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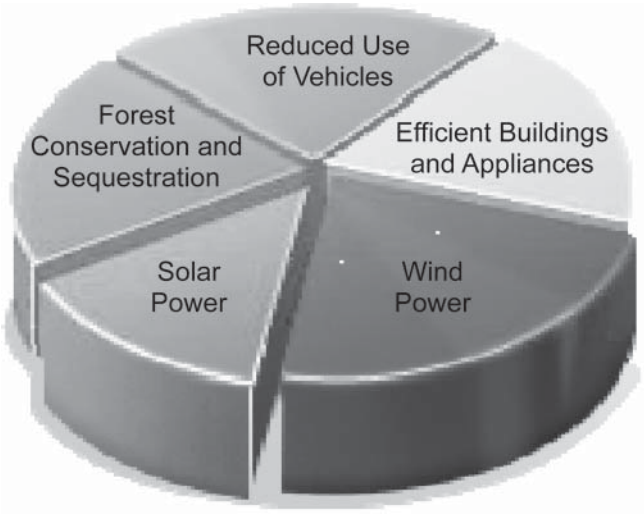
Shifting Ground to Address Climate Change: The Land Use Law Solution

By John R. Nolon

Strategies for Mitigating Climate Change

Robert Socolow, a professor of engineering at Princeton, set an action agenda for mitigating climate change by identifying 15 strategic "stabilization wedges," each one capable of preventing the emission of at least a billion metric tons of carbon annually using existing technologies.[1] The genius of Socolow's strategy is that it divides the daunting and discouraging task of climate change mitigation into categories that enable us to order our response efficiently. It makes a formidable challenge seem more doable and allows us to identify the actors who are capable of effective adaptation within each wedge and to formulate strategies that enable and empower those actors to succeed. One of Socolow's wedges focuses on reduced use of vehicles (vehicle miles traveled), which lowers the use of fossil fuels consumed by vehicles. A second aims at creating energy efficient buildings and appliances. A third fosters wind energy and a fourth energy produced through solar power. A fifth aims at preserving forests and vegetated soils to capture and sequester carbon.[2]

Chart 1



The Land Use Stabilization Wedge
Climate Change Mitigation

This article conceives and describes a Land Use Stabilization Wedge: a strategy that aggregates these five wedges and further organizes strategic energies. (See Chart 1). This builds on Socolow's optimistic assertion that "an excuse for inaction based on the world's lack of technological readiness does not exist."[3] I assert that the existing legal authority of state and local governments to regulate and guide land use and building is a powerful "technology already deployed somewhere in the world."[4] The Land Use Stabilization Wedge aggregates several of Socolow's initiatives and employs multiple mitigation techniques available to citizens in every locality in the country. (See Chart 1).

"The genius of Socolow's strategy is that it divides the daunting and discouraging task of climate change mitigation into categories that enable us to order our response efficiently."

The Land Use Stabilization Wedge comprises all the ways the device of land use control can reduce CO_2 and other greenhouse gas emissions. These include:

1. shifting development patterns so that less driving occurs,
2. reducing the size of housing units,
3. creating more compact and thermally efficient buildings,
4. reducing the materials consumed in building construction,
5. creating more energy efficient buildings,
6. utilizing more efficient equipment and appliances,
7. permitting and encouraging the use of wind energy generation facilities,
8. permitting and encouraging the use of solar energy generation facilities,
9. preserving undisturbed vegetated areas that sequester carbon, and
10. retaining agricultural lands and the production of farm products close to urban centers, further reducing transportation costs.

This article touches on corollary benefits that result from the implementation of the Land Use Stabilization Wedge. These include reduced use of drinking water, reduced impervious coverage and flooding, prevention of water pollution, and others. (See Chart 2).

These objectives can be achieved by local governments in most states through the legal authority already delegated to them to regulate land use and building construction.[5] The Land Use Stabilization Wedge targets local governments as key actors in climate change mitigation, understanding that considerable support and assistance from state and federal agencies and the cooperation and guidance of the private sector are essential to their success.

Potential Effects of Mitigation Through Land Use and Building Control—Shifting Ground[6]

The U.S. Census Bureau projects that the nation's population will grow by 100 million by the year 2043.[7] With a projected household size of 2.6 persons, this yields 40 million new households. This new population and the need to replace aging homes and buildings will cause the private sector to build 70 million new homes and 100 billion square feet of nonresidential space.[8] About two-thirds of the development on the ground by 2050 will be built between now and then. How that growth is placed on the landscape in human settlement patterns is critically important.

