Pathways to Urban Sustainability: A Focus on the Houston Metropolitan Region: Summary of a Workshop

ISBN
978-0-309-31346-9

90 pages
6 x 9
PAPERBACK (2013)

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PATHWAYS TO URBAN SUSTAINABILITY

A FOCUS ON THE HOUSTON METROPOLITAN REGION

Summary of a Workshop

Dominic A. Brose, Rapporteur

**Committee on Pathways to Urban Sustainability:
A Focus on the Houston Metropolitan Region**

**Science and Technology for Sustainability Program
Policy and Global Affairs**

NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES

THE NATIONAL ACADEMIES PRESS
Washington, D.C.
www.nap.edu

THE NATIONAL ACADEMIES PRESS 500 Fifth Street, NW Washington, DC 20001

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This summary report and the workshop on which it was based were supported by the Houston Endowment, Inc. and the Brown Foundation. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of the sponsor that provided support for the project.

International Standard Book Number-13: 978-0-309-31346-9
International Standard Book Number-10: 0-309-31346-5

Additional copies of this report are available from the National Academies Press, 500 Fifth Street, NW, Room 360, Washington, DC 20001; (800) 624-6242 or (202) 334-3313, http://www.nap.edu.

Printed in the United States of America.

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PREFACE AND ACKNOWLEDGMENTS

In January 2012 the National Research Council's Science and Technology for Sustainability Program held a workshop organized by the Committee on Pathways to Urban Sustainability: A Focus on the Houston Metropolitan Region. The workshop was held to foster a discussion on approaches to urban sustainability in the Houston metropolitan region; to highlight policies and programs that might be developed to further sustainability based on the evidence base; and to help identify place-based research needs and assess promising practices. The workshop was intended to serve as a platform to establish new cooperative programs between federal and local stakeholders, and to engage regional associations, academic institutions, think tanks, and other groups engaged in urban research.

This document has been prepared by the workshop rapporteur as a factual summary of what occurred at the workshop. The statements made in this volume are those of the rapporteur and do not necessarily represent positions of the workshop participants as a whole, the steering committee, the Science and Technology for Sustainability program, or the National Academies. This workshop summary is the result of substantial effort and collaboration among several organizations and individuals. We wish to extend a sincere thanks to each member of the steering committee for their contributions in scoping, developing, and carrying out this project, and to the Shell Center for Sustainability for their assistance in hosting the workshop at Rice University. The project would not have been possible without financial support from the Houston Endownment, Inc. and the Brown Foundation.

This report has been reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise, in accordance with procedures approved by the National Academies' Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its published report as sound as possible and to ensure that the report meets institutional standards for quality and objectivity. The review comments and draft manuscript remain confidential to protect the integrity of the process.

We wish to thank the following individuals for their review of this report: Lester King, Rice University; Judy Layzer, Massachusetts Institute of Technology; Stephen Linder, The University of Texas; and Kumares Sinha, Purdue University. Although the reviewers listed above have provided many constructive comments and suggestions, they were not asked to endorse the content of the report, nor did they see the final draft before its release. Responsibility for the final content of this report rests entirely with the rapporteur and the institution.

Dominic A. Brose
Rapporteur

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INTRODUCTION

More than 80 percent of the U.S. population now resides in urban areas, a number that is expected to continue to increase. Urban areas account for a far larger proportion of the U.S. economy than their share of population. They have also often been associated with environmental and social inequities, such as disproportionate levels of air and water pollution, loss of biodiversity, and increased rates of poverty, but urban centers have the potential to be more sustainable than rural areas.

In 2009, the National Research Council's Science and Technology for Sustainability (STS) Program hosted a public workshop to engage federal, academic, and the private sector in a discussion of emerging research on urban systems, and on how understanding human-environment interactions and the interplay among energy, water, transportation, and other systems could help decision makers address complex sustainability challenges. Recurring themes from the 2009 workshop included that cities can act as incubators of knowledge, and that bottom-up, place-based solutions are important in creating incentives that link housing and transportation planning in urban areas. Also, the federal government and research community have important roles to play by facilitating urban experiments and documenting the outcomes and lessons learned. Urban problems are multi-dimensional and so multi-dimensional responses drawing on a variety of disciplines and skills are important. Participants discussed how integrated research that includes social scientists, natural and physical scientists, engineers, public health professionals, and planners will be needed to address complex urban systems. Successfully meeting the challenges of urban sustainability will depend on social, economic, and cultural factors, and scientific knowledge will be one of many factors required in advancing urban sustainability principles and practices.

Following the 2009 workshop, STS convened the first of a series of place-based urban sustainability workshops. The first workshop was held in 2010 in Atlanta, Georgia, which provided a compelling case study as the region's rapid growth has had significant implications for water, land use, and transportation. The region's economy boomed in the 1980s as it developed into a hub for southern commerce. Today, it is the headquarters of six Fortune 100 companies, including Coca-Cola and UPS, and is a major transportation hub, with the world's busiest airport. This growth has taken a toll on the city's environment. Atlanta today faces major traffic congestion and increasingly scarce water supplies. The Atlanta workshop featured presentations and discussions with local, state, and federal officials, academics, and the private sector to examine how the challenges the still-growing region will face in coming years can be addressed within the context of sustainability.

This report is a summary of the second place-based workshop held in Houston, Texas in January 2012. Houston is the nation's fourth-largest city, and is home to strong oil and gas industries, which helped to make it one of the fastest growing metropolitan areas in the country. But as in Atlanta, growth has come at a cost to the region's environment. Air pollution, especially ozone and particulate matter, has been a persistent threat to human health for decades. And land-use decisions, such as the lack of a formal zoning code in the region, have resulted in a high degree of automobile dependency, traffic congestion, polluted sites (brownfields) close to residential areas, and a heat island effect. Additionally, Houston's low-lying location near the Gulf of Mexico makes it vulnerable to hurricanes and major flooding.

Recently, Houston has begun to promote some promising sustainability initiatives. It is now one of the country's largest municipal purchasers of wind-generated power, and has a light rail system that connects downtown with the Texas Medical Center and surrounding neighborhoods. In addition, all new city buildings must be Leadership in Energy and Environmental Design (LEED) certified. These new and promising initiatives were the starting point for workshop participants to explore additional pathways to urban sustainability.

ORGANIZATION OF THE WORKSHOP

The workshop was convened to explore the region's approach to urban sustainability, with an emphasis on building the evidence base upon which new policies and programs might be developed. Participants examined how the interaction of various systems (natural and human systems; energy, water, and transportation systems) affected the region's social, economic, and environmental conditions.

The objectives of the workshop were as follows:

- Discuss ways that regional actors are approaching sustainability—specifically, how they are attempting to merge environmental, social, and economic objectives.
- Share information about ongoing activities and strategic planning efforts, including lessons learned.
- Examine the role that science, technology, and research can play in supporting efforts to make the region more sustainable.
- Explore how federal agency efforts, particularly interagency partnerships, can complement or leverage the efforts of other key stakeholders.

The workshop was designed to explore the complex challenges facing sustainability efforts in the Houston metropolitan region and innovative approaches to addressing them, as well as performance measures to gauge success and opportunities to link knowledge with action. In developing the agenda, the planning committee chose topics that were timely and cut across the concerns of individual institutions, reflecting the interests of a variety of stakeholders. Panelists were encouraged to share their perspectives on a given topic; however, each panel was designed to provoke discussion that took advantage of the broad experience of the participants.

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FRAMING THE SUSTAINABILITY DISCUSSION

Jim Lester, president and CEO of the Houston Advanced Research Center (HARC), began the workshop by discussing various definitions of sustainability. Sustainability is traditionally thought of as meeting "the needs of the present without compromising the ability of future generations to meet their own needs," the definition put forward in the 1987 Brundtland Commission report. Lester also presented two other definitions: "a strategy for improving the quality of life while preserving the environmental potential for the future" (NCE, 1993) and "the reconciliation of society's developmental goals with the planet's environmental limits over the long term" (NRC, 1999). He noted that the business community also has embraced "the triple bottom line" approach, which focuses on the economic, environmental, and social pillars of sustainability.

The challenge is to understand what these definitions mean for a large urban area, like the Houston metropolitan region. As Dr. Lester explained, the metropolitan region consists of eight counties, an area the size of New Jersey, with six million people, making it the sixth largest metropolitan region in the country. Contributing to the city's economy are approximately 5,000 energy-related firms; the Texas Medical Center, which treats almost five million patients a year; and the Port of Houston, which ranks first in the country in terms of international tonnage shipped. Houston has international trade through its ports and airport, food sourced globally, and building materials shipped in from all over the world. In this context, making Houston sustainable is a global issue, said Dr. Lester; however, he noted that many of the drivers of sustainability for Houston can be addressed locally.

Katherine Lorenz, president of the Mitchell Foundation, stated that they have implemented such efforts locally, focusing on decarbonizing the power sector and funding projects around water issues for rivers and streams in central Texas. Sustainability is the issue of our time, she

stated, and more so than any other issue, it is important to get this one right.

Toward Sustainable Communities

John Randolph, professor at Virginia Polytechnic Institute and State University (Virginia Tech), gave his vision of a sustainable community, explained its importance, and discussed potential pathways toward sustainability. He noted that a sustainable community is foremost livable, accessible, and affordable, with a stable economy, healthy ecosystems, and an engaged public. Air quality, the efficient use of resources, and reduction of carbon emissions have become strong indicators of a region's movement toward sustainability. He explained that a sustainable community is also resilient, in that the community has the ability to adapt and change, in response to changes in the local environment and economy; economic resiliency is an important aspect of a sustainable community. Dr. Randolph described five "Ds" that relate to smart growth and mobility: density, diversity, design, destination accessibility, and distance to transit.

Five D's to Smart Growth and Mobility:

- **Density:** population and employment per acre
- **Diversity:** mixed use residential and commercial/jobs
- **Design:** aesthetics, sidewalks, and street connectivity
- **Destination Accessibility:** ease of trip from point of origin
- **Distance to Transit:** ¼ to ½ mile from home or work

John Randolph, Virginia Tech,
January 18, 2012

Smart growth, he noted, is the type of growth needed in urban areas. To prevent urban sprawl, density needs to be built up in places to relieve pressure on outside areas. Diversity is key, with mixed-use development needed not only in terms of commercial and residential properties, but also in terms of income diversity. Compact, mixed use, and walkable places that are accessible in terms of distance from transportation are needed.

Many communities are developing around the concept of the 10- or 20-minute walk—the distance to public transportation and commercial cores. Arlington County, Virginia is often cited as a model with major economic development along the route of the Washington subway system. Many people who live in Arlington County do not own cars because they participate in car-sharing programs or use the Metro subway system as their primary means of transportation.

Arlington County reveals the clear advantages of a smart growth development pattern over conventional sprawl, in terms of carbon emissions, land consumption, household vehicle miles traveled, and property values, Dr. Randolph said. Combining affordability for transportation and for housing into one metric makes it clear that auto dependency consumes more household income, leaving less for housing costs. In communities where distances traveled are shorter, households do not need multiple cars, making more financial resources available to cover housing costs.

Armando Carbonell, chairman of the Department of Planning and Urban Form at the Lincoln Institute of Land Policy, discussed scaling issues as they relate to sustainability. He cited a recent report from the Lincoln Institute of Land Policy, *Making Room for a Planet of Cities* (Angel et al., 2011), which stated that cities throughout the world and over a long period of time have been growing less dense. Rapidly growing cities in developing countries, where most of the urbanization will take place in the next 25 years, will take up twice as much space per capita as cities have taken up historically. There is a gross de-densification occurring even as our awareness of the need for density – and the value we place on it – grows.

Mr. Carbonell said that there are three scales that need to be considered when working toward urban sustainability: global, national/mega-regional, and local. As an example of a global issue affected by urban sustainability, he pointed to climate change. According to the Clinton Climate Initiative, cities cover less than one percent of the earth's surface, but are disproportionately responsible for causing climate change. A recent policy report from the Lincoln Land Institute found tremendous carbon savings from increasing the intensity of development (buildings and transportation) in an urban setting (Condon et al., 2009). There is also a need to integrate across scales – from building to block to city to region – in order to understand how various factors that contribute to greenhouse gas emissions and climate change operate together, Mr. Carbonell noted (Figure 2-1).

Climate adaptation will be necessary in adjusting to a world with more water than we currently have, added Mr. Carbonell. The Netherlands, for example, has about 50 percent of its land, 60 percent of its population, and 70 percent of its gross domestic production below sea level. After experiencing major flooding in the 1950s, the country built up a lot of experience in structural flood control and adapted by being resilient to floods. Their policy, called Room for the River, examines humanity's relationship to water and allows for more space to be given up as a way to accommodate changes occurring due to climate change.

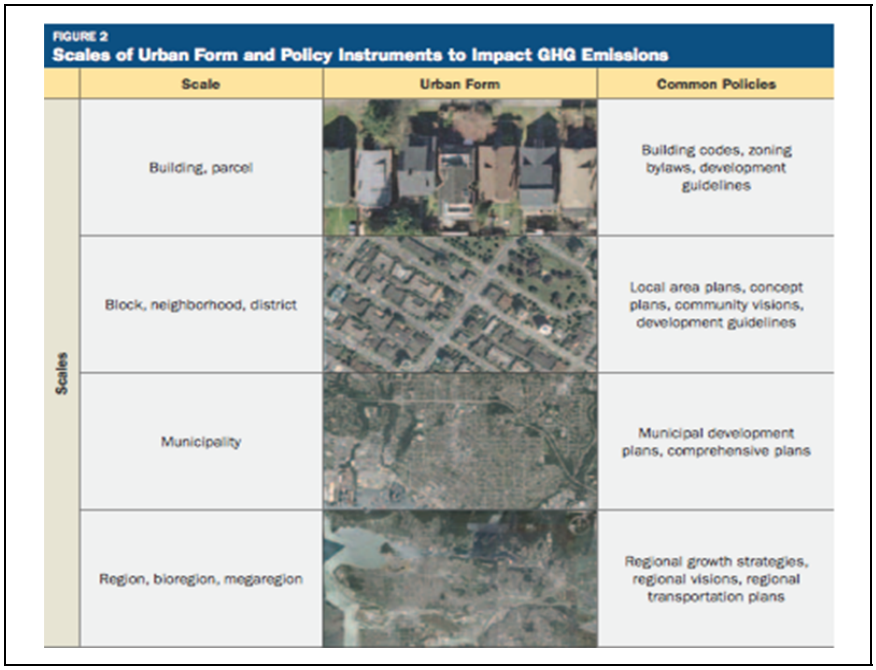


FIGURE 2-1 Scales of urban form and policy instrument to impact green house gas emissions.

SOURCE: Armando Carbonell presentation, January 18, 2012.

As an example of a national-scale sustainability effort, Mr. Carbonell discussed America 2050, a plan that the Lincoln Land Institute developed with the Regional Plan Association in New York (America 2050, 2012). The plan addresses issues such as national-level infrastructure planning, population change, climate change, dependence on foreign oil, and economic disparities. Though not widely known, Mr. Carbonell noted, the United States has a long tradition of national

planning. In 1808 Thomas Jefferson was responsible for encouraging the Gallatin Plan (Fishman, 2007), and in 1908 Theodore Roosevelt and Gifford Pinchot developed a natural resources plan for the country (Black and Saundry, 2008).

Although population growth has slowed in the United States, distinct megaregions have developed around the country (Figure 2-2), Mr. Carbonell said. For example, the zone running along the Atlantic corridor from Boston to Washington, D.C. is surrounded by a vibrant ecostructure—the Appalachian Mountains, coastal areas, and major river systems—which supports the cities of the eastern megaregion. While population growth in many of these megaregions has slowed, urban sprawl has not. If a more compact pattern of development were to occur, often referred to as smart growth, much less new land would be required to meet population needs. An important complement to smart growth is landscape conservation, biodiversity, and reduced impacts of climate change on the viability of these habitats. What is needed, Mr. Carbonell stated, is to link cities to wilderness areas and create opportunities for people who live in cities to have contact with nature.

On the local scale, Mr. Carbonell described edgeless cities—underutilized spaces or vacant and dead spaces that could be developed. Taking this space into consideration, there is enough land available to accommodate future population growth in the United States and much of this land could be redeveloped in a more sustainable way. One example he cited is the City of Surrey, British Columbia; the city wanted to design a community where sustainability policies became tangible elements of community development. The result is a 560-acre development in the East Clayton neighborhood with 5,000 units of housing, 13,000 residents, over 5,000 jobs, and a projected development time of 20 years. This development has proceeded in a sustainable way, with features such as a naturalized water retention system, greenways, and pedestrian- and bicycle-friendly corridors (East Clayton Neighborhood Concept Plan, 2000).

