Climate Friendly Communities:

A Review of What Economists Know About the Potential Business Impacts

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Executive Summary:

The City of Seattle recently commissioned an analysis of the technical feasibility of a range of strategies in transportation, building energy, and waste sectors to achieve net carbon neutrality by the year 2050 from maximum deployment of known technologies at reasonable penetration rates. The energy-saving strategies that were identified provide opportunities to reduce greenhouse gas emissions and redesign urban landscapes, architecture, and transportation systems to become more resilient to climate change and higher fossil fuel prices. They also introduce policies, incentives, and regulations, and require investments that other cities and regions have not necessarily made. ***Do these initiatives disadvantage businesses and households in Seattle, or do they incentivize efficiency and innovation and position the city more competitively for growth in the future?***

This report reviews the relevant literature in economics to help provide answers to these important questions. We consider how the suite of regulations and incentives considered by Seattle could affect business profitability and competitiveness. We also explore the benefits to Seattle and its businesses of becoming a more climate friendly. The report does not analyze the specific economic impacts of the emissions reduction strategies under consideration. Rather, it draws important insights from the literature to establish what economists currently know about the likely business impacts of creating climate friendly communities.

Economic research on the potential economic impacts of regulatory measures and other incentives to improve environmental outcomes spans decades. Empirical studies and other analyses have reached three general conclusions:

- There is ***no evidence of widespread flight of polluting industries to different regions or countries*** to escape environmental regulations. Firm relocation decisions have been driven mostly by the pursuit of lower wage and benefit costs; the costs of complying with environmental regulations are simply not high enough as a percentage of total business costs to motivate relocation.

- The empirical data shows that ***layoffs attributed to environmental regulation are rare***, even in heavily polluting industries.

- At the economy-wide level, there is ***no real tradeoff between environmental regulation and growth***. Regulation may slowly shift the composition of economic activity from polluting to clean technologies and specific businesses or industries may be disproportionately impacted. The net effect, however, should be small as indicated by historical evidence and trends.

In Seattle, the specific concern is whether businesses will choose to relocate to nearby suburbs to avoid the potential costs of implementing a city-wide carbon neutral strategy. Businesses based in nearby Seattle suburbs would draw from the same regional labor pool and pay the

same average wage rates; there would be no labor savings by moving outside of city limits. By moving to the suburbs, businesses would forgo the advantages of locating in an urban center and the benefits of Seattle's planned energy-saving and efficiency measures. To offset the loss of these benefits, the costs of implementing Seattle's carbon neutral plan would have to be very significant. Yet, as national studies have shown, the costs of environmental compliance are typically not large enough on average to drive relocations.

Strategies for achieving carbon-neutrality in Seattle by 2050 target expansive energy efficiency improvements in transportation and commercial and residential building sectors. Measures include new building design, building retrofits and renovations, and switching to district energy and heat pumps. ***These types of energy efficiency measures have been shown to generate savings for businesses and consumers and to contribute to economic growth and prosperity in a region***. The potential energy savings from efficiency improvements in the building sector are especially significant. In the U.S., buildings account for roughly 40% of all energy use. ***Energy efficiency improvements in buildings and appliances offer the greatest potential for negative-cost abatement opportunities that generate positive economic returns to society at large over the lifecycle of the project.*** The literature, therefore, is largely very supportive of the kinds of energy efficiency initiatives outlined in Seattle's carbon neutral strategy. Those initiatives have the potential to deliver high benefits at relatively low cost and risk.

As compared to other regions, Seattle may experience lower energy savings and longer payback periods from its energy efficiency investments. This is because the region already benefits from a mild climate and abundant hydropower. Energy efficiency improvements, however, offer Seattle businesses and households opportunities to save on more than just their energy bills. In addition to energy cost savings, energy efficiency investments provide benefits in the form of reduced maintenance costs, greater reliability, avoided future capital costs, lower water and chemical wastes, and greater product quality. Moreover, ***the potential energy cost savings from space heating and for transportation are significant***. Seattle's population is heavily dependent on single-occupancy vehicles and suffers some of the heaviest traffic patterns in the nation. With rising fuel costs and the potential time and cost savings from public transportation, pedestrian friendly walkways, or bicycling, Seattle's carbon neutral plan can deliver real savings.

Efficiency improvements, in turn, can increase the city's competitiveness and its ability to attract industry, capital, and a highly skilled workforce. Seattle is already home to multiple innovation clusters, including clean technology. The literature on regional innovation clusters finds that businesses benefit from co-location by reducing costs along a supply chain, expanding the labor pool, and attracting specialists to the region. High tech, green tech, and clean energy companies are not likely to locate to areas that do not support the very technologies, products, and services they produce. The realities of climate change and peak oil supplies strongly suggest that ***the most successful businesses of the future will be able to innovate ways of extracting more energy services from every dollar of energy expenditure***. Seattle's carbon neutral strategy would support local demand for clean technologies and create a policy apparatus and set of incentives that could attract more of these businesses to the area.

