An Urban Agenda For The New Climate

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Introduction

With the rising specter of climate change (IPCC, 2007), and a global economic recession that has contributed to worldwide unemployment (for example, the U.S. Department of Labor (2009) places the unemployed at 10% of the workforce), the modern order appears to stand at a crossroads. Will economic recovery be engaged as part of a new paradigm, one that places shared social and environmental progress – for all communities – at the forefront of adjudicating technological choice and economic value?

A host of issues, not only those embedded in changing weather patterns or in the machinations of international financial markets, suggests a need for paradigm shift. Alongside climate change, acid rain and smog continue to threaten air and water quality. Volatile energy prices, particularly for natural gas (U.S. Energy Information Administration (EIA), 2009), have been accompanied by episodic lapses in grid reliability and a broader lack of access to affordable energy service (Byrne and Mun, 2003). Wider advanced nuclear energy development, meanwhile, offered by some as the answer to our current carbon dilemma (Blees, 2008), promises neither greater affordability nor reliability of energy service, as it depends on an often congested grid for ultimate power delivery to consumers. Nuclear energy development furthers the agenda of expert-driven energy governance and impedes citizen control of decisions about this vital part of community infrastructure. The threat of large-scale disaster also remains unresolved (Byrne et al, 2006).

Globalizing economic forces and an increasing mobility of capital flows (Ranney, 2003) have spurred the loss of livable wage-based employment opportunities, threatening, in particular, urban communities in the U.S. and elsewhere with significant economic decline (Apollo Alliance, 2008; Bashi and Hughes, 1997). Together, these phenomena portend a fundamental challenge to traditional energy-economic development of the type that governed 20th century urbanization in the industrial countries and is now guiding Asian, African and Latin American metropolitan development.

As COP-15 commences in Copenhagen, the world's nations face the formidable task of negotiating the next wave of shared action for addressing climate change. A number of substantial issues remain to be addressed, such as the extent to which the U.S. will participate in any mandatory regime under a new treaty, and what commitments India and China may undertake beyond (for example) the Agreement on Cooperation[1] signed by the two nations in October 2009 (Indian Ministry of Environment and Forests, 2009). Significant debate among the totality of participants is almost unavoidable, regarding the potential structure of any new instrument that may be devised for guiding actions to reduce emissions beyond the current Kyoto Protocol (Rajamani, 2009).

Yet, it is likely that – no matter what the scale of treaty commitments or responsibilities prove to be – meaningful efforts to mitigate the climate threat will depend significantly upon what nations and their cities do to build a low-carbon future. Why? Urban strategies in and beyond the U.S. have surpassed,

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[1] The Agreement on Cooperation aims to "strengthen the cooperative activities" between the two countries, in "mitigation, programmes, projects, technology development and demonstration" for "energy conservation efficiency, renewable energies, clean coal, methane recovery and utilization, afforestation and sustainable management of forests and ecosystems, transportation and sustainable habitat" (Indian Ministry of Environment and Forests, 2009: 1).

and are likely to continue to surpass, in their quantitative and qualitative goals and actions the commitments adopted by the COP process (Byrne et al, 2007). This can be explained as an outgrowth of the governance opportunities that so called 'bottom-up' strategies offer (Byrne et al, 2007; Hughes, 2009a) and the fact that urban politics and economics frequently nourish progressive agendas which pioneer local and, eventually, national and international change. From labor law and social equity-based policy agendas to citizen movements for economic and environmental justice, cities have been the incubators of basic change in contemporary societies (Mumford, 1961; Droege, 2008; Muro, 2008). Therefore, at this historic crossroads for the environment and for policy responses to the climate problem, urban political economy will be vital to transformative change.

At the same time, cities utilize approximately 75% of the world's fossil fuel production (Droege, 2002) but must navigate demands for change with often deteriorating economic and infrastructural capabilities (Johnson and Schmidt, 2009). In this regard, the urban challenge in a carbon-constrained world is multi-dimensional, requiring not only a recognition of the progressive possibilities of urban political economy but also the modern tendency to sacrifice the economic and social health of urban communities and livelihoods for national and global gains (often driven by the evolving requirements of modern corporate structures seeking profit with as little risk of loss as possible). Indeed, the forces of progressive urban political economy and disinvestment in cities can be seen as elements of a common dialectic of change, with failing urban infrastructure prompting civil agendas for reform and, in turn, those reforms challenging the dynamics of disinvestment by raising its cost on national and corporate ledgers.

This paper explores the critical need for urban areas, including both traditional cities as well as their suburban counterparts, to redefine notions of "progress" in seeing to human health, safety and well-being as a function of energy-related choice. The challenge lies not merely in improving energy systems "on the margins" through isolated technological advances, but rather embracing energy-urban-infrastructure development that empowers human activity in the context of emerging resource constraints and the threatened capacity of the atmosphere and oceans to absorb greenhouse gas emissions. As devised by the Center for Energy and Environmental Policy (CEEP) in papers published in 1997 and 1998, the target for anthropogenic release of CO_2 on a global basis is 3.3 tons per person, annually (Byrne, 1997; Byrne et al, 1998). [2] The standard is sustainable, in that it reflects environmental realities, and also equitable, in that it apportions responsibility for a lower carbon footprint equally among the peoples of all nations.

To realize the sustainable and equitable target of 3.3 tons of CO_2 releases per person per year, a new relationship between traditional urban actors and their suburban counterparts, based on the articulation and implementation of a shared regional agenda. Possibilities for a reformed conceptualization of urban-suburban progress – made possible through a commons-based approach to energy development – are offered as tangible pathways to meaningfully address the unique sustainability imperatives of the 21st century. Four practical examples compatible with an *energy*

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[2] CEEP devised the target based on 1989 global population of 5.2 billion people, against the amount of greenhouse gas reduction required – as estimated by the IPCC in its First Assessment Report (1990) – to stabilize atmospheric levels without setting off a significant warming pattern.

commons approach[3] are described: 1) a political economy strategy – the creation of a *sustainable energy utility* (using the cases of Delaware in the U.S. and Seoul in South Korea); 2) a decision-making strategy – the development of an *energyshed* (with Philadelphia in the U.S. as a case exemplar); 3) an assessment strategy – specifically centered upon *energy assessments and improvements* in urban areas (with attention to an approach developed collaboratively between the TC Chan Center of Building Simulation and Energy Studies at the University of Pennsylvania and the Georgia Institute of Technology); and 4) a governance strategy -- the *municipal policy* model (using Austin, Texas as the case exemplar). Each offers models for deeper change than the targets-based approaches currently favored by national policies and plans. At the same time, each approach can be harnessed to meet and, indeed, exceed targets-based initiatives.

The Social Character of Energy Systems: Commodity versus Commons

An abundance of physical and social science literature has spotlighted the environmental and economic problems inherent in conventional energy-based systems (Scheer, 2008; IPCC, 2007; Byrne et al, 2006a and b; Rifkin, 2002; Flavin and Dunn, 1998; Lovins, 1977). Beyond particular impacts on air quality in given regions, or rising tariffs for electric service in given markets (as just two examples), an important field of analysis has attempted to specify the impacts of energy development across different places, diverse groups, and over time, as a function of how energy choice is governed. This type of analysis, questioning whether energy is approached as a "commodity" – or as a "commons" – can be understood to provide very different directions for the types of technologies, services and goals that are attached to energy generation, delivery and use (see Byrne et al, 2006a and 2009 for a review of this analytical strategy).

A commodity-based approach to energy would suggest that individuals (consumers) can vote with their dollars and participation in given markets and programs, regarding the type of energy service they prefer. Through the larger collective sum of the many choices made by these individual consumers over time (Tietenberg, 2000), and with attention to externalities as addressed via government taxation or price modification (Söderholm & Sundqvist, 2003), society will arrive at the optimum outcome as regards fuel sources utilized, the infrastructure deployed to deliver kilowatts, and the ultimate purposes to which energy is applied.

By contrast, a commons-based approach to energy development (Byrne et al, 2006a, 2009) would consciously interject the role of democratic decision making (beyond individual participation in the energy marketplace), long-term perspectives for evaluating environmental impacts as compatible with ecological processes over decades or longer, and consideration of how choices in one jurisdiction impact a range of jurisdictions elsewhere.

With regard to decision-making, citizen involvement would entail – or at least support – local, participatory and accountability-based action (Prayas Energy Group, 2001; Transnational Institute, 2003), as supported by diverse institutions and processes for agenda setting and evaluation. In turn, as regards the outcomes of such decision-making, an energy commons would promote greater equity of

[3] CEEP has pursued a program of theoretical and policy development of an energy commons approach for many years. Recent publications document the proposal. See, in particular, Byrne et al, 2006a, 2006b, 2006c, 2009.

impacts along ecological dimensions, where protection of the broader life web is explicitly valued (Byrne et al, 2006c).

Along social dimensions, energy choices would be favored that do not displace harmful impacts onto distant regions (far from the site of energy generation or consumption), or onto socio-economically disadvantaged groups (those populations benefiting least from energy generation or consumption), or far into the future (Agyeman and Evans, 2004). In the latter case, future impacts could entail climate change, with its implications for agriculture, water resources, disease vectors, and biodiversity, or the challenge of resolving the lingering toxicity of nuclear waste (where such waste should be stored, who should pay the costs of securing such facilities, etc.) In the case of climate change, issues of equity – under a commons approach – would call attention to the highly uneven patterns of energy use now observed among the world's richest nations, most specifically the U.S., compared to the world's developing nations (Agarwal and Narain, 1995; Byrne et al, 2002). For example, the U.S. presently retains a per capita CO_2-e footprint of 20 tons annually, while China approximates 4.6 tons CO_2-e per person each year (EIA, 2008).

