Contours of the Future:

Alternative Scenarios for the Boston Region

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for a Great Transition

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1. Overview

Introduction

If the past fifty years is any guide, it seems inevitable that the world will experience far-reaching and largely unanticipated technological, cultural, economic and political changes over the next half century. Developments in technology, institutions, culture, and politics are forging an increasingly interconnected world (Raskin et al., 2002). Economic expansion and integration is increasing the scale of the world economy, while broadening the distribution of wealth, albeit in a highly uneven manner among regions and within each region (UNDP, 2005; Milanovic, 2005). Far more than economic connectivity, globalization entwines the world's people through shared environmental concerns, cultural exchange, human mobility, and the planetary reach of health risks. The global environmental dimension includes such large-scale challenges as climate change, loss of biodiversity, and the decline of fresh water resources.

These emerging concerns highlight the need for forward-thinking to identify preventative approaches for steering development toward sustainability. This means adopting policies and behaviors for sustainability's three dimensions – economic, social, and environmental – that are mindful of the long-range implications of current choices. With its mandate to consider the needs of future generations, sustainability has brought the question of the long-term future agenda to planning efforts at global, national, and regional scales.

Nowhere is this challenge more apparent than in urban areas. While metropolitan development choices have significant implications for local residents such as the environmental and psychic tolls of uncontrolled sprawl and the health impacts of pollution, its effects on humanity at large, primarily through climate change and resource use, are perhaps more profound. As the coupling between local and global processes and problems grows tighter, the traditional concerns of urban planning require a wider perspective. We must now ask: is local development compatible with larger global goals of environmental stewardship, social justice, and climate change.

How are localities responding to these challenges? The 1992 United Nations Conference on Environment and Development in Rio de Janeiro (the Earth Summit) spawned thousands of local sustainability initiatives around the world, opening a new chapter in how to "think globally, act locally." While addressing an impressive range of issues and enjoying some measure of local success, they generally have not been closely linked to global understanding and action. Local sustainability initiatives tend to focus on parochial issues and priorities and are not informed by or connected to global considerations (Portney, 2003; Hallsmith, 2003). Too little emphasis on global drivers, impacts, and opportunities for action by local sustainability projects limit their effectiveness in contributing to sustainability broadly.

Meaningful incorporation of a global sensibility in local sustainability efforts underscores questions of equity and responsibility, both locally and globally. It enriches the process of envisioning a region's future, appealing to growing public concern for responsible forms of development. Embracing a global perspective also mobilizes new stakeholders for a more inclusive and robust discourse on the question of a region's future in a connected world.

This sets the context for the project discussed in this report: *Bringing Global Thinking to Local Sustainability Efforts: A Collaborative Project for the Boston Metropolitan Region* (referred to here as the Boston Scenarios Project, or just BSP). The project was an exploration of long-range futures for the region within a larger global perspective. It included three major phases: assembling data; creating and revising scenarios; and engaging with policy efforts. The scenarios span a spectrum of possible futures for the Boston region to the year 2050. The region includes 164 communities in the Boston metropolitan area with 4.4 million residents. Throughout the BSP process, the core project team benefited from the input of a Project Advisory Committee of academic, government, philanthropic and NGO sustainability leaders in the region (see Attachment 1).

The BSP analyzed conventional scenarios that gradually unfold from current trends under the influence of various policy adjustments. It also broke new ground in prospective regional studies by considering a normative scenario of "deep change" in which sustainability, social solidarity, and global responsibility become major organizing principles for the cultural, economic, and social development of the region. The BSP explores different suites of policies, technologies, behaviors, and values that might carry the region along these various pathways. The project demonstrates the value of scenario analysis, using an integrated systems computational framework for examining alternative long-term futures informed by the inputs of a diverse group of regional advisers. The project has worked with parallel regional planning efforts, an interaction that hopefully will continue as Boston faces the ongoing challenge of transitioning to a sustainable form of development.

Context

The Boston Scenarios Project was supported by the U.S. EPA through its Collaborative Science and Technology Network for Sustainability program in the Office of Research and Development. This program promotes explorations of innovate approaches for the transition to sustainability that are systems-oriented, forward-looking, and collaborative. It is a testing ground for scientifically-based tools and collaborative processes that improve the conceptual rigor and enrich the public dialog.

The BSP was developed in consultation with several key organizations in the region, including the Metropolitan Area Planning Council (MAPC), the regional planning agency for metropolitan Boston; the Massachusetts Office of State Sustainability; and the Boston Indicators Project conducted by The Boston Foundation. These entities play important roles in shaping the region's development agenda and actively participated on the BSP Project Advisory Committee. The Office of State Sustainability promotes state agency leadership in sustainability policy and implementation. Its recent initiatives have focused on green buildings, alternative energy, and mitigation of greenhouse gasses. The Boston Foundation (TBF) is the region's largest community foundation and acts as a grantmaker, convener, and civic leader. Its Boston Indicators Project is a biennial effort to create a shared civic agenda that tracks and reports on progress in ten key sectors.

The BSP was conducted in parallel with an ongoing planning effort in the Boston region called MetroFuture led by the Metropolitan Area Planning Council. The MetroFuture initiative was launched in 2004 to plan for growth and development in the region through 2030. MetroFuture

relied on a broad-based participatory process to identify visions for the future. Its scenarios are projections or forecasts from existing conditions that reflect different assumptions about how various dimensions of the region – such as location of new homes and businesses, water and energy consumption, travel patterns and modes – will change in the coming decades. Through its stakeholder process, MetroFuture adopted a preferred scenario characterized by "smart growth" practices in which new development is located primarily in already developed cities and town centers, resource use is more efficient, and transportation patterns shift modestly with increased use of mass transit. Simply called MetroFuture, the preferred scenario is in the process of becoming the official regional plan, which MAPC and its partners will attempt to implement in the coming years.

The BSP benefited from MetroFuture's data development on existing conditions in the region and its broad-based stakeholder process, while the contrasts between MetroFuture and BSP scenarios provides an illuminating basis for comparison. To facilitate such comparison, the BSP scenarios were tuned to MetroFuture data on current patterns wherever possible and utilized the same spatial structure of regional and community boundaries. At the same time, the BSP helped broaden MetroFuture's focus to include issues such as energy and climate change. The BSP also encouraged MetroFuture to consider unconventional scenarios that go beyond incremental adjustments around trend lines and include futures based on sustainability and global responsibility.

Summary of Key Findings

The BSP employed a scenario approach to assess the quantitative implications of current trends through the year 2050 and to explore alternatives that could alter the trajectory of the region's future. This approach recognizes the inherent uncertainties in predicting the long-range future, understanding that the future does not unfold in a predetermined way. Scenarios draw attention to the choices that governments, citizens, and other actors make in influencing the trajectory of development. Scenarios illuminate the notion that, rather than a place we are going, the regional future is a process we are constructing.

Current Trends: A Business As Usual (BAU) scenario paints a picture of a region continuing to grow and prosper, but failing to turn toward sustainability. Projecting recent demographic, economic, and environmental trends in the Boston area to 2050, the region sees:

- Population increase 12%, average income almost double, and regional GDP grow 2.7 times
- Significant worsening of income inequality
- Over 200,000 more people living in the outer suburbs
- Loss of 315,000 acres of open space, over 30% of the region's total
- Energy requirements increase 8%
- Little decline in carbon dioxide emissions
- Growing water use further stressing overstrained basins
- Growth of the region's ecological footprint on the rest of the world

These trends would portend a future of increasingly stressed environmental and social systems. While regional population growth is expected to be relatively moderate in coming decades, this increase, combined with the continuation of existing patterns of economic growth, income inequality, land development, natural resource use, and environmental emissions, is inconsistent with the notion of sustainability and global responsibility. Without a change of course, the essential character of the region – as reflected in its diverse landscape, social fabric, and richness of natural and cultural amenities – would be threatened.

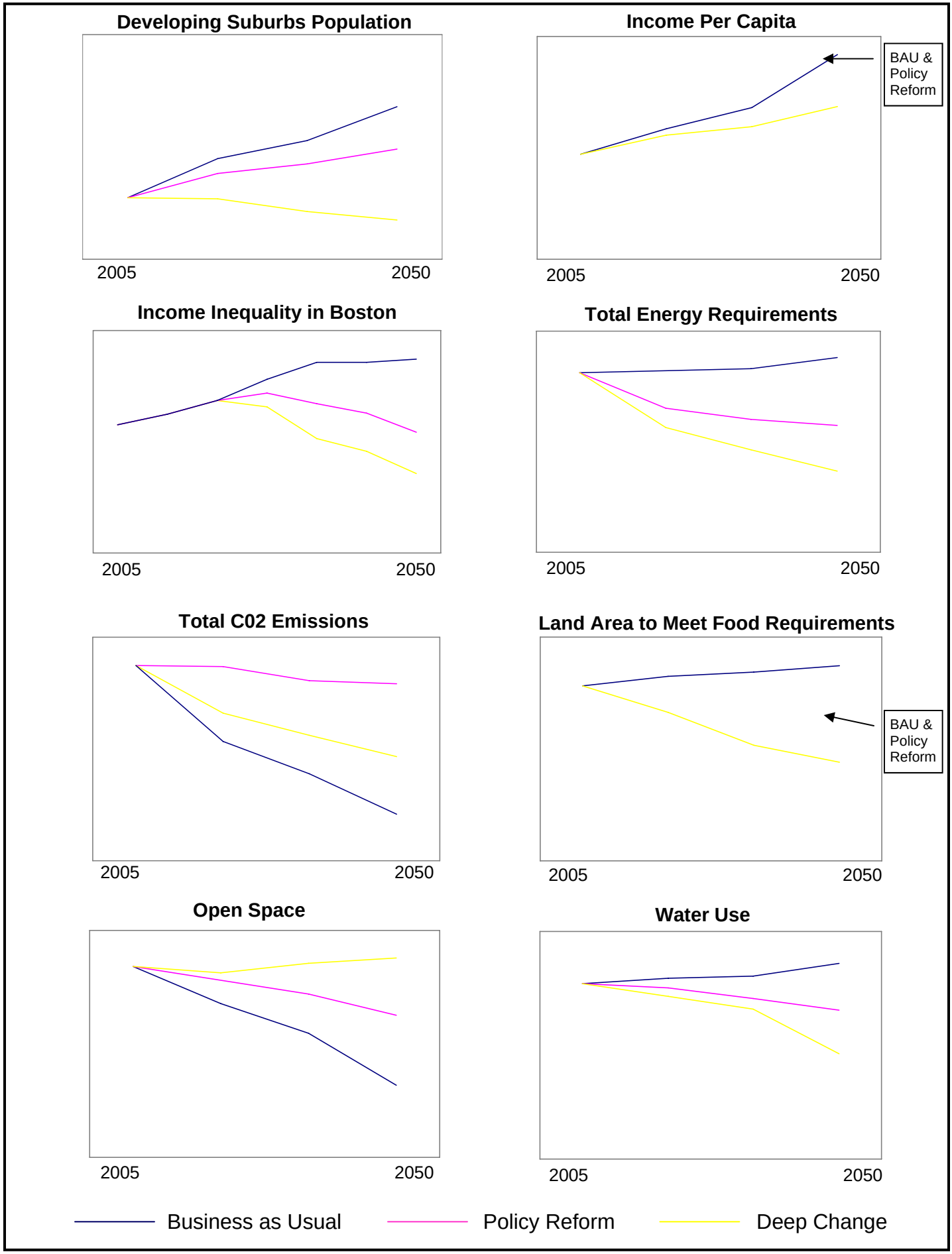
Changing Course: The aim of the BSP was to explore more promising alternatives for a sustainable regional future. Two primary alternatives were considered. The first, the Policy Reform scenario, assumes that the values and lifestyles that are currently dominant remain unchanged. It also assumes a sustained governmental push for improved technologies and policy instruments that address key environmental and social problems faced by the region. While partially successful in reducing sprawl and congestion, the region's contribution to global resource depletion persist and the reductions in greenhouse gas emissions, while significant, do not meet the targets necessary for climate stabilization.

The second alternative, the **Deep Change** scenario, was developed as a vision of a desired future based on a set of sustainability goals, and constructed as a backcast *from* the future. Key sustainability goals include a reduction of CO2 emissions by 80% by 2050, no net loss of open space in the region, a reduced average work week to 30 hours, reduced income inequality, and a shift in dominant societal values toward an emphasis on quality-of-life, social solidarity, and an ecological ethos. The normative approach embodied in the Deep Change scenario allowed for directly addressing the pressing issues facing the region, such as climate change, natural resource depletion, ecosystem destruction, and increasing social disparity.

