyze the key differences between different cities. As part of her analysis, she considered nine critical points.

1. A green economy centers on targeting economic opportunities in environmental preservation and align previously competing economic, environmental, and equity interests. There is a need to identify a comprehensible structure, clearly identified policies, and actionable programs to understand the green economy.
2. Metropolitan areas throughout the United States are positioned differently with regard to a green economy and some cities are better positioned to take advantage of specific areas for growth.

¹ (Kaye, 2012)

² (United States Census Bureau, 2013)

³ (Kaye, 2012)

⁴ (Chapple & Hutson, 2009)

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3. Individual cities have specific concentrations of industries and occupations that tie to a green economy, yet without a standard definition of what green industries and occupations are, there is no way to identify opportunities.
4. Municipal and metro departments and agencies are increasingly adopting green economy policies – whether as a conscious decision or not. The concentration of green jobs may correlate with institutional factors such as wealth/income, the strength of nonprofits, population in addition to the number of green economy policies and programs.
5. Municipal policies tend to be correlated with different industry based and occupation based opportunities. However whether policies drive success in industries and occupations or vice versa is unclear.
6. In many instances, municipalities and other agencies tend not to develop comprehensive sustainability policies and those sustainability policies that do exist frequently have the goal of environmental protection rather than economic growth.
7. Empirical evidence suggests that institutional nonprofit stakeholders are responding to a green economy vision. They are also playing a more proactive role in local economies through coalitions and alliances and provide leadership in developing a green economy where business, government, and other civic leaders may be proceeding with more caution.
8. There tend to be two types of alliances that local stakeholders are creating: green business associations and green labor alliances.
9. There is uneven interaction between green economy alliances and local governments. The business community, however, frequently takes a lead in emphasizing the emergence and development of a green economy.

Given these critical points, her research identifies and analyzes the institutions and groups that are key actors in green economic development leading to an increase in green jobs. She identifies the goal for green economic development is to maintain long term economic, environmental, and economic goals for a given community. Specifically, there is a need to get away from the notion that labor and business goals are in conflict with environmental goals and identify opportunities that allow everyone to become winners. Ultimately, environmental goals must be tied to market forces rather than altruistic notions. A green economy should increase the number of jobs rather than limit them. In order to chart a path towards a green economy, Kaye developed an analytical framework that focuses on key attributes and institutions in a metropolitan area to identify areas of comparative advantage which provide opportunities of green economy growth. This framework is the underlying basis for this report.

Overview of Methodology

The analytical framework that Kaye developed outlines a methodology for measuring, studying, and understanding the green economy at local level. The framework takes advantage of

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both qualitative and quantitative methods to analyze the local economy. It focuses on the existing activities undertaken by local institutions and groups in order to identify areas of competitive advantage and opportunities for economic development. Focusing on different aspects of the local economy can help create a more comprehensive perspective on economic development opportunities. In addition to understanding basic characteristics of the local green economy such as population, income levels, educational attainment, and number of environmental organizations, her framework utilizes three types of analysis for its overall methodology to identify opportunities for economic development of a green economy.

The first analysis begins with breaking down an overall green economy into discrete clusters. Given that nearly all economic activity has some tie to the environment, it is difficult to specifically identify a “green” industry or “green” occupation. However, by breaking down overall economic activity into discrete clusters, it becomes much easier to analyze a local economy and identify areas of competitive advantage. By looking at economic activity and seeing how it aligns with environmental impact, six green economy clusters emerge:

- Green Building and Construction
- Biofuels/ Farming/ Agriculture
- Transportation/ Alternative Fuel Vehicles
- Waste, Waste Management, and Recycling
- Environmental Compliance, Sustainability Planning, and Pollution Prevention
- Energy Generation, Renewable Energy, and Energy Storage

Tying different aspects of a local economy to these six green economy clusters can help stakeholders more clearly identify what resources are present in the local economy to identify opportunities for the future.

The second tool that Kaye’s framework utilizes is an economic development analysis that focuses on local occupations and industries. While there are no specific industries or occupations that can be clearly labeled as “green”, there are a number that can support the green economy, especially when tied to the previously identified green economy clusters. Therefore, it is crucial to understand the overall makeup of industries and occupations in a metropolitan area. Analysis focuses on which industries and occupations are in high concentrations and which industries and occupations can tie directly to green economy clusters. To identify industries and occupations that are in high concentrations within a metropolitan area, Kaye’s methodology collects federally published statistical data about industries and occupations. For industries, she uses data collected from County Business Patterns survey collected by the Census Bureau and classified under North American Industry Classification System (NAICS). For occupations, she uses data collected from the Occupational Employment Statistics program from the Bureau of Labor Statistics and classified under the Standard Occupational Classification (SOC) system.

To determine which industries and occupations are in high concentrations, she uses location quotients. According to Edward Blakely and Nancy Green Leigh, “the location quotient is a technique used to identify the concentration of an industry sector in a local economy relative to the

larger reference economy. Stated simply, an industry's share of the local economy is compared with the same share that industry has in the reference economy."⁵ The location quotient, therefore, can highlight which particular industries and occupations exist in high concentrations in a particular metropolitan area. Within her framework, Kaye identifies industries with location quotients greater than 1 and occupations with location quotients higher than 1.5 as existing in high concentrations. While these increased concentrations do not necessarily indicate the currently existing presence of "green employers" or "green jobs," they do indicate potential opportunities for economic development within a green economy.

In addition to analyzing industry and occupation concentrations, Kaye also looks to tie specific occupations with their potential role in a green economy. She cites a report written by the National Center for O*NET Development for the U.S. Department of Labor's Employment and Training Administration.⁶ In this report, the authors argue that rather than identifying "green" occupations, it is rather more useful to look at the "greening" certain of occupations. Certain economic activities within the green economy require the skills of certain occupations. As such, they categorize occupations into three categories: "green increased demand", "green enhanced skills", and "new and emerging." The O*NET authors define these categories as follows:⁷

Green Increased Demand Occupations: The impact of green economy activities and technologies is an increase in the employment demand for an existing occupation. However, this impact does not entail significant changes in the work and worker requirements of the occupation. The work context may change, but the tasks themselves do not.

Green Enhanced Skills Occupations: The impact of green economy activities and technologies results in a significant change to the work and worker requirements of an existing O*NET-SOC occupation. This impact may or may not result in an increase in employment demand for the occupation. The essential purposes of the occupation remain the same, but tasks, skills, knowledge, and external elements, such as credentials, have been altered.

Green New and Emerging (N&E) Occupations: The impact of green economy activities and technologies is sufficient to create the need for unique work and worker requirements, which results in the generation of a new occupation relative to the O*NET taxonomy. This new occupation could be entirely novel or "born" from an existing occupation.

Linking occupations within a metropolitan area to these three occupational categories and to green economy clusters can help identify where there are opportunities within a local green economy now and which occupations can tie to future development.

Detailed institutional analysis is the third tool Kaye uses within her framework. Within this institutional analysis she identifies two areas for investigation: political institutions, their policies, and programs; and local interest group activities. As indicated in the nine critical points outlined

⁵ (Blakely & Leigh, 2010)

⁶ (Rivkin, et al., 2009)

⁷ Ibid.

previously, municipal policies tend to be correlated with different industry based and occupation based opportunities within the green economy. Therefore, it is essential to understand all of the policies and programs that local municipal governments, county governments, and other non-governmental agencies have implemented and tie them to green economy clusters. A survey of relevant policies and procedures at all layers of government further enhances a perspective overview of the local green economy and can identify additional opportunities for economic development.

In addition to a policy and program analysis, it is crucial to understand the activities of nonprofit stakeholders within the green economy. As also previously stated, institutional nonprofit stakeholders are responding to a green economy vision and are playing a more proactive role in that economy through coalitions and alliances. Therefore, it is also essential to identify these stakeholders and what activities they are undertaking to influence local economy. Once the coalitions and their activities have been identified, they are tied to opportunities in green economy clusters. In particular, it is crucial to look at coalitions and alliances that have a broader base of stakeholders that can influence both policy and economic development.

Once these three analytical tools are applied to a metropolitan area, a clearer picture of a local green economy emerges. This picture identifies which particular clusters a city has a particular advantage or disadvantage with respect to a green economy. This picture can also help local stakeholders identify opportunities to dedicate resources for the development of a green economy. Additionally, it gives those same stakeholders a common reference point for understanding their own city and organizing themselves around goals that can encompass economic, environmental, and equity issues. And by setting those goals, they can help shape the future of a green economy within their city.

Data Collection

In addition to the data sources cited above, this report will collect data from a number of sources. These sources will include: public documents, information published online about activities of local groups and coalitions, personal interviews, and quantitative analysis of census data and other nationally published statistical data.

Case Study: Houston-Sugar Land-Baytown Metropolitan Statistical Area

In her dissertation, Laurie Kaye applied her methodology to three case study metropolitan statistical areas (MSA): San Francisco-Oakland-Fremont; Boston-Cambridge-Quincy; Los Angeles-Long Beach-Santa Ana. Using her methodology, she was able to identify areas of competitive advantage and relative weakness for each MSA. Her analysis highlighted opportunities for each area within the broader green economy. Given the applicability of her methodology for a number of

metropolitan areas across the United States, it is useful to choose other case study examples to further identify opportunities for development within the larger green economy.

The Houston-Sugar Land-Baytown MSA provides a useful example for a case study for a variety of demographic, economic, and policy reasons. With the City of Houston itself being the city with the 4th largest population in the United States, and the Houston-Sugar Land-Baytown MSA being the 7th most populous MSA in the country, Houston is a major population center.⁸ Between July 1, 2012 and July 1, 2013, Houston also had the largest numeric population increase of any large metropolitan area in the United States. In addition, the unemployment rate in the Houston has been lower in Houston than the national average in the last several years. In January 2014, the unemployment rate was 1.4% lower Houston than the national rate of 7%.⁹ With a 2012 Gross Metropolitan Product of \$ 449.4 billion, Houston has the fourth largest metropolitan economy in the United States.¹⁰ In 2012, the Port of Houston was ranked number 4 in the United States for ports with the highest value of shipments.¹¹ And in contrast to the previously analyzed metropolitan areas, Houston is in a “right-to-work” state.¹² Therefore, the labor market functions differently than in other case study examples. And finally, Houston is widely regarded as the energy capital of the United States. Given these particular characteristics, the Houston-Sugar Land-Baytown MSA provides a useful addition to the case study resources previously analyzed.

Houston Overview

The Houston-Sugar Land-Baytown Metropolitan Statistical Area provides a unique case study for determining the factors that would contribute to the growth of a green economy. Given the demographic and economic characteristics outlined above, it represents a key component for developing a green economy in the United States. Yet, based on many of the factors that Laurie Kaye uses to characterize cities across the country, Houston lags behind a number of other cities across the country with regards to developing a green economy. This lagging position may be attributed to a number of factors.

In order to understand how Houston can be characterized as being in a lagging position, it is informative to understand two of underlying factors. Looking at the “principal cities” within the Houston-Sugar Land-Baytown MSA, we can see how Houston compares in terms of population, median income, and number of number of environmental organizations to an area such as the San Francisco, which can be characterized as a green economy leader.

⁸ (United States Census Bureau, 2014)

⁹ (United States Bureau of Labor Statistics, 2014)

¹⁰ (United States Bureau of Economic Analysis, 2013)

¹¹ (United States Bureau of Transportation Statistics, 2014)

¹² (National Right to Work Legal Defense Foundation, 2014)

Table 1: Green Economy Factors across Principal Cities in Houston-Sugar Land-Baytown MSA

	Population ¹³	Median Income Level ¹⁴	Bachelor's degree or higher ¹⁴	Number of Environmental Organizations ¹⁵
Houston	2,099,451	44,648	28.7%	100
The Woodlands	93,847	105,099	59.3%	7
Sugar Land	78,817	107,149	53.8%	7
Baytown	71,802	48,782	14.3%	8
Conroe	56,207	44,613	18.4%	4
Totals	2,400,124	49,187 ¹⁶	30.0% ¹⁶	126

Table 2: Green Economy Factors Across Principal Cities in San Francisco-Oakland-Fremont MSA

	Population ¹³	Median Income Level ¹⁴	Bachelor's degree or higher ¹³	Number of Environmental Organizations ¹⁵
San Francisco	805,235	73,802	52.0%	100
Oakland	390,724	51,683	37.9%	68
Fremont	214,089	99,169	49.5%	9
Hayward	144,186	62,313	23.4%	4
Berkeley	112,580	63,505	69.5%	52
San Mateo	97,207	87,662	43.6%	11
San Leandro	84,950	62,195	26.4%	6
Redwood City	76,815	77,488	39.9%	9
Pleasanton	70,285	118,129	55.5%	2
Walnut Creek	64,173	83,419	60.5%	12
South San Francisco	63,632	73,568	30.4%	0
San Rafael	57,713	73,202	44.9%	16
Total	2,181,589	73,023 ¹⁷	45.9% ⁴	289

This data underscores some fundamental differences between the Houston-Sugar Land-Baytown MSA and San Francisco-Oakland-Fremont MSA. While the total population living in the principal cities in each region is relatively similar, other factors are noticeable different. Median income level in principal cities in the San Francisco area are 48.46% higher than in the Houston area. The percentage of people with a bachelor's degree in principal cities in the San Francisco area is 53.05% higher than in the Houston area. And there are 198% more environmental groups in the

¹³ (United States Census Bureau, 2013)

¹⁴ (United States Census Bureau, 2013)

¹⁵ (National Center for Charitable Statistics, 2014)

¹⁶ Weighted Average

¹⁷ Weighted average

principal cities in the San Francisco area than in the Houston area. With lower incomes, lower educational attainment, and fewer environmental organizations, it is crucial to look much deeper at the unique economic and institutional characteristics of Houston and identify which green economy clusters can take advantage of Houston's particular qualities so that they can thrive.

Economic Development Analysis

Occupational Development Analysis for the Houston-Sugar Land-Baytown MSA

In order to understand the potential for growing a green economy in the Houston-Sugar Land-Baytown Metropolitan Statistical Area, it is essential to understand the areas where Houston has a competitive advantage with respect to the national economy. An analysis of these advantages can help City of Houston officials identify opportunities in the future as they arise. By understanding the occupational and industrial landscape, officials can better target economic development resources so that they have the greatest impact in developing a green economy in Houston.

The first step in such an analysis is to understand how the distribution of occupations within Houston-Sugar Land-Baytown MSA can contribute to the growth of a green economy. As determined in Kaye's methodology, it is crucial to understand which occupations as determined by 6-digit SOC codes have high concentrations in the Houston-Sugar Land-Baytown MSA. An occupation with a high concentration is one that has a location quotient of 1.5 or higher.¹⁸ Table 3 below shows the occupations with high location quotients for the Houston-Sugar Land-Baytown MSA.

As seen by the data below collected from the Bureau of Labor Statistics' May 2012 Occupation Employment Statistics, the Houston-Sugar Land-Baytown MSA has several occupations that are useful to focus on. As Houston is widely regarded as a global hub for the oil and gas industry as well as petrochemicals, it comes as no surprise that life, physical, and social services occupations have a high concentration in the area. In particular, geoscientists and geological and petroleum technicians have a concentration that are both over ten times national averages. Architecture and engineering occupations also have a high concentration with chemical engineers also having a particularly high concentration. Construction and extraction occupations also show high concentrations, especially in categories related to the oil and gas and petrochemical industries. Production occupations also show a high concentration in the area, once again with categories related to the oil and gas and petrochemical industries showing high concentrations. Interestingly, installation, maintenance, and repair occupations also had a high concentration with wind turbine

¹⁸ Note: while Kaye's original methodology only included 2-digit SOC codes with more than 4 categories, Houston has a number of 2-digit SOC codes with location quotients significantly higher than 1.5. As such, they are included as part of this analysis.

service technicians in particular having a concentration nearly seven times higher than the national average.

Table 3: Occupational Location Quotients by Houston-Sugar Land-Baytown MSA¹⁹

SOC code	Occupation Title (SOC code)	Houston MSA Employment	National Employment	Location Quotient
17-000 Architecture and Engineering Occupations				
17-2041	Chemical Engineers	3,740	32,190	5.732510321
17-2051	Civil Engineers	10,050	258,100	1.921198669
17-2111	Health and Safety Engineers Except Mining Safety Engineers and Inspectors	730	23,490	1.533324458
17-2199	Engineers All Other	3,810	122,410	1.535685549
17-3011	Architectural and Civil Drafters	3,010	83,410	1.780502526
17-3024	Electro-Mechanical Technicians	1,080	16,990	3.13635054
17-3025	Environmental Engineering Technicians	730	18,590	1.937482061
17-3029	Engineering Technicians Except Drafters All Other	4,090	65,090	3.100296688
19-0000 Life, Physical, and Social Services Occupations				
19-2042	Geoscientists Except Hydrologists and Geographers	7,720	35,180	10.82718818
19-4041	Geological and Petroleum Technicians	3,550	15,360	11.4033212
47-0000 Construction and Extraction Occupations				
47-1011	First-Line Supervisors of Construction Trades and Extraction Workers(4)	16,310	456,640	1.762277228
47-2011	Boilermakers	1,480	17,660	4.134902143
47-2051	Cement Masons and Concrete Finishers	4,310	135,200	1.572877132
47-2061	Construction Laborers	31,130	814,470	1.885811363
47-2221	Structural Iron and Steel Workers	3,130	57,070	2.706018023
47-4041	Hazardous Materials Removal Workers	1,310	37,440	1.726353285
47-5013	Service Unit Operators Oil Gas and Mining	6,660	57,180	5.746776378
49-0000 Installation, Maintenance, and Repair Occupations				
49-9041	Industrial Machinery Mechanics	11,490	301,560	1.879924959
49-9081	Wind Turbine Service Technicians	440	3,200	6.78417306
49-9098	Helpers--Installation Maintenance and Repair Workers	5,290	124,370	2.098622175
51-0000 Production Occupations				
51-2031	Engine and Other Machine Assemblers	1,650	40,750	1.997793294
51-2041	Structural Metal Fabricators and Fitters	3,380	78,340	2.128763195

¹⁹ (Bureau of Labor Statistics, 2013)

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51-4011	Computer-Controlled Machine Tool Operators Metal and Plastic	4,280	138,870	1.520651005
51-4041	Machinists	14,090	388,370	1.790026819
51-4121	Welders Cutters Solderers and Brazers	16,420	329,710	2.457170277
51-8091	Chemical Plant and System Operators	4,490	38,170	5.803879685
51-8099	Plant and System Operators All Other	370	11,710	1.558974634
51-9011	Chemical Equipment Operators and Tenders	5,030	56,030	4.42936615

In understanding the occupational landscape of the Houston-Sugar Land-Baytown MSA, we can then relate that occupational distribution to activities within the green economy. As outlined in Kaye’s occupational research, we can start to identify potential “green occupational clusters” for the Houston-Sugar Land-Baytown MSA. We can match potential green occupations identified in her green occupational framework with occupations identified by 6-digit level SOC codes that have high location quotients in the area. As is also outlined in her framework, these potential green occupation clusters within the MSA can be matched with a training level identified as “increased demand occupations,” “green enhanced skills,” or “new and emerging occupations.” The distribution of potential green occupational clusters is shown in Table 4.

Because of the number of green occupations that can be linked to existing occupations with high location quotients in the Houston area, there are a number of areas where Houston could develop a clear advantage with respect to other parts of the United States. Education and training programs can be specifically geared to prepare the workforce in Houston for occupations classified as “increased demand.” Retraining efforts aimed at these increased demand occupations represent the most logical first step in developing a “green” workforce as there is potentially a ready and immediate need for their skills.

In addition to these increased demand occupations, there are also a number of additional occupations with job opportunities that require “green enhanced skills” and in occupations that are “new and emerging.” As these occupations have future growth potential, they illustrate opportunities for expansion of employment opportunities within the Houston area, and, therefore, growth of the overall workforce in the city rather than reclassifying occupations. Policies developed by the local municipalities and agencies can work to bolster expansion of this expansion of economic opportunities with the Houston area.