Our survey of the literature finds little evidence that Seattle's carbon neutral plan will create an environment hostile to businesses and profits. Contrary to some perceptions, the literature largely supports the use of incentives and smart public policies to incentivize efficiency and innovation and enhance economic competitiveness. ***The successful cities of the future will be those that pro-actively plan and invest in energy productivity, clean energy, and green infrastructure and design***. These are the cities that will gain a competitive advantage in the technologies which will be in high demand in the future. These are the cities best positioned to minimize impacts on the public and businesses from climate change and uncertain energy prices. We conclude, therefore, that there is sufficient evidence in the literature to support Seattle's goal of becoming a carbon-neutral, climate friendly community.

I. Introduction

The city of Seattle is updating its Climate Action Plan and developing short-term and long-term strategies for reducing greenhouse gas emissions, with the goal of achieving net carbon neutrality by the year 2050. To support the Plan update, the City commissioned an analysis of the technical feasibility of a range of strategies in the transportation, building energy, and waste sectors to evaluate the potential GHG reductions from maximum deployment of known technologies at plausible penetration rates.

In the absence of global and federal leadership and regulation on climate change, momentum behind city and regional initiatives is growing. In establishing aggressive goals for emissions reductions and greater energy efficiency, Seattle joins other major cities worldwide and across the U.S. in recognizing the important contributions cities can make to climate stabilization efforts and the growth opportunities inherent to the uptake of climate-friendly technologies. Emissions mitigation on a city-wide scale, however, poses some unique challenges.

Cities have limited scope for establishing the broad-based policies, such as a carbon cap or tax, which can raise the price of carbon emissions and incentivize broad scale reductions by businesses and households. A carbon price provides a direct market signal that carbon emissions are costly and should be economized, and it levels the playing field between fossil fuels and clean energy alternatives. Without the benefit of a carbon price, cities like Seattle can encourage emissions reductions by increasing the energy efficiency of their infrastructure, enhancing non-single occupant vehicle transportation systems, improving waste management, and to the extent possible, generating clean energy locally sourcing clean energy from suppliers. Seattle is already a well-recognized leader in this regard. The City of Seattle owns Seattle City Light, the utility that provides the majority of electricity to Seattle residents and businesses. City Light is the first carbon neutral electric utility in the nation. Over 90% of City Light's power comes from renewable hydroelectric power and any greenhouse gas emissions related to purchased power and operations are offset.

No matter how successful an individual city may be at mitigating carbon emissions, it alone cannot solve the global climate change problem. Climate change is a global externality that may be most efficiently solved through a coordinated global response. This fact, however, does not negate the importance of city climate initiatives. Cities can provide much needed leadership on the climate change front and demonstrate tangible pathways forward that can be replicated on a larger and more comprehensive scale.

Though the primary purpose of city climate action plans is to mitigate emissions and reduce energy use, these initiatives provide simultaneous opportunities to redesign urban landscapes, architecture, and transportation systems to become more resilient to climate change and higher fossil fuel prices in the future. Cities will bear the brunt of climate change impacts. Coastal cities like Seattle will witness the effects of sea level rise. Rising temperatures will exacerbate the urban heat island effect and local air pollution. In the long run, all U.S. cities will

need to break their dependence on fossil fuels and anticipate and plan for the impacts of climate change. Forward looking cities and regions that act early and effectively can smooth the transition and minimize impacts for businesses and citizens.

Cities that embrace bold climate change initiatives, however, introduce policies, incentives and regulations and make investments that are not necessarily present elsewhere. Some fear that these initiatives will disadvantage businesses, industries, and households and negatively impact income and employment in the region. Others have argued that the benefits of living and operating in a climate friendly community outweigh any potential competitive disadvantages. These advantages include energy savings and productivity gains, as well as the benefits of living and doing business in urban areas that are innovation clusters. Compared to other cities, the financial and emissions savings from energy efficiency improvements in Seattle will not run as deep, because the city relies on low cost renewable hydroelectric power and experiences a mild climate. However, electricity conservation measures in Seattle increase the availability of hydroelectric power to displace fossil fuel use elsewhere. Additionally, cost and emissions savings should be realized from energy efficiency improvements in transportation and natural gas use.

There is an established literature in economics that critically examines the benefits and costs of carbon regulations and incentives and analyzes the potential impacts on competitiveness, employment, and income in a region. In the sections that follow, we review the relevant literature in economics to help provide answers to the following questions confronting City of Seattle officials as they update the Climate Action Plan:

- How might the suite of regulations and incentives being considered affect business profitability and competitiveness?

- What are the benefits to Seattle and its business community of becoming a climate friendly community?

This report does not analyze the specific economic impacts of the emissions reductions strategies under consideration. Rather, the report draws important insights from the literature to establish what economists currently know about the likely business impacts of creating climate friendly communities.

II. Background

There is a large and growing literature in economics that compares the economic benefits and costs of carbon reductions to determine the optimal policy response to climate change. This literature relies on integrated assessment models, large-scale computer models which estimate and compare the aggregate benefits of avoiding climate change and the aggregate costs of mitigation. The analyses typically estimate national or global mitigation costs as a percentage

loss of economic output projected from a given level of emissions reduction as compared to business-as-usual. Recent estimates of the aggregate global costs of achieving atmospheric concentrations of carbon dioxide of 350-450 parts per million, the levels recommended by climate scientists to minimize the worst risks of climate change, range between 1-3% of global output annually (Stern 2006; Ackerman et. al 2009a).

