2009

The Land Use Stabilization Wedge Strategy: Shifting Ground to Mitigate Climate Change

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THE LAND USE STABILIZATION WEDGE STRATEGY: SHIFTING GROUND TO MITIGATE CLIMATE CHANGE

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ABSTRACT

This article describes how local governments, through the clever application of existing land use techniques, can mitigate climate change. This strategic path follows one developed by Princeton professor Robert Socolow, who identified and described fifteen categories for organizing society's climate change mitigation efforts.[1] Five of Socolow's strategic categories fall within the reach of local land use authority: reduced use of vehicles, energy efficient buildings, vegetative carbon sequestration, wind power, and solar power.[2] Through the aggregation of these local land use techniques, significant energy savings and carbon dioxide ("CO_2") reduction can be achieved. After making some background points, this article describes how local governments are attacking the root causes of climate change and how state and federal policies can embrace local power, energy, and people to launch a coordinated attack on perhaps the greatest challenge our nation faces.

INTRODUCTION TO SHIFTING GROUND

The dominant pattern of human settlement in the United States is the single-family neighborhood, with homes built on individual lots and located apart from shopping, recreation, entertainment, and workplaces.[3] Residents in these neighborhoods own cars and drive to most of their daily

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[1] Stephen Pacala & Robert Socolow, *Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies*, SCIENCE, Aug. 13, 2004, at 968, 970 tbl.1, *available at* http://www.sciencemag.org/cgi/reprint/305/5686/968.pdf.

[2] *See id.*

[3] Christopher B. Leinberger, *The Next Slum?*, ATL. MONTHLY, Mar. 2008, http://www.theatlantic.com/doc/200803/subprime.

destinations.[4] Their homes, on average, are large and consume considerable energy for heating, lighting, appliances, and cooling.[5]

This preference for living in single-family neighborhoods gained favor as soldiers returned from World War II.[6] Almost two-thirds of the houses constructed in the past decade are single-family detached residences.[7] This land use pattern causes resource consumption to outpace population growth. As the population grew by fifteen percent between 1982 and 1997, the total area of land dedicated to development grew by thirty-four percent.[8] This was accompanied by a dramatic reduction in the construction of multi-family dwellings.[9]

As concerns over the consequences of climate change heighten, policymakers are becoming increasingly aware that the single-family settlement pattern contributes significantly to climate change.[10] Single-family homes use more energy than do multi-family dwellings.[11] The

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[4] *See* Bekah Mandell, *Racial Reification and Global Warming: A Truly Inconvenient Truth*, 28 B.C. THIRD WORLD L.J. 289, 341 (2008) ("Auto-dependent development and the transportation hierarchy have increased car ownership in the United States, making it essential for every member of suburban households to have access to a car or risk complete isolation, both economic and social.").

[5] *See infra* notes 11–12.

[6] Leinberger, *supra* note 3.

[7] Arthur C. Nelson & Robert Lang, *The Next 100 Million*, PLANNING, Jan. 2007, at 4, 4, *available at* http://www.mi.vt.edu/uploads/The Next 100 Million.pdf.

[8] U.S. ENVTL. PROT. AGENCY, PROTECTING WATER RESOURCES WITH HIGHER DENSITY DEVELOPMENT 2 (2006), *available at* http://www.epa.gov/dced/pdf/protect_water_higher_density.pdf [hereinafter EPA PROTECTING WATER RESOURCES].

[9] U.S. Census Bureau, Highlights of Annual 2006 Characteristics of New Housing, http://www.census.gov/const/www/highanncharac2006.html (last visited Oct. 7, 2009) ("Multi-family construction has decreased dramatically over the last 20 years from 636,000 units, [sic] in 1986 to 153,000 units in 1993. It rebounded 325,000 units in 2006."). In addition, external connectivity in neighborhoods and pedestrian access to commercial uses also consistently declined. *See* Gerrit-Jan Knaap, Yan Song & Zorica Nedovic-Budic, *Measuring Patterns of Urban Development: New Intelligence for the War on Sprawl*, 12 LOCAL ENV'T 240, 253 (2007).

[10] *See* Goddard Space Flight Center, Land Cover Changes May Rival Greenhouse Gases as Cause of Climate Change (Oct. 1, 2002), http://www.gsfc.nasa.gov/topstory/ 20020926 landcover.html; Union of Concerned Scientists, The Impact of Land Use on Climate Change, http://www.ucsusa.org/global_warming/science_and_impacts/impacts/the-impacts-of-land-use-on.html (last visited Oct. 20, 2009).

[11] Reid Ewing & Fang Rong, *The Impact of Urban Form on U.S. Energy Use*, 19 HOUSING POL'Y DEBATE 1, 20 (2008), *available at* http://www.mi.vt.edu/data/files/hpd%2019.1/ewing_article.pdf

> Compared with households living in multifamily units, otherwise comparable households living in single-family detached units consume 54 percent more energy for space heating and 26 percent more energy for

dramatic differences in energy consumption and CO_2 emissions between the single-family and mixed-use, higher density land use pattern is due to the size of housing and its proximity to the daily destinations of residents.[12] The development of single-family, single use neighborhoods increases vehicle miles traveled significantly.[13] "Americans drive so much because [they] have given [themselves] little alternative. . . . From World War II until very recently, nearly all new development has been planned and built on the assumption that people will use cars every time they travel."[14]

In the post-World War II era, this settlement pattern made some sense; cities tended to be "dirty, sooty, smelly, and crowded."[15] This perception, however, is changing; in fact, the image of cities as concentrations of polluting influences is dead wrong when viewed through the lens of climate change. On a per capita basis, urban dwellers produce dramatically less CO_2 and other pollutants than those in surrounding suburbs.[16] This is a critical matter when one considers that, by the year 2039, the

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> space cooling. Not surprisingly, energy for heating, cooling, and all other uses increases with house size. Compared with a household living in a 1,000-square-foot house, an otherwise comparable household living in a 2,000-square-foot house consumes 16 percent more energy for space heating and 13 percent more energy for space cooling.

Id.

[12] Consortium for Atlantic Regional Assessment, Land Use Primer: Land Use and Global Change, http://www.cara.psu.edu/land/lu-primer/luprimer14.asp (last visited Oct. 8, 2009) ("Single family homes use more energy per person than multifamily homes. Larger homes use more energy per person than multifamily homes. The farther new homes are from existing population centers, from work and shopping, the greater the additional energy use in transportation per home and per person.").

[13] U.S. ENVTL. PROT. AGENCY, OUR BUILT AND NATURAL ENVIRONMENTS: A TECHNICAL REVIEW OF THE INTERACTIONS BETWEEN LAND USE, TRANSPORTATION, AND ENVIRONMENTAL QUALITY 21 (2001), *available at* http://www.epa.gov/smartgrowth/pdf/built.pdf [hereinafter EPA BUILT AND NATURAL ENVIRONMENTS] ("[L]and use patterns . . . have led to increases in average trip distances (38 percent) and in the number of trips made (25 percent)."); U.S. ENVTL. PROT. AGENCY, INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990–2007 ES-4 tbl.ES-2 (2009), *available at* http://www.epa.gov/climatechange/emissions/downloads09/InventoryUSGhG1990-2007.pdf [hereinafter EPA INVENTORY OF GREENHOUSE GAS EMISSIONS] (reporting that in 2007, out of the 6,103.4 Tg CO_2 released in the U.S., 1,887.4 Tg CO_2 was attributable to transportation sources).

[14] REID EWING ET AL., GROWING COOLER: EVIDENCE ON URBAN DEVELOPMENT AND CLIMATE CHANGE 2 (2008).

[15] Richard Florida, *How the Crash Will Reshape America*, ATL. MONTHLY, Mar. 2009, at 44, 55.

[16] *See* EWING ET AL., *supra* note 14, at 46 fig.3-10 (showing that Chicago citizens drive less than 21,000 miles, compared with nearly 30,000 in suburban Chicago County, and emit eighty percent fewer tons of CO_2 per household than suburbanites in the surrounding county).

population of the United States will have swelled to over four hundred million people, a dramatic increase of one hundred million people since 2006.[17] By 2040, it is projected that America will add 93 million new homes and 137 billion square feet of nonresidential construction to accommodate this growth and to replace obsolete buildings.[18] One hundred million people translates into forty million new households whose members will live, work, and shop in these buildings, traveling from one to the other and beyond, largely by car.[19]

Unless we change this current pattern of land development, the buildings and cars occupied by these new Americans will dramatically increase the emission of CO_2. CO_2 constitutes approximately eighty-five percent of total U.S. greenhouse gas emissions and can be reduced significantly by reshaping human settlement patterns.[20] Residential and

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[17] U.S. Census Bureau, U.S. Population Projections (2008), http://www.census.gov/population/www/projections/summarytables.html (follow "Projections of the Population and Components of Change for the United States: 2010 to 2050" hyperlink) (last visited Oct. 8, 2009). The United States population in 2006 was 299.4 million people. U.S. Census Bureau, Population Estimates, http://www.census.gov/popest/states/NST-ann-est2006.html (follow "Annual Estimates of the Population for the United States, Regions, States, and for Puerto Rico: April 1, 2000 to July 1, 2006" hyperlink) (last visited Oct. 8, 2009). Population projections are estimates only. *See* Robert E. Lang, Mariela Alfonzon & Casey Dawkins, *American Demographics—Circa 2109*, PLANNING, May 2009, at 10, 10. They depend on fertility, immigration, and aging trends that are difficult to project. *See id.* at 10–11. That said, most credible evidence indicates that the U.S. population will increase significantly throughout the next century. *See id.* at 13 ("[I]t is very likely that the U.S. population will be at 400 million by midcentury."). Calculations used in this article assume generally that within three or four decades there will be 100 million more Americans and that the average household size will be 2.5 persons per household, resulting in a net increase of 40 million households. The official U.S. projection for the next 100 years conducted by the U.S. Census Bureau, using a medium scenario for growth, projects a doubling of the 2000 population by the year 2100, a total of 571 million people. *Id.* at 10.

[18] *See* Arthur C. Nelson, University of Pennsylvania, Mega Trends: Thinking Beyond the Crisis 9–10 (Mar. 12, 2009), http://www.upenn.edu/penniur/pdf/Nelson Presentation.pdf.

[19] One hundred million divided by an average household size of 2.5 results in 40 million households. The average household size by 2039 could be smaller, resulting in more households and a demand for even more homes. *See* EWING ET AL., *supra* note 14, at 24 ("From 2000 to 2025, households without children will account for 88 percent of total growth in households. Thirty-four percent will be one-person households. By 2025, only 28 percent of households will have children.").

[20] CO_2 is the primary anthropogenic greenhouse gas and its control is critical to climate change mitigation. *See* EPA INVENTORY OF GREENHOUSE GAS EMISSIONS, *supra* note 13, at ES-4 (showing that CO_2 represents 85.4% of the total greenhouse gas emissions in the United States and is the primary greenhouse gas emitted by humans); *see also* BERT METZ ET. AL., INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007:

commercial buildings are responsible for nearly thirty-five percent of the CO_2 emissions in the United States,[21] and the use of personal automobiles alone is responsible for approximately seventeen percent of emissions.[22] This topic is of critical importance as evidence mounts that we must act urgently to address the catastrophic consequences of climate change.[23] By shifting ground from predominately single-family to predominately urban settlements,[24] which fosters more energy efficient buildings and transportation systems, we can lower per capita CO_2 emissions significantly. Indeed, unless we alter the current human settlement pattern, it may be impossible to reduce the nation's emissions of CO_2 in time to prevent the devastating consequences that our climate change crisis portends.[25]

Fortunately, it appears that the majority of the next one hundred million Americans will be oriented toward urban living and will create market pressures that will motivate the private sector to build and expand

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MITIGATION OF CLIMATE CHANGE: SUMMARY FOR POLICYMAKERS 3 (2007), *available at* http://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-spm.pdf [hereinafter IPCC WG III] (noting that CO_2 emissions represented 77% of the total global anthropogenic greenhouse gas emissions in 2004).

[21] *See* EPA INVENTORY OF GREENHOUSE GAS EMISSIONS, *supra* note 13, at 2–19.

[22] *Id.*

[23] *See infra* notes 106–132 and accompanying text.

[24] For the purpose of this article, "urban settlements" refers to populations living within and around existing cities and villages that have built water, sewer, and transportation infrastructure to serve an above average concentration of population.

[25] *See* Robert H. Socolow & Stephen W. Pacala, *A Plan to Keep Carbon in Check*, SCI. AM., Sept. 2006, at 52.

> The task of holding global emissions constant would be out of reach, were it not for the fact that all the driving and flying in 2056 will be in vehicles not yet designed, most of the buildings that will be around then are not yet built, [and] the locations of many of the communities that will contain these buildings and determine their inhabitants' commuting patterns have not yet been chosen . . . .

Id.

It is possible that future generations of Americans will live in a post-carbon era at some point, where most transportation is electrified and where energy is produced from predominately non-carbon sources. *See id.* at 53–55 (discussing alternative sources of renewable energy and means of "decarbonizing" energy resources). While such a society could better tolerate long and frequent automobile trips and large, single-family homes on individual lots, climate change must be mitigated now, using available technologies such as those this article describes. *See infra* notes 134–153 and accompanying text. Further, other critical environmental goals such as reducing water, material, and resource consumption, stormwater run off, water pollution, and the destruction of wetland and habitats will still require more concentrated patterns of settlement.

urban settlements.[26] Cities are responding already by creating higher density, mixed-use neighborhoods to accommodate these new American families.[27] Because sixty-six percent of the buildings in existence by the year 2050 will be built between now and then,[28] we have an opportunity to affect the shape and function of the places where the majority of all Americans will live.

As of 2003, the current density of housing in urban areas was approximately 7.5 net units per acre.[29] If we double that average to 15 units per acre, the projected 100 million new residents will emit up to 1,200 million fewer metric tons of CO_2 annually.[30] This is because fifteen dwelling units per acre is sufficient to support public transit,[31] increase walking, reduce vehicle trips and miles traveled, and decrease energy consumption in the smaller, more thermally-efficient residences that are built in urban areas.[32]

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[26] *See* Nelson & Lang, *supra* note 7, at 4, 6.
[27] *See infra* Part IV.B.
[28] *See* EWING ET AL., *supra* note 14, at 8.
[29] *Id.*
[30] Alex Williams, *Don't Let the Green Grass Fool You*, N.Y. TIMES, Feb. 10, 2008, http://www.nytimes.com/2008/02/10/fashion/10suburbs.html (estimating that suburban Atlanta residents generate up to 31.1 tons/year). *See also* CITY OF NEW YORK, PLANYC: A GREENER, GREATER NEW YORK 135 (2007) (reporting that the average resident of New York City produces 7.1 metric tons of CO_2 annually, compared with a national average of 24.5). The author adjusted the New York City number upward to 12.5 to approximate the lesser amount of emissions in higher density, transit oriented developments, and has used 24.5 metric tons as the nationwide average of CO_2 emitted due to car travel and buildings occupied by Americans. If the nationwide average is 24.5 and urban dwellers emit 12.5 metric tons per capita, then 100 million new residents will emit 1,200 fewer trillion metric tons. This calculation is designed intentionally as a provocative example to emphasize the positive effects of policies that foster urban settlements.
[31] *See* INST. OF TRANSP. ENG'RS, A TOOLBOX FOR ALLEVIATING TRAFFIC CONGESTION 93 (1989), *available at* http://www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/10803.pdf Transit systems require riders, and transit oriented communities must have enough population to support passenger rail service, bus rapid transit, or other commercial, multi-person conveyances. *See id.* The Institute of Traffic Engineers estimates that four to five housing units per acre are necessary to support a transit system at a minimum level, and approximately 15 units per acre are needed to support frequent service. *Id.* Increased commercial density also increases transit ridership. *Id.*
[32] Claiming that local land use reforms can shift settlement patterns and create more energy efficient buildings to achieve a reduction of 1,200 million metric tons of CO_2 annually is, at first blush, a radical statement. Other estimates of CO_2 saved through compact, mixed use development are much more conservative; they assume that we have time to adjust land use patterns and building construction gradually as demographics and market conditions change. *See* PEW CENTER ON GLOBAL CLIMATE CHANGE, INNOVATIVE

If savings that can be achieved by the adoption and enforcement of energy conservation codes are factored in, this reduction of 1,200 million metric tons of CO_2 annually becomes even more achievable.[33] The residential and commercial sectors account for approximately one-third of the

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POLICY SOLUTIONS TO GLOBAL CLIMATE CHANGE: TAKING CLIMATE CHANGE INTO ACCOUNT IN U.S. TRANSPORTATION 7 (2008) [hereinafter PEW POLICY SOLUTIONS], *available at* http://pewclimate.org/docUploads/ustransp_brief.pdf. However, this article's estimate is illustrative of what could be done if policymakers determine that the consequences of climate change are so serious that more ambitious measures to support population resettlement and efficient buildings are merited. For further discussion, see *infra* notes 137–143 and accompanying text (describing the impact that heightened energy conservation code standards can have on CO_2 reduction). *Cf.* PEW POLICY SOLUTIONS, *supra*, at 7.