Table 4: Green Occupations - Houston-Sugar Land-Baytown MSA²⁰

SOC code	Occupation Title (SOC code)	Increased Demand Occupation	Green Enhanced Skills	New and Emerging
Architecture and Engineering Occupations				
17-2041	Chemical Engineers	17-2041 Chemical Engineers		
17-2051	Civil Engineers	17-2051 Civil Engineers		
17-2111	Health and Safety Engineers Except Mining Safety Engineers and Inspectors	17-2111.01 Industrial Safety and Health Engineers		
17-2199	Engineers All Other			17-2199.01 Biochemical Engineers 17-2199.02 Validation Engineers 17-2199.03 Energy Engineers 17-2199.04 Manufacturing Engineers 17-2199.05 Mechatronics Engineers 17-2199.06 Microsystems Engineers 17-2199.07 Photonics Engineers 17-2199.08 Robotics Engineers 17-2199.09 Nanosystems Engineers 17-2199.1 Wind Energy Engineers 17-2199.11 Solar Energy Systems Engineers
17-3011	Architectural and Civil Drafters	17-3011.01 Architectural Drafters		
17-3024	Electro-Mechanical Technicians		17-3024 Electro-Mechanical Technicians 17-3024.01 Robotics Technicians	

²⁰ (O*NET, 2014)

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17-3025	Environmental Engineering Technicians		17-3025 Environmental Engineering Technicians	
17-3029	Engineering Technicians Except Drafters All Other			17-3029.02 Electrical Engineering Technologists 17-3029.03 Electromechanical Engineering Technologists 17-3029.04 Electronics Engineering Technologists 17-3029.05 Industrial Engineering Technologists 17-3029.06 Manufacturing Engineering Technologists 17-3029.07 Mechanical Engineering Technologists 17-3029.08 Photonics Technicians 17-3029.09 Manufacturing Production Technicians 17-3029.1 Fuel Cell Technicians 17-3029.11 Nanotechnology Engineering Technologists 17-3029.12 Nanotechnology Engineering Technicians
Life, Physical, and Social Services Occupations				
19-2042	Geoscientists Except Hydrologists and Geographers		19-2042 Geoscientists, Except Hydrologists and Geographers	
19-4031	Chemical Technicians		19-4031 Chemical Technicians	

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19-4041	Geological and Petroleum Technicians		19-4041.01 Geophysical Data Technicians 19-4041.02 Geological Sample Test Technicians	
Construction and Extraction Occupations				
47-1011	First-Line Supervisors of Construction Trades and Extraction Workers(4)			47-1011.03 Solar Energy Installation Managers
47-2011	Boilermakers	47-2011 Boilermakers		
47-2051	Cement Masons and Concrete Finishers	47-2051 Cement Masons and Concrete Finishers		
47-2061	Construction Laborers		47-2061 Construction Laborers	
47-2221	Structural Iron and Steel Workers	47-2221 Structural Iron and Steel Workers		
47-4041	Hazardous Materials Removal Workers		47-4041 Hazardous Materials Removal Workers	
47-5013	Service Unit Operators Oil Gas and Mining		47-5013 Service Unit Operators Oil Gas and Mining	
Installation, Maintenance, and Repair Occupations				
49-9041	Industrial Machinery Mechanics	49-9041 Industrial Machinery Mechanics		
49-9081	Wind Turbine Service Technicians			49-9081 Wind Turbine Service Technicians
49-9098	Helpers-- Installation Maintenance and Repair Workers	49-9098 Helpers-- Installation Maintenance and Repair Workers		
Production Occupations				
51-2031	Engine and Other Machine Assemblers	51-2031 Engine and Other Machine Assemblers		
51-2041	Structural Metal Fabricators and Fitters	51-2041 Structural Metal Fabricators and Fitters		

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51-4011	Computer-Controlled Machine Tool Operators Metal and Plastic	51-4011 Computer-Controlled Machine Tool Operators Metal and Plastic		
51-4041	Machinists	51-4041 Machinists		
51-4121	Welders Cutters Solderers and Brazers	51-4121.06 Welders, Cutters, and Welder Fitters 51-4121.07 Solderers and Brazers		
51-8091	Chemical Plant and System Operators	51-8091 Chemical Plant and System Operators		
51-8099	Plant and System Operators All Other			51-8099.01 Biofuels Processing Technicians 51-8099.02 Methane/Landfill Gas Generation 51-8099.03 Biomass Plant Technicians 51-8099.04 Hydroelectric Plant Technicians
51-9011	Chemical Equipment Operators and Tenders	51-9011 Chemical Equipment Operators and Tenders		

The concentration of a number of different occupation groups with high location quotients shown in Table 3 helps illustrate the occupational opportunities where the Houston area has a particular advantage. Given the numbers of occupations with high level of engineering and technical skill as well as those requiring fabrication and construction skills, there are a number of green economy clusters Houston could focus on developing. With high concentrations of employees within the architecture and engineering occupations –and particularly within the engineering and technical occupations –there is great potential for Houston to develop a green workforce through an advantage for solving the more technical challenges of a developing “green” economy. The high concentration of occupations in life, physical, and social services occupations, construction and extraction occupations, installation, maintenance, and repair occupations, and production occupations indicate the possibility of developing Houston into a technological leader in the emerging “green” economy. Additional information about developing these occupations will be provided in subsequent sections.

Industry Analysis for the Houston MSA

In conjunction with the occupational analysis provided above, it is also essential to understand the economic landscape in Houston from an industry-level perspective and analyze how existing conditions can contribute to the development of a green economy. The data for this analysis is collected from the 2010 County Business Patterns survey collected by the Census Bureau for the Houston-Sugar Land-Baytown Metropolitan Statistical Area. By looking at industries classified under the North American Industry Classification System (NAICS), we can get an overview of industry conditions with the Houston area as well as pinpoint areas of competitive advantage.

Table 5 summarizes industry categories by 2-digit NAICS codes to provide basic information about the distribution of industries in Houston. Table 6 displays the location quotients for industries at the 2-digit NAICS level. These two tables provide a contextual background for the industry composition for the Houston-Sugar Land-Baytown MSA.

Table 5: Houston-Sugar Land-Baytown MSA 2010 County Business Patterns²¹

2010 MSA Business Patterns Houston-Sugar Land-Baytown TX Metropolitan Statistical Area					
Industry code	Industry code description	Paid employees for pay period including March 12 (number)	First-quarter payroll (\$1,000)	Annual payroll (\$1,000)	Total establishments
-----	Total for all sectors	2,176,567	29,378,187	116,472,293	122,517
11----	Agriculture, forestry, fishing and hunting	451	2,967	13,344	86
21----	Mining, quarrying, and oil and gas extraction	36,042	1,435,397	5,037,518	1,306
22----	Utilities	15,199	494,978	1,527,980	365
23----	Construction	161,995	1,993,230	8,692,031	8,446
31----	Manufacturing	192,992	2,936,143	12,051,079	5,152
42----	Wholesale trade	125,875	2,200,249	8,576,696	8,940
44----	Retail trade	252,040	1,486,365	6,344,500	16,974
48----	Transportation and warehousing	105,667	1,508,327	6,135,232	3,440
51----	Information	41,974	762,486	3,041,942	1,679
52----	Finance and insurance	90,573	2,079,006	7,179,294	8,663
53----	Real estate and rental and leasing	45,148	495,402	1,995,679	6,346
54----	Professional, scientific, and technical services	175,650	3,296,997	14,457,092	16,267
55----	Management of companies and enterprises	100,013	4,364,596	13,937,347	1,162

²¹ (United States Census Bureau, 2013)

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56----	Administrative and support and waste management and remediation services	173,820	1,378,429	6,035,638	6,395
61----	Educational services	41,158	409,449	1,775,398	1,411
62----	Health care and social assistance	276,203	2,809,145	12,345,046	13,645
71----	Arts, entertainment, and recreation	32,245	219,473	994,504	1,303
72----	Accommodation and food services	209,011	774,931	3,270,449	10,394
81----	Other services (except public administration)	100,208	729,264	3,053,376	10,278
99----	Industries not classified	N/A	1,353	8,148	265

Table 6: Houston-Sugar Land-Baytown MSA Location Quotients by Employment²²

Industry code	Industry code description	Paid employees for pay period including March 12 (number)	Total Employment in the United States	Location Quotient
-----	Total for all sectors	2,176,567	111,970,095	
11----	Agriculture, forestry, fishing and hunting	451	156,055	0.148671889
21----	Mining, quarrying, and oil and gas extraction	36,042	581,582	3.188070613
22----	Utilities	15,199	638,058	1.225419715
23----	Construction	161,995	5,389,271	1.546327907
31----	Manufacturing	192,992	10,862,838	0.913957519
42----	Wholesale trade	125,875	5,598,507	1.156637488
44----	Retail trade	252,040	14,496,625	0.894401611
48----	Transportation and warehousing	105,667	4,011,989	1.354907511
51----	Information	41,974	3,124,036	0.691185048
52----	Finance and insurance	90,573	5,928,696	0.785904141
53----	Real estate and rental and leasing	45,148	1,946,424	1.193248980
54----	Professional, scientific, and technical services	175,650	7,822,417	1.155146846
55----	Management of companies and enterprises	100,013	2,832,953	1.816130665
56----	Administrative and support and waste management and remediation services	173,820	8,977,265	0.996060474
61----	Educational services	41,158	3,273,527	0.646797514
62----	Health care and social assistance	276,203	17,787,859	0.798793863
71----	Arts, entertainment, and recreation	32,245	2,003,595	0.827908704

²² (United States Census Bureau, 2013)

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72----	Accommodation and food services	209,011	11,312,122	0.950506452
81----	Other services (except public administration)	100,208	5,204,445	0.990507977
99----	Industries not classified	N/A	N/A	N/A

As with occupational concentrations, industry codes at the 2-digit level with higher location quotients – specifically location quotients above 1 – indicate high concentrations of a particular industry within the region. There are a number of industries that demonstrate a high location quotient as indicated in Table 7. In addition to the expected concentration of mining, quarrying, and oil and gas extraction industries, the Houston area also demonstrates higher concentrations in industries such as construction and management of companies and enterprises, both of which have a location quotient higher than 1.5.

Table 7: Houston-Sugar Land-Baytown MSA Location Quotients Greater than 1

Industry code	Industry code description	Paid employees for pay period including March 12 (number)	Total Employment in the United States	Location Quotient
21----	Mining, quarrying, and oil and gas extraction	36,042	581,582	3.188070613
22----	Utilities	15,199	638,058	1.225419715
23----	Construction	161,995	5,389,271	1.546327907
42----	Wholesale trade	125,875	5,598,507	1.156637488
48----	Transportation and warehousing	105,667	4,011,989	1.354907511
53----	Real estate and rental and leasing	45,148	1,946,424	1.193248980
54----	Professional, scientific, and technical services	175,650	7,822,417	1.155146846
55----	Management of companies and enterprises	100,013	2,832,953	1.816130665

While industries identified at the 2-digit level NAICS framework do not necessarily translate directly into a specifically “green,” there are potential opportunities for those in high concentrations to support the development of green economy clusters.” By understanding how different industries interact with one another, civic leaders in Houston can work to help industries work to reinforce each other’s efforts to establish robust green economy clusters.

Using the NAICS framework, Kaye developed a methodology to link more specific sectors of the broader industries to green economy clusters. By investigating total employment and total establishment levels at the 4-digit NAICS level, leaders in Houston can better understand where there are opportunities for potential development.

Table 8: Green Industrial Analysis Houston-Sugar Land-Baytown MSA²³

Green Economy Area/Sector	Industry Sector (2 digit NAICS)	NAICS	Description	Total Employees	Total Establishments
Green Building and Construction	22 – Utilities	2211	Electric power generation, transmission and distribution	10,680	169
		2212	Natural gas distribution	3,377	86
	23 – Construction	236	Construction of buildings	25,787	2,269
		236115	New single-family housing construction (except for-sale builders)	2,655	555
		236116	New multifamily housing construction (except for-sale builders)	728	51
		236117	New housing for-sale builders	3,585	209
		236118	Residential remodelers	2,385	630
		236210	Industrial building construction	5,669	79
		236220	Commercial and institutional building construction	10,765	745
		238	Specialty trade contractors	93,383	5,343
		238210	Electrical contractors and other wiring installation contractors	16,059	940
		238220	Plumbing, heating, and air-conditioning contractors	19,727	1,372
		238350	Finish carpentry contractors	1,637	248
		238990	All other specialty trade contractors	10,221	455
		31-33 – Manufacturing	3334	Ventilation, heating, air-conditioning, and commercial refrigeration equipment manufacturing	2,306
	333414		Heating equipment (except warm air furnaces) manufacturing	130	6
	335121		Residential electric lighting fixture manufacturing	N/A	2
	335122		Commercial, industrial, and institutional electric lighting fixture manufacturing	218	5
	335129		Other lighting equipment manufacturing	268	9
	335311		Power, distribution, and specialty transformer manufacturing	N/A	4
42 – Wholesalers	423720	Plumbing and heating equipment and supplies (hydronics) merchant wholesalers	1,150	94	
53 – Real	531311	Residential property managers	8,294	722	

²³ (United States Census Bureau, 2013)

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	Estate and Rental and Leasing	531312	Nonresidential property managers	4,121	461
	54 – Bus. Prof.	541310	Architectural services	3,226	350
		541320	Landscape architectural services	564	84
		541330	Engineering services	50,229	1,646
		541340	Drafting services	178	50
		541350	Building inspection services	783	114
		541420	Industrial design services	N/A	27
		541620	Environmental consulting services	1,768	201
Biofuels/ Farming/ Agriculture	11 – Agriculture, forestry, fishing and hunting	113110	Timber tract operations	N/A	2
		11321	Forest nurseries and gathering of forest products	N/A	1
		11511	Support activities for crop production	65	18
		115310	Support activities for forestry	N/A	8
	31-33 – Manufacturing	311223	Other oilseed processing	N/A	1
		311225	Fats and oils refining and blending	N/A	2
		311613	Rendering and meat byproduct processing	N/A	2
		3253	Pesticide, fertilizer, and other agricultural chemical manufacturing	614	21
		333298	All other industrial machinery manufacturing	561	16
	54 – Bus. Prof.	54133	Engineering services	50,229	1,646
		541380	Testing laboratories	6,874	254
		541620	Environmental consulting services	1,768	201
		541690	Other scientific and technical consulting services	3,727	564
		541711	Research and development in biotechnology	713	57
	Transportation / Alternative Fuel Vehicles	22 – Utilities	221122	Electric power distribution	8,529
221210			Natural gas distribution	3,377	86
31-33 – Manufacturing		334512	Automatic environmental control manufacturing for residential, commercial, and appliance use	N/A	4
		335312	Motor and generator manufacturing	a	8
		336	Transportation equipment	5,584	134

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		manufacturing			
	44 – Retail trade	4411	Automobile dealers	20,760	697
		447190	Other gasoline stations	1,604	175
	48 – Transportation and warehousing	4841	General freight trucking	10,535	767
		4842	Specialized freight trucking	9,951	522
		4851	Urban transit systems	N/A	5
		4852	Interurban and rural bus transportation	404	7
		488310	Port and harbor operations	N/A	14
	54 – Bus. Prof	541330	Engineering services	50,229	1,646
		541370	Surveying and mapping (except geophysical) services	1,920	157
		541380	Testing laboratories	6,874	254
		541614	Process, physical distribution, and logistics consulting services	1,522	165
		54162	Environmental consulting services	1,768	201
		541690	Other scientific and technical consulting services	3,727	564
	81 – Other services (except public administration)	81119	Other automotive repair and maintenance	6,395	527
	Waste, Waste Management, and Recycling	22 – Utilities	221310	Water supply and irrigation systems	647
221320			Sewage treatment facilities	395	29
23 – Construction		237110	Water and sewer line and related structures construction	4,631	177
		237990	Other heavy and civil engineering construction	2,556	94
31-33 – Manufacturing		334513	Instruments and related products manufacturing for measuring, displaying, and controlling industrial process variables	2,138	60
		541330	Engineering services	50,229	1,646
54 – Bus. Prof.		541380	Testing laboratories	6,874	254
		541620	Environmental consulting services	1,768	201
		541690	Other scientific and technical consulting services	3,727	564
56 – Administrative and support and waste management and remediation services		562111	Solid waste collection	2,461	107
		562112	Hazardous waste collection	659	20
		562119	Other waste collection	N/A	9
		562211	Hazardous waste treatment and disposal	694	27
		562212	Solid waste landfill	1,003	42
		562219	Other nonhazardous waste treatment and disposal	138	12
		562910	Remediation services	2,350	93

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		562920	Materials recovery facilities	171	17
		562998	All other miscellaneous waste management services	367	23
Environmental Compliance, Sustainability Planning, Pollution Prevention	54 – Bus. Prof	541370	Surveying and mapping (except geophysical) services	1,920	157
		541380	Testing laboratories	6,874	254
		541620	Environmental consulting services	1,768	201
		541690	Other scientific and technical consulting services	3,727	564
	81 – Other services (except public administration)	813312	Environment, conservation and wildlife organizations	430	52
Energy Generation, Renewable Energy, Energy Storage	22 – Utilities	2211	Electric power generation, transmission and distribution	10,680	169
		221122	Electric power distribution	8,529	116
		2212	Natural gas distribution	3,377	86
	31-33 – Manufacturing	334512	Automatic environmental control manufacturing for residential, commercial, and appliance use	N/A	4
		335311	Power, distribution, and specialty transformer manufacturing	N/A	4
		335312	Motor and generator manufacturing	a	8
	54 – Bus. Prof.	541330	Engineering services	50,229	1,646
		541380	Testing laboratories	6,874	254
		541620	Environmental consulting services	1,768	201
		541690	Other scientific and technical consulting services	3,727	564
		541711	Research and development in biotechnology	713	57
541690		Other scientific and technical consulting services	3,727	564	

a 1,000 to 2,499 employees

The data above provides a useful indication of Houston’s strengths with regards to specific industries. While the analysis of industries at the 2-digit NAICS level indicated higher concentrations in certain industries – and in the case of mining, quarrying, and oil and gas extraction, significantly higher – analysis at the 4-digit NAICS level, also provides useful information about specific industries where there are high numbers of workers and establishment. There are a number of industries with such as specialty trade contractors and engineering services that exist in particularly large numbers. Additionally, many more industries also have workforces greater than 10,000 employees which can also provide meaningful contributions to green economy clusters in Houston.

Results of Economic Development Analysis

Looking at occupation and industry data together can give a good perspective on which green economy cluster have opportunities for cultivation in Houston. High concentrations of industries and occupations give an indication where Houston has a comparative advantage. Looking at the industry and occupation analysis together provides insight for economic development professionals looking to grow a green economy in the area. Understanding which clusters in particular are particularly strong from an economic development standpoint also allows those professionals to focus efforts and resources toward those with the greatest growth potential.

The green building and construction cluster represents the most well developed cluster in the area. There are a number of occupations in high concentrations that can support it, including civil engineers, architectural drafters, boilermakers, construction laborers, structural iron and steel workers, hazardous materials removal workers, helpers--installation, maintenance, and repair workers, structural metal fabricators and fitters, welders, cutters, and welder fitters. The construction and real estate and rental and leasing sectors that tie to a green building and construction cluster are both in high concentration in the Houston area. At an industry level, there are high levels of employment and establishments in industries that tie directly to the cluster. The nearly 100,000 individuals employed in specialty trade contractor establishments alone represent a significant resource for the cluster. And with a workforce of nearly 280,000, there is potential for the green building and construction cluster to play a leading role in the development of a green economy in Houston.

The energy generation, renewable energy, and energy storage cluster also demonstrates characteristics favorable to growing a green economy in Houston. There are a number of occupations that exist in high concentrations that tie directly to this cluster including civil engineers; engineers all other; geological and petroleum technicians; service unit operators, oil, gas, and mining; wind turbine service technicians; machinists; plant and system operators all other. Service unit operators, oil, gas, and mining, and wind turbine service technicians are in particularly high concentrations within Houston. The mining, quarrying, and oil and gas extraction; utilities; and professional, scientific, and technical services industrial sectors that tie to this cluster are all in high concentrations. There are over 85,000 people employed in over 3,000 establishments in this sector. While those figures are not nearly as large as the green building and construction cluster, they do represent meaningful resources that Houston can use to build a green economy.

The transportation/ alternative fuel vehicles cluster and the waste, waste management, and recycling cluster do not exhibit quite as strong characteristics for green economy development. However, they should not be discounted altogether. Hazardous materials removal workers in the waste, waste management, and recycling cluster represent the only potential green economy occupations in either cluster that is in high concentration in Houston. The transportation and warehousing industry sector is the only one in high concentration in the area. At a lower industry level, both do have meaningful workforce sizes. The transportation/ alternative fuel vehicles cluster

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has over 133,000 people employed in over 6,000 establishments, while the waste, waste management, and recycling cluster has nearly 81,000 people employed in over 3,400 establishments. While all of the characteristics are not as strong as in the previous two clusters, they are not inconsequential either. Therefore, they represent possible areas for green economy expansion in Houston.

The remaining two clusters show poorer prospects for green economy development in Houston. The environmental compliance, sustainability planning, and pollution prevention cluster does have a number of occupations linked to it that are in high concentrations. The biofuels/ farming/ agriculture cluster does not. Other than professional, scientific, and technical services, there are no sectors in high concentration tied to them. And with just under 65,000 people employed in the biofuels/ farming/ agriculture cluster and less than 15,000 people employed in environmental compliance, sustainability planning, and pollution prevention cluster, they do not represent a large portion of the overall workforce. Given these conditions, the prospects of either cluster significantly contributing to the green economy in Houston is uncertain.

This economic development analysis provides a useful insight towards developing a green economy in Houston. Insight into comparative strengths in the region of industries and occupations helps local stakeholders understand which green economy clusters are ripe for cultivation. Some clusters, such as the green building and construction cluster and energy generation, renewable energy, and energy storage cluster, represent areas where stakeholders in Houston might focus their efforts. Others, such as the biofuels/ farming/ agriculture cluster and the environmental compliance, sustainability planning, and pollution prevention cluster, might be areas where they do not. Overall, having a clear perspective on an overall economic development analysis provides a clear backdrop when performing the following institutional analysis for developing a green economy in Houston.