With these considerations in mind, a perspective departing from energy as a "private commodity," and attuned to embracing energy development as a "public service" (Transnational Institute, 2003: 7) of the "commonwealth" borne from nature-society interactions (Byrne et al, 2009: 88-89), could result in "universal access to safe, reliable, affordable electricity service" for all consumers (National Association of State Public Interest Research Groups, 2004: 5), and "more services with less kWh" (Transnational Institute, 2003: 8 and 16). Movement in this direction, toward an "energy policy commons approach" (Byrne and Mun, 2003: 50), could thus dramatically open possibilities for utilizing much less energy and, when energy services are needed, to rely upon locally or regionally abundant indigenous renewable resources that advance economic development opportunities for communities (Lovins, 1977). Livelihoods-centered energy and economic development (Agarwal and Narain, 1995, 2002; Byrne et al, 2002) and participatory energy governance (Agyeman and Evans, 2004; the "community trust" agenda in Byrne et al, 2009: 89-90) could become hallmarks of the new approach. These types of indicators, supportive of a commons-based approach, are apparent in a number of energy models that are now emerging. A discussion of four approaches ensues below.

Toward an Energy Commons: A Sustainable Energy Utility

A new commons-based approach to the provision of energy services, in ways directly considering their environmental and social impacts (beyond immediate economic costs), is the Sustainable Energy Utility (SEU) model. Embedded in the SEU approach is a paradigmatic shift away from the "logic of unending growth" wed to the modern model of commodity-based energy-economic development, as it existed in the 20th century (Byrne et al, 2009: 87). Under that earlier regime, industrial-scale, centralized conventional energy development, linked to fossil fuels as well as nuclear energy (and more recently to large-scale renewable development, as in the form of mega-wind farms), was oriented to supporting the endless production and consumption of goods and services. Arrangements, here, were predicated on the idea that society would exhibit ever-increasing demands for new goods and services, so that energy supply was also conceived to be ever-growing in character. Based largely on supply-side choices made by energy producers (in terms of resources, the technological infrastructure of plant and grid, and financing), this system of energy development in turn expected energy users to adapt to such choices, with corporate and large-scale government bureaucracies as the primary authorities in decision making.

The SEU, by contrast, emphasizes a different paradigmatic approach. First, as a nonprofit organization, the SEU enables communities – as energy users – to make decisions according to their particular local or regional needs, to be achieved through the "creation of shared benefits and responsibilities" (Byrne et al, 2009: 88). The concept in practice thus aims to support commons-based, socially-oriented energy governance (in terms of the development and management of energy resources) by the ultimate users of energy, rather than prioritizing "the interests of energy producers" (Byrne et al, 2009: 89).

This type of governance structure opens up possibilities for energy-related choices to go beyond a focus on ever-increasing *supplies* of affordable electricity as wed to centralized generation, transmission and distribution (typically associated with more traditional energy utility models over the last several decades), in addressing social needs. Instead, the SEU explicitly seeks to provide energy *services* that meet the needs of varied consumers and communities. First prioritizing conservation (reducing the overall amount of energy required to operate homes, farms, or businesses), the SEU then proceeds with promoting energy generation solutions that are specifically renewable, small-scale, and incremental in character. With the goal of lessening costs for individuals *and* the community, approaches undertaken in this regard look to longer-term (years into the future) and wider impacts (assessing health outcomes, job opportunities, preservation of distinctive landscapes and ecosystems, and avoidance of remediation costs) of various energy options. The achievement of such "common benefits for the community" thus advances a "commonwealth economy" that prospers by "investing in the sustainability of a community and its lifeweb" (Byrne et al, 2009: 88). The SEU thus has the potential to obviate the otherwise "competitive" nature of modern energy investments as undertaken in many jurisdictions, where producers look to those resources, technologies and configurations (as installed in particular places or venues) providing the greatest returns to capital in the shortest period of time. Under the SEU, more "reciprocal" arrangements (Byrne et al, 2009: 89) are possible, as community-oriented ideas for energy development alter the fundamental cost-benefit perspective by which investments are made.

At that same time, the SEU can serve new tenets of "community trust" because of the voluntary nature of member participation. More specifically, individuals and groups choose to join the SEU, necessarily putting pressure on the organization to be responsive to its members, who govern the entity by "setting goals, monitoring performance, and enforcing rules" (Byrne et al, 2009: 89). And in this regard, the SEU is not limited to particular subsets of energy users (i.e., building owners or operators), but rather functions across all fuels and sectors, serving all types of customers across income levels and residential, commercial, industrial, and transport sectors. For example, customers may seek to simply replace home appliances or office equipment, or they may choose to retrofit older buildings. Others may want to design and construct "green" buildings, or they may seek widened options for sustainable transport (Byrne and Martinez, 2009).

As a nonprofit entity distinct from existing electric or gas utilities, the SEU nonetheless may work with these actors, or with for-profit or nonprofit organizations, and with towns and cities, etc., to deploy new customized energy solutions where they are desired. Diverse, decentralized, and flexible applications are specifically promoted through the SEU, for their contributions to boosting the reliability and performance of energy infrastructure.

These types of investments, spanning conservation, efficiency, and regional indigenous renewable resources, share the capacity to enhance social and economic conditions in a number of ways, beyond their strict contributions to reducing CO_2 emissions and associated pollutants. Improvements to building design and operation, taking advantage of local labor, materials and expertise, can not only save energy, but also enhance the appraised value of residential and commercial real estate through better performance and aesthetics. Through choices to site energy production much closer to the point of final use, jobs for researching, installing, maintaining and evaluating new technologies and systems should become more widely available across communities and neighborhoods, as well (Kampschroer, 2009; Hopkins, 2003). Meanwhile, lessened community or regional reliance (whether from conservation or from shifts to local renewable resources) on distant fossil fuel stocks, which have experienced dramatic price changes in recent years due to commodity-based trading (Mouwad and Timmons, 2006), can help retain local energy expenditures within particular jurisdictions.

The conceptual dimensions of the SEU, in turn, have been put into practice in a number of regions and locales. In the mid-Atlantic portion of the U.S., the SEU was adopted in Delaware in 2007, following a mix of energy-related concerns impacting the state over the last decade: with restructuring of Delaware's electricity market, price caps had been applied to electricity in 1999, but these were scheduled to expire in 2007. Some analysts predicted that power prices would subsequently increase by at least 50%. Also expected to jump significantly were natural gas and gasoline prices. In this context, provision of affordable energy service in Delaware appeared to be increasingly fraught with challenges (Byrne and Martinez, 2009).

In response to these conditions, the Delaware General Assembly in 2006 established a Sustainable Energy Task Force, a bipartisan body charged with identifying new strategies for meeting energy needs. The eventual outcome of the Task Force's efforts, as informed by research conducted at the Center for Energy and Environmental Policy, was a legislative proposal authored by Sen. Harris B. McDowell. Enacted as State Bill 18, Delaware's SEU became law in 2007. Its specific target is a 30% drop in energy use by 2015 compared to a 2006 baseline (based on customer participation), average yearly energy savings equaling a minimum of $1,000 per participating customer, and the installation of 300 MW renewable energy on-site at homes and businesses. A 33% drop in CO_2 emissions is sought by 2020 (Delaware Sustainable Energy Utility, 2009).

To help ensure that its legislative mandate is fulfilled, the Delaware SEU is governed by an Oversight Board[4], comprised of public officials, energy professionals, and citizens, alongside the Delaware Energy Office. The Oversight Board chooses the SEU Administrator, sets policy and engages in the planning and management of day-to-day practices. The SEU Administration is comprised of a team of professional experts in the areas of planning, installing, financing, and marketing a range of technologies, applications and projects for conservation, efficiency, renewables, and transport. These firms are tasked with meeting performance incentives established by the Oversight Board (Byrne and Martinez, 2009).

The SEU can finance such efforts in Delaware through its authority to issue tax-exempt "green" bonds, as well as its designation as the administrator of public-purpose energy funds and emissions proceeds from the Regional Greenhouse Gas Initiative (RGGI). The Delaware SEU can also utilize federal incentives (such as new funding made available by the American Recovery and Reinvestment Act of 2009), third-party financing, program revenues (as generated by energy efficiency savings, for example), and the leveraging of funds from other public sector or philanthropic providers. As specific measures, such as weatherization for example, are implemented for SEU customers in Delaware, the cost savings

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[4] Specific actors of note include the Secretary of the Department of Natural Resources and Environmental Control, the Delaware Public Advocate, gubernatorial appointees, and appointees made by the President Pro Tempore of the Senate and the Speaker of the House of Representatives.

generated through energy saving improvements are shared between the citizen or business and the SEU, benefiting both. This type of contribution by the SEU in Delaware is cutting the costs of energy service, a critical need since the state is confronting a 20% budget deficit in 2009 (Byrne and Martinez, 2009).

The myriad opportunities embedded in an SEU-style approach – based on an empowerment of commons approaches to address *diverse* citizen and community needs, in ways that *save* money and *protect* natural resources – have been recognized for their innovative potential to serve other jurisdictions. John Podesta, of the Center for American Progress, has cited the Delaware SEU as a vehicle for deploying clean technology, creating green jobs transitioning to a low-carbon economy (Podesta, 2009). [5]

In 2008, the District of Columbia has enacted its own version of the SEU, known as Green Energy DC. Its offerings target both the residential and business sectors, advancing affordable options for both renewable energy and energy efficiency programs in the nation's capital (Green Energy DC, 2009). Similar interest is now emerging in states such as Minnesota, where the town of Milan, with a population of just 350 residents, is investigating the potential of a rural town-oriented SEU model to achieve greater energy affordability and to boost energy-related entrepreneurship in the area. Also in Minnesota, in the city of St. Paul, the West Side Citizens Organization is working to implement a neighborhood-based SEU, focused on efficiency and customer-sited green energy installations. The neighborhood, with a population of 16,000 residents, is located in an abandoned industrial zone, and has a significant proportion of low-income households (IATP, 2009). These examples suggest the versatility and scalability of the SEU model.

