Climate Change Mitigation in Boston, Massachusetts:

What Is and Could Be Done

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Major Qualifying Project

February 6, 2014

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Abstract

This paper looks into the City of Boston's efforts to mitigate climate change and compares these efforts to potential ones. An introduction to climate change and social science concepts that affect the response to climate change are provided as background information. The City of Boston's Climate Action Plan Update (2011) is used to overview Boston's climate change mitigation efforts, with some deviation to initiatives in other cities. I argue that more effective policy is hampered by the failure of policy-makers to question three assumptions. I identify these assumptions and offer initiatives that would refute them and, in doing so, work as more effective policy.

Introduction

Anthropogenic climate change is the largest threat to ever face humanity. Humans inadvertently tampered with a process (the greenhouse effect) that has kept the climate within a habitable range. In this paper, I survey the human response to climate change and how the City of Boston, Massachusetts is addressing it. I claim that these efforts are hampered by at least three assumptions that policy-makers fail to question. For each assumption, I provide an example of an initiative to refute the obstructive assumption and, in doing so, work as more effective policy.

Chapter one introduces the greenhouse effect. This process was tampered with by the direct or indirect human emissions of four greenhouse gases (or groups of gases). Chapter one describes United States sources of these gases and the change in their atmospheric concentrations since preindustrial times (the start of excessive human contribution of greenhouse gases). The chapter concludes with the forecast consequences—termed climate change—of this behavior.

Chapter two introduces four concepts that contribute to an explanation for the observed human response to climate change. They are as follows: implicatory denial, a general tendency toward political inactivity, the disconnect of climate change from everyday life, and a conservative backlash against environmentalism.

Climate change *is* being addressed. Chapter three describes the City of Boston, Massachusetts's efforts to do so. These are efforts by a City government operating within a larger context, which is briefly described. This context includes Boston's academic community, business community, and ecosystem. I justify the choice to examine climate action at a City scale by the importance of local action in the United States on this issue. Chapter three summarizes the

City of Boston's climate action efforts as portrayed in its Climate Action Plan with a few deviations for comparison to initiatives in other cities.

Chapter three's description of Boston's actions to address climate change is offered as a contrast to chapter four's academic inquiry into Boston's potential climate actions. I argue that Boston is restricted by three assumptions that policy-makers fail to question. For each assumption, I provide an example of an actual or proposed initiative to refute the assumption. These initiatives are as follows: a carbon fee-and-dividend, policy attributing responsibility for waste disposal to producers, and a focus on user-owned energy in a transition to a renewable energy infrastructure.

Chapter One

Introduction to Climate Change

Earth's *climate* refers to it's global mean temperature and the variability around this mean. Earth's climate has always changed. People are most familiar with the changes to and from ice ages. The climate change referred to in this paper is *anthropogenic* climate change. It is the change Earth is currently experiencing. It results from human-caused increases in levels of atmospheric greenhouse gases and feedbacks triggered by this initial change. These gases, remaining in the atmosphere for various lengths of time, contribute to the greenhouse effect of climate regulation. This chapter briefly explains the greenhouse effect, United States emissions of each of these greenhouse gases, and the resultant climatic changes.

The Greenhouse Effect

The greenhouse effect is the process by which greenhouse gases regulate Earth's climate. Since the sun is hot, it irradiates shortwaves. The Earth absorbs the radiation that reaches it and, since it is cooler, reradiates the energy as longwaves. The atmosphere is composed mostly of gases that are transparent to both wavelengths but, importantly, also contains greenhouse gases that exhibit selective absorbency. These gases allow the shortwave radiation from the sun to pass through them, but absorb this same energy as it returns from the Earth as longwaves (Tarbuck, Lutgens, and Tasa 2014). Therefore, less energy leaves the system than enters. The measure of this difference is called *radiative forcing* (Chandler 2010). A planet must have neither too low nor too high a concentration of greenhouse gases in its atmosphere to have a temperature conducive to life. Earth is referred to as *the Goldilocks planet* for striking this balance.

The greenhouse gases are as follows: carbon dioxide, methane, nitrous oxide, and high-global warming potential (GWP) gases. Each of these gases has increased in atmospheric concentration since the current industrial era began in 1750. I discuss each gas' sources and increase in concentration from preindustrial times. A bit more detail goes into the discussion of carbon dioxide.

Carbon Dioxide

The greenhouse gas carbon dioxide is discussed most in relation to climate change. This is likely due to carbon dioxide emissions being responsible for 82.8 percent of greenhouse gas emissions. It is evidenced in the unit used to express total greenhouse gas emissions—carbon dioxide equivalents (CO_2e). This derived unit is necessary because the different greenhouse gases have different global warming potentials.

Carbon is the base of all life on Earth—a key component of all plants and animals—and naturally cycles among the different life forms. One part of this carbon cycle is the exchange of carbon between plants and the atmosphere. Plants remove carbon dioxide from the atmosphere and use it to grow (fixing carbon in non-atmospheric form is known as carbon sequestration). When they decompose or are burnt, this carbon is released back into the atmosphere. For most of human history, the biggest effect humans could have on this exchange was destroying more plant biomass than was allowed to regrow. Since industrial times, however, humans have been burning coal, oil, and natural gas. These fossil fuels are plant biomass from the Carboniferous period that was preserved under pressure rather than decomposing. Releasing the carbon stored in fossil fuels allows humans to significantly add to the concentration of carbon dioxide in the atmosphere in a way that was not possible when limited to burning or cutting down living plants.

United States carbon dioxide emissions are over ninety-eight percent due to energy generation (U.S. Energy Information Administration 2011). Carbon dioxide has a relative abundance to the year 1750 of 139 percent (World Meteorological Organization 2011). This is the percent change from 280 ppm (parts per million—or 0.028 percent of the composition of the atmosphere) to 389 ppm. "For about 10,000 years before the Industrial Revolution, the atmospheric abundance of CO_2 was nearly constant at ~280 ppm" (World Meteorological Organization 2011). The 389.0 ppm figure is the globally averaged carbon dioxide concentration in 2010. The concentration of atmospheric carbon has been recorded at the Mauna Loa Observatory in Hawaii since 1959. The famous graph of these data (commonly called the Keeling curve—see figure 1) shows the steady increase in carbon dioxide concentration since then.

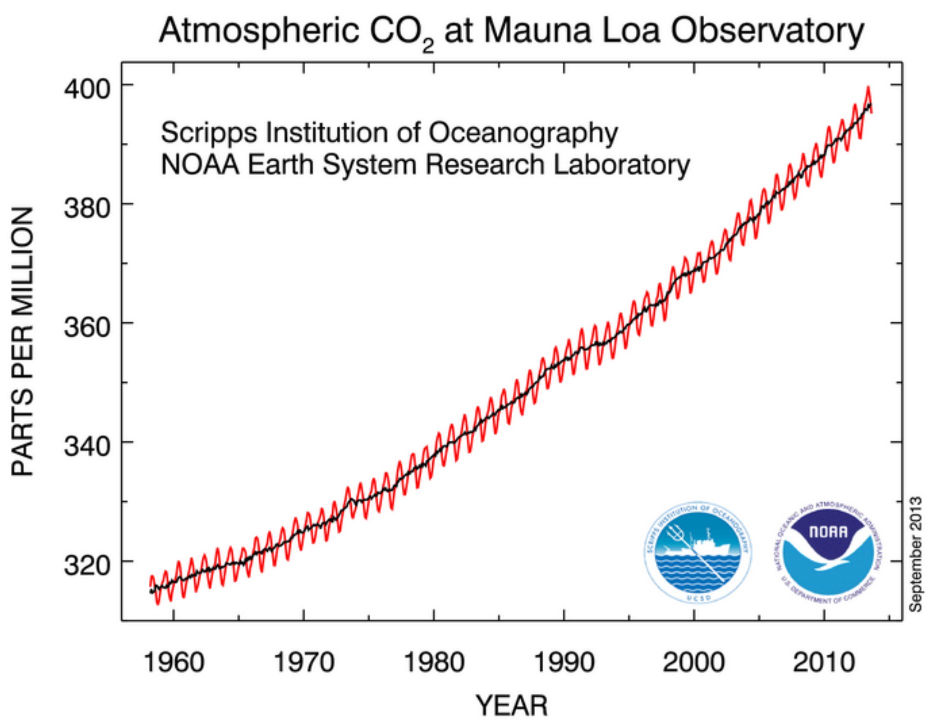

Figure 1. Keeling curve

Methane

United States methane emissions are due to energy production, distribution, and use; agriculture; and waste management (U.S. Energy Information Administration 2011). Methane has a relative abundance to the year 1750 of 258 percent (World Meteorological Organization 2011). Agricultural United States methane emissions come from livestock and the management of animal waste (U.S. Energy Information Administration 2011). Americans raise livestock, which produce methane through their digestion process, to supply their increasing consumption of meat. United States per capita meat consumption was about 110 pounds per person per year in 1909. This figure rose to 171 pounds in 2011, though it has been declining since 2004 (Larsen

2012). While livestock necessarily release methane gas, animal waste only does so in the anaerobic conditions created by the management of animal waste from *animal feeding operations*. If managed differently, this animal waste could be a valuable fertilizer rather than a harmful emitter of methane. Likewise, the methane emitted due to waste management practices need not occur. Methane emissions here are due to the decomposition of solid waste in anaerobic landfills. Solid waste in other conditions would not produce methane.