An alternative method to estimating emissions abatement costs involves a bottom-up approach, or what is sometimes called an engineering approach. This method builds upward from estimates of how much emissions reduction can be obtained through specific reduction levers (e.g. energy efficiency or fuel switching). Reduction levers are then ranked by lowest to highest cost to determine the amount of emissions reduction that can be achieved at particular price points. This method generates abatement costs curves, such as the widely cited greenhouse gas abatement cost curves produced by McKinsey & Company (McKinsey 2009).

The results of both types of studies are widely debated (Ackerman et. al 2009b). In principle, estimating mitigation costs in dollar terms is more straightforward than measuring the benefits of avoided climate change. The adoption of energy-efficient equipment, appliances, industrial processes, and automobiles, as well as more widespread use of combined heat and power technologies, wind energy systems, smart building energy systems, solar panels, alternative transportation and other measures for reducing emissions all involve purchases of marketed goods and services whose attendant cash flows can be counted. The evolution of these technologies is uncertain, however, particularly over the long time periods involved in climate modeling. Economic models are not particularly well-suited for capturing the dynamic, socially determined nature of technological change. They typically do not include the full emissions reduction potential of energy efficiency improvements, the positive spill-over benefits from technological change, the benefits of learning-by-doing, and the positive role public policy can play in steering investment choices and encouraging innovation. As a result, these studies likely overestimate the costs of emissions reduction (Ackerman et al. 2009b).

Modeling the benefits of avoided climate change is even more fraught with uncertainty, difficulty and controversy. The economic damages from climate change accrue to future generations and involve potential consequences for human lives and ecosystems that are virtually incalculable. For these reasons, precaution, risk assessment and risk management may be more appropriate frames for evaluating climate policy. Emissions mitigation could be viewed as insurance against uncertain, potentially catastrophic future damages from climate change. Recent economic research, pioneered by Martin Weitzman (2007, 2008) has proposed new ways of dealing with uncertainties inherent to climate change. According to Weitzman, in a world with uncertain future outcomes, the probability distribution of economic damages from climate change has ‘fat tails”; the less likely events are the most consequential. If people are risk-averse, the avoidance of losses from worst case scenarios dominates decision making. As Weitzman argues, fine-tuning estimates of the most likely climate damages is less important

that determining how bad and how likely the worst case scenarios of climate change may really be.

The conclusion to be drawn from this literature is that the potential consequences of climate change warrant investments in preventative measures today (Stern 2006; Weitzman 2007; Weitzman 2008; Ackerman et al. 2009b). This emerging consensus by economists, however, applies to national or global emissions reductions efforts, where reductions are potentially of large enough scale to impact the climate system. What this means for cities like Seattle, where even the most ambitious climate action plans will yield small or imperceptible changes in atmospheric carbon dioxide levels, is debatable. Carbon reduction as a strategy for minimizing risks from global climate change is most efficiently pursued on a global or national scale. To the extent, however, that cities, states, and regions view their emissions reductions as part of national or global stabilization efforts, however, there is there is a large and growing body of research in economics that supports these actions as precautionary investments in avoided climate change futures. The literature also demonstrates that carbon reduction produces economic benefits to cities and regions beyond climate change.

Recent proposals in the U.S. to cap or tax carbon emissions at the national level have led economists to investigate the impacts of a carbon price on businesses and households. These studies typically find that a carbon cap or tax will raise fossil fuel prices, and the prices of all other goods and services in proportion to their energy content. The net impact on households or businesses, however, will depend on several factors. With regards to businesses, the impacts depend on the energy intensity of production, and how much of the energy price increase can be passed along to consumers in the form of higher product prices. With regards to households, the net impacts depend on the size of their carbon footprint and whether policies are implemented to offset increases in energy costs. For example, if government implements a carbon tax or auctions carbon permits under a cap-and-trade system, the revenues generated can be redistributed back to households to offset higher energy costs. Studies that have disaggregated household impacts by state of residence and by income have found that the incidence of a carbon tax or cap will vary. Households in states with lower emissions per capita; states with lower energy demands; and states where energy supplies are not as emissions intensive typically fare better than households in energy intensive states that rely heavily on coal and oil supplies for heating and electricity. The carbon price impacts on household income in Washington state, for example, are expected to be lower than the national average, due to the region's mild climate (lower demands for heating and cooling) and the dominance of hydropower in its electricity supply (Ackerman et al. 2009c). In terms of household income, studies confirm that affluent households that consume more will pay more in total than lower income families under a carbon tax or cap; but lower-income households will pay more as a percentage of income and will be disproportionately affected. Again, studies have shown that the regressive impacts of higher carbon prices can be negated by policies that distribute carbon revenues back to households (Burtraw and Parry 2011; Boyce and Riddle 2009; Ackerman et al. 2009c).

The take home message from these economics studies is as follows. Measures that increase carbon prices in fossil fuel dependent economies will raise energy costs and the costs of other goods and services. The impacts are potentially regressive, but effective public policy tools can be used to lessen the burdens on households and businesses. Energy conservation, energy efficiency, and fuel-switching to cleaner energies can reduce the vulnerability of households and businesses to higher carbon prices and smooth the transition to a low carbon or carbon neutral future.