Beyond the U.S., an SEU-type model has been explored for utilization on the African continent (Agbemabiese, 2009) as well as in South Korea. In the latter case, the SEU has been given attention for its prospective contributions to the city of Seoul, to work in tandem with already existing programs to support the use of renewable energy and greater energy efficiency in the built environment, appliances, and other realms (Byrne et al, 2008). Considering the size of the city, with its population of more than 10 million residents, Seoul has the potential to enact far-reaching changes to its emissions profile through the creation of an entity dedicated to enhancing social access to a wider range of sustainable energy services.

Toward an Energy Commons: The Philadelphia Energyshed

Energy, as noted above, is the foundation for the broader sustainability agenda pursued by governments, businesses, and institutions in regions across the U.S., as they seek to bring human activity in line with the resource limits and biophysical capacities of the planet. Energy efficiency (which means creating value by reducing waste) and renewable energy (which means creating value by reducing carbon) provide resources and rationales for related goals ranging from recycling to local food as well as public health and job creation.

[5] Mr. Podesta headed the transition team of President Obama and is responsible for selecting the so called "dream 'green' team" now responsible for U.S. energy, environmental and climate policy.

As regards perspectives for lessening the negative impacts of conventional energy systems, technological change has often been pursued, such as at the level of the smokestack, at the end of the tailpipe, in the engineering design of motors and turbines, and in refurbishments to housing stock or transmission and distribution lines, as just a few examples. In other cases, end-users have been encouraged to purchase "green" or renewable kilowatt-hours (kWh), or to replace older appliances with newer, more energy efficient models.

In the U.S., these efforts may occur within a supportive policy context at the local, state or federal level, where certain government actors, bodies or legislation incentivize or mandate utility or customer change. However, the very diverse mix of actors that tend to influence a region's energy production and consumption (and thus the economic and environmental impacts of that energy system on metro inhabitants) – from generating facilities, wires utilities, energy service companies, government regulators, residential as well as commercial and industrial customers, architects and builders, operators and users of transit systems, automobile drivers, etc. – often operate independently of one another. In this manner, the range of energy-related impacts experienced in a given locality may be very detached (bureaucratically) from their technological or organizational points of origin.

This organizational separation is problematic, in that it yields a system of directing and evaluating energy-related investments that does not match the actual physical configuration and scale of energy production and consumption as it unfolds in practice, at the regional level. To be specific, significant aspects of energy generation, distribution, and consumption operate at a regional scale. These operations, which are a function of both technical and organizational realities, interact to form an "energyshed." The energyshed is an organizing idea that helps to clarify the connections between urban form and energy use and to engage regional stakeholders in optimizing energy.
With strategic energy management as key to a region's future as a prosperous place to live and work, three inter-locking changes in energy policy are worth understanding as part of defining a regional energy strategy. We sketch recent changes in local, state, and federal policy, as applied to the case of Philadelphia and its energyshed.

First, while national governments get all the attention at climate treaty negotiations in Kyoto and Copenhagen, local governments are critical to reducing emissions because that is where rhetoric meets reality. Both innovation and implementation happen on the ground, where people actually live and work. Yet local and regional governments have little voice and no formal recognition in frameworks being developed to govern climate change strategies.

Local governments in the U.S. have committed to reducing emissions and are devising ways to meet those commitments through local initiatives. Seattle, Portland, San Francisco, New York, Chicago, and this year Philadelphia have successively pushed the envelope on what it means to be the "greenest city in America."

Philadelphia's 2015 targets include lowering government's total energy consumption by 30% from 2008, lowering citywide building energy consumption by 10% from 2006, acquiring 20% of citywide electricity from alternative sources, and lowering citywide greenhouse gas emissions by 20% from 1990. Several of our County and suburban governments have made or are determining similar climate and energy goals, and DVRPC has completed a carbon inventory for the nine-county region that provides a basis for setting regional goals.

Second, Pennsylvania, New Jersey, and Delaware have advanced several important pieces of game-changing legislation on energy. In Pennsylvania, the Department of Environment Protection under the leadership of Secretary John Hanger is emerging as a powerful influence on energy markets across the state. The Alternative Energy Portfolio Standard (AEPS) requires electric companies to supply 18.5% of electricity using alternative energy resources by 2021. (In 2007, the amount was less than 6%). The AEPS is creating a market in Pennsylvania for the generation and distribution of energy resources like wind, geothermal, and solar.

Another important piece of legislation is called Act 129, which requires the Commonwealth's electric companies to reduce the total consumption of electricity in their service territories by 1% by 2011 and 3% by 2013, and to reduce peak demand by 4.5%. To meet these goals, electric companies are allowed to spend up to 2% of the annual rate base on energy efficiency programs, passing that cost on to customers in exchange for the reduced consumption.

This is a particular form of what is called "decoupling," meaning that an electric company's revenues are decoupled from how much electricity it sells because it can in effect charge rates for both conservation and consumption. Philadelphia Gas Works has developed a similar program that would allow it to generate resources to reduce the consumption of natural gas as well.

Finally, this change interacts with the expiration of electricity rate caps throughout Pennsylvania on December 31, 2010. After that, in this region, the electric distribution company PECO becomes only the "default provider" of electricity and anyone can purchase electricity from a long list of generation companies that should be able to provide power at lower rates. Soon, most consumers should participate in the wholesale electricity market.

And third, in addition to local and state policies, there has been a sea change in federal policy. The Recovery, or stimulus, spending in the summer of 2009 has attached new expectations for energy efficiency to the infrastructure, transportation, and housing grants distributed out by formula to states and cities. Also, for the first time, local governments were given Energy Efficiency and Conservation Block Grants (the City will receive $14.1 million and the five counties of SE Pennsylvania will receive a total of $26 million.)

Now attention is turning from the *formula* to the *competitive* Recovery grants that will be awarded in the coming months. PECO and its partners submitted and won a $200 million proposal for a Smart Grid project, the Philadelphia Industrial Development Corporation and its partners will submit a proposal to transform the Navy Yard into one of the nation's most important energy research centers, and Penn and its partners will submit a proposal to form a new center for sustainable communities.

These three interlocking policy changes—local innovation, state legislation, and federal funding—all demand more strategic management of energy than governments, businesses, and institutions have ever attempted. To be sure, a number of individual actors in the region surrounding Philadelphia from both the for-profit and non-profit sectors have pioneered strategic energy management over the past several years. Liberty Property Trust has developed one of the nation's largest portfolios of energy efficient commercial new construction, including the country's tallest LEED-certified building and the country's first speculative LEED-Platinum commercial office space. Thomas Jefferson University is a national leader in distributed energy generation through cogeneration and other advanced technologies. And the University of Pennsylvania consistently ranks highest among U.S. educational institutions on renewable energy and energy efficiency commitments and has developed a ground-breaking approach to using computer modeling to optimize energy efficiency investments.

In many ways, the next great challenge is creating the organizational incentives and mechanisms to aggregate these individual efforts and involve the large majority of governments, businesses, and institutions that do not now manage their energy in a strategic way. There is a need for new capacities to convene and coordinate the energy management of individuals and organizations to achieve both scale economies and maximum impact.

As noted above, much of that energy management needs to occur at the regional scale, for reasons that are both technical and organizational. We label this regional scale an "energyshed" and now briefly explore some of its features. The analogy with watersheds is instructive. A watershed organizes the drainage of water to a common point. The ridge lines of the landscape create the drainage patterns and define the boundaries of a watershed. It is a scalable hierarchy in which sub-watersheds combine to form larger systems of drainage. The impacts of water operations—such as stormwater runoff, soil erosion, stream temperature, fish and water quality, the recharge of ground water—reside at various watershed scales. In a similar way, an energyshed organizes the flow of energy from generation to consumption. Technical and organizational limits create boundaries and hierarchies in the system of energysheds and various energy operations—especially related to energy efficiency—reside at the scale of the regional energyshed. We begin with a set of observations, again drawn from the Philadelphia case.

- One simple but significant feature of an energyshed is the service territories of the utilities that delivery energy to consumers. For example, PECO's service territory consists of essentially the five counties of SE Pennsylvania. That territory defines the operations of its conservation programs being funded by Act 129. The rules that govern energy use have a regional quality because we tend to administer things geographically in the U.S. A complicating factor in this administrative geography stems from the state-level regulation of public utilities and energy more generally. While many features of the Philadelphia energyshed might operate most efficiently at metropolitan level, that scale would implicate at least three distinct state regulatory regimes.
- A more technically complex feature of an energyshed relates to what is called "curtailment" and more generally load shaping. This refers to a complex bundle of controls and contracts designed to prevent too much demand being placed on the electric grid at one time, both to protect it from blackouts and to reduce costs. This is even more important with the mandate to reduce peak load under Act 129. While this integrated load management can theoretically be done at any scale, in practice it gets organized among large institutions that can control their demand in response to the peak load, which basically means being able to raise dozens or hundreds of thermostats on a few hours notice on a hot August day. That takes a set of technical and organizational controls that are difficult to enforce beyond a regional scale.
- The preceding process of integrated load management raises a third feature of an energyshed. The ability to control the energy performance of buildings and to internalize the economic benefits of doing so more efficiently is defined by the structure of ownership. A university campus of one hundred buildings, for example, denominates a portfolio of energy efficiency investments that can be prioritized by return on investment thereby maximizing the savings that can be reinvested in future energy efficiency. But if those same one hundred buildings were owned by, say, ten owners, they would not realize the benefits of optimizing their investments across all one hundred buildings. Such patterns of ownership also define the limits of an energyshed and suggest the efficient portfolio that could be achieved by aggregated decision-

making (and shared returns on the best investments regardless of ownership) that better reflects the energyshed.