Nitrous Oxide

United States nitrous oxide emissions are due to agriculture, energy use, industrial processes, and waste management (U.S. Energy Information Administration 2011). The relative abundance of nitrous oxide to the year 1750 is 120 percent (World Meteorological Organization 2011). The largest source is agriculture and the majority of agricultural emissions result from nitrogen fertilization and animal waste management (U.S. Energy Information Administration 2011). Nitrous oxide is also a byproduct of fuel combustion with about two-thirds of emissions from energy use attributable to mobile sources (U.S. Energy Information Administration 2011). The industrial processes that make adipic acid and nitric acid (a primary ingredient in fertilizers) emit nitrous oxide. Lastly, nitrous oxide is emitted from wastewater treatment.

High-GWP Gases

The high-GWP gases' only source is industrial processes. Since the chemicals in this group are not present naturally, they were not in the atmosphere in preindustrial times.

The group includes the following: chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6).

The first two gases in the above list—CFCs and HCFCs—are ozone-depleting and therefore being phased out under the terms of the Montreal Protocol (U.S. Energy Information Administration 2011). Because of their long lifetimes, however, previous emissions of these gases will continue to enhance the greenhouse effect well into the twenty-first century.

The last four gases in the above list are still being emitted, yet it is being considered to add HFCs to the Montreal Protocol (U.S. Energy Information Administration 2011). HFCs are used as solvents, refrigerants, firefighting agents, and propellants for aerosols. PFCs are emitted from the production of aluminum and manufacture of semiconductors. SF_6 is used primarily in electrical applications. It is also used in the manufacture of semiconductors and magnesium smelting (U.S. Energy Information Administration 2011).

* * *

The modern lifestyle of people in developed countries is powered by fossil fuels, fed by industrialized agriculture, results in waste that is inappropriately managed, and supports industries that create man-made pollutants. All of these four categories are responsible for one or more human sources of greenhouse gases (see table 1). The result of these emissions is an atmosphere with an increased concentration of these climate-regulating gases as an unintentional outcome of human actions.

Table 1. Categories of greenhouse gas sources

Greenhouse gas	Fossil fuel use	Industrial agriculture	Waste management	Industrial processes
Carbon dioxide	X			
Methane	X	X	X	

Nitrous oxide	X	X	X	X
High-GWP gases				X

Climatic Consequences of Greenhouse Gas Emissions

The addition of greenhouse gases to the climate system results in an increase of heat energy to the system. This energy increase results in a warmer planet, which triggers climatic changes noticed terrestrially. In addition to these changes, climate change has a significant impact on ocean chemistry. There is also a philosophical effect from what climate change activist Bill McKibben (1989) terms the *end of nature*.

The most direct climatic change is a warmer planet, which affects precipitation patterns and melts sea ice. Land and ocean surface temperatures have increased 0.78ºC since 1850 (IPCC 2013) (see figure 2). A higher average temperature results in more frequent and severe heat waves, yet there will also be less frequent and severe cold waves. Warmer air holds more water, which results in both an increase in the area affected by droughts and increases in frequency of heavy precipitation events over most areas (Tarbuck, Lutgens, and Tasa 2014). These changes threaten terrestrial biodiversity, human food crops, and increase human vulnerability to storms. Melting sea ice, in addition to the threat of loss of an entire biome (the Arctic), increases sea levels. Warmer water takes up more room relative to cooler water. This thermal expansion contributes significantly to sea level rise (Vergano 2013). Rising seas destroy some coastal habitats and displaces coastal human communities—including many culturally significant human cities (such as Venice, Italy and New York, U.S.).

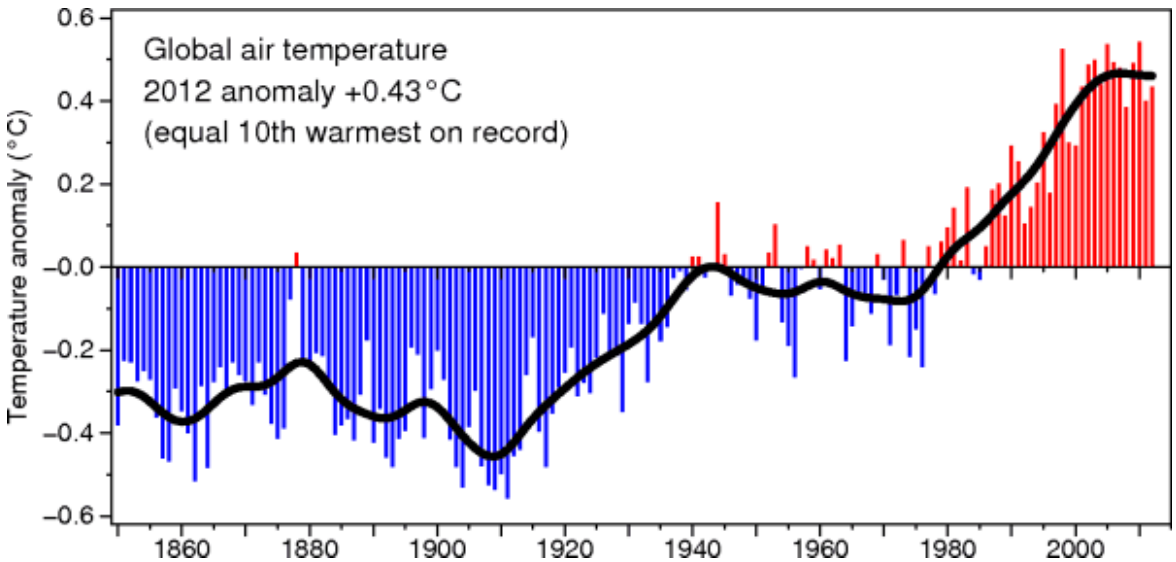

Figure 2. Temperature anomaly since 1850

The Earth is mostly a blue planet. Unsurprisingly, the oceans pay a heavy toll from changes in the planet's climate system. About ninety percent of the heat added to the environment from climate change has entered the oceans (Vergano 2013). They absorb the majority of the increased heat energy, which warms them. The change in evaporation patterns and melting of freshwater ice into them changes their salinity. They absorb most of the increased carbon dioxide. The dissolution of it in the oceans forms carbonic acid, which lowers ocean pH. There has already been a decrease of 0.1 pH units since preindustrial times (Tarbuck, Lutgens, and Tasa 2014). This ocean acidification—sometimes referred to as global warming's evil twin—"makes it more difficult for certain marine creatures to build hard parts out of calcium carbonate" (Tarbuck, Lutgens, and Tasa 2014, 735). This affects the very base of the ocean food chain—a huge threat to ocean biodiversity and the food security of the world's humans dependent on seafood.