Table 9: Green Building and Construction Green Economy Cluster Economic Analysis Review

NAICS Code	Description of Industry	Total Employees	Total Establishments
2211	Electric Power Generation, Transmission & Distribution [Energy conservation planning & consulting.]	10,680	169
2212	Natural Gas Distribution	3,377	86
236	Construction of Buildings	25,787	2,269
236115	New Single-Family Housing Construction (except Operative Builders)	2,655	555
236116	New Multifamily Housing Construction (except Operative Builders)	728	51
236117	New Housing Operative Builders	3,585	209
236118	Residential Remodelers	2,385	630
236210	Industrial Building Construction	5,669	79
236220	Commercial and Institutional Building Construction	10,765	745
238	Specialty Trade Contractors (incl. Electrical Contractors)	93,383	5,343
238210	Electrical Contractors and Other Wiring Installation Contractors	16,059	940
238220	Plumbing, Heating and Air-Conditioning Contractors	19,727	1,372
238350	Finish Carpentry Contractors	1,637	248
238990	All Other Specialty Trade Contractors	10,221	455
238990	Roofing Contractors		
3334	Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing	2306	39
333414	Heating Equipment (except Warm Air Furnaces) Manufacturing	130	6
335110	Electric Lamp Bulb/Parts Manufacturing		
335121	Residential Electric Lighting Fixture Manufacturing	N/A	2
335122	Commercial, Industrial, Institutional Lighting Fixture Manufacturing	218	5
335129	Other Lighting Equipment Manufacturing	268	9
335311	Power, Distribution, and Specialty Transformer Manufacturing	N/A	4
423720	Plumbing and Heating Equipment and Supplies (Hydronics) Merchant Wholesalers	1,150	94
531311	Residential Property Managers	8,294	722
531312	Nonresidential Property Managers	4121	461
541310	Architectural Services	3,226	350
541320	Landscape Architectural Services	564	84
541330	Engineering Services	50229	1646
541340	Drafting Services	178	50
541350	Building Inspection Services	783	114
541420	Industrial Design Services	N/A	27

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541620	Environmental Consulting Services	1,768	201
	Total	279,893	16,965
	Total Across All Industries In Houston	2,176,567	122,517
	Percentage Within Houston	12.86%	13.85%
SOC Code	Description of Occupation	Location Quotient	O*NET Classification
17-2051.00	Civil Engineers	1.92119866	Green Enhanced Skills
17-3011.01	Architectural Drafters	1.78050252	Increased Demand Occupation
47-2011.00	Boilermakers	4.13490214	Increased Demand Occupation
47-2061.00	Construction Laborers	1.88581136	Green Enhanced Skills
47-2221.00	Structural Iron and Steel Workers	2.70601802	Increased Demand Occupation
47-4041.00	Hazardous Materials Removal Workers	1.72635328	Green Enhanced Skills
49-9098.00	Helpers--Installation, Maintenance, and Repair Workers	2.09862217	Increased Demand Occupation
51-2041.00	Structural Metal Fabricators and Fitters	2.12876319	Increased Demand Occupation
51-4121.06	Welders, Cutters, and Welder Fitters	2.45717027	Increased Demand Occupation

Table 10: Biofuels/ Farming/ Agriculture Green Economy Cluster Economic Analysis Review

NAICS CODE	Description of Industry	Total Employees	Total Establishments
113110	Timber Tract Operations	N/A	2
113210	Forest Nurseries and Gathering of Forest Products	N/A	1
11511	Support Activities for Crop Production	65	18
115310	Support Activities for Forestry	N/A	8
311223	Other Oilseed Processing	N/A	1
311225	Fats and Oils Refining and Blending	N/A	2
311613	Rendering and Meat Byproduct Processing	N/A	2
325221	Cellulosic Organic Fiber Manufacturing	614	21
333298	All Other Industrial Machinery Manufacturing	561	16
541330	Engineering Services	50,229	1,646
541380	Testing Laboratories	6,874	254
541620	Environmental Consulting Services	1,768	201

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541690	Other Scientific and Technical Consulting Services	3,727	564
541711	Research and Development in Biotechnology	713	57
924120	Administration of Conservation Programs		
	Total	64,551	2,793
	Total Across All Industries In Houston	2,176,567	122,517
	Percentage Within Houston	2.97%	2.28%
SOC code	Description of Occupation	Location Quotient	O*NET Classification
No Occupations in High Concentration			

Table 11: Transportation/Alternative Fuels Green Economy Cluster Review

NAICS Code	Description of Industry	Total Employees	Total Establishments
221122	Electric Power Distribution	8,529	116
221210	Natural Gas Distribution	3,377	86
334512	Automatic Environmental Control Manufacturing for Residential, Commercial, and Appliance Use	N/A	4
335312	Motor and Generator Manufacturing	a	8
336	Transportation Equipment Manufacturing	5,584	134
441100	Automobile dealers [Service departments.]	20,760	697
447190	Other Gasoline Stations ¹	1,604	175
4841	General Freight Trucking	10,535	767
4842	Specialized Freight Trucking	9,951	522
4851	Urban Transit Systems [Includes commuter rail systems.]	N/A	5
4852	Interurban and Rural Bus Transportation	404	7
488310	Port and Harbor Operations	N/A	14
541330	Engineering Services	50,229	1,646
541370	Survey and Mapping Services	1,920	157
541380	Testing Laboratories	6,874	254
541614	Process, Physical Distribution, and Logistics Consulting Services [Relates to logistics.]	1,522	165
541620	Environmental Consulting Services	1,768	201
541690	Other Scientific and Technical Consulting Services	3,727	564
811190	Other Automotive Repair and Maintenance	6,395	527
	Total	133,179	6,049
	Total Across All Industries In Houston	2,176,567	122,517
	Percentage Within Houston	6.12%	4.94%
SOC Code	Description of Occupation	Location Quotient	O*NET Classification
No Occupations in High Concentration			

Table 12: Waste, Waste Management, and Recycling Green Economy Cluster Review

NAICS Code	Description of Industry	Total Employees	Total Establishments
221310	Water Supply and Irrigation Systems	647	77
221320	Sewage Treatment Facilities	395	29
237110	Water and Sewer Line and Related Structures Construction	4,631	177
237990	Other Heavy and Civil Engineering Construction [Relates to channel construction.]	2,556	94
333312	Commercial Laundry, Drycleaning, and Pressing Machine Manufacturing	2,138	60
541330	Engineering Services	50,229	1,646
541380	Testing Laboratories	6,874	254
541620	Environmental Consulting Services	1,768	201
541690	Other Scientific and Technical Consulting Services	3,727	564
562111	Solid Waste Collection	2,461	107
562112	Hazardous Waste Collection	659	20
562119	Other Waste Collection	N/A	9
562211	Hazardous Waste Treatment and Disposal	694	27
562212	Solid Waste Landfill	1,003	42
562219	Other Nonhazardous Waste Treatment and Disposal	138	12
562910	Remediation Services	2,350	93
562920	Materials Recovery Facilities	171	17
562998	All Other Miscellaneous Waste Management Services	367	23
	Total	80,808	3,452
	Total Across All Industries In Houston	2,176,567	122,517
	Percentage Within Houston	3.71%	2.82%
SOC Code	Description of Occupation	Location Quotient	O*NET Classification
47-4041.00	Hazardous Materials Removal Workers	1.72635328	Green Enhanced Skills

Table 13: Environmental Compliance, Sustainability Planning, and Pollution Prevention Green Economy Cluster Review

NAICS Code	Description of Industry	Total Employees	Total Establishments
541370	Survey and Mapping Services	1,920	157
541380	Testing Laboratories	6,874	254
541620	Environmental Consulting Services	1,768	201
541690	Other Scientific and Technical Consulting Services	3,727	564
813312	Environment, Conservation and Wildlife Organizations	430	52
	Total	14,719	1,228
	Total Across All Industries In Houston	2,176,567	122,517
	Percentage Within Houston	0.68%	1.00%

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SOC Code	Description of Occupation	Location Quotient	O*NET Classification
17-2041.00	Chemical Engineers	5.73251032	Increased Demand Occupation
17-2051.00	Civil Engineers	1.92119866	Green Enhanced Skills
17-2111.01	Industrial Safety and Health Engineers	1.53332445	Increased Demand Occupation
17-2199	Engineers All Other	1.53568554	New and Emerging
<i>17-2199.01</i>	<i>Biochemical Engineers</i>		
<i>17-2199.02</i>	<i>Validation Engineers</i>		
<i>17-2199.03</i>	<i>Energy Engineers</i>		
<i>17-2199.04</i>	<i>Manufacturing Engineers</i>		
<i>17-2199.05</i>	<i>Mechatronics Engineers</i>		
<i>17-2199.07</i>	<i>Photonics Engineers</i>		
<i>17-2199.08</i>	<i>Robotics Engineers</i>		
<i>17-2199.09</i>	<i>Nanosystems Engineers</i>		
17-3024	Electro-Mechanical Technicians	3.13635054	Green Enhanced Skills
<i>17-3024.01</i>	<i>Robotics Technicians</i>		
17-3025.00	Environmental Engineering Technicians	1.93748206	Green Enhanced Skills
17-3029	Engineering Technicians Except Drafters All Other	3.10029668	New and Emerging
<i>17-3029.02</i>	<i>Electrical Engineering Technologists</i>		
<i>17-3029.04</i>	<i>Electronics Engineering Technologists</i>		
<i>17-3029.05</i>	<i>Industrial Engineering Technologists</i>		
<i>17-3029.06</i>	<i>Manufacturing Engineering Technologists</i>		
<i>17-3029.07</i>	<i>Mechanical Engineering Technologists</i>		
<i>17-3029.08</i>	<i>Photonics Technicians</i>		
<i>17-3029.09</i>	<i>Manufacturing Production Technicians</i>		
<i>17-3029.11</i>	<i>Nanotechnology Engineering Technologists</i>		
19-2042.00	Geoscientists, Except Hydrologists and Geographers	10.8271881	Green Enhanced Skills
19-4041	Geological and Petroleum Technicians	11.4033212	Green Enhanced Skills
<i>19-4041.01</i>	<i>Geophysical Data Technicians</i>		
<i>19-4041.02</i>	<i>Geological Sample Test Technicians</i>		
47-4041.00	Hazardous Materials Removal Workers	1.72635328	Green Enhanced Skills

Note: Occupations in italics represent green economy occupations that are sub-categories of high concentration occupations.

Table 14: Energy Generation, Renewable Energy, and Energy Storage Green Economy Cluster Review

NAICS Code	Description of Industry	Total Employees	Total Establishments
2211	Electric Power Generation, Transmission & Distribution [Energy conservation planning & consulting.]	10,680	169
2212	Natural Gas Distribution	3,377	86
221122	Electric Power Distribution	8,529	116
334512	Automatic Environmental Control Manufacturing for Residential, Commercial, and Appliance Use	N/A	4
335311	Power, Distribution, and Specialty Transformer Manufacturing	N/A	4
335312	Motor and Generator Manufacturing	a	8
541330	Engineering Services	50,229	1,646
541380	Testing Laboratories	6,874	254
541620	Environmental Consulting Services	1,768	201
541690	Other Scientific and Technical Consulting Services	3,727	564
541711	Research and Development in Biotechnology	713	57
	Total	85,897	3,109
	Total Across All Industries In Houston	2,176,567	122,517
	Percentage Within Houston	3.95%	2.54%
SOC Code	Description of Occupation	Location Quotient	O*NET Classification
17-2051.00	Civil Engineers	1.92119866	Increased Demand Occupation
17-2199	Engineers All Other	1.53568554	New and Emerging
17-2199.10	<i>Wind Energy Engineers</i>		
17-2199.11	<i>Solar Energy Systems Engineers</i>		
19-4041	Geological and Petroleum Technicians	11.4033212	Green Enhanced Skills
19-4041.02	<i>Geological Sample Test Technicians</i>		
47-1011	First-Line Supervisors of Construction Trades and Extraction Workers(4)	1.76227722	New and Emerging
47-1011.03	<i>Solar Energy Installation Managers</i>		
47-5013.00	Service Unit Operators, Oil, Gas, and Mining	5.74677637	Green Enhanced Skills
49-9081.00	Wind Turbine Service Technicians	6.78417306	New and Emerging
51-4041.00	Machinists	1.79002681	Increased Demand Occupation
51-8099	Plant and System Operators All Other	1.55897463	New and Emerging
51-8099.01	<i>Biofuels Processing Technicians</i>		
51-8099.02	<i>Methane/Landfill Gas Generation System Technicians</i>		

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51-8099.03 Biomass Plant Technicians

51-8099.04 Hydroelectric Plant Technicians

Note: Occupations in italics represent green economy occupations that are sub-categories of high concentration occupations.

Institutional Analysis for the Houston-Sugar Land-Baytown Metropolitan Statistical Area (MSA)

The governance structure of the Houston region significantly impacts the development of a green economy in the area. This section will focus on the governance structure within the Houston region by collecting and analyzing relevant data that can help illuminate potential opportunities for green economic growth. This section will also look at important aspects of the broader region – such as inter-governmental organizations – that play a significant economic or policy role. Demographics, local governments and agencies, the programs they oversee, and not for profit groups help define this governance structure. Analysis of this structure, in conjunction with the previously outlined occupational and industrial analysis, can help identify opportunities for growing a green economy in Houston.

A number of factors – such as programs, policies, interests, and demographics – play a significant role in pinpointing areas of competitive advantage that could lead to the development of occupational and industrial clusters for the region. Overall demographics provide a background with which to view the potential capacity of a local green economy. Programs can provide explicit incentives for companies and organizations to focus on specific activities that underpin a local green economy. Nonprofit organizations and governmental agencies can provide additional support that allows companies and organizations to better perform these activities. In addition to the influences demographics, policies, programs, and interests have on occupational and industrial clusters, industries and occupations that would drive a local green economy can indicate options for new or expanded governmental and non-governmental policies and programs that would further allow green economy clusters to flourish.

City of Houston

As the City of Houston as primary city within the Metropolitan Statistical Area, it demographically and economically dominates the region. Therefore, it represents one of the most key areas of analysis for linking institutions to potential green employment. Analyzing it from a number of perspectives provides key information about the institutions that can drive a green economy. In order to understand those drivers, it is useful to first understand Houston’s underlying demographic characteristics to provide a background context for potential developing green economy clusters. Once that demographic baseline is established, how specific local policies and play a role in the green economy development becomes clearer. Finally, it is crucial to analyze the activities of nonprofit interest groups and coalitions, especially those that are alliances of broader groups of local actors. By tying their activities to green economy clusters, it becomes clearer as to what role they can play in economic growth.

Basic Demographic Characteristics

The basic demographics of the City of Houston provide an important contextual backdrop for developing a green economy in Houston. Basic demographic statistics, as summarized in Table 15 below, are taken from the 2010 Census.

In her dissertation, Laurie Kaye developed a typology to characterize and compare cities in terms of their potential to develop a green economy. This typology looked at three characteristics: population, income level, and development level of its sustainability programming.

With regards to these characteristics, Houston’s performs well in terms of population, but lags along the other two dimensions. As the fourth largest city in the United States, Houston has a clear advantage for green economy development potential. However, across other dimensions, Houston does not perform as well. Houston’s median household income at \$44,648 is below both the state average for Texas of \$51,563 as well as the national average of \$53,046. It is also significantly lower than the \$73,802 median income of the City of San Francisco, which is considered a leader in the green economy. The number of persons living below the poverty level is also higher than the state average, the national average, and San Francisco’s.

Across other dimensions, Houston’s performance is more mixed. On the negative side, educational attainment in Houston is at or below average state and national averages, though, as previously stated, significantly lower than that of San Francisco. On the positive side, diversity is high both for the population at large and in terms of business ownership. Additionally, housing is more affordable compared to the national average and especially compared to San Francisco. Population growth is also high which indicates potential for overall growth for a green economy.

Table 15: Demographic Profile Houston, TX vs. San Francisco, CA²⁴

People QuickFacts	Houston	Texas	USA	San Francisco	California
Population, 2010	2,099,451	25,145,561	308,745,538	805,235	37,253,956
Population, percent change, 2000 to 2010	7.5%	20.6%	9.7%	3.7%	10.0%
Population, 2000	1,953,631	20,851,820	281,421,906	776,733	33,871,648
Persons under 5 years, percent, 2012	8.10%	7.50%	6.40%	4.40%	6.80%
Persons under 18 years, percent, 2012	25.90%	26.80%	23.50%	13.40%	25.00%
Persons 65 years and over, percent, 2012	9.00%	10.90%	13.70%	13.60%	11.40%
Female persons, percent, 2012	49.80%	50.30%	50.80%	49.30%	50.30%
White alone, percent, 2012	50.50%	80.60%	77.90%	48.50%	57.60%
Black or African American alone, percent, 2012	23.70%	12.30%	13.10%	6.10%	6.20%

²⁴ (United States Census Bureau, 2013)

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American Indian and Alaska Native alone, percent, 2012	0.70%	1.00%	1.20%	0.50%	1.00%
Asian alone, percent, 2012	6.00%	4.20%	5.10%	33.30%	13.00%
Native Hawaiian and Other Pacific Islander alone, percent, 2012	0.10%	0.10%	0.20%	0.40%	0.40%
Two or More Races, percent, 2012	3.30%	1.70%	2.40%	4.70%	4.90%
Hispanic or Latino, percent, 2012	43.80%	38.20%	16.90%	15.10%	37.60%
White alone, not Hispanic or Latino, percent, 2012	25.60%	44.50%	63.00%	41.90%	40.10%
Living in same house 1 year & over, percent, 2008-2012	79.60%	82.60%	84.80%	84.00%	84.20%
Foreign born persons, percent, 2008-2012	28.30%	16.30%	12.90%	35.70%	27.10%
Language other than English spoken at home, pct age 5+, 2008-2012	46.20%	34.60%	20.50%	45.20%	43.50%
High school graduate or higher, percent of persons age 25+, 2008-2012	74.80%	80.80%	85.70%	85.90%	81.00%
Bachelor's degree or higher, percent of persons age 25+, 2008-2012	28.70%	26.30%	28.50%	52.00%	30.50%
Veterans, 2008-2012	88,567	1,611,660	21,853,912	31,553	1,952,910
Mean travel time to work (minutes), workers age 16+, 2008-2012	25.8	24.9	25.4	29.9	27.1
Housing units, 2012	892,646	10,154,230	132,452,405	376,942	13,680,081
Homeownership rate, 2008-2012	45.90%	63.90%	65.50%	36.90%	56.00%
Housing units in multi-unit structures, percent, 2008-2012	48.20%	24.10%	25.90%	67.40%	30.90%
Median value of owner-occupied housing units, 2008-2012	\$124,700	\$128,000	\$181,400	\$750,900	\$383,900
Households, 2008-2012	773,450	8,782,598	115,226,802	340,839	12,466,331
Persons per household, 2008-2012	2.69	2.8	2.61	2.31	2.93
Per capita money income in past 12 months (2012 dollars), 2008-2012	\$27,029	\$25,809	\$28,051	\$47,278	\$29,551
Median household income, 2008-2012	\$44,648	\$51,563	\$53,046	\$73,802	\$61,400
Persons below poverty level, percent, 2008-2012	22.20%	17.40%	14.90%	13.20%	15.30%
Business QuickFacts	Houston	Texas	USA	San Francisco	California
Total number of firms, 2007	219,324	2,164,852	27,092,908	105,030	3,425,510
Black-owned firms, percent, 2007	15.10%	7.10%	7.10%	2.70%	4.00%

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American Indian- and Alaska Native-owned firms, percent, 2007	0.90%	0.90%	0.90%	S	1.30%
Asian-owned firms, percent, 2007	10.40%	5.30%	5.70%	24.00%	14.90%
Native Hawaiian and Other Pacific Islander-owned firms, percent, 2007	0.10%	0.10%	0.10%	0.20%	0.30%
Hispanic-owned firms, percent, 2007	23.30%	20.70%	8.30%	6.60%	16.50%
Women-owned firms, percent, 2007	28.90%	28.20%	28.80%	30.10%	30.30%
Manufacturers shipments, 2007 (\$1000)	49,121,973	593,541,502	5,319,456,312	2,077,457	491,372,092
Merchant wholesaler sales, 2007 (\$1000)	189,998,400	424,238,194	4,174,286,516	10,562,176	598,456,486
Retail sales, 2007 (\$1000)	36,570,164	311,334,781	3,917,663,456	12,399,960	455,032,270
Retail sales per capita, 2007	\$16,573	\$13,061	\$12,990	\$15,516	\$12,561
Accommodation and food services sales, 2007 (\$1000)	6,263,910	42,054,592	613,795,732	5,039,171	80,852,787
Geography QuickFacts		Texas	USA	San Francisco	California
Land area in square miles, 2010	599.59	261,231.71	3,531,905.43	46.87	155,779.22
Persons per square mile, 2010	3,501.50	96.3	87.4	17,179.10	239.1
FIPS Code	35000	48		67000	6

The demographic context of the Houston provides a useful backdrop for a larger institutional analysis. Its basic demographic and economic characteristics give a clear picture of the scale and variations of various factors that influence institutions in the city. Placing Houston in context of Texas as well in comparison to San Francisco and California shows how it differs across different dimensions. Overall, these basic demographic characteristics represent the aspects of local conditions that will be impacted as a green economy develops in Houston.

Government Structure

City of Houston

As appropriate governmental bodies, programs, and policies are crucial for the development of a green economy, it is essential to analyze what systems and structures the City of Houston has in place that can work to foster a green economy in the area. As the administrative head of the city, the Mayor of Houston oversees the city departments and divisions that administer programs and policies of the City of Houston that promote a green economy in the city. As the legislative body of the city, the City Council develops and adopts the policies that allow these administrative activities to proceed.

Unlike other cities that have strong or independent departments that oversee the administrative activities that relate to environmental initiatives, the City of Houston has an Office of Sustainability that is relatively small and has few resources. It works to coordinate and encourage sustainability related activities within the numerous departments and divisions within city government. It also works to develop sustainability initiatives for the public at large. Current Mayor Annise created the Office of Sustainability and named Laura Spanjian, who relocated from San Francisco for the position, as director in April of 2010.²⁵ As the Sustainability Director for Houston, she is responsible for “for directing and coordinating projects and initiatives that improve air, land and water quality; and support and expand renewable energy, energy efficiency, green buildings, recycling and composting, alternative and clean transportation, local food production and more livable and vibrant neighborhoods.”²⁶

The Office of Sustainability currently has two full time staff members, including the director, and one intern staff member. The office also has an external advisor who works directly with the Office of Sustainability but is funded by the C40 Cities Climate Leadership Group. These staff members oversee the projects and programs initiated by or coordinated through the Office of Sustainability. The director of the Office of Sustainability reports to the City of Houston’s Chief Development Officer who reports directly to the Mayor. The budget allocated to the Office of Sustainability only includes money for the staff itself. There is no direct programmatic funding. The Office of Sustainability must secure outside funds to implement its programs or have departments within the municipal government allocate funds for its initiatives. As such the Office of Sustainability both directly oversees specific programs within the city such as the B-Cycle bike sharing program and developing a sustainability action plan for the city or coordinates with other departments within the city to assist them in implementing their own programs.²⁷ Given its limited resources, the Office of Sustainability is not as strong as in other cities, nor is it as independent in the projects and initiatives it can undertake.