In the past decade approximately 60% of households have chosen to live in single-family homes on individual lots. For a variety of reasons, the projected 40 million new households will be more urban oriented and willing to live in dynamic, walkable neighborhoods in cities and urban suburbs. Market projections indicate that urban housing located in compact developments will increase in price more rapidly than single-family, suburban homes.[9] It is quite possible that the market demand will support "shifting ground," so that the historical numbers are reversed. If 60% of these new households (24 million) choose to live in more compact, mixed-use environments and 40% (16 million) choose the single-family pattern, this will shift fully 8 million households (over 20 million people) from one human settlement pattern to the other.

Chart 2

The Land Use Stabilization Wedge Corollary Benefits

The new paradigm for development, one consistent with the Land Use Stabilization Wedge strategic approach, is a more compact, dense and mixed-use human settlement pattern, one capable of being implemented through coordinated local land use law. This envisions a shift in the dominant pattern of development from single-family, single-use neighborhoods to neighborhoods characterized by smaller homes, clustered and stacked, mixed with service and retail uses reachable by foot or on bicycle, with nearby schools and recreation, served by transit stops, now or in the future.

The movement of vehicles is responsible for about one-third of U.S. CO_2 emissions and that number is growing. "Single family homes use more energy per person than multifamily homes. Large homes use more energy than smaller 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."[10] A little over one-third of the increase in driving is associated with demographic change; the rest is attributed to "land use patterns that have led to increases in average trip distances (38%) and in the number of trips made (25%)."[11]

Portland, Oregon, is one city likely to achieve significant greenhouse gas emission goals, owing to the urban growth boundaries adopted in 1974 that were designed to protect farmland and contain sprawl. Climate change mitigation, in this case, is an unintended benefit that is due to the increased density, reduced vehicle trips and vehicle miles traveled, and increased transit ridership that land use law reform achieved.[12]

According to the Urban Land Institute's *Growing Cooler* report, "much of the rise in vehicle emissions can be curbed simply by growing in a way that will make it easier for Americans to drive less. In fact, the weight of the evidence shows that, with more compact development, people drive 20 to 40% less, at minimum or reduced cost, while reaping other fiscal and health benefits."

Compact development, as defined in the *Growing Cooler* report "does not imply high-rise or even uniformly high density development . . . that will result in the 'Manhattanization' of America."[13] It refers to development at about 12–14 dwelling units per acre, which is 75% above the 2003 national average density for all housing development. The report concludes that "shifting 60% of new growth to compact patterns would save 85 million metric

tons of CO_2 annually by 2030." This is aimed at abating the alarming increase in driving caused by the dominant single-family growth pattern, which will increase driving by 59% by 2030 while the population increases by 23%, according to the U.S. Department of Energy's forecasts.

If it were possible to shift half of these 8 million households from single-family settlements to higher density urban development—the type associated with transit-oriented development—the positive effect on the environment and climate change would be dramatic.[14]

1. In higher density urban developments, the amount of CO_2 emitted per capita can be 15 metric tons less annually, when compared with single-family living.[15] Multiplied by 10 million people shifted into higher density urban developments, the potential CO_2 reduction equals 150 million metric tons annually.
2. Residences in higher density urban and compact developments are smaller than the national average for single-family homes. Using an estimate of 1,500 square feet for these developments, compared with the single-family average of 2,600, yields a savings of 1,100 square feet. This space does not need to be heated and cooled. Less space to construct reduces the fossil fuel consumed in manufacturing and assembling building materials.
3. Additional CO_2 stabilization occurs when local governments zone to encourage wind and solar generation, preserve undisturbed landscapes, and preserve farm land close to urban market demand.

The corollary benefits of the compact development pattern are equally dramatic. The Hudson Park project in Yonkers, New York, discussed in the next section, is a representative example of a higher density, transit-oriented development in an urban neighborhood. Its first phase contains 118 dwelling units per acre, four or five times denser than the average compact development project. If half of the 8 million new households were shifted from single-family settlements to this type of development, the results would include:

1. 74 billion fewer cubic feet of stormwater annually.[16]
2. 33 billion square feet less impervious coverage.[17]
3. 100 billion gallons of potable water saved per year.[18]

Reducing Use of Vehicles

How can the Land Use Stabilization Wedge reduce the number of trips taken and the vehicle miles traveled in the U.S.? Comprehensive plans and zoning laws adopted by local governments, when aggregated, create the blueprint for the development of land and buildings for their region. Through changes in plans and zoning laws, communities can create transit-oriented development and transportation efficient development that shift development patterns from a single-family dominant pattern to one that fosters compact, mixed-use development. This new pattern greatly reduces automobile dependency, vehicle trips, and vehicle miles traveled: a method of implementing Socolow's Vehicle Travel Reduction Wedge.