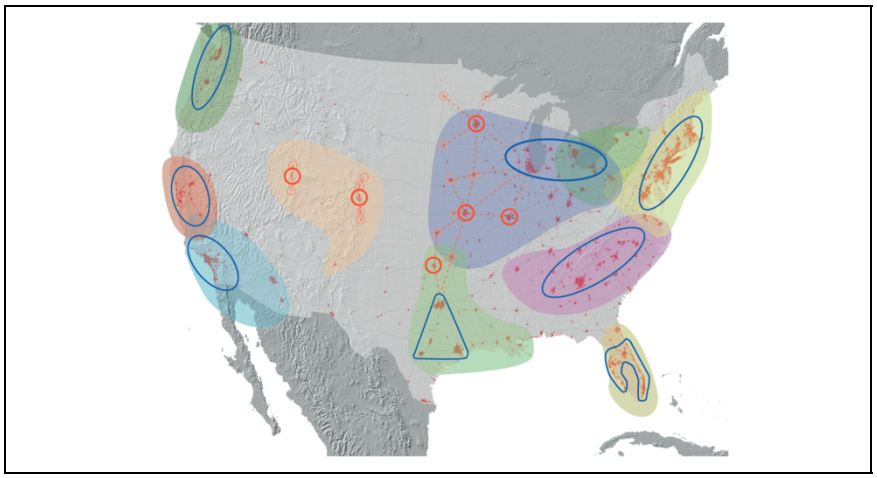


FIGURE 2-2 Mega-regions in the United States.
SOURCE: Armando Carbonell presentation, January 18, 2012.

Local and Regional Efforts in the Houston Metropolitan Region

Jeff Taebel, director of community and environmental planning at the Houston-Galveston Area Council (H-GAC), gave an overview of a recently awarded $3.75 million grant from the U.S. Department of Housing and Urban Development (HUD) under its Partnership for Sustainable Communities with the Department of Transportation (DOT) and the Environmental Protection Agency (EPA).[1] Houston was one of 45 regional areas that received funding through this program, aimed at building economic competitiveness by connecting housing with good jobs, quality schools, and transportation. In addition to the initial grant money, another $2 million in matching contributions was given by consortium partners. The consortium is composed of government, non-profit, academic, economic development organizations, private sector, and other special purpose entities, Mr. Taebel explained. Activities funded by the grant are now 14 months into a three-year planning process, which will conclude at the end of 2013. Despite the size and breadth in scope of topics covered, Taebel emphasized that they still view this as a neighborhood plan.

[1] Created in June 2009, the Partnership for Sustainable Communities was formed to ensure that housing and transportation goals are met, environmental protection is ensured, and equitable development promoted.

Mr. Taebel commented on Houston's rich history, including its geographic and demographic diversity, economic vitality, community inclusiveness, and affordability. H-GAC serves as staff and main fiscal agent for the project, with a steering committee providing guidance. H-GAC is made up of the region's local governments and their elected officials, and works with public-and private-sector organizations to solve area-wide problems. The 13 counties in H-GAC's service region are: Austin, Brazoria, Chambers, Colorado, Fort Bend, Galveston, Harris, Liberty, Matagorda, Montgomery, Walker, Waller, and Wharton. Additionally, there are more than 100 member cities in the region.

In addition to H-GAC's oversight, there are also technical advisory groups, comprised of experts in five subject areas: housing, transportation and infrastructure, economic development, the environment, and sustainable communities. The advisory groups provide technical input, and review and ensure that the plan is grounded in best practices. Social equity is cross-cutting and an element of all the subject areas, Mr. Taebel noted. The technical advisory groups define problems, and explore options for meeting goals. These options and goals are then evaluated by four Regional Transect Groups made up of stakeholders with expertise in urban, rural, and coastal topics, who are tasked with reviewing implementation strategies and ensuring that plan metrics are suitable for all geographic areas.

Much of the time and budget for the Sustainable Communities plan will be invested in two components, case studies and public engagement. Case studies will be done in each of the four transect areas. The intent is to use local jurisdictions in the urban, rural, and coastal groups to develop a comprehensive approach to improving sustainability by working with local officials, staff, and stakeholders. Feedback will be gathered on possible ways to implement the plan, in order to shed light on the activities most likely to be achievable. The public engagement component, Mr. Taebel explained, will consist of 200 community meetings throughout the region, a major survey, kiosks at high-traffic events, and a multi-prong social media approach. Additionally, there will be focus groups, interviews with community leaders, and training for community ambassadors, particularly in communities of color and communities where English is not primarily spoken, in order to gather ideas and input into what a more sustainable Houston would look like. Lastly, a governmental advisory community composed of elected officials from rural counties and other urban areas in the region will be tasked with periodically assessing the work as it is developed.

Several synergies have evolved from this process, Mr. Taebel explained. The first was with the Regional Transportation Plan (RTP). The public engagement process for the Sustainable Communities plan can also serve as the public engagement process for the RTP. In addition, the two projects will share goals, scenarios, and metrics moving forward. Another area of synergy involves the Conservation Fund, a non-profit organization aimed at conserving land, training leaders, and investing in conservation. The organization is leading efforts on a green infrastructure planning project for the Houston-Galveston region, and elements of the project will be incorporated into the environmental strategy for the regional Sustainable Communities plan. A third area of cooperation involves the Gulf Coast Economic Development District, a non-profit that envisions a healthy regional economy for citizens of the Gulf Coast. This organization, which is required periodically to do a comprehensive economic development strategy, will use the economic element of the Sustainable Communities plan as that strategy.

Breakout Discussions

During the workshop, a breakout group highlighted some of the many local and regional sustainability activities in the Houston metropolitan area. Some neighborhood activities discussed included Transition Houston;[2] Green and Healthy Homes Initiative (GHHI);[3] Houston Bike Ways Program;[4] Urban Harvest[5] and community gardens; the Houston-Galveston Area Council (HGAC) Sustainable Communities Plan,[6] and the expansion of the city recycling program.[7]

The Coastal Prairie Partnership[8] was discussed as a key effort for protecting the remaining coastal prairie ecosystem, which used to be the most prominent ecosystem in the Houston area. The partnership is trying to build an organizational structure that will restore and protect the coastal prairie. Those involved are passionate about protecting the prairie because they see it as the basis for the initial development of Houston as a major city. It also is symbolic of the need for restoration on a national

[2] Available at http://transitionhouston.wordpress.com.
[3] Available at www.greenandhealthyhomes.org.
[4] Available at www.houstonbikeways.org/index.php/home.
[5] Available at www.urbanharvest.org.
[6] Available at www.ourregion.org.
[7] Available at www.houstontx.gov/solidwaste/recycling.html.
[8] Available at http://prairiepartner.org.

scale, as much of the tall grass prairie across the United States no longer exists.

Challenges and barriers to the efforts of the local organizations listed above and others were also discussed. Many participants stated that limited financial resources were the most critical barrier to pathways forward, and that more work needs to be done to identify and share funding sources. Cultural change and education were also mentioned as elements necessary to support sustainability efforts. Some participants offered the example of the Bike Ways Program, which tries to better educate bicycle riders and automobile drivers about road safety. Communication was also mentioned as a challenge, as well as the lack of coordination among organizations and businesses that are focusing on the same issues.

Several participants discussed the possibility of developing a sustainability plan for the region. The group recognized the Houston-Galveston Area Council (H-GAC) as the central planning agency for the 13-county region, and therefore a key player in any regional sustainability plan. Participants in this breakout discussion also suggested including Region H for planning purposes in the region. Region H, which includes portions of the Trinity, San Jacinto, and Brazos river basins, and encompasses the Houston metropolitan area, adds an additional five counties outside of the H-GAC's 13 counties.

Several members of the breakout group suggested that a comprehensive regional sustainability plan could be developed from a set of existing separate plans. For example, regional plans for energy and transportation are currently being developed, and could feed into this larger plan and possibly serve as models for other areas, such as public health or education, where plans are not being developed. The regional plan would need to be implemented incrementally, as the challenge of dealing with many individual jurisdictions and partners is enormous. Conceivably, partners and stakeholders in the plan would be involved in some issues but not necessarily in all decision making. The five additional counties in Region H, for example, might be involved only in water planning issues in the region.

They explained that although most components of the plan, such as transportation or water, would have a clear agency lead, some areas such as hazard management would not. This plan would need to entail both hazard mitigation and adaptation strategies; so a research component would be needed to help identify those strategies. The group finished by discussing how such a plan would be implemented, and again identified

H-GAC as a key organization with the breadth and influence to implement a plan covering many topical areas. Other agencies, such as the Region H water planning group or Texas Forest Service, would also be expected to collaborate with H-GAC to implement different components of the plan. Another key component of the implementation plan would be public participation; however, a functional model for how best to do that still needs to be identified.

3

HUMAN CAPITAL

Winnie Hamilton, director of environmental health at Baylor College of Medicine, opened the Human Capital session by talking briefly about three separate parts or "pillars" of sustainability– social, environmental, and economic. She added to this definition noting that sustainable communities are healthy communities where natural and historic resources are preserved. This "human capital" consists of jobs, homes, education, health care, and opportunities for citizens to improve their quality of life; this is a more people-oriented definition of sustainability. Human capital, along with the built and natural environment, provides the infrastructure for metropolitan regions like Houston. To have a healthy, happy, and prosperous city, stated Dr. Hamilton, this infrastructure needs to be created in a sustainable way.

Stephen Klineberg, professor and co-director of the Kinder Institute for Urban Research at Rice University, described the demographic changes that have occurred in Houston and how the region might be transformed in the future. When Dr. Klineberg first started collecting survey data in 1982, one million people had moved into Harris County during the previous decade, in large part due to the booming oil refining sector and related businesses resulting from dramatic increases in oil prices—rising from $3.20 a barrel in 1978 to $32.50 a barrel in 1982. At that time, 82 percent of Houston jobs were in that sector.

Despite the economic boom, a range of social and environmental challenges, such as traffic congestion, emerging pollution problems, and growing crime rates faced the growing city. Dr. Klineberg and his group conducted what they intended to be a one-time survey in 1982 to measure how people were dealing with the social costs of growth while at the same time reveling in the benefits of a rapidly expanding economy. Two months after the survey, oil prices dropped and continued to fall to $28 a barrel by the end of 1983, resulting in a loss of 100,000 jobs. Dr. Klineberg and his group decided to repeat the survey that year in light of

the loss in jobs and kept repeating it every year after that for the past 30 years. The survey, a representative random sample of Harris County residents who are asked identical questions, has resulted in a valuable dataset on the demographics and reflections of residents in the region.

Dr. Klineberg noted that historically, economic prosperity in the region has not been based on education or human capital, but rather from land and commodities, cotton, timber, cattle, and oil. He noted that this is likely to change in the future, when the source of wealth will have less to do with natural resources and more to do with human capital. Many of the blue collar jobs from the 1970s have left Houston, and future employment will require higher levels of education.

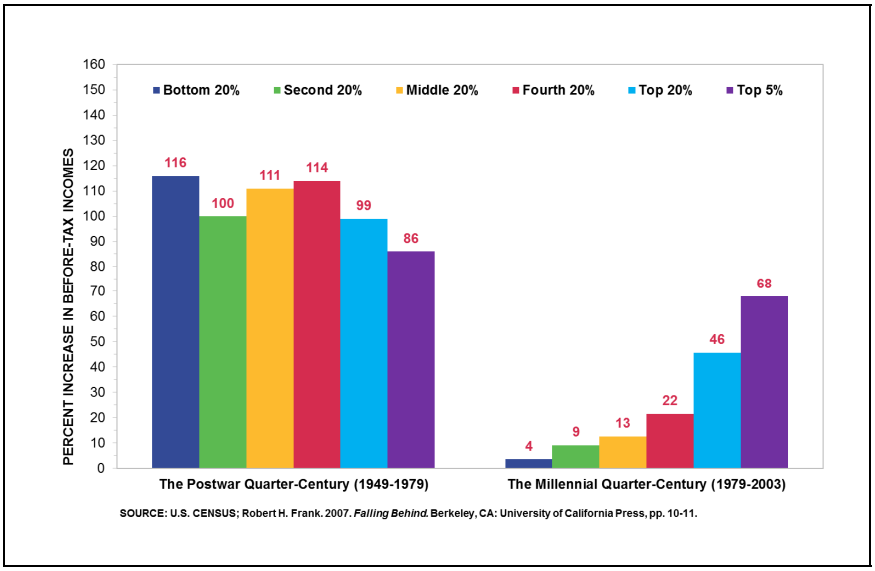


FIGURE 3-1 Increase in incomes from 1949-1979 compared to 1979-2003. SOURCE: Stephen Klineberg presentation, January 18, 2012.

Not only has the economic structure of Houston changed, but the national economy has also changed with increasing income disparity. Dr. Klineberg presented data comparing the increase in income in the United States from 1949 to 1979 to the increase in income from 1979 to 2003 (Figure 3-1). From 1949 to 1979, the poorest 20 percent of Americans more than doubled their income. The era also saw the emergence of the baby boom generation, as the average American woman gave birth to 3.6 children. In contrast, increases in income from 1979 to 2003 were

concentrated in the top one percent, and mostly in the top one-tenth of that one percent.

Equalizing institutions, noted Dr. Klineberg, need to be established to assure that all Americans are able to share in the prosperity of the country. Accelerating economic growth without any changes is not the way forward. The only way to improve is to invest in the skills of the American worker. Education has become the critical determinant of a person's ability to earn enough money to have a quality life and support a family. Houston is a good example of social and economic divisions inherent in much of the United States. Houston has one of the greatest medical complexes in the country—the Texas Medical Center—but it also has one of the highest percentages of children without health insurance of any major city in the United States. The gap between rich and poor has become a central political challenge, and new strategies are needed to replace older ones that worked in the past but no longer meet the needs of today's economy.

Dr. Klineberg described some of the sectors where job growth is most likely. For example, the biotechnology and nanotechnology sectors are expanding with research being conducted at the Texas Medical Center and Rice University. Houston's economy will move toward more of a knowledge economy, and the city will need to compete to attract the best and brightest people working at the cutting edge and put that knowledge into commercial ventures. This makes quality-of-life issues more important. A striking example is the attitude of business to air quality regulations. Through most of the 1990s, the business community in Houston pushed back against regulations EPA promulgated under the Clean Air Act, insisting that industry would not survive if it had to comply with more stringent standards. Then, in June 1999, newspaper headlines announced that Houston had surpassed Los Angeles in the number of dangerously polluted days (Institute for Health Policy, 2006). Now, Dr. Klineberg commented, the business community sees environmental regulations as far from being anti-growth or anti-business, but rather essential to Houston's economic prosperity in the 21st century. The business community understands that the city will not continue to prosper if it is perceived as hot, flat, and dangerously polluted.

Another example of progress can be seen in the desire for the revitalization of downtown Houston. In 2010, Dr. Klineberg's survey asked residents which type of home they would prefer to live in, and 41 percent of all adults in Harris County – one of the most automobile dependent areas in America – responded that they would prefer to live in

a more urbanized area within walking distance of shops and work places (Figure 3-2). And when the 2011 survey asked about the kind of neighborhood people would prefer to live in, 45 percent of Harris County residents expressed a preference for an area with a mix of developments including shops, restaurants, and work places.

The changing demographics of the Houston area, Dr. Klineberg, reflect the changing demographics of the nation in general. Until 1965, 82 percent of all U.S. immigrants came from Europe, another 12 percent were Africans originally brought here as slaves to serve the Europeans, and the remaining were mostly Asian farm workers and laborers. In 1924, Congress enacted the National Origins Quota Act, which limited the number of immigrants allowed into the United States using a national origins quota. The quota provided immigration visas to two percent of the total number of people of each nationality in the United States as of the 1890 national census, and excluded all immigrants from Asia (U.S. Department of State, 2012).

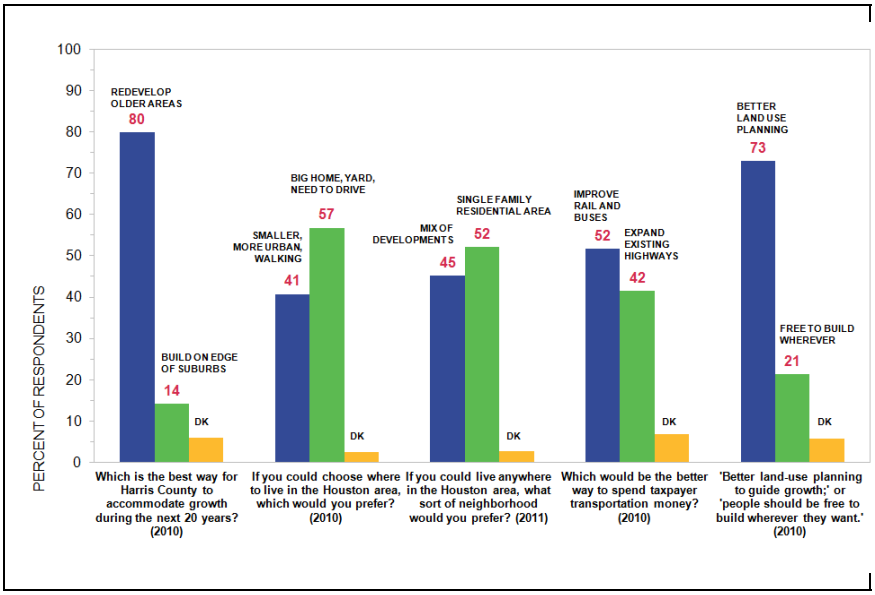


FIGURE 3-2 Select responses from survey of residents in Harris County, TX. SOURCE: Stephen Klineberg presentation, January 18, 2012.