The Deep Change scenario identifies possible trajectories for meeting its sustainability targets, and allows for an assessment of the feasibility of and contributions from a full range of initiatives in the areas of technology, policy, values, and lifestyle. The Deep Change scenario offers a hopeful vision of the region in 2050 characterized by:

- Increased sense of well-being, reduced work weeks and average income up almost 50%
- Reduced inequality
- New development concentrated in urban areas and reduced population in outer suburbs,
- No net loss of open space
- Overall energy requirements reduced by 55% with a major shift to renewables
- Carbon dioxide emissions reduced by nearly 80%
- Water use decline of 40%, restoring stressed basins in the region
- Land area needed to meet the region's food requirements is reduced by almost 50%
- Reduced ecological footprint

The magnitude of the required transition to a more sustainable region can be illustrated by comparing the BAU and Deep Change scenarios across key economic, social and environmental dimensions, as shown in the figure below.


Developing Suburbs Population
2005
2050
Income Per Capita
BAU & Policy Reform
2005
2050
Income Inequality in Boston
2005
2050
Total Energy Requirements
2005
2050
Total C02 Emissions
2005
2050
Land Area to Meet Food Requirements
BAU & Policy Reform
2005
2050
Open Space
2005
2050
Water Use
2005
2050
Business as Usual
Policy Reform
Deep Change

Although the cultural and economic transformation required in Deep Change would be significant, the scenario demonstrates the potential for fundamental changes to current trends guided by the collective vision of a sustainable future. With powerful and entrenched economic and socio-cultural forces supporting BAU, a key challenge for sustainability is whether an engaged public can, in turn, generate the necessary political will for a turn toward sustainability and responsibility.

Report Organization

The report is organized into four sections and appendices. Section 2 introduces the scenario approach for exploring long-range futures and provides narrative descriptions of the three scenarios developed for the BSP. Section 3 introduces the quantitative methodology and tools used to simulate the scenarios, and highlights key results.[1] Section 4 discusses the lessons learned from the BSP and implications for the use of scenarios and related tools for long-range planning in other regions. Two appendices provide a list of the members of the Project Advisory Committee, and information on the PoleStar software used in the simulations.

[1] A companion document, *Technical Report on Quantitative Scenarios*, provides detailed technical documentation for the BSP scenarios.

2. Why Scenarios?

Use of Scenarios

As current trends and driving forces unfold and interact with new social, economic and environmental conditions, the global trajectory and regional development can branch into alternative pathways. The decisions made now can influence the fundamental direction of development in the coming decades. Three distinct types of uncertainty pose challenges for long-range sustainability planning (Raskin, 2002):

- ignorance: we have a limited understanding of current conditions and the forces causing change
- surprise: novel phenomena and unexpected events can alter pathways
- volition: the future is subject to human choices that have not yet been made

Although we cannot predict the future, the scenario approach offers a powerful way to examine the forces shaping the world, the uncertainties that lie ahead, and the implications for tomorrow of trends and actions today. Scenarios are accounts of plausible futures told in words and numbers. They provide a structure for exploring alternative trajectories in an organized, systemic, and integrated way. An integrated, systemic view is fundamental to the notion of sustainability in order to discern important interactions among sectors, themes, and environmental pressures.

Scenarios help analysts, decision-makers, and the public consider possible images of the future and pathways to such futures. They address the critical questions of policy discourse: Where do we want to go? How do we get there? As such, scenarios encourage the collective imagination in thinking creatively about alternative possibilities; inspire and motivate action; provide early warnings on the prospective dangers of current trends; and generate knowledge and data for an ongoing, iterative process to conceive and evaluate alternative pathways. In addition, when developed through a stakeholder process, scenarios offer an arena for airing and reconciling differences, and provide social legitimacy for sustainability efforts.

BSP Scenarios

Three long-range scenarios were created for the BSP: Business As Usual (BAU), Policy Reform, and Deep Change. These integrated pictures of the regional future reflect developments across a number of dimensions: values, policy, demographics, land use, settlement patterns, economic activity, equity, transportation, agriculture, water, energy use, and environment. The BAU and Policy Reform scenarios are forecasts that unfold from current conditions, influenced by different policy choices that are currently under consideration. The Deep Change scenario is a backcast: it begins with a normative vision and a set of goals that assume fundamental changes in policy, values, and behavior. It then evaluates plausible pathways for attaining that vision. The point of departure of all three scenarios is current trends and driving forces in the region. All cover the same timeframe 2005 to 2050 and all consider the 164 communities that comprise the region (see map below).

The **BAU scenario** assumes that current conditions and recent trends unfold without major policy changes, surprises, or discontinuities. The dominant values and forces shaping the region – primacy of markets, increasing land conversions for development, reliance on fossil fuels, and

auto-dependency – remain intact. The "good life" and the American Dream are still defined primarily by income and the level of consumption it allows. Promotion of economic growth remains the accepted driving force underlying policy on housing and commercial development, taxes, energy, transportation, and the environment. The Boston region becomes ever more dependent on distant sources for food, lumber and other natural resources, increasing environmental pressures outside the region. Though there are efficiency gains, overall consumption of energy, water and other resources continues to grow.

In the **Policy Reform scenario**, residents and policymakers become increasingly concerned about emerging environmental and social problems. While conventional values remain dominant, the political will emerges for taking stronger action to harmonize economic growth with environmental protection and greater social equity. Technological development, tax policies, and new government investments are able to reduce sprawl, congestion, and greenhouse gas emissions. However, the achievements of the policy reform path are limited and the region's contribution to global resource depletion persists, and the reductions in greenhouse gas emissions, while significant, are not sufficient to meet the region's responsibilities for climate stabilization. Similarly, despite some reductions in inequality, basic social divisions remain and there is little or no change in how quality of life is defined or measured. Cumulatively the policy reforms imposed on unsustainable BAU trends are able to turn the region's development only partially toward a sustainable direction.

By contrast, the **Deep Change** scenario envisions more fundamental changes in order to achieve a strong set of sustainability and lifestyle goals. These goals include a reduction of CO2 emissions by 80% by 2050, no net loss of open space in the region, and a reduced average work week to 30 hours. Constructed as a backcast from the future, this scenario posits transformational change in dominant values promoted through widespread education and organizing efforts led by civil society. This would likely occur in the context of a wider cultural shift in the nation and beyond over the coming decades in response to the crises and opportunities of an increasingly interdependent world. Residents, governments, and NGOs in the region become increasingly aware of these global connections and their responsibility to contribute to a just and sustainable global future. The value shift leads to a reordering of priorities from economic growth and consumption to quality of life and well-being as recognition spreads that conventional lifestyles and consumption patterns have only limited capacity to bring well-being and fulfillment to the lives of residents in the region. Priority turns to reducing resource consumption and fossil fuel use, and enhancing quality of life through working and consuming less, living in more compact, mixed use, and socially integrated communities, community engagement, and personal fulfillment.

The Deep Change vision leads to an economy based on shorter work weeks, more dense land use patterns, smaller housing units, less commuting and greatly enhanced public transportation, dramatic reductions in fossil fuel use and GHG emissions, and a less meat-intensive, more organic, and more local diet. While technology and policy measures are critical to achieving Deep Change goals, they are not sufficient. The deep political commitment, public engagement, and shift in popular values are the essential foundations for changes in lifestyles and behavior that complement and drive the policy realm.

Note that many of the changes contemplated in the Deep Change Scenario would require broader changes on the state, national, or even global level, while others the Boston region could pursue on its own. For example, preserving open space and conserving natural resources by focusing new housing and commercial activity in already developed areas, while challenging, is something achievable at the regional level. Similarly, improving the efficiency of energy and water use in residential and commercial buildings can be pursued locally. On the other hand, shortening the average work week does not make sense at a regional level under current competitive economic conditions. Rather, the redefinition of societal values and quality of life is much more likely to be pursued within a larger national or global context.

3. Scenario Results: Quantitative Highlights

The PoleStar System

The quantification of the BSP scenarios relied on the *PoleStar* system, a comprehensive and flexible decision support tool for sustainability studies at the local, regional, national, or global levels. Initially developed by Tellus and the Stockholm Environment Institute in the early 1990s, *PoleStar* is a tool for developing integrated scenarios. The point of departure for the scenarios is a database of current information on social, economic and environmental variables. *PoleStar* provides a laboratory for flexibly creating and assessing alternative futures, based on relationships between current data, drivers of change, and indicators of their impacts. Rather than a rigid model reflecting a particular approach to environment and development interactions, it is an open framework for exploring the complexities and uncertainties of unfolding socio-ecological systems, and the role of human choice and action. (See Attachment 2 for more details.)

Simulations were developed for each of the three BSP scenarios: Business As Usual (BAU), Policy Reform, and Deep Change. Of course, all scenarios begin with the same "current accounts" data for the "base year" of 2005. Then, as time passes, they begin to diverge, varying significantly after several decades. The current accounts data, reflecting existing conditions in the region, draw from the compilations developed by the MetroFuture project and a number of supplementary sources. Effort was made to ensure that the BAU was broadly consistent with assumptions and parameters used in the MetroFuture "Current Trends Extended" (also called "Let It Be") scenario to facilitate comparison.

The quantification of the BAU scenario is guided by its basic vision: the gradual unfolding of , existing demographic, economic, environmental and technological trends without major surprise over the next half-century. The Policy Reform scenario adds technological improvements and incremental policy interventions that significantly impact future conditions. The Deep Change scenario is normative, defined by a vision of a desired future based on a set of sustainability goals, and constructed as a backcast *from* the future. Key assumptions and goals of the Deep Change vision are summarized in the box below.

For detailed descriptions of all data, assumptions and computations in the scenario simulations, see the companion document, *Technical Report on Quantitative Scenarios*.

Key Assumptions and Targets for Deep Change Scenario

Housing and Land-Use

- Higher density, mixed-use neighborhoods; almost all new construction multi-family.
- Square footage of housing units reduced, especially for single family houses.
- Green building practices institutionalized throughout the region.

Transportation

- Greater walk-ability, bike-ability, and opportunities for convenient public transit.
    - Extended subway, commuter rail and/or bus service throughout the region.
    - Extensive network of bike paths and sidewalks.
    - Non-motorized transport 20% of mode share by 2050.
- Decreased private vehicles use due to convenient and affordable public transport and desire to limit consumption of fossil fuels.
    - Use of private vehicles declines from 70% of mode share to 30% in 2050.
    - Adoption of new modes of transport ("bus rapid transit," light rail, car-sharing, shared taxis, electric and fuel cell cars and bicycles)

Energy

- 80% reduction in greenhouse gas emissions from 2000 levels by 2050.
- Renewable sources dominate region's energy mix, used directly or to produce hydrogen.
- Large-scale deployment of strong conservation technology and reductions in energy intensity.

Water

- Aggressive residential, commercial, industrial water conservation.
- Use declines by 30% by 2050.
- Strong conservation measures reduce residential uses
    - Higher density, fewer lawns, widespread xeriscaping.
    - Adoption of reuse technologies: rainwater harvesting, grey water systems, green roofs.
- Natural flows maintained and restored.