The 2005 Climate Action Plan and the strategies considered in the carbon neutral analysis, however, do not include measures like a carbon tax or cap that would directly raise local energy costs; rather, energy savings result from measures designed to reduce energy use through energy efficient design and retrofits. Actions contemplated include a variety of initiatives and incentives to reduce vehicle miles traveled, electrify the vehicle fleet, redesign and retrofit commercial and residential buildings to achieve greater efficiency, switch fuels, and increase recycling and composting rates. The carbon neutral analysis assumes that Seattle City Light will supply carbon neutral electricity to the city by adding new wind, geothermal, and other renewable resources to existing hydropower electricity supplies. The Plan also assumes that the overall electricity load will not increase; electricity savings from energy efficiency measures will offset electricity demands from vehicle electrification and switching to electric heat pumps in buildings (Lazarus et al. 2011).

How might this package of initiatives impact Seattle businesses? To answer this, we turn to related literatures in economics that explore: 1) the impacts of regulations on businesses; 2) the benefits to businesses of energy efficiency improvements; and 3) the benefits to businesses and cities of proactively planning for a carbon constrained future.

III. **Impacts of Regulation on Business**

The debate over the potential economic impacts of regulatory measures to improve environmental outcomes is long standing. The oft-cited concern is that environmental regulations will increase production costs, raising product prices and decreasing the quantity of goods and services demanded. This could potentially lead to layoffs and rising unemployment in sectors or industries of the economy affected by the regulations. Empirical evidence, however, finds little support for wide-scale job losses or relocations arising from strengthening of environmental policies. The economics research on this topic extends back over the last forty years, with some of the most important findings published in the late 1990s and 2000s. The Clean Air Act Amendments of 1990 marked the last significant package of environmental regulation passed in the U.S. and the creation of NAFTA in 1994 presented new opportunities for U.S. firms to relocate abroad to avoid environmental regulations. Thus, there is an extensive literature that covers a long time period that evaluates how environmental regulations impact businesses, employment, and income.

Economists have drawn three conclusions based on this history about the likely impacts on businesses from environmental regulation. The first conclusion is that businesses are unlikely to relocate to avoid compliance with environmental regulations. The empirical evidence shows

that there has been little movement by U.S. firms to other countries to escape environmental regulatory burdens. Nor has there been a migration of new investment in dirty industries to developing countries with lax regulations, the so-called "pollution havens". Over the last few decades of the neoliberal era, both dirty and clean industries have relocated outside of the U.S., but that movement has been driven mostly by the pursuit of lower wage and benefit costs (especially health costs), which comprise a much higher percentage of their total costs (Goodstein 1999; Gallagher 2006). What the research has found is that environmental compliance costs are generally below 2% of total business costs (Jaffe et al. 1995); the potential savings are just not large enough to compel relocation to escape environmental regulations alone. Economists searching for evidence of widespread flight of polluting industries to different countries or different states within the U.S. have yet to uncover evidence of a trend.[1]

Most of this literature, however, is focused on U.S. industries and the incentives to relocate to avoid national or state level regulatory burdens. Seattle, however, is rightly concerned with the potential relocation of businesses to nearby suburbs to avoid the potential costs of implementing a city-wide carbon neutral strategy. Relocations so nearby would seem easier to affect than relocations to China or Mexico. The literature demonstrates, however, that what drives firm relocation is mostly the potential labor cost savings. This driver would not be relevant for businesses contemplating a move to nearby suburbs. Businesses in nearby Seattle suburbs would draw largely from the same regional labor pool and pay the same average wage rates. By moving to the suburbs, businesses would forgo the benefits of locating in an urban center as well as the benefits of carbon savings. To offset the loss of these benefits, the costs of implementing Seattle's carbon neutral plan would have to be great. Yet, as national studies have shown, the costs of environmental compliance are typically not large enough on average to drive relocations.

The second major conclusion economists have drawn from studies examining the impacts of regulations on businesses and competitiveness at the national or regional level is that that plant closings and layoffs as a result of environmental regulations are actually rare. Numerous independent studies show this. Layoffs that can be attributed to environmental regulations account for only 1/10th of 1% of all mass layoffs (> 50 employees) nationwide. This is equivalent to roughly 1,000-3,000 jobs per year across the entire country. For example, fewer than 7000 jobs were lost between 1990-1997 as a direct result of the Clean Air Act Amendments taking effect. Over that same period, 10 million U.S. workers were laid off for non-environmental reasons (Goodstein 1999). Among the reasons for major layoffs, as reported by the Bureau of Labor Statistics, environmental and safety-related shutdowns are among the least common, accounting for about 0.1% of job losses (Goodstein 1999; Ackerman and Massey 2002). A study of the heavily regulated steel, petroleum, plastics, and pulp and paper industries concluded that, "while environmental spending clearly has consequences for business and labor, the hypothesis that such spending significantly reduces employment in heavily polluting industries is not supported by the data" (Morgenstern et al., 2002, p. 25).

[1] That is not to say that firms that leave the U.S. in pursuit of lower labor costs behave as good environmental citizens abroad.

The third major conclusion is that at the economy-wide level, there seems to be no real tradeoff between environmental regulation and growth. Environmental regulation leads to a very slow shift in the composition of spending: jobs are gained as workers produce, install and maintain clean-up equipment and engage in retrofits, and are lost as firms pass on those cost increases to consumers, who have to cut back their purchase of goods and services from that sector (Goodstein 1999). Environmental regulation begins a slow shift away from the products of dirty industry. An example would be the shift into new recycling jobs and out of waste disposal jobs, as the percentage of waste recycled in the U.S. rose significantly in the 1990s.