²⁵ <http://www.greenhoustontx.gov/spanjian.html>

²⁶ <http://www.greenhoustontx.gov/spanjian.html>

²⁷ Conversation with Lisa Lim, City of Houston Sustainability Manager, April 4, 2014

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In addition to the Office of Sustainability, the City of Houston also has the Environmental Coordinating Council. This council is comprised of representative employees from across a number of city departments including: Administration and Regulatory Affairs, Aviation, Convention and Entertainment Facilities, Fire, General Services, Health and Human Services, Human Resources, Information Technology, Legal, Municipal Courts, Parks, Planning, Police, Public Works and Engineering, and Solid Waste.²⁸ The Environmental Coordinating Council acts as a working group to share best practices and information about available resources that can support sustainable activities across the municipal government. The group is responsible for: *“coordinating environmental investigations and enforcement work across departments; creating and maintaining an electronic environmental case management system; enhancing cross-departmental environmental education, coordinating communications regarding environmental matters, including but not limited to maintaining the greenhoustontx.gov website, interfacing with 3-1-1, printing the environmental violation handbook (first published in 2007) and routinely updating it, and promoting the city’s environmental accomplishments and responsibilities; Identifying and supporting all departments to access opportunities for external funding for environmental projects, including grants and state or federal Supplemental Environmental Projects.”*²⁹ While this group does not necessarily determine policy initiatives for the city, it does work to improve the sustainability of city operations. These city operations can be used as a catalyst for driving a green economy in the city of Houston.

While Houston does not have a specific city council committee or appointed commission that directly sets a sustainable policy agenda for Houston, two of the City Council Committees do have oversight of departments that impact the local environment in Houston and work on policy initiatives that can help develop a green economy for Houston. The Quality of Life Committee directly oversees departments such as the Department of Neighborhoods and the Parks and Recreation Department. According to the Green Houston website,³⁰ the Neighborhood Protection and Quality of Life Committee will *“consider strategies to improve the quality of life for neighborhoods including issues related to the enforcement of deed restrictions and building codes, abatement of dangerous buildings and weeded lots, and management of illegal dumping and other solid waste collection. The committee will review Code of Ordinance regulations that are principally oriented to neighborhood protection and that are not addressed by another committee’s scope.”*

Additionally, the Transportation, Technology & Infrastructure Committee oversees a number of departments of the city that impact a green economy. These include the General Services and Public Works and Engineering departments. This committee also oversees ReBuild Houston, the City of Houston’s initiative to *“to improve the quality of life and mobility for residents of the city by rebuilding [its] drainage and street infrastructure.”*³¹ This committee also oversees policies related to water resource management. Specifically, it looks to *“consider potential benefits*

²⁸ <http://www.greenhoustontx.gov/ecc.html>

²⁹ Ibid.

³⁰ <http://www.greenhoustontx.gov/councilcommittees.html>

³¹ <http://www.rebuilddhouston.org/>

of and financing for innovative programs and projects, both inside and outside the City of Houston, that could conserve water and energy resources without compromising quality of life or regional economic growth."³² While a dedicated committee or commission on the environment might allow to the city to develop more comprehensive policies with regards to a green economy, the current committee structure does allow for sustainability policies to develop that would foster a green economy.

Within the city government, there are a number of specific programs that tie to a green economy especially as they relate to potential green economy clusters. They are as follows:

The City of Houston has a number of policies and programs that potentially could support a green building and construction cluster. The City's Brownfield Redevelopment Program works to *"help redevelop and revitalize properties that are abandoned or underutilized due to real or perceived contamination."*³³ The program helps landowners and developers by paying for site environmental assessments on a first come, first served basis as funding is available, coordinating tax abatements, and helping with regulatory coordination. The Land Redevelopment Committee serves an advisory board for the program.

Houston's Energy Efficiency Incentive Program (EEIP) provides financial incentives for *"office building owners, property managers, and tenants located in the [City of Houston] to reduce energy consumption and increase the economic performance of their building."*³⁴ The City will provide incentives of up to \$200,000 to perform building upgrades that result in a minimum of 15% increased energy efficiency. The City of Houston further advances the goals of the EEIP through the Green Office Challenge. The challenge serves as a competition between property owners and managers and provides Mayoral and media recognition for participants who demonstrate excellence in increasing building sustainability. In its first year, the 375 buildings participating in the program reduced electricity use by 28 million kilowatt hours and water use by 74 million gallons.³⁵ On the residential side of a green building and construction cluster, the City's Residential Energy Efficiency Program (REEP) provides home weatherization to income qualified individuals at no charge. To educate the public at large as well as professionals, Houston also operates the Green Building Resource Center to provide information about potential strategies, services, and technologies that can support green construction.

In addition to these public facing programs, departments within the municipal government have adopted operational practices that can further support a green building and construction cluster. In particular, the Design and Construction Division within the General Services Department has implemented a number of programs to support such a cluster. In adopting the Green Building Resolution, the City Council directed the Design and Construction Division to set a target of LEED

³² <http://www.greenhoustontx.gov/councilcommittees.html>

³³ <http://www.houstontx.gov/brownfields/index.html>

³⁴ <http://www.greenhoustontx.gov/eeip.html>

³⁵ <http://www.greenhoustontx.gov/goc20120426.html>

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Silver for all its new construction as well as retrofit projects over 10,000 square feet of occupied space. The City has also contracted with energy services companies to perform energy efficiency upgrades to increase energy efficiency in city owned and operated buildings and reduce overall maintenance costs. The City has also performed energy performance benchmarking across its 300+ buildings through the Energy Star Portfolio Manager to target ways of improving energy performance.³⁶

Additionally, the City of Houston has incorporated ideas of sustainability into its plans for future development within the city. The Urban Planning Corridor Initiative determined modifications to planning and public right of way ordinances to encourage an urban environment that improves pedestrian mobility along designated transit corridors. City Council adopted the modifications in 2009 that would promote high density, walkable development adjacent to light rail corridors and stations as well as adjacent streets that intersect the corridor or are within 1320 feet of a transit station.

All of these programs can act as catalysts for growth of a green building and construction cluster. While some work to foster such a cluster today, others could act promote a green building and construction cluster for a number of years in the future.

In addition to the initiatives that support a green building and construction cluster, Houston also has a number of programs that could support an environmental compliance, sustainability planning, and pollution prevention cluster. The Brownfields Program can support it in addition to the green building and construction cluster. In addition to helping land owners and real estate developers create new green buildings, the Brownfields Program also supports testing laboratories and environmental consulting services as part of environmental compliance. The Urban Planning Corridor Initiative could also help support an environmental compliance, sustainability planning, and pollution prevention cluster as enhanced sustainability planning could be integrated into broader urban planning efforts.

The Bureau of Pollution Control and Prevention under the Health and Human Services Department administers a number of initiatives that directly relate to environmental compliance, sustainability planning, and pollution prevention. In addition to the education and outreach they perform regarding pollution and its health effects, the bureau oversees a number of environmental monitoring programs that cover the entire city. Under the Texas Clean Rivers Program, the City of Houston measures a number of pollutants in Houston's waterways by collecting samples across 133 sites throughout the city and tests them at a City of Houston laboratory. Through funding provided by the U.S. Environmental Protection Agency, the bureau also monitors air quality throughout the city via both fixed monitoring stations as well as mobile monitoring laboratories.³⁷

³⁶ <http://www.houstontx.gov/general/services/design/sustainability.html>

³⁷ http://www.houstontx.gov/health/Environmental/bpcp_environmental.html

The Houston Parks and Recreation Department also oversees a number of programs that relate to an environmental compliance, sustainability planning, and pollution prevention cluster. In its most recent comprehensive master plan published in 2008, the Houston Parks and Recreation Department set two goals that support the sustainability planning aspect of such a cluster: “Create Connections” and “Demonstrate Environmental Leadership.” The “Creating Connections” goal is to create a network of green trails and wilderness corridors throughout the city. The “Demonstrate Environmental Leadership” goal is to determine and adopt best environmental operational and programming practices as well as setting high environmental standards for all park and open space development.³⁸

In addition to the objectives of this master plan, the Houston Parks and Recreation Department oversees more narrowly focused programs that involve sustainability planning. Its Million Trees + Houston program has been established, through both public and private support, with the goal of planting over a million trees in Houston over a three to five year period. In another public/private partnership, the Neighbor Woods program provides free trees to city residents to plant them in public rights of way adjacent to their property. And finally, the planning and development of “No-Mow” Zones in public rights of way throughout the city promotes regeneration of natural vegetation and native habitats. Each of these programs demonstrates a relationship to sustainability planning.³⁹

Many of the Planning and Development Department’s efforts can also support the development of an environmental compliance, sustainability planning, and pollution prevention cluster. While the Planning and Development Department nor any other department has published a specific sustainability plan for Houston, a number of plans they have developed do relate to sustainability planning.⁴⁰ In addition to the previously identified ReBuild Houston Initiative, the Urban Corridor Plans, and the Parks and Recreation Master Plan, the Planning and Development Department has also developed a number of plans that could relate to sustainability planning and environmental compliance. They have the potential to require environmental impact studies to be completed for project implementation. These plans potentially include: the Comprehensive Drainage Plan, the Major Thoroughfare and Freeway Plan, the Mobility Plan, and the Traffic and Transportation Strategic Plan. In addition to these plans, Mayor Parker announced the formation of a Water Conservation Task Force to investigate water conservation issues to make a recommendation for water use policy in the future.⁴¹

There are a number of initiatives that relate to a transportation and alternative fuel vehicle cluster. Houston has contracted with B Cycle to launch a bike sharing program in the central part of

³⁸ (City of Houston Parks and Recreation Department, 2008)

³⁹ <http://www.houstontx.gov/parks/aboutus.html>

⁴⁰ According to a conversation with Lisa Lin, Sustainability Manager for the City of Houston, the Office of Sustainability is working with the Houston Advanced Research Center to develop a sustainability plan for the Houston.

⁴¹ http://www.houstontx.gov/planning/AboutPD/abt_planning.html

the city. The system currently has 29 stations, and there are plans for expansion.⁴² Also related to bicycles, Houston in recent years has constructed over 300 miles of interconnected bikeways over a 500 square mile area.⁴³ In addition to these bicycle programs, the City has also implemented a number of automotive programs. In conjunction with Zipcar, Houston launched its municipal fleet-sharing program that allows city employees to share the use of 50 vehicles, 25 of which are Nissan Leaf electrical vehicles.⁴⁴ In addition to this fleet-sharing program, over half of the city's light duty fleet is composed of hybrid vehicles. The city has also installed 30 electric vehicle charging stations for municipal use as well as 30 public charging stations.⁴⁵

Houston also has a number of initiatives that relate to an energy generation, renewable energy, and energy storage cluster. As the largest municipal purchaser of renewable energy with nearly 50% of the energy the City uses coming from renewable sources, Houston has demonstrated leadership in supporting such a cluster.⁴⁶ Additionally, the city is currently testing solar technologies on the George R. Brown Convention Center, the City Hall Annex building, facilities at Discovery Green, and most recently, the Houston Permitting Center through the Department of Energy's Solar America Cities project.⁴⁷ Through a \$100,000 grant from the Department of Energy, the City, in conjunction with the Houston Advanced Research Center, is working to streamline and refine the solar permitting process.⁴⁸ And to further encourage adoption of solar energy, the city is looking to lower the cost of solar technologies through collective group discount plans. And finally, the city recently purchased 17 mobile solar-powered shipping containers developed through University of Houston's Green Building Components Program. The units are independent from the electrical grid and are furnished to act as self-contained command posts after large natural disasters such as hurricanes.⁴⁹

Although the City of Houston has not made as many advances in policies and programs related to a waste, waste management, and recycling cluster - Houston has a self-reported recycling rate of only 14%⁵⁰ compared to national averages of roughly 35%⁵¹ - city officials do have ambitious goals in this area. As part of the 2012-2013 Bloomberg Philanthropies Mayors Challenge, Houston was one of 5 winners for its "One Bin For All" initiative.⁵² Under this program, residents would discard all waste – including recyclable and non-recyclable waste – into a single bin. The waste would be taken to a newly built advanced sorting center that would separate recyclable materials

⁴² <https://houston.bcycle.com/About/WhatIsHoustonBcycle.aspx>

⁴³ <http://www.greenhoustontx.gov/bikeways.html>

⁴⁴ <http://www.zipcar.com/press/releases/zipcar-partners-with-houston-for-ev-fleet-sharing-program>

⁴⁵ <http://www.greenhoustontx.gov/ev/about.html>

⁴⁶ (United States Environmental Protection Agency, 2014)

⁴⁷ (United States Department of Energy, 2011)

⁴⁸ <http://www.greenhoustontx.gov/pressrelease20120607.html>

⁴⁹ <http://www.greenhoustontx.gov/pressrelease20100427.html>

⁵⁰ (City of Houston, 2013)

⁵¹ (United States Environmental Protection Agency, 2014)

⁵² (Bloomberg Philanthropies, 2014)

from the waste stream. The goal is to create a public private partnership to develop the facility which would increase recycling rates to 75% and be available as a service to all city residents.

In regards to a biofuels, farming, and agriculture cluster, Houston also has limited initiatives that relate to one. In October 2010, Houston launched a seasonal farmers market in front of City Hall.⁵³ The weekly Wednesday market gave downtown workers easy access to local produce and food items. The city has also supported programs to grow produce including the city employee run gardens in front of the 611 Walker building as well as a number of community gardens located on Parks and Recreation Department facilities around the city.

These City of Houston programs and initiatives represent an important component for the development of a green economy for the city. In conjunction with the industries and occupations with high concentrations in the region, they provide a strong foundation for economic growth.

Other Local Governments, Government Agencies, and Intergovernmental Bodies

In addition to City of Houston policies and initiatives outlined above, there are a number of other public sector institutions in the Houston-Sugar Land-Baytown Metropolitan Statistical Area that have programs and initiatives that would provide support to a green economy in Houston.

Harris County

While Harris County does not have many initiatives specifically focused on sustainability as the City of Houston, it does have programs that do tie to green economy clusters. Most have ties to an environmental compliance, sustainability planning, and pollution prevention cluster. For example, Harris County's Pollution Control Services Department enforces the Texas Commission on Environmental Quality (TCEQ) Air, Water, Solid Waste and Harris County Storm Water Rules and Regulations.⁵⁴ Additionally, the agency responds to complaints about pollution issues, performs monitoring and testing of air, water, storm water and solid and hazardous waste pollution, and assesses and compiles reports and evidence relating to violations of environmental laws for civil or criminal litigation. The Environmental Public Health Division of the Public Health and Environmental Services Department works to protect public health by *"ensuring the integrity of the food supply, clean drinking water, neighborhood cleanliness, and hazard-free workplaces."*⁵⁵

Given the region's flood prone nature, the Harris County Flood Control District has performed extensive planning for mitigating flood damage to the overall region. As part of its planning efforts it has developed, in conjunction with the Harris County Public Infrastructure Department, the "Harris County Low Impact Development & Green Infrastructure Design Criteria for Storm Water Management Manual."⁵⁶ This manual, adopted by the Harris County Commissioner's

⁵³ <http://www.greenhoustontx.gov/farmersmarket.html>

⁵⁴ <https://www.harriscountytexas.gov/pollutioncontrol/>

⁵⁵ <http://www.hcphes.org/eph/default.htm>

⁵⁶ (Harris County Flood Control District, 2011)

Court in April of 2011, outlines low impact design site planning concepts, an approval process, low impact design based project and design criteria, and design essentials for specific project types. The criteria outlined in the manual were adopted over an interim three year period, with final guidelines to be determined based on feedback from the trial period. Given the frequent tie between infrastructure projects and new building construction, these planning efforts performed by Harris County also tie to a green building and construction cluster.

The Flood Control District also has a Stormwater Quality Program that monitors and enforces stormwater quality from local sources and oversees a permitting process for new projects that discharge stormwater.⁵⁷ The Flood Control District has created the Greens Bayou Wetlands Mitigation Bank, which serves as a resource for new development in the Greens Bayou watershed that requires on-site stormwater detention. Projects could pay to reserve credits in the 1,400 acre wetland area in lieu of constructing detention areas on their own sites. At this point, all of the credits from the project have been reserved.⁵⁸ In addition to these programs, the Flood Control District has also worked closely with the City of Houston on developing the areas extensive hike-and-bike trails along local waterways and included significant tree planting activities as part of its flood mitigation efforts.⁵⁹ And its Vegetation Management Program aims to restore many local waterways and wetlands to a more natural state, as natural ecosystems help mitigate flooding effects.⁶⁰

Port of Houston Authority

As an institution that acts as a significant driver of local economic activity, the Port of Houston provides policies and initiatives that directly tie to the development of a green economy in Houston. Many of the programs that the Port has implemented relate to an environmental compliance, sustainability planning, and pollution prevention cluster. In 2002, the Port of Houston Authority became the first U.S. port authority to attain and subsequently also be recertified under the ISO 14001 program.⁶¹ ISO 14001 is an international standard that insures compliance with environmental management targets in a similar way that ISO 9000 insures to the international standards for quality management targets.

One program that supports achievement of ISO 14001 certification is the port's Clean Air Strategy Plan developed in 2011.⁶² The plan primarily targets emissions reductions of a number of airborne pollutants from both land and ocean-going vessels. Some recommendations target upgrading equipment to simultaneously reduce emissions and increase energy efficiency. Others looked at changes to operations and facilities configurations. Specific recommendations include strategies such as reconfiguring checkpoints to reduce truck idle times, providing on shore power

⁵⁷ <http://www.hcfcd.org/stormwaterquality.html>

⁵⁸ http://www.hcfcd.org/greensbayou_wmb.html

⁵⁹ <http://www.hcfcd.org/trailsnbayous.html>

⁶⁰ <http://www.hcfcd.org/vegetation.html>

⁶¹ <http://www.portofhouston.com/inside-the-port-authority/environmental-stewardship/>

⁶² (Environmental Affairs Department Port of Houston Authority, 2011)

generation for docked vessels, certifying new and existing buildings under the LEED rating system, or repaving open areas to reduce dust generation. In addition to relating to an environmental compliance, sustainability planning, and pollution prevention cluster, many of these strategies also support a green building and construction cluster as well as a transportation and alternative fuel vehicle cluster.

While the Clean Air Strategy Plan covers the Port of Houston's goals at a broader level, there are also a number of more granular programs that the Port has adopted. For example, the Port Drayage Truck Bridge Loan Program helps many of the drayage truck owners and companies operating in the port area – including owner-operators – to either replace older diesel-powered container trucks or upgrade their existing trucks to meet higher emission standards. The program can currently allow for 50 trucks per year to be upgraded.⁶³

In addition to emissions related issues, the port also has a number of programs that tie to water quality. A stormwater treatment system at the Bayport Container Terminal helps prevent contaminants and pollutants from reaching Galveston Bay. All dredge material removed from port facilities must undergo extensive testing to ensure they do not contain dangerous materials or chemicals. In addition to depositing this material into the port's dredge material placement area, the port also uses it to create new marsh and wildlife habitats in the area as part of the Better Bay initiative.⁶⁴

Metropolitan Transit Authority of Harris County, Houston, Texas (METRO)

The Metropolitan Transit Authority of Harris County, Houston, Texas (METRO) serves a broad constituency in the Houston area. Given such its large geographic and constituent footprint, it has the potential of contributing a great deal to a local green economy. The economic impact of the recently expanded and soon to be further expanded METRORail system provides ample evidence of that fact. In addition to the expanded METRORail services, METRO also has plans for developing commuter rail and bus rapid transit systems as well as expanding its high occupancy vehicle services as part of its 2025 Regional Transit Plan developed in conjunction with the Houston Galveston Area Council.⁶⁵

In addition to a number of the ambitious targets set as part of the 2025 Regional Transit Plan, METRO is also currently undertaking the Transit System Reimagining Project. The goal of the project is to develop specific strategies, with direct input from the public, to be incorporated into METRO's next 5-Year Transit System Plan. The stated goals of this 5-Year Transit System Plan are to “to devote 80% of local bus resources to the goal of maximum ridership and the remainder to the goal of maximum coverage of existing riders.”⁶⁶

⁶³ <http://www.portofhouston.com/inside-the-port-authority/environmental-stewardship/air-quality/>

⁶⁴ <http://www.portofhouston.com/inside-the-port-authority/environmental-stewardship/water-quality/>

⁶⁵ (Houston-Galveston Area Council, 2005)

⁶⁶ <http://transitsystemreimagining.com/>

Metro has also incorporated sustainability initiatives into its existing operations. Metro's current bus fleet includes over 440 diesel-electric hybrid buses. Metro cleans and recycles all the water it uses to clean its bus fleet. Metro also recycles all scrap metal, tires, batteries, wood pallets and motor oil. Additionally, Metro has chosen to scrap its older buses from its fleet, rather than reselling them to other operators who might continue to use these high emitting vehicles. Metro buses automatically shut down when sitting idle for more than 15 minutes. Most Metro buses are equipped with bike racks to allow passengers the option to travel via multi-modal means. Metro's 708 Star vans help commuters located far from Metro's commuter routes organize van pools to reach work on a daily basis. And Metro has joined NuRide, a rewards program for commuters that gives them restaurant coupons, retailer discounts, and tickets to local shows & attractions.⁶⁷

Houston Galveston Area Council (H-GAC)

As the regional intergovernmental planning organization overseeing a geographic footprint that covers twelve counties and one hundred thirty four municipalities, the Houston-Galveston Area Council (H-GAC) has a great deal of influence over the overall development of the Houston-Sugar Land-Baytown MSA. Environmental stewardship is a key component of its regional planning efforts. As such, the programs and initiatives it oversees directly relate to the development of a green economy in Houston.

H-GAC has identified two in particular areas directly to the development of a green economy: Transportation and Air Quality as well as Community and Environment. Under the Transportation and Air Quality section, H-GAC has a number of plans that address issues related to a green economy. Its annual Mobility Report measures key indicators of how well the regional transportation systems are performing.⁶⁸ The Transportation Improvement Program, which includes components for both public and private transportation as well as bicycle and pedestrian projects, is the local conduit for federal funding distributed to the State of Texas for regional transit projects. The 2040 Regional Transportation Plan and the 2035 Regional Transportation Plan Update set long term goals for regional transportation investments.^{69,70} Parallel to these efforts, H-GAC also oversees the Regionally Coordinated Transportation Plan as well as planning public transportation planning services for incorporated and unincorporated areas that fall outside of METRO's service areas.⁷¹ Additionally, H-GAC's Clean Cities and its Clean Vehicles programs provide information and funding for alternative fuels and infrastructure as well as clean diesel technologies for local area stakeholders.^{72,73} And finally, H-GAC's Area Emission Reduction Credit Organization oversees public and private funding for the local Clean School Bus Houston Program for local school districts.⁷⁴ All of

⁶⁷ <https://www.ridemetro.org/Community/GoingGreen.aspx>

⁶⁸ (Houston-Galveston Area Council, 2013)

⁶⁹ <https://www.h-gac.com/tag/plan/2040/default.aspx>

⁷⁰ (Houston-Galveston Area Council, 2011)

⁷¹ (Houston-Galveston Area Council, 2011)

⁷² (Houston Galveston-Area Council, 2012)

⁷³ <http://www.mysolutionis.com/fleet-management/clean-cities-coalition/default.aspx>

⁷⁴ <http://www.h-gac.com/tag/airquality/aerco/>

these programs and initiative tie directly to a transportation and alternative fuel vehicle green economy cluster and an environmental compliance, sustainability planning, and pollution prevention cluster.