- A fourth feature of an energyshed has to do with energy consumers aggregating their energy purchases in order to get better and more stable prices, in other words volume discounts. These purchases have to be delivered through distribution systems of pipelines or transmission wires and are based on needs determined to some extent by weather and seasonal conditions that again exist at a regional scale. These purchasing groups are most likely to be organized locally and then linked within a region.
- A final feature of an energyshed relates to the market area of businesses and nonprofits that work within the energyshed. For example, many Recovery programs as well as Act 129 spend money on weatherizing buildings to increase their energy efficiency. That work has to be financed by lenders, marketed to building owners, and done by trained workers. Again, all this happens only when specific companies do work in specific places, and small to mid-sized contractors will likely operate within a specific region where they develop a reputation and their workers can commute.
- A related feature of an energyshed is its impact, both actual and potential, on commuting patterns and thereby on investment in transportation and housing development. This is a large topic and we provide only a placeholder here to acknowledge its importance. Location-efficient mortgages, transit-oriented development, and green infrastructure to support water and air quality are all energy strategies that operate on the scale of the energyshed. Metropolitan settlement structure understood as an energyshed is an approach to investment and policy development that views the energy implications of buildings, transportation, and infrastructure as linked, rather than separate. In a carbon-constrained economy that prices energy efficiency, emissions reductions being calculated and accounted for within the energyshed could help finance transit investments and TOD.

These features—regulatory rules, load management, energy purchasing, energy efficiency investments, transportation and housing patterns—all happen at the scale of a regional energyshed. Yet, we have no existing apparatus dedicated to pursuing the common interest in the energyshed and capable of convening parties that could benefit from a regional energy strategy. Such a strategy would lower our vulnerability to rising energy prices and climate change, and indeed could transform that vulnerability into an asset that can brand particular regions as smart places in which to live and work.

Toward an Energy Commons: Energy Assessments and Decision Making

In rebuilding America's infrastructure, the Obama Administration wants to do more than repair crumbling roads, bridges, and tunnels. As part of the American Recovery and Reinvestment Plan, major projects will be launched to improve the energy performance of the built environment, through the retrofit of obsolete or under-performing building elements and the use of cleaner, alternative forms of energy. This will not only jump-start the construction industry but also lay the foundation for a clean energy economy. In the immediate term, the stimulus package is intended to "double the production of alternative energy in the next three years, modernize more than 75 percent of federal buildings, and improve the energy efficiency of two million American homes, saving consumers and taxpayers billions on our energy bills" (Climate Progress, 2009).

This initiative has already been labeled as the "Retrofit America" initiative, a cornerstone of efforts to make the U.S. economy less energy intensive. By merging much-needed infrastructure projects with energy retrofit initiatives and alternative energy programs, the administration is positioning the country to effectively utilize its greatest resources at home and efficiently plan for a stronger, safer, and sustainable economy.

Corporations in the U.S. and worldwide need to invest in consuming less energy. The large scale energy retrofit agenda is already on the radar of companies with large corporate portfolios, federal building managers, i.e. GSA[6], university campuses[7], city mayors (greening the city[8]) and governors[9]. The current U.S. administration launched a green worker initiative[10] that will spend $500 million on new green job training and $5 billion for the retrofit of homes. This is in addition to the $4.5 billion[11] budget set aside for the energy retrofit of federal buildings.

The size of the building energy retrofit economy will be $10 billion plus over the next 10-15 years. The proper allocation of this money will encounter serious challenges, i.e. how to map the energy footprint of built assets and do this in a cost effective way. It is important to recognize that many buildings are not metered, or only metered through the utility company based on the entire building consumption. This monthly rolled-up consumption data is wholly inadequate to make retrofit decisions. An energy assessment needs to show what systems consume how much energy, and then ascertain those building parts and systems that are responsible for the major part of the consumption and possibly exhibit deficient performance. Current management of building portfolios is largely done with average and rolled-up data, such as the total energy consumption per unit of net floor area. This is inadequate for decision making with regard to possible improvement interventions.

Current challenges include:

- How to make optimal investment decisions, deciding where and when to invest to get the biggest bang per invested dollar. These decisions need to be supported at different investment policy making levels, i.e. corporations, metropolitan areas and counties, and ultimately states and the country as a whole.
- How to maintain an energy model of the built environment; this requires the combination of available data repositories from any sources, and combining this data in a comprehensive and manageable energy model of the built environment, supported by adequate digital representations, i.e. a database with representations of built objects, that contain an energy model used for performance predictions, and monitored energy consumption over time.
- How to create and maintain a network of experts that can augment the database of built objects possible retrofit interventions options, their investment cost predictions such that the database can support portfolio investment choices between competing retrofit options.
- How to manage uncertainties and risk in the prediction of costs, performance degradation over time, and risks posed by uncertain energy price scenarios, and climate change.

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6 http://www.gsa.gov/Portal/gsa/ep/contentView.do?contentType=GSA_BASIC&contentId=24402&noc=T

7 http://www.facilities.upenn.edu/environment/energy_overview.htm

8 http://news.prnewswire.com/ViewContent.aspx?ACCT=109&STORY=/www/story/04-23-2009/0005012299&EDATE=

9 http://www.state.ny.us/governor/press/lt_0925074.html

10 http://www.philly.com/philly/news/20090228_Biden_to_Philly__Green_jobs_are_coming.html

11 http://www.politifact.com/truth-o-meter/promises/promise/464/reduce-energy-consumption-in-federal-buildings/

Large-scale energy management requires simulation models and continuous control methodologies. Current simulation models are vastly underdeveloped and do not support rapid decision making and control. In addition, continuous control needs to be further researched and efficient ways of implementation need to be explored.

A new approach for urban large-scale energy management simulation was recently developed using normative calculation methods calibrated with simplified audits, spot metering and available utility that allowed – for the first time – fast, robust and comprehensive modeling for large building portfolios. The system is linked to other financial cost-benefits and greenhouse gas emission reduction analysis tools. The approach was developed collaboratively between the TC Chan Center of Building Simulation and Energy Studies at the University of Pennsylvania and Georgia Institute of Technology.

The model contains performance information about built assets that is an order of magnitude richer than utility billing data, and yet cost effective to generate. In addition, it has the capacity to model both commercial and residential buildings that allows long-term energy retrofit planning, energy investment optimization and identification of underperforming buildings that are prime candidates for energy audits and system upgrades through retrofit interventions.

Over the past five years, the TC Chan Center at Penn has deployed this system at the University of Pennsylvania of around 160 buildings. The system allowed decision makers to identify and target underperforming buildings for deeper audits with savings that ranged from 0.5-2 $/sq/year. The system was also used to plan a robust carbon reduction strategy for the campus. It allowed what-if scenarios to be conducted based on projected investments and allocating part of these investments to building energy retrofits and optimization for existing buildings, which constitutes the majority of carbon emissions. The Model is currently being expanded to cater to the needs of three constituents:

Constituent 1: City and large-scale building portfolio owners and energy policy makers: the model allows policy makers to chart metropolitan areas and verify total energy demand, identify low-performing buildings, verify investment options and see ROI. A project planning layer charting out the planned retrofits and showing the savings that have been accomplished over time through appropriate improvement dashboards is also possible.

Constituent 2: Network of “front end” retrofit planners: the model will allow retrofit experts to browse a city grid and call up building data of good candidates for retrofit. The expert will decide which options will be most appropriate; the model will inspect predicted energy performance for the options selected. For viable options the expert will enter a preliminary cost estimate in the database.

Constituent 3: Network of back-end energy auditors (certified CEM): the auditing firms will have access to the system to plan and conduct energy audits on selected built objects, both before and after the intervention.

Through the interaction of the three constituents, all essential data can be stored in the system to enable the special retrofit policy task group to run different investment scenarios and decide on the optimal investment plan among many competing investment portfolios.

Public and private stakeholders are increasingly under pressure to reduce their carbon emissions and energy costs while increasing productivity. Governments around the world are adopting new legislation that will require public and private institutions to reduce energy consumption and carbon emissions, evidenced by new definitions, policies, and codes that require adherence to ever-stricter energy savings standards. Increasingly, organizations are required to calculate and control their carbon footprint and disclose their performance to the public, fulfill requests from investors, and ascertain the level of emissions that need to be offset in order to ensure "carbon neutrality" in compliance with energy and environmental management regulations.

Current information about the energy consumption of built assets, e.g. through in-house installed metering or utility provider records is vastly incomplete, mostly incidental and hard to normalize. In addition, this data provides no information about each individual consumer-system in a building and does not provide the actionable information that is necessary to decide between different improvement interventions. Deep energy audits on a scale of more than 10 buildings are prohibitively expensive and provide more information than is necessary and relevant for energy management decisions.

In addition, attention is shifting towards smart energy grids that incorporate dispersed green electricity suppliers and new types of consumers that move from all time power contracts to reduced power availability contracts at lower cost. Utility companies will deploy energy pricing tactics that are informed by detailed energy consumption maps of existing and new urban development. Current management of building portfolios is largely done with rolled-up data such as total energy consumption per unit of net floor area. This is inadequate for decision making with regard to possible improvement interventions. Utilizing "smart" computational techniques that are fast, simple and scalable is an essential element in the mix of solutions provided in this paper, in assisting groups, organizations and communities to shift energy systems toward much more sustainable approaches and applications.