> Transportation demand is influenced by the geographic distribution of people and places, especially the density of development and zoning. Studies have shown that a combination of land use and transit policies might succeed in reducing vehicle miles in large urban areas by 5 to 10 percent over thirty years, if combined with policies to charge for parking and for use of congested roads. Vehicle travel might be reduced by 10 to 25 percent by changing the design of subdivision development to accommodate walking and cycling and mixed land uses to reduce the need for motorized trips.

Readers are also encouraged to probe the more precise and measured projections contained in Keith Bartholomew & Reid Ewing, Land Use-Transportation Scenario Planning In an Era of Global Climate Change (November 5, 2007) (unpublished paper), *available at* http://faculty.arch.utah.edu/bartholomew/Bartholomew_Ewing_Revision.pdf (illustrating the complexity of factoring all of the influences of compact, mixed-use development in reducing energy consumption and CO_2 emissions as the population shifts).

[33] Energy conservation codes are either adopted by state governments—which typically require local enforcement and allow localities to adopt stricter standards—or by local governments directly. *See* Building Codes Assistance Project, http://www.bcap-energy.org (last visited Oct. 10, 2009). However, the use of the American Recovery and Reinvestment Act to incentivize state adoption of the more strict 2009 ICC energy conservation code is an example of a catalytic action at the federal level that can change radically state and local land use regulations and dramatically reduce energy use and CO_2 emissions. *See* BUILDING CODES ASSISTANCE PROJECT, BUILDING CODES IN THE AMERICAN RECOVERY AND REINVESTMENT ACT OF 2009 (ARRA) (2009) *available at* http://bcap-energy.org/files/Building_Codes_in_the_ARRA_2009.pdf. Yet there are many other areas left open to state and local regulation. For example, "[r]esearchers estimate that if 80 percent of commercial buildings were retrofitted with 'cool' roofs that reflected heat, the nation could save enough on air-conditioning to reduce carbon dioxide emissions by 6.23 million metric tons annually—the equivalent of taking 1.2 million cars off the road." Felicity Barringer, *White Roofs Catch On as Energy Cost Cutters*, N.Y. TIMES, July 30, 2009, at A1. Thus, cool roofs could be required or encouraged by state energy conservation codes or local site plan regulations to achieve further emissions reductions.

total U.S. CO_2 emissions,[34] or 2.256 million metric tons of CO_2 per year.[35] Some estimate that enforcement of the standards contained in energy conservation codes can decrease energy use in buildings by approximately twelve quads, which would constitute more than fifty percent of the 2007 residential energy consumption.[36] The International Code Council ("ICC"), whose International Energy Conservation Code ("IECC") is the model for most states, is committed to increasing the efficiency of its energy code every three years.[37] Programs, such as Energy Star, encourage homeowners and developers to meet energy efficiency standards that make these homes twenty to thirty percent more efficient than standard homes.[38] The 2030 Challenge entertains the prospect of achieving carbon neutrality in buildings by the year 2030.[39]

This article describes how, through the clever application of existing land use techniques, such as transit oriented development zoning and enhanced energy conservation code adoption, strategies can be

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[34] *See* EPA INVENTORY OF GREENHOUSE GAS EMISSIONS, *supra* note 13, at 2-18 to 2-19.
[35] *See id.*
[36] PRESIDENTIAL CLIMATE ACTION PROJECT, PRESIDENTIAL CLIMATE ACTION PROJECT PLAN § 6-12 (2007), http://www.climateactionproject.com/docs/PCAP_12_4_2007.pdf. This is equivalent to eliminating 125 million cars and light trucks from the road every year. *Id.*
[37] International Code Council, http://www.iccsafe.org/news/energy/ (last visited Oct. 10, 2009).
[38] *See* Energy Star, New Homes: ENERGY STAR, http://www.energystar.gov/index.cfm?c=new_homes.hm_index (last visited Oct. 10, 2009) ("To earn the ENERGY STAR, a home must meet strict guidelines. . . . These homes are at least 15% more energy efficient than homes built to the 2004 International Residential Code (IRC), and include additional energy-saving features that typically make them 20–30% more efficient than standard homes.").
[39] Architecture 2030, The 2030 Challenge, http://www.architecture2030.org/2030_challenge/index.html (last visited Oct. 10, 2009). The 2030 Challenge was established by architect Edward Maxaria in 2002, along with Architecture 2030, a non-profit, non-partisan and independent organization. Architecture 2030, About Architecture 2030, http://www.architecture2030.org/about.php (last visited Oct. 10, 2009).

> [Architecture] 2030's mission is to rapidly transform the US and global Building Sector from the major contributor of greenhouse gas emissions to a central part of the solution to the global-warming crisis. Our goal is straightforward: to achieve a dramatic reduction in the global-warming-causing greenhouse gas (GHG) emissions of the Building Sector by changing the way buildings and developments are planned, designed and constructed.

The 2030 Challenge was adopted by the American Institute of Architects, the U.S. Conference of Mayors, and the International Council for Local Environmental Initiatives ("ICLEI"). PEW POLICY SOLUTIONS, *supra* note 32, at 5.

developed for use by local governments to mitigate climate change.[40] This strategic path follows one developed by Princeton professor Robert Socolow, who identified and described fifteen categories for organizing society's efforts to mitigate climate change.[41] Five of Socolow's strategic categories fall within the reach of local land use authority: reduced use of vehicles, energy efficient buildings and appliances, vegetative carbon sequestration, wind power, and geological storage.[42] Through the aggregation of local land use techniques, significant energy savings and CO_2 reduction can be achieved in each of these categories.

After making some background points, this article describes how local governments are attacking the root causes of climate change and why they should be full partners in emerging federal and state climate action initiatives. Part I provides information on climate change and its causes, particularly those linked to our current pattern of human settlement, and demonstrates that settlement patterns adjust to societal change. Part II highlights the positive effects that result from a shift of suburban to urban living by describing other important environmental benefits.

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[40] Although this article discusses only the reduction in the increased CO_2 emissions due to the nation's growing population, rather than a net decrease from current levels, this reduction is nonetheless significant. Consider the following chart, which shows that the 1,200 million metric tons of CO_2 reduced by the land use stabilization wedge is 20% of current domestic CO_2 emissions. By making urban communities more livable for future households, they might also affect a percentage of the current population and begin a process of reducing CO_2 emissions below current levels.

THE MATH OF CLIMATE CHANGE

Total CO_2 Globally	38.0 Gt (gigatons)
Total U.S. CO_2	7.1 Gt (18 % of global emissions)
Net Savings From Natural Sequestration	- 1.0 Gt
Total Net U.S. CO_2	6.1 Gt
Total CO_2 Stabilized by Land Use Stabilization Wedge	1.20 Gt (20% reduction in net U.S. emissions)

The total CO_2 global emissions figure was taken from INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE ("IPCC"), CLIMATE CHANGE 2007: SYNTHESIS REPORT 36 (2007) [hereinafter IPCC SYNTHESIS REPORT], *available at* http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf; *see also* EPA INVENTORY OF GREENHOUSE GAS EMISSIONS, *supra* note 13.

[41] Stephen Pacala & Robert Socolow, *Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies*, SCIENCE, Aug. 13, 2004, at 968, 970 tbl.1, *available at* http://www.sciencemag.org/cgi/reprint/305/5686/968.pdf.

[42] *Id.*

Part III explores Dr. Socolow's wedge strategy and describes the Land Use Stabilization Wedge as an aggregation of several of his categories for stabilizing climate change. Part IV discusses transit oriented development, showing how local planning and zoning can follow a step-by-step approach to connecting new development to transit services and integrating other elements of the Land Use Stabilization Wedge in the process. Part V examines the authority of local governments to amend building codes and zoning ordinances to create much more energy efficient buildings, while Part VI discusses other components of the Land Use Stabilization Wedge that promote the sequestration of CO_2 and foster the deployment of wind and solar power facilities. The last part concludes by cautioning federal lawmakers not to ignore the potential of local governments to mitigate climate change as they hasten to fashion systemic fixes to this alarming global threat.

I. PAST AND FUTURE GROWTH

Following World War II, the United States experienced tremendous population growth, from 150 million people in 1950 to 300 million as of October 16, 2006.[43] The most populous state in 1950, New York, now ranks third behind California and Texas.[44] Three states contained ten million residents in 1950, but today there are seven.[45] Slightly more than half of the population resided in metropolitan areas in 1950, compared to eighty percent of today's population.[46] People aged 65 years and older doubled in that period, and the percentage of single-person households increased by a factor of 2.5.[47] Racial diversity increased over the twentieth century as well, from one out of eight non-white Americans in 1900 to one out of four in 2000.[48]

Twenty million Americans moved to the suburbs between 1950 and 1960,[49] and conversion of land to urban use increased consistently, from 15 million acres per year in 1945 to 60 million acres in 2000,[50] occurring

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[43] JOHN R. NOLON, PATRICIA SALKIN & MORTON GITELMAN, LAND USE AND COMMUNITY DEVELOPMENT: CASES AND MATERIALS v (7th ed. 2008).
[44] *Id.*
[45] *Id.*
[46] *Id.*
[47] *Id.*
[48] *Id.*
[49] NOLON, SALKIN & GITELMAN, *supra* note 43, at v.
[50] *Id.*

primarily in areas dedicated to farming, ranching, or forestry.[51] Nearly 2,250 of the 3,000 counties in the contiguous United States suffered losses of 10 percent or more of their farmland after 1950.[52] The catalysts for this immense movement of people included the availability of low cost mortgages, highway construction, and building technology improvements.[53] Moreover, these enticements lowered average acre population densities per acre and led to sprawling development.[54] As a result, growth in land use outpaced population growth.[55] For example, between 1950 and 1990, St. Louis witnessed a 355 percent increase in developed land during a population increase of 35 percent.[56] Similarly, the Chesapeake Bay watershed population increased by 50 percent from 1950 to 1980, while the Bay's land development increased by 180 percent in the same period.[57] Deteriorated and impoverished cities saw many of their wealthy residents and businesses move to nearby suburbs,[58] leading cities to become "a place from which men turn."[59]

Each of these changes was geographic in nature, causing dramatic alterations in the physical landscape and the places where our population lives and works.[60] These changes implicate land use law; with each economic and demographic shift, the law of the land was amended to accommodate changing conditions.[61] As our concerns over the consequences of climate change heighten, the legal system must continue to adapt and lead the way to create climate friendly settlement patterns.

Studies show that the historical settlement pattern in the United States is already beginning to change.[62] The demand for "attached, small

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[51] *Id.*
[52] *Id.*
[53] *Id.* at v–vi.
[54] *Id.* at vi.
[55] NOLON, SALKIN & GITELMAN, *supra* note 43, at vi.
[56] *Id.*
[57] *Id.*
[58] *Id.*
[59] Berman v. Parker, 348 U.S. 26, 32–33 (1954).
[60] NOLON, SALKIN & GITELMAN, *supra* note 43, at vi.
[61] *Id.*
[62] Leinberger, *supra* note 3 ("[R]ecent consumer research by Jonathan Levine of the University of Michigan and Lawrence Frank of the University of British Columbia suggests that roughly one in three homeowners would prefer to live in [walkable urban places]."); *see also* EWING ET AL., *supra* note 14, at 23–24 ("[A] national consumer survey by the global public relations company Porter Novelli found that 59 percent of U.S. adults now 'support the development' of compact communities. . . ."); Nelson & Lang, *supra* note 7, at 4–6.

lot[s], cluster, and other high-density options" is increasing, pushed by the desirability of in-town, walkable neighborhoods, transportation oriented developments, downtown amenities, and a greater stability of housing prices.[63] For a variety of reasons, the majority of the projected 100 million new Americans will be inclined to shift ground; they will be more urban oriented and willing to live in dynamic, walkable neighborhoods in urban areas.[64]

"While baby boomers may be looking to downsize their homes and simplify their lives in urban condominiums, millennials often look to cities as a way of rebelling against the suburban cul-de-sac culture that pervaded their youth . . . ."[65] Two additional demographic factors will drive this preference for urban areas: Americans are living longer—with almost 50 years of their lives spent without having to care for children—and a growing number of families are choosing to raise their families in urban areas.[66]

Market projections indicate that housing located in compact urban developments will increase in price more rapidly than single-family, suburban homes.[67] "[T]he demand for attached, small lot, cluster, and other high-density options appears likely to outpace the demand for detached houses on large lots."[68] Additionally, "[w]ith more than 30 U.S. cities that have or are developing commuter-rail systems, demand for mixed-used [sic], mixed-income projects is bound to increase . . . ."[69] In a recent survey, approximately one-third of respondents were more interested in compact, mixed-use, or smart growth, housing than conventional housing.[70] "Because the demand [for compact communities] is greater than the current supply . . . the price-per-square foot values of houses in mixed-use [and higher density] neighborhoods show price premiums ranging from 40 to 100 percent, compared to houses in nearby single-use subdivisions . . . ."[71] This is true not only for the cities with large downtowns, but also for suburban towns and cities outside of the major metropolises that have

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[63] Nelson & Lang, *supra* note 7, at 6.
[64] *See id.* at 4–6 (discussing the influences that affect living preferences).
[65] Jonathan Karp, *Suburbs a Mile Too Far for Some*, WALL ST. J., June 17, 2008, at A18.
[66] Nelson & Lang, *supra* note 7, at 5.
[67] *See generally* CHRISTOPHER B. LEINBERGER, THE OPTION OF URBANISM: INVESTING IN A NEW AMERICAN DREAM (2008) (describing the re-emergence of, and increased demand for walkable urban development as the "new American dream").
[68] Nelson & Lang, *supra* note 7, at 6; *see also* EWING ET AL., *supra* note 14, at 23 (discussing the growing popularity of smart growth housing options).
[69] Karp, *supra* note 65, at A18 (quoting Dan Rosenfeld).
[70] EWING ET AL., *supra* note 14, at 8–9.
[71] *Id.* at 9.

"lifestyle centers:" walkable urban centers, offering mixed-use amenities.[72]

In contrast, the prognosis for housing demand in suburban single-family neighborhoods is not good.[73] Over the next few decades, the number of childless households will surpass the number of those with children.[74] The 40 million new households include a sharp increase in the number of retirees—who have voiced a preference for compact, walkable neighborhoods[75]—and young households who are starting families later and having fewer children than previous generations.[76] Baby boomers and millennials[77] are currently the country's two most thriving population cohorts, with approximately 82 million and 78 million people, respectively.[78] Aging, empty-nester and single-person households are projected to constitute the bulk of the market demand for housing over the next half century and, on average, will not seek quarters in single-family suburban neighborhoods.[79]

The recent economic downturn seems to have turned the tide of America's preoccupation with the single-family, single-use settlement pattern. Studies indicate that by 2025, there will be upwards of 22 million unwanted large-lot suburban homes, partially due to the economic pressures of suburban living, with its heavy consumption of energy and

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[72] Leinberger, *supra* note 3; *see also* Nelson & Lang, *supra* note 7, at 6 ("[There is] already [demand for] in-town living . . . transportation oriented developments, . . . central city and close-in suburban infill and redevelopment, and greater stability of housing prices closer in than in more distant suburbs.").

[73] Leinberger, *supra* note 3, at 2. "Nelson projects that by 2025, the demand for attached and small-lot housing will exceed the current supply by 35 million units (71 percent), while the demand for large-lot housing actually will fall short of the current supply." EWING ET AL., *supra* note 14, at 9.

[74] *See* EWING ET AL., *supra* note 14, at 24 ("From 2000 to 2025, households without children will account for 88 percent of total growth in households. Thirty-four percent will be one-person households. By 2025, only 28 percent of households will have children."); Nelson & Lang, *supra* note 7, at 6.

[75] EWING ET AL., *supra* note 14, at 24.

[76] *See* Leinberger, *supra* note 3.

[77] *See* Karp, *supra* note 65, at A18 ("[A] generation of young people, called the millennials, born between the late 1970s and mid-1990s . . . .").

[78] *Id.*

[79] Nelson & Lang, *supra* note 7, at 5 ("Aging, empty-nester, and single-person households will dominate America's future housing markets. . . . [A] growing number of families are raising their children in decidedly urban settings—not most of them, but perhaps enough to have a significant effect on planning.").

fuel for driving and heating and the "prohibitive inefficiencies of low-density construction."[80]

These demographic and market projections indicate that market and demographic forces will support the movement of future populations into urban settlements and de-emphasize single-family neighborhood living.[81] This has profound consequences for land use planning and zoning at the local level. Shifting ground to lower CO_2 emissions and promote sustainable development is not a matter of social engineering through policy and legal change but an environmental and market imperative.