Following the act, 86 percent of all immigration came from Northern Europe, mostly Germany, Britain, and Ireland (Koven and Götzke, 2010). The act, however, did not survive the shift in consciousness that came with the Civil Rights Movement, and in 1965

Congress changed the law, enacting the Immigration and Nationality Act of 1965 (Hart-Cellar Act). This act abolished the national origins quota system and replaced it with a preference system focusing on immigrants' skills and family relationships with citizens or U.S. residents. Since the passage of this act, millions of people have emigrated to the United States from Asia, Latin America, Africa, and the Caribbean. The United States became a microcosm of the world as the U.S. economy became more fully integrated into a single global economic system.

Dr. Klineberg commented that no other city has been transformed as fundamentally, suddenly, and irreversibly as Houston. In the space of just 30 years, Houston has become one of the most ethnically and culturally diverse cities in the country. Whereas the city was predominately Anglos in the 1980s, by the 2000s, no ethnic group held a majority. In the 2010 survey, the population of Houston was 7.7 percent Asian, 18.4 percent African American, 33 percent Anglos, and 40.8 percent Hispanic (Figure 3-3). The changing demographics of Houston have been one of the key drivers to keeping the city a vibrant metropolitan area. Other cities in the United States have been losing population. Dr. Klineberg also discussed the changing age distribution in Houston and the rest of the country; 76 million babies were born in the United States between 1946 and 1964, and the leading edge of those baby boomers turned 65 in 2011. The number of Americans over the age of 65 will double in the next 25 years, a trend that will have major effects on Social Security and Medicare benefits. Anglos are overrepresented among the baby boomers with young people disproportionately non-Anglo. Nowhere is that more obvious than in Houston, Dr. Klineberg noted. Of all the people currently living in Harris County aged 65 and older, 69 percent are Anglo, 18 percent are African American, 11 percent are Hispanic, and 2 percent are Asian. In the age group 18 to 29, the percentage of African American, Asian, and above all Hispanic surges – 22 percent are African American, 45 percent are Hispanic, and 10 percent are Asian (Figure 3-4).

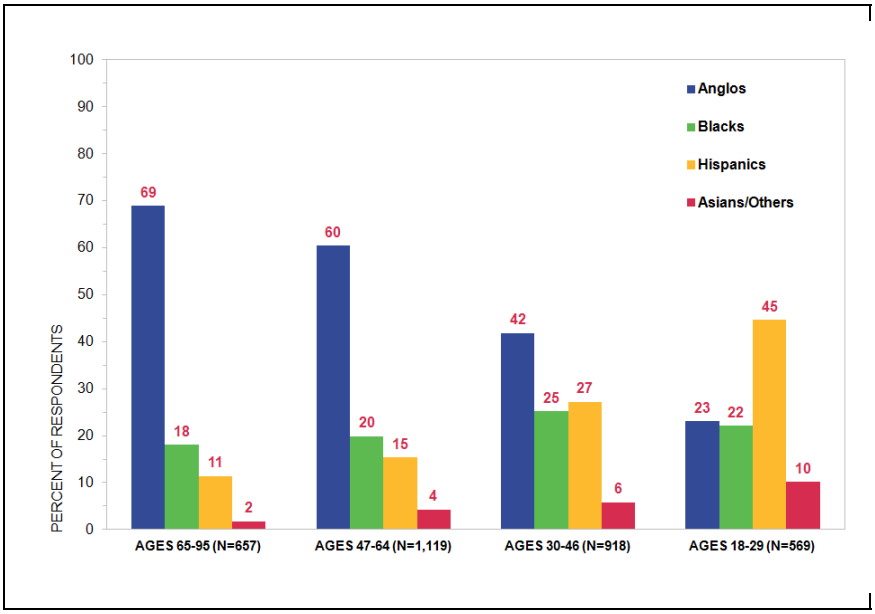


FIGURE 3-3 Change in demographics in Texas from 1960 - 2010.
SOURCE: Stephen Klineberg presentation, January 18, 2012.

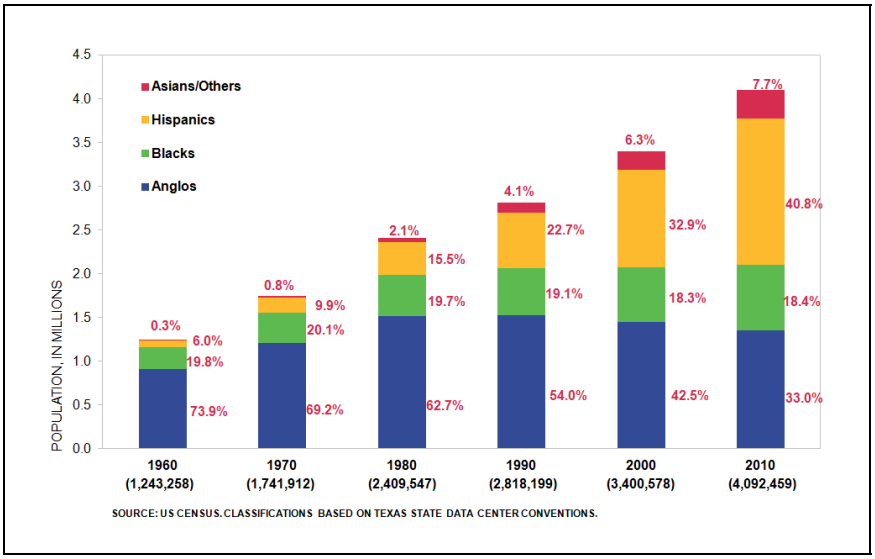


FIGURE 3-4 Change in demographics in Texas across age groups.
SOURCE: Stephen Klineberg presentation, January 18, 2012.

One of the biggest assets that Houston could have, stated Dr. Klineberg, is the ability to contribute to a multi-ethnic economy for the 21st century. To prosper in a new high-technology, knowledge-based, world-wide economy, Houston and the nation as a whole will need to nurture a far more educated workforce and fashion policies to reduce inequalities and prevent the rise of a new urban underclass. The Houston metropolitan region will need to grow into a more aesthetically and environmentally appealing destination in order to attract the most innovative companies and talented individuals. Houston will also need to develop the research centers that will fuel the growth of this new economy. And in order to have an economy that flourishes, stated Dr. Klineberg, it will need to develop into a more united and inclusive multiethnic society, where equality of opportunity is truly made available to all residents and where all communities are empowered to participate as full partners in shaping the future.

Sustainable and Healthy Communities

Winifred Hamilton said that the World Health Organization definition of environmental health encompasses "those aspects of human health including quality of life that are determined by physical, chemical, biologic, social, and psychological factors in the environment". These factors in the environment affect the ability of people in metropolitan regions to build healthy lifestyles, develop personal and neighborhood resilience during disasters, and foster sustainable futures. Dr. Hamilton added that we need to have a resilient and healthy population capable of facing future challenges and improving the quality of life for coming generations. The role of the public health sector is to tie together these many facets of a healthy lifestyle.

Brenda Reyes, chief of the Bureau of Community and Children Environmental Health at the Houston Department of Health and Human Services, explained that sustainability and resilience start at the home with families. The lack of clean and affordable housing is a national problem that is increasing economic stress on families and communities. It is vital for Houston to build and maintain healthy, sustainable, and affordable housing for its citizens, because housing is at the heart of the community. Additionally, she noted, healthy housing and improvements in energy efficiency generate higher resale value and equity for homeowners, and the communities they form will see lower crime rates and greater neighborhood involvement. Studies show that children growing up in healthy housing are less likely to suffer from respiratory

problems, and are more likely to succeed in schools and society. Homes built prior to 1978 are most likely to be the ones that put children's health at risk due to lead-based paint, mold, leaking water, and other environmental hazards (Figure 3-5). Dr. Reyes emphasized that sustainable housing includes both personal dwellings and office buildings. These should be located in neighborhoods that are close to jobs, walkways and bikeways, public transport, and community centers. Neighborhoods such as these promote personal health and safety, community engagement, prosperous local business, and local economies and jobs. Community engagement is key, Dr. Reyes noted. For example, property that is not maintained well becomes infested with pests, making a single property a neighborhood-scale issue and responsibility.

Seven Principles of Healthy Housing

- Dry
- Clean
- Pest-Free
- Safe
- Contaminant-Free
- Ventilated
- Maintained

Brenda Reyes, Houston Department of Health and Human Services, January 18, 2012

Healthy and sustainable housing also reduces the environmental impact of that housing. Sustainable homes have a smaller carbon footprint, conserve more resources and raw materials, and have lower utility and water bills, Dr. Reyes commented. Lower bills provide financial rewards to homeowners and help them recoup the upfront costs of renovating to install higher efficiency systems. Sustainable homes are also healthy homes with better air quality, resulting in less exposure to mold and chemical toxins, as well as greater durability and reduced maintenance. These high-performing homes require less upkeep and fewer repairs, saving money and time, which contributes to more quality family time, comfort, and increased home values. The most important factor in making communities more resilient and sustainable is the human component, Dr. Reyes said, and in order to have buy-in and make

further progress, communities need to believe that they can and should be healthy.

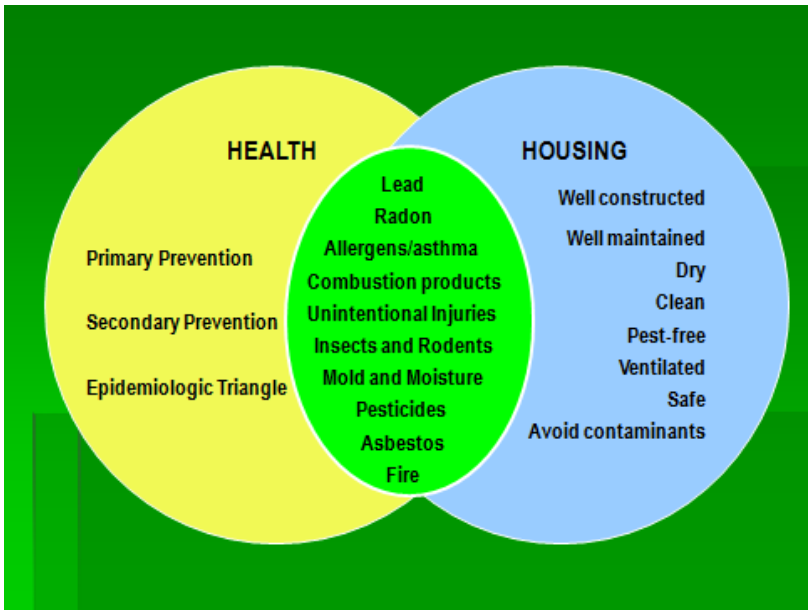


FIGURE 3-5 Eliminating or reducing environmental toxins shown in the overlapping section of the Venn diagram is key to healthy housing.

SOURCE: Brenda Reyes, presentation, January 18, 2012

Herminia Palacio, director of Harris County Public Health and Environmental Services, discussed the concept of "community capital". Capital, from a business case perspective, can be thought of as the cash or goods to generate income either by investing in a business or in a different income-generating property; the net worth of a business – the amount by which its assets exceed its liabilities; or the money, property, and other valuables which collectively represent the wealth of an individual or business. The economist Gary Becker defined human capital as investments in education, expenditures in health care, and other activities that raise earnings, improve health, and add to a person's assets over time. Using this definition, Palacio stated that expenditures on education, training, and medical care, for example, can be considered investments in human capital.

Dr. Palacio described community capital as using sound policy and funding strategies to generate sustainable and healthy communities by investing in quality education, sustainable environmental planning, and equitable economic development opportunities. Instead of the net worth of a business, the amount by which a community's health assets sustainably and equitably exceed its health liabilities is equivalent to the "net health" of that community. Instead of money or property and other valuables that collectively represent the wealth of an individual or a business, the health of a community is represented by its educational and economic opportunities.

Dr. Palacio noted that from a planning and environmental health perspective, developing sustainable communities is really about protecting public health and developing healthy communities. The Obesity Prevention Collaborative, funded by the Houston Endowment, is a good example of a health policy program providing a pathway to urban sustainability. The collaborative is a two-year community planning process with the ultimate goal of developing a robust, comprehensive plan to address obesity, diseases associated with obesity, and chronic diseases more broadly in Harris County.

There are two well-established tools that make this community planning process possible, Dr. Palacio said. The first is the Mobilizing Action for Planning and Partnerships (MAPP) process, and the other is the Protocol for Assessing Community Excellence in Environmental Health (PACE EH). These tools bring together multiple sectors—business, education, development and urban planning—in government-private partnerships to examine changes that are needed in policies, systems, and the environment.

Several grants awarded to the Harris County Public Health and Environmental Services address policy systems, Dr. Palacio said. She described a grant funded by the Centers for Disease Control and Prevention (CDC), the Community Transformation Grant, which supports community-level efforts to reduce chronic diseases such as heart disease, cancer, stroke, and diabetes, in the hopes that these efforts will improve health, reduce health disparities, and control health care spending in these communities. Similarly, a Community Prevention Grant is addressing tobacco use, mental health and substance abuse, and the need for physical activity.

Dr. Palacio noted that the Sustainable Communities Regional Planning grant received by the Houston-Galveston Area Council also supports planning efforts that "integrate housing, land use, economic and

workforce development, transportation, and infrastructure investments in a manner that empowers jurisdictions to consider the interdependent challenges of: (1) economic competitiveness and revitalization; (2) social equity, inclusion, and access to opportunity; (3) energy use and climate change; and (4) public health and environmental impact".[9] These three grants were awarded nearly simultaneously, noted Dr. Palacio, and require close communication and contact among the funded organizations. The project leaders of these grants are actively identifying opportunities for synergy and ways to minimize duplication. By aligning planning processes, the organizations are working together to achieve their individual missions and to optimize benefits for the community.

Dr. Palacio concluded her talk by challenging the group to think about how to develop some clear and consistent language related to complex problems that arise in creating more sustainable communities. For example, she noted that in talking about resilience, there is often confusion about what this refers to and what mitigation strategies should be used, as well as the costs of those strategies. Similarly, when talking about adaptability, the goals and outcomes are not often clear. Dr. Palacio noted that the words we choose do matter because they help us move forward together.

Natasha Prudent, health scientist with the National Center for Environmental Health, Centers for Disease Control & Prevention (CDC), provided a brief overview of the health impacts of climate change. Health impacts associated with climate change generally fall into three broad categories: (1) weather-related impacts; (2) impacts related to environmental changes that occur in response to climate change; or (3) impacts resulting from the consequences of climate-induced economic dislocation, environmental decline, and conflict. Health effects associated with weather are somewhat more easily quantifiable, because they can be measured using indices such as deaths and injuries due to extreme weather events, including flash floods, wildfires, and extreme heat waves.

The second category of health impacts, those resulting from environmental changes that occur in response to climate change are more difficult to quantify because these changes are not limited to a specific health effect; instead, other, more-complicated factors are involved such

[9] Availabile at http://portal.hud.gov/hudportal/HUD?src=/program_offices/sustainable_housing_communities/sustainable_communities_regional_planning_grants.

as the built environment or population dynamics. An example of this type of health impact would be the spread of infectious diseases due to changes in ambient temperature, Ms. Prudent said. The last category of health impact related to climate change includes climate-induced economic dislocation, environmental decline, and conflict. This category is the most difficult to quantify and is typically discussed as a qualitative measure—for example, the rise in domestic violence among hurricane evacuees who are relocated. Ms. Prudent noted that mechanisms such as climate adaptation measures could help mitigate many of these health effects.

Ms. Prudent discussed CDC's efforts to develop vulnerability assessments or decision support tools to help states and public health entities identify communities most vulnerable to health problems resulting from climate change, as well as adaptation measures and resiliency efforts that could reduce those effects. CDC found that vulnerability can vary significantly depending on scale; for example, vulnerability is likely to be less at the state level than at the county or census block levels.

Ms. Prudent stated that the CDC developed vulnerability assessments for Travis County, Texas, which along with Austin, is participating in the Climate-Ready Cities and States Initiative. This initiative offers localities assistance in developing and using models to predict climate-related health impacts, monitor health effects, and identify those areas that are most vulnerable to these effects. So far, health impacts have not generally been a part of the climate change discussions. The CDC program focuses on climate policies that could benefit human health, and identifies communities within Travis County where policies can be developed to address the built environment and social demographics, in addition to human health.

Two natural hazards—extreme heat and flash flooding—were identified as critical priorities in Travis County as a result of this assessment, Ms. Prudent said. To conduct the vulnerability assessment, CDC evaluated various social measures in Travis County, including population density, ethnicity, age, renters' status, low educational attainment, primary language spoken at home, prevalence of disability, and measures of low income and public assistance. For the built environment, measures of impervious surface or lack of vegetative cover, and average surface temperature were used. To assess flood vulnerability, data for 100-year floods and the density of low water crossings were used.