Toward an Energy Commons: The Municipal Policy Model of Austin, Texas

Besides the SEU and energyshed models now emerging in the U.S., other cities and states are forging commons-based approaches to energy development (Hughes, 2009b). In the southwestern part of the U.S., the community of Austin, Texas, is notable for its efforts over more than a decade to spur a comprehensive set of changes to energy production and use. Targeting action in the public and private sectors, the city and its municipal utility, Austin Energy, have worked within the community while also promoting shared regional approaches. The larger goal is to advance affordable, reliable, and clean energy service that simultaneously cultivates local economic prosperity and job creation in the central portion of the state.

Austin's interest in an alternative approach to energy development originated in the late 1970s. At that time, a small group of citizens began to question the cost-effectiveness of local reliance on natural gas, which was experiencing a regional supply crunch. These stakeholders also expressed concerns about the safety and affordability of nuclear power generation, which local officials advocated as a long-term source of electricity for the community. This small group of citizens researched, and ultimately pushed successfully for, a municipal policy in the 1980s that prioritized conservation as a first-order strategy for meeting Austin's energy needs. Their efforts further resulted in early municipal support for experimental programs for the local installation of solar photovoltaic systems (Hughes, 2009a).

Energy-saving policy, from 1982 to 2003, allowed Austin to avoid some 600 MW of peak demand (Austin Energy, 2009a). The equivalent economic savings have also been significant, as the investment cost for energy efficiency in Austin has been identified as falling between $250 and $400/kW, compared to $1500/kW for new installed generation running on fossil fuels (Regelson, 2005). This type of success, over time, has inspired citizens to pursue even more ambitious change.

A renewable portfolio standard (RPS) mandate in Austin now calls for such sources to provide 30% of total electricity supply by 2020. A specific solar energy target of 100 MW also applies. Targets to reduce CO_2 emissions in the public and private sectors are organized under the Austin Climate Protection Plan, devised in 2007. Among various initiatives embedded in the Plan, all new home construction in the community is to be zero-energy capable by 2015.

If current momentum is maintained, an additional 700 MW of community peak demand should be offset before 2020 (Austin Energy, 2009a). Meanwhile, renewable sources at present provide 12% of the community's electricity (Austin Energy, 2008, 2009b). This achievement has made Austin the top utility for renewable energy sales (kWh/year) in the U.S. for six years running, with 723,824,901 "green" kWh sold just in 2008 (NREL, 2009).

Alongside distributed solar PV and solar thermal[12] applications throughout the city, Austin has met its RPS target through investment in regional wind resources in McCamey and Sweetwater, Texas, totaling 439 MW installed capacity by 2009 (Austin Energy, 2008). Customers in Austin Energy's service area can purchase this renewable electricity by participating in the utility's GreenChoice power program.

To further support the achievement of its 100 MW solar goal, the Austin City Council in 2009 approved an initiative to purchase still more renewable electricity, to be generated at a 30 MW solar development on city-owned land some 20 miles from downtown (Austin Energy, 2009c). Austin's policy for 100 MW solar energy in 2020, if achieved by that year, has been estimated to yield the following economic benefits: a $952 million net increase in gross regional product; 293 net new jobs; $283 million increased earnings; $8.8 million in net sales tax revenue; and $0.6 million in net property tax revenue (City of Austin, 2006). The city's groundbreaking Green Building program, launched in 1991, has – with a yearly budget investment of $1.2 million – already been observed to save $2.2 million annually in savings (Large Cities Climate Summit, 2007).

More broadly, Austin has linked its renewable energy, efficiency and conservation programs to explicit regional action for economic development in Central Texas. For example, the Opportunity Austin 2.0 initiative, launched in 2007, unites the Austin Chamber of Commerce and similar actors in the larger five-county region. Its goal is to achieve "sustainable, broadly shared prosperity" in Central Texas, toward creating 25,000 "green jobs" in the area (Austin Chamber of Commerce, 2009: 1).

Actors such as the Clean Energy Incubator and the IC2 Institute, associated with the University of Texas at Austin, have played a strategic role in aiding new firms, helping them to gain funding, engage in beta testing technologies, form management teams, and proceed with business plans. Meanwhile, the Center for Commercialization of Electric Technologies includes members such as Austin Energy, Bluebonnet Electric Cooperative, Direct Energy, the Lower Colorado River Authority, Reliant, TXU Energy, IBM, National Instruments, Itron, Oncor, Freescale Semiconductor, Gridpoint, and five Texas universities. Its goal is to facilitate research and development of clean technology applications for the smart grid. The Pecan Street Project, active since 2008, represents a public-private coalition of Austin area municipal, utility, university, business, and environmental stakeholders, which focuses on

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[12] Austin has supported solar PV installations at local homes and businesses through a net metering policy. A solar rebate program also offers $4.50/watt of installed PV electric capacity (Austin Chamber of Commerce, 2009).

researching, testing and evaluating such technologies, with an emphasis on preparing for the wider integration of distributed solar generation on local rooftops. As of September 2009, Austin Energy was scheduled to finalize the installation of automated meters serving each of its 400,000 customers, with the utility "one of the first in the country with system-wide smart meter capability" (Austin Energy, 2009b).

Efforts are also underway to identify and coordinate enhanced regional job training in critical skill areas for green technology. With leadership provided by the Capital Area Workforce Board, actors sought for assistance here include Texas State Technical College, The University of Texas at Austin, Austin Community College, Alamo Colleges, American Youthworks, the Austin Area Urban League, the Digital Workplace Academy, Texas Hero, Austin Electrical JATC, and Sheet Metal Workers Local 67. These efforts have helped encourage the formation or retention of some 40 clean technology firms in the area (Austin Chamber of Commerce, 2009).

In pursuing these initiatives, Austin-area stakeholders have sought the "future integration of the electric and transportation sectors," through efforts to promote the commercialization of flexible-fuel plug-in hybrid vehicles. Austin Energy, under the leadership of General Manager Roger Duncan, has galvanized a nationwide effort – with some 100 cities and counties, alongside 500 additional organizations – to campaign for the mass production of such vehicles by major automakers. Under best case scenarios, Austin Energy has envisioned that wind turbines could be used to charge the vehicles from 10 pm to 6 am, for example, providing a clean and relatively inexpensive energy source for local transport (City of Austin, 2005). The city also seeks to expand opportunities for electricity to power mass transit infrastructure in Austin and the surrounding area, which may include regional rail alongside enhanced metro bus service for new mixed-use neighborhoods (City of Austin, 2009a, 2009b). This approach can increase the cost effectiveness of utilizing local and regional renewable resources, allowing for the additional capture of electricity generated at night for use during the day. Such a switch in transport fuels, away from traditional reliance on gasoline and diesel, can further aid the region in meeting federal clean air requirements (City of Austin, 2005).

Transforming the Efficiency versus Equity Tradeoff

With commons-oriented approaches in ascendance in a number of jurisdictions, this is the moment when central cities in the U.S. can recover their place within the American and global economy. For over half a century, urban assets—regional networks of walkable places connected by transit and green infrastructure with a low energy profile—have been declining in value. Such assets could not compete in a world of cheap energy and the off-ramp economy it produced.

This outcome – as unfolding over decades – was not the simple product of "neutral" forces, but rather came on the heels of a confluence of larger policy choices. More specifically, as our present industrial society unfolded during the 1800s and through the mid-1900s, compatibility between urban form and industrial technology facilitated economic development specifically within cities. At that time, the spatial concentration of urban areas was relatively matched to the types of energy resources captured and utilized in service to industrial production. In this manner, 'industrialization and urbanization became virtually inseparable' (Byrne et al, 1985: 102). While cities were certainly not immune from social and environmental problems under this relationship, the joint nature of energy-economic development did facilitate the localized availability of jobs, community-based retention of capital and financial resources, and a notion that energy system choice should be directed via municipal control, as typically carried out through municipal utilities.

As the 20th century advanced, however, these relationships began to fragment in a number of ways. With advances in technology, new forms of transportation and communication allowed individuals to live further away from their places of work. Businesses also would expand away from the inner core of cities, toward less congested and usually less expensive zones for purchasing land and financing new construction. This phenomenon was long ago characterized by Park and Burgess in their concentric zone theory (Burgess, 1925 as referenced in Cutler, 2006; Park, 1967).

Over time, larger, more sophisticated systems of electricity generation, transmission and distribution allowed energy systems to operate far from urban centers. Yet technology evolution alone does not explain these phenomena. Federal support for interstate highway construction, vastly exceeding investments in public transit options, "assured that de-concentration would become the dominant spatial trend" (Byrne et al, 1985: 103). Similarly, federal home mortgage policies encouraged home construction in new emerging suburbs, even as certain political and economic forces rallied for the vesting of authority over electric industry operations in state regulatory bodies, rather than local agents. This latter arrangement helped to facilitate the rise of private electric utilities in the U.S., and "ultimately nullified city influence" (Byrne et al, 1985: 104; Hughes, 2000).

These processes were deemed by some as necessary antecedents for achieving a modern, prosperous post-industrial society, with predictions that innovations in a number of areas would lower "the energy, materials, and capital required to support social and economic interaction" (Harkness and Standal, 1982: 219, cited in Byrne et al, 1985: 105). However, a different set of conditions – departing in myriad ways from the imagined ideal – have actually been observed in U.S. cities over the last two decades.

Where economic efficiency was expected, rising costs have been the norm, as an ever-increasing de-concentration of social activity has coincided with a requirement for ongoing construction of new, often duplicative infrastructure to serve growing suburban populations (Congress of the New Urbanism, 2006). In the U.S. specifically, a 50-year trend of decentralization has consumed land at an accelerating rate on the urban periphery and committed much of our metropolitan settlement structure to an energy and water intensive operating profile (Congress for the New Urbanism, 2007; Cutler, 2006; Satler, 2006).