II. COROLLARY ENVIRONMENTAL BENEFITS OF SHIFTING GROUND

The corollary environmental and economic benefits of using land use controls to shift settlement patterns to more urban oriented living are equally dramatic.[82] At a density of 15, rather than 7.5 dwelling units per acre, 40 million new households will consume half as much land. At 7.5 units per acre, these households will occupy nearly 5.5 million acres for housing alone. Doubling the net density per acre reduces that figure to roughly 2.5 million acres, a savings of nearly three million acres, just under 5,000 square miles: an area about the size of the state of Connecticut.[83] Not developing three million acres saves the materials needed for the construction of—and the vehicle miles traveled on—thousands of miles of roads.[84] It also saves hundreds of thousands of acres of wetlands and

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[80] Michael Cannell, *Suburbia R.I.P.*, YAHOO! FINANCE, Mar. 12, 2009, http://finance.yahoo.com/family-home/article/106732/Suburbia-R-I-P (relying on a study conducted by the Metropolitan Institute at Virginia Tech).

[81] This shift will be uneven. *See generally* Florida, *supra* note 15 (discussing the effects of the current economic downturn on settlement patterns, including the decline of Sun Belt and Rust Belt cities, as well as a new demand for urban living resulting from the competitive advantages of the urban environment).

[82] *See, e.g.*, PEW POLICY SOLUTIONS, *supra* note 32, at 7 (discussing the impacts of land use on transportation).

[83] The area of Connecticut is 4,845.4 square miles. State of Connecticut, Department of Economic and Community Development, Connecticut Population, Land Area, and Density by Location, http://www.ct.gov/ecd/cwp/view.asp?A=1106&Q=250664 (last visited Oct. 10, 2009).

[84] *Cf.* U.S. ENVTL. PROT. AGENCY, GROWING TOWARD MORE EFFICIENT WATER USE: LINKING DEVELOPMENT, INFRASTRUCTURE, AND DRINKING WATER POLICIES 3 (2006) [hereinafter EPA DEVELOPMENT], http://www.epa.gov/dced/pdf/growing_water_use_efficiency.pdf (discussing how surface transportation infrastructure construction costs and efficiency can be optimized by higher-density land development).

habitats and millions of square feet of impervious surfaces, thereby reducing stormwater runoff and surface water pollution.[85]

Less water use and better water quality are two of the main corollary benefits of compact, mixed-use development. Historically, single-family, suburban homes use more than 101 gallons of water per capita per day, while multifamily housing can use as little as 45–70 gallons.[86] Lawn care alone is responsible for up to fifty percent of annual household water usage, while car washing, swimming pools, and other outdoor water uses comprise up to twenty percent more.[87] Studies have shown that at higher densities, water usage drops to half the amount of lower density areas.[88]

Moreover, costs for installing water infrastructure to houses in dispersed suburban neighborhoods can cost a municipality 10,000 dollars more than the infrastructure in urban areas,[89] and water service costs are proportionately lower in denser developments.[90]

> More compact development allows for shorter transmission systems, making them more efficient to operate and less susceptible to water loss through leakage. Encouraging

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[85] Water pollution issues are Americans' chief environmental concern, according to a recent Gallup poll. *See* Lydia Saad, *Water Pollution Americans' Top Green Concern*, GALLUP, Mar. 25, 2009, http://www.gallup.com/poll/117079/Water-Pollution-Americans-Top-Green-Concern.aspx. Fifty-nine percent of Americans worry "a great deal" about the pollution of drinking water; fifty-two percent about the pollution of surface waters; fifty-two percent about toxic contamination of soil and water; forty-nine percent about the supply of fresh water; forty-five percent about air pollution; forty-two percent about the loss of tropical rain forests; thirty-seven percent about species extinction; and only thirty-four percent about global warming. *Id.*

[86] AMY VICKERS, HANDBOOK OF WATER USE AND CONSERVATION 12 (2001).

[87] EPA DEVELOPMENT, *supra* note 84, at 3.

[88] *Id.*

> In Utah, planners have determined that water demand drops from approximately 220 gallons per capita per day at a density of two units per acre, to about 110 gallons per acre at a density of five units per acre. . . . A study of Seattle-area households found that moving from 12 dwelling units per acre to four units per acre decreases density by 67 percent but increases water use for landscaping by 158 percent per household. Put another way, Seattle homes on 6,500-square-foot lots use 60 percent less water than those on 16,000-[square]-foot lots.

Id.

[89] *Id.* at 6.

[90] *Id.* at 8. "[T]he annual cost of providing water and sewer service to a half-acre lot in a centrally located, dense development is $283 per household, while it is $472 for the same lot in a highly dispersed development far from the water service center." *Id.*

> compact neighborhood design on smaller lots reduces water demand for landscaping. Directing development to areas served by existing infrastructure and maintaining that infrastructure can make systems more efficient.[91]

Local actions that facilitate green buildings, green construction technology, solar and wind facilities, and other green initiatives add to the positive transformation of the domestic economy and complement efforts to increase the local tax base, building public support for the associated environmental benefits of climate change mitigation. In fact, jobs in the emerging green economy are among the most robust among employment sectors.[92] Action at the local level can embody both environmental and economic objectives: the two are not necessarily in opposition.[93] Economic growth may also follow adoption of climate mitigation strategies.

Municipalities have the power to encourage developments that reduce energy consumption and CO_2 emissions, such as Hudson Park, an enhanced transit oriented development ("TOD") project in Yonkers, New York.[94] This project, which is near the main commuter rail station in downtown Yonkers,[95] is designed for and marketed to young professionals,

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[91] EPA DEVELOPMENT, *supra* note 84, at 7.

[92] A recently published report by The Pew Charitable Trusts found that jobs in the clean energy sector grew by 9.1 percent between 1998 and 2007, compared to total job growth of 3.7 percent. PEW CHARITABLE TRUSTS, THE CLEAN ENERGY ECONOMY: REPOWERING JOBS, BUSINESSES AND INVESTMENTS ACROSS AMERICA 15 (2009), *available at* http://www.pewcenteronthestates.org/uploadedFiles/Clean_Economy_Report_Web.pdf. Although the report indicates that this growth will slow with the downturn, the drop in the clean energy sector will be less severe than the drop in U.S. jobs overall. *Id.*

[93] *Addressing Global Climate Change: The Road to Copenhagen: Hearing before the S. Comm on Foreign Affairs*, 111th Cong. (2009) (statement of Al Gore, former Vice President of the United States), *available at* http://foreign.senate.gov/testimony/2009/GoreTestimony090128p.pdf

> For years our efforts to address the growing climate crisis have been undermined by the idea that we must choose between our planet and our way of life; between our moral duty and our economic well being. These are false choices. In fact, the solutions to the climate crisis are the very same solutions that will address our economic and national security crises as well.

Id.

[94] For more information on Hudson Park Apartments, see Hudson Park Luxury Residential Apartment Community, http://www.hudsonpark.net/index.php (last visited Oct. 10, 2009).

[95] Hudson Park Luxury Residential Apartment Community, Amenities, http://www.hudsonpark.net/amenities.html (last visited Oct. 10, 2009).

most of whom commute to Manhattan or one of the other New York City boroughs.[96]

The Hudson Park Apartment Community occupies 4.362 acres and contains 560 rental apartments, as well as 15,000 square feet of commercial and office space.[97] The density of this development is 128 dwelling units per acre,[98] much more than the 15 dwelling units per acre used in the climate change mitigation calculations above,[99] and a density more typical of that needed around express stop transit areas to make commuter rail service economically viable.[100]

If we could shift twenty-five percent of the nation's next forty million households, or ten million households (twenty-seven million people),[101] from single-family dwellings on quarter acre lots to developments such as Hudson Park, the corollary benefits to the environment would be dramatic.[102] To illustrate, such a shift would save:

1. 876,951 acres of impervious coverage;[103]

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[96] *See* E-mail from Arthur Collins, President, Collins Enterprises, LLC, to John R. Nolon, James D. Hopkins Professor of Law, Pace University School of Law (May 14, 2009, 08:58 EST) (on file with author) (discussing services and amenities); E-mail from Rona Siegel, Operations Vice President, Collins Enterprises, LLC, to Arthur Collins, President, Collins Enterprises, LLC (May 14, 2009 08:51 EST) (on file with author) (noting that 42.47 percent of tenants are between the ages of twenty and thirty). As of June, 2009, 79.28 percent of the occupants commuted to Manhattan or one of the other New York City boroughs. E-mail from Siegel, *supra*. *See also* Elsa Brenner, *It Had the Setting; Now It Has the Housing*, N.Y. TIMES, March 9, 2008, http://www.nytimes.com/2008/03/09/realestate/09livi.html (discussing Hudson Park Apartments and Rona Siegel's role at Collins Enterprises).

[97] *See* E-mail from Collins, *supra* note 96; E-mail from Siegel, *supra* note 96.

[98] *See* E-mail from Collins, *supra* note 96; E-mail from Siegel, *supra* note 96. 560/4.362 = 128.

[99] *See supra* note 83 and accompanying text.

[100] INST. OF TRANSP. ENG'RS, *supra* note 31, at 83.

[101] *See* T. RANDOLPH BEARD, GEORGE S. FORD, & LAWRENCE J. SPIWAK, THE BROADBAND ADOPTION INDEX: IMPROVING MEASUREMENTS AND COMPARISONS OF BROADBAND DEPLOYMENT AND ADOPTION 15 n.27 (2009), *available at* http://www.phoenix-center.org/pcpp/PCPP36Final.pdf ("U.S. has about 2.7 people per home. . . .").

[102] The emphasis on higher density development, which projects like Hudson Park reflect, leaves thousands of acres of land undisturbed. *See supra* notes 82–85 and accompanying text. This is similar to the discussion at the beginning of this section, which demonstrated that increasing housing density can save land roughly equivalent in size to the state of Connecticut. *Id.* Other factors must be considered when comparing the stormwater benefits gained by encouraging multifamily development versus single-family. *Id.* For example, the amount of impervious surface a project generates is related to building design, associated streets and walkways, and associated parking structures. *Id.*

[103] Five hundred and sixty rental units occupy Hudson Park's 4.362 acres, which has 178,008 square feet of impervious surfaces, for a per household average of 318 square feet. *See* E-mail from Collins, *supra* note 96; E-mail from Siegel, *supra* note 96. A quarter

2. 477 billion gallons of stormwater runoff per year,[104] and
3. 394 billion gallons of potable water per year.[105]

III. CLIMATE CHANGE AND THE LAND USE STABILIZATION WEDGE

A. Climate Change: Causes and Consequences

In 2007, the Intergovernmental Panel on Climate Change ("IPCC")[106] issued its Fourth Assessment report, which concluded—for

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acre lot contains 10,890 square feet. *See id.* An average U.S. single-family home on a quarter acre site has 4,138 square feet of impervious surface. *See* EPA PROTECTING WATER RESOURCES, *supra* note 8, at 27 (concluding that thirty-eight percent of one acre is impervious surface when the acre is split into quarter acre lots). Thus, the Hudson Park model saves 3,820 square feet of impervious surface per household. If 10 million households are shifted to this type of development, a net savings of 876,997 acres of impervious surface is achieved.

[104] One inch of rain falling on one square foot of impervious surface yields 0.625 gallons of water (1/12 foot x 1 square foot = 0.0833 cubic feet x 7.5 gallons/cubic feet = 0.625 gallons). In an area with average rainfall of 20 inches per year, 12.5 gallons of stormwater will run off from each square foot of impervious coverage (0.625 x 20 = 12.5). 876,951 acres of impervious coverage x 43,560 square feet/acre = 38.2 billion square feet saved. 12.5 gallons x 38.2 billion = 477 billion gallons of stormwater runoff saved.

[105] *See* EPA DEVELOPMENT, *supra* note 84, at 3–4 (discussing the relationship between lot size and water demand). If occupants of single-family homes use an average of 100 gallons of water/day per capita, and average multifamily use is 60 gallons/day per capita, the savings per day is 40 gallons per capita. If there are roughly 27 million people in 10 million households, multiplying that number by 365 days per year, then multiplying by 60 gallons saved, yields 394 billions of gallons saved. This number is not meant to be precise, but representative. Also, these figures may be skewed somewhat, as it is likely that fewer people will live in households occupying multifamily homes than this example purports. Nonetheless, this should not diminish the point that considerable savings occur through this shift. *See generally* U.S. ENVTL. PROT. AGENCY, OUTDOOR WATER USE IN THE UNITED STATES (2008), http://www.epa.gov/watersense/docs/ws_outdoor508.pdf (discussing methods of reducing wasteful water usage).

[106] The Intergovernmental Panel on Climate Change, established by the United Nations Environment Programme ("UNEP") and the World Meteorological Organization ("WMO"), is a scientific body that "reviews and assesses the most recent scientific, technical and socio-economic information produced worldwide relevant to the understanding of climate change." Intergovernmental Panel on Climate Change, Organization, http://www.ipcc.ch/organization/organization.htm (last visited Oct. 10, 2009). The IPCC is an intergovernmental body that welcomes all UN and WMO member countries. *Id.* It is 21 years old. Intergovernmental Panel on Climate Change, History, http://www.ipcc.ch/organization/organization_history.htm (last visited Oct. 10, 2009). There are currently 194 countries represented within the IPCC. Intergovernmental Panel on Climate Change, Structure, http://www.ipcc.ch/organization/organization_structure.htm (last visited Oct. 10, 2009).

the first time—that human activity is "very likely" the cause of global climate change:

> Most of the observed increase in global average temperatures since the mid-20th century is *very likely* [i.e. between 90–95% likely] due to the observed increase in anthropogenic GHG [greenhouse gas] concentrations. This is an advance since the TAR's [Third Assessment Report's] conclusion that "most of the observed warming over the last 50 years is *likely* [i.e. greater than 66% likely] to have been due to the increase in GHG [greenhouse gas] concentrations."[107]

The report further found that influences now extend to other climate aspects, including ocean warming, continental-average temperatures, temperature extremes, and wind patterns.[108] In conclusion, the report found:

> The observed widespread warming of the atmosphere and ocean, together with ice mass loss, support the conclusion that it is *extremely unlikely* [less than 5%] that global climate change of the past fifty years can be explained without external forcing and *very likely* that it is not due to known natural causes alone.[109]

Since the IPCC's Fourth Assessment was published, new studies indicate that climate change is more advanced than previously thought and that standards for acceptable levels of CO_2 concentration in the atmosphere—the point at which anthropogenic interference is regarded as dangerous—should be lowered.[110] The present concentration of CO_2 in

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The IPCC provides reports at regular intervals which immediately become standard works of reference on the issue of climate change. *See id.*

[107] IPCC SYNTHESIS REPORT, *supra* note 40, at 27, 39.

[108] *Id.* at 30, 39–40.

[109] *Id.* at 39. *See also* NATIONAL ACADEMIES, UNDERSTANDING AND RESPONDING TO CLIMATE CHANGE 2 (2008), *available at* http://dels.nas.edu/dels/rpt_briefs/climate_change_2008_final.pdf ("Most [climate] scientists agree that the [Earth's] warming in recent decades has been caused primarily by human activities that have increased the amount of greenhouse gases in the atmosphere." (emphasis added)).

[110] *See, e.g.*, Susan Solomon et al., *Irreversible Climate Change Due to Carbon Dioxide Emissions*, 106 PROCEEDINGS OF THE NAT'L ACAD. OF SCI. [PNAS] 1704, (2009) (discussing the potential irreversible effects of climate change); James Hansen et al., *Target Atmospheric* CO_2*: Where Should Humanity Aim?*, 2 OPEN ATMOSPHERIC SCI. J. 217 (2008) (discussing the need to lower levels of CO_2 to avoid irreversible effects).

the atmosphere is roughly 385 parts per million ("ppm").[111] The IPCC suggests that atmospheric CO_2 concentration should not exceed 450 ppm.[112] However, recent studies state that the proper level of concentration is closer to 350 ppm, if not lower.[113] Because CO_2 lingers in the atmosphere for centuries, some scientists believe some of the consequences of climate change caused by anthropogenic CO_2 emissions, such as polar ice melts, they say are irreversible.[114] Other scientists state that we have not yet reached a point of no return, although we are alarmingly close to that tipping point.[115]

Among the most dramatic consequences of climate change is the rise in sea level, which is discussed in a recent report from the U.S. Climate Change Science Program.[116] The report notes that "thoughtful precaution suggests that a global sea-level rise of 1m[eter] to the year 2100 should be considered for future planning and policy discussions."[117] Coastal

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[111] Hansen et al., *supra* note 110, at 218.