Central cities and their older and developing suburbs constitute the relevant region for transportation planning purposes. In these regions, Metropolitan Planning Organizations (MPOs) prepare capital plans for all types of transportation infrastructure, including transit services. Developing mechanisms to coordinate state and MPO transportation planning with local land use planning is key to the success of connecting higher density urban developments and compact developments to transit services now or in the future and is arguably required under federal law.[19]

Whether legally mandated or not, for practical reasons, land use planning among localities in a transportation region must be coordinated with transportation infrastructure planning and development. Local land use plans and zoning determine how much population can increase over time, and this, in turn, determines demand for various types of transportation services. Transit lines for rail and Bus Rapid Transit (BRT) services cannot be planned in isolation, station by station. The economics of transit station development and rail and bus lines are dependent upon land use densities; there must be a sufficient number of commuters in a relevant group of adjacent communities to provide a minimal level of ridership throughout the area served by the transit system. Where transit service is not feasible because of insufficient land uses and densities, other modes of transportation must be planned.

Transportation Efficient Development (Compact Development)

Compact developments may not be intense enough to support ridership at various locations in a transportation region. In the near term, they may have to be developed as "transportation efficient" communities that are ready to receive transit services in the future as the region grows. Compact developments not near existing transit services can incorporate a variety of land use and transportation features that reduce vehicle miles and trips. Land use plans can allow for mixed uses, a variety of housing types and sizes, parking and bicycle facilities, and transportation related improvements. These can be coordinated with planned capital improvements such as interconnected sidewalks and trails, bike paths, and jitney service from moderate density hamlets to regional transit stations. Together these initiatives can reduce congestion and car dependency, and provide for transit stops in the future.

The Town of Malta, just outside Albany, New York, used an innovative land use technique that can be employed by communities to manage and define future

growth in a way that creates more livable places that are transportation efficient and transit ready. It adopted a central business district overlay zone that is transit ready. The Malta zoning law provides densities at the compact development level and contains a number of standards that will create a typical mixed-use and walkable neighborhood. Currently, the town is not served by transit, but the Capital District Transportation Plan calls for BRT service in the future. In anticipation, the overlay zone provides for mass transit. It states that "to promote 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."[20]

The Town of LaGrange, in Dutchess County, New York, adopted a mixed-use Priority Growth District, or PGD, that directs development to a specific location and contains design and amenity standards that provide an alternative to the large lot single family zoning prevalent in suburban areas that are distant from the metropolitan center and transit services.[21] The PGD concept is particularly well suited for outlying suburban communities, where the rate of growth is significant but where there are still rural characteristics and significant natural resources to be preserved. The pressure to provide new homes in these suburban growth areas can be addressed through the identification of Priority Growth Districts where roadways and other infrastructure either exist or can be accommodated in ways that reduce the length and number of automobile trips and create the possibility for some type of transit service in the future.

LaGrange worked with Dutchess County to create a PGD zone where there was an existing suburban transportation corridor and intersection. The zone in effect creates a new hamlet, serving new and existing residential development and providing some retail services. It combines mixed-use development, a variety of housing types including affordable units, and trails and sidewalks. The zone encompasses 616 acres, and provides for up to 220,000 square feet of commercial space, including up to 160,000 square feet of retail, a supermarket and restaurants, a 50,000 square foot government center with a library, and between 560 to 680 housing units of several types: senior housing and assisted living units, apartments, townhouses, and single-family residences. It will be served by central water and sewer with potential to serve additional adjacent growth, and is located along a state highway.

Transit-Oriented Development (Higher Density Urban Development)

In many urban areas served by transit stations, densities of housing at 15–40 dwelling units per acre can be achieved. Around transit stops, particularly, higher urban density development can be planned for and supported by zoning and infrastructure planning. These types of developments, as demonstrated above, significantly reduce per-capita carbon emissions and yield numerous other climate change and environmental benefits.

The 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.[22] It attempts to reduce vehicle trips and vehicle miles traveled by maximizing high-intensity development in close proximity to transit. The ordinance prohibits drive-through uses that obstruct sidewalks and discourage walking. It provides a minimum density of 30 dwelling units per acre for residential development. It also provides a minimum floor area ratio of 1.5 and a maximum of 2. 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. Parking is restricted in the ordinance in order to promote walking, biking, and transit use. Parking must be located below grade, within structured ramps, or in individual on-street spaces parallel with and adjacent to low-volume streets. Bicycle parking must be provided near building entrances. Development directly adjacent to transit stations must provide sidewalk and bikeway connections to the transit station as well as to adjacent sites. The Bloomington zoning strategy evinces a commitment to development that is truly transit oriented. It restricts parking, connects to nearby transit, locates retail and service uses within short walks of residences, and thereby reduces vehicle trips and vehicle miles traveled.