In addition to the physical challenges that humans face from climate change, there are philosophical, spiritual, and cultural ones. Bill McKibben realized this as early as 1989—when climate change was a relatively new threat. This is when he wrote The End of Nature on the philosophical implications of human interference with the climate system. The title refers to the fact that, now that humans have altered a global aspect of the Earth system, there is no place on Earth untouched by human presence. Humans have lost the humility and wonder that come from the existence of an untamed nature. This nature has been used in Judeo-Christian and indigenous religious traditions to inspire spirituality. The culture of places is closely tied to their natural features—snow for skiing in Norway, colorful autumn maple trees in New England, the traditions of harvest times worldwide. In addition to devising technical solutions to new climate conditions and dealing with the knowledge of human suffering and species' extinction from climate change, people with have to confront these challenges to their sense of ontological security.

Chapter Two

Why Is More Not Being Done?

This section looks at social science ideas of impediments to action addressing climate change (*climate action*). I have chosen the following four social concepts to introduce in relation to climate change: implicatory denial, a disconnect from everyday life, political inactivity, and conservative backlash. I chose implicatory denial and the disconnect of climate change from everyday life as partial explanations for why, regardless of context, climate change would be a challenging issue to adequately address. I chose political inactivity and conservative backlash to add a larger context to the challenge, as well.

Implicatory Denial

Implicatory denial may partially explain an arguably inadequate response to climate change. Sociologist Stanley Cohen describes implicator denial as acceptance of the information but denial of "the psychological, political or moral implications that conventionally follow" (Norgaard 2011, 11). This contrasts with literal denial, which is the commonly known definition of "the assertion that something did not happen or is not true" (Norgaard 2011, 10). Cohen gives the following examples of implicatory denial: "children starving to death in Somalia, mass rape of women in Bosnia, [and] a massacre in East Timor" (Norgaard 2011, 11). People are aware of and accept these facts, but are not bothered by them or impelled to act on them as may be expected by their severity. The minority of the population who are climate change skeptics may not be as large of a threat regarding inaction on climate change as is a well-informed but implicated population experiencing this sort of denial.

Disconnect from Everyday Life

The disconnect between the issue of climate change and people's daily lives may partially explain an arguably inadequate response to climate change. This problem seems similar to that of mobilizing an anti-capitalist movement in early twentieth century Germany, which Wilhelm Reich (1934) wrote about in *What is Class Consciousness?*. Movement leaders' understanding of a problem's technical causes is insufficient to create a movement against the problem. Reich (1934, 154) writes that "there are *two kinds* of class consciousness, *that of the leadership and that of the masses*, and the two have to be brought into harmony with one another." The leadership contains the thorough knowledge of the problem and solutions while the masses are concerned with everyday life. A point of contact must be found between the two for the movement to be made.

A climate change point of contact must be found between the climate science and people's everyday lives. The problem of climate change has the additional hurdle of being unconnected to people's *present* everyday lives; rather, to their *potential future* lives or that of their children and grandchildren. There are signs that climate activists realize the need for this point of contact rather than more and better science. They are questioning the value of the Intergovernmental Panel on Climate Change's role of creating periodic scientific reports. Despite high confidence in quite negative effects of business as usual policies, there lacks a proportionate policy response. This is because these reports contribute nothing to establishing that point of contact with the masses.

Political Inactivity

A trend of political inactivity may partially explain an arguably inadequate response to climate change. In his book History and Subjectivity, philosopher Roger Gottlieb (1987) discusses how the legitimization of advanced capitalism by the modern ideologies of democracy and science, as well as media coverage of authorities professionally handling every crisis, render the population politically inactive. The population believes that superiorly qualified individuals are handling each problem. It fails, however, to follow through on any solutions achieved and so is unaware of it's authorities' failures to adequately solve the problem. Gottlieb explains,

> In these cases, the general population is led to feel that the authorities, functioning on the basis of a popular mandate and scientific expertise, are dealing with a crucial social problem. Yet the speed and intensity with which public attention is focused on and then shifted away from social problems leads to an inability to keep track of the concrete relation between "public" outcry and public reality. (Gottlieb 1987, 158)

Climate change activism may fall partially victim to this proclivity to delegate to authorities without supervision.

In the case of climate change, who are these under-competent authorities being delegated the problem? Despite a common view of climate change as a scientific problem, these authorities would not be scientists—who seem understandably alarmed by the threat. The authorities would be the political players who either fail to understand the socioeconomic factors behind the problem or are unwilling to initiate the radical change such an understanding would suggest. It's akin to, for example, political scientist Bjorn Lomborg advocating for a renewed Green Revolution (Lomborg 2014). This is despite social scientists' demonstrations that the original Green Revolution had disastrous effects and famines are not caused by inadequate food supplies, anyway; rather, by inadequate distribution of food. Research into technical solutions to nontechnical problems is suggested to avoid necessary social change.

Conservative Backlash

A conservative backlash to environmentalism may partially explain an arguably inadequate response to climate change. Before believing that liberal/Democrat equals environmentalist and conservative/Republican equals anti-environmentalist, there are notable exceptions. The Evangelical Environmental Network promotes *creation care*—environmentalism as seen through the evangelical Christian lens of caring for God's creation. This is one example of the many discussed in A Greener Faith—author Roger Gottlieb's (2006) exploration of the ways in which all manner of Christians, Jews, and other religious followers are finding environmentalism in their faiths. In addition to conservatives inspired to environmentalism by their religion, there are those who simply see their own self-interest in it. This extends even to business leaders despite the usual discourse of business and environmental interests being antagonistic. Even businesses require a healthy environment within which to function and the stable social situation harbored by a healthy environment (no resource wars to impede the free market). The potentially disastrous consequences of climate change could upset the deal capitalists made with society—that of a decent standard of living in return for political passivity toward the capitalist system.

Having provided this disclaimer, there is still the matter of conservative Republican anti-environmentalist political action to address. In his book What's the Matter with Kansas?, author Thomas Frank (2004) describes what he terms *backlash*. This is the phenomenon describing working class people voting against their own economic interests because of cultural issues. Campaigning politicians, pundits, and journalists stoke hatred among lower-income Kansans of the *latte liberal*. Much of this hatred is geared against mere taste preferences—a fondness for lattes, fashion, art, chardonnay, etc. On this basis, class consciousness is raised and a movement created. This movement, of course, cannot actually change these things which provoked it (cannot win this culture war). Instead, the elected politicians use their positions to promote neoliberal economic policies which worsen their constituents' material interests.

What does this have to do with climate change? One of the traits of the East Coast liberal elites against whom this culture war is waged is an environmentalist sensibility. The resentment of this perceived class of pretentious elites therefore causes a backlash against environmentalism. The result is anti-environmentalism among those with no material reason to harbor such sentiments.

Chapter Three

What Is Being Done?: Boston's Efforts at Adapting to and Mitigating Climate Change

I now address the question "What is being done about climate change?" I have chosen to use the decisions of the government of the City of Boston as a case study. I first provide the context of *Boston* within which this City operates. Then, I give a short explanation of why I chose a city-sized unit to work with. Finally, I summarize Boston's efforts at adapting to and mitigating climate change as presented in its Climate Action Plan.

What is Boston?

As it is referred to in this paper, *Boston* is the government of the City of Boston. Boston, more generally, is also its citizens, nongovernmental organizations, religious institutions, an academic community, a business community, and an ecosystem.

An Academic Community

Boston's academic community has the potential to be important to Boston's efforts at mitigating climate change through the research conducted by its many institutions, as a source of politically active students and faculty, and as a source of well-informed graduates. This academic community, according to *Wikipedia*'s "List of colleges and universities in metropolitan Boston" consists of 60 colleges and universities (not all within city limits).

Both science and social science departments of Boston's universities could tailor their research to climate action. Many already are. Boston University has "153 sustainability-focused and 315 sustainability-related courses" (BU Sustainability 2014). Boston University is also the main recipient of a grant to study the *Metabolism of Boston*, meaning Boston's creation and absorption of carbon dioxide emissions (see its website at: www.bu.edu/ultra-ex). The University of Massachusetts/Boston has a Center for Governance and Sustainability (www.umb.edu/cgs/research/sustainability?nossil). Northeastern University considers research and education in sustainability as one its three "main strategic and programmatic pillars" (the others being Health and Security—see www.northeastern.edu/research/about/research-areas/sustainability).