[112] *See* IPCC SYNTHESIS REPORT, *supra* note 40, at 67 ("[S]tabili[z]ing CO_2 concentrations at, for example, 450 ppm could require cumulative emissions over the 21st century to be less than 1800 [1370 to 2200] $GtCO_2$, which is about 27% less than the 2460 [2310 to 2600] $GtCO_2$ determined without consideration of carbon cycle feedbacks"). *See also* ELIZABETH KOLBERT, FIELD NOTES FROM A CATASTROPHE 126 (2006) (reporting studies that regard 500 ppm as the proper threshold). Kolbert writes that "this figure has at least as much to do with what appears to be a socially feasible goal as with what has been scientifically demonstrated." *Id.*

[113] Hansen et al., *supra* note 110, at 229.

[114] Solomon et al., *supra* note 110, at 1704 ("[T]he physical climate changes that are due to anthropogenic carbon dioxide already in the atmosphere today are expected to be largely irreversible.").

[115] *See, e.g.*, Pacala & Socolow, *supra* note 41, at 968 ("[F]undamental research is vital to develop the revolutionary mitigation strategies needed in the second half of this century and beyond. But it is important not to become beguiled by the possibility of revolutionary technology. Humanity can solve the carbon and climate problem. . . ."); Hansen et al., *supra* note 110, at 225–26, 229 ("A point of no return can be avoided, even if the tipping level is temporarily exceeded. . . . The greatest danger is continued ignorance and denial, which could make tragic consequences unavoidable."). See also KOLBERT, *supra* note 112, at 153 (explaining that the goal of the international community is to avoid "dangerous anthropogenic interference" ("DAI")—the tipping point at which global catastrophes become unavoidable); Press Release, National Oceanic and Atmospheric Administration, Greenhouse Gases Continue to Climb Despite Economic Slump (Apr. 21, 2009), http://www.noaanews.noaa.gov/stories2009/20090421_carbon.html.

[116] *See generally* U.S. CLIMATE CHANGE SCI. PROGRAM, COASTAL SENSITIVITY TO SEA-LEVEL RISE: A FOCUS ON THE MID-ATLANTIC REGION (2009), *available at* http://www.climatescience.gov/Library/sap/sap4-1/final-report/sap4-1-final-report-all.pdf (discussing trends and projections for changes in sea level).

[117] *Id.* at 20.

communities are becoming aware of the consequences and the potential threat they pose to their homes, businesses, and infrastructure.[118] As a result, these communities are starting to adjust their land use regulations for existing and new infrastructure in potentially inundated areas accordingly.[119]

While American public opinion on the existence and consequences of climate change is still mixed,[120] changes in our backyards will build support for mitigation strategies.[121] In its recent report, the United States Global Change Research Program points to the observable signs of climate change affecting the day-to-day life of Americans: powerful tropical storms,[122] erosion of ocean coastlines,[123] worsening of drought in the Southwest,[124] heat waves of greater intensity in the Northeast,[125] more heat-related illness and deaths,[126] and an increase in asthma and other respiratory ailments.[127] This study group reports that the rate of climate change progress will depend on how rapidly the U.S. and other countries respond with emission reduction strategies.[128]

B. The Land Use Stabilization Wedge: Existing Technology for Mitigating Climate Change

Business as usual ("BAU") projections of climate change, which contemplate what will happen if we do nothing effective to reduce CO_2 emissions, are alarming.[129] Worldwide and domestic CO_2 emissions are

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[118] *See generally* Jessica Bacher, *Zoning and Land Use Planning Yielding to the Rising Sea: The Land Use Challenge*, 38 REAL EST. L.J. 93 (2009) (discussing the response of many states and localities to the possibility of rising sea levels).
[119] *Id.*
[120] *See* Saad, *supra* note 85 (discussing the level of concern of Americans regarding various environmental problems).
[121] *See* U.S. GLOBAL CHANGE RESEARCH PROGRAM, GLOBAL CLIMATE CHANGE IMPACTS IN THE UNITED STATES 8 (2009), *available at* http://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf [hereinafter GLOBAL CLIMATE CHANGE IMPACTS] (summarizing the importance of mitigation measures).
[122] *Id.* at 25.
[123] *Id.* at 57.
[124] *Id.* at 83.
[125] *Id.* at 107.
[126] *Id.* at 90.
[127] GLOBAL CLIMATE CHANGE IMPACTS, *supra* note 121, at 107.
[128] *See id.* at 153–56.
[129] *See generally* Pacala & Socolow, *supra* note 41 (discussing the likely effects of BAU emissions).

increasing steadily, with some studies predicting that, absent effective action, CO_2 levels in the atmosphere could reach 750 million ppm by the year 2100.[130] This projected figure is well in excess of the 450 ppm maximum level established by the IPCC,[131] and it is more than twice the tipping point calculated by more recent studies.[132] With so many sources of emissions spread over so many jurisdictions, and with many climate change mitigation technologies still under development, policy makers and the public are struggling to find a coping strategy to stimulate effective and immediate action.[133]

In 2004, Dr. Robert Socolow, a professor of engineering at Princeton University, set an action agenda for mitigating climate change through "stabilization wedges," with each one capable of preventing the emission of at least a billion metric tons of carbon annually by using existing technologies.[134] The genius of Socolow's strategy is that it divides the daunting and discouraging task of climate change mitigation into categories, or wedges, which enables an efficient and orderly response.[135] This makes the formidable challenge of reducing CO_2 emissions seem more attainable and allows identification of the actors who are capable of effective adaptation within each wedge.[136]

The role of local land use law in climate change is critical. In our system of government, municipalities have been given a key, if not the principal, role in land use regulation.[137] Local legislatures may adopt land use plans, zoning ordinances, and maps that provide blueprints for the future development of their communities and, when aggregated, their

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[130] *See* KOLBERT, *supra* note 112, at 135. *See also* Nat'l Oceanic & Atmospheric Admin., Trends in Atmospheric Carbon Dioxide [hereinafter NOAA Trends], http://www.esrl.noaa.gov/gmd/ccgg/trends/ (last visited Oct. 10, 2009) (displaying monthly trends in global emissions of carbon dioxide).

[131] IPCC SYNTHESIS REPORT, *supra* note 40, at 67.

[132] *See, e.g.*, Hansen et al., *supra* note 110, at 229 (suggesting a tipping point of 350 ppm, if not lower).

[133] *See* Pacala & Socolow, *supra* note 41, at 968 ("The debate in the current literature about stabilizing atmospheric CO_2 at less than a doubling of the preindustrial concentration has led to needless confusion about current options for mitigation."). *See also id.* at 970 tbl.1 (listing potential strategies to reduce carbon emissions).

[134] *Id.* at 968 ("A wedge represents an activity that reduces emissions to the atmosphere that starts at zero today and increases linearly until it accounts for 1 GtC/year of reduced carbon emissions in 50 years.").

[135] *Id.*

[136] *Id.*

[137] *See* NOLON, SALKIN & GITELMAN, *supra* note 43, at 17–19.

region.[138] They also adopt local subdivision and site plan regulations and establish planning and zoning boards to review, approve, and impose conditions on applications for housing and commercial development.[139] These tools can be used by municipalities to play an active role in the mitigation of climate change by fostering the shift from suburban to urban living.[140] Thus, municipalities can reduce CO_2 emissions by lessening vehicle miles traveled, increasing energy efficiency in buildings, promoting renewable forms of energy production, and protecting sequestering open space.

Local land use plans and law can be used as a primary means to increase the average housing density in the United States from 7.5 to 15 dwelling units per acre by encouraging mixed-use, walkable neighborhood development.[141] This will yield the promising dramatic reductions in CO_2 and other environmental damage referenced above, which only a few other climate change strategies can achieve.[142] Thus, "simply by scaling up what [they] already know how to do," as Dr. Socolow recommends actors do, local governments can use their existing legal authority to help "solve the carbon and climate problem."[143]

The Land Use Stabilization Wedge, proposed by this article, incorporates many of the ways the devices of land use control and zoning can reduce CO_2 emissions.[144] It incorporates five of the stabilization wedges introduced by Socolow: (1) Reduced Use of Vehicles, (2) Efficient Buildings, (3) Conservation of Natural Carbon Sinks, (4) Solar Power, and (5) Wind Power.[145]

Localities are already using a variety of land use planning and zoning techniques to reduce energy consumption and carbon emissions. These techniques can easily be incorporated into the Land Use Stabilization Wedge. Reduced use of vehicles can be accomplished by adopting transit oriented and transportation efficient planning and zoning[146] and by

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[138] *Id.* at 17–18.
[139] *Id.* at 18.
[140] *Id.* at 18–19.
[141] *See supra* notes 97–105 and accompanying text.
[142] *See generally* Pacala & Socolow, *supra* note 41 (discussing stabilization wedges to reduce carbon emissions).
[143] *Id.* at 968.
[144] John R. Nolon, *Shifting Ground to Address Climate Change: The Land Use Law Solution*, GOV'T L. & POL'Y J., Summer 2008, at 23, 23 [hereinafter Nolon, *Shifting Ground*].
[145] Pacala & Socolow, *supra* note 41, at 969, 971.
[146] *See, e.g.*, PALO ALTO, CAL., CODE ch. 18.34.010(a) (2007), *available at* http://www.cityofpaloalto.org/civica/filebank/blobdload.asp?BlobID=13770 (discussing the purposes of the California Avenue Pedestrian and Transit Oriented Combining District).

encouraging walking and biking though site plan standards can ensure the construction of energy efficient buildings and appliances by enforcing and strengthening energy conservation construction codes,[147] by zoning for compact mixed use developments that use less energy per household,[148] and by adopting standards that require high-emissivity or vegetated roofs and integrated building management.[149] Natural sequestration can be accomplished by adopting local environmental laws that preserve existing open space or require landscape amenities in proposed developments.[150] Localities can facilitate the use of solar power by encouraging central solar systems for multiple buildings.[151] Lastly, the use of wind power can be encouraged by adopting special use permit provisions in zoning that allow for small wind turbines on buildings[152] and by eliminating design and dimensional requirements that discourage the use of both wind farms and solar panels.[153]

In fact, local governments are doing a great deal already with their legal, financial, and program development capacities. As they progress,

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[147] *See, e.g.*, OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY, U.S. DEPT. OF ENERGY, CASE STUDY: NEW YORK ENERGY CONSERVATION CONSTRUCTION CODE (2002), http://www.energycodes.gov/implement/pdfs/new_york_case_study.pdf (discussing how New York's progressive energy code is projected to provide energy cost savings of up to 80 million dollars per year).

[148] *See, e.g.*, BLOOMINGTON, MINN., CODE Ch. 19, § 19.29(a)(4) (2008), *available at* http://www.ci.bloomington.mn.us/code/Code19_8.html. ("The provisions . . . are intended to . . . [r]educe vehicle trips and vehicle miles traveled . . . by allowing residences in close proximity to employment and services, by allowing intense development in close proximity to high frequency transit services, and by encouraging multi-purpose trips, walking trips, carpool trips and transit trips[.]").

[149] *See, e.g.*, CITY OF PORTLAND BUREAU OF PLANNING AND SUSTAINABILITY, REGULATORY IMPROVEMENT CODE AMENDMENT PACKAGE (RICAP) 5 "GREEN BUNDLE"—SUMMARY OF PROPOSALS (2009), http://www.portlandonline.com/bps/index.cfm?a=246768&c=48212.

[150] *See, e.g.*, BLOOMINGTON, MINN., CODE Ch. 19, § 19.29(g)(4)(C) (2008), *available at* http://www.ci.bloomington.mn.us/code/Code19_8.html ("The plaza or park must include at least 5,000 square feet of contiguous area.").

[151] *See, e.g.*, *Intel Adds 100-kW Solar System at Oregon Campus*, ENVTL. LEADER, May 1, 2009, http://www.environmentalleader.com/2009/05/01/intell-adds-100-kw-solar-system-at-oregon-campus (discussing the installations of solar power systems and solar panels in Oregon and California).

[152] *See, e.g.*, N.Y. ST. ENERGY RES. & DEV. AUTH., EXAMPLES OF NY LOCAL GOVERNMENT LAWS/ZONING PROVISIONS ON WIND 6 (2005), http://www.gflrpc.org/programareas/wind/LL/Fenner,Martinsburg,Westfield,Eden, Henderson, Portland, Clinton, Ellenburg.pdf.

[153] *See, e.g.*, N.Y. ENERGY LAW § 21-106(2) (2009), *available at* http://law.justia.com/newyork/codes/energy/eng021-106_21-106.html("No state department, board, . . . or any agency thereof may require any approval, consent, permit, certificate, statement, report or other condition for the construction or operation of: (a) a co-generation or alternate energy production facility. . . .").

local governments are adding strategies to the Land Use Stabilization Wedge by using innovative techniques and new technologies. Localities may, for example, adopt standards that require buildings to accommodate plug in vehicles and reduce idling.[154] They can facilitate the use of renewable energy and on-site small power generation facilities through site plan requirements, financial incentives, zoning bonuses, and environmental impact mitigation requirements.[155] Localities may also accommodate the growing, harvesting, and processing of biofuel feedstocks,[156] and increase cooling through water efficient landscaping and green or reflective roofs.[157] Localities can implement district electricity systems in neighborhoods,[158] as well as building standards that combine heat and power sources in buildings.[159] They can also encourage low impact retrofitting in existing private buildings through efficiency standards and incentives.[160] On an administrative level, local governments can lay the foundation for green development by building the professional infrastructure needed for green development services, verification methods, and weatherization programs through training, certification, and building demand and support for these services. Finally, localities can increase the use of state and federal energy-saving and transportation-enhancement programs, including subsidies, grants, and loans.[161]

The key concept behind the Land Use Stabilization Wedge is that there are already adequate land use techniques that can be employed

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[154] *See, e.g.*, BOSTON, MASS., ZONING CODE, § 37-4 app. A (2007), *available at* http://www.bostonredevelopmentauthority.org/pdf/ZoningCode/Article37.pdf (requiring hotels to have enough electric vehicle charging plug-in stations for one percent of the occupants of a building).

[155] *See, e.g.*, BOSTON, MASS., ZONING CODE, § 37-4 app. A (2007), *available at* http://www.bostonredevelopmentauthority.org/pdf/ZoningCode/Article37.pdf.

[156] *See, e.g.*, Mass. Executive Office of Energy and Envtl. Affairs, Clean Energy Biofuels Act, http://www.mass.gov/envir/eoea.htm (follow the "Alternative Fuel" hyperlink; then follow the "Clean Energy Biofuels in Massachusetts" hyperlink; then follow the "Clean Energy Biofuels Act" hyperlink) (last visited Oct. 10, 2009).

[157] *See, e.g.*, CITY OF PORTLAND BUREAU OF PLANNING AND SUSTAINABILITY, *supra* note 149.

[158] *See* Jayson Antonoff, *Scandinavia Taps Power District Energy Systems*, SEATTLE DAILY J. OF COM., May 26, 2004, http://www.djc.com/news/ae/11157334.html ("District energy systems have proven to be the most efficient model for generation and distribution of electrical and thermal energy in urban environments.").

[159] *See id.* (discussing energy systems in Scandinavia).

[160] *See, e.g.*, Andrew Stern, *FACTBOX: Incentives to Retrofit Buildings*, REUTERS, Sept. 2, 2009, http://www.reuters.com/article/idUSTRE5817F220090902 (discussing tax incentives and rebate programs to encourage retrofitting of buildings).