The City of Yonkers, New York, struggled for years to jump-start its downtown and adjacent industrial waterfront on the Hudson River, an area that is served by three commuter train stations, less than a half-hour trip from New York City's Grand Central Terminal. During the past two decades, the city amended its waterfront urban renewal plan over a dozen times before the private market began to respond. Governmental commitments to provide urban recreational and design amenities, build an impressive central library, renovate historic buildings, clear deteriorated buildings, remediate brownfields—all within walking distance of the renovated central rail station on the river—began a process that has led to considerable success.

The zoning and land use techniques that the City of Yonkers used were numerous and are instructive. It adopted a highly detailed master plan for the waterfront area that contained certain specifications regarding the types of development the city wanted on available vacant land in the area. An innovative zoning technique—called the Master Plan Zone—was adopted that provided as-of-right status for developments that conform to the design standards contained in the master plan. 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 provided.

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. As the city developed its plan and conducted its environmental impact review, the private developer began site planning and provided economic and market input. 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.

The result is the development of Hudson Park, a two-phase project that contains nearly 500 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. Hudson Park is a dramatic transit-oriented development where parking provided is approximately 50% less than the amount required by traditional urban zoning. This is possible because the buildings and area appeal to commuters who travel to work by train and the developer's marketing was designed to attract them. 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. Three high quality restaurants and a number of retail stores catering to the middle income population of these buildings have appeared since the first 250 residents moved into phase one of the Hudson Park development. This project and the public amenities provided by the government are credited with sparking considerable additional private sector interest in the area.

Efficient Building Location, Construction, and Operation

Suburban and urban communities can mitigate carbon emissions and promote energy efficiency by adopting building design and location standards, such as those promoted by the Leadership in Energy and Environmental Design (LEED) criteria promulgated by the U.S. Green Building Council.[23] They can do this in at least three ways: by committing themselves to meeting LEED and other energy standards in newly built or renovated municipal buildings, or in those funded by the municipality; by requiring new privately built or renovated buildings to meet such standards; and by adopting zoning standards for appropriate districts similar to those contained in the Council's evolving Neighborhood Development Rating System.

There are four levels of LEED certification for individual buildings which can be attained by accumulating points for implementing design standards in the categories of sustainable site development, water savings, energy efficiency, materials selected, and indoor environmental quality. The LEED standards can serve as a model for incorporating energy efficient design standards into local building codes and requirements. LEED standards also contain design features normally associated with land use planning and zoning. For example in a LEED for Homes Certification, a new home receives 10 points, one-third of the required number of points for certification, just for being smaller than the national average.[24] A project can also earn points toward certification by developing at higher densities, by being located near public transportation, or by using energy efficient appliances.

Building Code Adaptation

New York is one of 22 states that have adopted a set of building codes that must be enforced at the local level but that allow local legislatures to add more restrictive standards.[25] These codes create the standards that local building inspectors must enforce when asked for a building permit by a private contractor or developer prior to undertaking a building project. Under section 379 of the New York Executive Law, the legislative body of a local government may adopt local ordinances imposing more restrictive standards for construction to ensure energy efficiency and minimize carbon loading.

The Town of Greenburgh, New York, amended its code to add new energy conservation requirements more restrictive than the adopted statewide mandatory energy code.[26] Greenburgh's local law requires that all new homes constructed in the town comply with Energy Star guidelines introduced by the EPA in 1992.[27] The program provides several methods of making a home at least 15% more energy efficient through such mechanisms as effective insulation, high performance windows, efficient heating and cooling equipment, and various energy efficiency products. The law applies to one- and two-family dwellings and multi-family buildings of three stories or less. In 2006, the Town of Babylon, New York, adopted a law requiring all newly constructed commercial buildings, office buildings, industrial buildings, multiple residences, and some senior citizen residences to comply with LEED standards.[28]

Zoning Law Reform

The Boston Zoning Code Green Building Amendments were adopted in 2007 to "ensure that major building projects—buildings over 50,000 square feet—are planned, designed, constructed, and managed to minimize adverse environmental impacts; to conserve natural resources; to promote sustainable development; and to enhance the quality of life in Boston."[29] The Boston legislation incorporates by reference the U.S. Green Building Council's LEED rating system.[30] The LEED building certification standards do not impose requirements but rather allow developers to choose among a variety of criteria to obtain sufficient points for the project to become a certified LEED building. Compliance with the local law is required but developers are allowed to choose voluntarily which LEED standards to meet.

The U.S. Green Building Council is providing additional guidance to municipalities interested in promoting energy efficiency at the neighborhood development level. Under its LEED for Neighborhood Development Rating System, it integrates smart growth, new urbanism, and green building standards into a system for designing and rating neighborhood development.[31] Under this system, both the location and the design of buildings can be certified as meeting the Council's standards for environmentally responsible and sustainable development.