In large cities like Seattle, jobs are regularly gained and lost. While job loss can be catastrophic to an individual worker, net job loss (or gain) is the variable that matters most for public policy. As with all public policy, changes in environmental regulations create winners and losers. Specific businesses or industries may be disproportionately impacted (for example, the coal industry from national carbon legislation). An analysis of the business cost impacts of achieving carbon neutrality in Seattle could reveal which businesses and industries would be most impacted. Based on the economics literature, however, there is little evidence to suggest that businesses in Seattle will engage in major layoffs or relocate in response to carbon neutral strategies or that new investment will be steered towards cities with less ambitious (or non-existent) climate action plans. Labor market conditions in Seattle will continue to be more heavily influenced by larger structural changes in the U.S. and global economy, than any proposed regulatory changes at the city level. Furthermore, to the extent that Seattle's carbon neutral strategy helps position the city to attract the innovative, high tech, or clean industries that will be competitive in the future, it may position the city for longer term employment growth.

IV. The Benefits of Energy Efficiency Improvements

The City of Seattle is exploring the potential for major emissions reductions from energy efficiency improvements in the commercial and residential building sectors. Measures include new building design, building retrofits and renovations, and switching to district energy and heat pumps. These measures build-on Seattle City Light's longstanding commitment to energy conservation as the lowest cost and least risky option for reducing load and meeting long-term energy needs. The utility projects that it can meet energy needs through 2020 without acquiring new generating resources (Seattle City Light 2010).

Across most of the U.S. the benefits of energy efficiency improvements have long been overlooked; energy efficiency has been characterized by some as an invisible resource (Ayers and Ayers 2010). Unlike new solar or wind facilities, people can't see the benefits of energy efficiency at work. Nevertheless, the literature on energy efficiency reveals its potential to generate savings for businesses and consumers and contribute to growth (Ayers and Ayers 2010).

All businesses consume energy; energy services are vital to economic activity. Measures that reduce the costs of energy services, therefore, can contribute to economic growth and prosperity in a region. Energy generation and use in the U.S. is incredibly inefficient. U.S. electricity generation, for example, is only 33% efficient. This inefficiency is compounded by the inefficiency with which consumers then use that generated electrical power. According to a recent analysis by Ayers and Ayers (2010), the overall efficiency of the different kinds of energy used in the U.S. to produce 'useful work' is only 13%. This signifies a tremendous amount of energy waste as well as enormous opportunities for energy savings through investments in energy efficiency.

Energy efficiency is an under-utilized resource in the U.S. economy and an important component of any emissions mitigation strategy. Investments in energy efficiency are typically low-risk but yield high returns. McKinsey & Company (2009), for example, estimates the investment potential for energy efficiency in the U.S. at $520 billion with returns of $1.2 trillion over the next 10 years. Such a program could reduce energy consumption by 23% of projected demand and abate 1.1 gigatons of greenhouse gases annually using technologies already demonstrated to be cost-effective (McKinsey & Company 2009). As much as 75% of new U.S. energy demand over the last two decades was met by increased efficiency; only 25% came from new fossil fuel supplies (Ayers and Ayers 2010; Laitner and Ehrhardt-Martinez 2008). Roughly 72% of the "invisible energy boom" took place in buildings and industry sector (Ayers and Ayers 2010, Laitner and Ehrhardt-Martinez 2008). A recent study by the Union of Concerned Scientists (Cleetus, Clemmer and Friedman 2009) details a portfolio of technology and program options that could lower U.S. greenhouse gas emissions 56% below 2005 levels by 2030. The study estimates an annual $414 billion in savings for U.S. households, vehicle owners, businesses, and industries by 2030. The study concludes that the net cumulative savings (energy savings less the costs of the technologies) could total $1.7 trillion dollars over the period 2010-2030. Laitner and McKinney (2008) provides a meta-review of 48 policy studies that examine the costs of economy-wide efficiency investments over a 15-25 year time period. Their analysis finds that the energy savings from these investments are more than two-times the estimated cost to implement the suggested policies. (Laitner and McKinney 2008). AEC et al. (1991) and Energy Innovations et al. (1997) similarly demonstrate a two-to-one benefit-cost ratio for energy efficiency investments.

The potential energy savings from efficiency improvements in the building sector are significant. In the U.S., buildings account for roughly 40% of all energy use. McKinsey and Company (2007) find the greatest potential for negative-cost abatement options amongst energy efficiency improvements in buildings and appliances. These opportunities can generate positive economic returns to society at large over the lifecycle of the project. A study published by the National Renewable Energy Laboratory (Griffith et al. 2007) found that commercial buildings could reduce their average energy use by as much as 60% if rebuilt to include a comprehensive package of energy efficiency technologies and practices. New building designs and technologies can render buildings net energy producers – generating more energy than they consume. Also significant is the potential to recycle high-quality waste energy from industrial plants. A study produced by the Lawrence Berkeley National Laboratory suggested

that a variety of waste-to-energy and recycled energy systems could capture enough waste heat from industrial facilities to offset 10% of current U.S. electricity demand (Ayers and Ayers 2010).