Many of the programs within the Transportation and Air Quality section of H-GAC also tie more specifically to an environmental compliance, sustainability planning, and pollution prevention cluster. H-GAC's Clean Air Action Program promotes awareness and ground level ozone reduction.⁷⁵ The Regional Air Quality Planning Advisory Committee appointed by H-GAC's Board of Directors reviews and makes recommendations to regional and local governments, transportation organizations and other agencies on air quality issues.⁷⁶ In addition to these programs, H-GAC also performs air quality modeling to insure that many of the transportation programs it oversees meet regional emission reduction goals that are part of its guidelines.

H-GAC also oversees a number of programs under its Community and Environment section that also tie directly to the development of a green economy in Houston. While many of the programs also relate to a transportation and alternative fuel vehicle cluster and an environmental compliance, sustainability planning, and pollution prevention cluster, they also have potential implications for a green building and construction cluster and as well as a waste, waste management, and recycling cluster. Developed as a tool for public officials, urban planners, and transit planners, H-GAC's Eco-Logical GIS-based online mapping tool identifies valuable environmental resources within the region. The tool is particularly valuable for officials and professionals making land-use decisions in the region.⁷⁷ H-GAC's Board of Directors has also established the Foresight Panel on Environmental Effects to look at the impacts of local and global environmental changes on the region and report on their findings.⁷⁸ The expert panel investigated such changes on human health and safety, public infrastructure, and natural systems as well as identified a number of regional adaptation goals.

H-GAC oversees a number of programs related to regional water resources - such as the Clean Rivers Program, the Clean Waters Initiative, the Regional Flood Management Council, and the Natural Resources Advisory Committee. It also coordinates water-resource related activities such as water quality management planning and development of watershed protection plans.⁷⁹

As the regional body that acts as the State designated planning agency for solid waste management issues in the region, H-GAC provides a number of resources that relate to a waste, waste management, and recycling cluster. As part of its services, it provides educational resources and provides assistance for local officials for the enforcement of environmental laws and

⁷⁵ <http://www.mysolutionis.com/about/clean-air-action/default.aspx>

⁷⁶ <http://www.h-gac.com/tag/airquality/raqpc/>

⁷⁷ <http://arcgis02.h-gac.com/EcologicalGIS/>

⁷⁸ (Houston-Galveston Area Council, 2008)

⁷⁹ <http://www.h-gac.com/community/water/default.aspx>

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prosecution of offenders. It also provides training, information, and resources for issues such as waste minimization, storm debris reductions, and increased recycling adoption.⁸⁰

And finally, H-GAC coordinates a number of programs that tie to urban and regional planning and development. Under its Livable Centers Program, H-GAC works with neighborhoods, communities, and municipalities develop planning studies for “walkable, mixed-use [destinations] that provide multimodal transportation options, improve environmental quality and promote economic development.”⁸¹ In addition to this formal program, H-GAC also offers services related to parks and natural areas planning, urban forestry planning, and pedestrian-bicyclist planning.

This examination of the City of Houston’s and other local bodies’ governance structures demonstrates how they can provide support for developing a green economy in Houston. A good deal of that support comes from local programs, policies, and initiatives that are directly focused on the green building and construction and environmental compliance, sustainability planning, pollution prevention clusters. Additionally, they may also provide indirect support for the transportation and alternative fuel vehicles and energy generation, renewable energy, energy storage clusters. While the overall level of support may not be as broad nor as deep as in other cities that have focused on sustainability issues for a number of decades, there have been significant advances in recent years. The establishment of the Office of Sustainability has led to the creation of a number of programs and policies that can support the development of a green economy. Additionally, longer term leadership by the Houston-Galveston Area Council and the Port of Houston also provide support for the establishment of a green economy in Houston. Continued policy, program, and initiative advances in the future will continue to bolster a green economy as well.

⁸⁰ <http://www.h-gac.com/community/waste/default.aspx>

⁸¹ <http://www.h-gac.com/community/livablecenters/default.aspx>

Nonprofit Governance Structure

Overall Nonprofit Governance Structure

Table 16 below summarizes the how the City of Houston compares to other major cities in the United States with regards to nonprofit activity related to a local green economy. As indicated in the table, Houston falls significantly behind leading cities such as San Francisco and Boston across a number of metrics, especially on a per capita basis, while it leads Los Angeles across those same metrics.

Houston has a relatively high concentration of environmental organizations with twice the number per capita as Los Angeles (.34 vs. .17). Additionally, contributions and grants, total revenue, total expenses, and total assets to those same organizations are also significantly larger on a per capita basis. With respect to San Francisco and Boston, though, Houston falls far behind both in terms of aggregate numbers as well as on a per capita basis. Only in the total number of environmental organizations that file annually is Houston relatively on par with other cities.

In terms of civil rights and social action, Houston performs relatively worse. While the largest number of organizations in Houston (57) might indicate a healthy nonprofit sector, the contributions/grants, revenue, and expenditure numbers undermine that assumption. Across all dollar figure metrics, Houston is anywhere between four and six times lower both on an aggregate and per capita basis.

This information provides background information of overall nonprofit activity in Houston. While Houston performs better than Los Angeles across some dimensions, it falls far behind Boston and San Francisco. While this data does not directly project potential growth of green economy clusters, it does give an indication of the resources available in the nonprofit sector in Houston for green economy development activities.

Table 16: Distribution of Nonprofit Groups

Nonprofit Public Charity Activities - Environment				
City	Houston (2011) ⁸²	San Francisco (2009) ⁸³	Boston (2009) ⁸³	Los Angeles (2009) ⁸³
Number of organizations filing annually	71	97	61	64
Private contributions & government grants	\$37,300,314	\$269,226,472	\$148,361,160	\$35,775,297
Total revenue	\$53,390,837	\$372,647,164	\$233,480,262	\$48,588,794
Total expenses	\$42,595,204	\$417,279,667	\$213,676,868	\$48,601,877

⁸² Adapted from National Council of Charitable Statistics (<http://nccs.urban.org/>) and Federal 990 IRS filings

⁸³ (Kaye, 2012)

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Total assets	\$115,706,635	\$777,935,742	\$629,756,911	\$76,299,644
Nonprofit Public Charity Activities per Capita – Environment				
Number of organizations (per 10,000 persons)	0.34	1.25	1.04	0.17
Private contributions & government grants (\$ per capita)	\$17.77	\$347	\$252	\$10
Total revenue (\$ per capita)	\$25.43	\$480	\$369	\$13
Total expenses (\$ per capita)	\$20.29	\$537	\$363	\$13
Total assets (\$ per capita)	\$55.11	\$1,001	\$1,069	\$21
Nonprofit Public Charity Activities - Civil rights & social action				
Number of organizations filing annually	57	33	32	23
Private contributions & government grants	\$3,922,645	\$37,195,471	\$14,895,547	\$28,044,048
Total revenue	\$4,714,941	\$41,693,640	\$18,650,417	\$33,221,393
Total expenses	\$4,609,520	\$41,871,110	\$18,597,165	\$33,221,393
Total assets	\$2,701,401	\$58,066,374	\$18,022,759	\$36,085,063
Nonprofit Public Charity Activities per Capita - Civil rights & social action				
Number of organizations (per 10,000 persons)	0.27	0.42	0.54	0.09
Private contributions & government grants (\$ per capita)	\$1.87	\$48	\$24	\$8
Total revenue (\$ per capita)	\$2.25	\$54	\$32	\$9
Total expenses (\$ per capita)	\$2.20	\$54	\$32	\$10
Total assets (\$ per capita)	\$1.29	\$75	\$31	\$28

Green Economy Alliances

There are a number of coalitions in Houston relevant to the development of a green economy for the city. Given the pro-business attitude in the city, most of these coalitions broadly focus on creating economic opportunities for business and industry as well as fostering a business environment that is geared towards green economic growth. In many instances, the coalitions focus on the business side of a green economy rather than on an environmental justice/social justice side. Two of the coalitions bring together organizations and individuals from across a number of green economy clusters, while the remaining focus much more narrowly on specific industries or clusters.

Greater Houston Partnership

In its role as the regional chamber of commerce for the Houston-Sugar Land-Baytown Metropolitan Greater, the Houston Partnership (GHP) brings together the largest number of

organizations, people, governmental bodies, and academic institutions in the region. According to its website, it represents over 2,000 companies in the region that employ 20 percent of the region's workforce. Given its overarching goal of growing the Houston economy, it addresses sustainability issues as it relates to economic growth. Given Houston's leading role in the energy sector, the GHP focuses many its efforts regarding sustainability on energy. Additionally, since mobility is an essential component of economic growth and effective infrastructure is an essential component of that mobility, the GHP also focuses its efforts in improving enhanced public transportation systems as well as improving existing rail networks. And finally, the GHP views high quality of life as a crucial component for attracting and retaining the workforce necessary for a strong regional economy. As such, the GHP focuses efforts on improving and expanding green space and multiuse trails, growing the urban forest, and increasing development of green buildings.⁸⁴

The GHP has four advisory committees that specifically deal with issues related to green economy clusters: Energy; Environment; Transportation; and Quality of Life.⁸⁵ The stated goal of the Energy policy committee is to engage "leadership at the local, state and federal levels to ensure development and implementation of sound energy policy that promotes economic growth, job creation, and energy security, while maintaining environmental protection, human health, and safe operations."⁸⁶ While some critics may view a number of its policy resolutions – such as its support for the XL Pipeline, its support of increased domestic hydrocarbons production, or its support for the promotion and expansion of oil and natural gas in Texas – as antithetical to growing a green economy in Houston, the policy committee has put forth a number of resolutions that do support that growth.

For example, in its resolution in support of renewable energy and energy efficiency initiatives, the Energy Advisory Committee advocates for a number of strategies to expand and diversify renewable energy resources in the state as well as increasing adoption of energy efficiency measures. While its resolution in support of balanced energy policy does contain some recommendations for increasing use of all domestic energy sources including expanded fossil fuel extraction, it also advocates for promotion of energy efficiency and conservation as well as measures to ease market entry for low or no carbon energy technologies.⁸⁷ The committee also advocates for long term incentives for renewable energy so that companies developing new technologies can be assured that they can take advantage of those incentives during extended periods of adoption.⁸⁸

The Environment Advisory Committee put forth a resolution that advocates for implementing plans to mitigate sources of pollution within the local watershed to reduce health

⁸⁴ (Greater Houston Partnership, 2014)

⁸⁵ Note: The Energy Advisory Committee and the Environment Advisory Committee had previously been joined together under the Energy and Environmental Policy Committee.

⁸⁶ <http://www.houston.org/policy/policy-committees.html#/t3>

⁸⁷ (Board of Directors, Greater Houston Partnership, 2012)

⁸⁸ (Board of Directors, Greater Houston Partnership, 2013)

risks to local residents, protect wildlife and natural habitats, and provide additional water resources for recreation.⁸⁹

The Transportation Advisory Committee also addresses issues that tie to growing green economy clusters in Houston. In its resolution for solving the regions long term mobility issues through a multi-modal approach, the committee specifically identifies developing a commuter and intercity rail system as well as providing additional transit options for commuters as keys to the regions long term economic growth.⁹⁰ In another resolution in support of re-routing many of Houston's extensive number of freight lines to ease congestion and reduce overall emissions due to idling, the committee advocates for the development of public transportation within remaining right-of-way from freight rail relocations.⁹¹

While the Quality of Life policy committee has put forth no published resolutions, it does make efforts that would support the development of green economy clusters as well. It describes itself in the following manner: "The Quality of Life Committee works closely with interested GHP members to support policies related to improving and enhancing the region's quality of life related to the visual environment (particularly in the areas of (1) trees and landscaping; (2) multi-use trails, parks, green space and recreational water quality; (3) flood control and prevention; (4) green buildings and (5) other related sustainability issues. The committee works with business, governmental and civic leaders and groups on the above-stated policies (particularly related to existing Quality of Life Agenda priorities contained in GHP resolutions from 2001 to the present)."⁹² As such, it works across a number of areas to advocate for policies that would support a number of green economy clusters, such as green building and construction cluster as well as an environmental compliance, sustainability planning, pollution prevention cluster.

In addition to these policy committees that bring together public officials, industry representatives, and members of academia, the GHP has also established interest-area councils aligned to many of their policy committees. As stated on the GHP website, the councils "provide Members an opportunity to build connections to people, for business development and professional network-building, and to information, to help make informed business decisions."⁹³ A number of these councils have the potential to allow for cross-pollination of ideas, provide opportunities for collaboration, and inform members about job prospects and financial resources that would support the development of green economy clusters. As with the policy committees, the energy, the transportation, and the quality of life councils would provide the most support for the development of a number of green economy clusters.

Given the breadth of its membership, the specific issues it addresses through its policy committees, and the opportunities to interact through its councils, it is clear that the GHP

⁸⁹ (Board of Directors, Greater Houston Partnership, 2012)

⁹⁰ (Board of Directors, Greater Houston Partnership, 2012)

⁹¹ (Board of Directors, Greater Houston Partnership, 2012)

⁹² <http://www.houston.org/policy/policy-committees.html#t7>

⁹³ <http://www.houston.org/membership/councils.html>

represents an important coalition for developing green economy clusters within the region. Given the focuses of its energy and environment, transportation and infrastructure, and quality of life policy committees and associated councils, the GHP can provide resources that would support virtually any green economy cluster with the possible exception of a waste, waste management, and recycling cluster.

Citizens' Environmental Coalition

While the Greater Houston Partnership primary goal is economic growth and addresses sustainability issues in relation to that economic growth, the Citizens' Environmental Coalition (CEC) focuses specifically on environmental issues and works to provide information and connections for individuals and organizations interested in those issues. Specifically, its mission is: "To foster dialogue, education, and collaboration on environmental issues in the Houston / Gulf Coast region."⁹⁴ With 102 member organizations representing a broad spectrum of environmental interests, the CEC can help support companies and individuals in any green economy cluster.⁹⁵ While the GHP creates a more formalized –and well-funded–structure to exchange ideas and make connections, the CEC takes a more informal approach in its efforts to allow individuals to connect.

The CEC primarily works to disseminate information into the community about environmental groups, programs, and initiatives. Its web site provides a calendar of events of environment and sustainability related programs and activities held across the city and region by numerous organizations and institutions. The web site also provides links to articles and features focusing on environmental issues published by local news media organizations. Additionally, the site also provides listings for employment opportunities and announcements for opportunities to participate in various programs and initiatives. The CEC also publishes a weekly newsletter that provides much of this same information in email form.

The CEC also publishes the annual CEC Environmental Resource Guide.⁹⁶ The guide provides information about all of the coalition member organization throughout a 13 country region. Included for each group is contact information, organizational leadership, organizational purpose, information about meetings, programs, major events, volunteer opportunities, publications, and any speakers bureau that the organization offers. In addition to the individual listings of each organization, the Environmental Resource Guide also categories each organization as they relate to specific issues such as air quality, architecture/community development/urban issues, conservation, recycling/trash, transportation, and water quality.

In addition to providing information to the community through its website, newsletter, and resource guide, the CEC also has a number of formal programs to bring together members from different organizations and institutions. The CEC holds roundtable discussions that are open to members and the public at large "to further facilitate cross-functional discussion around key

⁹⁴ <http://www.cechouston.org/>

⁹⁵ <http://www.cechouston.org/about-cec/cec-member-groups/>

⁹⁶ (Citizens' Environmental Coalition, 2013)

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environmental challenges.”⁹⁷ CEC also acts as a local call and email referral center to direct help individuals and organizations connect with other organizations and resources that may be of assistance to them. Its annual business meeting allows all organizations to come together and gives CEC the opportunity to highlight achievements that have occurred throughout the year. And finally, the CEC also has held two Environmental Community Summits that allow members to exchange ideas about the direction of environmental issues in the Houston region.

These efforts by the CEC provide a crucial resource for organizations and institutions in any green economy cluster. The breadth of issues addressed by the member organizations allows for meaningful interactions within each cluster and across them. Additionally, the information that the CEC provides and the programs it holds allow organizations to also quickly connect to other resources that can provide much more specific support. And the informal structure of member interactions allows for flexibility for individuals and organizations to congregate around topical environmental issues and current green economy opportunities.

Other Coalitions and Alliances

In addition to these two alliances that relate to the development of a green economy at a broad level, there are a number of organizations, coalitions, and alliances in the Houston region that focus much more narrowly on specific environmental issues and sustainable business opportunities that tie more directly to individual economy clusters.

Air Alliance Houston

Air Alliance Houston’s mission is “to reduce air pollution in the Houston region and protect public health and environmental integrity through research, education, and advocacy.” The alliance organizes a number of programs throughout the year that further its mission. Its largest and most public program is its annual Earth Day celebration held at Discovery Green with the goal of educating the public on “the merits of mindful, sustainable living while educating and encouraging Houstonians to preserve, conserve and enhance our city and the Earth.” The festival features booths for 100 environmental organizations that allow them to engage with the general public. In addition to this large public event, Air Alliance Houston also: develops educational programs about air quality for school children; works with local neighborhood groups and communities – especially near the Houston Ship Channel and Port of Houston – to inform them about air quality issues in their area and help them through advocacy efforts with local public officials; provides online information about current air quality conditions in the region; and provides local residents information about how they can take action on air quality violations with the City of Houston’s Bureau of Pollution Control and Prevention, the Houston Police Department’s Environmental Investigation Squad, Harris County Pollution Control, or the Texas Commission for Environmental Quality. With its narrow focus on air quality, Air Alliance Houston would most directly relate to

⁹⁷ (Citizens' Environmental Coalition, 2013)

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supporting an environmental compliance, sustainability planning, and pollution prevention green economy cluster in Houston.⁹⁸

American Institute of Architects – Committee on the Environment (AIA-COTE)

The American Institute of Architects – Committee on the Environment is an open forum that connects practitioners from the field of architecture with “educators and institutions of learning, manufacturers, government agencies, environmental organizations, and industry groups.” The goal of the committee is to “advance, disseminate, and advocate—to the profession, the building industry, the academy, and the public—design practices that integrate built and natural systems and enhance both the design quality and environmental performance of the built environment.” Its most frequently held activity is its monthly lunch meetings that allow practitioners and non-practitioners to share information about current issues and developments in green building practices. The forum focuses on green building solutions and strategies whether they relate to technical information about building construction, advice for getting clients to adopt green building practices, or achieving green building certifications. In addition to this public forum, AIA-COTE also has periodic programs that focus on specific topics such as developing a vision for the committee or highlighting the financial implications of developing green buildings. Many of these programs provide practitioners continuing education credits. The efforts of AIA-COTE tie directly to the green building and construction green economy cluster.⁹⁹

American Institute of Chemical Engineers – South Texas Local Section (AIChE)

The American Institute of Chemical Engineers – South Texas Local Section’s vision is to “serve chemical engineering professionals in the South Texas region through education, professional development, and networking.” While AIChE is not specifically focused on issues relating to the green economy, a number of its programming does in fact tie directly to a green economy. For example, before each of its monthly meetings, it holds continuing education workshops for its members. Two of its continuing education topic areas in particular – Environmental Issues and Process Safety Management – tie directly to green economy issues. These monthly meetings also provide engineers networking opportunities to further discuss sustainability issues tied to a green economy. In addition to these monthly educational opportunities, AIChE also publishes a newsletter that provides information about these same topic areas. And AIChE also co-sponsors and organizes an energy conservation forum twice each year. These activities could tie to an environmental compliance, sustainability planning, and pollution prevention green economy cluster, as well as possibly the biofuels/farming/agriculture and energy generation, renewable energy, energy storage clusters and in Houston.¹⁰⁰

⁹⁸ <http://airalliancehouston.org/>

⁹⁹ <https://aiahouston.org/v/site-home/Committee-On-The-Environment/3b/>

¹⁰⁰ <http://sts.aiche.org/>

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Citizens' Transportation Coalition (CTC)

The Citizens' Transportation Coalition describes itself as a grassroots organization working to engage with public officials in planning a modern transportation system for the city of Houston. The CTC engages both planning professionals as well as local residents interested in transportation planning issues. CTC organizes two monthly events: a monthly board meeting that is open to the general public to discuss current transportation related initiatives and programs in the region and how to engage with local government bodies in the transportation planning process and a monthly happy hour co-sponsored with Air Alliance Houston and Houston Tomorrow to connect individuals interested in the long term development of the Houston. CTC's activities could help support a transportation and alternative fuel vehicle green economy cluster as well as the green building and construction and environmental compliance, sustainability planning, and pollution prevention green economy clusters in Houston.¹⁰¹

Greens Bayou Corridor Coalition

The Greens Bayou Corridor Coalition's mission is to: "to develop . . . the Greens Bayou Corridor as an essential, attractive and well-planned multi-use waterway, a linear park and trail system, a utility corridor and a high-capacity cross-county transit/highway link." In 2001, Tropical Storm Allison led to significant flooding throughout the Greens Bayou watershed. This coalition's has worked with member input to develop flood damage reduction plans, a parks and trails master plan, and engineering plans for flood mitigation, habitat restoration, and development of public green spaces and recreation areas.