The U.S. Green Building Council adopted the LEED-ND program as a pilot. At the end of 2008, the early results will be evaluated and a revised rating system will be instituted. Among the standards contained at the pilot stage are reduced automobile dependence, creation of a bicycle network, compact development, diversity of uses and housing types, affordability of housing, the proximity of housing and job sites, reduction of parking footprints, proximity to transit facilities, and transportation demand management. These are matters that go to the heart of traditional local land use regulation and are at the forefront of integrating transportation and land use planning.

Communities can incorporate the lessons of the LEED-ND program in their land use plans, regulatory standards, and development approval processes.

Regulation and Use of Public Buildings and Property

The City Council of Scottsdale, Arizona, adopted a formal Green Building Policy for municipal buildings in March 2005. The mandatory policy for municipal buildings requires that "all . . . city buildings of any size will be designed, contracted and built to LEED Gold Certification levels or higher."[32] The Township of Cranford, New Jersey, passed a local ordinance in 2005 adopting a policy that township owned and funded projects will meet LEED Silver ratings.[33]

There are 40,000 localities in the U.S. Many of them are recycling solid waste, planting trees, greening public buildings, using biodiesel fuel in vehicles and machinery, developing methane recovery systems in landfills, using solar energy to power municipal buildings, installing geothermal pump systems to heat and cool public facilities, replacing incandescent traffic signals with light-emitting diode signals, mounting police on bicycles, adopting anti-idling protocols for municipal vehicles, and exhibiting extraordinary creativity along the way.

Wind Power

Although wind-generated power constitutes a small fraction of the nation's power needs (around 1%), it is growing quickly and could eventually meet over 20% of the nation's demand for energy.[34] General Electric, whose Renewable Energy Global Headquarters are in Schenectady, NY, is in the process of building nearly 900 1.5 megawatt wind turbines, many in upstate New York. A 1.5 megawatt turbine can supply the power needs of over 400 single-family homes. This trend is encouraged by New York State's adoption of a state policy establishing a goal that 25% of energy consumed by 2013 will be produced by renewable sources such as wind, solar, biofuels, tidal energy, and other mechanisms.

One way that municipalities may encourage wind power use is to purchase electricity from wind farms to run locally owned utilities or to heat and cool town buildings. Lisle, 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 carbon dioxide emissions annually.[35]

Localities may also amend zoning to permit and encourage homeowners to install individual wind generation systems. Individuals are beginning to install backyard wind turbines on towers 50–70 feet high that generate enough power for their household use. In some cases, excess power is created that can be directed back to the local power company grid, sometimes for credit or cash. Some claim that a single wind turbine of this size can produce enough electricity for two average sized homes in an area with moderate wind speeds, raising a host of regulatory and real estate law issues. These types of "distributed generation systems" are supported by the American Planning Association's Energy Policy Guide.[36] Under the New York State Real Property Tax Law, local tax assessors are permitted to offer property owners who construct small wind energy systems an exemption or partial exemption from local real property taxes for the increased value of the property due to the addition of the facility to the land.[37]

Local governments are adopting comprehensive plan components that contain local energy goals and policies, moratoriums that prevent the construction of wind-generation facilities until they can be properly regulated, and a number of zoning, subdivision, site plan, special use, and environmental review mechanisms to balance the benefits of wind-generated power and the detrimental effects such facilities can have on the community. 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, tax abatement, and other initiatives.

Solar Power

Local governments can mitigate climate change in at least two ways that employ solar energy generation: equip public buildings with solar facilities and adopt land use regulations that encourage their use by homeowners and businesses.

The New York State Comptroller reports that Albany County, the Ulster County towns of Woodstock and Rosendale, the Ulster County village of New Paltz, the Nassau County town of Hempstead, and the Tompkins County town of Lansing received financial and technical assistance from the New York State Energy and Research Development Authority (NYSERDA) for their public building initiatives. The audit, conducted for the period January 2003 to July 2007, determined that by installing solar panel electrical systems, each of these municipalities could save roughly a million dollars and reduce the release of the greenhouse gases carbon dioxide, nitrous oxide, and sulfur dioxide by over 6.6 million pounds during the life of the panels, which should exceed 40 years. With state assistance these municipalities paid roughly a quarter of the total project costs.[38] An impressive number of state and federal initiatives are available to local governments as well as private property owners that lower the capital costs of solar installations.

In 1979, the state legislature granted express power to local governments to add provisions to their zoning regulations to permit and encourage solar energy systems and equipment, including access to sunlight.[39] The legislature declared that access to solar energy is a valid public purpose and left it to each local government to adopt regulations suitable to its local environment and circumstances. This authority, which probably existed as an implied power prior to the act, makes the power of local governments to permit solar power facilities explicit. Local governments may amend their zoning to permit solar energy systems in all zoning districts, to provide waivers of any height, area, or bulk requirements that obstruct solar facilities, or to create zoning overlay districts within which solar access is particularly appropriate.