Boston's academic community is also home to a fossil fuel divestment movement and its professors educate much of the future workforce of Boston. According to the website *Go Fossil Free*, the following twelve Boston-area universities have divestment movements: Suffolk, MIT, Northeastern, BU, Lesley, Harvard, UMass/Boston, Tufts, BC, Brandeis, Babson, and Wellesley (see figure 3 of divestment poster). If Boston university students choose not to take advantage of either academic offerings or student political activism in environmental/sustainability fields, their education may still affect the future of Boston. Boston university graduates could enter the workforce (many in Boston) with or without exposure to issues such as climate change.

A Business Community

Boston's business community could affect climate action if business owners adopted missions additional to making short-term profit, if Boston consumers gave preference to more sustainable businesses, and if the industry that business leaders join promotes an energy transition. Many of Boston's businesses are members of the Sustainability Business Network of Massachusetts, based in nearby Cambridge. According to its website, its mission is to "build a Massachusetts economy that is local, green and fair." The Boston GreenScene website maintains a directory of local green businesses (www.bostongreenscene.net/local-green-directory.html). Boston businesses can aid in the transition to renewable energy by benefitting from

Figure 3. Divestment political poster

Boston's Green Tech economic cluster, created by the Boston Redevelopment Authority. According to GreenTech Boston's website, this initiative helps shape energy and resource management policy, assists relevant companies, maintains a Green Jobs Training Institute and green job listings, and encourages networking among relevant actors.

An Ecosystem

The current environmental crises may be partly due to neglecting humans as part of an ecosystem. Therefore, I include Boston as an ecosystem here. By this, I mean that the "natural" elements of the metropolitan region of Boston behave differently as part of this socioeconomic context than they would absent it. This influence on natural elements should not be looked at as a uniquely human ability to alter our environment. When wolves were reintroduced to Yellowstone National Park, they changed the flow of the rivers (Monbiot 2014). The study of urban areas as ecosystems is newer, however, than ecological studies of National Parks. The aforementioned Boston University research into Boston's metabolism, however, gives a glimpse of what such research may reveal.

The Keeling Curve's zigzag is sometimes described as a display of the Earth breathing—the drop in carbon dioxide concentration as it inhales during the summer and the rise as it exhales during the winter. Boston also breathes. Unlike the natural causes—growth and decay of vegetation—that cause the planet's breaths as depicted by the Keeling Curve, human activity causes Boston's breaths. Carbon dioxide levels are higher during rush hour and lower during weekends; higher during peak winter heating months and lower during summer vacation (Friday 2013). The point of this description is that the same metaphors that can be used to describe the natural Earth as a living organism can be used to describe very human-altered areas in the same way. Whether the philosophy behind policy choices are *humans as part of an ecosystem* or *save the world from humans* may have a significant effect on policy.

The atmosphere in the Boston ecosystem is more carbon-rich and, due to the urban heat island effect, warmer than nearby areas. The urban heat island effect results in longer growing seasons for the trees. “Those in Boston Common leafed out nearly three weeks before those in Harvard Forest—just 70 miles west” (Friday 2013). The carbon-rich atmosphere has resulted in trees with higher concentrations of carbon than in forested or residential areas and which possibly grow faster (Friday 2013). Exposed soils also have comparably increased carbon concentrations. Soils under impervious surfaces however, assuming similarity to soils studied in New York City, contain sixty-six percent less carbon than exposed soil (Friday 2013).

It is necessary to know how much carbon is contained in vegetation and soil is in order to know whether Boston overshooting the carbon cycle. This depends on knowing the carbon sequestration of actually existing vegetation and soils—not the sequestration ability of vegetation and soils as they would be absent human influence. The City of Boston’s plans, for example, to plant more trees may actually underestimate the effectiveness of the initiative’s carbon sequestration if trees that were not specifically adapted to Boston’s ecosystem were used for the calculations. Currently, Climate Action Plans mostly concentrate on only one half of the carbon balance—emissions. Eventually, maybe the second half—sequestration, using place-specific data—could complete the picture of a city’s carbon balance.

Local Action on Climate Change

I’ve chosen the city scale because it seems a significant phenomenon that this global issue of climate change is being tackled most effectively at this local scale. Environmentalists have long cried for localization—of food, goods, lifestyles. But perhaps what need come first is effective local governance. What is better proof of effective local governance than the ability to address the global, overwhelming issue of climate change? Local governments have entered into regional agreements, collaborated across national borders, and created voluntary plans toward behavioral change to mitigate this threat. This local action on climate change may corroborate the theory of Bruce Katz and Jennifer Bradley of the Brookings Institute. On the website for their book The Metropolitan Revolution (2013), they argue that "power in the United States is shifting away from Washington and toward our major cities and metropolitan areas. Across the nation, these communities, and their resolutely pragmatic leaders, are taking on the big issues that Washington won't."

Consider the following comparison of federal versus local climate action. The federal United States government did not ratify the international treaty—the Kyoto protocol—whose aim was to reduce greenhouse gas emissions. The United States federal agency charged with environmental protection—the Environmental Protection Agency—currently does not regulate greenhouse gases. They will soon, but only after several states—led by Massachusetts—sued them for not doing so. Their eventual regulation may have no effect on some states, regions, and cities that have, upon their own initiative, begun the task of reducing greenhouse gas emissions in the hopes of mitigating a problem many would consider beyond their scale. At the 1992 World Environmental Summit in Rio de Janeiro, then-president of the United States George H. W. Bush, when negotiating an international greenhouse gas treaty, declared that "the American way of life is not negotiable." This was an assertion that, though the United States would be willing to commit some funds for change in developing countries, it would not promote behavioral change of its own citizens (Noble 2013, 50). By three years later (1995), thirty cities had adopted the *Toronto Target* of a twenty percent reduction in emissions below 1988 levels by 2005 (Linstroth

2007, 31). According to its website, the international nonprofit ICLEI—Local Governments for Sustainability works with "12 mega-cities, 100 super-cities and urban regions, 450 large cities as well as 450 small and medium-sized cities and towns in 84 countries." This includes 587 in the United States and 32 in Massachusetts. This city-centered climate action may be significant considering that seventy percent of global carbon dioxide emissions come from cities, which are home to more than half of the world population (Friday 2013).

A Short History of Boston's Climate Action Program

Boston began its climate action program when it joined the Cities for Climate Protection Campaign of ICLEI in 2000. In 2003, Massachusetts and ten other New England and Mid-Atlantic states initiated the Regional Greenhouse Gas Initiative, which was the first plan in the United States to require mandatory emissions reductions. In 2005—on the day the Kyoto Protocol went into effect for ratifying countries—then-mayor Thomas Menino signed the U.S. Mayor's Climate Protection Agreement. In 2007, Boston published its first climate action plan—*Climate: Change*. On Earth Day 2010, the Climate Action Leadership Committee presented its recommendations in its report *Sparking Boston's Climate Revolution.* On Earth Day 2011, Boston included the recommendations from this report in its update to its climate action plan—*A Climate of Progress*. As of fall 2013, the City has been preparing its 2014 climate action plan update (City of Boston 2014). The 2011 *A Climate of Progress* is the main reference for the actions discussed here.

Adaptation

Even if all carbon dioxide emissions were immediately ceased, climate change would continue for another hundred years due to previous emissions (Friday 2013). Therefore, adaptation would be required even the event of this impossible scenario of zero emissions by tomorrow. Adaptation is even more important in more realistic scenarios. *A Climate of Progress* begins with Boston's adaptation strategies.

Boston's adaptation plans mostly address sea level rise. "Relative sea level in Boston has already increased approximately 11.8 inches…since 1900—half due to climate change and half due to natural land subsidence [the gradual settling of the Earth's surface]" (Natural Resources Defense Council 2011). The landmarks at risk of flooding by a hundred-year storm under a high emissions scenario are the following: Faneuil Hall, Quincy Market, North Station, Fan Pier, Copley Church, John Hancock Tower, and the Public Garden (New England Aquarium 2014) (see figure 4). Boston is compelled by state law in "issuing permits, licenses and other administrative approvals and decisions,…[to] consider reasonably foreseeable climate change impacts...such as predicted sea level rise" (City of Boston 2011, 9). Examples of the effects of this law include the Deer Island Sewage Treatment Plant built in 2000 and the Spaulding Rehabilitation Hospital built in 2009. Both of these structures were built two feet higher than they otherwise would have been due to consideration of future sea level rise.