One significant consequence of this decentralization has been the sorting of most U.S. metropolitan areas into advantaged and disadvantaged, growing and declining, rich and poor locations (Hughes 1989, 1991, 1999). With the loss of employers in traditional urban centers, city residents have consequently faced a lack of sufficient jobs based on livable wages. In turn, the loss of taxable revenue and declining property values in the city contribute to budgetary gaps for the municipal and county governments charged with serving urban populations. Since most U.S. metropolitan areas are fragmented across municipal, county, and often state jurisdictions, the process of residential and employment decentralization has led to funding shortfalls for a range of local services in already existing cities, such as schools, community hospitals, parks and recreation, street maintenance and transit (Katz, 2009; Duany et al, 2000; Wiewel, 1999).

The lack of local capacity to redress funding imbalances has cultivated a downward spiral of inequitable patterns for community development, as better educated populations and advanced infrastructure in other locales attract still more desirable businesses, thereby generating the revenue by which schools, roads, economic development partnerships, and other amenities may be refined to further enhance that city's competitiveness. In such a context, the relative political power of "declining" urban spaces and their inhabitants may be insufficient to tackling the changes necessary in the halls of state government to capture a larger share of the economic resources available more broadly in the region. This may be particularly evident, where "ascending" areas attract still further migrants and thereby bolster their voting power and representational influence in decision making bodies.

This mobile, fragmented settlement structure has meant that regional cooperation is almost always limited to the voluntary pursuit of efficiency improvements, so-called enlightened self-interest. For example, shared action may be mutually beneficial, where cities lack the funds to invest in more extensive transit services, and where surrounding suburbs face daily gridlock and congestion on roads used intensively by commuters. While voluntary action among these jurisdictions may thus be necessary and commendable in such cases, reliance on voluntary efforts alone can limit the capacity of regional efforts to achieve more complex efficiency gains and make the pursuit of equity gains virtually impossible. This reality leads to the conventional textbook result that equity goals based on redistribution must be pursued at higher levels of government with jurisdictions broad enough to internalize the benefits to collective action.

The dynamics of the commons-based approaches discussed in the four case studies (see above) however, fundamentally change this 'efficiency versus equity' tradeoff by reallocating resources across locations within a region. Much like the mechanics of the CDM, central cities are the low-cost locations for both carbon-reduction and low-carbon growth because of their density and infrastructure. Metropolitan areas that face energy and emissions mandates will find them much easier to meet if both investments in reductions and investments in growth are located in dense locations served by transit and other infrastructure. This will be true whether constituent municipalities and counties voluntarily collaborate or a regional organization is dedicated to the sustainable energy mission, though the latter would likely be more efficient.

With urban assets rising in value, the federal government seems committed to accelerating rather than undermining that trend. For example, as previously noted within this paper, the American Recovery and Reinvestment Act of 2009 (the Recovery Act) provides some $80 billion in funding to energy and environmental projects that can strengthen the U.S. economy and improve public health and safety.
The Recovery through Retrofit program, unveiled in October 2009, aims to lower barriers to energy efficiency improvements in buildings to "lay the groundwork for a self-sustaining home energy efficiency retrofit industry" (The White House, 2009a). With the nation's 130 million homes presently producing some 20% of total U.S. CO_2 emissions, Recovery through Retrofit provides a vehicle for advancing technology installations and retrofits that can lower energy consumption in homes by as much as 40%, with potential savings in household energy bills of $21 billion each year. Specific components of the program include: efforts to leverage private capital alongside public funding commitments; steps to enhance the accessibility and consistency of retrofit information, to include likely costs and benefits; initiatives to improve access to retrofit financing; and support for national workforce certification and training benchmarks (Middle Class Task Force Council on Environmental Quality, 2009).

The American Recovery and Reinvestment Act also provides $3.4 billion in funding for energy grid modernization in the U.S. With matching funds from industry, the total investment should come to $8 billion, with awards going to cities, utilities and private companies, manufacturers, and other actors. Improvements in infrastructure and technology should generate tens of thousands of new jobs in supportive industries, while decreasing power losses that presently equate to $150 billion in costs, each year, with lower peak demand generating additional savings of $1.5 billion (The White House, 2009b).

Meanwhile, the Obama Administration has created The White Office of Urban Affairs, to facilitate more coordinated action among federal agencies and offices in devising a policy agenda to support "highest-impact programs" that spur economic development, employment gains, and housing opportunities in cities (The White House, 2009c).

More broadly, the Obama Administration has signaled its commitment to enacting legislation to reduce CO_2 emissions in the U.S., through a market-based cap-and-trade system. The American Clean Energy and Security Act of 2009 (H.R. 2454, also known as the Waxman-Markey bill), passed by the House of Representatives on June 26, 2009, sets the preliminary stage for such a system, toward a 17% drop in greenhouse gas emissions by 2020 and ultimately an 83% decrease by 2050, against a 2005 baseline. The Senate has yet to act on the proposal, and controversy has surrounded certain aspects of its design, such as provisions supporting the initial free allocation of emissions permits to polluters. Nevertheless, eventual legislation could provide a supportive context for heightened actions by utilities, energy companies, and other businesses to limit the emissions impacts of their operations, spurring markets for new technologies and other measures across residential, industrial, commercial, governmental and other sectors.

With these dynamics at play, cities are no longer warehouses of great need. Rather, they are once again storehouses of great value — value waiting to be unlocked by regional leadership. And in this regard, there is no better place to build a low-carbon economy than a region like Philadelphia. As carbon and GHG emissions rise in price, through some combination of scarcity and taxation, then locations that can produce reductions at lowest cost will gain a competitive advantage. Cities that can develop the organizational capacity to exploit their advantages and leverage their assets will be able to produce more carbon reduction at lower cost as well as produce more composite goods at less carbon per capita.

The main difference between the Kyoto cap-and-trade process and the dynamics of an energy commons is that resources in the latter are flowing within an economy, rather than between economies. Rather than simply compensating for more emissions by (presumably) lowering them elsewhere in the world, the commitments made by an SEU or within an energyshed would actually shift investments from the high-carbon urban periphery to the low-carbon urban core. In this way it would function more like Transferable Development Rights than the Kyoto mechanism.

There are many well-understood instruments for such carbon reduction and low-carbon growth. The use of green construction materials and techniques for new buildings is one obvious way to lower energy consumption in a given community. Improved operations and maintenance and deep retrofits can also be applied to existing structures, in ways that may additionally yield substantial energy savings compared to baselines. In either case, guidelines such as LEED® Rating Systems[13] provide performance criteria for identifying and implementing improvements (U.S. Green Building Council, 2009). Energy demand in buildings can further decline, when customers voluntarily agree to curtail energy use during times of peak demand (for example, raising the thermostat on home air conditioning systems on hot summer days), in exchange for new appliances or lower energy bills.

Distributed generation at homes and businesses can serve remaining electricity demand, avoiding the efficiency losses that otherwise occur as electrons travel over the grid from their point of origin at

[13] "LEED" refers to Leadership in Energy and Environmental Design (LEED) Green Building Rating System™.

traditional power plants, to the point of final consumption. In turn, the use of distributed energy can improve the overall reliability of energy service in the community or region, by reducing the stress that would otherwise be placed on the grid. The avoidance of brownouts and blackouts is particularly important to venues such as hospitals, which provide critical care (Gellings & Yeager, 2004), and commercial actors like data centers and banks as well as manufacturing centers that require "premium" power quality delivery. In the latter case, "voltage dips that last less than 100 milliseconds can have the same effect on an industrial process as an outage that lasts several minutes or more" (National Energy Technology Laboratory, 2007). More generally, efforts to bolster on-site power generation can help lessen the impacts of large-scale grid failure, as occurred on August 14, 2003, when a power line in Ohio faltered after coming into contact with overgrown trees. As a cascading blackout unfolded, power service was cut to some 50 million people in 8 northeastern U.S. states and southeast Canada. In some places, the blackout lasted two days, with an economic cost of approximately $6 billion (Minkel, 2008). In this regard, distributed, renewable energy-based generation can serve as "dual-use technologies" (Allenby & Fink, 2005: 1034) that contribute to the larger resiliency of urban systems while also saving money and avoiding carbon emissions.

High-density mixed-use neighborhoods, where residences and businesses are found in close proximity to each other, can be located along bus or rail lines with ample sidewalks and bicycle lanes. Such transit-oriented development avoids the need for individual use of motor vehicles, and likewise may lower the necessity for new road construction over time. These high-density settlements can further facilitate the reuse of waste process heat for district heating (Sawin and Hughes, 2007; United Nations Centre for Human Settlements, 1996).

These types of energy choices can substantially reduce the economic and environmental impacts of modernity. Where new development can "fit" into preexisting urban infrastructure, driving can decline some 61%, allowing for a 50% decrease in related CO_2 emissions. When development is combined with pedestrian-friendly options as well as public transit service, the typical household can avoid some $2,000 in transport costs annually (Sierra Club, 2009). If undertaken at scale, an annual investment of $50 billion over one decade, as put toward improved energy efficiency in buildings and other non-transport changes, could achieve energy savings in the U.S. of $1.2 trillion while creating 900,000 jobs and lowering greenhouse gas emissions by 1.1 gigatons (Granade, 2009).