Carbon Capture Through Sequestration

In developing suburban areas, there are often significant land areas that have been undeveloped for some time that contain undisturbed vegetated areas. As noted earlier, suburban communities can mitigate climate change by zoning to accommodate the bulk of population growth in compact developments as the towns of Malta and LaGrange are doing. By so doing, they may find it easier politically to adopt strong environmental protection ordinances applicable to the land outside these higher density zones. 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.[40]

The preservation of such resources will provide valuable environmental 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. Soil organic carbon accumulates in undisturbed naturally vegetated areas.[41] Further carbon stabilization occurs when developing communities preserve existing farmland where food products can be produced closer to population centers, thereby reducing transportation costs. 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.[42]

In local zoning and subdivision regulations, standards that prevent the disturbance of soils and vegetation on development sites have similar effects. The emerging field of "low impact development" experiments with pervious alleys and green roofs in urban projects and, in compact developments, vegetated swales that replace curbs and gutters for storm water control, cluster development, tree retention, and retaining permeable topsoil on site during and after construction.[43]

Conclusion

Climate change has altered the federal and state agenda and will reshape funding programs and priorities for programs and projects that promise to reduce fossil fuel consumption, dependency on foreign oil, and greenhouse gas emissions. There are relatively few local initiatives in the nation that utilize the Land Use Stabilization Wedge techniques described in this article. Localities that do move in this direction should enjoy considerable success in soliciting state and federal funding for land use and transportation planning, environmental studies, workforce housing, transportation and urban amenity capital projects, and other support needed to create successful transportation and land use demonstration projects.[44]

Local governments, with their power to plan and regulate land use, are a critical ally of state and federal governments in the race to mitigate climate change. They have always been laboratories for experimentation—crucibles of change—from the time that New York City invented the comprehensive zoning ordinance through a host of celebrated land use movements: post-Euclidean zoning, growth management, the advent of local environmental law, and smart growth. Now we have the Land Use Stabilization Wedge: the climate change mitigation movement. While models exist for greening public and private buildings, reducing vehicular travel, preserving undisturbed lands, and fostering wind and solar power, much needs to be done.

Not all states empower their localities as thoroughly as does New York. Relatively few localities have the capacity to grow cooler with all the staff and technical attention that this task requires.[45] They need resources, technical assistance, and funding as incentives to continue this exciting trend toward green growth. Local initiatives cropping up around the nation must be harvested by state and federal programs designed to shift ground: to ensure that new population growth occurs in compact and higher density urban developments.