Figure 4. Boston landmark flooded in future scenario 100-year flood

Boston is also planning for hotter days, in general, and more frequent heat waves. Since green spaces keep temperatures cooler, Boston announced in 2007 its goal of planting 100,000 new trees and increasing the number of trees by twenty percent. Since then, over 4,000 new trees have been planted although the effect on the overall tree population is not known (because of tree losses over the same period) (City of Boston 2011, 13).

Mitigation

Climate change has already happened and will continue to happen—it cannot be stopped, but we may speak of *mitigating* it by reducing the extent to which we contribute to it. Mitigation efforts are expressed in terms of greenhouse gas emissions (e.g., percent reduction in emissions since a certain date, per capita emissions for a certain place, etc.). Efforts to account for emissions are stymied by the difficulty of getting accurate figures such as these. Atmospheric carbon levels can easily be measured, but their sources are harder to identify. Accepted models used to estimate emissions vary by up to thirty percent (Friday 2013). Indicators used to measure a city's emissions are not standardized. Even when different cities use the same indictor (vehicle miles travelled, for instance), they may calculate it differently. Lastly, city Climate Action Plans tend to treat the city as a closed system rather then the open one that it is. For instance, emissions associated with production of goods consumed in the city but produced elsewhere are not accounted for. The Climate Action Plans may mention this, but there is currently no solution to this difficult problem.

With the above warning in place, I will use emissions figures throughout this section. Emissions figures are typically calculated by multiplying the amount of fuel sold by a conversion factor that converts it to CO_2e. See table 2 in the Appendix for the conversion factors that Boston uses and the data from these calculations for the years 2007–2012. In 2009, Boston emitted 8.2 million tons eCO_2. This is 13 tons eCO_2 per resident, which compares to a United States average (in 2007) of 23.59 tons eCO_2 per capita (World Bank 2011). Boston ranked sixth out of twenty-seven major U.S. and Canadian cities on Siemens Green City Index (Siemens 2014).

A Climate of Progress organizes the actions taken to get to this point and to continue past it into four mitigation categories. These are as follows: buildings, transportation, solid waste and recycling, and municipal operations. Boston focuses its efforts on the first two categories, which make up over ninety-five percent of the greenhouse gas emissions.

Buildings

Under the category of buildings, Boston is affected by the following statewide legislation: the Renewable Portfolio Standard and Alternative Energy Portfolio Standard. Additionally, the city has adopted the stretch energy code of the International Energy Conservation Code, created the Renew Boston program and implemented Leadership in Environmental and Energy Design (LEED) requirements.

"The Massachusetts Renewable Portfolio Standard and Alternative Energy Portfolio Standard…together require that 20 percent of electricity sales must come from renewable and alternative sources by 2020" (City of Boston 2011, 23). What has been the effect of this? Sixty to eighty percent of the energy produced in Massachusetts is renewable energy. This is not to be confused with sixty to eighty percent of energy used in Massachusetts being renewable. Still, this gives Massachusetts a state ranking by percent renewables of sixteen out of the fifty US states (U.S. Department of Energy 2014).

Using a larger percentage of renewable/alternative energy must go hand in hand with increasing the efficiency of energy use. According to its website, the American Council for an Energy Efficient Economy in 2013 ranked Boston the number one most energy efficient city. The Commonwealth of Massachusetts has adopted the International Energy Conservation Code, which is a standard for energy efficiency in all new buildings and major renovations. The state also created an optional, more rigorous stretch energy code that could lead to buildings being about ten percent more efficient than the base code (under Massachusetts law, individual cities and towns cannot make their own changes to the building code) (City of Boston 2011, 21-22).

Boston is one of the 134 municipalities (out of a possible of 351) to adopt the stretch energy code as of October 2013 (Massachusetts Department of Energy and Environmental Affairs 2014b).

An amendment not present in Massachusetts's energy code but added to that of Chicago in 2003 is the requirement that low-sloped roofs on most new buildings reflect at least twenty-five percent of incoming solar radiation (Linstroth 2007, 66). Traditional roofs strongly absorb solar radiation. The alternatives are roofs that are white or made with newer cool-colored roofing material designed to mimic the aesthetic of traditional roofs while reflecting radiation. These roofs increase energy efficiency of the structure, reduce the urban heat island effect, and directly mitigate climate change by reflecting the radiation (Berkeley Lab Heat Island Group 2014).

In addition to the stretch energy code required of all buildings, Boston requires the stricter LEED standards for several categories of new buildings. These include those funded under the Department of Neighborhood Development's Green Affordable Housing Program, all new municipal buildings, and all projects greater than 50,000 ft^2 (City of Boston 2011, 22). In doing so, it joins over fifty city and counties (as of 2007) to have passed ordinances that all new municipal construction meet LEED standards (Linstroth 2007, 66).

The Renew Boston program, meanwhile, aims to increase the energy efficiency of already-existing private homes. "Eligible Bostonians receive low-hassle, no-cost home energy assessments and free efficiency upgrades including insulation, air sealing, water saving devices, and high-efficiency light bulbs" (City of Boston 2011, 20). This residential energy efficiency program could perhaps benefit from additional legislation such as exists in Berkeley, California. "For over twenty years, Berkeley has required existing residential structures to meet certain energy efficiency standards before being sold or undergoing renovations that will cost over $50,000" (Linstroth 2007, 52).

Transportation

Under the category of transportation, Boston is affected by the Commonwealth of Massachusetts's Rideshare program. Additionally, the City has worked to increase the number of hybrid and other high-mileage vehicles in the taxicab fleets, designed streets that are more amenable to nonvehicle transportation, and encouraged bicycling by the building of biking infrastructure.

Under the state Rideshare program, businesses or educational institutions with 1,000 or more applicable commuters and businesses with 250 or more applicable commuters that are also subject to the Massachusetts Air Operating Permit program must develop plans and set goals for reducing commuter drive-alone trips by twenty-five percent (MA EEA 2014a). The City has not implemented any stricter such regulation than the state's. This lack of City policy can be compared to the existence of a policy in Santa Monica, California, mandating employers with as few as ten employees to submit an Emission Reduction Plan to the City each year and employers with fifty or more employees to designate an Employee Transportation Coordinator with the responsibility of bringing the Average Vehicle Ridership up to at least 1.5 persons per vehicle (City of Santa Monica 2014). In this way, the City of Santa Monica passes some of the responsibility of emissions due to work commuting from the City to employers.

In 2006, Boston City Government, the Boston Public Health Commission, and Massport created incentives to encourage hybrid taxis (City of Boston 2011). In 2008, the City announced that it would require all new taxis purchased to be hybrid-powered vehicles. In 2009, in an example of the federal government actually impeding local action on climate change, Boston was told by federal court that it cannot enforce this rule. "According to Mayor Thomas A. Menino, Rule 403 [the relevant legislation] would cut carbon emissions from the Boston taxi fleet in half" (Kamping-Carder 2009).

Excepting this failed attempt at converting the city's taxis to hybrid vehicles, no other mention is made in *A Climate of Progress* of encouraging hybrids/alternative fuel vehicles. Some examples of such encouragement elsewhere are San Diego and Los Angeles offering free parking at city meters for hybrids/alternative fuel vehicles, the state of California allowing them in the carpool lane, and several municipalities offering lower vehicle registration fees and taxes for them (Linstroth 2007, 63). Additionally, in 2009 the Environmental Protection Agency granted California the authority to reduce greenhouse gases from passenger vehicles (CA EPA 2013). The standards that California choose effect the entire nation as car manufacturers meet the California standards and sell the same models nationwide.

Regardless of how much vehicle miles traveled and miles per gallon may be reduced, the ideal post-carbon city would be much less dependent on automobiles for transportation. Accordingly, Boston does try to encourage other modes of transport (see figure 5 of bicyclists in Boston). "The Boston Complete Streets program, launched in 2009, aims to put pedestrians, bicyclists, and transit users on equal footing with drivers, and promote a vision of streets that are safe, attractive, and conducive to healthy, active transportation" (City of Boston 2011, 27). Concrete actions taken under this program include the following:

- a narrower minimum width for vehicle travel lanes to accommodate wider sidewalks and more bicycle facilities
- permeable pavement and rain gardens in sidewalks
- minimum sidewalk widths and clear zones for pedestrians
- a new multimodal approach to intersection analysis and design
- installation of thirty-eight miles of bike lanes and 1,500 bike parking spaces (City of Boston 2011, 28-31)

This last measure likely contributed to Boston's 2012 ranking as America's sixteenth most bike-friendly city (of cities with populations of 95,000 or more) (Bicycling.com 2014).