To evaluate health issues associated with extreme heat, CDC assessed cardiovascular and hypertension mortality and diabetes. Ms. Prudent noted that the literature supports a fairly strong relationship between heat vulnerability and cardiovascular mortality. With extreme events, pre-existing chronic conditions tend to be exacerbated—a concern given the large demographic shift from a younger population to an elderly one in the region. When heat events do occur, there tends to be a corresponding spike in cardiovascular deaths. This is somewhat due to public health departments classifying these deaths as cardiovascular in nature rather than due to hyperthermia. Flood-related health effects tend to be more difficult to understand, and there has been little research to date on this issue; however, some data are available on displacement associated with flooding.

CDC developed several vulnerability maps of the county to identify communities at risk of impacts from extreme heat and flooding, Ms. Prudent said. The purpose of the maps was to assist city planners in thinking about land use; for example, to determine where to plant trees to lessen the urban heat island effect. Two areas were identified as having high vulnerability—both socially and in terms of the built environment—due to extreme heat events and their resulting negative health outcomes. The high vulnerability was driven by population demographics. One area includes a poor, traditionally minority community. Another area highly vulnerable to extreme heat included a community with a significant elderly population. The agency also developed vulnerability maps for flooding, and found that an indicator for a highly vulnerable community was one that is traditionally minority and had experienced flooding in the past.

It is important to look at vulnerability assessments not only from the perspective of science but also from the perspective of a community's human and cultural dynamics, said Ms. Prudent. These dynamics offer an appreciation for the community and understanding of the implications of policy decisions. Also, without understanding the community, it may not be possible to gain the buy-in needed to successfully implement policies.

4

NATURAL CAPITAL AND THE BUILT ENVIRONMENT

Among the skyscrapers and office buildings of Houston are streets and bikeways, open spaces, and waterways that make up the natural and built environment of the city. John Nielsen-Gammon, professor and state climatologist at Texas A&M University, discussed the interaction between cities and natural resources and what they mean to each other in the context of urban sustainability. For an urban center, sustainability implies longevity, and a factor becoming more relevant to Houston is the role drought and water have played historically in the sustainability of urban regions. Dr. Nielsen-Gammon presented data demonstrating the trend in summertime rainfall and temperatures from 1895 to 2011, with 2011 having the lowest amount of rain and highest temperatures in the record (Figure 4-1). If the conditions seen in 2011 were to become normal, stated Dr. Nielsen-Gammon, then the climate in Houston would be equivalent to that in north central Pakistan.

Much of the heat in 2011 was due to a lack of rainfall, and with climate change, rainfall over the long term is projected to decline. Also complicating these projections, and contributing to potential risk, is that rainfall over the past century has been difficult to predict. Because of this, it is hard to predict how long the current drought will last. Dr. Nielsen-Gammon explained that model projections show a steady increase in temperature and these predictions match observed conditions across the state over the past 30 years. The consequences of higher temperatures mean that more energy will be used for cooling, and that more drought-like conditions will occur with increased evaporation. The increase in evaporation will impact water storage in lakes and reservoirs at the same time that population growth in the region is driving increased demand for water. Dr. Nielsen-Gammon described how many systems – energy, water, and food supply – are interconnected, so that negative impacts in one affect the others; sustainability in this context is about

adaptability and being able to change course to maintain a pathway to sustainability.

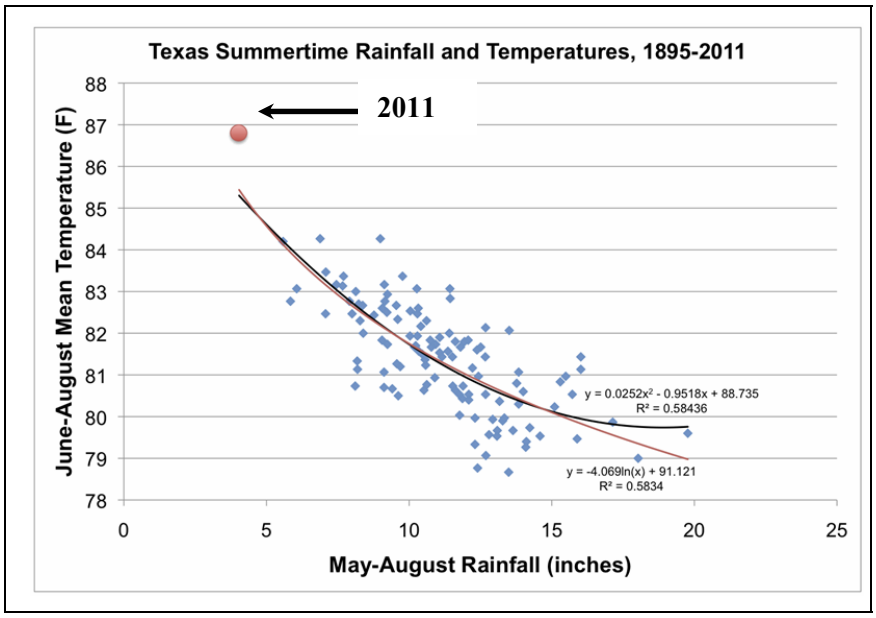


FIGURE 4-1 Texas summertime rainfall and temperatures.
SOURCE: John Nielsen-Gammon, presentation, January 18, 2012.

Lisa Gonzalez, research scientist at the Houston Advanced Research Center (HARC), highlighted some of the key habitats and ecosystem services in the Houston metropolitan region. Houston is often referred to as the "Bayou City" due to the number of bayous and waterways in the region, and those waterways serve as distributary channels for storm water, freshwater inflows for Galveston Bay, and conduits for transportation and international trade. Buffalo Bayou, one of the city's most symbolic bayous, faces challenges due to industrialization in the lower reaches, urbanization in the middle reach, and suburbanization in the upper reaches.

Land development around Buffalo Bayou and the city's other bayous affects the water quality of these systems, said Ms. Gonzalez. The Texas Council on Environmental Quality (TCEQ) found that as many as 90 percent of the streams in Harris County are impaired. The TCEQ determines whether water quality in a water body used for recreation meets the standard for levels of indicator bacteria, such as

Escherichia coli (*E. coli*). High concentrations of bacteria in water bodies have been associated with an increased risk of becoming ill from recreational activities. In the Houston region, bacteria are the most common pollutant of concern, and an implementation plan has been drafted to address 60 bacteria-impaired segments representing 80 percent of assessed streams in the region (TCEQ, 2011). In the Houston ship channels, industrial toxins such as polychlorinated biphenyl (PCBs) and other dioxins remain a threat to aquatic wildlife and human health; consumption advisories exist for several species of fish.

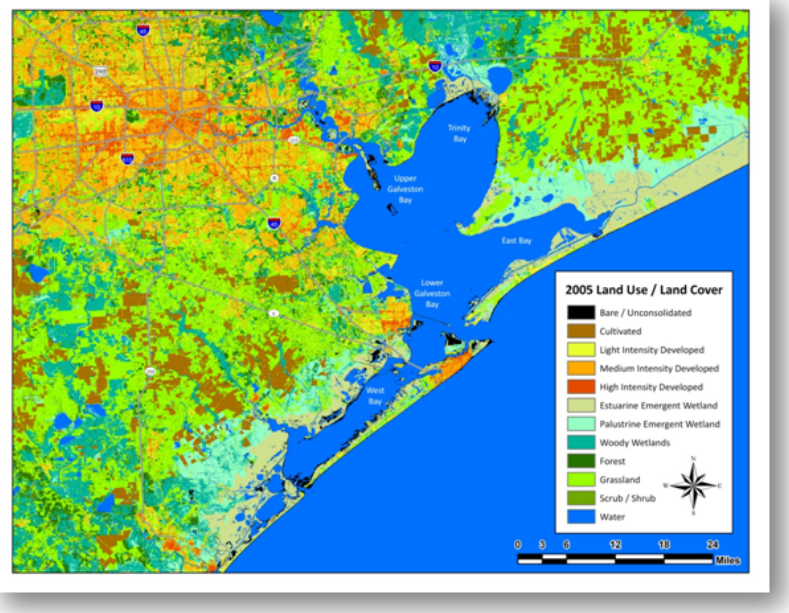
The Houston region has two large river systems—the Trinity River and the San Jacinto River. These rivers are important for freshwater inflows into the Galveston Bay, with the Trinity River supplying more than half of that inflow. Ms. Gonzalez stated that with current drought conditions and rising salinity levels, many freshwater plants along the Trinity Bay Delta can no longer be found. Houston also has extensive riparian forests and bottomlands that are intricately linked to the rivers, bayous, and waterways in the region. The Trinity River bottomlands are found on the eastern side of the city, the Columbia bottomlands on the western edges of the region along the Brazos River, and riparian forests along all the bayous. These riparian zones and bottom lands provide storm water retention, flood mitigation, and water quality protection in more densely populated areas. Historically, many of these riparian zones were cleared during a period of channelization and development.

Another habitat important to the Houston region are coastal prairies, said Ms. Gonzalez; less than one percent of all native coastal prairies are estimated to be left in the United States. Early accounts from people first arriving to the Houston region described a land covered by coastal prairie with green ribbons of riparian forests along waterways. There are examples of remaining coastal prairie, including the Armand Bayou Nature Center and Katy Prairie near the University of Houston, Coastal Center. The Katy Prairie is considered conservation land and is privately held and managed for that purpose. In addition to development occurring in this habitat, invasive species such as the Chinese Tallow tree are a growing threat and require extensive resources, money, and manpower to help control. Some of the services provided by coastal prairie habitat include grazing for food production, wildlife habitat, nature viewing, and hunting.

Wetlands are another important habitat in the region, and particularly unique are Estuarine wetlands, which exist along the bay. Palustrine wetlands are freshwater wetlands that extend into the upper

reaches of the watershed. Both kinds of wetlands provide protection from storm surge, fish and wildlife habitat, and water quality protection in urban areas. However, since the 1950s more than 30,000 acres of wetlands have been lost in the region. Estuarine wetlands have been the focus of restoration efforts and regulatory protection, and their acreage has been consistent. Freshwater wetland areas, in contrast, have experienced a decline in acreage in areas where there has been more development because they are not included in wetland permitting regulations (Figure 4-2).

	1996	2005	Change
Palustrine	809,522	783,536	**-25,986**
Estuarine	163,258	163,452	**194**



Credits: (Photo) Dr. John Jacob; (Data) NOAA CCAP in State of the Bay, 3rd Edition

FIGURE 4-2 Change in wetlands in the Houston metropolitan region. SOURCE: Lisa Gonzalez, presentation, January 18, 2012.

Oyster reefs in Houston are an example of a bay habitat linked directly to the urban setting because they provide commercial seafood, explained Ms. Gonzalez. Extreme storm events result in excess storm

water flowing into urban bayous, and the resulting elevated bacteria levels directly affect oyster reefs' ability to provide their economic and ecological service. Oyster reefs that were abundant in the 1950s were gone by the 1990s, partly due to intensive shell dredging. Additionally, the remaining reefs were damaged by Hurricane Ike in 2008 and again by decreased inflows due to drought in 2011.

A rich assortment of habitats continue to provide numerous services to the human population, stated Ms. Gonzalez; however, urban development and other human uses often do not consider the ecosystem services that are lost. Also, many important habitats lie outside of the regulatory realm (e.g. freshwater wetlands) and so novel, non-regulatory management approaches are needed. Although restoration has been a focus in the region for the past 30 years, greater efforts to conserve habitat are needed. Habitat conservation is difficult to fund due to the lack of non-federal matching funds, conservation landholders, and managers, but these issues must be addressed in coming years if the remaining habitat diversity around Houston is to be protected.

Ms. Gonzalez provided a vision for a path forward for natural capital considerations in the Houston Metropolitan region:

- Use existing strategies in novel ways, such as watershed protection plans in permitting activities or changing existing policies and legislation
- Create incentive programs to encourage private land owners and developers to work with conservation organizations and land trusts in order to foster more low-impact development in Houston
- Bring more non-federal dollars to Houston and increase the leveraging of funds through new partnerships with large conservation organizations
- Increase and better coordinate the use of existing technologies and data for decision making at local government level, such as GIS and decision support systems
- Shift thinking away from preserving nature's past and change the discussion, engaging the general public to create a better future

John Randolph, a professor at Virginia Polytechnic Institute and State University (Virginia Tech), explained that one mechanism used for land conservation in Virginia that allows for permanent protection of land resources is a tax credit for the donation of conservation easements. The state government, under democratic leadership, had a goal of establishing 400,000 new acres of permanently conserved land in

Virginia. That goal was achieved and the same proposal, under republican leadership, was recently adopted. This conservation tax credit has become a non-partisan, financial incentive to put land in permanent conservation. Although Texas does not have an income tax, there may be other financial incentives for conserving privately owned land, Dr. Randolph said. Another mechanism is the transfer of development rights, he continued; however, a lack of zoning in the Houston region is a barrier to this mechanism. Zoning would provide opportunities to transfer development rights from private-sector land that could be conserved to land suitable for development—where density could be increased.

From the natural habitats in the Houston metropolitan area, the discussion moved toward the built environment and the infrastructure required for transportation. Carol Lewis, associate professor of transportation studies and director of the Center for Transportation Training and Research at Texas Southern University, discussed the linkages between transportation and sustainability. To move away from traffic congestion, pollution associated with vehicular traffic, and dependence on foreign oil, explained Dr. Lewis, more attention needs to be given to walkable communities, light rail systems, and bikeable pathways. This is the idea of complete streets; they are not just for cars but for many modes of transit. Transit-oriented development (TOD) has shown that households in these communities are twice as likely to not own a car. This results in tremendous energy savings as well. A study conducted by Lewis and Goodwin (1996) showed that if only 5 percent of employees at that time in downtown Houston gave up driving for just one day a week, the annual energy savings would be 239 million BTUs. Changing habits can make profound differences, they concluded.

It is also important to think about planning more broadly at the regional or mega-regional level, Dr. Lewis said. The Houston-Galveston Area Council (H-GAC) bridges the planning efforts of several communities across the area and pulls them together into a broader more overarching plan. This example should be replicated with communities letting go of political boundaries and focusing more on needs across the region. The Houston region, for example, is part of a mega-region consisting of Dallas, San Antonio, and Austin, and so there should be better planning efforts among these regions.

Dr. Lewis also elaborated on how providing parking spaces could be detrimental to sustainability initiatives. Donald Shoup from University of California, Los Angeles, is known for his discourse on the high cost of

free parking and his argument that if parking was eliminated, then development costs would be greatly reduced and more efficient urban design could be developed that would reduce auto dependence and also restrain sprawl—all important contributors to sustainability, noted Dr. Lewis. One policy barrier to such programs is the City of Houston's requirement that parking be provided for individual developments. An example of a solution to this barrier is a transit corridor ordinance passed three years ago by Houston that allows developers who build next to the light rail to provide fewer parking spaces than other builders – an issue that has been contentious in Houston. Although developers often claimed that banks would not finance development with fewer parking spaces, the opposite has proven true in some instances. There appears to be a disconnect, noted Dr. Lewis, between what the city is trying to do sustainably and what banks and developers tend to finance and build.

One area that needs further attention, noted Dr. Lewis, is the ability to fund sustainability initiatives, as there is a lot of competition for available resources. It will also be important to identify the policies and technical guidelines that need modification, such as the requirement for a certain number of parking spaces per so many thousand square feet of development, and identify case studies in the published literature, draw out lessons learned, and apply them to the Houston region and elsewhere. Change is incremental, concluded Dr. Lewis, but it is important to continue to move incrementally toward better sustainability.

In addition to the infrastructure for transportation that makes up the built environment, there are also numerous buildings that comprise the Houston skyline. Rives Taylor, director of sustainable design at Gensler discussed regeneration as a way to move toward sustainability. Buildings have a major impact in terms of energy and water use, he noted; the approximately 76 million residential buildings and 5 million commercial buildings across the United States consume 40 percent of the nation's energy and 76 percent of all electricity (EIA, 2008). Much of the air pollution that exists in Houston and the health effects associated with it comes from the burning of fossil fuels for electricity.

Water use in buildings—from the potable water coming directly into a building to the water used to cool turbines in the generation of electricity—is another area where efficiency can be gained, said Mr. Taylor. Much of the water coming into buildings does not need to be potable, because it is used for cooling, toilets, or fire suppression. Water will continue to be an issue in the Houston region, and will need to be used differently moving forward. Building materials is also an area with

a large impact on waste, Mr. Taylor added; construction debris, for example, accounts for over 25 percent of landfill content.

Buildings can be expensive to construct, but operating costs can be even more, Mr. Taylor said. Investing in smart design before you build allows for the building to operate more efficiently later. One dollar invested in smart design can actually translate into as much as $30 in operational cost savings over a 30-year life of a building. Insulating buildings is the simplest, most cost-effective way to tackle climate change, he said. Insulation is a onetime cost with a payback that makes sense for most developers and builders. Developers need to rethink the nature of buildings so that there is more low-impact design and transit-oriented development.