[161] *See* BUILDING CODES ASSISTANCE PROJECT, *supra* note 33.

immediately to help stabilize CO_2 emissions.[162] The most promising among them are enhanced transit oriented development zoning and enhanced energy code and zoning standards.[163] These two techniques alone have the potential to reduce CO_2 emissions, over the BAU scenario, by approximately 20 percent as the next 100 million Americans are added to the population.[164]

IV. LOCAL TRANSIT ORIENTED DEVELOPMENT—THE BROAD EDGE OF THE WEDGE

One of the most critical contributions of the Land Use Stabilization Wedge is the extent to which it can be used to reduce vehicle trips and VMT by encouraging transit oriented development ("TOD").[165] The use of personal automobiles alone is responsible for approximately sixteen percent of domestic CO_2 emissions,[166] and much of the fuel consumed by buses, vans, and trucks is consumed traversing our spread out landscape.[167] It is the nation's human settlement pattern that causes most of the annual increase in VMT, the resultant fossil fuel consumed, and CO_2 emitted from tailpipes.[168] Over the past half century, annual VMT have increased nearly five-fold.[169] Meanwhile, since 1980, the total number of miles driven by Americans has grown three times faster than the population.[170] These

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[162] *See supra* notes 29–39 and accompanying text.
[163] *See* discussion *infra* Parts IV, V.
[164] *See supra* notes 29–39 and accompanying text.
[165] PRESIDENTIAL CLIMATE ACTION PROJECT, *supra* note 36, at § 7-6 ("The greatest potential for reducing greenhouse gas emissions and imported petroleum is to reduce vehicle miles traveled—the miles Americans drive each year.").
[166] *See* EPA INVENTORY OF GREENHOUSE GAS EMISSIONS, *supra* note 13, at 2–19.
[167] EPA BUILT AND NATURAL ENVIRONMENTS, *supra* note 13, at I ("Certain patterns of development encourage increased use of motion vehicles, which is associated with growth in emissions of air pollution and the greenhouse gases that contribute to global climate change."); *see also id.* at 2 fig.1-1.
[168] EPA BUILT AND NATURAL ENVIRONMENTS, *supra* note 13, at 21; *see also* EWING ET AL., *supra* note 14, at 2–3 ("Population growth has been responsible for only a quarter of the increase in vehicle miles driven over the last couple of decades. A larger share of the increase can be traced to the effects of a changing built environment . . . .").
[169] Pew Center on Global Climate Change, US Vehicle Miles Traveled: 1936–2005, http://www.pewclimate.org/global-warming-basics/facts_and_figures/us_emissions/vmt.cfm (last visited Oct. 10, 2009) (showing that between 1941 and 2005, annual VMT per capita in the United States has increased from approximately 2000 miles to approximately 10,000 miles).
[170] EWING ET AL., *supra* note 14, at 2.

trends outstrip improvements in fuel efficiency and engine technology.[171] Using the Land Use Stabilization Wedge to create higher population densities and transit accessibility is a critical component of climate change mitigation.[172] Shifting ground to house and employ more Americans in urban areas will cause a significant reduction in VMT while placing households in smaller, more energy efficient homes, further reducing fossil fuel consumption and CO_2 emissions.[173] TOD plans and zones locate housing and jobs near transit stops and significantly reduce the number and distance of vehicle trips.[174]

To make transit systems feasible, land use planning among localities in a transportation region must be coordinated with transportation infrastructure planning and development.[175] Local land use plans and zoning, which regulate density, determine how much population will increase over time in a certain area.[176] This, in turn, dictates the demand for various types of transportation services.[177] Transit lines for rail and bus rapid transit services cannot be planned individually, one station at a

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[171] Keith Bartholomew & Reid Ewing, Land Use-Transportation Scenario Planning In an Era of Global Climate Change 5 (Nov. 5, 2007) (unpublished paper), *available at* http://faculty.arch.utah.edu/bartholomew/Bartholomew_Ewing_Revision.pdf.

[172] *See supra* Part III.B.

[173] *See supra* Part III.B.

[174] PATRICK CONDON, LINCOLN INSTITUTE OF LAND POLICY, PLANNING FOR CLIMATE CHANGE 7 (2008), *available at* https://www.lincolninst.edu/pubs/dl/1322_Jan08LLA1.pdf. *But see supra* notes 33–39 and accompanying text (discussing the potent effect of producing more energy efficient buildings).

[175] John R. Nolon & Jessica Bacher, *Zoning and Land Use Planning*, 36 REAL EST. L. J. 211, 220 (2007). Transportation planning generally occurs in urban and metropolitan areas. *Id.* In these regions, Metropolitan Planning Organizations ("MPOs") create capital plans for transit services as well as other transportation infrastructure. *Id. See, e.g.*, San Antonio-Bear County Metropolitan Planning Organization, http://www.sametroplan.org (last visited Oct. 31, 2009) (providing an overview of MPOs). Coordination between local land use planning and MPO transportation planning is critical to the success of efforts to connect higher density urban developments and compact metropolitan developments to transit services, both now and in the future. Nolon & Bacher, *supra*, at 220. Furthermore, such coordination is arguably required by federal law. *Id.* Federal law requires MPOs to implement planning processes that "provide for consideration of projects and strategies that will . . . protect and enhance the environment, promote energy conservation, improve the quality of life, and promote consistency between transportation improvements and State and local planned growth and economic development patterns." Nolon & Bacher, *supra*, at n.28 (quoting 49 U.S.C. §5303(h)(1)(E) (2006). 23 U.S.C. § 135 (2006)) makes this language applicable to statewide transportation planning and programming by requiring each state to carry out a statewide transportation planning process that achieves these same objectives. *Id.*

[176] Nolon & Bacher, *supra* note 175, at 220.

[177] *Id.*

time.[178] The development of transit stations and rail and bus lines is dependent upon land use densities.[179] There must be a large enough number of commuters in a relevant region to provide a base level of ridership within the area served by the transit system.[180] Ridership must be diverse as well, so that people are traveling to work, to shop, to seek entertainment, and to go home at various times during the day, thereby increasing the cost efficiency of the service.

Even where communities are not currently served by transit systems, they can create compact, mixed-use neighborhoods that reduce car trips and miles traveled.[181] The country cousin of TOD is Transportation Efficient Development ("TED"), where the emphasis is on reducing car trips within TED zoning districts.[182] Zoning controls can limit the size of housing units and combine retail, office, and residential land uses. Zoning controls may also be used to require new construction to meet energy standards and reduce greenhouse gas emissions.[183] Communities not yet served by transit can design one or more priority growth districts of this type and create overlay zones for them that allow greater densities and more land uses than permitted in the underlying zoning districts.[184] By clustering development strategically, these growing localities position themselves for future service by commuter rail or bus rapid transit, thereby becoming "transit ready."[185]

The Town of Malta, located outside Albany, New York, adopted a TED approach to rezoning its central business district by using an overlay zone to prepare for future transit services.[186] The Malta zoning law provides for compact mixed-use development emphasizing pedestrian amenities.[187] Malta is not currently served by transit, but the regional Capital District Transportation Plan calls for bus rapid transit service to downtown Malta in the future.[188] In anticipation, the overlay zone states that "[t]o promote

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[178] *Id.*
[179] *Id.*
[180] *Id.*
[181] *See* EPA BUILT AND NATURAL ENVIRONMENTS, *supra* note 13, at iv.
[182] Nolon, *Shifting Ground*, *supra* note 144, at 25.
[183] Nolon & Bacher, *supra* note 175, at 233.
[184] *See, e.g.*, City of Portland Bureau of Planning and Sustainability, Overlay Zones, http://www.portlandonline.com/bps/index.cfm?a=64465&c=36238 (last visited Oct. 10, 2009).
[185] *See* Nolon, *Shifting Ground*, *supra* note 144, at 25–26.
[186] MALTA, N.Y., CODE ch. 167, art. XIV, § 167-61(F) (2005).
[187] *See id.* § 167-61(C)(3) ("Commercial projects shall incorporate sidewalks and building features . . . which maximize safety, comfort, ease of movement, and convenience for pedestrians.").
[188] Nolon, *Shifting Ground*, *supra* note 144, at 7.

pedestrian activity and multimodal transportation, developments should be located within 1,320 feet of an existing or future transit stop as approved by the Planning Board."[189]

Seattle's municipal code includes provisions for a Density Bonus Incentive. This program offers developers bonus floor-area-ratio ("FAR"), beyond that provided in the basic zoning regulations, if the developer makes a commitment to achieve at least Leadership in Energy and Environmental Design ("LEED") Silver certification.[190] In addition, the developer must contribute to the city's development of low-income housing and provide needed childcare facilities to accommodate downtown workers.[191] Developers can build the facilities or make a contribution to the city to fund the building of the necessary housing or childcare facilities.[192] Adopted in 2006, the program has generated 8,700 new dwelling units and 6.3 million square feet of green office development.[193]

Suburban areas that adopt higher density, mixed-use zoning will find it easier politically to adopt strong environmental protection ordinances applicable to the land outside high density zones.[194] Density bonuses may be allotted in the transportation efficient overlay area, and cash contributions may be secured from developers in exchange.[195] This money can be used to purchase development rights from landowners in valuable open space areas outside the higher density zone.[196]

Alternatively, communities can adopt transfer of development rights programs with the transportation efficient overlay zone serving as the receiving district and designated critical environmental areas serving as sending districts.[197] The preservation of natural resources in these critical environmental areas will provide additional benefits, such as "carbon sequestration, food production, wetlands and habitat preservation, stormwater management and flood prevention, watershed protection, and the prevention of erosion and sedimentation."[198]

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[189] MALTA, N.Y., CODE ch. 167, art. XIV, §167-61(F) (2005).
[190] SEATTLE, WASH., CODE ch. 23.49.011 (2006).
[191] *Id.* ch. 23.49.012.
[192] *Id.*
[193] John Raham, *The Quest for Green Communities: Lessons from Seattle and San Francisco*, National Planning Conference (April 2009) (presentation on file with author).
[194] Nolon & Bacher, *supra* note 175, at 233–34.
[195] *Id.* at 234.
[196] *Id.*
[197] *See* John R. Nolon, *Zoning and Land Use Planning*, 36 REAL EST. L.J. 350, 376–77 (2007).
[198] Nolon & Bacher, *supra* note 175, at 234.

A. A Step-by-Step Approach to TOD through the Wedge

Each of the components of the Land Use Stabilization Wedge can be created by following a step-by-step approach at the local level.[199] The following ten step plan for promoting transit oriented development illustrates an approach that can be replicated to implement each component of the wedge strategy, or that could be used to implement them all simultaneously.[200]

1. Feasibility Study and Transit Area Designation

Transportation planning is site specific and dependent on local transit and traffic circumstances.[201] Requisite densities of development and a variation of land uses—residential, retail, office—are needed in a sufficiently large transit area to entice enough riders for transportation service to be economically feasible.[202] The viability of a local transit oriented development plan depends on an area regional transit system that services sufficient patrons at each station,[203] thus demanding close and thorough communication between regional transportation planning and local land use planning. The two work in conjunction with each other; municipalities must be amenable to creating transit ready plans while regional transportation agencies must produce plans that can service a number of transit ready locations.[204]

2. Develop and Adopt a Transit Area Land Use Plan

State law authorizes most localities to adopt comprehensive land use plans.[205] As a corollary, they are allowed to adopt area-wide plans for distinct neighborhoods to serve purposes such as urban renewal, local

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[199] *See id.* at 228–29.
[200] *See id.* at 228–33.
[201] *See* TODD LITMAN, INTRODUCTION TO MULTI-MODAL TRANSPORTATION PLANNING: PRINCIPLES AND PRACTICES (2009), *available at* http://www.vtpi.org/multimodal_planning.pdf (summarizing basic transportation planning principles).
[202] CITY OF AUSTIN NEIGHBORHOOD AND PLANNING DEPARTMENT, TRANSIT ORIENTED DEVELOPMENT GUIDEBOOK 5–6 (2006), *available at* ftp://coageoid01.ci.austin.tx.us/GIS-Data/planning/TOD/TODGuidebook.pdf. In order to encourage the use of transit, most studies indicate that seven to fifteen dwellings per acre are needed. Robert H. Freilich, *The Land-Use Implications of Transit-Oriented Development: Controlling the Demand Side of Transportation Congestion and Urban Sprawl*, 30 URB. LAW. 547, 552 n.18 (1998).
[203] CITY OF AUSTIN NEIGHBORHOOD AND PLANNING DEPARTMENT, *supra* note 202, at 5.
[204] Nolon & Bacher, *supra* note 175, at 229.
[205] JOHN R. NOLON & PATRICIA R. SALKIN, LAND USE IN A NUTSHELL 5–6 (2007).

waterfront development, and transit oriented development, among others.[206] For communities with two or more transit hubs, such area specific plans can be formed for each station.[207] These area plans can be form based and can show design elements that define the scale, intensity, and density of buildings and the particular features that discourage use of cars and encourage pedestrian access to the transit hub.[208] Such plans can be designed in sufficient detail so that developers know what to propose and so that proposals can be judged for compliance with the plans.[209]

3. Conduct Environmental Impact Review

In many states, local governments have the power to conduct generic environmental reviews of amendments to their comprehensive plans, such as the adoption of a TOD component.[210] Environmental reviews demonstrate the public purposes of such amendments, which, in the case of TOD, can include proper economic development, tax base expansion, relief from traffic congestion, climate change mitigation, the provision of workforce housing, and energy conservation.[211] Involving the public in the adoption of plan amendments creates public support for the zoning and land use actions that must be taken to achieve these purposes.[212]

If transit area plans are sufficiently detailed, developers will know precisely what types of developments communities want near their transit stations and how the public objectives served by such projects are to be accomplished.[213] Development projects that comply with the plan can be accelerated since no additional environmental impact studies will be required and public support for them is more likely.[214] This is particularly true where the public is involved meaningfully in the environmental review process.[215] Loans or grants from regional, state, and federal transportation and land use agencies can be sought to

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[206] Nolon & Bacher, *supra* note 175, at 229.
[207] *Id.*
[208] *Id.*
[209] *Id.*
[210] *See, e.g.*, N.Y. COMP. CODES R. & REGS. tit. 6, § 617.10 (2009) (defining a generic environmental impact study and explaining its potential uses and functions).
[211] CITY OF AUSTIN NEIGHBORHOOD AND PLANNING DEPARTMENT, *supra* note 202, at 6.
[212] *See, e.g.*, *id.* at 15–16 (emphasizing extensive public meetings and workshops throughout the station area plan process).
[213] *See* Nolon & Bacher, *supra* note 175, at 230.
[214] *Id.*
[215] *See* CITY OF AUSTIN NEIGHBORHOOD AND PLANNING DEPARTMENT, *supra* note 202, at 15–16.

pay for these detailed planning and environmental studies.[216] These costs can be recovered by collecting fees from developers who submit projects that are in line with the plan.[217]

4. Adopt Transit Area Overlay Zone

The current zoning in the Transit Area can be held in place along with the adoption of an overlay zone that is coterminous with the boundaries of the designated Transit Area.[218] The overlay zoning ordinances can state that any project that conforms to the Transit Area Land Use Plan and the Environmental Impact Statement is an as-of-right land use.[219] This converts the plan into a regulatory instrument: one that is specific enough to define the design, bulk, and use standards normally found in the zoning ordinance itself.

The overlay district can be designed as a bonus density zone and give greater building height or floor area to developers who comply with applicable standards.[220]

5. Develop Strategy with Landowners and for Selecting Developers

In most localities, much of the land within a Transit Area will be privately owned.[221] The Transit Area will contain developed, underdeveloped, and vacant land.[222] For a public plan to be implemented, private landholders must make a commitment to work with the plan.[223] One strategy is to include provisions in the zoning ordinances that allow adjacent landowners to make a request for the rezoning of their land to the Transit Area Overlay Zone and to submit a development proposal that conforms to the Transit Area Land Use Plan.[224] Another strategy is to form a local development corporation that can bargain for options to buy land from landowners and to empower this quasi-public corporation to sell the optioned property

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[216] Nolon & Bacher, *supra* note 175, at 230.
[217] *Id.*; *see also* N.Y. COMP. CODES R. & REGS. tit. 6, § 617.13(a) (2009) (allowing agencies to charge a portion of the lead agency's costs of preparing a generic environmental impact statement ("GEIS") to developers in the study area).
[218] Nolon & Bacher, *supra* note 175, at 230.
[219] *Id.*
[220] *Id.* at 230–31.
[221] *Id.* at 231.
[222] *Id.*
[223] *Id.*
[224] Nolon & Bacher, *supra* note 175, at 231.

to developers.[225] A third option is to utilize a local renewal agency or other quasi-public entity to carry out this function.[226]

6. Add Zoning and Site Plan Standards to Achieve Energy Efficiency and Other Environmental Benefits of the Land Use Stabilization Wedge

To lower energy use and CO_2 emissions, zoning and site plan standards can limit the size of residential units and can require all buildings to incorporate renewable energy facilities or mechanical systems, such as solar panels or combined heat and power.[227] Zoning and site plan regulations can, in addition, prescribe the use of low impact development standards to reduce stormwater runoff and flooding,[228] orient buildings to maximize solar exposure and reduce lighting needs,[229] and specify other site and building design standards desired by the community.[230] The other components of the Land Use Stabilization Wedge, described in Part VI below, can be incorporated either as zoning provisions, code amendments, or site plan standards.[231]

7. Streamline Approval of Proposed Transit Area Developments

Developers who propose projects that comply with the GEIS and the Transit Area Overlay Zone provisions can enjoy significant streamlining of the local approval process of their proposed projects.[232] This can be accomplished informally by simply requiring local staff and boards to expedite the project review process. Designating projects that comply with the plan and environmental impact statement as permitted uses under step 4 above significantly shortens the approval process for developers.[233] This is a major incentive that will attract quality developers to the community.