Food and Agriculture

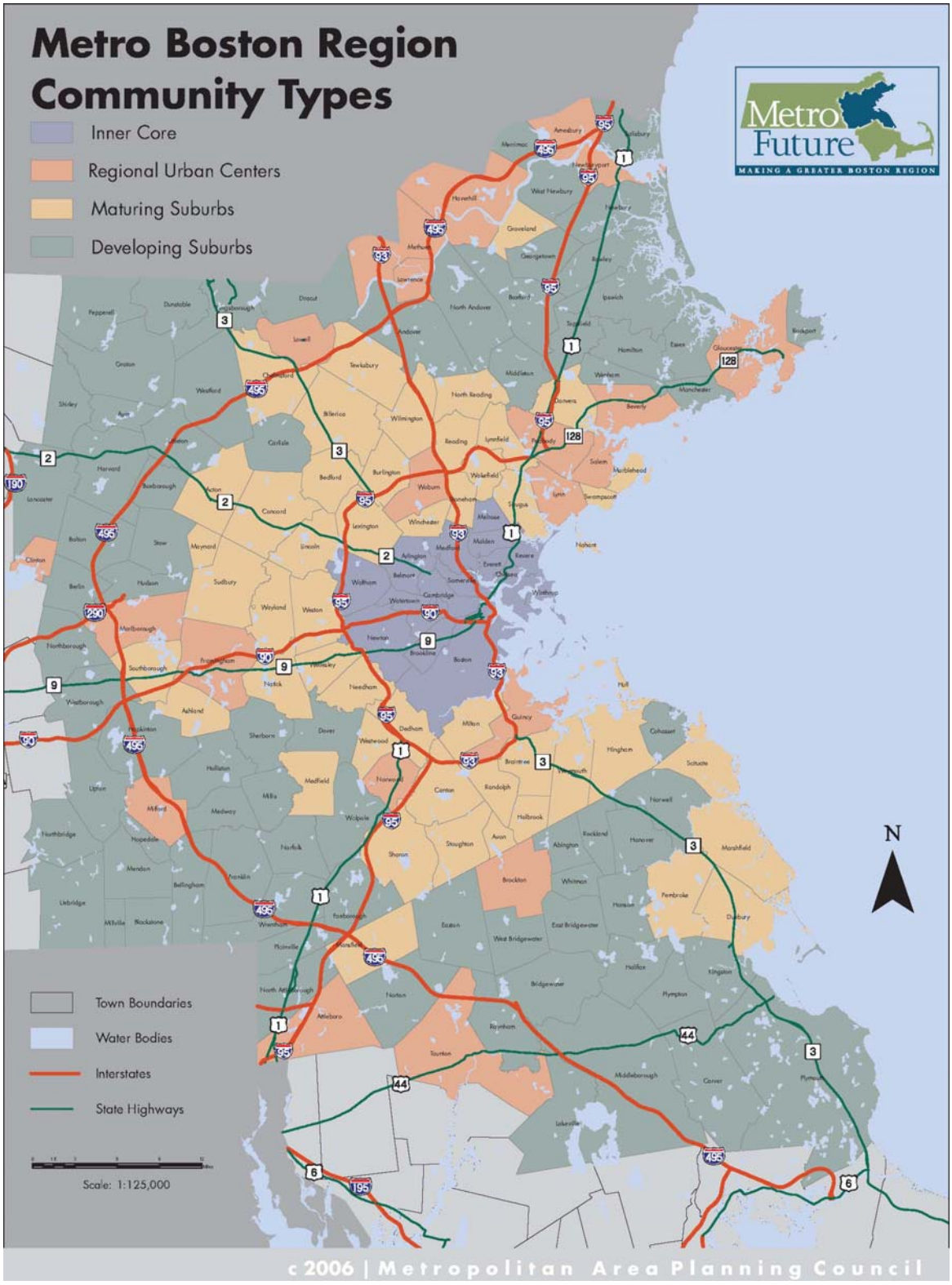
- Healthier diets (less calorie intake and meat consumption).
- Local food production doubles by 2050.

Regional Definition

The region comprises 164 communities in the Boston metropolitan area, coinciding with the boundary for the ongoing MetroFuture regional planning process. The region has 4.4 million residents living in a range of community types in eastern Massachusetts. The BSP scenarios have adopted the sub-regional definitions used in MetroFuture – Inner Core, Regional Urban Centers, Maturing Suburbs, and Developing Suburbs – that group communities with similar characteristics. These are summarized in the table below and depicted spatially in the Boston Metro Region Community Types map on the following page.

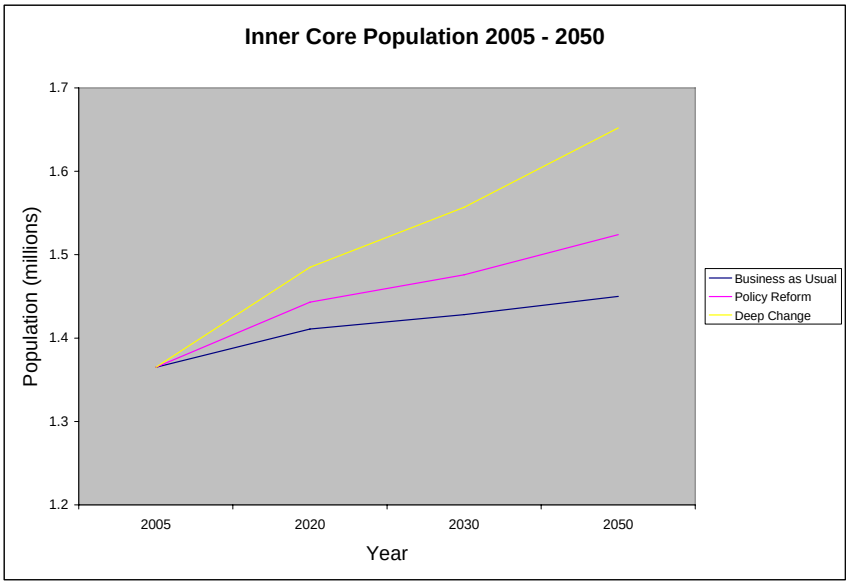
Metro Boston Region Community Types

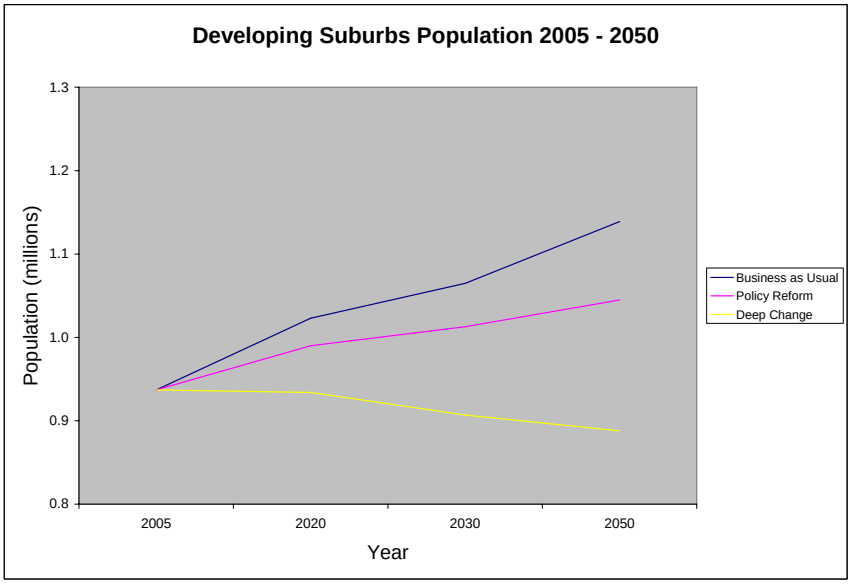
Inner Core • 16 cities and towns inside Route 128 • 1.3 million residents • High density neighborhoods, multifamily housing, immigrant populations • Virtually no undeveloped land • Includes: Boston, Cambridge, Somerville, Chelsea, Brookline, Newton,	**Regional Urban Centers** • 21 urban centers mostly outside Route 128 • 1.1 million residents • Urban neighborhoods, large immigrant communities • Some developable land remaining • Includes: Quincy, Brockton, Framingham, Woburn, Lynn, Peabody, Salem
Maturing Suburbs • 50 towns, generally along Route 128 • 1.0 million residents • Moderate density neighborhoods • Dwindling supply of developable land • Includes: Milton, Braintree, Wellesley, Lexington, Reading, Saugus	**Developing Suburbs** • 77 towns along Rte. 495 + No & So Shores • 900,000 residents • Some have strong town centers, but many are more rural • All have abundant developable land • Includes: Plymouth, Walpole, Hopkinton, Ayer, Andover, Ipswich


Metro Boston Region
Community Types
Inner Core
Regional Urban Centers
Maturing Suburbs
Developing Suburbs
Metro Future
MAKING A GREATER BOSTON REGION
N
Town Boundaries
Water Bodies
Interstates
State Highways
Scale: 1:125,000
c 2006 | Metropolitan Area Planning Council

Demographics

Regional population is projected to increase slowly (about 1% per year) in coming decades, from 4.42 million in 2005, to 4.78 million in 2030 and 4.93 million in 2050 (MAPC, 2007a). While these overall projections are used in all scenarios, the allocation across sub-regions varies. In BAU, reflecting the recent history of sprawling development, much of the population growth takes place in suburban areas, especially the Developing Suburbs. The Policy Reform scenario sees the implementation of smart growth policies to reorient most of the growth to already developed areas and town centers. The Deep Change scenario goes beyond smart growth strategies, adding behavioral and lifestyle changes, including preference for more urban living with less square footage per housing unit. The result is a shift in population towards the Inner Core (and Regional Centers to some extent) and away from Developing Suburbs. These patterns are highlighted in the figures below.