Also important is the environment buildings create, Mr. Taylor said. Recruiting the next generation of the best and brightest workers is challenging if they are expected to work in an atmosphere that does not convey a clean, healthy building. Research has shown, Mr. Taylor stated, that healthy, day-lit buildings result in better productivity and 80 percent less energy used. Currently, every building being built or renovated in Houston is a Leadership in Energy and Environmental Design (LEED)-certified building. There are innovations in design that have led to more efficient buildings. Passive design, for example, is a natural system that cools the building through basic physics and not through internal climate control mechanisms. A double skin on a building allows for a ventilation system made from metal that cools when the sun goes down and pulls cool air in below that warms as it rises. An under floor air distribution system (Figure 4-3) puts air where people sit rather than up in the air, and also has the following benefits:

- Heated air temperature sits lower in a room
- Less fan energy needed
- Only the occupied zone is heated or cooled
- Less overall energy needed to provide the same level of comfort

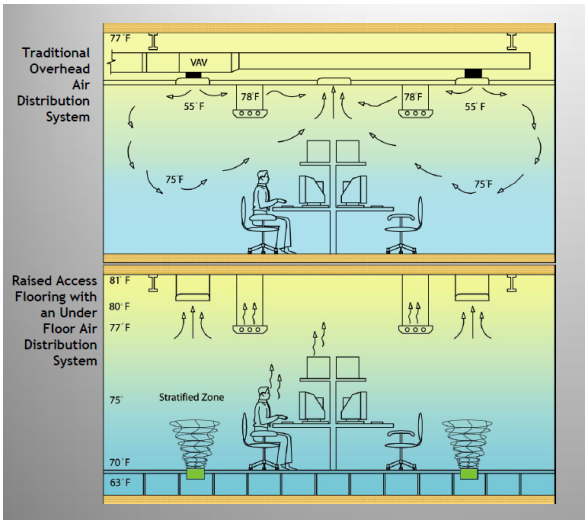


FIGURE 4-3 Illustration depicting air currents of an under floor air distribution system.
SOURCE: Rives Taylor, presentation, January 18, 2012.

Another example of sustainable building design at the industrial level is a LEED platinum project at a global energy corporation (name not disclosed). This building is 423,500 gross square feet in area, has an occupancy of 2,200 seats, and generates its own power through a cogeneration plant using natural gas. This building also captures rainwater, condensate, and groundwater to generate somewhere between 100,000 and 115,000 gallons a day of nonpotable water used to flush toilets and irrigate, Mr. Taylor said. This building reduces water use by over 68 percent and although it is an energy-intensive building, it optimizes the energy it uses. There are catalysts for transforming a city into a livable city, which requires thinking at a much larger scale, Mr. Taylor said in conclusion. The challenge is looking not at an individual building, but at streets, blocks, or districts. It's having a city that is diverse and that has green infrastructure, efficient mass transit, accessible medical care, and integrated parks and trees.

5

MEASURING SUCCESS AND TRANSLATING RESULTS

Jim Blackburn, professor of the practice of environmental law at Rice University, discussed sustainability in the context of a triangle that has social, economic, and ecological points at each of the three corners (Figure 5-1). He noted that the midpoints between each corner—meeting basic needs, eco-efficiency, and place-based initiatives—are also important. As a course project with the Shell Center for Sustainability at Rice University, Mr. Blackburn engaged students to review 20 studies that addressed sustainable indicators for a city. They started with 1,000 indicators and then developed a winnowing process to identify 25 indicators which were discussed in detail in a report issued in 2011.[10] The project aimed to identify indicators that were quantifiable and to use GIS imagery to identify spatial patterns within the city. The spatial patterns, noted Mr. Blackburn, were just as informative as the numerical values given by the indicators.

[10] Available at http://shellcenter.rice.edu.

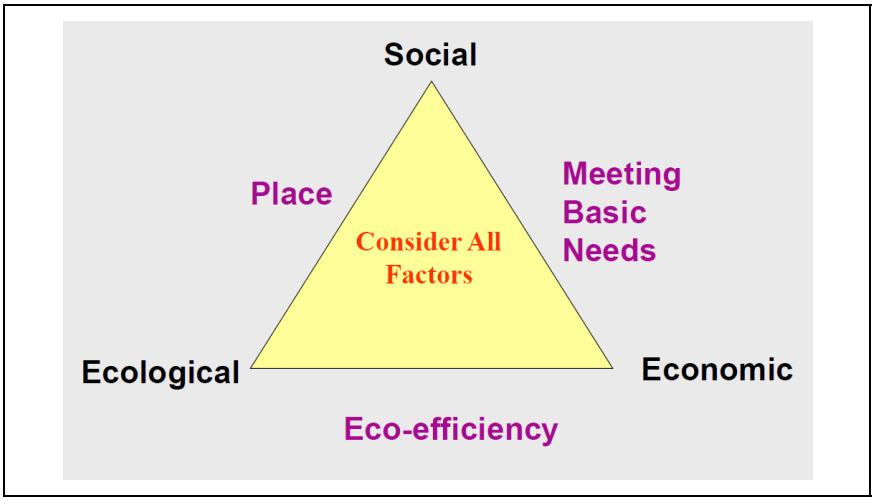


FIGURE 5-1 Illustration depicting social, ecological, and economic components of sustainability as points of a triangle.
SOURCE: Jim Blackburn, presentation, January 18, 2012.

One indicator demonstrating that basic needs are not being met for some of Houston's population is the number of individuals living below the poverty level; twenty percent of Houston's population is below the poverty level. Some neighborhoods in Houston, added Mr. Blackburn, can have as many as 40 to 60 percent of its residents below the poverty level (Figure 5-2). Income disparity is another indicator. A report issued by the Center for Budget and Policy Priorities and the Economic Policy Institute stated that the income disparity between the top 5 percent and middle 20 percent in Texas is greater than in any other state in the United States (Bernstein et al., 2006). This is a sustainability issue for the entire nation, and not just for Houston, said Mr. Blackburn. Other social, economic, and environmental indicators he discussed included:

- Air quality: Monitored Benzene levels in 2010 in Houston were 1.39 ppb relative to a standard of 1.40 ppb.
- Environmental justice: Minority areas on the east side of Houston have high air pollution levels.
- Education: In 2009 Harris County had a high school dropout rate of 35 percent, which draws in racial disparity issues.
- Food supply: 143 square miles in total and 60 percent of the low-income area of Houston is a food desert, meaning there is not enough access to healthy food (Figure 5-3).

- Community gardens: There are 125 community gardens in the Houston metropolitan region.
- Cost of living: In Houston the ACCRA[11] cost of living index is 8 percent below the national average, and 34 percent of the population spends more than 30 percent of income on housing.
- Land use: The City of Houston has a density of 3,492 people per square mile.[12]
- Flood damage: For the years 2007 to 2009 in Houston, three percent of the total gross domestic product (GDP) annually went to flood damages. Floodplains increased by 34,000 acres from 1996 to 2007. The increases were due in part to better data but also to more flow, resulting in less protection for development built along or within the floodplains.

Standard economic indicators—such as GDP, commercial leasing, home sales, building permits, new housing starts, and unemployment—do not address sustainability issues very well, said Mr. Blackburn. Economics is generally discussed in the context of production, distribution, and consumption of goods and services that meet the needs of today. Sometimes economic indicators are not entirely informative; hurricane damage, for example, is taken into account as positive GDP because of the economic activity associated with rebuilding, rather than being negative, which would account for the damage inflicted on communities. This is an issue, stated Mr. Blackburn, which should be addressed if GDP is to be considered a major economic indicator.

An alternative way of viewing economic success could be by the minimization of the use of energy and water in the production of goods. An example of an energy efficiency indicator would be one that takes total electricity consumption and compares that to GDP to come up with an index of gross area product (GAP) divided by residential energy consumption per capita. This number should increase over time with higher levels of efficiency.

[11] The ACCRA Cost of Living Index is a measure of living cost differences among urban areas in the United States compiled by the Council for Community and Economic Research.

[12] New York City has approximately 27,000 people per square mile (NYC Department of Urban Planning, 2012).

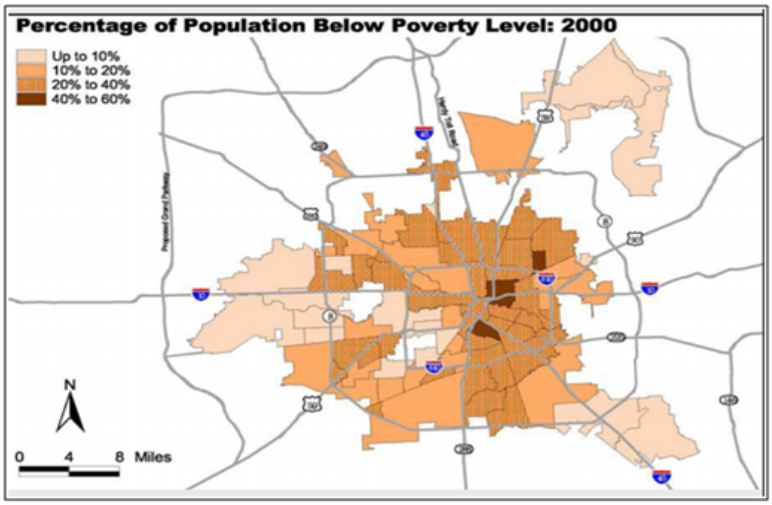


FIGURE 5-2 Percentage of population below poverty level in the Houston metropolitan region in the year 2000.

SOURCE: Jim Blackburn, presentation, January 18, 2012.

The loss of natural capital is as much an economic issue as an ecological one. The Galveston Bay contributes billions of dollars per year in ecological services to the Houston economy; however, the bay seems to be treated as though it has no value at all, said Mr. Blackburn. Freshwater inflow is necessary to maintain Galveston Bay, and it needs two and a half to three million acre feet of inflow per year, but perhaps more. Currently there are only about 300,000 acre feet permanently dedicated to the future of Galveston Bay. More water, needs to be dedicated to the bay as an economic proposition, as well as an ecological one. It is key to think about the future, and to develop metrics to measure success in the long-term.

Walter Peacock, professor and director of the Hazard Reduction and Recovery Center at Texas A&M University, discussed sustainability in terms of disaster resilience—reducing levels of damage following natural disasters and speeding a system's recovery—and what can be learned from such events. Such learning allows communities to recover, build more sustainability into their systems, and reduce the potential for loss and failures with future disasters. The recovery process is a window of opportunity in which communities can enhance their mitigation status and the robustness of their systems in order to reduce exposure and risk,

said Dr. Peacock. Recovery can also be sustainable when ecological, environmental, and social sustainability are all increased during the process.

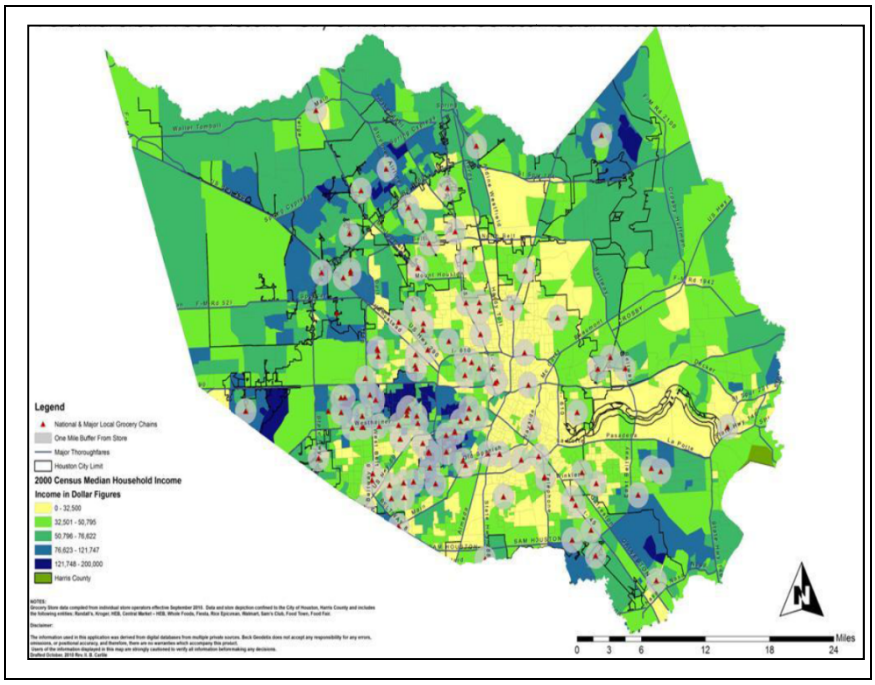


FIGURE 5-3 Map of food deserts in the Houston metropolitan region where triangles indicate grocery stores, and lighter to darker shades indicate median household income from lower to higher dollar figures.

SOURCE: Jim Blackburn, presentation, January 18, 2012.

An example of how to address social vulnerability measurements and resiliency issues is with a framework that has been developed by Susan Cutter, Dr. Peacock said. This Disaster Resilience of Place (DROP) Model takes into account a range of indicators—ecological, social, economic, infrastructure, institutional capacity, and community competencies—to assess a community's overall resiliency. Another example is the Sustainable Livelihoods Framework, stemming from work done internationally. This framework defines categories that should be targeted at the community level in order to feed and enhance the community's overall sustainability. It identifies the different phases of the disaster process, the kinds of resources required to meet particular

needs, and the activities that need to be undertaken at the different phases of the process.

Another approach taken by Dr. Peacock was to place disaster phases into a Community Disaster Resilience Framework (CDRF), which can be thought of as a wheel that has different types of capital subsumed under each section (Figure 5-4). This framework still needs to have natural capital and ecosystem resources incorporated so that they feed into the different phases. The framework tries to capture the social, economic, physical, and human capital needed to carry out given activities under each phase, as shown for hazard mitigation in Figure 5-5. The unit of analysis used for the framework is at the county level, and data sources include national agencies, such as the Census Bureau, Federal Emergency Management Agency (FEMA), Department of Health and Human Services, Centers for Diseases Control and Prevention, Internal Revenue Service, and others. The framework incorporates 75 indicators across the four areas of capital: social, economic, physical, and human.

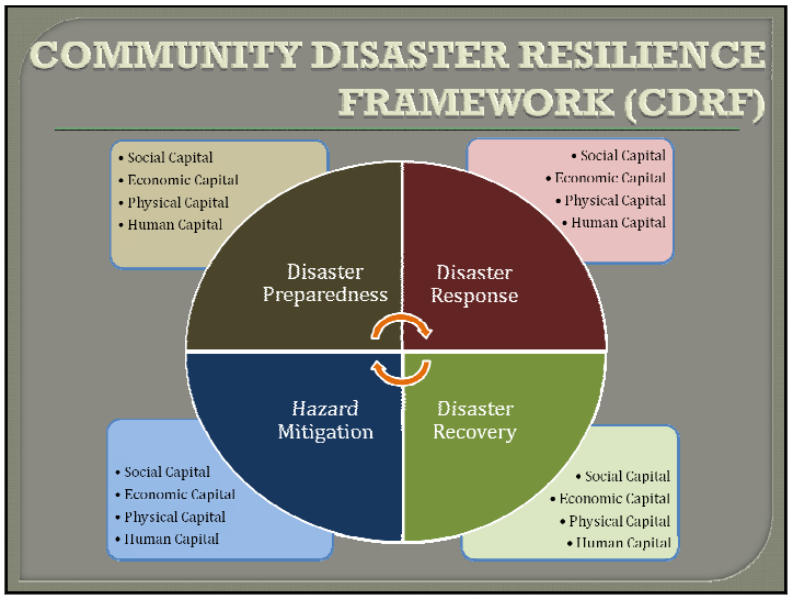


FIGURE 5-4 Relationship between community capital assets and disaster management phases under the Community Disaster Resilience Framework. SOURCE: Walter Peacock, presentation, January 18, 2012.

Using the framework, Peacock examined 144 counties from six Gulf Coast States, including Florida, Texas, Louisiana, Mississippi, Alabama, and Georgia. The social capital indicators were used to capture civic and political organizations, religious organizations, housing, professional associations, and other components of social networks. Economic indicators included per capita income, median household income, employed civilian population, and median value of owner-occupied housing units. The largest set of indicators were for physical capital and human capital. Physical capital captured components such as nursing homes, hospitals, landscape firms, housing units, and fire stations, among others. Human capital targeted technical expertise and communities, including zoning regulations, building code, FEMA-improved mitigation plans, environmental consulting workers, building inspectors, and construction workers.