Figure 5. Bicyclists in Boston

Chapter Four

What Can Be Done?

I have addressed the questions of "What is climate change?" and "What is Boston doing about climate change?" The next step is to compare what is being done by the City of Boston to what potentially *can* be done. Boston is addressing this challenge while in a larger context of assumptions that can work against such an effort. For example, while admirable compared to other U.S. cities, Boston is attempting to reduce the emission of greenhouse gases without challenging the following assumptions:

1. Private parties have the right to degrade the common resource that is the atmosphere without compensating for the degradation.

2. Private parties may leave the cost of defense and remediation from such degradation with the very public whose resource is degraded.

3. Energy is a commodity produced by the few and bought by the many.

This section discusses three policies which, if enacted, would refute these assumptions. These policies are as follows: a carbon fee-and-dividend, Extended Producer Responsibility (EPR), and the example of Germany's energy transition.

Carbon Fee-and-Dividend

Noted climate activist James Hansen promotes a carbon fee-and-dividend (Hansen 2009). Senator Bernie Sanders sent a bill for such a policy to Congress on February 14, 2013. It proposes a fee "on any manufacturer, producer, or importer of a carbon polluting substance" (US Senate 2013, S.332). Of the income from this fee, three-quarters would be used "to provide a monthly residential environmental rebate to legal residents of the United States" (US Senate

2013, S.332). The remaining revenue would go to a Pollution Reduction Trust Fund, which would fund energy efficiency investments, sustainable technology research, and other programs.

Under the fee-and-dividend approach, only buyers of carbon polluting substances would be affected by the increased cost of the substances as a result of the fee. Meanwhile, everyone would receive the same dividend as a reflection of their equal entitlement to the atmosphere. The policy would disincentivize carbon-polluting substances and, unlike other approaches, compensate everyone for the degradation of the atmosphere. While the reduction of everything to its monetary value may not be the direction society should be heading toward, viewing natural assets as public ones (equally owned by everyone in the language of property rights) may be. Receiving a monthly check in the mail to compensate you for the damage done to "your" atmosphere is reinforcing a different way to look at what you inherently lay claim to, its value, and your entitlement to at least be compensated for its degradation. In this way, a carbon fee-and-dividend overturns the first assumption that private parties have the right to degrade the common resource that is the atmosphere without compensating for the degradation.

Though the above bill by Congressman Sanders is for the federal scale, the City of Boston, inasmuch as it can participate in a regional cap-and-trade program, can participate in a regional fee-and-dividend program. Boston is within the jurisdiction of the Regional Greenhouse Gas Initiative (RGGI). According to its website, "RGGI is a cooperative effort among the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont to cap and reduce CO_2 emissions from the power sector." Changing the RGGI from cap-and-trade to fee-and-dividend would improve its effectiveness at reducing emissions because the fee-and-dividend approach puts a fee on emissions whereas the cap-and-trade approach puts a value on them.

Cap-and-trade is the concept of setting a cap on emissions, issuing permits for emissions, and allowing these permits to be tradable. By measuring emissions rather than the fossil-fuel sources of the emissions, as in fee-and-dividend, it is difficult to enforce. Emissions have been shown to increase under these programs despite the caps. Additionally, by commodifying emissions, a positive value is put on a negative outcome. Capitalists are able to profit by selling the rights to pollute the atmosphere. In this way, the atmosphere is, in a sense, privatized. In addition to an inherent repulsion to a small elite having the right to pollute the air that everyone breathes and alter the climate in which everyone lives, this type of privatization actually disincentivizes care for the atmosphere. The polluter benefits solely from the pollution and then shares the cost of polluted air with everyone. If cap-and-trade can be implemented on a regional scale, then it can be replaced at the same scale with the preferable fee-and-dividend.

Extended Producer Responsibility

The assumption that the government has the responsibility of managing waste is a result of path dependency starting in a very different circumstance and ending in current policy with distorted incentives. Path dependency refers to the fact that policy is not created from a blank slate. Waste management policy is affected by its history and the existing infrastructure for it. The collection and disposal of waste as a government/public responsibility began in early twentieth century New York City. The lack of sanitary methods for disposing of human and animal waste led to disease epidemics and public pressure for the government to act. Since then, the quantities and types of waste have drastically changed (Product Policy Institute 2014b) (see figure 6 for a graph of this change). The government's role did not experience a proportionate

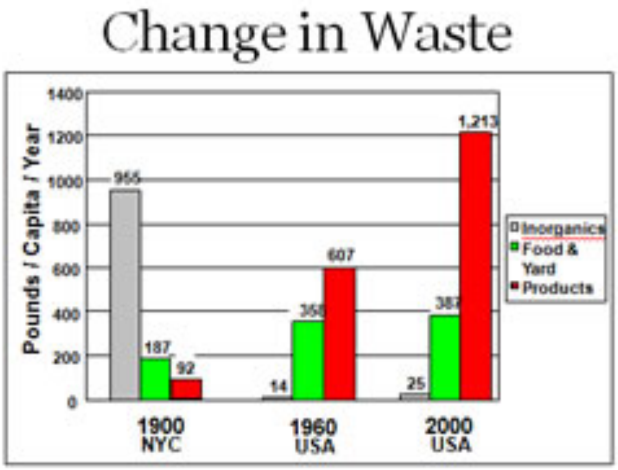

Figure 6. Graph of the change in waste composition

change. The result is that the government has come to, in effect, inadvertently subsidize wasteful product makers (Product Policy Institute 2014b).

The alternative that has arisen to government responsibility for a product's end of life is EPR. This framework makes the producer ultimately responsible for its products—collecting, sorting, and disposing of them. The European Union requires EPR for appliances and electronic equipment. Texas requires it of computers (Weston 2012, 33). The concept of EPR is relevant to climate change because the decomposition of solid waste in landfills emits methane, which directly contributes to climate change.

EPR would shift the expense of product disposal from the general population to those responsible for its need to be disposed. The expense to producers of the disposal of their products would be reflected in a higher cost of the products. Only those who purchase the products would pay this cost. Taxpayers, regardless of consumption patterns, would no longer be paying it. In this way, EPR overturns the second assumption that private parties may leave the cost of defense and remediation from such degradation with the very public whose resource is degraded.

Is EPR able to be implemented on a city scale? In California, 133 local jurisdictions have passed EPR resolutions (Green Cities California 2013). Additionally, according to the Product Policy Institute (2014a), Massachusetts has twelve cities or towns (Boston is not one of them), Minnesota has three cities and eight counties, New Jersey has one city, New York has one town and six counties, Rhode Island has twelve cities or towns, and Texas has four.

What could the world look like if EPR resolutions were adopted broadly such that governments everywhere stopped subsidizing wasteful production? In his book Farewell to Growth (2009), Serge LaTouche gives us a glimpse. Even lacking the pressure from an EPR resolution, the following innovations were created: an upholstery fabric that is naturally degradable once it has reached the end of its lifecycle (Rohner, Design Tex); carpets made of organic materials that can be used as mulch when they are worn out (multiple companies); a fabric that can be recycled indefinitely and breaks down into its basic elements (BASF); and a program that allows products to be seen as an assemblage of parts that can be recycled when the product has reached the end of its life (Xerox). EPR would encourage these kinds of innovations.

Energy

Bostonians are accustomed to buying their energy from large, centralized producers. The transition to renewable energy could reproduce this and its implications for the energy user's dependence on large corporations. Or it could also be a transition to decentralized, home-based energy production. Solar energy could be produced from photovoltaic panels located on the roofs of homes using the energy. Or the photovoltaic energy could be transported to individual homes from massive solar farms. Though photovoltaic panels on roofs are generally known, small wind turbines on roofs are not. Wind energy, however, also need not be restricted to huge turbines producing energy for whole regions. They can also be made small and located on-site to where the energy is used (see figure 7).