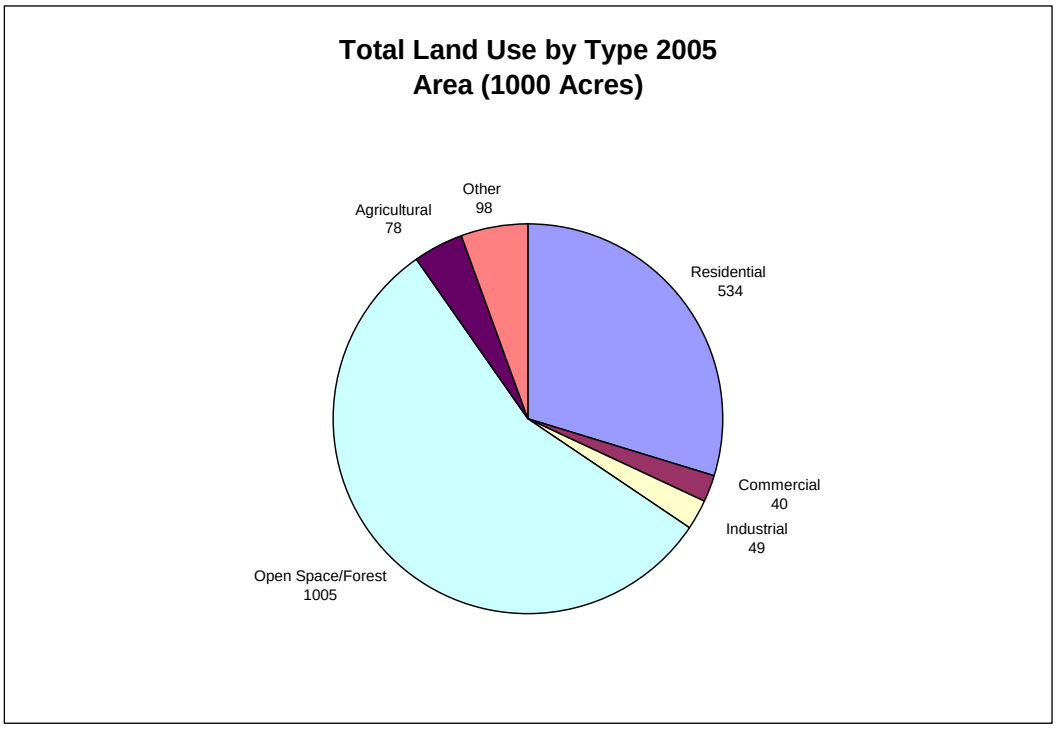




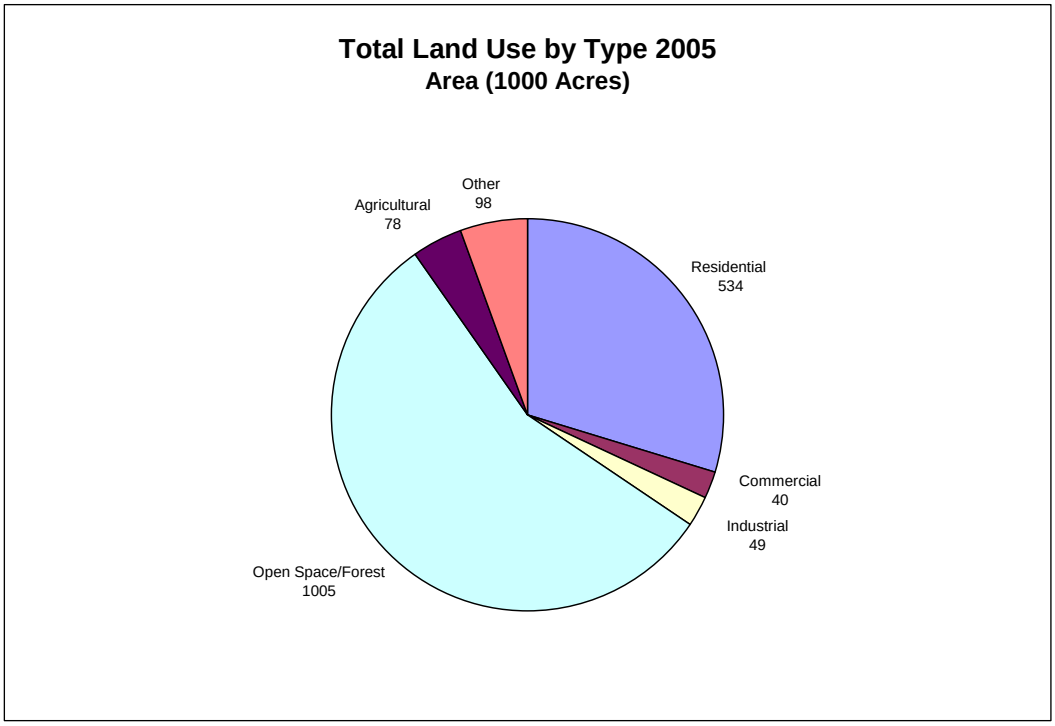
The number and location of households is a key driver of land use change and an important factor for computing energy and water use, as well as housing and transportation demands and associated CO2 emissions. The average household size varies somewhat across the sub-regions, with smaller households in urban regions and larger ones in suburban areas, especially Developing Suburbs. This pattern reflects the larger fraction of single and elderly people in the urban sub-regions and higher numbers of families with children in the suburbs. Average household size has declined in all sub-regions in recent decades (MAPC, 2007) and this trend is assumed to continue in all the BSP scenarios (e.g., from 2.49 persons per household in the Inner Core in 2005 to 2.36 in 2050, and from 2.79 to 2.46 in the Developing Suburbs).

Land Use

The 164 communities in the Boston region contain approximately 1.8 million acres. The allocation of land area among the sub-regions is depicted in the following figure.



The BSP scenarios track six land use types: residential, commercial, industrial, open space/forest, agricultural, and other. Though the region is heavily developed, more than half of the area (56%) is still open space or forest. Residential land use covers 30% of the region, while the other uses account for less than 5% each. These land use shares are summarized in the figure below.



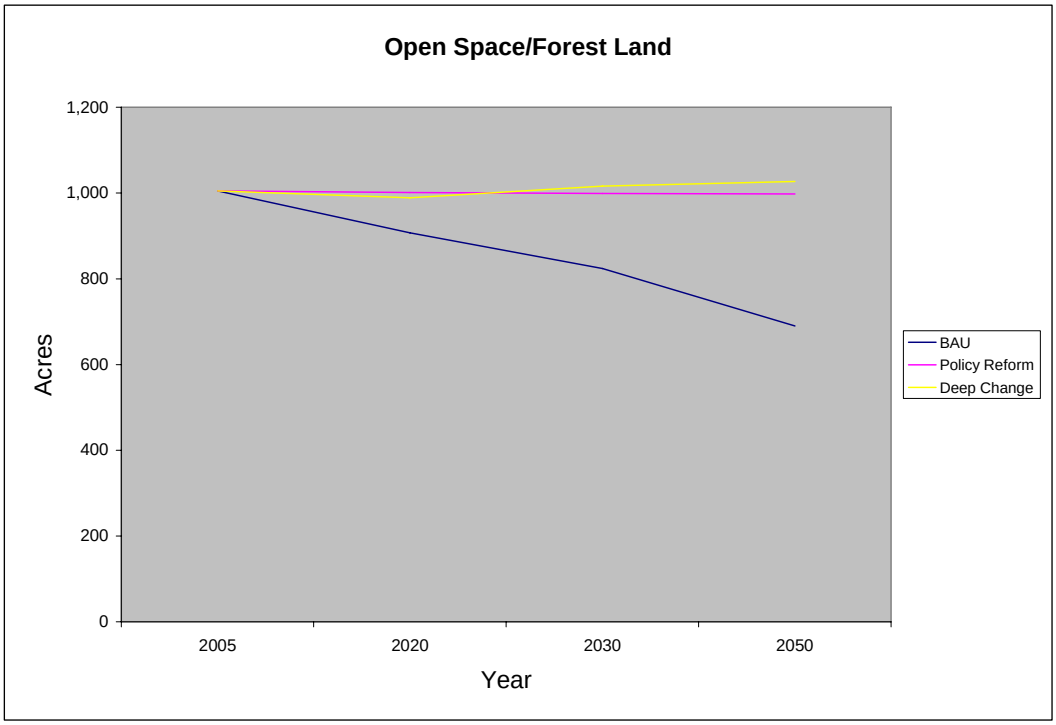
The most significant regional difference in regional land use patterns has to do with the ratio of developed to undeveloped land and, in particular, the share of residential land versus open space/forest. In the Inner Core, 47% of the land area is residential and 26% is open space/forest. In Regional Centers, residential land accounts for 35% of the total area and open space/forest 47%. In Mature suburbs the split is 39% residential, 48% open space/forest, while in Developing Suburbs only 22% of the land area is residential and fully 64% is open space/forest. Given the relative densities of the sub-regions, these variations are not surprising.

With the population of the Boston region projected to grow by roughly 500,000 by 2050, where these additional residents of the region locate, as well as the type and density of housing they occupy, are the most important factors that will impact the character of the regional landscape. If recent development patterns continue, fully 63% of the new population will reside in suburban communities; almost 40% in the outlying Developing Suburbs. Of course commercial and infrastructure development will follow in these locations in order to serve this population. These low-density communities with a preponderance of large, single-family homes currently contain vast tracts of unprotected open space, including forested areas and some agricultural land. More suburban development, particularly the large-lot subdivisions that have become commonplace, will result in the loss of a considerable fraction of the remaining open space. This also has important implications for the region's transportation system, as well as energy and water use, as suburban communities are generally not as well served by public transit and consume more natural resources per household than their urban counterparts. In addition to the pattern of development for new residents, the housing and locational decisions of existing residents will also exert a major influence on future land use conditions.

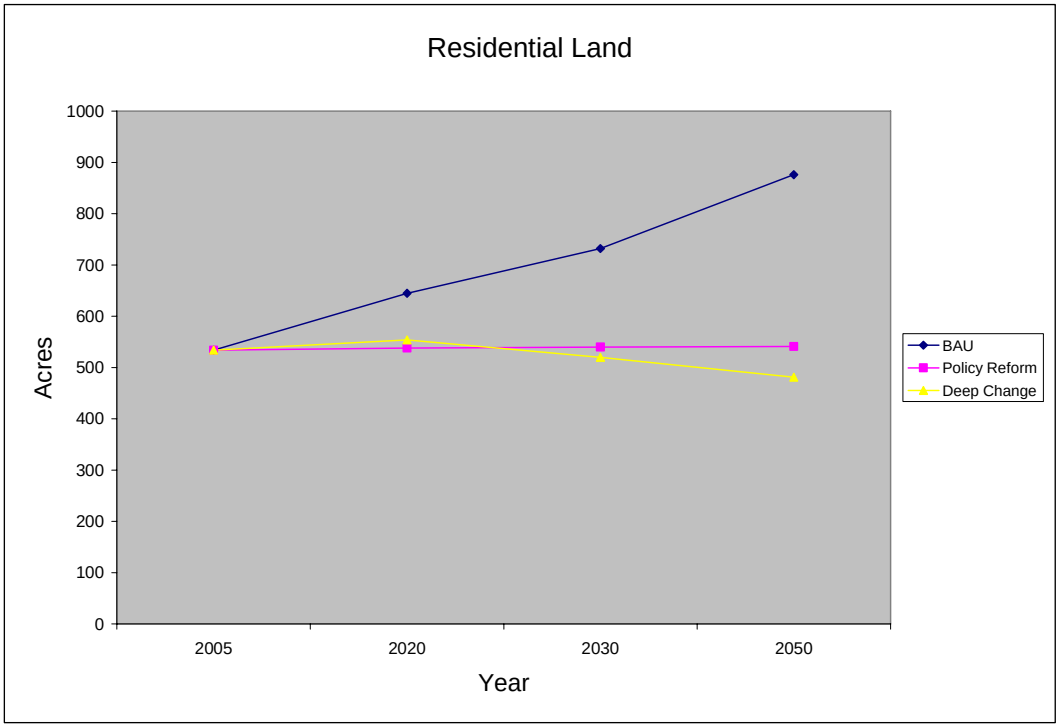
The consequences of the continuation of recent development patterns are explored in the BAU scenario. For the region as a whole, from 2005 to 2050 the land area occupied by residential

development grows by more than 340,000 acres, while about 315,000 acres of open space/forest are lost. In addition, commercial and industrial land area increases along with the sprawling residential development. Also, agricultural land declines about 70%, from 78,000 acres to about 23,000 acres. Although agricultural land represents a small fraction of current overall land use (about 4%), it is an important part of the landscape in some communities in the Developing Suburbs, and its loss has an impact on the character of the entire region.

In the Policy Reform scenario, the smart growth and housing policies introduced emphasize multi-family housing and concentrating development in urban areas and town centers. As a result, less open space is lost to residential and commercial development, and agricultural areas are preserved. In Deep Change, there is an absolute reduction in the land area devoted to residential development of about 50,000 acres, as virtually all the new housing is built in already developed urban areas, and a significant shift to multi-family housing allows conversion of some land to open space and agriculture. Consistent with the increased densities of established residential areas, small decreases in commercial and industrial land area also occur in the Deep Change scenario. Moreover, a strong commitment to expanding locally grown food increases the land devoted to agriculture by about 50,000 acres. The most dramatic changes – the land use requirements for residential development and the impact on open space – are depicted in the figure below.[2]



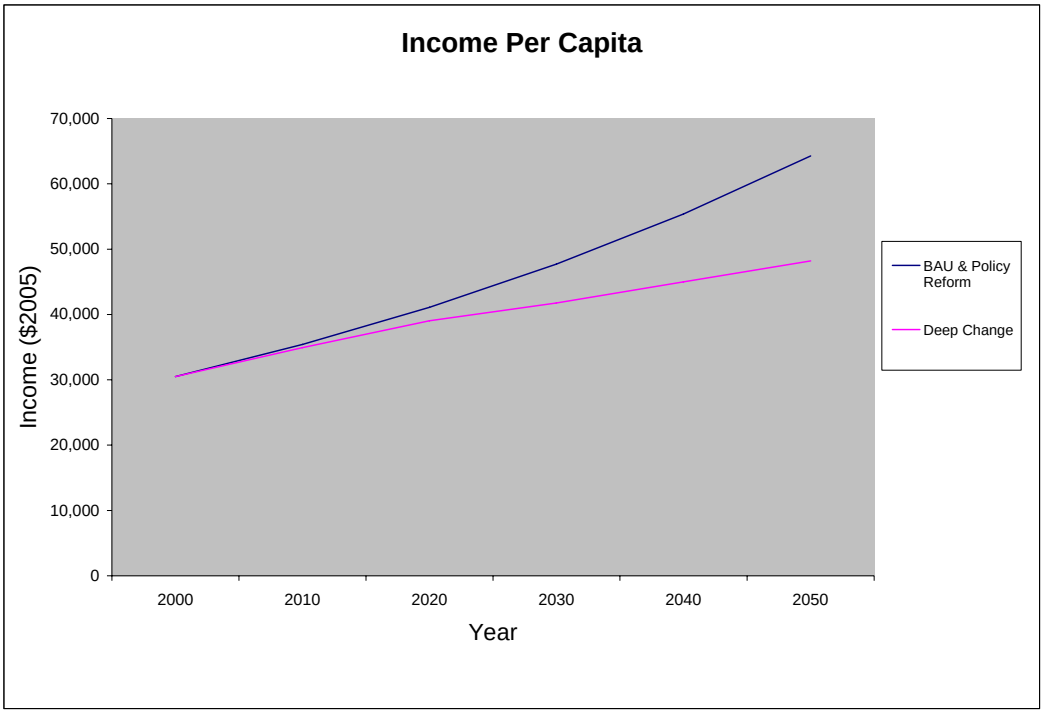
[2] For a detailed summary of the land use changes for each of the scenarios, see Table 9.4, Land Use by Type, 2005-2050, in the companion Technical report on Quantitative Scenarios.