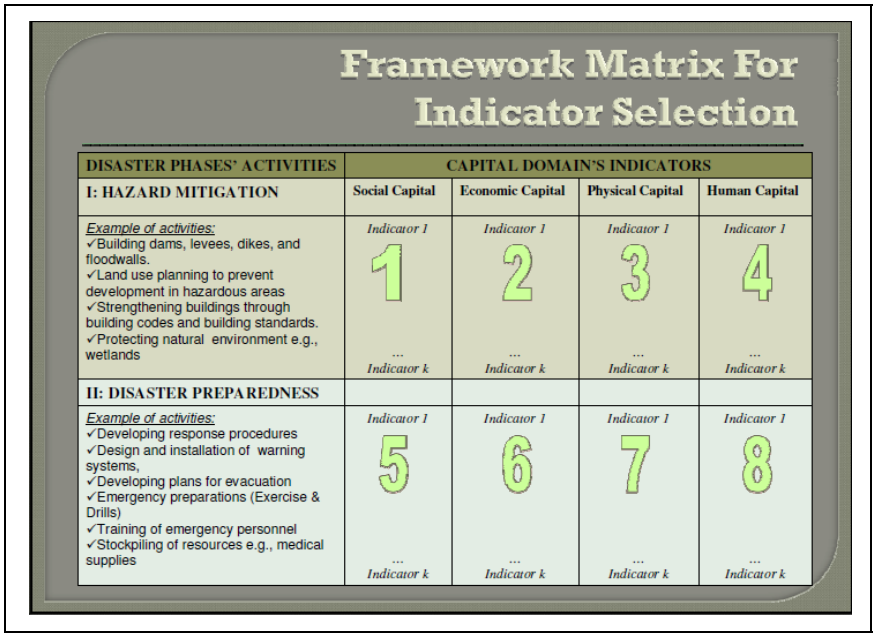


FIGURE 5-5 Framework matrix for indicator selection, shown for hazard mitigation and disaster preparedness as examples.
SOURCE: Walter Peacock, presentation, January 18, 2012.

The indicators were then scaled and standardized. They were combined into a variety of resiliency indices, with separate indices for phases (mitigation, preparation, response, and recovery) and for capitals

(economic, human, social, and physical) in order to develop an overall County Disaster Resilience Index (CDRI). When the CDRI was mapped over the counties in the Gulf Coast region, a range of community resilience was shown (Figure 5-6). The darker the color, the higher the resiliency index for the county, and from the map it can be seen that there are many light-shaded areas across the Gulf Coast States that remain vulnerable.

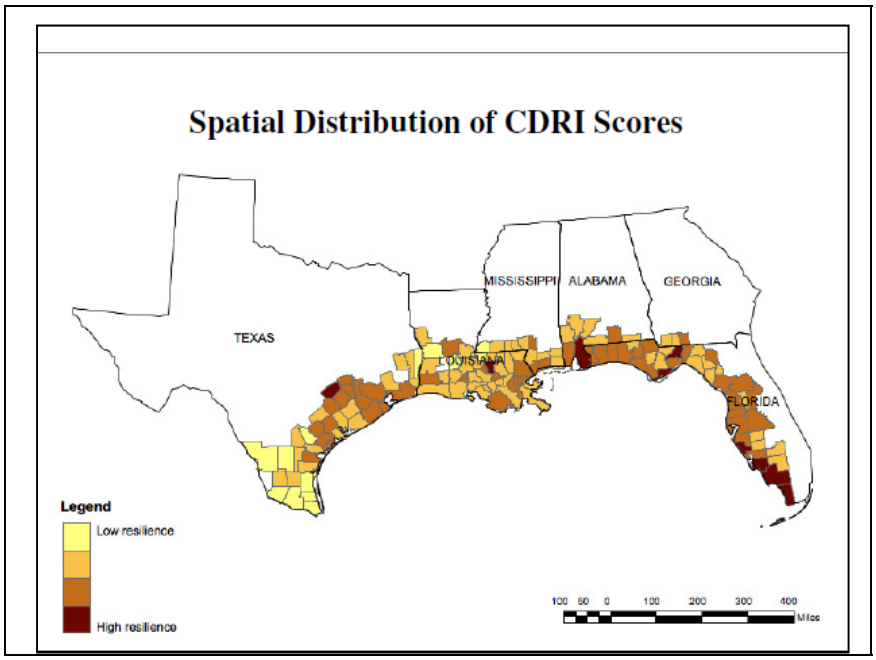


FIGURE 5-6 Map indicating the degree of resiliency for different communities. The lighter the shading, the lower the resilience and more vulnerable the community.
SOURCE: Walter Peacock, presentation, January 18, 2012.

There is a range in CDRI values across the Gulf Coast States, with Texas holding the last position when ranked (Table 5-1). In general, counties with comprehensive planning, that adopt hazard-relevant building codes and zoning regulations, participate in FEMA CRS rating, and implement other similar policies, were more disaster resilient. Overall, the CDRI was shown to have the potential as a measure of community resilience and as a way to facilitate future research to promote disaster resilience. Resiliency research, Dr. Peacock added, is

critically important as it brings into focus crucial lines of research, sustainability, social vulnerability, mitigation, recovery, and coupled social-ecological systems. Consistent community disaster management and response plans are also important in order to better address damage from disasters and decrease vulnerability, and these plans ultimately need to be integrated into ongoing community development.

TABLE 5-1 Ranking of CDRI scores for six states.
SOURCE: Walter Peacock, presentation, January 18, 2012.

State	CDRI	
	Mean	Rank
Florida	.2539	1
Alabama	.0067	2
Georgia	-.0479	3
Mississippi	-.0860	4
Louisiana	-.0981	5
Texas	-.1418	6

Bruce Wilcoxon, HSE/SD lead for Deepwater Gulf of Mexico Exploration, ConocoPhillips, and a member of their corporate sustainable development group, provided a private sector perspective on measuring sustainable development performance in the context of a large, multi-cultural urban setting. A number of key points were highlighted. First, when measuring the success of a sustainability program, metrics and feedback mechanisms must be aligned with the goals of the program, he said. Second, developing meaningful metrics is not a trivial exercise, but one that requires proper attention to integrating economic development, environmental performance, and social benefits. Third, it is important to gain integrated feedback on sustainable development performance at a variety of scales and to ultimately move away from a simple dashboard model to developing more inclusive metrics. The challenges and issues that fall under the umbrella of sustainability are complex and numerous, further complicating efforts to develop a set of metrics or feedback programs that accurately capture progress in this area, Mr. Wilcoxon said. ConocoPhillips adheres to the triple bottom line approach to

sustainability, meaning a focus on economic growth, social progress, and environmental stewardship. He added that if the sustainability program is not furthering the bottom line, then the program itself will not be sustainable.

Mr. Wilcoxon listed several key areas for measuring success in the area of sustainability: producing energy in a cost-competitive manner, growing the business, identifying and managing risks, identifying and capitalizing on new opportunities, and providing a fair return to shareholders. He noted that ConocoPhillips is moving away from developing a dashboard approach or a set of key metrics to assess their sustainability efforts due to the limitations of defining a simple metric to capture all of the complexity in their programs. He added that measuring good data can be a resource-intensive effort; it requires buy-in from all necessary parties, which can sometimes be difficult given that businesses are already under resource constraints. Mr. Wilcoxon added that it can be more difficult to develop metrics that address performance within communities and societal issues than to assess environmental data. It is also challenging to develop metrics that cross various timeframes—metrics that can be used in the company's quarterly and annual performance reviews and in five-year and 10-year planning cycles.

The company now uses classic business performance metrics in its annual report, such as revenues, net income, and return on investment in production. Additionally, ConocoPhillips developed a variety of planning processes to assist in directing business efforts and in measuring performance. For example, in 2008, the company adopted a five-year climate change action plan. The plan includes 31 actions, all of which have accountability measures and goals associated with them. The company measures and tracks performance according to the plan and has its own operating standards and auditing process that includes issues related to environmental impact. Mr. Wilcoxon added that it is imperative that sustainable development feedback be communicated both internally and externally. The company uses its website and sustainable development report to communicate information to the public. Internally, these reports are provided on a regular basis to management and the public policy committee of the board of directors.

Participants discussed incentives that could be used to move organizations towards better sustainability practices. Often metrics are not available to show that sustainability is a good long-term business decision and is worth the investment in better practices, noted one participant. Mr. Wilcoxon said that there are different types of

individuals in an organization— those who respond to the carrot, the stick, or the halo. How you shape your message depends on which of these audiences are being addressed. Quantitative metrics are really helpful in demonstrating the benefits of integrating sustainability, but often the evidence is anecdotal, which works well with those who respond to the carrot. Being mindful of the bottom line is important in the private sector, and those who watch this closely respond to the stick—the risk associated with not doing business properly and affecting that bottom line. Lastly, noted Mr. Wilcoxon, there are those who try to integrate sustainability into their practice because they believe it is the right thing to do—the halo. For any of these types, qualitative and quantitative metrics and results are important for strengthening the business case for sustainability.

Mr. Blackburn noted that he has had his students track the language used on corporate websites to capture the evolution of corporate rhetoric on sustainability. He noted that overall there has been increasing substance to the statements made on the sites and that increasingly there are more quantitative metrics reported, such as water and energy balances. There is a strong movement in which more companies are internalizing sustainability principles and practices so that much progress has been made across the corporate sector, he said. Participants discussed the difficulty in operationalizing sustainability principles and practices.

The Houston-based group of ConocoPhillips developed a sustainable development scorecard for major projects, Mr. Wilcoxon said. In order for funding to be approved on a new project, a sustainable development scorecard is required. The score is not the real endpoint of this process, though. The scorecard requires that the conversation be expanded to include a diverse set of other employees, which expands the group's view of potential risks and opportunities associated with the project. This approach provides an organizational structure and formal process for integrating these concepts across the different groups within one company.

In contrast to this scorecard, which serves as a vehicle for furthering sustainability principles, ConocoPhillips has a reward system in place for individual performance that can prevent some sustainability activities, Mr. Wilcoxon said. For example, business unit managers are rewarded

on the basis of production, and when presented with an energy efficiency project versus a project that includes drilling a natural gas well, the manager has more incentive to move forward with the well in order to demonstrate performance in production. This is a challenge that should be addressed so that energy efficiency projects are not disincentivized, said Mr. Wilcoxon.

6

MOVING FORWARD

Catherine Mosbacher, president and CEO of the Center for Houston's Future, explained that the center's goal is to help make Houston one of the top 10 global regions in which to work and live. She noted that there are language problems when it comes to discussions around sustainability, and that her center couples the word competitiveness with sustainability because this better resonates with the business community. One of the center's projects is Scenarios 2040, which is a business-led regional public interest scenario that engaged up to 50 people from across the region from many different ages, industries, ethnicities, and political views to work for three years on different scenarios of what Houston might look like in the future.

The scenarios are presented as short films—*Learning to Live* and *Playing to Win*—and can serve as tools to identify areas of concern, as well as areas where opportunities exist to better compete and be sustainable. *Learning to Live* showed that the region has become very inwardly focused, emphasizing quality-of-life issues. *Playing to Win* showed a vastly increased population, a booming economy, and an increased global presence. Three overarching themes guided the research for the scenarios: Houston's support system, the economy, and Houston's relationship to its biosphere. Also important to the research was understanding how Houston relates to other cities in the United States and globally.

The films were created to be neutral and as straightforward as possible in order to engage the intellect instead of drawing on emotions. The films are narrated equally and have the same graphic style in order to emphasize the difference between the content of the films. The films are presented to different audiences, including business groups and non-profit organizations. One of these scenarios shows a population of 7 million and the other shows a population of 12 million, so the films

caught the attention of the business groups in terms of the workforce and infrastructure that may be needed in the future.

John Randolph noted that thinking about the future through such scenario-based storylines allows viewers to identify both the negative attributes of the future that can be addressed, as well as positive elements. These scenarios also enable the conversation around sustainability to continue as a collaborative discussion about the future. He added that some of the topics in the scenarios are debatable, such as the role of energy in the economy and hazard mitigation from natural disasters.

Incentives and Challenges to Pathways to Sustainability

Participants discussed barriers to collaboration in moving sustainability initiatives forward, focusing on external stakeholder collaboration and inter-organizational collaborative models. One of the challenges identified during the discussion was a general lack of awareness about sustainability efforts in the region and about the existence of other potential collaborators. Better dissemination of activities and communication tools to share initiatives with other organizations are needed, some participants noted. Also mentioned was the need for a process that can develop trust and serve as the foundation or underpinning of collaborative efforts among organizations. One step in beginning that process is to recognize that many people share common goals even though they may approach issues differently. It is also important to recognize privacy in the collaborative process, and that when engaging the private sector, proprietary information may need to be protected.

Collaboration is an important process as it builds social and intellectual capital, some participants stressed, noting that collaborations that are done well lead to further collaboration. If they are not done well, however, then barriers to more collaboration are created. Participants discussed the need to preserve the value of a collaboration created during the process once a given activity is over so that a collaborative network can be continually expanded. This allows for engaging new participants, and bringing in knowledge from new communities and different socio-economic backgrounds. During collaboration it is important to create a vision, many said, and once the vision is created, it is possible to share leadership, goals, message, planning, and the many other steps needed in the collaboration process.

Some participants emphasized that a functional collaboration is a process and a practice. Organizations must remove themselves from their own silos in order to learn from the process and improve it moving forward. It is important to be cognizant of the goal while moving through the process, and to keep expanding the network into new communities. Noting that there are challenges in finding funding sources for collaborations, several participants discussed a network model in which funding is provided to support the collaboration of different organizations and further build collaborative capacity within those organizations. It is important to have funders at the table, they stated, in order to provide updated information and expectations of the collaboration.

Participants also discussed incentives to advance sustainability, which revolved mainly around communication. Many participants reinforced the importance of the three pillars—environment, economics, and social equity—in order to find the best way to engage others and discuss what is needed to best maximize the benefits from the three pillars. A collaborative engagement is needed to identify co-benefits and commonalities among the pillars, and to closely consider the language used in communicating visions. The audience is important too. Engaging developers and the business community is just as important as involving other organizations.

Major Themes for Moving Forward

Jim Lester, president of the Houston Advanced Research Center, summarized what he saw as some of the major themes voiced by many participants in the workshop:

- The poverty rate, underdeveloped areas, substandard housing, and health issues are all linked, and a more sustainable Houston will address all of these elements, resulting in a happier, healthier, and more prosperous population.
- Houston's political and regulatory legacy may be problematic in moving forward. There still exists an anti-regulatory culture in the Houston area, and so the pathways to sustainability will require a long time and creative approaches to affect change in land use decisions, infrastructure development, policies, culture, and regulations.
- To engage political leadership, it is important for decision makers and elected leadership to understand that it is in everyone's interest,

including their constituents, to move in the direction of a more sustainable metropolitan region.

- Better communication is important in identifying commonalities among organizations and across ethnic communities in Houston, but tremendous challenges remain given the complexity involved in interfacing with diverse audiences and economic groups.
- A common language is needed for more effective communication around sustainability, so that the social, economic, and environmental conditions are all addressed
- The components for making the region sustainable already exist, but need to be brought together and integrated at all scales—from larger neighborhood projects down to backyard projects.
- Implicit in collaborations are networks, and multiple collaborations mean multiple networks, but the challenge is connecting all of those networks. A functional collaboration is a process and a practice, and there is a role for social media in making these bridges. It is not practical to bring tens of thousands of people together to hold a meeting on making the region more sustainable, but through social networking it is possible to have many smaller meetings that can ultimately be connected and informed by other meetings and individuals.
- To change legacy issues, it will be important to integrate economic development, social progress, and environmental stewardship by maximizing the benefits in each of these pillars of sustainability.