Future projections for energy efficient technologies are bright. As energy efficient technologies achieve greater penetration, and as behavioral, institutional, and structural obstacles to wider market implementation are identified and addressed, the energy efficiency resource should become progressively cheaper (Laitner and Ehrhardt-Martinez 2008). Effective public policies can accelerate the rate of improvement and adoption of these technologies, enabling lower costs and higher performance over time (McKinsey 2009; Koomey 2008). The literature, therefore, is largely very supportive of the kinds of energy efficiency initiatives outlined in Seattle's carbon neutral strategy. Those initiatives have the potential to deliver high benefits at relatively low cost and risk.

In Seattle and the Northwest, the carbon and monetary savings from deep retrofits and other energy efficiency measures may be lower, and the payback periods may be longer, than in other parts of the country. This is because the region already benefits from a mild climate and relies heavily on relatively low cost hydroelectric power. Energy efficiency improvements, however, offer Seattle businesses and households opportunities to save on more than just their energy bills. In addition to energy cost savings, energy efficiency investments provide benefits in the form of reduced maintenance costs, greater reliability, avoided future capital costs, lower water and chemical wastes, and greater product quality. In residential buildings, non-energy benefits may be equivalent to 10-50% of household energy savings (Amann 2006).

In the Northwest, concerns about lower-energy cost savings from energy efficiency improvements apply mostly to electricity. The potential costs savings for space heating and for transportation are still great (Lazarus et al. 2011). Seattle's population is heavily dependent on single-occupancy vehicles and has some of the heaviest traffic patterns in the nation. With rising fuel costs and the potential time and cost savings from public transportation, pedestrian friendly walkways, or bicycling, Seattle's carbon neutral plan can deliver real savings.

V. Advantages of Climate Friendly Communities

Competitiveness

The literature on competitiveness is rapidly evolving. Once narrowly construed in terms of labor costs, competitiveness is now understood more broadly to involve the productivity of diverse resources: labor, capital, knowledge, and natural assets. Studies of competitiveness and economic development historically focused on national policies and attributes. Economists today increasingly recognize the importance of regions as incubators of economic growth and innovation and the role local policy makers can play to actively support cluster-oriented economic development (Porter 2003).

Regional innovation clusters, or simply "clusters", refer to geographic concentrations of interconnected enterprises and supporting institutions (Muro and Katz 2010). There are multiple innovation clusters in the Seattle area that contribute to the region's prosperity:

aerospace, information technology, clean technology, life sciences, logistics and international trade, military, and tourism. The clusters theory, which dates back to Michael Porter's seminal 1990 publication, *The Competitive Advantage of Nations*, is based on the idea that businesses of similar type cluster together in the same place because there are benefits to be derived from their "colocation" (Porter 1990, 2003). Locating close to rivals can increase a businesses' customer base, reduce costs along the supply chain, and expand the labor pool and attract specialists to the region. Porter, however, argues that colocation can also increase productivity, innovation, encourage new business formation, and support local start-ups (Porter 1990, 2003). Clustering fills in information gaps and enables ideas to flow more freely between businesses. (Glaeser 2008). Empirical studies have found that doubling the employment density of an urban area can raise its labor productivity by 6% (Melo et al. 2009; UNEP 2011).

The research on clusters finds that the strength of clusters and the diversity of innovation strongly influence regional economic performance (Porter 2003). The research also cites the importance of public policy in creating and supporting the vitality of regional clusters. The benefits of colocation stem from positive spill over benefits, or what economists call externalities. Externalities contribute to market failures in the form of underinvestment in specialized skills, scientific knowledge, and specialized infrastructure. No one firm has the incentive to invest sufficiently in these areas, as the benefits accrue to existing competitors and lower barriers to entry to new competitors. Public policy can satisfy investment needs in these areas or provide the incentives and structure firms need to capture some the spill-over benefits themselves. Public policy can strengthen the positive externalities present in clusters, thereby enhancing productivity and growth as a result (Muro and Katz 2010; Porter 2007).

The clusters literature argues that cluster-based policies should be neutral with regards to the type of industry or economic activity; the role of policy is to support existing or emerging clusters, not pick winners. In part, this reflects the notion that the evolution of particular clusters is somewhat organic, resulting from regional attributes that are not easily identifiable. Seattle, however, already harbors a cluster of more than 400 clean technology companies. Seattle's carbon neutral strategy, to the extent that it creates local demand for clean technologies and creates a policy apparatus and set of incentives that encourages green innovation and efficiency, complements and supports its clean technology cluster. Green technologies will emerge in the areas where there is greatest demand. The U.S. lags behind other nations in developing clean energies because it lacks a national carbon policy, unlike all other industrialized countries. High tech, green tech, and clean energy companies are not likely to locate to states and cities that do not support the very technologies, products, and services they produce. The realities of climate change and beyond-peak oil supplies imply that successful businesses of the future will likely be those that innovate ways of extracting more energy services from every dollar of energy expenditure. Successful businesses will be those that manage and invest for energy productivity, as well as labor productivity. (Ayers and Ayers 2010).

The idea that public policy can play a positive role in supporting innovation and growth runs counter to the belief of many that the free market (not government) is ideally suited to

identifying profit-making opportunities. But only if we believe that all profitable opportunities have been discovered, that there are no dollar bills lying unclaimed on busy sidewalks, can we assume that smart regulation cannot contribute to the development of new businesses and investment opportunities. Economists have long recognized that there are many barriers to innovation that prevent managers from identifying, and capitalizing on, new money making or money saving opportunities. There are, in fact, dollar bills lying on crowded sidewalks and public policy can help steer businesses to their location.