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[225] *Id.*
[226] *Id.*
[227] *Id.*
[228] *See* U.S. GREEN BUILDING COUNCIL, LEED GREEN BUILDING RATING SYSTEM VERSION 2.0: LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN 6 (2000), *available at* http://www.gulfcoastinstitute.org/cleanair/resources/LEED-RSv2.0.pdf.
[229] *See id.* at 23.
[230] *See id.* at 10.
[231] *See infra* Part VI.
[232] Nolon & Bacher, *supra* note 175, at 231–32.
[233] *See id.*

8. Provide Bonus Zoning Incentives to Developers

Land use law in many states allows municipalities to provide a variety of zoning bonuses, waivers, and incentives to developers in exchange for providing public benefits.[234] Some of these statutes provide that, in lieu of providing benefits directly, developers can be required to provide cash in exchange for zoning incentives.[235] In a Transit Area Overlay Zone, the higher densities permitted by the overlay provisions can be designated as bonus densities under these statutes.[236]

9. Use Cash to Create Workforce Housing and Livable Spaces

Where such incentives are provided, any cash contributed by developers can be accumulated in trust funds and used for transit area enhancements such as affordable workforce housing, parks, pedestrian amenities, and neighborhood design enhancements.[237] This housing can put workers within walking distance of the jobs provided by the zoning, further reducing VMT, and the other enhancements can make the transit neighborhood more liveable, healthy, and climate friendly.[238]

10. Leverage Cash to Secure State and Federal Assistance

Climate change has altered federal and state priorities and will reshape funding programs to benefit local strategies that promise to reduce fossil fuel consumption, foreign oil dependency, and greenhouse gas emissions.[239] Local TOD strategies should improve the locality's competitiveness for state and federal funding for urban development, transportation planning and development, urban infrastructure, environmental protection, and affordable housing.[240] This funding, in turn, should make local TOD projects that are much more feasible.[241]

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[234] *Id.* at 232.
[235] *Id.*
[236] *Id.*
[237] *Id.*
[238] *Id.*
[239] Nolon & Bacher, *supra* note 175, at 232.
[240] *Id.* at 232–33.
[241] *Id.* at 233.

B. Illustrations[242]

In this section, two cases are discussed—the first suburban and the second urban—to illustrate how local governments have used their land use laws and processes to create Transit Oriented Development.

The suburban Bloomington, Minnesota city code provides for an "HX-R" zoning district (high intensity mixed-use with residential) that is aimed at getting people out of their cars.[243] It aims "to reduce vehicle trips and vehicle miles traveled . . . by allowing intense development in close proximity to high frequency transit service, and by encouraging multi-purpose trips, walking trips, carpool trips and transit trips."[244] The ordinance prohibits drive-through uses that obstruct sidewalks and discourage walking.[245] It provides a minimum density of thirty dwelling units per acre for residential development.[246] It also provides a minimum floor area ratio of 1.5 and a maximum of 2.0.[247] This maximum may be increased through density bonuses to encourage retail and service businesses, below grade parking, development of plazas or parks, affordable housing, public art, and sustainable design.[248]

Parking is restricted in the ordinance in order to promote walking, biking, and transit use.[249] "[P]arking must be located below grade, within structured ramps, or in individual on-street spaces parallel with and adjacent to low volume streets."[250] Bicycle parking must be provided near building entrances.[251] Development directly adjacent to transit stations must provide sidewalk and bikeway connections to the transit station as well as to adjacent sites.[252] The Bloomington zoning strategy evinces a commitment to development that is truly transit oriented by restricting parking, connecting to nearby transit, locating retail and service uses within

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[242] The following illustrations discussed, *infra* notes 243–264 and accompanying text, are derived from the author's earlier article addressing local government means of creating Transit Oriented Development.
[243] *See* BLOOMINGTON, MINN., CODE ch. 19, § 19.29(a) (2008).
[244] *Id.* § 19.29(a)(4).
[245] *Id.* § 19.29(k).
[246] *Id.* § 19.29(f).
[247] *Id.* § 19.29(g).
[248] *Id.* § 19.29(g)(4).
[249] BLOOMINGTON, MINN., CODE ch. 19, § 19.29(i)(2) (2008).
[250] *Id.* § 19.29(i)(2)(A).
[251] *Id.* § 19.29(i)(3).
[252] *Id.* § 19.29(k)(4)–(5).

short walks of residences, and thereby reducing vehicle trips and vehicle miles traveled.

The City of Yonkers, New York, adopted a highly detailed master plan for its central commuter rail station area that contained certain specifications regarding the types of development the city wanted on available vacant land in the area.[253] The zoning for the area was amended to provide "as-of-right" status for developments that conform to the design standards contained in the master plan.[254] Compliance with New York State's extensive environmental review requirements was waived for such projects, since the impacts of development contemplated by the master plan had already been studied in detail and mitigation of adverse environmental impacts provided.[255]

Early in this process, a developer was selected through a request-for-proposals process to plan the redevelopment of two centrally located sites, immediately adjacent to the train station.[256] As the city developed its plan and conducted its environmental impact review, the private developer began site planning and provided information to the city planners regarding economic and market realities.[257] Information provided by citizens, environmental consultants, other professionals, and the developer were integrated as the process progressed and the master plan and designs for the two sites were adjusted.[258]

The result is the development of Hudson Park, a two-phase project that contains 560 middle-income rental residential units, public pedestrian access to a renovated waterfront, restaurants, office and retail space, and immediate access to the train station through carefully designed walkways and entrances that provide security to riders.[259] Hudson Park is a dramatic transit oriented development where parking provided is approximately 50% less than the amount required by traditional urban zoning.[260] This is possible because the buildings and area appeal to commuters who travel to work by train and the developer's marketing was designed

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[253] Nolon, *Shifting Ground, supra* note 144, at 26.
[254] *Id.*
[255] *Id.*
[256] *Id.* at 27.
[257] *Id.*
[258] Nolon, *Shifting Ground, supra* note 144, at 27.
[259] *See* E-mail from Collins, *supra* note 96; E-mail from Siegel, *supra* note 96; Nolon, *Shifting Ground, supra* note 144, at 27.
[260] Nolon, *Shifting Ground, supra* note 144, at 27.

to attract them.[261] The developer saved $25,000 in development costs for each parking space not constructed, and residents save $6,000 annually for owning one car instead of two.[262] Three high quality restaurants and a number of retail stores catering to the middle-income populations of these buildings have appeared in the neighborhood.[263] This project and the public amenities provided by the government to support it are credited with sparking considerable additional private sector interest in the area.[264]

V. BUILDINGS

A. Regulation of CO_2 Emissions Through Energy Conservation Codes

Residential and commercial buildings are responsible for nearly thirty-two percent of the CO_2 emission in the United States.[265] Buildings consume energy primarily for heating, lighting, and air conditioning.[266] There are a number of methods that have been developed that can be used to reduce energy consumption in residential and commercial buildings. They include passive solar design, high energy lighting and appliances, multiple glazing, highly efficient ventilation and cooling systems, solar water heaters, insulation materials and technologies, high-reflectivity building materials, geothermal energy systems, combined heat and power systems for individual buildings, and district energy systems for multiple buildings.[267]

In our legal system, the principal means of regulating building construction to achieve energy efficiency is through energy conservation codes.[268] Most states and cities that adopt such codes adopt the IECC promulgated by the ICC.[269] Once adopted, compliance with the IECC is

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[261] *Id.*
[262] *Id.*
[263] *Id.*
[264] *Id.*
[265] *See* EPA INVENTORY OF GREENHOUSE GAS EMISSIONS, *supra* note 13, at 2–19.
[266] *Id.* at 2–22.
[267] *See* BERT METZ ET. AL., INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: MITIGATION 389 (2007), *available at* http://www1.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-frontmatter.pdf.
[268] *See* THOMAS W. FLEMING, FRESHWATER, ENERGY CODES—ORIGINS AND CURRENT CODES: A PRIMER (2009), *available at* http://www.freshwaterfl.com/EnergyCodesPrimer.pdf.
[269] *Id.* The ICC was established in 1994 as a nonprofit organization for the purpose of establishing a single set of model construction codes. Int'l Code Council, About the ICC, http://

required before new or significantly renovated buildings are legally eligible to receive a Certificate of Occupancy ("CO") and begin operations.[270] The CO is given by local codes departments, which are responsible for certifying that all construction meets the provisions of all applicable codes—building, electrical, plumbing, as well as energy efficiency.[271] This is another local land use responsibility, which must be exercised effectively to ensure that new construction complies with the energy efficiency provisions of energy conservation codes.

The IECC is divided into separate chapters.[272] Discrete provisions regulate the construction of smaller residential buildings, defined as buildings three stories in height or less.[273] Other provisions regulate all other buildings, generally denominated commercial buildings.[274] Most commercial buildings built in the last 30 years have been designed to conform to either the provisions of the IECC commercial building energy standards or Standard 90.1, promulgated by the American Society of Heating, Refrigerating, and Air Conditioning Engineers ("ASHRAE").[275] Both the IECC and ASHRAE were developed following a process that invites the input of the building science community, industry representatives, code officials, mechanical engineers, and lighting designers.[276]

Energy conservation codes regulate the building envelope, mechanical systems, and lighting.[277] They provide minimum standards for these particular components of structures[278] and, in most cases, stop short of

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www.iccsafe.org/news/about/ (last visited Oct. 16, 2009). The ICC was founded by Building Officials and Code Administrators International, Inc. ("BOCA"), International Conference of Building Officials ("ICBO"), and Southern Building Code Congress International, Inc. ("SBCCI"). *Id.* These predecessor organizations developed three separate sets of model codes that were adopted or adapted by most of the fifty states. *See* Int'l Code Council, International Code Adoptions, http://www.iccsafe.org/government/adoption.html (last visited Oct. 16, 2009) (stating that forty-two states, plus Washington D.C., have adopted the IECC).

[270] INT'L CODE COUNCIL, INT'L PERFORMANCE CODE § 402.3.1 (2003).

[271] INT'L CODE COUNCIL, INT'L ENERGY CONSERVATION CODE § 105.1 (2003) (commentary).

[272] *See* Thomas E. Glavinich, *Energy Codes*, ELEC. CONTRACTOR MAG. Sept. 2005, http://www.ecmag.com/index.cfm?fa=article&articleID=6430.

[273] INT'L CODE COUNCIL, INT'L ENERGY CONSERVATION CODE § 202 (2006).

[274] *See id.* ch. 6.

[275] Glavinich, *Energy Codes*, *supra* note 272.

[276] *See* INT'L CODE COUNCIL, PARTNERSHIP DEVELOPMENT GUIDELINES (2005), *available at* http://www.iccsafe.org/news/about/pdf/CP02-05.pdf; BUILDING EQ, ASHRAE'S BUILDING ENERGY LABELING PROGRAM: FREQUENTLY ASKED QUESTIONS, http://buildingeq.com/files/ABELFAQ.pdf (last visited Oct. 16, 2009).

[277] INT'L CODE COUNCIL, INT'L ENERGY CONSERVATION CODE: PREFACE iii (2009), http://www.iccsafe.org/ps/pdf/3800S09.pdf.

[278] *Id.*

mandating the use of available high energy efficiency technologies. They also do not regulate much of what consumes energy in completed buildings, such as consumer appliances and computers.[279] Energy conservation codes, additionally, do not regulate building orientation and layout or the quality of construction, equipment maintenance, building operations, and occupant behavior, which greatly affect the amount of energy consumed in a completed structure.[280] As a result, for local energy conservation codes to achieve the maximum energy and climate efficiency, they must be "enhanced" to include means for reaching some of these aspects of building design, construction, and operation, to the extent authorized by law. Energy efficiency code enhancements can take various forms, such as code provisions that strengthen the energy efficiency of building construction and land use regulations and protocols that affect site planning, building design, and other environmental impacts of construction.[281]

Some states have preempted local action of any kind regarding energy conservation code enhancement.[282] They simply adopt an energy conservation code as a state-wide minimum and then forbid local governments from adopting more restrictive provisions.[283] Other states allow local governments to adopt provisions that affect greater efficiency than the state code.[284] Still other states adopt no code at the state level but allow individual cities and towns to adopt energy codes if they wish.[285] Massachusetts, which has a statewide energy code that preempts local action, adopted a package of enhanced code provisions that can be

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[279] *See* INT'L CODE COUNCIL, INT'L ENERGY CONSERVATION CODE (2006).

[280] *Id.*

[281] *See* CITY OF ARCATA, CA, COMMUNITY GREENHOUSE GAS REDUCTION PLAN: DRAFT 6 (2004), *available at* http://www.cityofarcata.org/images/stories/community_greenhouse_gas_reduction_plan_copy.pdf.

[282] BCAP, HOME RULE AND ENERGY CODES: AN INTRODUCTORY OUTLINE (2009), *available at* http://bcap-energy.org/files/Home_Rule_outline_FINAL.pdf.

[283] *Id.*

[284] *See, e.g.*, N.Y. ENERGY LAW § 11-109(1) (McKinney 2009) ("Nothing in this article shall . . . be construed as abrogating or impairing the power of any municipality to promulgate a local energy conservation construction code more stringent than the code."). There is no requirement that these more restrictive standards be pre-approved, but such local enactments must be on file with the New York State Codes Council within 30 days of adoption. *Id.* § 11-109(2). For further information, see New York Department of State, NYS Energy Code, http://www.dos.state.ny.us/code/energycode/nyenergycode.htm (last visited Oct. 16, 2009).

[285] *See* Steven Bodzin, *State Energy Codes: An Uphill Battle*, HOME ENERGY, Mar./Apr. 1997, http://www.homeenergy.org/archive/hem.dis.anl.gov/eehem/97/970311.html ("In . . . five states . . . statewide energy codes are limited or nonexistent, and no changes are currently proposed.").

implemented locally, a so called "stretch code."[286] This allows local governments to either apply the "base energy code," or adopt and enforce the full set of enhanced provisions if they wish.[287] The Massachusetts code enhancements for smaller residential buildings are based on the Energy Star for Homes standards and the Residential Energy Services Network ("RESNET") rating approach.[288] For commercial buildings, enhancements are based on the IECC 2009 energy conservation code,[289] which is more restrictive than the Massachusetts base code, and the New Buildings Institute's Core Performance Guide for commercial buildings.[290] Under the enhanced code, large commercial buildings are required to perform more efficiently than the ASHRAE 90.1-2007 standards.[291]

The State of New York allows local governments to adopt standards more restrictive than the New York State Energy Conservation Construction Code.[292] The Town of Greenburgh made changes to its local code to expand energy conservation requirements.[293] Greenburgh's local law mandates that all new homes (small residential buildings) comply with New York's Energy Star-labeled home requirement.[294] The New York State Energy Star Program provides several methods for making a home at least fifteen percent more energy efficient than required by the state's baseline energy code, including the increased use of energy efficient products, more effective insulation, more efficient heating and cooling equipment, higher performance windows, and tightening the building envelope

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[286] *See* 780 MASS. CODE REGS. 120.AA (2009), *available at* http://www.mass.gov/Eeops/docs/dps/inf/120_aa.pdf.
[287] *Id.* § 101.3.
[288] 780 MASS. CODE REGS. 6101.1 § 404.7 (2009). *See also* EXECUTIVE OFFICE OF PUBLIC SAFETY AND SECURITY, COMMONWEALTH OF MASSACHUSETTS, SUMMARY OF THE MASSACHUSETTS BUILDING CODE APPENDIX 120.AA, 'STRETCH' ENERGY CODE 1, http://www.mass.gov/Eeops/docs/dps/inf/stretch_code_overview_jun05_09.pdf [hereinafter STRETCH CODE SUMMARY]; U.S. ENVTL. PROT. AGENCY, A GREEN HOME BEGINS WITH ENERGY STAR BLUE, *available at* http://www.energystar.gov/ia/new_homes/Green_Begins_with_ENERGYSTAR_Blue.pdf (last visited Oct. 16, 2009); RESIDENTIAL ENERGY SERVICES NETWORK, RESNET STANDARDS (2008), *available at* http://www.natresnet.org/standards/audit/National_Energy_Audit_Standard.pdf.
[289] *See* STRETCH CODE SUMMARY, *supra* note 288, at 2.
[290] *Id. See generally* NEW BLDGS. INST., CORE ENERGY CODE DRAFT IECC LANGUAGE FOR ADDITIONAL ENERGY EFFICIENCY IN COMMERCIAL BUILDINGS (2009) *available at* http://www.newbuildings.org/downloads/codes/Core_Energy_Code_7-31-09.pdf.
[291] *See* STRETCH CODE SUMMARY, *supra* note 288, at 2.
[292] N.Y. ENERGY LAW § 11-109 (McKinney 2009).
[293] *See* TOWN OF GREENBURGH, N.Y. CODE § 100.15 (2009).
[294] *Id.*

to reduce air infiltration.[295] As the EPA works to improve the Energy Star program, it fills in some of the gaps in energy efficiency compliance that exist in the IECC. These include, for example, field verification of the quality of construction and of mechanical systems, higher efficiency heating, cooling, and water heating equipment, and new requirements for energy efficient lighting and appliances.[296]

An important benefit of adopting the Energy Star requirements for small residential buildings is that compliance with them must be certified by trained third party Home Energy Rating System ("HERS") raters who are trained by RESNET.[297] The HERS verifier submits a certification of compliance to the local code inspector or department prior to the issuance of the formal Certificate of Occupancy.[298] The addition of this trained cadre of verifiers is key to the success of energy conservation code enforcement. Most local code enforcement officers have been trained in traditional building code standards and enforcement,[299] not the energy performance of buildings, and local code departments are often understaffed and freighted with many responsibilities beyond energy conservation code compliance.[300]

B. LEED as a Regulatory Tool for Local Governance

The City of Boston enhanced its local codes in a different way when it adopted the Boston Zoning Code Green Building Amendments in 2007.[301] These amendments "ensure that major building projects are planned, designed, constructed, and managed to minimize adverse environmental impacts; to conserve natural resources; to promote sustainable development;

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[295] John R. Nolon & Jennie C. Nolon, *Local Governments Weigh Green Building Standards*, N.Y. L.J., Apr. 15, 2009, at 5.