Economy

Regional Gross Domestic Product (GDP) and personal income drive a number of variables in the scenarios. The BAU and Policy Reform scenarios assume the continuation of the relatively robust annual growth rate in GDP and per capita income enjoyed by the region in recent years. Informed by trends since 1990 (U.S. Census Bureau, 2007), real per capita income grows 1.5% in all sub-regions.

In the Deep Change scenario, on the other hand, the values-driven emphasis on quality of life, including a shorter average work week (reduced incrementally to 30 hours by 2050), and restructuring of the economy, translates into slower growth in per capita income. By 2050 average real per capita income is about $48,000 (in 2005$) in the Deep Change scenario, 25% lower than the $64,000 per capita in the other scenarios. The following figure depicts this difference.



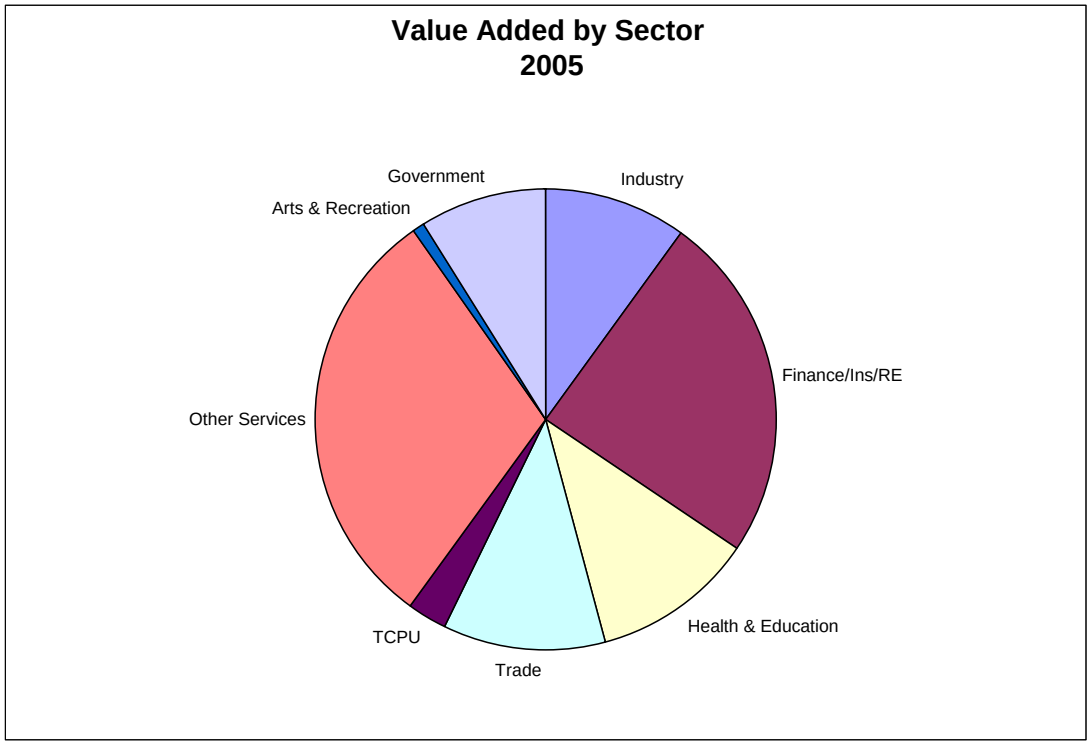
The regional GDP for the Boston metropolitan area in 2005 was $220 billion (US Census Bureau, 2007), with per capita GDP of just under $50,000. Informed by recent trends, for the BAU and Policy Reform scenarios per capita GDP grows 2% per year through 2050. Combined with the population growth over this regional real GDP (in 2005$) grows from $220 billion in 2005 to almost $600 billion in 2050. In the Deep Change scenario, per capita GDP growth is moderated by the reduction in the average hours worked per week, so total regional GDP grows to about $450 billion by 2050. As with personal income, this lower per capita and overall GDP reflects the value shifts away from consumerism in Deep Change and a focus on quality of life through a shorter work week.

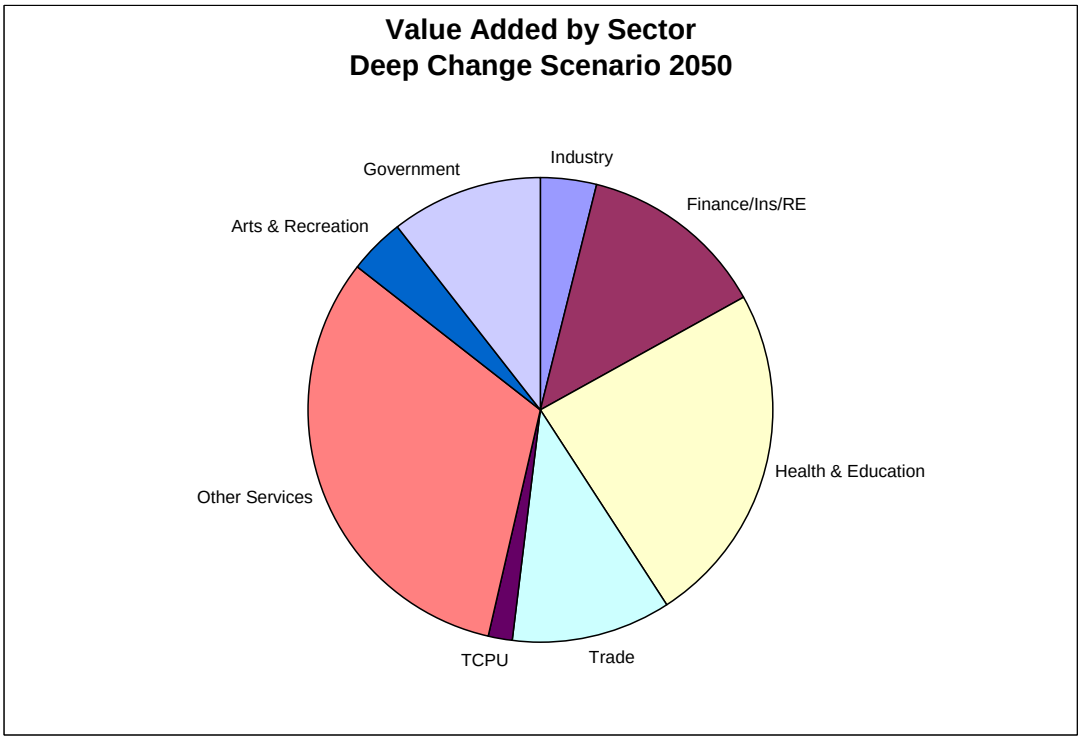
The structure of the regional economy is another important parameter that varies across the scenarios. The BSP scenarios consider eight economic sectors:

- Industry
- Finance, Insurance and Real Estate (FIRE)
- Health and Education
- Trade
- Transportation, Communication and Public Utilities (TCPU)
- Other Services
- Arts and Recreation
- Government.

In the BAU and Policy Reform scenarios, the relative share of economic activity among the various sectors continues recent trends. In Deep Change, however, the relative importance of the various sectors changes significantly. For example, the Finance, Insurance & Real Estate (FIRE) sector, which includes considerable speculative activity, becomes much less important by 2050. On the other hand, the value added share from Health & Education and Arts & Recreation see

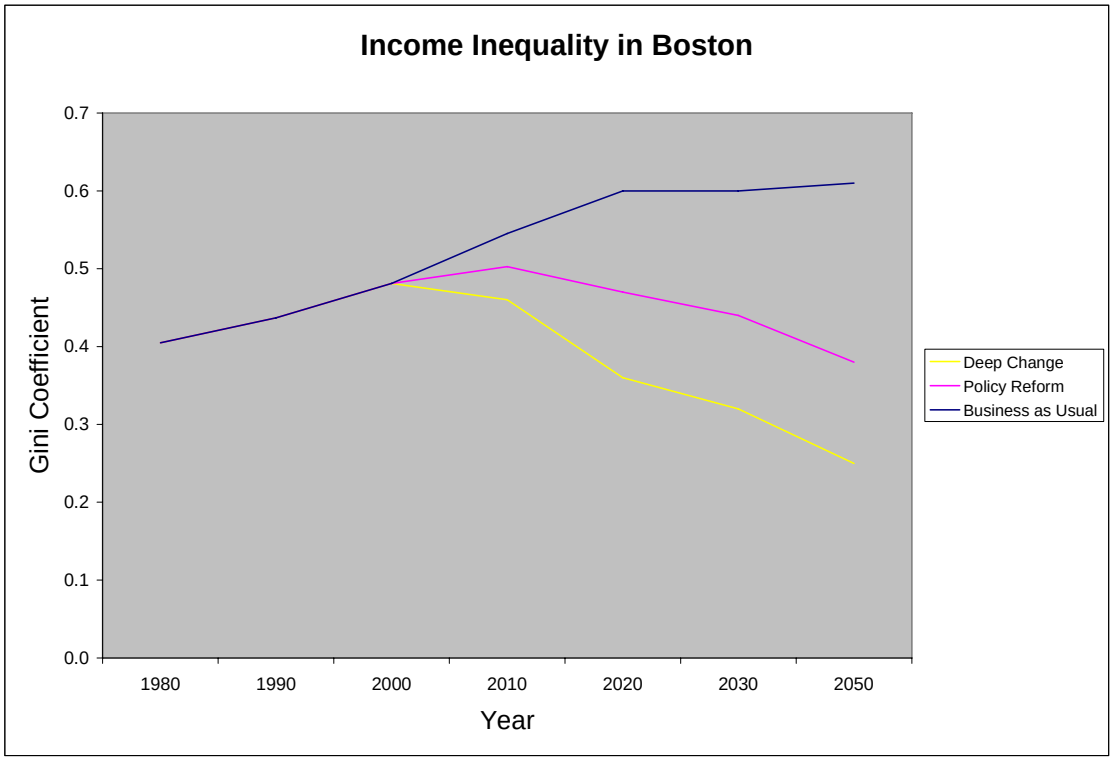
large growth, as societal investments are shifted to these sectors and added leisure time allows greater pursuit of educational, cultural, and recreational activities. Thus, in the Deep Change Scenario, the structure of the regional economy by 2050 has been transformed, as depicted below.





Income inequality as measured by the Gini coefficient[3] also varies significantly across the scenarios. Income inequality has increased (the Gini has risen) steadily in the Boston metro region for almost 50 years. Sub-regional variations are consistent with the intuitive understanding that some of the highest and lowest income households are in the Inner Core and other densely populated communities, while suburban communities are somewhat more homogeneous.

In the BAU scenario, the existing trend of increasing income inequality continues through 2050. In the Policy Reform scenario, this trend is reversed due to policy initiatives aimed at reducing poverty, including real increases in the minimum wage, improved education and job training as well as progressive tax changes. The result is a significant reduction in income inequality and a lowering of the Gini to about 1970 levels. In the Deep Change scenario, a firm commitment to poverty alleviation, community cohesion, and social equity promotes far greater income equality. This is summarized in the following figure.