This is the basic logic behind the Porter Hypothesis, first articulated in a paper by Porter and van der Linde in 1995, which suggests that carefully crafted environmental regulation can spur innovation and increase competitiveness (Porter and van der Linde 1995, 1999). According to the Porter Hypothesis, smart regulation can encourage long run growth and competitiveness by: 1) putting pressure on companies to innovate, especially in situations where learning takes time and the resulting improvements in resource productivity do not fully offset compliance costs in the short run; 2) pushing companies to identify resource inefficiencies and find new and innovative ways to do business; 3) encouraging companies to consider the environmental bottom-line in their product and process innovations, thereby contributing to environmentally friendly business practices more broadly; 4) creating demand for environmental improvements until such time as the public and companies can better understand and measure the environmental impacts of economic activity; 5) leveling the playing field during the transition to a more sustainable economy so that companies cannot gain position by avoiding environmental investments; 6) moving companies ahead of the learning curve for clean technologies so that they can become more globally competitive as compared to competitors in countries with more lax environmental controls. (Porter and van der Linde 1995, 1999).

Recent research supports Porter's hypothesis, with many studies suggesting better stock market performance from "green" companies (Konar and Cohen 2001). Nations with the strictest standards and regulations often lead in exports of the affected products (Porter 1990). Heavily regulated countries like Germany and Japan maintain strong economic performance and standards of living comparable to those in the U.S. (Ackerman 2006; Porter 1990). At present, the U.S. is the only industrialized country in the world without a national carbon policy. Carbon reducing technologies and know-how is a growth industry; without competitive carbon technologies and efficiencies the U.S. not only forgoes opportunities to develop a growth industry, it becomes increasingly dependent on imports. China, for example, is moving aggressively to capture leadership in solar, wind, high-speed rail, and other key clean energy solutions. As recently as 1995, the U.S. was the technology leader in wind and solar thermal (Goodstein 1999). Today, U.S. utilities purchase these technologies from China, Denmark and Spain. Global investment in renewable energy is expanding dramatically. Excluding large-scale hydropower, global investment in renewable energy has grown from $10 billion in 1998 to an estimated $66 billion in 2007 (Renner et al. 2008).

California is a national leader in energy efficiency and energy conservation for a variety of reasons, including a very progressive and supportive public policy framework (Ackerman et al 2009c). With the passage of AB 32 (California's global warming solutions act), California has the

strictest controls on carbon emissions in the U.S. Initial opposition to AB 32 and recent attempts to repeal it were led by concerns over its economic impacts, especially for small businesses. A 2009 report by the Brattle Group (Weiss and Sarro 2009) concluded that the impacts on small businesses from AB 32 would be small, since most small businesses would not be directly regulated. The impacts would be more indirect, in the form of higher energy and other input costs. They note that the vast majority of small businesses in California are not energy-intensive; the average small business in California spends less than 1.5% of revenues on energy-related costs. A study of the employment impacts of AB 32 (Zabin and Buffa 2009) projects net job growth, due mostly to the magnitude of savings to households from lower expenditures on fuel and energy due to energy efficiency measures.

Jobs

To the extent that public policy can steer investment towards green or clean industries, it has the potential to create jobs. Green investment can contribute to net job growth because it tends to be both domestic content and labor intensive, as compared to other types of investment or spending. Energy savings for businesses and households from energy efficiency improvements can stimulate demand for other goods and services, contributing to aggregate net job growth. One recent study examined a "green stimulus" package recommendation for the Obama administration that called for $100 billion of spending over two years on: (1) retrofitting buildings to improve energy efficiency, (2) expanding mass transit and freight rail, (3) constructing a "smart" electrical grid and (4) investing in wind power, solar, and second generation biofuels. The study estimated that total jobs created would be 1.9 million. Had the same amount of money been given to households to finance general consumption, only 1.7 million jobs would have been created (Pollin et al. 2008). Numerous other studies find that investing in the environment, energy efficiency, and renewable energy will generate more jobs than investing in extractive industries and fossil fuels (Goodstein 1999; Kammen et al. 2004; Bezdek et al. 2008; Laitner 2009; Pollin et al. 2009). One widely-cited recent study found that spending a given amount of money on a clean-energy investment in the US generates approximately 3.2 times the number of US jobs as does spending the same amount of money within the fossil fuel sectors (Pollin et al. 2009a). Another recent study that examined the local job creation potential of bicycle and pedestrian infrastructure projects estimated an average of 9 new jobs created for every $1 million in project cost (Garret-Peltier 2011). These studies find employment gains from expenditures in clean energy, energy efficiency, and green infrastructure because they tend to be more labor-intensive than comparable expenditures in fossil fuels or others sectors.