The coalition brings together stakeholders from industry, local governments and government agencies, community college systems, elected and appointed officials, and private individuals. Organizational and institutional members include KBR, Haliburton, Lyondell Bassell, CeterPoint Energy, Amegy Bank, the Port of Houston, various management districts and municipal utility districts, property owners associations, and the Lone Star College System. The majority of the coalition's activities include developing plans for the 45-mile span of Greens Bayou and then implementing those plans through site development and construction projects. Additionally, the coalition has engaged local stakeholders and members to shape those plans. Because its activities cover both planning and implementation, the coalition ties directly to an environmental compliance, sustainability planning, and pollution prevention green economy cluster as well as a green building and construction cluster.¹⁰²

Houston Coalition for Complete Streets

The Houston Coalition for Complete Streets states that its vision is: "Streets are safe for all users at all times throughout Houston." It currently counts 33 coalition members including professional associations, neighborhood associations, management districts, neighborhood business

¹⁰¹ <http://www.ctchouston.org/wordpress/>

¹⁰² <http://greensbayou.org/>

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alliances, advocacy organizations, religious organizations, and educational institutions. Its overall goal is to advocate for complete streets which it defines as the following:

Complete streets provide a safer environment for pedestrians, bicyclists, vehicles, and residents, while attracting residential and commercial real estate investment. With less pavement and storm water runoff, Complete Streets can reduce capital and maintenance costs. Complete streets increase connectivity, including the ped/bike network and the “Bayou Greenways” program. By promoting walking and cycling in urban neighborhoods and districts, Complete Streets can improve community health and obesity rates.

It organizes a number of activities to achieve a longer term goal of transforming roadways in Houston to complete streets. It has organized a petition drive among citizens that advocates that the City of Houston should adopt a policy of using complete streets design principles in all projects under the ReBuild Houston initiative. It provides information about alternative transportation options and activities that Houston residents can take advantage of for both commuting and entertainment purposes. In addition to these resources and activities, the Houston Coalition for Complete Streets also helps organize the Better Block Houston event. A Better Block event temporarily transforms an existing street into a complete street using makeshift street furniture and fixtures and organizes vendors and activities to enliven the street for a brief period of time. The intended purpose of a Better block event is to demonstrate to the general public what a complete street is and promote its advantages. Given its public infrastructure and development goals, the Houston Coalition for Complete Streets could help support a green building and construction, a transportation/ alternative fuel vehicles, and an environmental compliance, sustainability planning, pollution prevention cluster in Houston.¹⁰³

Houston Renewable Energy Group

The Houston Renewable Energy Group (HREG) is the local chapter of the Texas Solar Energy Society. Its goal is to provide “residents in the Houston metro area on renewable energy technologies, energy efficiency, conservation and green building techniques and innovations.” HREG largely focuses on the technical and policy aspects of renewable energy. It also concentrates on a number of other renewable energy technologies and energy efficiency measures, as well as on how renewable energy technologies can be incorporated into buildings and other development projects. HREG holds quarterly meetings for members to learn about new developments in renewable energy technologies and policies. HREG also publishes an online newsletter and maintains an email forum for members to exchange ideas and information about new developments in the industry. HREG hosts an annual Renewable Energy Tour of local projects. And it also organizes educational workshops and partners with other organizations to host them as well. Membership in the group spans industry, academia, local government, research institutions, and

¹⁰³ <http://houstoncompletestreets.org/>

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nonprofit organizations. HREG ties directly to energy generation, renewable energy, energy storage; green building and construction; and biofuels/farming/agriculture green economy clusters.¹⁰⁴

Houston Renewable Energy Network

The Houston Renewable Energy Network (HREN) is a coalition of professionals that focus on renewable energy technologies and markets. While Houston Renewable Energy Group focuses on the policy and technical aspects, HREN focuses much more on the business side of renewable technology. While the two coalitions are distinct, they frequently collaborate and co-sponsor events and programs.

The HREN holds quarterly speaking events that focus on different issues that impact businesses and professionals that focus on renewable energy. Previous topics have included issues such as global, federal and state climate policy; wind energy transmission; biofuels energy; and renewable energy priorities at the Texas Legislature. Overall, HREN gives local professionals and businesses working in the renewable energy sector information that can help them advance their businesses and provide networking opportunities to where individuals can share ideas. As with HREG, the Houston Renewables Energy Network ties directly to energy generation, renewable energy, energy storage; green building and construction; and biofuels/farming/agriculture green economy clusters.¹⁰⁵

National Algae Association

The National Algae Association headquartered in The Woodlands is an organization that provides technical and educational support for companies and individuals focused on developing algae-based biofuels. The National Algae Association has established a certificate program “to introduce individuals to the multifaceted concepts of not only strain selection, cultivation, harvesting, and extraction methods; but also the economic considerations prevalent in the commercial algae production industry.” The National Algae Association provides both local and national business opportunity listings and job opportunities on its web site. The National Algae Association conducts research on technological advances for algae-based biofuel production, has a committee that develops and reviews fuel specifications, and works to establish an incubator program for landowners and biofuel entrepreneurs looking to establish biofuel production. The National Algae Association would provide direct support to a biofuels/farming/agriculture green economy cluster.¹⁰⁶

Texas Association of Environmental Professionals

The Texas Association of Environmental Professionals (TAEP) is a membership based association with over 300 environmental professionals in the Houston area. TAEP holds monthly

¹⁰⁴ <http://houstonrenewableenergy.org/>

¹⁰⁵ <http://houstonrenewables.org/>

¹⁰⁶ <http://www.nationalalgaeassociation.com/index.html>

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luncheons to educate and update members on regulatory issues and major environmental planning issues that the Houston region faces. The presentations provide industry professionals continuing education credits for maintenance of their professional accreditations. TAEP also provides online information about regulatory updates that impact the work that environmental professionals perform. TAEP also organizes the annual Environmental Challenges and Innovations Conference. Topics covered at the conference include remediation, operations, due diligence, technology innovation, environmental risk and liability, wetlands and water bodies, air quality, and ethics. In addition to this conference, TAEP organizes Annual Regulatory Updates, as well. TAEP also provides educational opportunities and scholarships to college students and outreach opportunities for engaging youth on environmental issues. And TAEP also organizes networking events for young environmental professionals in the region. TAEP's activities would help support an environmental compliance, sustainability planning, and pollution prevention green economy cluster in Houston.¹⁰⁷

Urban Harvest

Urban harvest views itself as the leader in the local food movement in Houston. Its mission is to “[promote] healthy communities, sound nutrition and respect for the environment by educating children and adults and facilitating harvest and habitat gardens.” It organizes a number of programs that support a local food movement in the Houston area. Its most visible efforts are the farmers markets that it organizes during the week – the seasonal City Hall farmers market it organizes on Wednesdays during warmer months and the farmers market it organizes in the Upper Kirby District on Saturdays and Sundays. Urban Harvest provides local produce growers, ranchers, and food producers the administrative and logistical support necessary for local agriculture to develop. Urban harvest also provides education support by offering continuing education classes on topics such as growing organic vegetables and gaining a permaculture designers certificate.

In addition to the support Urban Harvest provides local agriculture and food industry professionals, Urban Harvest also provides support for local community gardens through complimentary spots in their workshops, free seeds, volunteer referral, and by including information about the garden in its community garden listings. Urban Harvest also helps local schools with establishing school gardens and provides curriculum support for agricultural education for local schools. Given its programs and services, Urban Harvest can provide support for the development of a biofuels/ farming/ agriculture green economy cluster.¹⁰⁸

Urban Land Institute Houston (ULI-Houston)

The Urban Land Institute Houston is the local district council of the national organization of the same name. ULI's mission is to “provide leadership in the responsible use of land and in building sustainable, thriving communities.” ULI-Houston brings together professionals from across the real estate spectrum “including property owners, investors, advisers, developers, architects, lawyers,

¹⁰⁷ <http://www.taep.org/>

¹⁰⁸ <http://urbanharvest.org/home>

lenders, planners, regulators, contractors, engineers, university professors, librarians, students and interns.” ULI-Houston organizes presentations and workshops that focus on improving the overall development of Houston through green building principles such as transit and pedestrian-oriented development and mixed use projects. Presentation topics cover aspects of the entire development process – from project finance to design and construction to ongoing operations. In addition to the formal presentations, ULI-Houston also organizes tours of noteworthy projects that demonstrate sustainable development principles. ULI-Houston also provides networking opportunities for local professionals. With regards to outreach, ULI-Houston works to educate local public leaders about the merits of sustainable community development, works with local universities to advise on curriculum development for real estate professionals, volunteers with local community groups facing land use challenges, provides seed capital for community projects, and convenes open discussions on the ties between health and sustainable development. ULI-Houston also annually gives awards to local projects that demonstrate excellence in sustainable land use and development. With a membership of several hundred individuals and organizations, ULI-Houston could provide strong support for the development of a green building and construction green cluster in Houston as well as indirect support for a transportation/ alternative fuel vehicles and environmental compliance, sustainability planning, and pollution prevention clusters.¹⁰⁹

U.S. Green Building Council - Texas Gulf Coast Chapter

The U.S. Green Building Council - Texas Gulf Coast Chapter brings together professionals from the architecture, design, manufacturing, and construction industries to promote the development of green buildings in the Houston region. Many of the chapter’s activities focus on USGBC’s LEED (Leadership in Energy & Environmental Design) green building certification program. Such activities include educational workshops and meetings for professionals interested in passing tests to gain USGBC’s Green Associate or Accredited Professional designation. The chapter also provides additional education opportunities for professionals on individual topics related to green buildings and construction. The chapter also organizes its Annual Energy Summit that focuses on new developments in green building practices and policy, regulatory, and economic issues that impact the building industry. The chapter also organizes tours of local green building projects to education professionals about green building solutions. The USGBC Texas Gulf Coast Chapter represents a useful resource to support a green building and construction green economy cluster as well as the energy generation, renewable energy, and energy storage cluster.¹¹⁰

These coalitions and alliances represent the array of resources that can provide support for the development of resources for a green economy in Houston. The more narrowly focused coalitions and alliances can contribute greatly to that development. In particular, the green building and construction; the environmental compliance, sustainability planning, pollution prevention green economy cluster; and the energy generation, renewable energy, energy storage clusters have a number of resources to draw upon both in terms of program support as well as

¹⁰⁹ <http://houston.uli.org/>

¹¹⁰ <http://usgbctexasgulfcoast.org/index.php>

networking opportunities. Many of the coalitions are highly active and represent a broad range of interests and stakeholders.

Yet while these more focused coalitions provide useful support for specific aspects of a green economy, Houston largely lacks environmental and social justice coalitions that can provide broader support for a green economy at large. While the Greater Houston Partnership has an annual budget nearing \$14 million;¹¹¹ an active membership that includes major civic, business, and academic leaders; and receives support from many of the largest employers in the region, its fundamental goal is to increase economic activity in the city and draw new businesses into the region. As such, issues related to sustainability and a green economy are peripheral to its primary efforts. While the Citizens' Environmental Coalition does represent a broad constituency of green alliances, its roughly \$80 thousand annual budget is less than 1% of the Greater Houston Partnership's.¹¹² As such, its ability to have a significant impact on the overall direction of a green economy in the city is fairly limited. A green coalition or alliance that had significant resources, a constituency that included both environmental coalitions as well as major civic, business, and academic leaders, as well as support from major employers and businesses in the city would have a much greater impact on the overall direction of a green economy in Houston.

¹¹¹ (Greater Houston Partnership, 2013)

¹¹² (Citizens' Environmental Coalition, 2013)

Local Perspectives on the Green Economy

In order to supplement this qualitative and quantitative analysis, it is useful to understand individual viewpoints on the local green economy. As part of the research for this project, I conducted interviews with a sample of individuals that represent stakeholders' viewpoints of a green economy in Houston. While these perspectives in no way should be interpreted as an exhaustive review of opinions of a green economy in Houston, they do represent a snapshot of the major issues that these individuals feel surround the current and future state of one. The following individuals participated in interviews for the purpose of this report:

- **Violeta Archer**, President of the Houston Renewable Energy Group
- **Lisa Lin**, Sustainability Manager, Office of Sustainability, City of Houston
- **Joshua Owens**, Senior Regional Planner, Houston-Galveston Area Council
- **Rachel Powers**, Executive Director, Citizens' Environmental Coalition
- **Adrian Shelly**, Executive Director, and **Tifani Pust**, Artistic and Educational Programs Director, Air Alliance Houston
- **Amanda Tullos**, Houston Chapter of the American Institute of Architects, Committee on the Environment

At a broader level, interviewees expressed that there are a number of cultural and physical drivers that impact the development of a green economy in Houston. A number of people commented on how Houston's immense size, both in terms of geography and population, impacts the development of a green economy in Houston. Unlike Austin which is smaller and more culturally cohesive, Houston's immensity means that it exists as a collection of communities that are separated by distance and by culture. As such, getting a message out about opportunities in a green economy can present a challenge. Long commute times mean that people have less time to devote to learning about a green economy and can be isolated from their peers, though an abundance of open and accessible professional networks are seen to help mitigate the geographic barriers Houston's size presents. Additionally, significant infrastructure investment is prioritized towards suburban developments, which constrain growth of the green economy. Legacy infrastructure closer to the center of Houston prevents adoption of numerous technologies and developments that a green economy would provide. The significant numbers of governing jurisdictions can hamper green economy development. For example, the fact that there are nearly 3,000 Municipal Utility Districts limits adoption of creating biofuels from wastewater at sewage treatment facilities. And some individuals perceived the fact that working populations to be somewhat transient within the city. With individuals only spending a certain number of years in Houston, they may be less inclined to engage in long term initiatives that would help grow a green economy in the city.

The pro-business attitude that dominates the local culture is useful when a green economy business opportunity is proven to be successful. Because of its recently booming economy, there are tremendous resources within the region for investment. However, the same pro-business attitude means investors seek results and can be relatively risk averse. This low risk tolerance leads to less support for entrepreneurial activities and innovation that could underpin a green economy.

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This attitude also translates into how companies work with each other: existing business-to-business relationships have significant traction. Purchasing habits, therefore, can be challenging to change. Pro-business attitudes also mean local stakeholders do not always recognize the potential opportunities and benefits a green economy could provide, as the value of externalities have proven difficult to quantify. Recent extreme droughts and falling water tables, though, have raised local stakeholders' attention towards the growing need to adapt to a changing climate and the potential economic benefits that that adaptation could provide.

In some instances, the pro-business attitudes are compounded by financial constraints from market forces. These constraints limit adoption of green economy services and products. For example, the financial requirements imposed by commercial mortgage backed securities mean that Class B and Class C commercial property owners are dis-incentivized from improving their investments. The financial implications of low natural gas prices make many alternative energy projects infeasible given low energy prices. Low electricity costs also present a restraint. When developers want to develop power co-generation facilities, electricity producers attempt to reduce rates to make the projects financially untenable.

Some individuals saw Houston as a relatively antagonistic environment to a green economy and that it was actually struggling in the region. They do not see green businesses being supported at a broad level or see any cohesive effort to develop a green economy in Houston. One cited the fact that there was no green business alliance indicated a lack of support for a green economy. Others went a bit further and indicated that there was a lack of support for small businesses in general. As such, entrepreneurs struggled in the city. One individual cited that in the last 6 to 8 months, there were three businesses that she could identify as green economy businesses that had actually failed. In areas where there is potential demand for green services, there are no firms or organizations to meet that demand. For example, a number of recycling centers have closed in recent months. And one individual stated that any effort to depart from mainstream business practices was actively quashed. A few indicated that because of the booming economy, there is a lack of incentive to invest in anything but fossil fuels. And a number of individuals criticized Houston's Office of Sustainability for not taking on bolder and broader steps towards sustainability in the city.

Viewpoints also differ when people focus more specifically on the current state of a green economy in Houston. Some individuals expressed opinions of extreme optimism, while others had a more pessimistic perspective. Some individuals cited a number of ways they felt there were opportunities for a green economy in Houston. They felt many people now want to live in walkable, mixed use communities. There has been a noticeable increase in bicycle activity – both because of the B-Cycle program and individual bike ownership. Though still somewhat controversial with the population at large, many did see the expansion of the METRORail system as expanding opportunities for green economy growth. Most residents in the region are also acutely aware of stormwater issues and support stormwater planning efforts.

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A number of individuals saw the green building and construction cluster as the most robust in the region. Several individuals indicated that some level of LEED certification has become an expected prerequisite for all new Class A commercial office buildings in the city. Programs that are encouraging Class B property owners to upgrade their buildings are also seen as beneficial. While adoption of residential green building practices are less prevalent, people do see attitudes changing and indicators of possible future success. A new green builders group is in the process of developing. The streamlining of permitting for renewable energy systems and the code requirement that all new construction be able to accommodate those systems is seen as particularly beneficial.

In addition to a healthy green building and construction cluster, a number of people also saw a great deal of activity within the environmental compliance, sustainability planning, and pollution prevention cluster. Most attention was focused on long term investments in public infrastructure. Several individuals cited efforts in stormwater management. The extensive flooding mitigation projects implemented across the region were seen as a boon for this cluster. Harris County's Low Impact Design standards were seen as particularly innovative as they were adopted by other governments within the area. The extensive hike and bike network and natural habitats incorporated into the flood mitigation projects further underline their success. A number of people also emphasized the planning efforts to transform roadway infrastructure as indicators of success in the cluster. ReBuild Houston and Complete Streets initiatives were highlighted in particular. Air pollution was one area of the cluster where people had mixed viewpoints. A number of people cited the city's continual poor air quality as indicator of weakness. Others indicated that there was, in fact, a great deal of activity around air quality. That activity, however, was centered on defending large corporations from law suits and regulatory efforts of the US Environmental Protection Agency.

A number of people highlighted the transportation and alternative fuel vehicles cluster as showing signs of progress, though many felt Houston would remain an automobile centric city for a number of years. Many people cited expansion of the B-Cycle program and increased interest in having bicycles included within planning efforts as an area of progress. The construction of the expanded light rail system was also seen as providing jobs within this cluster. One person cited the entrance of alternative driving platforms such as Zipcar, Uber, Lyft, and Rideshare as indications of significant opportunities in the transportation and alternative fuel vehicle cluster for the Houston area. And the shale gas boom also meant that more people were considering converting vehicles to compressed natural gas for fuel.

The energy generation, renewable energy, and energy storage cluster was seen with a more nuanced perspective. With shale gas dominating a renewed interest in the energy sector, many saw little interest in the sustainable aspects of energy given Houston's dominant position in the global oil and gas sector. The lack of state-level incentives for renewable energy is also seen as a hindrance. However, not everyone expressed such pessimism. Houston is seen to play a significant role in transforming Texas into a leading producer of wind energy. Many attributed that position to the efforts local companies undertook to develop many of the west and north central Texas wind farms and because of the Port of Houston acted as a domestic gateway for large scale wind turbines.

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Additionally, because of the multinational scale of many of Houston's energy companies, many felt their internal efforts with regards to renewable energy are not always apparent to local residents.

Many people saw little in terms of success in the remaining two clusters. Other than a great deal of activity with local farmers markets, few individuals saw any signs of growth within the biofuels, farming, and agriculture cluster. Once again, the boom in shale gas was seen as significantly hampering any developments in biofuels. While a number of people cited the One -Bin-For-All program with regards to recycling, many saw it as an inferior solution for recycling. There was, however, recognition that there are financial opportunities of taking advantage of those growing waste streams.

Viewpoints were equally varied when looking to the future of a green economy in the city. Some individuals expressed optimism especially with regards to changing attitudes. These individuals felt that such changing attitudes would slowly lead consumers and investors choose more sustainable options for their daily needs. One individual gave the example that, in talking to people who had recently switched to driving a Tesla, they would never go back to a fossil fuel vehicle. This individual felt more consumers would try sustainable options, enjoy the results, and never look back. As attitudes change, the biggest potential for economic growth across all clusters was in activities that help conserve resources. Those efforts would lead to the biggest potential gains for both consumers of conservation services and the firms that provide those services. Additionally, many felt local residents would more likely adopt conservation measures since they frequently saved people money.

Others, however, felt no such optimism. Several cited efforts by the state that severely limited the potential growth of a green economy in Houston. One, for example, felt that the only solution that the Texas Department of Transportation understood with regards to transportation planning was to build more roads. Another cited how lower level officials at the Texas Department of Environmental Quality were actually stymied in their efforts to enforce air quality standards by higher level appointed officials. Many felt that until policies changed at a state level, there would be very little green economic development in Houston.

In terms of particular clusters, a few standouts emerged. A number of individuals saw continued growth in the green building and construction cluster with its growth trajectory varied from steady to exponential. Many felt that green building practices would start to become as pervasive in the residential market as in the commercial market. While builders may not market their homes as "green" or identify themselves as "green" builders, they would adopt many green building practices to reduce energy and water consumption as homebuyers demanded higher efficiency. Others felt that there were also still opportunities for commercial buildings to undergo deeper efficiency upgrades. Additionally, increased commute times have the potential of creating a backlash against further sprawl. A corollary effect of long commutes would be that people will want to avoid using their car when they could. As such, there will be increased demand for horizontally mixed use developments where residents can minimize driving. This type of

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development will become even more prevalent within the Loop and older neighborhoods just outside the loop as individuals look to decrease their commute times.

Transportation was also an area some people felt there was growth potential. The introduction of car-sharing and ride-sharing platforms in Houston could potentially have a significant impact for commuters and for local drivers. Increased bicycling activity would lead to increased sales and servicing as the extensive network of bayou greenways will open up vast stretches of the city to bicycles. Lisa Lim with the city indicated that the city regularly receives inquiries from companies looking to install electric vehicle charging stations throughout Houston. Increased numbers of charging stations would make driving electric vehicles much more appealing. One person highlighted the re-imagining of Metro's entire bus network. That individual felt such a transformation allows for the creation of more comprehensive alternative transportation networks further boosting the cluster. And while its future is still far from secure, a few individuals highlighted the fact that the initiative to develop high speed rail service between Houston and Dallas is gaining traction. Such service could have a significant impact on transportation networks in both cities.

Given the concentration of the energy sector in Houston, many felt there would be continued growth in the energy generation, renewable energy, and energy storage cluster. As now, the growth of that cluster might be difficult to ascertain as much growth would happen within much larger global corporations. One individual gave the anecdotal example of speaking to many people within oil and gas companies who were interested in pursuing jobs in renewable and alternative energy systems. Newly enacted legislation that allows municipalities to develop Property Assessed Clean Energy (PACE) financing to provide financing to alternative energy capital projects would also likely bolster this cluster.