By increasing and recognizing the value of urban assets, the emerging features of a low-carbon economy and a de-carbonizing policy regime scramble the efficiency versus equity dilemma that has hamstrung U.S. urban and antipoverty policies for over half a century. What have been the low-resource and dim-future locations of most U.S. metro areas are now the locations in control of assets that are appreciating in value. This change creates an alignment between efficiency and equity outcomes for the first time since the confluence of technology and policy that led to postwar suburbanization.

More careful attention to the spatial organization and political economy of energy operations can make metropolitan areas a critical venue for achieving emissions reductions and managing climate change, in ways that simultaneously improve the affordability and quality of local building stock, create livable wage jobs for community residents, enhance public health, and restore meaningful, democratic connections among the users of energy with the providers of energy services. The intra-metropolitan dynamics found in the commons approaches discussed in the four case studies align the efficiency and equity agendas of regions in new and important ways, facilitating energy development approaches that advance the paradigm shift essential to our realization of a sustainable and equitable future.

Conclusion

Over the last half-century, policy and markets facilitated a globalizing economy, fueled by centralized energy systems intended to supply rapidly growing demand with low prices (U.S. Department of Energy, 2008; Lindsey, 2008). This model helped to propel the modern industrial economy and was a key prong in the rise of the U.S. as the largest economy in the history of the world. This model treats energy and most natural resources and services as commodities.

For those urban areas which have managed to capture the interest of global capital, luring industrial facilities and commercial enterprises within their borders, the benefits to their urban inhabitants can be large: higher wages, creative employment, and access to social services and cultural amenities. For those cities which have struggled to keep pace with the sweep of technological change, or which have fought for – and fallen short – in attracting the agents of modern economic progress, their viability as anchors for social life have been systematically threatened. For all modern urban settlements, however, another host of issues – climate change and pollution, and the rising social costs of attending to the needs of the greater numbers of citizens left behind by the "new economy" – suggest that disjointed energy-economic policies that privilege certain places while neglecting others cannot stand as a long-term pathway toward national, and international, economic stability and well-being.

The 20^{th} century model of proceeding with energy-economic development through a commodity-based approach, with tangential consideration of simultaneous social and environmental costs now appears outdated. A new model, specifically commons-oriented, is needed. A revitalized urban policy for energy-economic investment – turning the old rationale of 'efficiency' versus 'equity' on its head – can place social and environmental well-being at the *forefront* of action for change. This shared pathway can result in win-win outcomes, as urban areas recapture the resources necessary for investing in real improvements to their local neighborhoods, infrastructure, and economies. Their suburban counterparts, meanwhile, can benefit through this transfer of resources as the regional burdens of poor health, unemployment, urban blight, crime, and migratory pollution are abated, resulting in healthier and more vibrant communities and lower tax assessments on property and income, among other benefits.

A commons-based approach for comprehensive applications of new energy technologies, new building strategies, and new transportation approaches – as married through cooperative, creative, and democratic frameworks for assessing real social needs in particular places – are sustainable, in that they move carbon footprints much closer to the 3.3 tons CO_2 per capita standard. They are also equitable, in that they can maximize opportunities for greater social participation across all groups and income levels, in identifying and then capturing deeper improvements through a sustainable urban infrastructure.

By uniting sustainability and equity, commons approaches such as the sustainable energy utility, the energyshed, and the municipal policy model can unleash a new chapter of progressive urban strategy where the forces of social innovation benefit all groups, as well as the environment that sustains all life. The artificial demarcation of costs and benefits that limited possibilities for urban viability and larger national prosperity in the 20^{th} century energy-development model can assume its position as a historical antecedent to a new wave of environmentally-focused, urban-led, and commons-based cooperative action for real social security *and* environmental sustainability in our time.

References

Agarwal, A., & Narain, S. 1995. Global warming in an unequal world: A case of environmental colonialism. In K. Conca, M. Alberty, & G. D. Dabelko (Eds.), *Green planet blues: Environmental policy from Stockholm to Rio* (pp. 150-153). Boulder, CO: Westview.

Agbemabiese, Lawrence. 2009. A Framework for Sustainable Energy Development Beyond the Grid: Meeting the Needs of Rural and Remote Populations. *Bulletin of Science, Technology and Society*, 29(2): 151-158.

Agyeman, J., & Evans, B. 2004. Just sustainability: The emerging discourse of environmental justice in Britain? *The Geographical Journal, 170*(2), 155-164.

Alroe, H. F., Byrne, J., & Glover, L. 2006. Organic agriculture and ecological justice: Ethics and practice. In N. Halberg, H .F. Alroe, M. T. Knudsen, & E. S. Kristensen (Eds.), *Global development of organic agriculture: Challenges and promises* (pp. 75-112). Wallingford, UK: CABI Publishing.

Apollo Alliance. 2008. *Clean energy strategies for the manufacturing sector*. Retrieved July 15, 2008, from http://www.apolloalliance.org/resources_manufacturing.php

Austin Energy. 2008. Austin Energy GreenChoice #1 in the Nation. Press Release (May 5).

Austin Energy. 2009a. Austin Energy General Manager Announces Retirement. Press Release (Oct. 7).

Austin Energy. 2009b. Austin Energy Among Nation's Top 25 Intelligent Utilities. Press Release (Sept. 2).

Austin Energy. 2009c. Austin Council Approves Largest Solar System in the Nation, One of Largest in the World. Press Release (March 5).

Austin Chamber of Commerce. 2009. Green Job Task Force Initiative Report. Available at: http://www.austin-chamber.org/DoBusiness/ExistingBusiness/GreenJobs.pdf

Bashi, Vilna, and Mark Alan Hughes. 1997. Globalization and Residential Segregation by Race. *The Annals of the American Academy of Political and Social Science*, Vol. 551: 105-120.

Blees, Tom. 2008. *Prescription for the Planet: The Painless Remedy for Our Energy & Environmental Crises*. Booksurge Publishing.

Burgess, E. W. 1925. The growth of the city: An introduction to a research project. In R. Park, E. W. Burgess, & R. D. McKenzie (Eds.), *The City* (pp. 47-62). Chicago: University of Chicago Press.

Byrne, John, Leigh Glover, and Cecilia Martinez. 2002. The production of unequal nature. In J. Byrne, L. Glover, & C. Martinez (Eds.), *Environmental justice, discourses in international political economy* (pp. 261-291). New Brunswick, NJ: Transaction Publishers.

Byrne, John, Leigh Glover and Hugo F. Alroe. 2006c. Globalization and sustainable development: a political ecology strategy to realize ecological justice. In Niels Halberg et al (eds.), *Global Development of Organic Agriculture: Challenges and Prospects*. Oxfordshire , UK : CABI Publishing, pp. 49-74.

Byrne, John, Kristen Hughes, Noah Toly, and Young-Doo Wang. 2006b. Can Cities Sustain Life in the Greenhouse? *Bulletin of Science, Technology and Society*, 26(2): 84-95.

Byrne, John, Kristen Hughes, Wilson Rickerson, and Lado Kurdgelashvili. 2007. American Policy Conflict in the Greenhouse: Divergent Trends in Federal, Regional, State, and Local Green Energy and Climate Change Policy. *Energy Policy*, 35(9): 4555-4573.

Byrne, John, and Cecilia Martinez. 2009. Delaware's Sustainable Energy Utility. *Delaware Lawyer* (Summer): 26-31.

Byrne, John, Cecilia Martinez and Colin Ruggero. 2009. Relocating Energy in the Social Commons: Ideas for a Sustainable Energy Utility. *Bulletin of Science, Technology and Society*, 29(2): 81-94.

Byrne, John, Cecilia Martinez, and Daniel Rich. 1985. The Post-Industrial Imperative: Energy, Cities and the Featureless Plain, in *Energy and Cities*, pp. 101-141.

Byrne, John, and Yu-Mi Mun. 2003. Rethinking reform in the electricity sector: Power liberalisation or energy transformation? In N. Wamukonya (Ed.), *Electricity reform: Social and environmental challenges* (pp. 48-76). Roskilde, Denmark: UNEP-RISØ Centre.

Byrne, John, and Noah Toly. 2006a. Energy as a Social Project: Recovering a Discourse. In John Byrne, Noah Toly, and Leigh Glover (eds). *Transforming Power: Energy, Environment, and Society in Conflict.* New Brunswick, NJ and London: Transaction Publishers, pp. 1-32.

Byrne, John, Young-Doo Wang, Hoesung Lee and Jong-dall Kim. 1998. An Equity- and Sustainability-Based Policy Response to Global Climate Change. *Energy Policy*, 26(4): 335-343.

Byrne, John, Young-Doo Wang, Jung Min Yu, Ashok Kumar, Lado Kurdgelashvili, and Wilson Rickerson, 2008. *Sustainable Energy Utility Design: Options for the City of Seoul (Final Report to Seoul Development Institute)*. Newark, DE: CEEP.

City of Austin. 2005. *Integrating the Electric and Transportation Sectors: Plug-In Hybrid Vehicles/Information Packet*. Austin, TX: Austin Energy.

City of Austin. 2009a. Downtown Austin Plan – Urban Rail. Retrieved Dec. 1, 2009, from www.ci.austin.tx.us/downtown/dap_urban_rail.htm

City of Austin. 2009b. Downtown Redevelopment. Available at: www.ci.austin.tx.us/downtown/

Climate Progress. 2009. Obama: 'We Will Double the Production of Alternative Energy in the Next Three Years.' Retrieved Dec. 9, 2009, from http://climateprogress.org/2009/01/08/obama-we-will-double-the-production-of-alternative-energy-in-the-next-three-years/

Congress of the New Urbanism. 2006. Charter of the New Urbanism. Retrieved October 1, 2008, from http://www.cnu.org/aboutcnu/index.cfm?formAction=charter

Congress for the New Urbanism. 2007. Learn About New Urbanism. Available at: http://www.cnu.org/intro_to_new_urbanism

Cutler, I. 2006. *Chicago: Metropolis of the mid-continent* (4th ed.). Carbondale, IL: Southern Illinois University Press.