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A

WORKSHOP AGENDA

Pathways to Urban Sustainability: A Focus on the Houston Metropolitan Region

January 18-19, 2012
Shell Center for Sustainability
Rice University
Bioscience Research Collaborative Auditorium
6500 Main St.
Houston, Texas

Wednesday, January 18, 2012

9:00 AM..... Welcome from the National Academies
Rich Bissell, Executive Director, Policy and Global Affairs, National Academies

9:05 AM..... Welcome and Goals of the Workshop
Jim Lester, Vice President, Houston Advanced Research Center (HARC)

9:15 AM..... Why Sustainability
Katherine Lorenz, President, The Cynthia and George Mitchell Foundation

Session I: Perspectives on Urban Sustainability

Moderator: Bruce Wilcoxon, Director, Climate Change, ConocoPhillips

9:30 AM..... *John Randolph, Urban Affairs and Planning, Professor Virginia Tech*

10:00 AM..... *Philip Berke, Professor and Deputy Director, Institute for the Environment, University of North Carolina*

10:30 AM..... BREAK

10:45 AM..... *Armando Carbonell, Chairman, Department of Planning and Urban Form, Lincoln Institute of Land Policy*

11:15 AM..... Panel Discussion

12:00 PM..... LUNCH BREAK

Session II: Building Bridges

1:00 PM ..... Natural and Built Capital

Moderator: John Nielsen-Gammon, Professor and State Climatologist, Texas A&M University

Lisa Gonzalez, Research Scientist, Houston Advanced Research Center

Carol Lewis, Associate Professor, Transportation Studies and Director of the Center for Transportation Training and Research, Texas Southern University

Rives Taylor, Director, Sustainable Design, Gensler

2:15 PM ..... Human Capital

Moderator: Winnie Hamilton, Director, Environmental Health, Baylor College of Medicine

Stephen Klineberg, Professor and Co-Director, Kinder Institute for Urban Research, Rice University

Brenda Reyes, Bureau Chief of the Community and Children Environmental Health, Houston Department of Health and Human Services

Herminia Palacio, Director, Harris County Public Health and Environmental Services

Natasha Prudent, Health Scientist, National Center for Environmental Health, Centers for Disease Control & Prevention

3:30 PM ..... BREAK

3:45 PM ..... Breakout groups

Incentives to Change Practice and Advance Sustainability (Auditorium)

Moderator: ..... Jennifer Ronk, Houston Advanced Research Center

Neighborhood and City-Scale Projects (Room 282)

Moderator: ..... Lisa Lin, Sustainability Manager, Office of the Mayor, Houston

4:45 PM ..... Report back in plenary

5:30 PM ..... ADJOURN

Thursday, January 19, 2012

Session III: Integrating Goals, Measuring Progress, Translating Results

Moderator: ..... *Walter Peacock, Professor and Director, Hazard Reduction and Recovery Center, Texas A&M University*

9:00 AM ..... Efforts from Government

Peggy Crist, Director, Office of Planning & Program Development, Federal Transit Administration - Region VI, U.S. Department of Transportation

Patrice Parsons, Director of External Affairs, ICLEI

Jeff Taebel, Director, Community and Environmental Planning, Houston-Galveston. Area Council

10:30 AM ..... BREAK

10:45 AM ..... Measuring Success

Walter Peacock, Professor and Director, Hazard Reduction and Recovery Center, Texas A&M University

Bruce Wilcoxon, Director, Climate Change, ConocoPhillips

Jim Blackburn, Professor of the Practice, Rice University

12:15 PM ..... LUNCH BREAK

Session IV: "Moving Forward"

Moderator: ..... Jim Lester, Houston Advanced Research Center

1:15 PM ..... *Catherine C. Mosbacher, President and CEO, Center for Houston's Future*

1:45 PM ..... Breakout groups

Overcoming Barriers to Collaboration (Auditorium)

Moderator: ..... *Marilu Hastings, Environment Program Director, Cynthia and George Mitchell Foundation*

Regional Projects and Plans (Room 286)

Moderator: ..... *Dr. Lester King, Shell Center for Sustainability, Rice University*

2:45 ..... PM BREAK

3:00 PM ..... Report back to plenary

3:45 PM ..... Workshop Re-Cap and Major Themes
Jim Lester, Vice President, Houston Advanced Research Center (HARC)

4:00 PM ..... ADJOURN

B

REGISTERED PARTICIPANTS

Lilibeth Andre
Rice University Shell Center for Sustainability

Melissa Bain
Houston-Galveston Area Council

Katrina Bayer
Houston-Galveston Area Council

Dagmar Beck
Rice University

Rich Bissell
The National Academies

Jim Blackburn
Rice University

Dominic Brose
The National Academies

Armando Carbonell
Lincoln Institute of Land Policy

Nancy Christopherson
METRO

Amma Cobbinah
METRO

Peggy Crist
U.S. Department of Transportation

Jeremy Cross

Gavin Dillingham
Houston Independent School District

Andrea Galindo
Rice University

Kathleen Garland
University of Houston, Clear Lake

Renissa Garza Montalvo
City of Houston, Parks and Recreation Dept

Camilo Gomez
Rice University

Lisa Gonzalez
Houston Advanced Research Center

Tamar Greasby
National Center for Atmospheric Research

Winnie Hamilton
Baylor College of Medicine

Marilu Hastings
The Cynthia and George Mitchell Foundation

Mary Ellen Hynes
U.S. Department of Homeland Security

Tom Ivy
Texas Stream Team

Mark Juedeman
Transition Houston

Lester King
Shell Center for Sustainability

Stephen Klineberg
Rice University

Jim Lester
Houston Advanced Research Center

Carol Lewis
Texas Southern University

Dolly Li
Shell Center for Sustainability

Lisa Lin
Office of the Mayor of Houston

Katherine Lorenz
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Graciela Lubertino
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Angela Martinez
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Sarah Mason
City of Houston

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The National Academies

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City of Houston, Department Of Public Works & Engineering

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Virginia Tech

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Houston Department of Health and Human Services

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Wells Consulting

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Houston-Galvesotn Area Council

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ConocoPhillips

Leah Wolfthal
University of Houston

Michaelle Wormly
WOMAN, Inc.

Amanda Zuniga
Houston-Galveston Area Council

C

BIOGRAPHIES OF PLANNING COMMITTEE, SPEAKERS, AND STAFF

JIM LESTER (Committee Chair) is currently President of the Houston Advanced Research Center (HARC). Previously, he served as vice president and as director of HARC's Environment Group where he was responsible for developing and implementing projects to make more sustainable our management of water, air and biological resources. From 1975 to 2002 he was a faculty member and administrator in the University of Houston System, where he held administrative positions at the University of Houston, Clear Lake, as a dean, associate vice president, and director of the Environmental Institute of Houston. His scientific work is grounded in ecological and population genetics, which he has applied to projects dealing with biodiversity and development of new species for sustainable aquaculture. Dr. Lester has worked in Asia and Latin America on aquaculture and fishery development projects. He is currently engaged in projects that analyze compilations of datasets from multiple sources to obtain new insights for watershed or landscape management. Dr. Lester also serves in an advisory capacity to a variety of organizations. He is past president of the Texas Environmental Education Partnership. He serves as the chair of the Monitoring and Research Committee of the Galveston Bay Estuary Program, and on advisory committees for the Texas Sea Grant Program and the Texas Environmental Research Consortium. Dr. Lester holds a Ph.D. in zoology from the University of Texas at Austin.

PHILIP BERKE is professor in the Department of City and Regional Planning. He is deputy director of the Institute for the Environment (IE), director of the Center for Sustainable Community Design of IE, and adjunct professor in the Curriculum of Ecology at the University of North Carolina. He is currently a collaborative research scholar of the International Global Change Institute in New Zealand. The central focus of his research is to develop a deeper understanding of the connections between human settlements and the natural environment. His research seeks to explore the causes of land use decisions and their consequences on the environmental, social, and economic systems of human settlements. He is a member of the Steering Committee on Disaster

Resilience, Vulnerability, and Risk Reduction of the National Science Foundation. He recently served as a member of the Committee on Disaster Research and the Social Sciences of the National Research Council which produced *Facing Hazards and Disasters: Understanding Human Dimensions* (2006). He currently serves on the Scientific Advisory Council of the French Association of Disaster Prevention, as well as numerous other scientific and environmental organizations. Dr. Berke's current research projects address domestic and international issues in the areas of environmental impacts of urbanization, land use planning, natural hazard mitigation, environmental justice, and sustainable development. His research has been supported by the United Nations Division of Humanitarian Affairs, U.S. National Science Foundation, New Zealand Foundation for Research Science and Technology, Federal Emergency Management Agency, North Carolina Water Resources Research Institute, and the Lincoln Institute of Land Policy. He is the lead co-author of *Urban Land Use Planning* (University of Illinois Press, Fifth Edition, 2006), which focuses on integrating principles of sustainable communities into urban form. He received his Ph.D. in urban and regional science from Texas A&M University.

RICHARD E. BISSELL has been executive director of the Policy and Global Affairs division of the National Research Council since 1998. Prior to coming to the National Research Council, he headed the organizing secretariat of the World Commission on Dams, and earlier was chair of the Inspection Panel, an independent accountability mechanism for the board of directors of the World Bank. During the years between 1986 and 1993, he was assistant administrator at the U.S. Agency for International Development, first as head of the Bureau of Policy and Program Coordination; and later as head of the Bureau of Research and Development. His B.A. is from Stanford, and his Ph.D. from the Fletcher School of Law and Diplomacy at Tufts University.

JIM BLACKBURN is a partner in Blackburn Carter, P.C., a firm devoted to environmental law and planning. Mr. Blackburn is also a professor in the Practice of Environmental Law in the Department of Civil and Environmental Engineering at Rice University, teaching courses in sustainable development and environmental law. He serves as director of the Interdisciplinary Minor in Energy and Water Sustainability at Rice and is a faculty associate for the SSPEED Center, studying "Lessons Learned from Hurricane Ike" as well as leading a course/project titled "Measuring Sustainability: Project Houston." His current caseload includes litigation over the future of the whooping crane on the Texas Coast and opposition to permits needed to enable uranium mining in Goliad County. Mr. Blackburn is active in community issues

and is a co-founder of Houston Wilderness, the Matagorda Bay Foundation and the Galveston Bay Foundation. He was the recipient of the Barbara C. Jordan Community Advocate Award presented by Texas Southern University in 2007, the National Conservation Achievement Award from the National Wildlife Federation in 2001, and the Bob Eckhardt Lifetime Achievement Award for coastal preservation efforts from the General Land Office of the State of Texas in 1998. In 2004 Texas A&M press published his manuscript *The Book of Texas Bays*, which focuses upon the environmental health of Texas bays and discusses various facts and issues. In 2009 Blackburn co-authored a compilation of art and poems *Birds: A Collection of Verse and Vision*. Mr. Blackburn received both a B.A. in history and a J.D. from the University of Texas at Austin and an M.S. in environmental science from Rice University.

DOMINIC A. BROSE (Staff) is a program officer for the Science and Technology for Sustainability Program (STS) at the National Academies. Prior to joining STS, Dr. Brose was with the Institute of Medicine (IOM) of the National Academies where he collaborated on science policy reports sponsored by the Department of Veteran Affairs (VA) that addressed the potential for adverse health effects from exposure of select military personnel to environmental contaminants. Previously, he was an environmental scientist at ToxServices LLC, where he reviewed product formulations for EPA's Design for the Environment (DfE) program, a third-party service provided to EPA that evaluated product formulations against human health and environmental screening criteria. Dr. Brose received his M.S. and Ph.D. in environmental soil chemistry from the University of Maryland, and his B.S. in natural resources and environmental science from Purdue University.

ARMANDO CARBONELL, senior fellow and chairman of the Department of Planning and Urban Form at the Lincoln Institute of Land Policy, is an urban planner. His areas of expertise include city and regional planning, property rights and regulation, and land use and the environment. He also teaches planning at Harvard University and the University of Pennsylvania. Prior to his appointment to the Lincoln Institute of Land Policy, Mr. Carbonell was the founding executive director of the Cape Cod Commission, a regional planning and land use regulatory agency. He is a member of the American Institute of Certified Planners. Mr. Carbonell received his A.B. degree from Clark University and was a doctoral fellow at the Johns Hopkins University and a Loeb Fellow at Harvard University.

PEGGY CRIST is the director of the Office of Planning and Program Development at the Federal Transit Administration. Ms. Crist has thirty

years of experience in the project planning, environmental review and grant development programs of the Federal Transit Administration. Ms. Crist received her bachelor's degree from Butler University and her master's degree in urban and regional affairs from the University of Texas at Arlington.

GLEN T. DAIGGER (Committee Member) (NAE) is senior vice president with CH2M HILL in Englewood, Colorado. He serves as chief wastewater process engineer and is responsible for wastewater process engineering on both municipal and industrial wastewater treatment projects on a firm wide basis. Dr. Daigger is the first Technical Fellow for the firm, an honor that recognizes the leadership he provides for CH2M HILL and for the profession in developing and implementation of new wastewater treatment technology. He is also the chief technology officer for the firm's Civil Infrastructure Client Group, which includes the firm's water, transportation, and operations businesses. From 1994-1996, Dr. Daigger served as professor and chair of the Department of Environmental Systems Engineering at Clemson University. Dr. Daigger is a registered professional engineer in the states of Indiana and Arizona, and a board certified environmental engineer. Dr. Daigger received his B.Sc.E. degree, his M.S.C.E. degree, and his Ph.D. degree, all in environmental engineering, from Purdue University.

LISA GONZALEZ is a research scientist with the Houston Advanced Research Center (HARC). Her work focuses on the analysis and dissemination of data related to the health and productivity of bays and estuaries, coastal watersheds, and the Gulf of Mexico. Ms. Gonzalez manages projects and conducts research related to various coastal issues including coastal water quality, fish and wildlife populations, invasive species, habitat characterization, freshwater inflows, and seafood safety. Ms. Gonzalez has experience managing and analyzing large environmental monitoring data sets, developing estuarine indicators, conducting status and trends analyses of estuarine natural resources and resource use, and disseminating science-based information to interested stakeholders and the public. Her recent work includes the *State of the Bay: A Characterization of the Galveston Bay Ecosystem*, Third Edition; the Galveston Bay Status and Trends Project; the *Quiet Invasion* Galveston Bay Invasive Species Field Guide Series; and the development of an Invasion Potential Scorecard for Aquarium Species. Lisa joined HARC in 2002 after working as a research associate for the Environmental Institute of Houston at the University of Houston, Clear Lake. Prior to that, Ms. Gonzalez served as operations manager at the Institute of Marine Life Sciences at Texas A&M University at Galveston. Lisa earned a Master of Science degree in Environmental Management

from the University of Houston, Clear Lake in 2000. She received a bachelor of science degree in marine fisheries from Texas A&M University at Galveston in 1992.

WINIFRED J. HAMILTON (Committee Member) is a professor at Baylor College of Medicine, with joint appointments in medicine and neurosurgery, and is director of Baylor's Environmental Health Service in the Section of General Internal Medicine. She also holds an adjunct faculty appointment at Rice University, where she teaches a course on environmental health, and is a certified Healthy Homes Specialist. Dr. Hamilton earned her graduate degrees from the University of Michigan, Rice University, and the Harvard School of Public Health, the latter in environmental health epidemiology. She has been or is principal investigator of more than 20 funded research projects in environmental health, and is author or co-author of more than 45 peer-reviewed journal articles, several books, and approximately 20 reports. Dr. Hamilton has been program director of three regional pediatric environmental health symposia and is founder and until recently co-chair of the Texas Medical Center Sustainability Advisory Council. She has served on the boards of the Alliance for Healthy Homes, Galveston-Houston Association for Smog Prevention, Mothers for Clean Air, and Urban Harvest, and currently serves on the board of directors of Houston Tomorrow. She has also served on the Regional Air Quality Planning Committee of the Houston-Galveston Area Council and on the Clean Air Task Force of the Greater Houston Partnership. She speaks regularly to various academic and community groups on environmental health topics, with over 100 presentations since 2000. She also regularly serves on grant review panels for the National Institutes of Health and the U.S. Environmental Protection Agency and is a reviewer for the *American Journal of Public Health*. Dr. Hamilton has received numerous awards for her work in environmental health, including the U.S. EPA's Children's Environmental Health Champion Award, and was recently invited to speak to the President's Cancer Panel on the role of environmental exposures. Her professional interests within environmental health are broad, with particular emphasis on geospatial modeling of hot spots of disproportionate exposure and/or health effects and on the education of health care professionals with regard to the importance of environmental exposures in their practices.

MARILU HASTINGS (Committee Member) is a program officer for the Energy Foundation and the environment program director for the Cynthia and George Mitchell Foundation. She is responsible for the philanthropic activities of these charities that currently involve supporting clean energy and climate change mitigation policies in Texas,

as well as Texas water policy. Prior to her current position Ms. Hastings was the director of climate programs for the Houston Advanced Research Center (HARC) where she was employed for twelve years. At HARC she specialized in examining the complex interactions between social, corporate and political behavior and environmental protection. She also focused on developing integrated research initiatives related to sustainability science. Ms. Hastings has over twenty years of experience analyzing an array of policy issues related to sustainable development, environmental protection, climate change, hazardous and solid waste management, water resources, market development for recycled products, and corporate sustainable development. She has worked in the public and independent sectors, as well as in collaboration with industry groups and companies. Ms. Hastings is a trustee of the Regional Endowment for Sustainability Science, a $30 million endowment established by George P. Mitchell in 2005. Ms. Hastings is on the science advisory board for the Environmental Law and Policy Center in Chicago. She is co-chair of the advisory board for the Friends of Big Bend National Park. She is also on the board of directors of Living Word Lutheran Church in The Woodlands, Texas. Ms. Hastings earned a Master of Business Administration from the University of Texas at Austin and a Master of Public Affairs from the University of Texas at Austin. She earned a B.A. in economics and political science from Duke University.

MARY ELLEN HYNES (Committee Member) is the director of research for the Infrastructure and Geophysical Division within the Science and Technology Directorate (S&T) at the Department of Homeland Security. Before joining S&T in December 2006, Dr. Hynes spent 30 years as a researcher, rising to the position of technical director at the US Army Engineer R&D Center (ERDC). Her research focused on extreme loading of critical infrastructure. She obtained, with honors, her bachelor's and master's degrees in civil engineering from the Massachusetts Institute of Technology and her Ph.D. in civil engineering from the University of California at Berkeley.

LESTER KING is a sustainability fellow in the Shell Center for Sustainability at Rice University. His research focus will be on developing the Houston Sustainability Indicators Program at Rice. He is an AICP-certified planner and holds LEED certification as well. His work experience includes consulting and planning for various projects at the local and regional levels. He has also produced multiple presentations and publications on sustainability at the local, regional and national levels. Dr. King has spent time researching sustainable development planning in Israel and Barbados, which included visiting with key

stakeholders in both countries. Dr. King was responsible for developing Houston's first sustainable development indicators project in 2007. He holds a Ph.D. in urban planning and environmental policy from Texas Southern University.