Viewpoints on the future of the remaining clusters were varied. Few saw much progress in the biofuels, farming, and agriculture or waste, waste management, and recycling clusters. The continued boom in shale gas would stymie the biofuels cluster which would otherwise have an advantage in Houston. One individual noted that landfills are cheap in Texas. As such, there would be little economic incentive for growth in the waste, waste management, and recycling clusters. Many felt that the environmental compliance, sustainability planning, and pollution prevention would likely continue on its current trajectory. Many of the long term planning initiatives in the region – flood control, roadway and infrastructure transformation, and hike and bike trail planning – would lead stability within this cluster.

With respect to what Houston needs to grow a green economy, viewpoints once again varied but a few common themes did emerge. A number of people saw a lack of leadership with regards to a green economy in Houston, especially with regards to the business community. While some individual clusters had strong leadership – the green building and construction cluster was frequently mentioned in that regard – many saw a lack of leadership to bring together groups from across all clusters. As such, some individuals saw duplication of efforts. Some individuals felt that the Citizens' Environmental Coalition should take that leadership role, but it had struggled in recent

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years and lacked resources. Others, however, stated that there was a need for a complementary organization that brought together for-profit firms. Whatever form of leadership was needed, there was almost universal consensus that there was a need for increased communication and coordination across different groups to reinforce each other's efforts.

Another common viewpoint was the need to speak about the green economy in terms of quality of life issues. Most agreed that framing it in terms of quality of life has a number of benefits. With a large conservative population, many in Houston view environmental issues with suspicion or outright antagonism. However, when described in its constituent parts – clean air and water, local and organic foods, mixed use neighborhoods, walkability, access to greenspace, lower energy and water bills, etc. – those interviewed felt many stakeholders across the ideological spectrum would respond more favorably to supporting a green economy. In addition to connecting green economy issues to local individual interests, many interviewees indicated that increased quality of life is important for attracting talent to Houston. Reprioritizing the focus of development towards the inner city and away from continued sprawl will lead to significant improvements in that quality of life. With a number of disadvantages when compared to cities like San Francisco or Seattle, many felt that developing a green economy would positively impact the quality of life in the city as many green economy firms evaluate quality of life when considering relocation. As such it would be an issue the Houston business community could support.

One individual gave an example of how demonstrating a green economy in terms of quality of life can be successful. The Houston Land Water Sustainability Forum was held in 2010 and had a Low Impact Design competition focusing on suburban residential development, urban residential development, and a green roadway project. Engineers, architects, landscape architects, and designers developed proposals for each category that not only conserved natural resources, but also reduced overall development and operational costs. A number of environmental professionals acted as the jury. Local developers, who had never been exposed to low impact design, also attended the final presentations. The interviewee said that these developers were astonished with the results of the competition and realized many of the amenities the design teams proposed could become selling points for their developments. One new development near the Woodlands is incorporating many of these concepts as amenities for its residents. She felt that demonstrating that green economy solutions can provide positive financial outcomes can be a powerfully persuasive argument to local business leaders. She felt that more of these types of interactions across all sectors of a green economy would have a powerful impact in Houston. While developing a green economy in Houston will present a significant challenge, this interaction proves that it is possible to develop one.

Conclusion: Linking Industries, Occupations, Policies, and Coalitions in Houston

What the Analysis Tells Us

While the Houston-Sugar Land-Baytown Metropolitan Area is not as developed as other areas, such as San Francisco-Oakland-Fremont or Boston-Cambridge-Quincy, there are a number of resources within the area that have the potential of underpinning a green economy. From an economic development and an institutional standpoint, there are many opportunities for local stakeholders to take advantage of in a green economy. Yet, many of the institutional structures that would underpin a green economy would require additional development for it to thrive in the area. However, many of the existing institutional structures could be built upon and would not necessarily need to be created outright.

At a government level, there has been progress made to develop the structures that a green economy can depend upon. The recent development of the City of Houston's Office of Sustainability demonstrates a strong first step by the city which had previously demonstrated a limited commitment to sustainability issues. Since its creation, it has spearheaded a number of highly visible initiatives such as the B-Cycle program, the Green Office Challenge, and the City Hall Farmers market that are generally viewed as successful. While some community members criticized the Office of Sustainability for not taking bolder steps with regard to making sustainability a priority both within city government and the broader community at large, others recognized its achievements given its limited resources. Overall, however, there are many opportunities for the Office of Sustainability to launch new initiatives, especially with regards to more comprehensive and cohesive sustainability and climate adaptation plans. The fact that the Office of Sustainability is currently drafting a sustainability action plan is a positive step in this regard.

In addition to opportunities for expansion of environmental policy, there is also an opportunity to bridge sustainability efforts between different governments and governmental agencies within the region as well as tying sustainability efforts to economic development efforts. Various local governments and governmental agencies, such as Harris County, the Port of Houston, the Metropolitan Transit Authority, and the Houston-Galveston Area Council, have spearheaded a number of sustainability efforts within the region. There are opportunities for those bodies to enhance coordination between themselves to further advance sustainability efforts within the city. While the Houston-Galveston Area Council has acted to coordinate regional activities, there are additional opportunities to work with economic development officials to tie sustainability efforts to economic development efforts. Such coordination could have tremendous economic, environmental, and social benefits for the entire region.

Public efforts to tie sustainability to economic development needs to be matched by private efforts. While the Greater Houston Partnership and the Citizens' Environmental Coalition focusing some programming on linking the two, there is no overarching green business alliance in Houston to

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bring stakeholders together to focus on developing a green economy. And while a number of individual clusters do have robust professional networks that support green economy efforts – those in the green building and construction cluster, for example – there is a lack of coordination that allows groups to connect efforts across different clusters. As such, there are duplicated and overlapping efforts toward supporting a green economy. Options for increasing coordination would be: to develop a new green business alliance that connects stakeholders from different green economy clusters; have the Greater Houston Partnership or Citizens' Environmental Coalition step into this role; or have another existing network, such as the participants of the Green Office Challenge, formalize their coordinating activities and act as a umbrella business alliance organized around green economy goals. Local stakeholders should be engaged to determine the best solution for Houston.

While there is significant potential for success in aligning business efforts with sustainability goals, the potential of incorporating social justice efforts and equity goals into those activities is less clear. In terms of nonprofit institutional support, the social justice nonprofits in the area are few and have relatively limited resources. Since union activity in the region is also limited, those organizations also have few resources to influence broader efforts towards incorporating equality goals. And the prevalent pro-business attitude in the region further hampers the potential of tying social justice goals to economic and environmental goals. If many of the benefits of a green economy are to be spread throughout all residents of Houston, social justice goals must be incorporated into any efforts to grow a green economy.

Focusing on a number of the specific green economy clusters in the Houston-Sugar Land-Baytown MSA, there are significant opportunities for developing a robust green economy in Houston. By far the most robust and well developed cluster is the green building and construction cluster. There are numerous policy initiatives that are relevant to developing this cluster. These policies include: The City of Houston's Brownfield Redevelopment Program, its Energy Efficiency Incentive Program, its Green Building Resolution, its Green Office Challenge, its LEED Silver target for municipal buildings, its Residential Energy Efficiency Program, its Urban Planning Corridor Initiative, the Port of Houston's Clean Air Strategy Plan, the Houston-Galveston Area Council's Eco-Logical GIS mapping tool, its Foresight Panel on Environmental Effects, and its Livable Centers Program. Based on industry data, employment within this cluster accounts for 279,893 total jobs and 16,965 establishments. This cluster represents 12.86% of employment in the region and 13.85% of establishments. The most prominent industries include: specialty trade contractors; engineering services; construction of buildings; plumbing, heating, and air-conditioning contractors; electrical contractors and other wiring installation contractors; commercial and institutional building construction; electric power generation, transmission and distribution; residential property managers; industrial building construction; and all other specialty trade contractors. Prevalent occupations include: engineers all other; architectural and civil drafters; boilermakers; cement masons and concrete finishers; construction laborers; structural iron and steel workers; hazardous materials removal workers; helpers--installation maintenance and repair workers; structural metal fabricators and fitters; and welders, cutters, solderers, and brazers. Given the large numbers of

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policies and green business alliances that play a very active role in this cluster as well as the high level of employment and number establishments, it is clear that this cluster is robust and has potential for continued growth in Houston.

There are also potential opportunities to develop a transportation and alternative fuel vehicle cluster in Houston. The development of this cluster is especially important given the importance mobility will play in Houston's long term growth. Given mobility's importance, it comes as no surprise that there are numerous policy initiatives in the region that are relevant to a transportation and alternative fuel vehicle cluster: The City of Houston's City of Houston Urban Planning Corridor Initiative; its ReBuild Houston program; its B-Cycle Bike Sharing program; its municipal fleet-sharing program; its electric vehicle fleet program; its municipal electric vehicle charging programs; the Port of Houston's Port Drayage Truck Bridge program; the Metropolitan Transit Authority's MetroRail expansion; its high-occupancy vehicle lane expansion program; its 2025 Regional Transit Plan; its Transit System Reimagining Project; its hybrid bus fleet; its installation of bus racks on buses; and its vanpool fleet; the Houston-Galveston Area Council's Annual Mobility Report; its Transportation Improvement Program; its 2040 Regional Transportation Plan; its Clean Cities and Clean Vehicles Program; its Area Emission Reduction Credit Organization; and its Eco-Logical GIS mapping tool. Though not nearly as large of an amount of employment in the area, this still represents a high number of jobs in the region. Total employment in the cluster is 133,179 based on industry analysis while the total number of establishments is 6,049. As a percentage of total employment, these figures represent 6.12% of total employment and 4.94% of total establishments. While there are no occupations associated with this cluster in high concentrations, industries with the highest employment include: engineering services; automobile dealers; general freight trucking; specialized freight trucking; electric power distribution; testing laboratories; other automotive repair and maintenance; and transportation equipment manufacturing. While there is less occupational emphasis in this cluster, there are significant policy initiatives associated with it, and there is a healthy level of employment in it as well. Given the continued importance of mobility in the region, there are opportunities for development within this cluster.

While Houston is closely associated with the global energy sector, much of that association comes from the oil and gas and the petrochemical industries. The energy generation, renewable energy, energy storage green economy cluster represents a smaller, but still significant, percentage of that economic activity. While there are fewer policies in the region focusing on this cluster, there are still a number of policies that do tie to it. In addition to the fact that Houston is the largest municipal purchaser of renewable energy in the country, the following policies and initiatives are relevant to this cluster: the City of Houston's Solar PV test installations at municipal buildings; its streamlined solar permitting process; solar powered emergency command posts created from converted shipping containers; code requirement for all homes to be ready for installation of solar energy systems; and the State of Texas's PACE Financing Program. Employment in this particular cluster is also not as robust as in the previous two clusters. Based on industry analysis, total employment in the cluster is 85,184, while there are 3,109 establishments in it. These figures

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represent 3.95% of total employment and 2.54% of total establishments in the region. The most prominent industries include: specialty trade contractors; engineering services; construction of buildings; plumbing, heating, and air-conditioning contractors; electrical contractors and other wiring installation contractors; commercial and institutional building construction; electric power generation, transmission and distribution; all other specialty trade contractors; residential property managers; and industrial building construction. Occupations with high concentrations in the area include: geological and petroleum technicians; first-line supervisors of construction trades and extraction workers; service unit operators oil gas and mining; wind turbine service technicians; machinists; and plant and system operators all other. While overall employment in this cluster may not be as high as in the previous two clusters, certain occupations are in particularly high concentrations in the region with geological and petroleum technicians, service unit operators oil gas and mining, and wind turbine service technicians in concentrations six to eleven times higher than in other areas of the country. Given its prominence in the global energy sector and very high concentrations of employees in occupations that can support this cluster, there is significant potential for growth in this cluster. Additional policy initiatives would contribute to the success of this cluster.

The remaining three clusters are less developed in the city and present less clear opportunities for growing a green economy in Houston. The waste, waste management, and recycling cluster does not represent a significantly consequential level of economic activity in Houston. With limited policy initiatives in the region, growth in the cluster is not certain. Local policies include: the City of Houston's One-Bin-For-All Initiative; the Metropolitan Transit Authority's Recycling policy; and its Vehicle scrapping policy. Full scale development of the One-Bin-For-All program could lead to increased economic development in this cluster. Employment in the cluster is moderate. Based on an industry analysis, total employment in this cluster is 80,808, and it has 3,452 total establishments. These figures represent 3.71% of total employment and just below 2.82% of total establishments. As one interviewee indicated, the presence of inexpensive landfills in Texas may contribute to fewer initiatives in this cluster. As such, it is unclear whether there are areas for significant development in this cluster.

The biofuels, farming, agriculture cluster has limited potential for development. Other than the launch of the City Hall farmers market, there are few policy initiatives to support this cluster. Based on industry analysis, total employment in this cluster is 64,551, and it has 2,793 establishments. These figures represent just below 3% of total employment and just above 2% of total establishments. As several interviewees commented, the shale oil boom in Texas may be hampering development of this cluster, especially in the biofuels area. Given this data, there is likely very little space for development of this cluster.

The final environmental compliance, sustainability planning, and pollution prevention cluster represents a bit of an uncertainty with regards to future development. On one hand, there are significant policy initiatives that tie directly to this cluster. However, actual employment in this cluster represents a minute fraction of overall employment in the city. Policy initiatives in this

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cluster include: the City of Houston's Brownfield Redevelopment Program; Urban Planning Corridor Initiative; its Texas Clean Rivers Program; its Parks and Recreation "Demonstrating Environmental Leadership" Initiative; its Comprehensive Drainage Plan; its Water Conservation Task Force; Harris County's Harris County Flood Control District; its Low-Impact Development & Green Infrastructure Criteria for Stormwater Management; its Stormwater Quality Program; its Greens Bayou Wetlands Mitigation Bank; its Vegetation Management Program; the Port of Houston's ISO 14001 Certification; its Clean Air Strategy Plan; its Bayport Container Terminal stormwater treatment program; its Better Bay Initiative; the Houston-Galveston Area Council's Clean Air Action Program; its Regional Air Quality Planning Advisory Committee; its Clean Waters Initiative; and its Natural Resources Advisory Committee. Given these significant number of policies, there could be opportunities in this cluster. However, employment levels do not provide the same level of support. Based on industry analysis, total employment in the cluster is only 14,719, and it has 1,228 establishments. This is only 0.68% of total employment and 1.00% of total establishments. Given the dichotomy between policy and employment in this cluster, the opportunities or developing it are unclear.

Based on this cluster analysis, there are clear areas that economic development stakeholders can focus their attention. Three of the outlined clusters represent moderate to significant potential opportunities for development. Each cluster has economic, demographic, and institutional structures in place to allow them to develop. Support from a broader-based green alliance could help bolster the activities of coalitions that support individual clusters. Such support could help local stakeholders better manage resources and help coordinate activities that could drive development of each of the identifies clusters. While green employment may not be currently be a central focus of economic development efforts, Houston could focus its resources to allow it to grow.

Table 17: Green Building and Construction Green Economy Cluster

Sample Policies by Green Economy Cluster	Prevalent Occupations	Employment	Establishments	Industries with Highest Employment	Alliances/ Coalitions Associated with Cluster
City of Houston <ul style="list-style-type: none"> • Brownfield Redevelopment Program • Energy Efficiency Incentive Program • Green Building Resolution • Green Office Challenge • LEED Silver target for municipal buildings • Residential Energy Efficiency Program • Urban Planning Corridor Initiative 	<ul style="list-style-type: none"> • Engineers All Other • Architectural and Civil Drafters • Boilermakers • Cement Masons and Concrete Finishers • Construction Laborers • Structural Iron and Steel Workers • Hazardous Materials Removal Workers • Helpers-- Installation Maintenance and Repair Workers • Structural Metal Fabricators and Fitters • Welders Cutters Solderers and Brazers 	279,893	16,965	<ul style="list-style-type: none"> • Specialty trade contractors • Engineering services • Construction of buildings • Plumbing, heating, and air-conditioning contractors • Electrical contractors and other wiring installation contractors • Commercial and institutional building construction • Electric power generation, transmission and distribution • All other specialty trade contractors • Residential property managers • Industrial building construction 	<ul style="list-style-type: none"> • Greater Houston Partnership • Citizens' Environmental Coalition • American Institute of Architects – Committee on the Environment • Green Bayou Corridor Coalition • Houston Coalition for Complete Streets • Urban Land Institute Houston • USGBC Texas Gulf Coast Chapter
		12.86%	13.85%		
		Percentage of Total Green Employment/ Establishments in Cluster			
Port of Houston <ul style="list-style-type: none"> • Clean Air Strategy Plan 					
Houston-Galveston Area Council <ul style="list-style-type: none"> • Eco-Logical GIS mapping tool • Foresight Panel on Environmental Effects • Livable Centers Program 					

Table 18: Biofuels/ Farming/ Agriculture Green Economy Cluster

Sample Policies by Green Economy Cluster	Prevalent Occupations	Employment	Establishments	Industries with Highest Employment	Alliances/ Coalitions Associated with Cluster
Houston <ul style="list-style-type: none"> • City Hall Farmers Market 		Total Green Employment/ Establishments in Cluster	2,793	<ul style="list-style-type: none"> • Engineering services • Testing laboratories 	<ul style="list-style-type: none"> • Greater Houston Partnership • Citizens' Environmental Coalition • American Institute of Chemical Engineers – South Texas Local • Urban Harvest
		Out of Total Employment/ Establishments in MSA	2.97%		

Table 19: Transportation and Alternative Fuel Vehicles Green Economy Cluster

Sample Policies by Green Economy Cluster	Prevalent Occupations	Employment	Establishments	Industries with Highest Employment	Alliances/ Coalitions Associated with Cluster
City of Houston <ul style="list-style-type: none"> • Urban Planning Corridor Initiative • ReBuild Houston • B-Cycle Bike Sharing • Municipal fleet-sharing program • Electric vehicle fleet program • Municipal electric vehicle charging programs Port of Houston <ul style="list-style-type: none"> • Port Drayage Truck Bridge Program Metropolitan Transit Authority <ul style="list-style-type: none"> • MetroRail expansion • High-occupancy vehicle lane expansion tool 		133,179	6,049	<ul style="list-style-type: none"> • Engineering services • Automobile dealers • General freight trucking • Specialized freight trucking • Electric power distribution • Testing laboratories • Other automotive repair and maintenance 	<ul style="list-style-type: none"> • Transportation equipment manufacturing • Greater Houston Partnership • Citizens' Environmental Coalition • Citizens' Transportation Coalition • Houston Coalition for Complete Streets • Urban Land Institute Houston

Table 20: Transportation and Alternative Fuel Vehicles Green Economy Cluster (cont'd)

<ul style="list-style-type: none"> • 2025 Regional Transit Plan • Transit System Reimagining Project • Hybrid bus fleet • Bus racks on buses • Vanpool fleet 	<p>Houston-Galveston Area Council</p> <ul style="list-style-type: none"> • Annual Mobility Report • Transportation Improvement Program • 2040 Regional Transportation Plan • Clean Cities and Clean Vehicles Program • Area Emission Reduction Credit Organization • Eco-Logical GIS mapping 			<p>6.12%</p>	<p>4.94%</p>	
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Table 21: Waste, Waste Management, and Recycling Green Economy Cluster

Sample Policies by Green Economy Cluster	Prevalent Occupations	Employment	Establishments	Industries with Highest Employment	Alliances/ Coalitions Associated with Cluster
Houston <ul style="list-style-type: none"> One-Bin-For-All Initiative 	<ul style="list-style-type: none"> Hazardous Materials Removal Workers 	80,808	3,452	<ul style="list-style-type: none"> Engineering services Testing laboratories 	<ul style="list-style-type: none"> Greater Houston Partnership Citizens' Environmental Coalition
Metropolitan Transit Authority <ul style="list-style-type: none"> Recycling policy Vehicle scrapping policy 		3.71%	2.82%		
		Total Green Employment/ Establishments in Cluster			
		Out of Total Employment/ Establishments in MSA			

Table 22: Environmental Compliance, Sustainability Planning, Pollution Prevention Green Economy Cluster

Sample Policies by Green Economy Cluster	Prevalent Occupations	Total Green Employment/ Establishments in Cluster	Employment	Establishments	Industries with Highest Employment	Alliances/ Coalitions Associated with Cluster
<p>City of Houston</p> <ul style="list-style-type: none"> • Brownfield Redevelopment Program • Urban Planning Corridor Initiative • Texas Clean Rivers Program • Parks and Recreation “Demonstrating Environmental Leadership” Initiative • Comprehensive Drainage Plan • Water Conservation Task Force <p>Harris County</p> <ul style="list-style-type: none"> • Harris County Flood Control District • Low-Impact Development & Green Infrastructure Criteria for Stormwater Management 	<ul style="list-style-type: none"> • Health and Safety Engineers Except Mining Safety Engineers and Inspectors • Engineers All Other • Electro-Mechanical Technicians • Environmental Engineering Technicians • Engineering Technicians Except Drafters All Other • Geoscientists Except Hydrologists and Geographers • Geological and Petroleum Technicians • Hazardous Materials Removal Workers 	Total Green Employment/ Establishments in Cluster	12,951	1,027	<ul style="list-style-type: none"> • Testing laboratories • Greater Houston Partnership • Citizens’ Environmental Coalition • Air Alliance Houston • American Institute of Chemical Engineers – South Texas Local • Citizens’ Transportation Coalition 	<ul style="list-style-type: none"> • Greens Bayou Corridor Coalition • Houston Coalition for Complete Streets • Texas Association of Environmental Professionals • Urban Land Institute Houston

Table 23: Environmental Compliance, Sustainability Planning, Pollution Prevention Green Economy Cluster (cont'd)

<ul style="list-style-type: none"> • Stormwater Quality Program • Greens Bayou Wetlands Mitigation Bank • Vegetation Management Program <p>Port of Houston</p> <ul style="list-style-type: none"> • ISO 14001 Certification • Clean Air Strategy Plan • Bayport Container Terminal's stormwater treatment program • Betterbay Initiative <p>Houston-Galveston Area Council</p> <ul style="list-style-type: none"> • Clean Air Action Program • Regional Air Quality Planning Advisory Committee • Clean Waters Initiative Natural Resources Advisory Committee 		<p>Out of Total Employment/ Establishments in MSA</p>	<p>0.60%</p>	<p>0.84%</p>		
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Table 24: Energy Generation, Renewable Energy, Energy Storage Green Economy Cluster

Sample Policies by Green Economy Cluster	Prevalent Occupations	Employment	Establishments	Industries with Highest Employment	Alliances/ Coalitions Associated with Cluster
<p>City of Houston</p> <ul style="list-style-type: none"> • Largest municipal purchaser of renewable energy • Solar PV test installations at municipal buildings • Streamlined solar permitting process • Solar powered command posts from converted shipping containers • Code requirement for all homes to be ready for installation of solar energysystems <p>State of Texas</p> <ul style="list-style-type: none"> • PACE Financing 	<ul style="list-style-type: none"> • Geological and Petroleum Technicians • First-Line Supervisors of Construction Trades and Extraction Workers (4) • Service Unit Operators Oil Gas and Mining • Wind Turbine Service Technicians • Machinists • Plant and System Operators All Other 	85,184	3,052	<ul style="list-style-type: none"> • Engineering services • Electric power generation, transmission and distribution • Electric power distribution • Testing laboratories 	<ul style="list-style-type: none"> • Greater Houston Partnership • American Institute of Architects – Committee on the Environment • Citizens’ Environmental Coalition • Houston Renewable Energy Group • Houston Renewable Energy Network • Texas Association of Environmental Professionals • USGBC Texas Gulf Coast Chapter
		3.91%	2.49%		
		Out of Total Employment/ Establishments in MSA			

Looking Ahead

These conclusions provide direction for future economic development efforts within the Houston area. The analysis highlights Houston's relative strengths relative to a green economy. Recognizing the three identified clusters where Houston has an advantage – green building and construction; transportation and alternative fuel vehicles; and energy generation, renewable energy, and energy storage – allows local stakeholders to focus their efforts. There are a number of ways local stakeholders can channel these efforts.