[296] U.S. Envtl Prot. Agency, ENERGY STAR Qualified Homes 2011, Fact Sheet, May 4, 2009, *available at* http://www.energystar.gov/ia/partners/bldrs_lenders_raters/downloads/2011_Fact_Sheet.pdf.

[297] Residential Energy Services Network, How to Become a Certified Rater, http://www.natresnet.org/rater/certified/default.htm (last visited Oct. 16, 2009).

[298] *See, e.g.*, CITY OF BOULDER, GREEN BUILDING AND GREEN POINTS PROGRAM: BUILDING SCIENCE AND COMPLIANCE REQUIREMENTS 7 (2008), *available at* http://ci.boulder.co.us/files/buildingscience_compliancerequirements.pdf.

[299] *See generally* American Association of Code Enforcement, Code Enforcement Administrator (2008), http://www.aace1.com/displaycommon.cfm?an=1&subarticlenbr=3 (listing requisite skills and abilities for zoning and code enforcement and omitting mention of energy conservation).

[300] *See* Sara C. Bronin, *The Quiet Revolution Revived: Sustainable Design, Land Use Regulation, and the States*, 93 MINN. L. REV. 231, 256–57 (2008).

[301] BOSTON, MASS., ZONING CODE art. 37 (2007).

and to enhance the quality of life in Boston."[302] The Boston legislation incorporates by reference the LEED building rating systems promulgated by the U.S. Green Building Council ("USGBC").[303] The Boston zoning amendment requires affected buildings to be "LEED Certifiable," rather than "certified."[304] Affected developers are required to design and construct a building to meet the minimum level of LEED certification requirements but are not required to apply for actual certification from the USGBC.[305]

Under Boston's LEED compliance approach, developers are allowed to choose which LEED standards to meet and to demonstrate to the city that the building is able to achieve certification, rather than to receive actual certification prior to the issuance of the CO.[306] This approach may or may not achieve better energy conservation, but it does ensure that buildings achieve a variety of environmental benefits. LEED's New Construction certification standards ("LEED-NC") include several categories: sustainable sites, water efficiency, energy and atmosphere, materials and resources, and indoor environmental quality.[307] Developers are required, under LEED, to secure a certain number of points to achieve various levels of certification, but they are allowed to choose which points to earn.[308] The LEED-NC energy and atmosphere category includes measures that are not included in energy conservation codes, such as on-site renewable energy, enhanced building commissioning, enhanced refrigerant management, measurement and verification, and "[g]reen [p]ower."[309] The materials and resources category includes building reuse and construction waste management, which indirectly save energy.[310]

Another method embodied in the zoning approach to LEED compliance is to use LEED standards as performance objectives or review protocols, rather than as requirements or conditions precedent to the issuance of the CO.[311] This approach encourages developers to come as close

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[302] *Id.* § 37-1.
[303] *Id.* § 37-4.
[304] *Id.*
[305] Patricia Burke, et al., *Boston's Green Affordable Housing Program: Challenges and Opportunities*, 11 N.Y.U. J. LEGIS. & PUB. POL'Y 1, 8 (2007).
[306] *See* BOSTON, MASS., ZONING CODE art. 37, § 37-4. (2007).
[307] *See* Charles J. Kibert & Kevin Grosskopf, *Envisioning Next-Generation Green Buildings*, 23 J. LAND USE & ENVTL. L. 145, 149 tbl.2 (2007).
[308] *See* U.S. Green Building Council, How to Achieve Certification, http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1991 (last visited Oct. 16, 2009).
[309] *See* LIV HASELBACH, THE ENGINEERING GUIDE TO NEW CONSTRUCTION 119–21 (2008).
[310] *Id.* at 165–66.
[311] *See* Bronin, *supra* note 300, at 256 (noting that "[o]ptional codes are an alternative to

as possible to meeting LEED standards. This implicates the land use review and approval powers and processes of local governments and requires the planning commission and the development staff of the municipality, rather than the codes division, to urge developers to comply with LEED to expedite the permitting process.[312] Taking this approach allows the commission and staff to encourage compliance with the energy and atmosphere standards of LEED-NC in order to enhance its energy conservation code enforcement efforts.[313]

VI. THE OTHER COMPONENTS OF THE LAND USE STABILIZATION WEDGE

The other components of the Land Use Stabilization Wedge are land use strategies that facilitate wind power, solar power, and sequestration.[314] The intention of this part of the article is to illustrate how local land use authority can be employed as a strategy to stabilize energy use and CO_2 emission in each of these arenas of engagement. Each one will be discussed briefly and a potpourri of examples will be cited to demonstrate that the Land Use Stabilization Wedge Strategy is a worthy partner of higher profile climate change mitigation methods.

A. Sequestration

Two of Socolow's wedges deal with the sequestration of CO_2 by the natural environment.[315] He discusses the management of forests and agricultural soils and urges that forests be preserved and expanded, that forests and natural grasslands not be converted to cropland, and that croplands be tilled using conservation practices.[316] As Socolow demonstrates, these natural features absorb and store CO_2, while tree harvesting, the conversion of natural pastures to croplands, and intensive farming practices, release stored CO_2.[317]

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mandates . . . .").
[312] *Id.* at 259.
[313] *But see id.* at 256–57 (noting that overworked local land use officials who have to draft and regulate under such a new legal regime may oppose optional codes).
[314] *See* Pacala & Socolow, *supra* note 41, at 970 tbl. 1.
[315] *Id.* at 971. Sequestration, as discussed in this section, does not include the subterranean sequestration and storage of CO_2 referred to by the article.
[316] *Id.*
[317] *Id.*

Viewed through the lens of the Land Use Stabilization Wedge, sequestration takes on additional importance as a mitigation strategy. United States CO_2 emission data indicates that natural sequestration reduces domestic emissions by approximately fifteen percent.[318] Were it not for the absorption of CO_2 by forests, grasslands, croplands, and urban trees, U.S. gross CO_2 emissions would be 7,150 million metric tons, rather than a net 6,103.[319] By doubling the density of dwelling units to accommodate the next 100 million people, an area roughly the size of Connecticut will not be developed: the CO_2 emissions savings from this single result of the Land Use Stabilization Wedge are significant.[320]

Land use planning and regulation can further sequestration in a variety of other ways as well.[321] Municipalities can adopt tree ordinances regulating the cutting, pruning, and replacement of trees on existing developed lots.[322] They can adopt tree canopy objectives in their comprehensive plan and aspire to increase the percentage of the community that is

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[318] U.S. Envtl. Prot. Agency, Carbon Sequestration in Agriculture and Forestry: Frequent Questions, http://www.epa.gov/sequestration/faq.html#6 (last visited Oct. 17, 2009) ("Net sequestration . . . in U.S. forests, urban trees and agricultural soils totaled almost 840 teragrams (Tg) of CO_2 equivalent . . . in 2001. This offsets approximately 15% of total U.S. CO_2 emissions from the energy, transportation and other sectors.").

[319] EPA INVENTORY OF GREENHOUSE GAS EMISSIONS, *supra* note 13, at ES-4-6 tbl.ES-2.

[320] *See supra* notes 82–85 and accompanying text. *See also* TRIP POLLARD, SOUTHERN ENVIRONMENTAL LAW CENTER OF VIRGINIA, NEW DIRECTIONS: LAND USE, TRANSPORTATION, AND CLIMATE CHANGE IN VIRGINIA 2 (2007), *available at* http://www.southernenvironment.org/uploads/publications/new_directions_dec07.pdf ("Sprawl plays a critical role . . . by destroying forests and farmland that help store carbon.").

[321] *See* Erle Ellis, *Land-Use and Land-Cover Change*, ENCYCLOPEDIA OF EARTH, Aug. 10, 2007, http://www.eoearth.org/article/Land-use_and_land-cover_change.

> At global scale, LULCC ["land use and land-cover change"] is responsible for releasing greenhouse gases to the atmosphere, thereby driving global warming. LULCC can increase the release of carbon dioxide to the atmosphere by disturbance of terrestrial soils and vegetation, and the major driver of this change is deforestation, especially when followed by agriculture, which causes the further release of soil carbon in response to disturbance by tillage. Changes in land use and land cover are also behind major changes in terrestrial emissions of other greenhouse gases, especially methane (altered surface hydrology: wetland drainage and rice paddies; cattle grazing), and nitrous oxide (agriculture: input of inorganic nitrogen fertilizers; irrigation; cultivation of nitrogen fixing plants; biomass combustion).

Id.

[322] *See* David J. Nowak, *Atmospheric Carbon Reduction by Urban Trees*, 37 J. ENVTL. MGMT. 207, 207 (1993) ("[I]ncreasing the amount of trees can potentially slow the accumulation of atmospheric carbon. Managers in urban areas must be aware of the potential of trees to mitigate atmospheric carbon, one of many benefits derived from urban trees.").

shaded. Trees provide windbreaks, reduce air conditioning costs, mitigate urban heat island effects, and make urban environments more comfortable and healthful.[323] Municipalities can adopt timber-harvesting ordinances regulating the environmental impacts of forestry, through which they can promote practices that increase carbon absorption by preventing clear cutting and prescribing best stewardship practices.[324] Urban forests and vegetation can be expanded and enhanced by municipal tree planting programs and zoning and site plan regulations that prevent tree removal and require tree replacement. Localities may also encourage or require developers to plant street trees, create small parks, build green roofs, and provide landscape buffers and vegetated recreational and sitting areas or tree lined walking and bike paths.[325] Density bonuses can be provided to developers of compact developments, and cash contributions can be received in exchange for such bonuses, which can be used to purchase the development rights of valuable open space areas that contain critical natural resources.[326] Through the use of cluster subdivision requirements and conservation subdivision standards,[327] small gains on individual development

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[323] *See* BRIAN KANE & JEFF KIRWAN, VIRGINIA COOPERATIVE EXTENSION, VALUE, BENEFITS AND COSTS OF URBAN TREES 1 (2009). *See also* D.E. Pataki et al., *Urban Ecosystems and the North American Carbon Cycle*, 12 GLOBAL CHANGE BIOLOGY 1, 4 (2006).

[324] *See generally* National Association of Home Builders, Tree Preservation Ordinances, http://www.nahb.org/generic.aspx?genericContentID=19086 (last visited Oct. 16, 2009) (discussing various types of tree ordinances).

[325] *See* Rowan A. Rowntree & David J. Nowak, *Quantifying the Role of Urban Forests in Removing Atmospheric Carbon Dioxide*, 17 J. ARBORICULTURE 269, 270 (1991) ("[T]he net amount of carbon sequestered by urban forests in the United States is estimated at about 6.5 million tons/year."). This translates into 26 million tons of CO_2.

[326] Permit conditions can be imposed to protect the environment, which can include curbing greenhouse gas emissions. In *Konecelik v. Planning Board of East Hampton*, 590 N.Y.S.2d 900 (N.Y. App. Div. 1992), the court upheld a planning board's conditional approval of a subdivision plat that imposed several conditions designed to protect "the extensive area of undisturbed forest, and the presence of numerous important plant species scattered throughout the site." *Id.* at 901.

[327] CO_2 Sequestration gains from these two land use requirements can be dramatic. Clustering requires developers to preserve a percentage of the development parcel for open space and requires that it be left in its natural condition and be carefully managed to preserve community benefits of open land. *See* James Joshi Wynn, Open Space Cluster Developments to Conservation Subdivisions: Standards and Management Plans Influencing Conservation Goals 1, 103–04 (Aug., 2008) (unpublished thesis, Ohio University). Conservation subdivisions go farther and require more aggressive conservation practices on both the preserved and developed portions of the land. *See id.* at 27 (discussing conservation subdivisions). In areas experiencing rapid growth where thousands of acres are proposed for subdivision development, these techniques can promote practices that preserve the absorptive qualities of natural landscapes and prevent the release of stored CO_2.

projects can add up to significant CO_2 benefits while promoting the more localized gains of cooling the urban environment, reducing the heat island effect of densely developed neighborhoods, and securing public health benefits for the urban population.[328]

Adopting local zoning and subdivision regulations and standards that avoid disturbing vegetation and soils on development sites have related effects.[329] The emerging field of "low impact development" experiments with pervious alleys and green roofs in urban projects,[330] and, in compact developments, with vegetated swales that replace curbs and gutters for storm water control, cluster development, tree retention, and retention of permeable topsoil on site during and after construction.[331] In rural communities, local zoning can protect and preserve fertile agricultural soils for farming.[332]

The preservation of such resources provides valuable environmental benefits in addition to carbon sequestration: food production, wetlands and habitat preservation, stormwater management and flood prevention, watershed protection, and the prevention of erosion and sedimentation.[333] Further carbon stabilization can occur when developing communities are able to preserve farmland where food products are produced closer

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[328] The American Planning Association ("APA"), at its annual meeting in 2007, tipped its hat to sequestration. "There was also some limited attention to connections between mitigation and adaptation, in terms of, say, urban forestry that both sequesters carbon in the trees and cools our cities." WILLIAM R. TRAVIS, GLOBAL WARMING AND LAND USE 5 (2008), *available at* http://spot.colorado.edu/~wtravis/warming_land_use.pdf. *See also* HUGH T. SPENCER, CLIMATE CHANGE MITIGATION STRATEGIES FOR KENTUCKY: POLICY OPTIONS FOR CONTROLLING GREENHOUSE GAS EMISSIONS THROUGH THE YEAR 2020 AD 111 (1998), *available at* http://www.epa.gov/climatechange/wycd/stateandlocalgov/downloads/ky_2_fin.pdf.

> Sampson *et al.* after developing a careful analysis of the potential for urban forest cover concluded that the "role of U.S. urban and community trees in affecting the global carbon dioxide balance is admittedly modest." These authors estimate that work to improve urban forest could potentially provide a 2 to 3 percent reduction in national emissions which, while small, would still be of some importance.

Id.

[329] Nolon, *Shifting Ground*, *supra* note 144, at 29.

[330] *Id.*

[331] *Id.*

[332] *See, e.g.*, The *Future of the Goleta Valley's Agriculture*, GOLETA VALLEY URBAN AGRICULTURE NEWSLETTER, at 5, http://longrange.sbcountyplanning.org/programs/Newsletters/documents/Goleta_Urban_Ag/2.pdf (last visited Oct. 16, 2009) ("The County protects urban agricultural land through adopted land use policies that discourage conversion of productive agricultural land to other uses. . . .").