Delaware Sustainable Energy Utility. 2009. Delaware Sustainable Energy Utility FAQs. Available at: http://www.energizedelaware.org/FAQs

Dougherty, Conor. 2009. The Long Slog: Out of Work, Out of Hope. Wall Street Journal (Sept. 25).

Duany, Andres, Elizabeth Plater-Zyberk, and Jeff Speck. 2000. *Suburban Nation: The Rise of Sprawl and the Decline of the American Dream*. New York: North Point Press.

Droege, Peter. 2008. *Urban Energy Transition: From Fossil Fuels to Renewable Power*. Oxford: Elsevier.

Energy Information Administration (EIA). 2008. World Per Capita Carbon Dioxide Emissions from the Consumption and Flaring of Fossil Fuels. Retrieved December 8, 2009, from http://www.eia.doe.gov/pub/international/iealf/tableh1cco2.xls

Energy Information Administration (EIA). 2009. Natural Gas Prices. Retrieved December 8, 2009, from http://tonto.eia.doe.gov/dnav/ng/ng_pri_sum_dcu_nus_m.htm

Flavin, C., & Dunn, S. (1998). Responding to the threat of climate change. In L. Brown & L. Starke (Eds.), *State of the world 1998* (pp. 113-130). New York: W.W. Norton & Company.

Granade, Hannah Choi, Jon Creyts, Anton Derkach, Philip Farese, Scott Nyquist, and Ken Ostrowski. 2009. *Unlocking Energy Efficiency in the U.S. Economy*. McKinsey Global Energy and Materials. Available at: http://www.mckinsey.com/clientservice/electricpowernaturalgas/US_energy_efficiency/

Green Energy DC. 2009. Welcome to Green Energy DC! Available at: http://green.dc.gov/green/cwp/view,a,1244,q,461275.asp

Herig, Christy. 2006. *City of Austin, Austin Energy Tool for Analysis of Economic Development Benefits For Solar Manufacturing & Installation*. Austin, TX: Austin Energy.

Hopkins, 2003. Renewable Energy and State Economies. The Council of State Governments.

Hughes, Mark Alan. 1989. Mis-Speaking Truth to Power: A Geographical Perspective on the 'Underclass' Fallacy. *Economic Geography*, Vol. 65: 187-207.

Hughes, Mark Alan. 1991. Employment Decentralization and Accessibility: A Strategy for Stimulating Regional Job Opportunities. *Journal of the American Planning Association*, Vol. 57: 288-299.

Hughes, Mark Alan, and Anais Loizillon. 1999. Over the Horizon: Job Deconcentration in Major Metropolitan Areas, in Anita A. Summers et al (eds.), *Urban Change in the United States and Western Europe, Second Edition*. Washington, DC: Urban Institute Press.

Hughes, Mark Alan. 2000. Federal Roadblocks to Regional Cooperation: The Administrative Geography of Federal Programs in Large Metropolitan Areas, in Greenstein and Weiwal (eds.), *Urban-Suburban Interdependence: New Directions for Research and Policy*. Cambridge, MA: Lincoln Institute for Land Policy.

Hughes, Kristen. 2009a. *The City as a Community-Based Force for Sustainability in Energy Systems*. Dissertation submitted to the University of Delaware, Newark.

Hughes, Kristen. 2009b. An Applied Local Sustainable Energy Model: The Case of Austin, Texas. *Bulletin of Science, Technology and Society*, 29(2): 108-123.

Institute for Agriculture and Trade Policy (IATP). 2009. SEU Updates. Available at: http://www.iatp.org/seu/.

Intergovernmental Panel on Climate Change (IPCC). 1990. *Climate Change: The IPCC Scientific Assessment*. J.T. Houghton, G.J. Jenkins and J.J. Ephraums (Eds.). New York: Cambridge University Press.

Intergovernmental Panel on Climate Change (IPCC). 2007. *Climate Change 2007: Physical Science Basis*. Cambridge, England: Cambridge University Press.

Johnson, Katherine M., and Charles G. Schmidt. 2009. Room to Grow: Urban Ambitions and the Limits to Growth in Weld County, Colorado. *Urban Affairs Review*, 44(4): 525-553.

Kampschroer, Kevin. 2009. Remarks to the Subcommittee on Economic Development, Public Buildings, and Emergency Management Committee on Transportation and Infrastructure, U.S. House of Representatives (July 16). Available at: http://www.gsa.gov/Portal/gsa/ep/contentView.do?contentType=GSA_BASIC&contentId=28312&noc=T

Katz, Bruce. 2009. "What Comes Next for Our Metro Nation: The New Forces Driving Regionalism." Remarks prepared for the Regional Policy Conference, Minneapolis, MN (September 23).

Large Cities Climate Summit. 2007. Austin's Green Building Program Facilitates the Construction of Sustainable Buildings. Available at: http://www.nycclimatesummit.com/casestudies/building/bldg_austin.html

Lovins, A. 1977. *Soft energy paths: Toward a durable peace*. Cambridge, MA: Ballinger.

Mouwad, Jad and Heather Timmons. 2006. Commodity trading fueling price of oil. *New York Times* (April 30).

Middle Class Task Force Council on Environmental Quality. 2009. Recovery Through Retrofit. Washington DC: Vice President of the United States and Executive Office of the President of the United States.

Minkel, J.R. 2008. The 2003 Northeast Blackout--Five Years Later. *Scientific American* (August 13).

Mumford, Lewis. 1961. *The City in History: Its Origins, its Transformations and its Prospects*. New York: Harcourt Brace & Jovanovich.

Muro, Mark, Bruce Katz, Sarah Rahman, and David Warren. 2008. *MetroPolicy: Shaping a New Federal Partnership for a Metropolitan Nation*. Washington, DC: The Brookings Institution Metropolitan Policy Program.

National Energy Technology Laboratory. 2007. *Appendix A4: A Systems View of the Modern Grid/Provides Power Quality For 21st Century Needs*. Washington, DC: U.S. Department of Energy Office of Electricity Delivery and Energy Reliability.

National Renewable Energy Laboratory (NREL). 2009. NREL Highlights Utility Green Power Leaders. Press Release (April 13).

Park, R. E. 1967. *The city* (Midway reprint, with E. W. Burgess & R. D. McKenzie). Chicago: University of Chicago Press.

Podesta, John. 2009. Testimony of John D. Podesta at Vice President Biden's Middle Class Task Force (February 27). Available at: http://www.agobservatory.org/library.cfm?refID=106295

Prayas Energy Group. 2001. The real challenge in power sector restructuring: Instilling public control through TAP. *Energy for sustainable development, 5*(3), 95-02.

Ranney, D. 2003. *Global decisions, local collisions*. Philadelphia: Temple University Press.

Rifkin, J. (2002, October 10). The U.S. must follow Europe's lead and turn its back on oil. *The Guardian*, pp. 1-2.

Regelson, K. 2005. *Sustainable Cities*. Denver, CO: Sierra Club.

Satler, G. 2006. *Two tales of a city: Rebuilding Chicago's architectural and social landscape, 1986-2005*. DeKalb, IL: Northern Illinois University Press.

Sawin, J., & Hughes, K. (2007). Energizing cities. In L. Starke (Ed.), *State of the world: Our urban future* (pp. 90-107). Washington, DC: The Worldwatch Institute.

Scheer, H. (2008). Solar city: Reconnecting energy generation and use to the technical and social logic of solar energy. In P. Droege, *Urban energy transition: From fossil fuels to renewable power* (pp. 17-26). Amsterdam: Elsevier.

Sierra Club. 2009. A Primer on Sprawl and Smart Growth. Available at: http://www.sierraclub.org/dc/sprawl/background/index.html

Söderholm, P., & Sundqvist, T. 2003. Pricing environmental externalities in the power sector: Ethical limits and implications for social choice. *Ecological Economics, 46*(3), 333-350.

Tietenberg, T. 2000. *Environmental and natural resource economics* (5th ed). Reading, MA: Addison-Wesley.

Transnational Institute. 2003. Lights on! Towards equitable, sustainable, and democratic electricity policies. *Power & Society Debate Papers, 3*(2), 1-20.

United Nations Centre for Human Settlements. (1996). *An Urban World: Global report on Human Settlements 1996*. Oxford, UK: Oxford University Press.

U.S. Department of Labor. 2009. Employment situation. Retrieved Dec. 4, 2009, from http://www.bls.gov/news.release/empsit.toc.htm

U.S. Department of State. 2002. The international aspects of U.S. energy security. Retrieved March 10, 2007, from http://www.state.gov/e/rls/rm/2002/11311.htm

U.S. Energy Information Administration (EIA). 2004. *Annual energy outlook 2004 with projections to 2025*. Washington, DC: U.S. Department of Energy.

U.S. Green Building Council. 2009. LEED Rating Systems. Available at: http://www.usgbc.org/DisplayPage.aspx?CMSPageID=222

The White House. 2009a. Vice President Biden Unveils Report Focused on Expanding Green Jobs and Energy Savings for Middle Class Families. Press Release (Oct. 19).

The White House. 2009b. President Obama Announces $3.4 Billion Investment to Spur Transition to Smart Energy Grid. Press Release (Oct. 27).

The White House. 2009c. Establishment of the White House Office of Urban Affairs. Press Release (Feb. 19).

Wiewel, Wim, Joseph Persky, and Mark Sendzik. 1999. Private Benefits and Public Costs: Policies to Address Suburban Sprawl. *Policy Studies Journal*, 27(1): 96-114.