Figure 7. Small-scale wind turbines

Massachusetts's renewable energy incentives do not look past the current centralized energy system to the potential of a new decentralized energy system. The legislation encourages the reproduction of the existing system albeit with renewables replacing fossil fuels. Quotas associated with increasing the percentage of renewable energy are only a statutory obligation for suppliers—"both regulated distribution utilities and competitive suppliers" (MA EEA 2014a). What gets measured is also an indicator of what is being promoted. Though Massachusetts has a rebate program for photovoltaic (DSIRE 2014), it is difficult to find the effect of this program as the percentage of energy that is user-owned is not measured.

Massachusetts's energy transition contrasts with Germany's, which recognizes the opportunity of the transition to renewables as also an opportunity to transition to user-owned energy. Germany's percentage of user-owned energy is easy to find and currently at almost fifty percent (Energy Transition 2014) (see figure 8). The ability to own one's own alternative energy source seems to encourage use of alternative energy, in general. Alternative energy provides nearly eleven percent of the country's energy needs, leading G-20 members and comparing favorably to the three percent in the U.S. (Friday 2013).

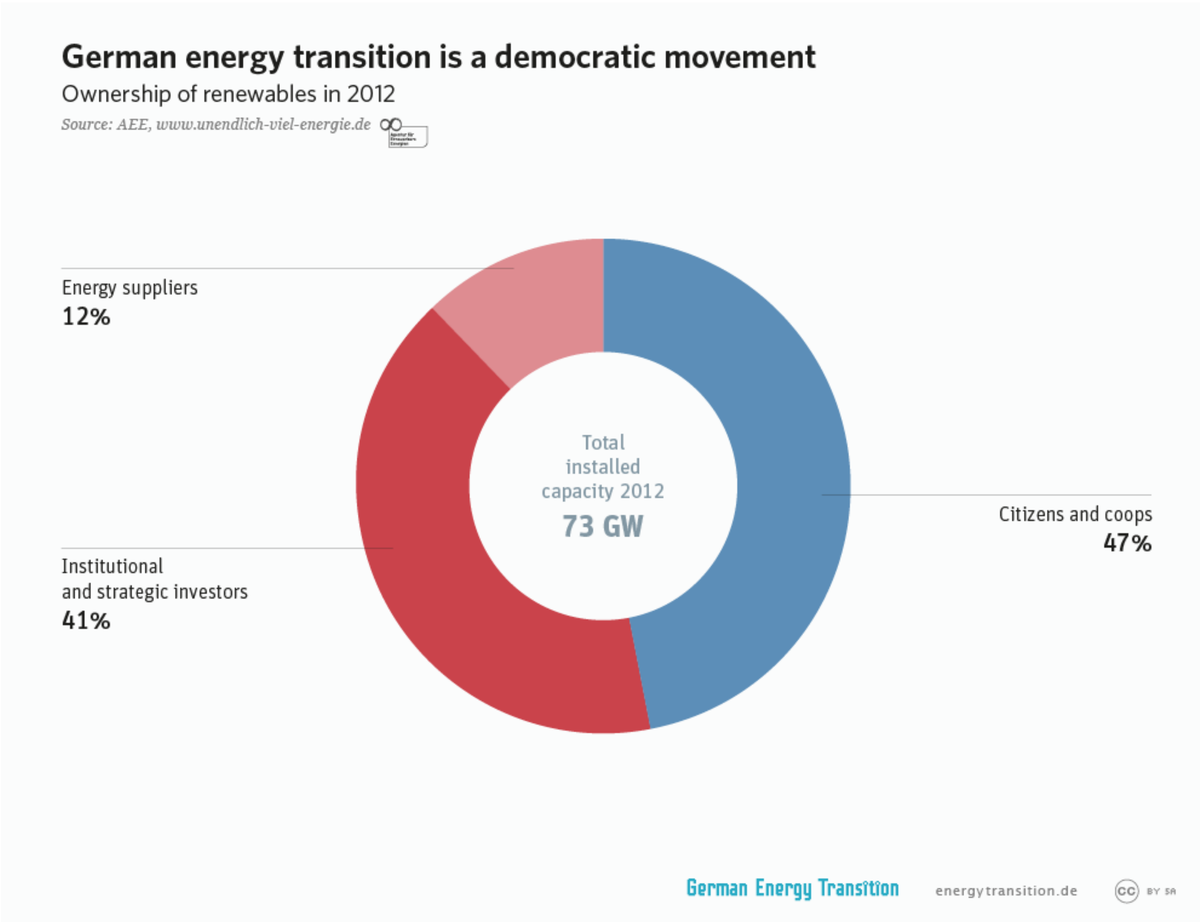

Figure 8. Percentage of user-owned energy in Germany

Germany's legislation regarding energy both gives renewables a chance against fossil fuel-based energy and small-scale energy production a chance against large suppliers. Germany's Renewable Energy Act supports renewable energy by specifying "that renewables have priority on the grid and that investors in renewables must receive sufficient compensation to provide a return on their investment irrespective of electricity prices on the power exchange" (Energy Transition 2014). This legislation supports user-owned energy because "under quotas, only the least expensive systems go up after time-consuming reviews, and they remain in the hands of corporations; under feed-in tariffs, everything worthwhile goes up quickly, and ownership of power rapidly transfers to citizenry. In other words, Germany is democratizing its energy sector" (Energy Transition 2014). By changing the framework that kept energy production in the hands of large corporations, Germany's energy transition overturns the third assumption that energy is a commodity produced by the few and bought by the many.

On what scale involving Boston could a similar energy transition work? The current legislation already governing the state of Massachusetts could be reworked to be more amenable to broader concepts of what our energy future could look like.

Conclusion

Climate change involves relatively sudden changes in weather patterns and the resultant implications for ecosystem collapse, species extinction, human disaster risk, food security, and political stability. These are threats across the board. However, wealthier individuals and nations will be more resilient to these threats such that a seriously inadequate response to climate change could exacerbate current inequalities. One inadequate response is one in which systemic change is avoided for modification of the individual parts of the existing system.

Climate change requires socioeconomic change. Some of the initiatives proposed to address climate change are not this type of change. Cap-and-trade contributes to current neoliberal trends that increase privatization. This paper contrasted cap-and-trade with fee-and-dividend, which hints at a future of increased public goods instead. The current completely ineffectual approach to curb excessive consumption and waste with Earth Day messages that encourage individual austerity and "green" consumption choices reproduces the attribution of blame onto individuals rather than on any larger context. The EPR could be a move toward ending this hyper-individualist mode of thinking. Encouragement of green versions of our current energy monopolies is also not the socioeconomic change that climate change compels. An energy transition that also empowers individuals to meet their own energy needs alludes to new relationships between technological change and subsequent social change. Past technological change has resulted in decreased self-sufficiency and, therefore, an increase in the power of the capitalist class. Small-scale energy systems and the appropriate technology movement show that this need not be the case.

In this paper, I argued that Boston's efforts to address climate change are hampered by three assumptions that I identified. I argued that the greater significance of finding these hampering assumptions is that climate change requires change that is more systemic than is currently being proposed. I matched each assumption with a possible initiative to refute it. Boston is large enough to be important and small enough to enact these ideas easier than a larger entity. As such, Boston would be a good scale at which to try these initiatives. If successful, they could be implemented at larger scales or spread to new cities.

Future researchers could identify more general assumptions that underlie why certain approaches to address climate change are chosen and others are not. They could also discover or suggest more ways of refuting the ones I have identified. My paper is very anthropocentric. Perhaps future researchers could remedy this by focusing particularly on how our society's anthropocentrism results in inadequate approaches to address climate change. They could also do a better job of incorporating the social science research into how people respond to climate change with the political economic perspective on the approach to climate change.