[333] Nolon, *Shifting Ground*, *supra* note 144, at 29.

to population centers to reduce transportation costs.[334] Wetlands preservation, seen though the lens of climate change mitigation, offers the additional benefit of carbon sequestration since most wetlands have been undisturbed by previous development.[335]

B. Regulating Wind Generation Facilities

Wind power is an alternative source of energy identified by Socolow. Technology exists in certain areas to increase the amount of renewable power produced in the United States.[336] Wind generation is promoted through requirements adopted by at least fifteen states, mandating that renewable sources make up a percentage of the electricity sold by regulated utilities.[337] Thirty-seven states have wind resources that would support utility-scale wind energy projects,[338] and wind power is currently the fastest growing category of renewable energy in the country.[339] In most states, however, wind generation facilities—large and small—are subject to local land use regulation.[340] Following Socolow's strategy,[341] then, local governments are among the critical actors whose cooperation must be secured to stabilize CO_2 emissions through this source of renewable energy. Some are doing so through well-written, reasonable standards, while others are raising barriers because of concerns over noise, public safety, viewshed interruption, and other environmental impacts.[342] Other

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[334] *Id.*
[335] *Id.*
[336] CARBON MITIGATION INITIATIVE, CMI IN BRIEF: BUILDING THE STABILIZATION TRIANGLE 1, *available at* http://www.princeton.edu/pr/news/04/q3/0812-carbon/backgrounder.pdf (last visited Oct. 16, 2009).
[337] *See* Frederick C. Menz, *Green Electricity Policies in the United States: Case Study*, 33 ENERGY POLICY 2398, 2403 (2005) ("While most states use several [types of] regulations . . ., four states had no rules or regulations to promote electricity from green energy sources at either the state or local level in 2003 (Alabama, Mississippi, South Dakota, and West Virginia.")).
[338] U.S. GOV'T ACCOUNTABILITY OFFICE, RENEWABLE ENERGY: WIND POWER'S CONTRIBUTION TO ELECTRIC POWER GENERATION AND IMPACT ON FARMS AND RURAL COMMUNITIES 17 n.19 (2004), *available at* http://www.gao.gov/new.items/d04756.pdf.
[339] Ronald H. Rosenberg, *Making Renewable Energy a Reality—Finding Ways to Site Wind Power Facilities*, 32 WM. & MARY ENVTL. L. & POL'Y REV. 635, 637 (2008).
[340] *See* JODI STEMLER, WIND POWER SITING REGULATIONS AND WILDLIFE GUIDELINES IN THE UNITED STATES (2007), *available at* http://www.batsandwind.org/pdf/afwastsitsum.pdf (discussing state wind power regulations).
[341] *See generally* Robert. H. Socolow & Stephen W. Pacala, *A Plan to Keep Carbon in Check*, 295 SCI. AM. 50 (2006).
[342] *See, e.g.*, TOWN OF BENNINGTON, WIND ENERGY ADVISORY COMMITTEE FINAL REPORT

localities are promoting wind power by purchasing electricity from wind farms to run locally owned utilities or to heat and cool municipal buildings.[343]

Local governments are adopting comprehensive plan components that contain local energy and environmental policies, moratoria that impede wind facilities until they can be properly regulated, and numerous zoning, subdivision, site plan, special use permit, and environmental review mechanisms.[344] The purpose is to balance the benefits of wind generated power with the detrimental effects such facilities can have on the community.[345] These laws create spacing and set back requirements, limit or buffer noise, and mandate aesthetic controls.[346] Other local laws impose regulations on noise levels, views, heights, location, size, lighting, color, or design.[347] Some require licenses or allow for decommissioning.[348] While these laws can be used to limit and discourage wind generation facilities, they can also become part of the Land Use Stabilization Wedge by encouraging the construction and use of wind-generation projects both large and small through zoning and site plan provisions. Land use regulations of this type can be supplemented by local property tax abatements and other incentives.

Most of these local controls and initiatives are of recent origin and are just beginning to be litigated. The Town of Islip, New York, for example, recently amended its zoning ordinance to allow homeowners to install accessory wind turbines to provide a supplemental source of power.[349] A federal district court upheld a locally imposed moratorium on wind farm projects in *Ecogen, LLC v. Town of Italy*.[350] Ecogen proposed the construction of over 50 wind turbines in two towns: Prattsburgh and Italy.[351]

(2009), *available at* http://www.benningtonny.com/index_files/wecfinal.pdf (discussing concerns related to the use of wind power).

[343] *See* Alex Williams, *supra* note 30. Northbrook, a village in Illinois, purchases 4,500 megawatt-hours a year of electricity from a nearby wind farm to provide power to its water utility, saving nearly five million pounds of CO_2 emissions annually. *Id.*

[344] John R. Nolon & Jessica A. Bacher, *Wind Power: An Exploration of Regulations and Litigation*, N.Y. L.J., Feb. 20, 2008, at 5 [hereinafter Nolon & Bacher, *Regulations and Litigation*].

[345] *Id.*

[346] *Id.*

[347] *Id.*

[348] *Id.*

[349] ISLIP, N.Y., CODE § 68-420.9 (2009), *available at* http://www.ecode360.com/?custId=IS0324&guid=13282054.

[350] 438 F.Supp.2d 149, 162 (W.D.N.Y. 2006).

[351] *Id.* at 152.

Although Prattsburgh approved the project, Italy was concerned with the scenic and aesthetic impacts of the facility and imposed a six-month moratorium on the construction of wind farms to give it an opportunity to adopt protective regulations.[352] The moratorium was extended several times and finally challenged by Ecogen,[353] which argued that the moratorium constituted an arbitrary and unreasonable deprivation of its property rights.[354] The court disagreed, stating that protecting aesthetic interests is a legitimate governmental concern and that Ecogen had failed to prove that the moratorium was not rationally related to that interest.[355]

Localities can promote wind-generation on a smaller, though significant, scale by permitting homeowners and businesses to install individual wind energy conversion systems. Individuals are beginning to install backyard wind turbines on towers reaching heights of 120 feet that generate enough power for their household use.[356] Applications are submitted to the building department and, if the proposed system meets the height and building restrictions, a permit is granted.[357] In some cases, excess power is created that can be directed back to the local power company grid, sometimes for credit or cash.[358] Some claim that a single wind turbine of this size has the ability to generate enough electricity for two average size homes in a location with moderate wind speeds.[359]

These types of "distributed generation systems" are recognized and favored by the American Planning Association's Policy Guide on Energy.[360] Under New York's Real Property Tax Law, local tax assessors are permitted to offer property owners who construct small wind energy systems either an exemption or partial exemption from local real property taxes assessed for the increased property value due to the addition of the facility to the land.[361] One simple zoning approach to smaller wind generation facilities is to permit them as accessory uses, appropriate in

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[352] *Id.* at 152–53.
[353] *Id.* at 153.
[354] *Id.* at 153–54.
[355] *Id.* at 158–59.
[356] *See* SOUTHOLD, N.Y., CODE §§ 277-1, 277-3 (2007) The Town of Southold permits small wind energy systems defined as "[a] wind energy conversion system consisting of a wind turbine (not to exceed 25 kilowatts of production), a tower, and associated control or conversion electronics, which has a rated capacity intended primarily to reduce on-site consumption of utility power." *Id.* § 277-1.
[357] *Id.* § 277-2.
[358] Nolon & Bacher, *Regulations and Litigation*, *supra* note 344, at 5.
[359] *Id.*
[360] AMERICAN PLANNING ASSOCIATION, POLICY GUIDE ON ENERGY 9 (2004).
[361] N.Y. REAL PROP. TAX LAW § 487.2 (Consol. 2009).

individual circumstance to support the primary permitted use in the zoning district.[362] Another is to permit them as specially permitted uses, which expresses the legislature's policy that they can be appropriate in the districts where permitted, if they are conditioned to mitigate their impact in a particular place.[363]

Wind generation provisions of local zoning, however, can also be more restrictive, exhibiting caution and asserting control over facilities. The Town of Newstead, New York, for example divides facilities into two types; type one is a commercial unit designed for the generation of power supplied to the local grid, and type two is a unit designed to supply power primarily to a single residence.[364] Both require a special use permit from the town board and site plan review.[365] All variances must be approved by the town board.[366]

Local wind generation regulations exhibit a mix of acceptance and resistance to facility construction on the part of the localities, and are often at odds with state and federal policy.[367] Local concerns are logical; they center on the small-scale impact of facilities in particular places, concerns which are known uniquely to the locality.[368] While understandable for this reason, local barriers to the rapid deployment of wind generation facilities can obstruct important federal and state policies that are based on national security concerns,[369] aimed at weaning the nation from dependence

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[362] *See* RIGA, N.Y., CODE § 95-76 (2008), *available at* http://www.townofriga.org/RigaTownCode/tabid/61/Default.aspx (classifying "wind energy conversion systems" as accessory structures provided they are incidental to the primary permitted use on the same lot). Only one system is permitted on a lot and an existing lot cannot be subdivided solely to install multiple wind energy conversion systems. *Id.* § 95-76(H)(2).

[363] EDEN, N.Y., CODE § 217-4 (2008) (requiring applicants that seek to construct wind energy conversion systems of any size to obtain a special use permit in accordance with the code's requirements). The requirements listed are aimed at regulating noise, location, safety, and connection to utilities.

[364] NEWSTEAD, N.Y., CODE § 422-5 (2009).

[365] *Id.*

[366] *Id.* § 422-7. *See also* EAGLE, N.Y., LOCAL LAW No. 3 (2009) (requiring that a planning board conduct site plan review before a wind energy conversion facility is constructed). Upon completion of site plan review, the planning board renders an advisory recommendation to the town board. *Id.* If final site plan approval is obtained from the town board, the applicant must apply for a license to operate a wind facility. *Id.* The license is for a minimum of ten years and is subject to annual certification. *Id.* A licensing fee is assessed based on the megawatt capacity of the facility. *Id.*

[367] See Melanie McCammon, *Environmental Perspectives on Siting Wind Farms: Is Greater Federal Control Warranted?*, 17 N.Y.U. ENVTL. L.J. 1243, 1245–46 (2009).

[368] *See id.* at 1259. *See also id.* at 1260–61 (discussing the role of a local cost-benefit calculus in relationship to Vermont policies on siting wind farming facilities).

[369] *See* U.S. GOV'T ACCOUNTABILITY OFFICE, *supra* note 338, at 2 n.4.

on "foreign oil,"[370] and creating jobs and stimulating economic development.[371] Some suggest that areas or zones of frequent, high wind velocity, should be identified by federal or state law and that local regulatory authority should be preempted or constrained in those places.[372] This is further complicated by the fact that the creation of regional and national power transmission grids is not a local issue, but a state and federal issue.[373]

C. Solar Power: Local Efforts to Regulate and Promote

According to the Carbon Mitigation Initiative, along with wind power, solar energy production is one of the most currently accessible renewable energy sources available to put climate change in check.[374] Local governments can help. They can equip their own buildings with solar facilities and they can adopt land use regulations that encourage the use of solar facilities by developers, businesses, and homeowners. Conversely, however, local governments can also retard the deployment of solar facilities.

An example of how local land use power can be used as a barrier can occur when a local architectural review board decides to deny a permit for solar panels for aesthetic reasons.[375] Because the board is charged with ensuring the conservation of property values by preserving architectural character and appearance, it might prefer aesthetically pleasing design qualities over designs that, while environmentally friendly, are deemed visually offensive.[376] This result can have the unintended consequence of hindering the use of solar power and other alternative energy sources. Some state legislatures have partially preempted local power over solar facilities because of this possibility. California and Nevada have partially stripped local governments of their power to regulate wind and solar power

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[370] *Id.* at 29.
[371] *Id.* at 2–3.
[372] McCammon, *supra* note 367, at 1289–90.
[373] *See* Matthew L. Wald, *Wind Energy Bumps into Power Grid's Limits*, N. Y. TIMES, Aug. 27, 2008, http://www.nytimes.com/2008/08/27/business/27grid.html.
[374] *See* CARBON MITIGATION INITIATIVE, *supra* note 336 (recommending the installation of 700 times the current capacity of solar electricity and the use of 40,000 square kilometers of solar panels to create hydrogen for fuel cell cars).
[375] *See* SCARSDALE VILLAGE, N.Y., CODE § 18-13 (2009) (providing authorization to approve a building permit application if it "would not be visually offensive").
[376] *See id.*

devices.[377] Colorado and Connecticut have adopted legislation requiring local zoning to accommodate solar energy technology.[378]

Other states take a different tack; either trusting local governments to further renewable sources of energy under their zoning enabling laws or granting express power to local governments to add provisions to their zoning regulations that permit and encourage solar energy systems and equipment, including access to sunlight.[379] There are many examples of how traditional land use regulatory tools can be used toward this end. Local governments could, for example:

1. Amend their comprehensive plans to state their support for the rapid deployment of solar facilities;
2. Amend zoning codes to define solar facilities broadly in their zoning code definitions section and allow them as a permitted or accessory use in all zoning districts to provide waivers of any height, area, or bulk requirements that obstruct solar facilities, or to create overlay districts within which solar access is particularly appropriate;
3. Adopt site plan standards to require east-west axis, where feasible, to maximize solar access or to require developers to include protection of solar access on adjacent or neighboring properties or among buildings on the proposed development site;
4. Require subdivision developers to conduct cost benefit analyses of installing solar facilities in single-family developments and requiring them to install such facilities where they are cost effective for the potential purchasers.[380]

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[377] *See* CAL. GOV'T CODE § 65850.5 (a) (West 2009); NEV. REV. STAT. § 111.239 (West 2009). *See also* Wind Power Nevada, Policies affecting Wind Power, http://www.windpowernevada.com/go/policies-affecting-wind-power/ (last visited Oct. 20, 2009); Jessica A. Bacher & Jenni C. Nolon, *Energy Code Updates Needed to Tap U.S. Stimulus Funds*, N.Y. L.J. June 17, 2009, at 5.

[378] COLO REV. STAT. ANN. § 40-2-124 (2009); Conn. Gen. Stat. Ann § 7-147f (2009).

[379] *See, e.g.*, N.Y. GEN. CITY LAW § 20(24) (Consol. 2009); N.Y. TOWN LAW § 263 (Consol. 2009); N.Y. VILLAGE LAW § 7-704 (Consol. 2009).

[380] *See* New Jersey Residential Development Solar Energy Systems Act, N.J. STAT. ANN. § 52:27D-141.1 to 141.4 (West 2009) (requiring developers of projects with 25 or more single-family homes to offer to install a solar energy system during negotiations with potential buyers). Local land use regulations, in most states, can employ this technique or go further by requiring developers to do a cost benefit analysis of solar installations

5. Encourage solar energy provision through exemptions from fees, provision of property tax rebates, and other techniques; or
6. Authorize the zoning board of appeals to make provisions for the accommodation of solar energy systems and equipment and access to sunlight when hearing a request for an area variance.

In balance, local governments have helped with small scale solar energy deployment. Many are anxious to lower energy costs for local taxpayers and further state energy conservation.[381] Their actions educate and sensitize local citizens, who also vote in state and federal elections about the importance of alternative energy sources.

CONCLUSION

The purpose of this article is to demonstrate that local governments can, if they wish, play a critical role in promoting sustainable development while mitigating climate change. They can attack climate change at several strategic points, using land use planning and regulation to reduce CO_2 emissions from buildings and personal vehicles, while promoting renewable energy and preserving and increasing the sequestering environment. The fact that so many positive local actions can be cited illustrates what can be done to harness the legal powers of cities, town, counties, and villages to reduce CO_2 emissions and energy consumption.

This article demonstrates that there is a regulatory system in place that can be used and expanded which, if adjusted prudently, will not affect existing societal norms, economic realities, or political sensibilities. As such, it may stand a better chance of attracting political support than strategies that impose untested burdens on previously unregulated markets, such as cap and trade or carbon taxes.[382] In any event, both approaches can operate compatibly in separate, but important, realms.

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during the development review and approval process. Then, as a condition of the approval, they would be required to install such facilities where the analysis proves the cost effectiveness for the system to potential purchasers.

[381] Leigh Kellett Fletcher, *Green Construction Costs and Benefits: Is National Regulation Warranted?*, 24 NAT. RES. & ENV'T 18, 21 (2009).

[382] Tom Redburn, *The Real Climate Debate: To Cap or to Tax?*, N.Y. TIMES, Nov. 2, 2007, http://www.nytimes.com/2007/11/02/us/politics/04web-redburn.html?_r=1 (discussing differences between cap-and-trade and carbon taxes).

The number of local governments making meaningful progress, however, is a small fraction of the total. Why is this so? What has made some aggressive and successful, while others remain on the sidelines of this critical race with global warming? These topics beg for further research and evaluation. They are raised and evaluated in some detail in two recent articles in the *Planning and Environmental Law Journal*, published by the American Planning Association.[383]

These articles suggest that a national framework of law be designed and used as the organizing force for positive change in developing a flexible and integrated approach to climate change mitigation. This is necessary to avoid wasteful duplication of effort, unhealthy competition among levels of government and sectors, and unnecessary opposition to needed reform. Such a framework is also necessary to capture and leverage the competencies and resources of federal, state, regional, and local governments and the many stakeholders whose futures depend on our legal system to address the alarming consequences of climate change.

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[383] *See* John. R. Nolon, CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT: THE QUEST FOR GREEN COMMUNITIES, 61 PLANNING & ENVTL. L. NO. 10, 3 (2009); 61 PLANNING & ENVTL. L. NO. 11, 3 (2009).