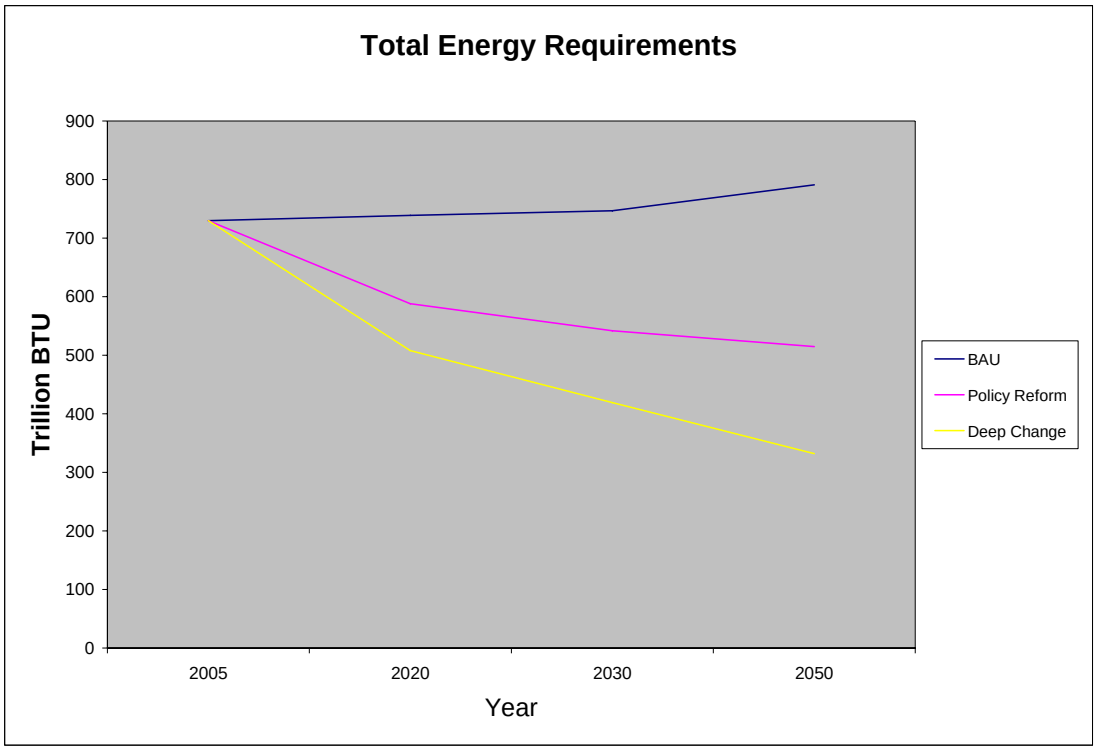
[3] The Gini coefficient is a standard measure of income inequality. It ranges from between 0 and 1, with a value of 0 signifying complete equality, in which all have an identical income and a value of 1 signifying maximum inequality, e.g., one person has all the income and everybody else has zero. The higher the Gini coefficient the more unequal income is distributed.

Energy Use

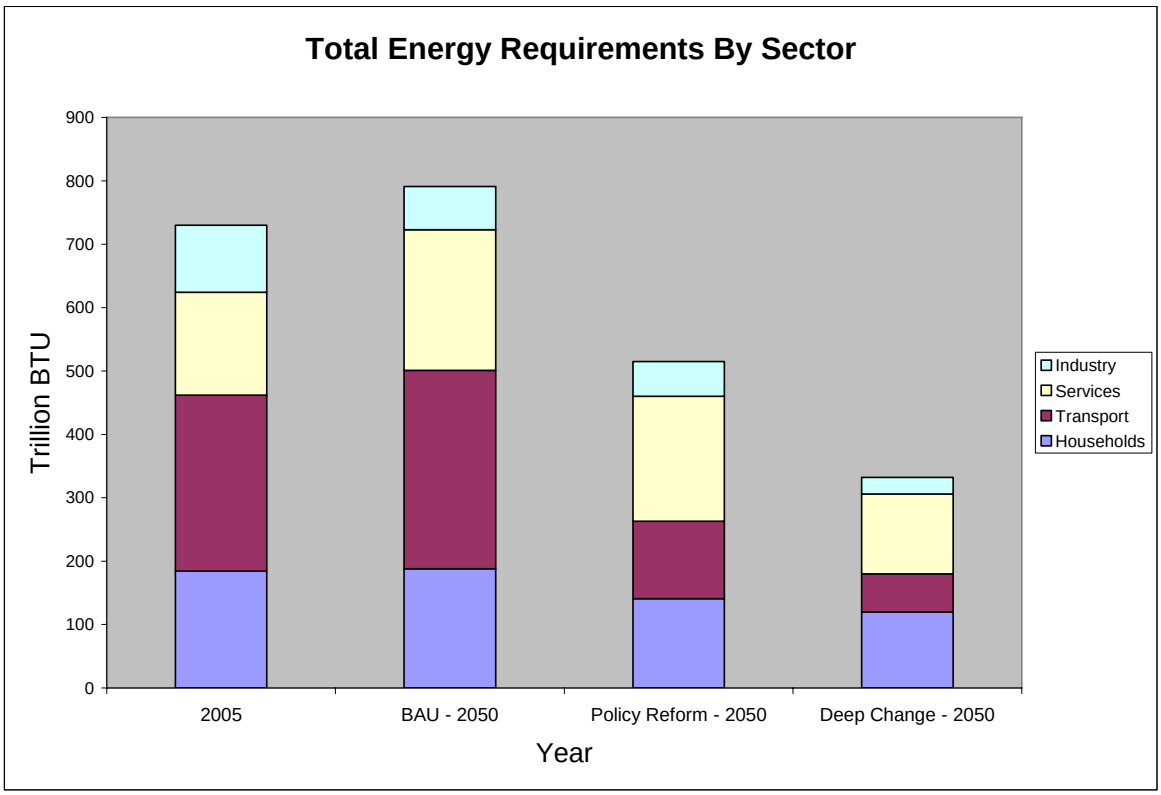
Energy use and the associated emissions are key indicators of sustainability in the BSP scenarios. Energy is used for heating, cooling, lighting, powering machinery, and mobility, across most major sectors including: residential, commercial, industrial, transportation (all modes), and electricity generation. While energy use was modeled by individual sector, this section provides an overview for the region as a whole, as well as the electricity generation profile for the three scenarios.

Primary fuel sources considered in the scenarios include electricity, natural gas, fuel oil, other fossil fuels, and renewables. In 2005 the region used a total of 730 trillion BTUs of energy across the various sectors, with households accounting for 25%, transport 38%, the commercial sector 22%, and industry 15% of overall use. In the BAU scenario, while there are efficiency gains in each sector these are offset by GDP growth as well as regional population growth. The net effect is a modest overall increase in energy use to 791 trillion BTUs by 2050 (about 8% overall growth).

In the Policy Reform scenario, a combination of policy initiatives and technological advances more than offset GDP increases and regional population growth. By 2050 overall energy use declines 29% to 515 trillion BTUs, with the most significant reductions in the transport and industry sectors. In Deep Change, with a societal commitment to reducing dependence on fossil fuels and lowering greenhouse gas emissions, total energy use declines by 55% by 2050 to 332 trillion BTUs. This is summarized in the following figure.



Note that energy use in certain sectors is more amenable to improved efficiency, policy initiatives, and/or lifestyle changes. Thus, in the Deep Change scenario, though there is a 55% overall reduction in energy use, the share used by the household and services sectors increase, while the share used by transport, and especially industry, declines. This is summarized in the figure below.



Greenhouse Gas Emissions and Climate Change

Anthropogenic climate change has emerged as a Major public policy issue. The scientific consensus has grown firmer over the past two decades that the enhanced emissions of a suite of "greenhouse gasses" (carbon dioxide, methane, nitrous oxide, and others) has already caused the planet's average temperature to rise by about 0.8ºC since pre-industrial time, with additional warming committed but not yet realized due to the thermal inertia of oceans. Meanwhile, emissions of carbon dioxide, the most important anthropogenic greenhouse gas, continue to increase and concentrations, already 35% above pre-industrial levels, rise at an accelerating pace. The human transformation of climate is approaching the level considered dangerous by many climate scientists of a cumulative rise of 2.0ºC. Indeed, the impacts observed already are troubling: contraction of mountain glaciers, sea level rise, vegetation relocation, migration of disease vectors to new areas, and increased frequency of extreme weather events, to name a few.

The perceived importance of limiting greenhouse gas emissions (GHGs) is very much in evidence in the Boston region. Relevant recent actions include the participation of Massachusetts in the Regional Greenhouse Gas Initiative (RGGI), the development of the MA Climate Action Plan, and the enactment of the Greenhouse Gas Emissions Policy and Protocol (MA

Environmental Policy Act Office, 2007). Vigorous activity by non-governmental organizations, such as the Massachusetts Climate Action Network (MCAN), has helped mobilize public attention and advance policy responses to the climate challenge.

One of the key metrics of sustainability used in the design and evaluation of the BSP scenarios is CO2 emission projections. Since typical climate stabilization scenarios find that reductions of emissions in the wealthier nations should be no less than 80% by 2050, that target is a primary driver of the BSP Deep Change scenario. Fossil fuel combustion accounts for about 80% of total anthropogenic GHG emissions. All major sectors – households, services, industry, transport, and electricity generation – use fossil fuels and thus contribute to CO2 emissions.[4] The BSP scenarios focus on CO2 as the dominant GHG in the region, though the others will need to be tracked and addressed in a comprehensive climate mitigation effort.

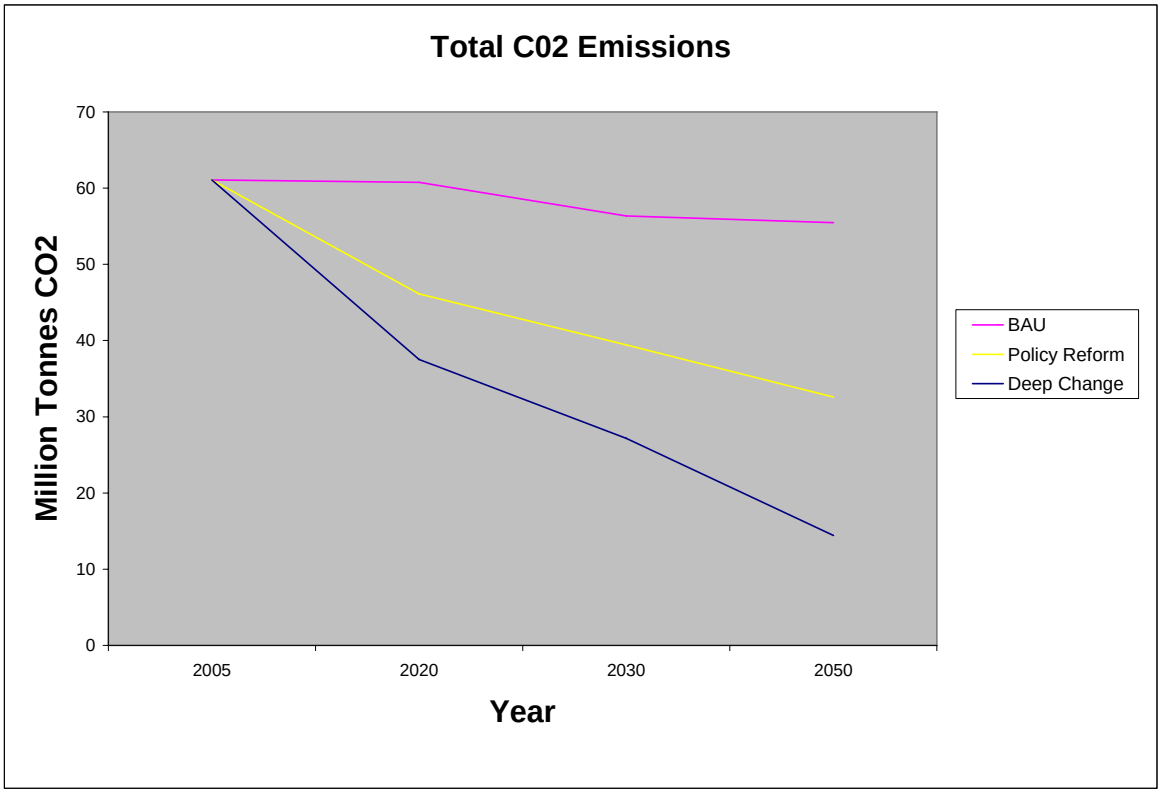
In 2005 the region produced over 61 million tons of CO2, with electricity generation accounting for 44% of total emissions. In the BAU case, CO2 emissions decline to about 55 million tons by 2050. While certain sectors experience modest growth in CO2 emissions over this period, the overall decline is driven by reductions in the electricity generation and passenger travel sectors. Given the projected growth in regional GDP and population, this represents a reversal of current trends and reflects significant efforts to improve energy efficiency, especially in passenger vehicles, as well as fuel switching away from coal and petroleum in the electricity generation sector.

In the Policy Reform scenario, driven by the broad range of technological innovations and policy efforts described in previous sections, overall CO2 emissions decrease by 47%, from 61 million tons to 33 million tons in 2050. While emissions are reduced in all sectors, the largest absolute decline is in the electricity generation sector, though its share of overall emissions actually increases to about 49% of the region's total. On a percentage basis, the greatest reductions occur in the passenger and freight transport sectors, as vehicle efficiencies improve, mode shifts occur, and alternative fuel vehicles are introduced.