Endnotes

1. S. Pacala & R. Socolow, *Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies*, 305 SCIENCE 968, 968–972 (2004) [hereinafter Pacala & Sokolow]. "A wedge is 1 GtC/y of emissions savings in 2054, achieved by a single strategy that will not occur without deliberate attention to global carbon." *Id. See also* ELIZABETH KOLBERT, FIELD NOTES FROM A CATASTROPHE: MAN, NATURE, AND CLIMATE CHANGE 137 (Bloomsbury 2006) .
2. Pacala & Socolow, *supra* note 1, at table 1.
3. Pacala & Socolow, *supra* note 1, at 3.
4. *Id.*
5. *See* John R. Nolon, *Historical Overview of the American Land Use System: A Diagnostic Approach to Evaluating Governmental Land Use Control*, 23 PACE ENVTL. L. REV. 821, 821–22 (2006).
6. Data and supporting material for this section are taken from REID EWING ET AL., GROWING COOLER: THE EVIDENCE ON URBAN DEVELOPMENT AND CLIMATE CHANGE (Urban Land Institute 2007) and from the recent assessment reports of the Intergovernmental Panel on Climate Change. WORKING GROUP III REPORT, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, MITIGATION OF CLIMATE CHANGE (2007), *available at* http://www.ipcc.ch.
7. U.S. CENSUS BUREAU, U.S. INTERIM PROJECTIONS BY AGE, SEX, RACE, AND HISPANIC ORIGIN (2004), *available at* http://www.census.gov/ipc/www/usinterimproj/.
8. The new development forecast by 2043 includes homes and non-residential buildings needed to replace obsolete buildings that exceed their useful lives. *See* Arthur C. Nelson & Robert E. Lang, *The Next 100 Million*, 73 PLANNING 4, 4-6 (2007).
9. *See generally* CHRISTOPHER B. LEINBERGER, THE OPTION OF URBANISM: INVESTING IN A NEW AMERICAN DREAM (Island Press 2008), describing the re-emergence of walkable urban development as the "next American dream."
10. Consortium for Atlantic Regional Assessment, Land Use Primer: How Does Land Use/Land Cover Affect Global Climate?, http://www.cara.psu.edu/land/lu-primer/luprimer14.asp.
11. DEVELOPMENT, COMMUNITY, & ENV'T DIV., 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.
12. Patrick Condon, *Planning for Climate Change*, LAND LINES, Jan. 2008, 5, 5–6 (citing a report of the Institute for Local Self Reliance). *See also* LEINBERGER, *supra* note 12 ("Because of the strong links between energy use, greenhouse gas emissions and climate change, rates of new construction are strongly related to rates of climate change, especially when this new construction is relatively distant from existing population centers.").
13. EWING, *supra* note 9, at § 1.2.
14. Calculations in this section are the author's, based on per-capita or per-household consumption figures estimated by the EPA, the U.S. Public Health Service, and the Department of Energy.
15. Alex Williams, *Don't Let the Green Grass Fool You*, N.Y. TIMES, Feb. 10, 2008, at 1. The article quotes statistics from the PlaNYC report of the Bloomberg administration in New York City indicating that the average citizen of New York City produces 7.1 metric tons annually, compared with a national average of 24.5. Statistics in that article indicate that suburban Atlanta residents generate up to 31.1 tons/year. The author has adjusted the New York City number upward to approximate the greater emissions in cities generally and has used the 24.5 metric ton nation-wide number in these calculations.
16. The EPA estimates that single-family homes generate 18,700 cubit feet/year/unit of runoff. Hudson Park contains 266 units on 2.26 acres and generates 229 cubic feet of runoff per household annually, a difference of 18,471 cubic feet. Multiplied by four million shifted households, this yields a savings of nearly 74 million cubic feet per year.
17. Under typical suburban single-family zoning standards, 8,713 square feet of space can be covered with impervious surfaces. Hudson Park units create 370 square feet per unit, a difference of 8,343 square feet. Multiplied by four million households this yields a saving of 33.5 billion square feet of impervious cover. The fossil fuel saved by not producing and installing that impervious material generates additional savings in CO_2 emissions.
18. According to U.S. Public Health Service estimates, single-family homes use, on average, 28 gallons per day per capita for outdoor water use; since Hudson Park uses a negligible amount of exterior water, it consumes that much less potable water; multiplied by 10 million people times 365 days, this would save over 100 billion gallons of potable water per year at a time when 36 states are projecting drinking water shortages.
19. Federal law requires MPOs to conduct 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*." 49 U.S.C.A. § 5303(h)(1)(E) (2005) (emphasis added). This same language is made applicable to statewide transportation planning and programming in 23 U.S.C.A. § 135 (2005), which requires each state to carry out a statewide transportation planning process that achieves these same objectives.
20. MALTA, N.Y., CODE ch. 167, art. XIV, §§ 167-60 and 167-61(2005).
21. LAGRANGE, N.Y., CODE ch. 240 art. II; art. III, § 240-35 (2006).
22. BLOOMINGTON, MINN., CODE ch. 19, § 19.29 (2008).
23. U.S. GREEN BUILDING COUNCIL, LEED RATING SYSTEMS (2008), *available at* http://www.usgbc.org/DisplayPage.aspx?CMSPageID=222.
24. *See* U.S. GREEN BUILDING COUNCIL, RATING SYSTEM FOR PILOT DEMONSTRATION OF LEED FOR HOMES PROGRAM 22 (2005), *available at* http://www.usgbc.org/FileHandling/show_general_file.asp?DocumentID=855.
25. David Listokin & David B. Hattis, *Building Codes and Housing*, 5 CITYSCAPE 1, 11 (2005). Note that there are six states that do not allow their localities to adopt more stringent code provisions.
26. GREENBURGH, N.Y. CODE, §§ 100-15–100-17 (2002).
27. *See* History: Energy Star, http://www.energystar.gov/index.cfm?c=about.ab_history (2007).
28. BABYLON, N.Y., CODE ch. 89, art. VIII (2006).
29. BOSTON, MASS., Zoning Code, § 37.1 (2007).
30. U.S. Green Building Council: About USGBC, http://www.usgbc.org/DisplayPage.aspx?CMSPageID=124.
31. U.S. GREEN BUILDING COUNCIL, LEED FOR NEIGHBORHOOD DEVELOPMENT RATING SYSTEM (2007), *available at* http://www.usgbc.org/ShareFile.aspx?DocumentID=2845.
32. SCOTTSDALE, ARIZ., RESOLUTION NO. 6644, (2005). Scottsdale's Green Building Program is described at http://www.scottsdaleaz.gov/greenbuilding/.
33. CRANFORD, N.J., ORDINANCE NO. 2005-46, § 106-2(c) (2005). The ordinance also encourages private redevelopers to adopt LEED standards by offering a Green Building Density Incentive Program. *Id.* § 106-3. The incentive includes a slightly larger building than permitted by the underlying zoning in the applicable district.
34. According to the American Wind Energy Association, wind energy generation capacity increased by over 27% in 2006 and by a dramatic 45% in 2007. AMERICAN WIND ENERGY ASSOCIATION 2007 MARKET REPORT 1 (Feb. 6, 2008) *available at* http://www.awea.org/projects/. Over 6,500 wind turbines are in operation globally and by the end of this year that number should exceed 10,000 units.