Adaptation

Seattle's carbon neutral strategies focus on mitigation – near term reductions in carbon emissions. No matter how successful cities and countries will be reducing emissions, the consensus of climate scientists is that some climate change is unavoidable. This reality, coupled with the implications of declining oil supplies worldwide, suggests that all cities should effectively plan for adaptation and the transition from fossil fuels. Forward looking cities and

regions that act early and effectively and can smooth this transition and minimize impacts for businesses and citizens. For decades, U.S. cities benefitted from relatively stable electricity prices and abundant fossil fuel supplies. Without a plan in place to bridge the transition from fossil fuels, economies will suffer the pressures of rising energy demands from population growth, fossil fuel shortages, environmental degradation, and climate change. Ayres and Ayres (2010) argue that the cities that achieve greater energy efficiency will be better able to withstand such shocks. Energy efficiency, therefore, is a key component of a resilience strategy. For example, by upgrading buildings to zero net energy or zero emissions standards, we transform the risks of blackouts, traffic congestion; automobile exhaust (Ayers and Ayers 2010). While the primary purpose of much of the urban redesign described in Seattle's Climate Action plan is to reduce emissions and energy use, these measures provide simultaneous opportunities to prepare for climate change impacts. Long term savings from energy efficiency and conservation will free up resources for investment in adaptation to climate change (Ayers and Ayers 2010).

Urbanization

Businesses that left Seattle to avoid the potentially higher costs associated with the City's carbon neutral objectives would lose certain advantages that could not be readily found in the suburbs or even other cities. Seattle offers the most important benefits of high density urban centers that produce for local and global markets: efficient transportation infrastructure; a well-educated workforce; innovation clusters; and ports that offer ready access to global markets.

Seattle's carbon neutral vision reflects many of the emerging priorities of urban planning: compact, development with convenient access to many destinations, shorter commuting distances between home and work; and public transportation oriented. While the primary purpose of much of the urban form described by Seattle's carbon neutral plan is to reduce emissions and energy use, these measures yield other benefits as well.[2] Compact, densely populated cities with mixed-use developments are typically more resource-efficient than other settlement patterns with comparable levels of economic output (UNEP 2011). High density urban design captures efficiency gains and technological innovation through the colocation of economic activities (UNEP 2011; Porter 2003). Moreover, it reduces resource and energy consumption by spreading the costs of urban infrastructure (e.g. streets, railways, water, and sewage systems) over a greater population. A recent study compared the costs savings between smart growth region and car-dependent developments and estimated the direct cost savings per household to range between $5000 to $75,000 (UNEP 2011).

The reduction in pavement as cities shift from personal vehicles to public transportation may open up space for personal use, as well as public parks, bike and pedestrian pathways, etc (Ayers and Ayers 2010; Kahn 2010). Studies have also shown that traffic reduction and safer

[2]For an excellent summary, consult the United Nations Energy Program (UNEP) report: *Cities: Investing in Energy and Resource and Efficiency*. Available at:
http://www.unep.org/greeneconomy/Portals/88/documents/ger/GER_12_Cities.pdf

pathways for bicyclists and pedestrians contribute to a higher quality of life within communities (UNEP 2011). It has also been shown that the extension of public transportation systems can reduce socioeconomic inequality by improving access to public resources for disadvantaged communities (UNEP 2011). Reducing energy use and vehicle transportation will produce localized health benefits from cleaner air and safer streets. Therefore, cities like Seattle that execute ambitious climate action plans can expect a range of non-climate change benefits.

VI. Conclusion

This report reviewed the economics literature to establish what economists currently know about the likely business impacts of creating climate friendly communities. Though it does not identify or analyze the specific economic impacts of Seattle's carbon neutral strategy, the report finds solid evidence from the literature to support the ambitious emissions reduction efforts Seattle has championed.

There is large and growing support by economists for ambitious and immediate emissions reductions as precautionary investments to avoid future climate change damages. Seattle's emissions reductions will have minimal impact on atmospheric carbon dioxide levels and temperatures, but they will yield a range of economic benefits for Seattle and help establish Seattle as a global leader in climate change solutions. The research demonstrates that cities that embrace energy efficiency, conservation, and urban redesign and begin the transition from fossil fuels will be more resilient to future climate change impacts and the instability of rising oil prices post peak-oil.

The non-climate change related benefits of investing in clean technologies and urban redesign are many, including energy cost savings, safer and healthier communities, and higher quality of life more broadly. The research demonstrates the enormous potential of the energy efficiency resource and the potential dynamism and growth unleashed by the creation of clean technology clusters. Moreover, the research is clear that the strength and diversity of innovation is dependent on carefully crafted public policy. By supporting green innovation and creating local demand for clean technologies, Seattle's carbon neutral strategy can support its emerging clean energy cluster as an engine for growth and prosperity in the region.

Finally, the research provides little evidence that Seattle's carbon neutral plan will create an environment hostile to businesses and profits. Contrary to some perceptions, the economics literature on the impacts of environmental and health regulations on firm performance finds evidence that smart public policy can incentivize efficiency and innovation, improving firm competitiveness over time. While specific impacts on firms or sectors may vary, at the aggregate level, the research finds little evidence of wide-scale flight by businesses or new investment to avoid compliance with environmental regulations. The evidence finds that investing in green technology and infrastructure will create jobs on average, not lose them.

The successful cities of the future will be those that pro-actively plan and invest in energy productivity, clean energy, and green infrastructure and design. These are the cities that will be

poised to gain a competitive advantage in the technologies which will be highly demanded in the future. These cities can minimize the future impacts to the public and businesses from climate change and higher energy prices. Seattle, therefore, should benefit from becoming a climate friendly, carbon neutral community.

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