The Deep Change scenario enhances the emission-reducing effects of Policy Reform technology and policy initiatives with changes in lifestyles and consumption patterns. Rising ecological awareness translates into a societal commitment to cut regional CO2 emissions by 80% by 2050 in order contribute to global climate stabilization. As described earlier, key features of the Deep Change scenario that impact energy use and CO2 emissions include: a redefinition of well-being from a focus on material wealth and consumption to quality-of-life in terms of leisure time, social equity, and the health of the environment; a reduction in the average work week and the associated reduction in GDP and use of resources; more compact land-use patterns as open space is preserved and urban areas and town centers are densified; and conscious behavioral change to minimize the use of fossil fuels.

[4] Note that while the agricultural sector is also an important emitter of CO2 (primarily from enteric fermentation of livestock, land degradation, and fertilizer use), due to the complexity of estimating the relevant agricultural emissions, they are not included in the BSP scenarios. Moreover, since the local agricultural sector is small and most food is imported into the region, the vast majority of agricultural CO2 is emitted in the locations from which the Boston region obtains its food.

Overall CO2 emissions decline by nearly 80% in the Deep Change scenario, from 61 million tons to about 14 million tons by 2050. On an absolute basis the largest reduction is in the electricity generation sector, while the largest percentage declines are in passenger travel and industry. These dramatic reductions are attributable to the combination of several factors: using 50% less energy overall; shifting the fuel mix away from fossil fuels, especially oil and coal; and, most importantly, significantly increasing the amount of energy produced from renewables, particularly for electricity generation. The following figure summarizes CO2 emissions for the three scenarios.



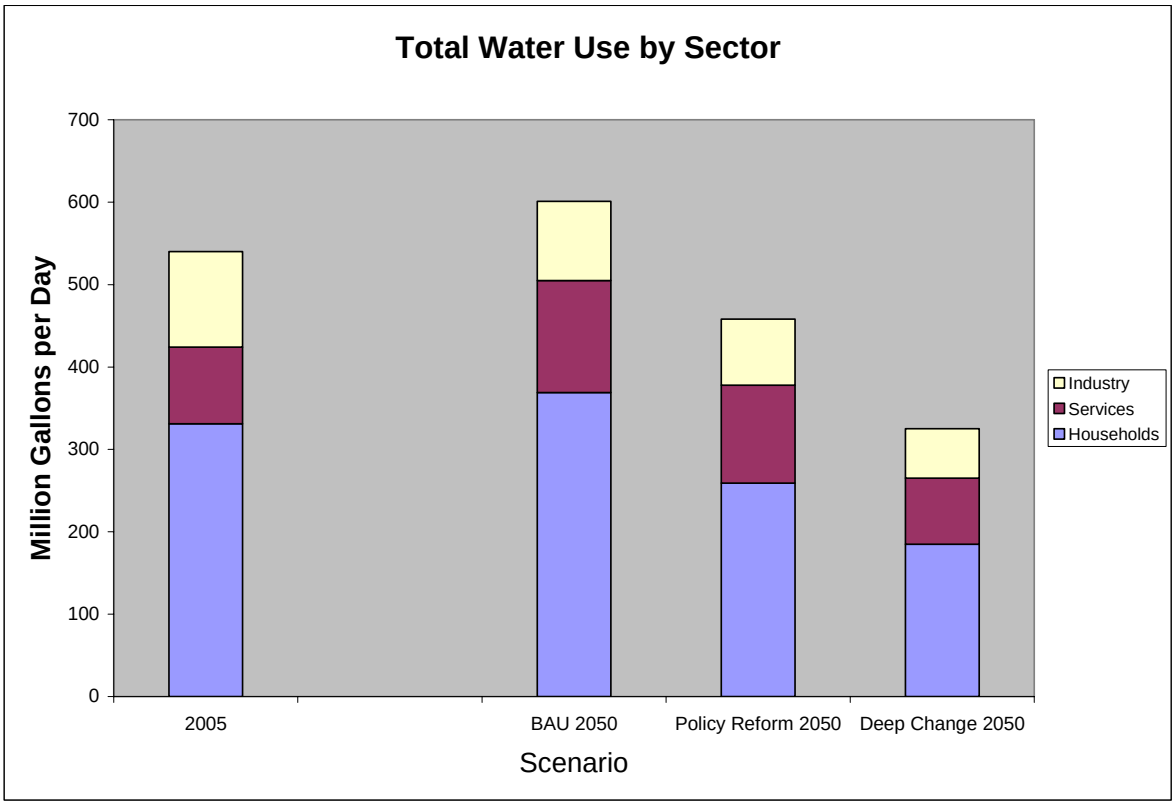
Water Use

The Boston region enjoys abundant water resources, receiving over 40 inches of rain per year. Nevertheless, certain basins suffer from prolonged low-flow periods, especially during the summer months, and are considered stressed by the MA Water Resources Commission (MWRC, 2001). The primary cause of the stress is over withdrawals for household use, which in 2005 accounted for 62% of total water demand in the region. Other major users of water are the industrial (21%) and commercial (17%) sectors. Agricultural production in the region is limited and mostly rain-fed, rather than irrigated. Thus agricultural water use is minimal and not considered in the BSP scenarios.

In 2005, total water use in the region was 540 million gallons per day (mgd). In the BAU scenario, this grows to 601 mgd, due largely to population growth, economic expansion and increased commercial water use, and a continuation of a sprawling development pattern in the Developing Suburbs with considerable outdoor water use. In the Policy Reform scenario, total

water use declines 15% by 2050 to 458 mgd. This is driven by further technological improvements in the efficiency of end-use devices (e.g., shower heads, faucets, and toilets), the introduction of dual-flush and waterless toilets, and increased penetration of these and other water saving devices. The broader use of low-flow fixtures in the residential sector, supported by policy initiatives and increasing costs for water and sewer service, more than offsets the modest growth in population over this period.

In the Deep Change scenario overall water use drops by 40%, reflecting not only the efficiency and policy initiatives mentioned above, much greater penetration of water saving devices such as dual-flush toilets and waterless urinals, but also a broad societal awareness concerning the value and limits of the region's water resources. Reductions in water use are achieved in all sectors, but most significantly in households, where housing patterns are more dense and outdoor water use has been virtually eliminated. With the reductions estimated in the Deep Change scenario, summertime flows would be restored to several stressed basins in the region. The following figure summarizes water use by sector in the BSP scenarios.



Food and Agriculture

Food production and consumption patterns have important impacts on the use of land, energy and other natural resources. The choice of production practice and the distance to market carry significant environmental implications. Moreover, shifting diet patterns are germane to public health concerns. In the U.S. as a whole, the food production system has become more industrialized and diets have shifted to include more processed foods over the past 50 years. Estimates indicate that for consumers in the U.S. food typically travels more than 1,500 miles from where it is produced to where it is consumed. The Boston region, with its heavily developed urban/suburban character, is no exception. Currently the vast majority of food consumed within the Boston area is produced and processed far outside of the region.

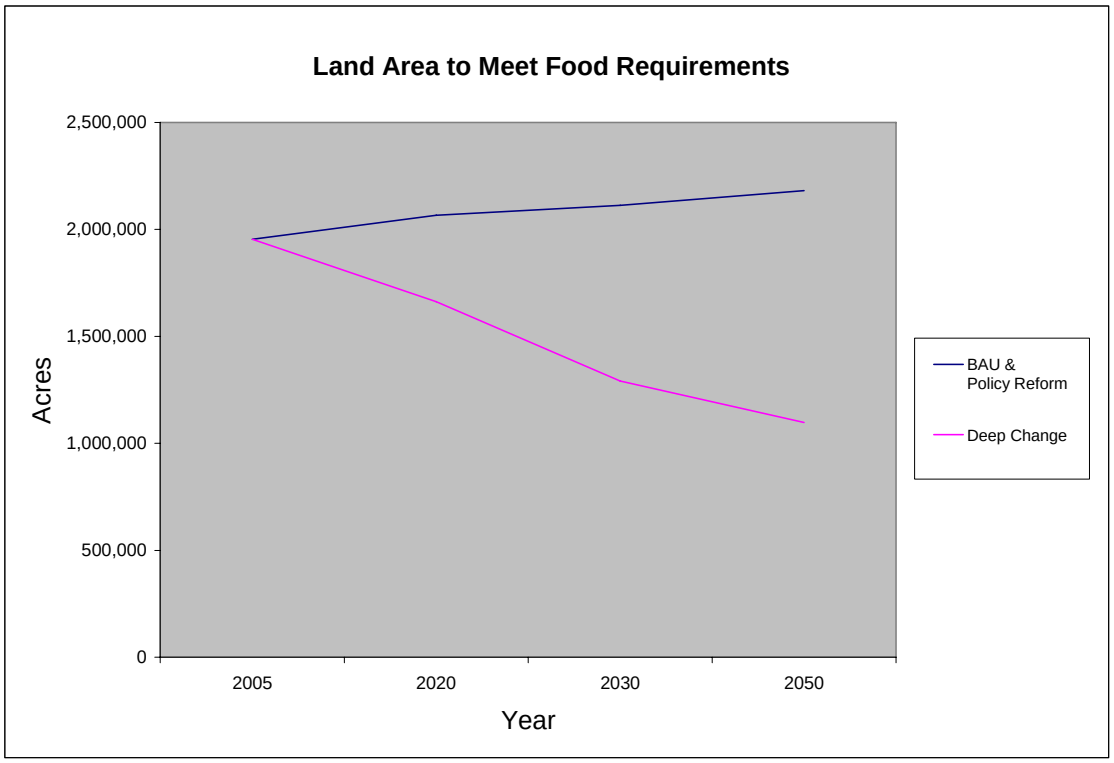
The food sector simulations in the BSP scenarios focus primarily on the level of food consumed (in calories) per capita, the share of calories derived from vegetable versus animal/fish sources, and the land requirements associated with the food consumed in the Boston region. It is important to note that meat production requires a large area to supply the grains, forage, and pastures for animal feed (Pimentel, 2008). Of course most of the land required for food production is located outside the region, some even outside the U.S. This larger land "footprint" is an important consideration in understanding the region's contribution to stress on global ecosystems, greenhouse gas emissions, and pollution.

In the BAU and Policy Reform scenarios per capita calorie intake remains constant at 2005 levels of 3750 calories per day throughout the study period. This apparent stability in average calorie intake masks two countervailing trends. On the one hand, over the past few decades average per capita calorie intake in the U.S. has been increasing owing to more reliance on processed and fast foods in the American diet. On the other hand, the availability of a broader range of low-fat and no-fat products, a modest market shift related to an increase in public dietary awareness as well as emerging regulatory pressures (e.g., to prohibit trans fats) will help offset increases in caloric intake.

By contrast, average per capita calorie intake decreases in the Deep Change scenario to 3,100 calories by 2050, resulting from widespread educational campaigns, strong regulatory efforts, higher food costs, and a change in consciousness and values around health and good environmental citizenship. The absolute reduction in food intake is complemented by a change in the composition of the average diet toward reduced dependence on processed foods, and increased reliance on more healthy and more local options. In the BAU and Policy Reform scenarios, 72% of total calories consumed are from vegetable sources (grains, nuts, fruits, vegetables), while 28% are from meat, fish, and dairy throughout the period, as no major lifestyle changes take place. In the Deep Change scenario, unprecedented public commitment to sustainable diets that reduce resource intensiveness and the related environmental footprint of food production results in a reduction in the share of calories derived from meat and fish. By 2050 83% of calories are from non-meat sources and only 17% from meat, dairy and fish. This does not necessarily imply that more people in the region are vegetarian (though this is likely); it simply means that meat is eaten less often and/or in smaller portions.

In the BAU and Policy Reform scenarios, without changes in average caloric intake or food production intensities, total land requirements increase in line with the overall population growth

of the region from about 791,000 to 883,000 hectares (10%) from 2005 to 2050. In the Deep Change scenario, the reduction in average per capita food requirements (from 3,750 to 3,100 calories per capita per day), plus the smaller share of calories derived from meat, results in a 44% decline in overall land requirements for food production to about 443,000 hectares . This is summarized in the following figure.