35. *See* Williams, *supra* note 18, Correction Mar. 2, 2008, *available at* http://www.nytimes.com/2008/02/10/fashion/10suburbs.html?_r=1&scp=1&sq=&st=nyt&oref=slogin.

36. Am. Planning Ass'n, Energy Policy Guide, Initiative 9 (2004), *available at* http://www.planning.org/policyguides/pdf/Energy.pdf.

37. N.Y. Real Prop. Tax Law § 487 (2006).

38. Office of the N.Y. State Comptroller, Usage of Solar Panels in Municipalities (2008), *available at* http://www.osc.state.ny.us/localgov/audits/swr/08solarpanel/solarpanels.pdf.

39. N.Y. Gen. City Law, § 20(24) (2001); N.Y. Town Law § 263 (2004); N.Y. Village Law § 7-704 (1979).

40. Permit conditions can be imposed to protect the environment, which can include curbing greenhouse gas emissions. In *Konicelik v. Planning Board of East Hampton*, the court upheld a planning board's conditional approval of subdivision plat that imposed several conditions designed to protect "the extensive area of undisturbed forest, and the presence of numerous important plant species throughout the site." 590 N.Y.S.2d 900, 901–02 (2d Dep't 1992).

41. Wilfred M. Post & K.C. Kwon, *Soil Carbon Sequestration and Land-Use Change: Processes and Potential*, 6 Global Change Biology 317 (2000), *available at* http://cdiac.ornl.gov/programs/CSEQ/terrestrial/postkwon2000/postkwon2000.html.

42. Office of Science, U.S. Department of Energy Carbon Sequestration Focus Areas: Enhancing the Natural Terrestrial Cycle, (2004), *available at* http://cdiac2.esd.ornl.gov/scienceman.html#enchancing.

43. P.M. Condon & K. Isaac, *Green Municipal Engineering for Sustainable Communities*, 156 Mun. Eng'r 3 (March 2003), *available at* http://www.yorku.ca/carmelca/6000P/readings/AddOns0301-Neighborhoods2Streets/b.municipal_engineer_article.pdf.

44. The Transit Village Act of 1995 in California encourages local jurisdictions to zone and plan for intensive, mixed-use development around rail stations, and gives state transportation funds to those who pursue TOD. Robert T. Dunphy et al., Developing Around Transit: Strategies and Solutions that Work 36 (Urban Land Institute 2004). The Federal Transit Administration evaluates specific aspects of a site to determine if it should receive grants for major capital projects. These aspects included the following: 1. *Existing Land Use* (What is the density of the population in the area, and how pedestrian friendly is it?); 2. *Containment of Sprawl* (What kind of growth management is in place?); 3. *Station Area Zoning* (Do the ordinances support increased development near stations?); 4. *Corridor Planning* (Is transit-supportive development encouraged in the transit corridors?); 5. *Policy and Plan Implementation Processes* (What public and private processes facilitate station area development?); and *Impact of Transit Oriented Planning* (Is there a positive development impact on the area due to transit?). *Id. at* 90.

45. The *New York Times* reports that Arlington County, Virginia, an "urban suburb of Washington [D.C.], seems well-prepared for a leading role in the green revolution embraced by hundreds of the nation's cities, counties, and towns." But "county officials are reckoning with the fact that though green is the dream, the shade of civic achievement is closer to olive drab. Constraints on budgets, legal restrictions by states, and people's unwillingness to change sometimes put the brakes on ambitious plans to cut carbon dioxide emissions." Arlington is not alone in running up against problems. Counties across the nation are having trouble lowering their carbon emissions, as community lifestyles, homeowners associations, and legal limits on county officials stymie environmental initiatives. "We have been doing things like filling potholes and reducing crime since cities began," David N. Cicilline, the mayor of Providence, R.I., said, adding that "energy efficiency requires 'a whole new infrastructure to evaluate and measure.'" Felicity Barringer, *In Many Communities, It's Not Easy Going Green*, N.Y. Times, Feb. 7, 2008, at A18.

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