STEPHEN KLINEBERG is a professor of sociology and the co-director of the Kinder Institute for Urban Research at Rice University. A graduate of Haverford College near Philadelphia, Dr. Klineberg received an M.A. in psychopathology from the University of Paris and a Ph.D. in social psychology from Harvard. After teaching at Princeton, he joined Rice University's sociology department in 1972. The recipient of ten major teaching awards, including the George R. Brown Lifetime Award for Excellence in Teaching, he is a faculty associate and divisional advisor at Lovett College, where he twice served as Interim Master. In March 1982, he and his students initiated the annual Houston Area Survey, now in its 29th year of tracking changes in the demographic patterns, life experiences, attitudes, and beliefs of Harris County residents. The project has attracted great interest and generous support from foundations, corporations, and individuals in the wider Houston community and beyond. That support has made it possible not only to fund these professional surveys, but also to expand the research each year with additional interviews in Houston's Anglo, African-American, and Latino communities. Co-author of *The Present of Things Future: Explorations of Time in Human Experience*, Dr. Klineberg has written numerous journal articles and research reports, and appears frequently on radio and television. He is also the founding co-director of Rice University's Institute for Urban Research. Its mission is to provide a permanent home for the annual Houston Area Survey, stimulate other metropolitan research, sponsor educational programs, and engage in public outreach that advances understanding of pressing urban issues and fosters the development of more humane and sustainable cities.

CAROL LEWIS is director of the Center for Transportation Training & Research and associate professor in the Department of Transportation Studies at Texas Southern University. At Texas Southern Dr. Lewis teaches students the fundamentals of transportation and urban transportation issues and conducts operational and policy-related transportation research. In March 2008, Dr. Lewis was asked to serve as principal investigator for the university's Petrochemical Transportation Security Center of Excellence. This multidisciplinary initiative conducts research to reduce the nation's vulnerability to potential terrorist attacks in selected components of the surface transportation system. Since joining TSU in 1992, Dr. Lewis has conducted research for the Texas Department of Transportation (TxDOT) regarding regionalizing public

transit, smart growth, strategic planning and more. She has served as transportation advisor to former Houston Mayor Bill White and as chair of the Houston's Planning Commission. Dr. Lewis holds a doctorate in political science from the University of Houston and master's and bachelor's degrees from the University of Iowa.

LISA LIN is the sustainability manager for the City of Houston, overseeing various environmental programs and initiatives for the city. Projects include the Houston Green Office Challenge, the city's bike share program, benchmarking city buildings, and updating the GHG inventory reports. Before joining the Mayor's staff, Ms. Lin was a program associate for ICLEI USA's Climate Programs Division, assisting with the development of technical guidance and other resources for local government climate mitigation activities. She also served as the South Central Regional Associate, helping cities with climate action planning and local sustainability programs. Ms. Lin has also worked for a commercial architecture firm where she developed the company's green building initiatives and continuing education program. She was the first in her office to attain her LEED Accredited Professional credential in 2006. Her extensive involvement with the local chapter of the U.S. Green Building Council Emerging Professionals has led her to attain local and national recognition. Currently, she sits on the USGBC Emerging Professionals National Committee as the South Central Representative. She holds a bachelor's degree in environmental design from Texas A&M University.

KATHERINE LORENZ was elected president of the Cynthia and George Mitchell Foundation in January 2011. Before taking on this role, she served nearly three years as deputy director for the Institute for Philanthropy, whose mission is to increase effective philanthropy in the UK and internationally, and she now sits on the Institute's board of directors. Prior to her work with the Institute for Philanthropy, Ms. Lorenz lived and worked in Oaxaca, Mexico for nearly six years where she co-founded Puente a la Salud Comunitaria, a non-profit organization working to eradicate malnutrition and advance food sovereignty in rural Oaxaca through the integration of amaranth into the local diet. She continues to be highly involved with Puente's work as an active board member. Before founding Puente, she spent two summers living and working in rural, poor communities in Latin America with the volunteer program Amigos de las Américas and later served on their Program Committee and as a trustee of the Foundation for Amigos de las Americas. Additionally, she currently serves on the boards of directors of the Endowment for Regional Sustainability Science and the Amaranth Institute and formerly was a board member of Resource Generation.

Along with her family, Ms. Lorenz is a member of the Global Philanthropists Circle (through the Synergos Institute) and is an active participant in the GPC Next Generation subgroup. She sits on the Council on Foundations Committee on Family Philanthropy and serves on their 2012 Family Philanthropy Conference Planning Task Force. Ms. Lorenz holds a B.A. in economics and Spanish from Davidson College.

CATHERINE MOSBACHER is president and CEO of the Center for Houston's Future, a position she assumed in October 2008. Before coming to the Center, Ms. Mosbacher served as chair of the Joint City-County Commission on Children for Houston and Harris County, and as board chair of the Texas Department of Protective and Regulatory Services (child and adult protective services, child care licensing, and prevention and intervention). She served as an adjunct professor at the University of Houston Law Center for eight years. She is the founder of BEAR, Be a Resource for CPS Kids, a nonprofit that provides help and hope to abused and neglected children. Ms. Mosbacher was legislative counsel to Texas Eastern Corporation and assistant counsel to the United States Senate Legislative Counsel in Washington, D.C. She is a member of the Bar of the District of Columbia, and the Bar of Texas. She has served on numerous nonprofit boards, including the Houston Area Women's Center, St. Luke's Health Charities, Houston Metropolitan YMCA, and the Alley Theatre. She is a graduate of the Center for Houston's Future Leadership Forum, senior fellow of the American Leadership Forum, and a former trustee of St. John's School. Honors include the Depelchin Award for Community Leadership, the Anti-Defamation League's Torch of Liberty Award, and the Center for Public Policy Priorities Legacy Award.

MARINA S. MOSES (Staff) serves as the director for the Science and Technology for Sustainability Program (STS) in the Policy and Global Affairs division of the National Academies. In this capacity, she also serves as the director of the Roundtable on Science and Technology for Sustainability. Under her leadership, the STS program issued the consensus report, *Sustainability and the U.S. EPA*, and has recently undertaken the multi-sponsored study, Sustainability Linkages in the Federal Government. Prior to joining the Academies, Dr. Moses served on the faculty of the George Washington University School of Public Health and Health Services in the Department of Environmental and Occupational Health, where she also directed the doctoral program and was the practicum coordinator for the graduate program. Dr. Moses was the recipient of the 2005 Pfizer Scholar in Public Health Award and has worked in emergency preparedness and communication with communities on public health issues. Previously, Dr. Moses held senior

scientific positions in the Environmental Management Division of the U.S. Department of Energy, where she worked on the development of a qualitative framework to assess hazardous and nuclear waste risks, and served as the senior health risk assessor in the New York City office of the U.S. Environmental Protection Agency's Superfund Program. Dr. Moses received her bachelor of arts (chemistry) and her master of science (environmental health sciences) degrees from Case Western Reserve University. She received her doctorate of public health (environmental health sciences) from Columbia University School of Public Health.

JOHN NIELSEN-GAMMON (Committee Member) is a Regents Professor at Texas A&M University and is the Texas State Climatologist. Dr. Nielsen-Gammon conducts research on large-scale and local-scale meteorology, air pollution meteorology, drought monitoring and forecasting, and climate data quality. His air quality research includes field forecasting support, numerical simulation, and diagnostic analysis of ozone events in Houston and Dallas for the Texas Air Quality Studies in 2000 and 2005-6. He teaches courses in weather analysis, weather forecasting, climatology, and atmospheric dynamics, and writes the Climate Abyss blog hosted by the Houston Chronicle. Dr. Nielsen-Gammon received a Presidential Faculty Fellow award (now known as PECASE) from the National Science Foundation and the White House in 1996, a Distinguished Achievement Award in Teaching at Texas A&M University from the Association of Former Students in 1996, was named a fellow of the American Meteorological Society (AMS) in 2011, and received the 2011 Newsmaker Image Award from Texas A&M University. He is past president of the International Commission for Dynamical Meteorology and is past chair of the AMS Board on Higher Education. Dr. Nielsen-Gammon received an S.B. in earth and planetary sciences, an S.M. in Meteorology, and a Ph.D. in meteorology, all from the Massachusetts Institute of Technology.

HERMINIA PALACIO is the executive director of Harris County Public Health and Environmental Services (HCPHES), a post to which she was appointed in January 2003. In this role, Dr. Palacio applies a broad range of academic, clinical, and public policy experience to meet the diverse public health challenges of today. Dr. Palacio received her medical degree from the Mount Sinai School of Medicine in New York City and completed her residency training at the University of California San Francisco (UCSF) Primary Care Internal Medicine Program at San Francisco General Hospital. After becoming a board certified internist, she obtained a master of public health, with an emphasis in epidemiology, from the University of California, Berkeley, School of

Public Health. She spent several years on the faculty of UCSF, where she served as principal investigator or co-investigator in several HIV epidemiology and health services research studies. She currently holds faculty appointments at the Baylor College of Medicine and the University of Texas School of Public Health. Dr. Palacio currently serves as chair of the Texas Public Health Coalition and previously served as president of the Texas Association of Local Health Officials and chair of the Harris County Healthcare Alliance. Her national activities include service as a member of the National Association of County and City Health Officials Board of Directors, the Centers for Disease Control and Prevention (CDC) Advisory Committee to the Director, the Board of Scientific Counselors for the CDC Office of Public Health Preparedness and Response, and the Institute of Medicine's Committee on Prepositioned Medical Countermeasures for the Public. She was awarded the Excellence in Health Administration Award by the American Public Health Association in 2007 and was recently appointed by President Obama to serve on the Advisory Group on Prevention, Health Promotion, and Integrative and Public Health.

PATRICE PARSONS is the director of external affairs at ICLEI. In this role she is responsible for coordinating all fundraising activities including maintaining and developing new strategic relationships with potential partners, including existing foundations, private industry, and the federal government. Prior to this, Ms. Parsons was responsible for supporting all ICLEI members within Texas, Oklahoma, Louisiana and Arkansas in furthering the momentum of greenhouse gas emission reductions within the region. Her previous experience in environmental and energy policy included marketing, governmental relations, development and finance. She also established the first industry-funded energy demonstration center focused on the commercialization of fuel cell technology at the Houston Advanced Research Center. Additionally, she was the previous associate deputy land commissioner at the Texas General Land Office. In that role, her responsibilities included the development of public/private partnerships and projects to advance the use of sustainable, clean energy transportation alternatives to improve air quality, and the promotion of economic development and energy security. She was also the director of the Texas State Energy Conservation office (SECO) where she was responsible for the management and distribution of approximately $200M in thirty-three different program areas while directing a staff of 45 employees. Ms. Parsons is the graduate of the University of Texas.

NATASHA PRUDENT is a health scientist with the National Center for Environmental Health at the Centers for Disease Control & Prevention.

Before joining CDC, Ms. Prudent studied global environmental health at Rollins School of Public Health at Emory University, graduating with her M.P.H. in May 2008. While at Emory, she did research in Malawi studying the efforts of a faith-based program in maintaining shallow wells. Her project used quantitative methods, such as GPS identification of water-points, and qualitative methods, such as interviewing program officers and well users, to gauge the functionality of wells built by the program.

WALTER G. PEACOCK (Committee Member) is director of the Hazards Reduction and Recovery Center, professor in landscape architecture and urban planning and in the Sustainable Coastal Margins Program and the Rodney L. Dockery Endowed Professor in Housing and the Homeless at Texas A&M University, College Station. His research focuses on natural hazards and disasters emphasizing social vulnerability and resiliency, evacuation, and the socio-political ecology of long-term recovery and mitigation. Much of his current research focuses on hazard mitigation planning and policies along the Texas coast, long-term recovery following Hurricane Ike, and conceptualization and measurement of resiliency. He has conducted research in the United States, Guatemala, Mexico, Peru, Italy, India, Turkey, the former Yugoslavia, and the US Virgin Islands. Various agencies have funded his research, including the National Science Foundation, Sea Grant, and the National Oceanic and Atmospheric Administration. He has authored or co-authored two books and over ninety chapters, articles, papers, and technical reports. His published articles have appeared in a variety of journals including American Sociological Review, Journal of the American Planning Association, Natural Hazards Review, Disasters, the International Journal of Mass Emergencies and Disasters, Landscape and Urban Planning and Ekistics.

JOHN RANDOLPH is professor of urban affairs and planning at Virginia Tech, where he has been on the faculty since 1979. He has a Ph.D. in civil engineering from Stanford and a B.M.E. in mechanical engineering from Minnesota. Dr. Randolph was director of the Virginia Center for Coal and Energy Research from 1988-1995, department head of urban affairs and planning from 1995-2003, and Director of the School of Public and International Affairs from 2003-2008. He has authored more than 100 articles and reports and two textbooks, *Environmental Land Use Planning and Management* (2nd edition, 2012) and *Energy for Sustainability: Technology, Planning, Policy* (with Gilbert Masters, 2008). He received the national 2006 William R. and June Dale Prize for excellence in Urban and Regional

Planning and the statewide Virginia Energy Award in 1992 for his energy research.

BRENDA M. REYES started working with the city of Houston Department of Health and Human Services in 2001and now she is chief of the Bureau of Community & Children Environmental Health. She obtained her medical degree from the Universidad Autónoma de Guadalajara, Mexico and her master's degree in public health at Florida International University, Florida. During this time and under her leadership she combined the Childhood Lead Poisoning Prevention and Lead Based Paint programs into one lead program with indoor air, asthma, pest, pesticides, unintentional injuries, non-smoking ordinance enforcement, ambulances and funeral homes combining two Bureau's into one, cutting costs and adding value with an efficient delivery of holistic services to the citizens in the home environment and creating the perfect platform for healthy housing in Houston. Dr. Reyes has successfully been awarded over 20 grants from EPA, CDC and HUD, including for her collaboration at the Superfund Site MDI, Screening Targeted Areas at Risk (STAR) Program, and with Beyond Translation and Beyond the Forum. Also, the U.S. Department of Housing and Urban Development Office of Healthy Homes and Lead Control Hazard presented her with a Recognition Award for Leadership and Commitment, and the National Safe and Healthy Housing Coalition award for Healthy Homes Champion (only four in the nation). She is a member of the National Advisory Committee for Childhood Lead Poisoning Prevention (ACCLPP), National HUD Grantees Association Board Member, Houston Healthy Homes Coalition Co-Chair, Houston Consolidated Plan Advisory Committee Member, Texas Gulf Coast Asthma Coalition Chairperson, and others. She is co-director of the Texas Healthy Homes Training Center in Houston and Mentor of several lead programs nationwide and had worked internationally in Honduras and Costa Rica.

DYLAN RICHMOND (Staff) is a research assistant for the Science and Technology for Sustainability Program (STS) at the National Academies. Before joining the Academies in the fall of 2010, he attended Georgetown University and graduated with a B.A. in economics in May 2010. While at Georgetown, Dylan was an editor for *The Georgetown Voice.*

JENNIFER RONK is an environmental manager at the Houston Advanced Research Center with more than 18 years of experience addressing a wide range of energy and environmental issues, including clean energy and climate change law and policy, and soil and groundwater contaminant investigation and remediation. She has

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JEFF TAEBEL (Committee Member), FAICP, is director of community and environmental planning at the Houston-Galveston Area Council, where he oversees the agency's community and economic development, disaster recovery, environmental planning, livable communities, socioeconomic modeling and sustainable development programs. He has 28 years of experience in urban and regional planning, including 24 in his current position. Actively involved in community service, professional development and planning education, Mr. Taebel is a former president of the Texas Chapter of the American Planning Association and in 2008 was inducted into the College of Fellows of the American Institute of Certified Planners. Mr. Taebel received a master of urban planning from Texas A&M University and a B.S. in life sciences from the University of Nebraska.

RIVES TAYLOR is a Texas-licensed, practicing architect and educator. As a principal, he leads Gensler's firm-wide Sustainable Design Task Force precipitating several successful sustainable building projects, including several recent LEED Platinum projects. The Gensler Task Force is actively involved in education about sustainability, both inside the firm and to peers and clients. He lectures at schools of architecture at Rice University and the University of Houston. In addition, he is on the convention program committees for the USGBC, Texas Society of Architects and serves as a committee chair of the AIA Education Committee.

BRUCE WILCOXON (Committee Member) is the director of climate change for ConocoPhillips, a position he has held since 2007. Prior to this assignment he served in the positions of climate change advisor for ConocoPhillips Canada in Calgary, Alberta and as sustainable development coordinator within the Corporate Health, Safety and Environmental group in Houston Texas. Mr. Wilcoxon began his career in the oil industry as an exploration geologist with British Petroleum, joining ConocoPhillips in 2001. Mr. Wilcoxon holds B.S. and M.S. degrees in geology and an M.B.A. degree from the University of Texas. He currently resides in Houston with his wife and two children.