While the vast majority of the land needed to support the Boston area's food requirements is outside the region, this is a useful metric for the region's food "footprint." Converting to acres, the current footprint for food production in 2005 is about 2 million acres or two times the total land area of the region (close to 1 million acres). In the BAU and Policy Reform scenarios, the footprint grows to 2.2 million acres, while in Deep Change the footprint is about 1.1 million acres or just over the region's total land area.

4. Conclusions and Implications

The Boston region faces some difficult choices over the coming decades. A continuation of existing economic, social, and environmental trends portend increasing threats from climate change, ecosystem destruction, water shortages, resource depletion, and social polarization. But such a future is not inevitable.

The BSP project helps demonstrate that the decisions made over the coming years can profoundly alter this trajectory and lead to a very different outcome. It has shown that:

- Scenario analysis, with qualitative and quantitative components, is a useful methodology for organizing information, visions, and discussion about alternative regional futures.
- Normative scenarios with sustainability targets and backcasting are valuable for identifying the scale of the challenge, raising fundamental questions about development goals, and exploring plausible pathways for achieving desired futures.
- Given the inertia of the region's social, economic, and environmental systems, the level of change required is profound. It is likely to take decades of sustained efforts to alter the institutional, policy and regulatory frameworks, and cultivate lifestyles and values appropriate for the task of a transition to sustainability.
- Technological and policy initiatives are necessary but insufficient to reach certain sustainability targets (e.g., 80% CO2 reduction); lifestyle changes are also required.
- While it is important to achieve broad input into the creation of alternative scenarios, it is difficult to involve all relevant parties in the stakeholder engagement process. Active participants are generally not representative of the economic, racial, and cultural profile of the region.
- Data collection at the regional level is challenging. Most data are collected on the state or municipal basis and consistency across jurisdictions is often lacking.
- The Deep Change scenario provided a powerful alternative that significantly influenced the MetroFuture long-range regional planning process. By providing a scenario with very ambitious sustainability goals, Deep Change helped reposition the other scenarios under consideration and the level of change that is plausible. Moreover, specific aspects of the Deep Change scenario were adopted in MetroFuture's preferred scenario, including more aggressive reductions in regional energy and water requirements.
- The BSP project approach – linking regional sustainability initiatives with global considerations through a combination of engagement, visioning, scenarios, backcasting, and tracking of indicators – offers a useful model for other cities or regions wishing to explore the implications of sustainability transitions using integrated scenarios. The analytical tools, data and lessons learned in the project are readily transferable to other planning efforts.
- The project's engagement with policy-makers, citizens and other regional stakeholders has enhanced recognition of the need to examine the role of values and lifestyle in social, environmental and economic elements of sustainability.

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Attachment 1

Project Advisory Committee Members

Julian Agyeman	Tufts University
Gene Benson	Alternatives for Community & Environment (ACE)
Marc Breslow	Massachusetts Climate Action Network
Sean Caron	Metropolitan Area Planning Council (MAPC)
Robin Chase	Meadow Networks
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Nancy Goodman	Environmental League of Massachusetts
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Charlotte Kahn	The Boston Foundation
Sivan Kartha	Stockholm Environment Institute – U.S.
Lee Ketelson	Clean Water Action
Ken Kruckmeyer	Massachusetts Institute of Technology
Charles Lord	Boston College/Urban Ecology Institute
Meizhu Lui	United for a fair Economy
Martin Pillsbury	Metropolitan Area Planning Council
Dan Raffterty	Cambridge Sustainability Initiative
Eric Strauss	Boston College/Urban Ecology Institute
Mariella Tan Puerto	Barr Foundation
Greg Watson	Massachusetts Technology Collaborative

Attachment 2

PoleStar System Description

The Polestar System

A Flexible Platform for Studying Sustainability Transitions

- **A comprehensive framework for environmental and social assessment**
- **Transforming sustainability from a goal to a practical basis for policy and action.**
- **Using scenarios and quantitative simulation to explore possible futures.**
- **Raising awareness, stimulating creative thinking, supporting decision-making.**

What technological, economic, and behavioral adaptations are required to achieve sustainability? The PoleStar system developed by the Tellus Institute provides a unique platform for such analyses. Named for the star that guided explorers through uncharted waters, the PoleStar System is a comprehensive, flexible analytic platform and resource-accounting framework that aids in visualizing alternative development scenarios. It is particularly well-adapted for global studies of energy, agriculture, water, land-use, and other resources.

PoleStar has been used by the United Nations Environment Programme (UNEP), the Organization of Economic Cooperation and Development (OECD), and the U.S. Environmental Protection Agency (EPA), as well as by country-level projects throughout the world. Some scenario results have also been incorporated in reports from the Intergovernmental Panel on Climate Change (IPCC).

Updated findings to be released in early 2008.

The Tellus Institute welcomes inquiries from organizations interested in partnering in the use of the PoleStar System.

Contact Dr. Richard Rosen (RRosen@Tellus.org)

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TELLUS INSTITUTE
for a Great Transition

A New Era of Uncertainty and Urgency

As people wrestle with issues like climate change, resource shortages, and poverty reduction they need a framework for doing so. One useful element is a set of stories or scenarios that describe various ways the world might evolve. A second element is a comprehensive data set, assembled in one place. A third element is a quantitative system that allows users to manipulate the data. Stories, data, and an analytical framework pulled together into one package — that describes the PoleStar System.

A Scientifically Based Policy-Oriented Tool

Modelers, activists, policy-makers, academics, and non-governmental organizations are exploring sustainability questions that can benefit from PoleStar's capacity for scenario building and quantitative modeling.

- Are current energy policy approaches sufficient?
- What are the implications of peak oil?
- How can necessary growth in the developing world be squared with global resource constraints?

PoleStar can put issues like these in a broad context, reaching beyond specific analyses to paint a comprehensive picture of global resource use, environmental impact, and economic and social development.

The PoleStar Framework

The computer-based PoleStar System can:

- First, paint a comprehensive, accurate, data-rich picture of the current state of affairs.
- Second, build on this platform of data to project alternative futures.

The PoleStar System is applicable at national, regional, and global scales. Data structures, time horizons, and spatial boundaries can be altered during an analysis. The system comes with an initial data set drawn from reputable sources such as UN agencies, the World Bank, and the International Energy Agency.

Scenarios can be used to challenge the imagination, to reveal gaps in current thinking, and to test strategies for robustness.

A PoleStar application begins with a snapshot of the present. Alternative scenarios are then created to explore different futures, developing out of this baseline. Unlike other systems that build forecasts solely based on past trends, PoleStar allows the user great flexibility to input parameters to create scenarios of their chosing.

For example, sustainability targets may be set for greenhouse gas emissions, ground level pollutants, forest and wetland preservation, nonrenewable resource depletion rates, water stress, and so on. The policy routes needed to reach these goals then become more visible. For each scenario, the model computes impacts down various chains — transportation, energy production, agriculture and land use, mineral use, water use, and so on — so that an internally consistent picture is created.

Tellus Scenarios

Scenario building is central to the PoleStar System. A scenario is not a prediction of the future. It is a plausible story — backed by quantitative analysis — of how the future might unfold. At their richest, scenarios offer narratives describing societal evolution and environmental impact, integrated with quantitative representations of changing supply and demand patterns.

Scenarios can be used for many purposes: to challenge the imagination, to reveal gaps in current thinking, to test strategies for robustness, and to raise public awareness.

Drawing initially on the expertise of an international body of experts called the Global Scenario Group convened in 1995, the Tellus Institute — in partnership with the Stockholm Environment Institute — has taken the lead in developing a series of future scenarios. These have been used by governments and leading international organizations around the world. They have also served as the basis for a series of PoleStar reports, exploring the implications for global sustainability in areas such as energy, agriculture, land, water, and hazardous wastes. More recently, a series of 15 Tellus papers explore the implications of the most hopeful scenario, that of a Great Transition toward sustainability. (Download papers at www.Tellus.org).

Tellus scenarios are built on the premise that cultural shifts are coming, but their nature remains undetermined. Whether the 21st century becomes an era of rising chaos or a time of positive transformation depends upon choices within our grasp. Physics teaches us that complex systems — economic, political, or ecological — can, at critical thresholds, reorganize themselves. Such changes are ushered in by turbulence, which leaves the system's basic structure in crisis. The structure resists change, but as deepening tensions build toward instability, the system can shift into a highly transformed state. We are today approaching the point of turbulence, and basic social structures are in flux.

We cannot predict the future, but we can think about it in an organized way through scenarios.

Four Paths to the Future

The Tellus scenarios include four broad possible future paths:

1. Market Forces scenario:
Current trends of consumption and resource use follow current trajectories of unsustainability. Using 1995 data, Tellus found that by 2050, world population was expected to increase by more than 50 percent, average income to multiply over 2.5 times, and economic output to more than quadruple. Food requirements would almost double, yet one billion would remain hungry. The energy requirements of China would approach those of North America by 2050. By 2100, carbon emissions would be double those required for climate stabilization. The number of people living in water-scarce conditions would more than double by 2025. The message of this scenario was that our existing path poses grave risks.

2. Policy Reform scenario:
Sustainability is sought by constraining market globalization within social and environmental targets imposed by government. However, the underlying values and lifestyles of consumerist society remain essentially unchanged. Carbon emissions stabilize and water stress abates to some extent. But the plausibility of this scenario rests on the supposition that political will can be mustered to impose the needed constraints. Inside a culture celebrating consumerist self-interest, an unswerving government commitment to sustainability must somehow coalesce.

3. Fortress World scenario:
Emerging problems are poorly managed and cascade into self-amplifying crises. Environmental conditions deteriorate, combining with food insecurity and emergent diseases to foster a vast health crisis. As the bite of climate change and environmental devastation grows fiercer, poverty increases. The gulf between rich and poor widens still further, leading to a resurgence in terrorism. With governmental priorities focused on security, a state of planetary emergency is declared and draconian police measures sweep through hot spots of conflict. The world becomes bifurcated, with the affluent living in protected enclaves amid oceans of misery.

4. Great Transition scenario:
A fundamental reshaping of organizing principles creates a new social order of strengthened human communities, enriched quality of life, and a reviving biosphere. Going beyond political reform, this scenario envisions that we revise our fundamental notion of progress, seeing that well-being turns not on the quantity of stuff but the quality of life. Under this scenario, conspicuous consumption would be viewed as a vulgar throwback to an earlier era. There would be cultural support for narrowing the gap in income distribution and guaranteeing a decent minimum income for all. Acquisitive values based on self-interest would give way to a new community spirit, reinforced by reliance on more locally produced products and environmental pride. Awakened to the interdependence of life, people would come to a deeper awareness of their connections with one another, future generations, and the web of life.

Going beyond political reform, the Great Transition scenario envisions that we revise our fundamental notion of progress.

Updates Now Underway

These scenarios are currently being updated and elaborated for release in early 2008. Over recent years, the pace of economic growth has been more rapid than previously projected, in large part because of the growth of India and China. This change alone will impact the future more negatively.

At the same time, environmental constraints are continuing to tighten. There has been greater degradation at multiple points than anticipated, and a decade has been lost without significant progress toward reducing global warming gases. Meanwhile, the spotlight has broadened to include issues like peak oil production, the geo-politics of energy and water, and the fragility of the rapidly evolving global financial system. Based on preliminary analysis, one can read the tea leaves on the coming transition. It must indeed be great, not small.

To see the scope of PoleStar data covered, see Scenario Quantification charts at this web address: http://www.polestarproject.org/

To see 15 new essays on the Great Transition concept, see: http://www.tellus.org

Partnerships Welcome

PoleStar would be of use to those interested in special studies on individual topics like peak oil or water use, or a study comparing the impact of using land for food versus land for biofuels. It can be used for regional or local analyses as well — studying sub-Saharan Africa, Southeast Asia, a single nation, or a metro area like Boston. Government and civil society organizations can use the system to test the robustness of policies and build visions for the future.

In this time of transition, the fundamental premise that Tellus shares with many others is that humankind can, to a great extent, influence its destiny. We, as a culture, can find guidance for the changes ahead in scenarios that serve as self-fulfilling attractors, offering visions of the hoped-for future that can spur the actions needed for their own realization.

The Tellus Institute is a 30-year-old nonprofit research and consulting organization, with areas of focus that include energy, water, corporate transformation, sustainable communities, and human well-being. The aim of the institute is to help society navigate a Great Transition toward ways of producing, consuming, and living that balance the rights of people living today with future generations and the wider community of life.

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