Framing the Green Economy

Before any individual strategy can be adopted to support the development of a green economy in Houston, stakeholders need to engage in a public dialogue to advocate for its growth. Yet, as a number of interviewees indicated in the local perspectives section of this report, the pervasive pro-business attitude that exists in Houston may hamper the development of a local green economy. They further indicated the existence of large swaths of the local population who are leery or outright hostile to sustainability efforts. However, the anecdotal example of local residential developers incorporating sustainable technologies into their new homes yet shying away from using any mention of sustainability in any marketing materials demonstrates that there are opportunities for a green economy to develop in Houston. How a green economy gets framed becomes important. Given local attitudes, there are two methods of framing a green economy in Houston that can reinforce one another and allow stakeholders across the ideological spectrum to embrace its development: green economy development as an economic issue or green economy development as a quality of life issue.

Many people view economic development goals and environmental protection goals as mutually exclusive. Protecting the environment is a “job killer.” However, given the emergence of increased demand for more sustainable options across various sectors of the economy, the goals no longer need to be conflicting. In order to diminish resistance to the development of the green economy, it is crucial to discuss it as an economic development issue and describe outcomes in terms of increased demand and increased job opportunity. Economic benefits are welcomed. Environmental benefits are viewed as either a secondary benefit or a benign side effect. Green business alliances that focus on economic benefits and work to achieve those economic benefits will likely see greater success than environmental groups merely focus on environmental results. While this framing type may not incorporate ideas of equity, many in the region that economic success will ultimately flow through the entire local economy and benefit all residents.

Developing a green economy can also be framed as a quality of life issue. With many Houstonians questioning how well their city compares to others, quality of life becomes an important issue. Local stakeholders can take advantage of this issue and discuss the development of a green economy in quality of life terms. The antagonism that locals may have towards the concept of sustainability can be diffused when people focus on many of the results of a green economy:

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clean air and water, local foods, mixed use neighborhoods with close proximity to daily needs, access to greenspace, lower energy and water bills, etc. There can be more consensus developed around achieving these common tangible goals than more abstract notions of sustainability. Focusing on quality of life also incorporates notions of equity. The benefits of developing a green economy are accessible to everyone and not just those that gained economic development.

Both of these framing methods are compatible with the pro-business attitude that culturally pervades Houston. Emphasizing economic benefits connects directly to such an attitude. Emphasizing quality of life connects more indirectly to such an attitude. Attracting top talent for many companies in Houston is crucial. While its low cost of living gives Houston an advantage in one respect, quality of life is high in other cities looking to attract talent, such as Austin, San Francisco, Seattle, or Portland. Therefore, having a high quality of life becomes an economic issue for firms looking to attract top talent. And these two framing methodologies are not mutually exclusive but rather reinforce one another: Higher quality of life can lead to economic development and vice versa. Ultimately, by framing development of a green economy in these ways, there is a higher likelihood that local stakeholders will embrace it.

Strategies for Developing a Green Economy

Framing the green economy in terms local stakeholders will embrace helps pave the way for specific strategies them to focus efforts on specific strategies that help it develop. While the following does not represent either an exhaustive list nor does it advocate for a particular course of action, the following strategies provide guidance on how local stakeholders can focus their efforts.

Workforce Development Strategies

Workforce development is critically important for a green economy to become firmly established in an area. Workforce development is particularly effective in areas where there are high concentrations of specific occupations. As previously indicated in this study, there are a number of occupations where Houston has high concentrations of employment. These areas provide a comparative advantage. Focusing workforce development efforts on these occupations will have the greatest potential impact, as training will further enhance local skills and high concentrations of workers mean focused efforts will reach a larger group of workers.

Table 25 below lists occupations in the Houston area that exist in high concentrations and indicates which ones O*NET classifies as a green occupation and ones with a bright outlook in the future.¹¹³ The list provides additional information about subcategories at the 8 digit SOC level of those high concentration occupations that O*NET also classifies as a green occupation. These sub-occupations are listed in italics.

¹¹³ (O*NET, 2014)

Table 25: Workforce Development Opportunities for Green Economy Occupations

SOC code	Occupation Title (SOC code)	Green Occupation	Bright Outlook
17-000 Architecture and Engineering Occupations			
17-2041	Chemical Engineers	Yes	No
17-2051	Civil Engineers	Yes	Yes
17-2051.01	<i>Transportation Engineers</i>	Yes	Yes
17-2111	Health and Safety Engineers Except Mining Safety Engineers and Inspectors	No	No
17-2111.01	<i>Industrial Safety and Health Engineers</i>	Yes	No
17-2199	Engineers All Other	No	No
17-2199.01	<i>Biochemical Engineers</i>	Yes	Yes
17-2199.02	<i>Validation Engineers</i>	Yes	Yes
17-2199.03	<i>Energy Engineers</i>	Yes	Yes
17-2199.04	<i>Manufacturing Engineers</i>	Yes	Yes
17-2199.05	<i>Mechatronics Engineers</i>	Yes	Yes
17-2199.06	<i>Microsystems Engineers</i>	Yes	Yes
17-2199.07	<i>Photonics Engineers</i>	Yes	Yes
17-2199.08	<i>Robotics Engineers</i>	Yes	Yes
17-2199.09	<i>Nanosystems Engineers</i>	Yes	Yes
17-2199.10	<i>Wind Energy Engineers</i>	Yes	Yes
17-2199.11	<i>Solar Energy Systems Engineers</i>	Yes	Yes
17-3011	Architectural and Civil Drafters	No	No
17-3011.01	<i>Architectural Drafters</i>	Yes	No
17-3024	Electro-Mechanical Technicians	Yes	No
17-3024.01	<i>Robotics Technicians</i>	Yes	Yes
17-3025	Environmental Engineering Technicians	Yes	No
17-3029	Engineering Technicians Except Drafters All Other	No	No
17-3029.01	<i>Non-Destructive Testing Specialists</i>	Yes	Yes
17-3029.02	<i>Electrical Engineering Technologists</i>	Yes	Yes
17-3029.03	<i>Electromechanical Engineering Technologists</i>	Yes	Yes
17-3029.04	<i>Electronics Engineering Technologists</i>	Yes	Yes
17-3029.05	<i>Industrial Engineering Technologists</i>	Yes	Yes
17-3029.06	<i>Manufacturing Engineering Technologists</i>	Yes	Yes
17-3029.07	<i>Mechanical Engineering Technologists</i>	Yes	Yes
17-3029.08	<i>Photonics Technicians</i>	Yes	Yes
17-3029.09	<i>Manufacturing Production Technicians</i>	Yes	Yes
17-3029.10	<i>Fuel Cell Technicians</i>	Yes	Yes
17-3029.11	<i>Nanotechnology Engineering Technologists</i>	Yes	Yes
17-3029.12	<i>Nanotechnology Engineering Technicians</i>	Yes	Yes
19-0000 Life, Physical, and Social Services Occupations			

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19-2042	Geoscientists Except Hydrologists and Geographers	Yes	No
19-4041	Geological and Petroleum Technicians	No	No
19-4041.01	<i>Geophysical Data Technicians</i>	Yes	No
19-4041.02	<i>Geological Sample Test Technicians</i>	Yes	No
47-0000 Construction and Extraction Occupations			
47-1011	First-Line Supervisors of Construction Trades and Extraction Workers(4)	No	Yes
47-1011.03	<i>Solar Energy Installation Managers</i>	Yes	Yes
47-2011	Boilermakers	Yes	No
47-2051	Cement Masons and Concrete Finishers	Yes	Yes
47-2061	Construction Laborers	Yes	Yes
47-2221	Structural Iron and Steel Workers	Yes	Yes
47-4041	Hazardous Materials Removal Workers	Yes	No
47-5013	Service Unit Operators Oil Gas and Mining	Yes	No
49-0000 Installation, Maintenance, and Repair Occupations			
49-9041	Industrial Machinery Mechanics	Yes	Yes
49-9081	Wind Turbine Service Technicians	Yes	Yes
49-9098	Helpers--Installation Maintenance and Repair Workers	Yes	No
51-0000 Production Occupations			
51-2031	Engine and Other Machine Assemblers	Yes	No
51-2041	Structural Metal Fabricators and Fitters	Yes	No
51-4011	Computer-Controlled Machine Tool Operators Metal and Plastic	Yes	No
51-4041	Machinists	Yes	No
51-4121	Welders Cutters Solderers and Brazers	No	Yes
51-4121.06	<i>Welders, Cutters, and Welder Fitters</i>	Yes	Yes
51-4121.07	<i>Solderers and Brazers</i>	Yes	Yes
51-8091	Chemical Plant and System Operators	Yes	No
51-8099	Plant and System Operators All Other	No	No
51-8099.01	<i>Biofuels Processing Technicians</i>	Yes	Yes
51-8099.02	<i>Methane/Landfill Gas Generation System Technicians</i>	Yes	Yes
51-8099.03	<i>Biomass Plant Technicians</i>	Yes	Yes
51-8099.04	<i>Hydroelectric Plant Technicians</i>	Yes	Yes
51-9011	Chemical Equipment Operators and Tenders	Yes	No

As this table indicates, O*NET classifies many of the occupations that currently exist in high concentrations in Houston as green occupations. For those occupations that are in high concentrations that are not classified as green, O*NET also provides information about corresponding 8 digit SOC occupations that are classified as green. This list provides guidance for

stakeholders looking to create workforce development programs to support green economy clusters. By understanding the skills workers in these occupations have and matching them to industries that are in need of those skills, economic development stakeholders can tailor workforce development programs to meet those needs.

Understanding and cultivating a green workforce can also have corollary benefits for attracting new companies and industries to Houston. While attracting new industries is crucial for diversifying the local economy, there should be methodical approach for attracting those industries. Understanding the occupational strengths and weaknesses of the local workforce can help economic development stakeholders target the industries and firms would succeed in Houston. They can then tailor incentives to attract the most appropriate industries and firms.

Geographic and Land-Use Strategies

Understanding the areas where Houston has a comparative advantage can also have implications for land use. While there are no zoning policies in Houston, the existing distribution of commercial, industrial, and residential development means that particular areas are better suited to particular industries than others: the land requirements for manufacturing a large scale energy systems would likely be dramatically different than for a company looking to manufacture custom bicycles. Analyzing and understanding the distribution of existing developments and land use within Houston would allow economic development stakeholders to match industry needs with areas that have appropriate and available land. Working with local land owners who have parcels that fit the needs of particular industries could provide economic benefits to both the land owners and the industries. Therefore, once particular industries are targeted, it is crucial for economic development professionals to understand the land use requirements of the targeted industries.

Looking beyond this targeting analysis, there are also opportunities to actively develop co-location programs to concentrate a particular industry in a given area. Concentrating such industries provide economies of agglomeration benefits both for the industries themselves, and the suppliers and service providers that support them.¹¹⁴ Economic development professionals and policy makers can encourage the development of such concentrations through a number of strategies. Promoting public/private partnerships to develop co-location facilities for industries that require less space or have specific technical requirements for the space they occupy is one route. Developing clean tech zones or eco-industrial parks is another through tax abatement strategies presents another option. Should the Federal government re-institute programs such as empowerment zones and other such incentives, local stakeholders could use those programs to establish particular areas for industries to concentrate.

Financing Mechanisms

Appropriate financing mechanisms are crucial for the development of any green economy cluster. Understanding the economics of a particular industry can help identify areas where there

¹¹⁴ (Porter, 2000)

are opportunities for growth. Some funding mechanisms are already in existence, while others are on the immediate horizon.

The Small Business Innovation Research Program (SBIR) and Small Business Technology Transfer Program (STTR) are two mechanisms funded through various agencies of the Federal government to support innovation and commercialization of new technologies. The SBIR program is “a highly competitive program that encourages domestic small businesses to engage in Federal Research/Research and Development (R/R&D) that has the potential for commercialization.”¹¹⁵ The Small Business Technology Transfer Program “expands funding opportunities in the federal innovation research and development (R&D) arena. Central to the program is expansion of the public/private sector partnership to include the joint venture opportunities for small businesses and nonprofit research institutions.”¹¹⁶ Participating Federal agencies include:

- Department of Agriculture
- Department of Commerce - National Institute of Standards and Technology
- Department of Commerce - National Oceanic and Atmospheric Administration
- Department of Defense
- Department of Education
- Department of Energy
- Department of Health and Human Services
- Department of Homeland Security
- Department of Transportation
- Environmental Protection Agency
- National Aeronautics and Space Administration
- National Science Foundation

Overall, both programs have the goal of fostering innovation of new technology. Given the potential investment requirements of green economy technologies, these programs could provide much needed financial support to entrepreneurial endeavors – especially when more traditional sources of funding are leery of high risk, unproven technologies. Economic development professionals who are well familiarized in these programs could prove invaluable to local green economy firms in Houston.

In its recent 83rd session, the Texas Legislature passed Senate Bill 385¹¹⁷ which allowed for the creation of Property Assessed Clean Energy (PACE) financing. The Governor signed this bill with immediate effect. PACE financing allows local municipalities to establish funding mechanisms for owners of existing buildings to install renewable energy systems on existing buildings or perform retrofits to improve the energy efficiency of their structures. PACE funding can come either directly from municipal governments themselves through bonds or from third party lenders. This type of funding mechanism would be crucial as commercial financing for renewable energy and energy efficiency upgrades is frequently difficult for property owners to secure through traditional financing

¹¹⁵ <http://www.sbir.gov/about/about-sbir#policy>

¹¹⁶ <http://www.sbir.gov/about/about-sttr#policy>

¹¹⁷ (Legislature of the State of Texas, 2014)

avenues. PACE financing has the potential of providing significant support for both the green building and construction cluster and the energy generation, renewable energy, and energy storage cluster where Houston has a comparative advantage.

A Portland, OR based company, Energy-RM, recently developed a financial mechanism called Metered Energy Efficiency Transaction Structure (MEETS)¹¹⁸ that could further supplement PACE financing for increased energy efficiency and renewable energy projects for new and existing buildings. In many commercial buildings, property owners pay for capital improvements to a property, but tenants pay for utilities. This condition creates a split incentive: the building owner gains no additional revenue from improving energy efficiency or installing renewable energy systems as all of the benefits of lower energy cost go to the tenant. The owner has no incentive to invest in their building as they will get no additional revenue in return for such investment. While the details of the MEETS funding mechanism are somewhat complicated, it uses technology that allows third parties to invest in energy efficiency and renewable energy projects in property owners' buildings and pay those owners dividends while the tenants pay the same amount for energy as they previously had. While this funding mechanism is in its infancy, it was developed by the same individual who created Renewable Energy Credits (RECs) that are in widespread use today. Once again, this type of funding mechanism could provide significant support to green building and construction cluster and the energy generation, renewable energy, and energy storage cluster where Houston has a comparative advantage.

This funding list is in no way exhaustive. There are potentially numerous additional funding mechanisms available. Once economic development stakeholders identify specific industries to target, they can search for additional funding mechanisms to take advantage of.

Business Incubation

Business incubation could provide an additional opportunity to foster growth in green economy clusters in Houston. With many green economy industries still in their nascent stages, many firms within them are likely small to medium and have limited resources not just in terms of capital, but also in terms of organizational or administrative support. Developing incubators that foster specific industries could provide the needed resources for entrepreneurial firms to grow into stable and successful companies. Such incubators could also provide access to valuable technology research and marketing research information that is frequently cost prohibitive for companies to invest in. Creating incubators that tie to clusters where Houston has a comparative advantage would have the greatest likelihood of developing successful businesses.

LA Cleantech Incubator in Los Angeles provides a good example of such an incubator.¹¹⁹ They offer a number of programs and services to support green economy startup companies that they accept into their incubator. They provide leadership coaching, strategy development sessions,

¹¹⁸ (Energy Resource Management Corporation, 2013)

¹¹⁹ <http://laincubator.org/>

and workshops on seminars and workshops on accounting and banking, intellectual property, business development, real estate, public relations, social media and marketing. They have an advisory board of industry experts that provide mentorship support for selected. With their position in the community, they provide access to professional networks and to venture capital funding sources that can give support to incubator portfolio companies. They provide affordable, fully furnished space on a month-to-month lease basis that gives companies the ability to scale up, scale down, or terminate their lease. Included in the rent structure are all of the technology and administrative services and support spaces that companies would need to operate. And particularly useful for green economy startup companies, LA Cleantech provides business planning, pre-audit readiness, and investor identification services as well as access to investor databases. Similar incubator spaces could be created in Houston to support particular green economy clusters.

Government Procurement

Government Procurement could also provide support for development of targeted green economy clusters. In her dissertation, Laurie Kaye cites a number of benefits that government procurement of green economy goods and services could provide.¹²⁰ Procuring goods and services from local green economy vendors will help create real markets that that might not otherwise exist. Fulfilling government procurement contracts helps startup companies establish a performance track record that will assist them when pursuing procurement contracts with the private sector. City officials can also develop public-private partnerships by developing green economy purchasing platforms. Joint development of these platforms can help mediate costs.

However, to benefit the local green economy, such marketplaces must insure that goods and services be developed locally. In order to make those assurances, Kaye suggests two questions city officials should consider: What green goods and services can be locally produced given the existing workforce, land-use conditions, and economic base? And how can municipal procurement be utilized in order to bolster existing and/or appropriate localized green industries? By answering these questions, city officials can better understand what would be appropriate goods and services Houston could procure to foster green economy clusters.

Closing Thoughts

While the overall analysis and potential strategies in this report are extensive, it does provide a comprehensive perspective of the current state and future possibilities of a green economy in Houston. Dividing the overall economy into clusters facilitates a more useful framework for analysis. Industry and occupational analysis provide information about the comparative advantage the Houston workforce can provide for the green economy clusters identified. Institutional analysis of both the local policies and coalitions in Houston provides additional perspective of potential green economy opportunities. Input from local green economy stakeholders puts that qualitative and quantitative analysis in perspective.

¹²⁰ (Kaye, 2012)

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Looking at all of this information provides a more comprehensive picture of where Houston has comparative advantages in a green economy. A green building and construction cluster potentially has the strongest support in Houston. There are high concentrations of occupations and industries in Houston that it ties to, and there are a number of local policies and coalitions that encourage its development. Local stakeholders feel that, in certain development types, green building and construction practices are almost required. The transportation alternative fuel vehicles cluster and the energy generation, renewable energy, and energy storage cluster also have potentially significant support. While not as large of a potential workforce as the green building and construction cluster, there are still large numbers of workers for each. Policy and coalition support is also varied but significant. And attitudes are changing for both clusters with respect to a green economy. The remaining three clusters have potentially marginal opportunities for growth in a green economy.

Looking ahead, it is useful to understand how this knowledge can be applied. A green business alliance based on broad support from Houston's business community would provide much needed leadership to existing efforts. Because of the strong pro-business attitude prevalent in Houston, it is important to frame those efforts to develop a green economy in an appropriate way. A green economy should be presented as an opportunity for economic growth or for improved quality of life. Presenting it in that manner would help overcome antagonistic attitudes that exist toward the green economy by some segments of the population.

Once the green economy is framed in the appropriate way to local stakeholders, there are a number of strategies economic development professionals in Houston can use to foster its development. Workforce development strategies aligned with the three identified clusters can help prepare the Houston workforce for jobs in a developing green economy. Those same programs can also be used to attract new green economy industries and firms where Houston will have comparative advantage. Land use and co-location strategies can benefit the firms within the green economy clusters and the firms that support them with goods and services. There are a number of existing and potential financing mechanisms that could support green economy clusters in Houston. Business incubators can also provide a crucial avenue for establishing stable and successful firms in the area. And government procurement policies can establish markets in Houston for green economy goods and services.

Given all of these strategies, there are a number of ways economic development stakeholders can foster a green economy that would benefit Houston. Based on the perspectives of green economy stakeholders, there is optimism that a green economy could develop. Many felt that many segments of the population are ready for one. Moving forward, it is important to engage the entire community to determine how it wants to focus its efforts. Once that engagement takes place and consensus is reached, Houston has the opportunity to develop a significant green economy.

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