Appendix

Definitions

lbs CO_2e = pounds CO_2e
mton CO_2e = metric tons of CO_2e
MWh/GWh = megawatt hours/gigawatt hours, units in which electricity is sold

therms = unit in which natural gas is sold
BTU = British Thermal Unit, a unit of energy
mmBTU = a million BTUs

Table 2. Boston CO2e conversion factors

Emissions factors	2012 conversion factors: mton CO_2e/mmbtu	2008	2009	2010	2011	2012
lbs CO_2e/MWh	…	894.00	832.00	833.00	784.00	732.00
mton CO_2e/GWh	.096111783	405.51	377.39	377.84	355.62	327.95
mton CO_2e/millions of therms	.053168973	5315.62	5315.62	5315.62	5315.62	5315.62
mton CO_2e/millions of gallons of fuel oil	.070770669	10268.82	10268.82	10268.82	10268.82	10268.82
mton CO_2e/millions of pounds of steam	.061132762	93.44	77.11	66.22	82.10	73.48
miles per gallon of oil-BTU equivalent	…	16.36742944	16.78051858	16.61699176	16.80819152	17.10569651
CO_2e per average mmBTU in city	.751285437	…	…	…	…	0.07242461

Source: Personal Email dated 20 February 2014 from Charles Zhu, Greenovate Boston.

References

Berkeley Lab Heat Island Group. 2014. "Cool Science: Cool Roofs." Accessed February 2014. http://heatisland.lbl.gov/coolscience/cool-science-cool-roofs.

Bicycling.com. 2014. "America's Top 50 Bike-Friendly Cities." Accessed February 2014. http://www.bicycling.com/ride-maps/featured-rides/16-boston.

Boston University (BU) Sustainability. 2014. "Academics." Accessed February 2014. http://www.bu.edu/sustainability/academics/.

California Environmental Protection Agency (CA EPA) Air Resources Board. 2013. "Clean Car Standards—Pavley, Assembly Bill 1493." Accessed February 2014. http://www.arb.ca.gov/cc/ccms/ccms.htm.

Chandler, David. 2010. "Explained: Radiative Forcing." MIT News, March 10. Accessed October 16, 2013. http://web.mit.edu/newsoffice/2010/explained-radforce-0309.html.

City of Boston. 2011. *A Climate of Progress: City of Boston Climate Action Plan Update 2011.*

———. 2014. "History of Climate Action in Boston." Accessed February 2014. https://www.cityofboston.gov/climate/progress/history.asp.

City of Santa Monica Planning & Community Development. 2014. "Employers and Ordinance 1604." Accessed February 2014. http://www.smgov.net/Departments/PCD/Transportation/Employers/.

Database of State Incentives for Renewables & Efficiency (DSIRE). 2014. "Massachusetts." Accessed February 2014. http://dsireusa.org/incentives/incentive.cfm?Incentive_Code=MA71F&re=0&ee=0.

Energy Transition. 2014. "Energy by the People." Accessed February 2014. http://energytransition.de/2012/10/energy-by-the-people/.

Frank, Thomas. 2004. *What's the Matter with Kansas?* New York: Metropolitan Books.

Friday, Leslie. 2013. "The Climate Crisis: Measuring Boston's Metabolism." BU Today. Accessed February 2014. http://www.bu.edu/today/2013/the-climate-crisis-measuring-boston-carbon-metabolism/.

Gottlieb, Roger. 1987. *History and Subjectivity: The Transformation of Marxist Theory.* Philadelphia: Temple University Press.

———. 2006. *A Greener Faith: Religious Environmentalism and Our Planet's Future.* New York: Oxford.

Green Cities California. 2013. "Waste Reduction Best Practice." Accessed February 2014. http://greencitiescalifornia.org/best-practices/waste-reduction/CA_extended-producer-responsibility.html.

Hansen, James. 2009. "Carbon Tax and Dividend." Accessed February 2014. http://www.policyinnovations.org/ideas/innovations/data/000128.

Intergovernmental Panel on Climate Change (IPCC). 2013. *Summary for Policymakers. Assessment Report 5, Working Group 1.*

Kamping-Carder, Leigh. 2009. "Boston Told It Can't Enforce Hybrid Taxi Rule." Law 360, August 17. Accessed February 2014. http://www.law360.com/articles/116871/boston-told-it- can-t-enforce-hybrid-taxi-rule.

Larsen, Janet. 2012. "Peak Meat: U.S. Meat Consumption Falling." Earth Policy Institute, March 7. Accessed February, 20 2014. https://www.earthpolicy.org/data_highlights/2012/highlights25.

LaTouche, Serge. 2009. *Farewell to Growth.* Translated by David Macey. Malden, MA: Polity Press.

Linstroth, Tommy. 2007. *Local Action: The New Paradigm in Climate Change Policy.* Burlington, VT: University of Vermont Press.

Lomborg, Bjorn. 2014. "Prioritizing Our Greatest Problems Versus Prioritizing Our Efforts to Find Solutions." Lecture, Worcester Polytechnic Institute, February 24.

MA Department of Energy and Environmental Affairs (MA EEA). 2014a. "RPS and APS Program Summaries." Accessed February 2014. http://www.mass.gov/eea/energy-utilities-clean- tech/renewable-energy/rps-aps/rps-and-aps-program-summaries.html.

———. 2014b. "Stretch Code Adoption, by Community." Accessed February 2014. http://www.mass.gov/eea/docs/doer/green-communities/grant-program/stretch-code-towns-adoption-by-community-map-and-list.pdf .

McKibben, Bill. 1989. *The End of Nature.* New York: Random House.

Monbiot, George. "How Wolves Change Rivers" (video). Posted February 13, 2014. Accessed February 2014. http://www.youtube.com/watch?v=ysa5OBhXz-Q&feature=youtu.be.

Natural Resources Defense Council. 2011. "Boston, Massachusetts: Identifying and Becoming More Resilient to Impacts of Climate Change." Accessed February 2014. http://www.nrdc.org/water/files/ClimateWaterFS_BostonMA.pdf.

New England Aquarium. 2014. "Climate Change in New England." Accessed February 2014. http://www.neaq.org/conservation_and_research/climate_change/climate_change_in_new_england.php.

Noble, Olivia. 2013. "The American Way of Life is Not Negotiable: The Impact of the North/South Divide on the Negotiation of the Millennium Development Goals." Bachelor's thesis, Middlebury College.

Norgaard, Kari Marie. 2011. *Living in Denial: Climate Change, Emotions, and Everyday Life.* Boston: Massachusetts Institute of Technology.

Product Policy Institute. 2014a. "Adopt EPR Resolutions." Accessed February 2014. http://www.productpolicy.org/content/adopt-epr-resolutions.

———. 2014b. "History of Waste." Accessed February 2014. http://www.productpolicy.org/content/history-waste.

Reich, Wilhelm. 1934. "What is Class Consciousness?" In *An Anthology of Western Marxism,* edited by Roger S. Gottlieb, . New York: Oxford University Press.

Siemens. 2014. "U.S. and Canada Green City Index." Accessed February 2014. http://www.siemens.com/entry/cc/en/greencityindex.htm.

Tarbuck, Edward, Frederick Lutgens, and Dennis Tasa. 2014. *Earth: An Introduction to Physical Geology.* 11th ed. Upper Saddle River, NJ: Pearson Education.

U.S. Department of Energy. 2014. "Percent Renewable Energy Production By State." Accessed February 2014. http://energy.gov/maps/renewable-energy-production-state.

U.S. Energy Information Administration. 2011. *Emission of Greenhouse Gases in the United States 2009.*

US Congress. Senate. *S.332, A Bill to address climate disruptions, reduce carbon pollution, enhance the use of clean energy, and promote resilience in the infrastructure of the United States, and for other purposes.* [Introduced in the U.S. Senate; 14 February 2013]. 113th Cong., 1st sess. Congressional Bills, *GPO Access.* February 2014. http://www.gpo.gov/fdsys/pkg/BILLS-113s332is/pdf/BILLS-113s332is.pdf.

Vergano, Dan. 2013. "Ocean Warming Faster Now Than in 10,000 Years." National Geographic Daily News, October 31. Accessed February 2014. http://news.nationalgeographic.com/news/2013/10/131031-climate-ocean-temperatures-years/.

Weston, Anthony. 2012. *Mobilizing the Green Imagination: an Exuberant Manifesto.* Gabriola Island, Canada: New Society Publishers.

World Bank. 2011. "Representative GHG Baselines for Cities and their Respective Countries." Accessed February 2014. http://siteresources.worldbank.org/INTUWM/Resources/GHG_Index_Mar_9_2011.pdf.

World Meteorological Organization. 2011. *WMO Greenhouse Gas Bulletin: The State of Greenhouse Gases in the Atmosphere Based on Global Observations through 2010.*