

## Sustainable Land Use Impact on Climate Change and Health



*Leslie Dorworth, Aquatic Ecologist, Illinois-Indiana Sea Grant*  
*Robert McCormick, Planning with POWER Project Leader, Illinois-Indiana Sea Grant.*

### The Way We Grew

Wherever you look, communities have spread out from their urban centers, taking over lands that were traditional agricultural lands and habitat for wildlife. In so doing, distances between homes, stores, and jobs have increased, creating an automobile-dependent lifestyle.

Current development patterns standardized after World War II include:

- Spread-out, low-density development that can only be sustained by the use of the automobile
- Street networks with large blocks and cul-de-sacs that foster additional driving and congestion and inhibit walking
- Strict segregation of land uses, separating homes from schools, work, and other activities

These development practices—reinforced through a combination of governmental policies, investment, and private-sector practices—have led to populations distributed by income, housing type, family status, and age.

Sprawling developments have been blamed for everything from wasting tax money to extending infrastructure into these new areas and from adding to obesity problems nationwide to increasing the atmospheric input of greenhouse gases and degradation of water quality. Sprawled residential development costs more in services than it generates in tax dollars and, therefore, has a negative fiscal impact and burdens local government.



### Greenhouse Gas Caused by Development

Unfortunately, our development practices have produced another problem: lots of greenhouse gases. April 17, 2009, the U. S. Environmental Protection Agency declared that carbon dioxide and other greenhouse gases are a significant threat to human health and, thus, will be listed as pollutants under the Clean Air Act.

Many chemical compounds found in the Earth's atmosphere act as greenhouse gases. These gases allow sunlight to enter the atmosphere freely. When sunlight strikes the Earth's surface, some of it is re-radiated towards space as infrared radiation (heat). Greenhouse



gases absorb this infrared radiation and trap the heat in the atmosphere. Some gases that exhibit these “greenhouse” properties occur in nature (water vapor, carbon dioxide, methane, and nitrous oxide), while others are exclusively human-made (certain industrial gases). Over time, if atmospheric concentrations of greenhouse gases remain relatively stable, the amount of energy sent from the sun to the Earth’s surface should be about the same as the amount of energy radiated back into space, leaving the temperature of the Earth’s surface roughly constant.

### What Are Sources of Greenhouse Gases?

In the United States, greenhouse gas emissions come primarily from the combustion of fossil fuels for energy production. Energy use is largely driven by economic growth, with short-term fluctuations in its growth rate created by weather patterns affecting heating and cooling needs, as well as changes in fuel used in electricity generation. Energy-related carbon dioxide emissions, resulting from the combustion of petroleum, coal, and natural gas, represented 82 percent of total U.S. anthropogenic greenhouse gas emissions in 2006. The

values in the figure represent U.S. Anthropogenic Greenhouse Gas Emissions by Gas, 2006 (Million Metric Tons of Carbon Dioxide Equivalent).

### Emissions of Greenhouse Gases in the United States

Another greenhouse gas, methane, comes from landfills, coal mines, oil and natural gas operations, and agriculture; it represents approximately 9 percent of total emissions. Nitrous oxide (5 percent of total emissions) is emitted through the use of nitrogen fertilizers, from burning fossil fuels, and from certain industrial and waste-management processes. Several human-made gases, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF6) that are released as byproducts of industrial processes and through leakage, represent 2 percent of total emissions.

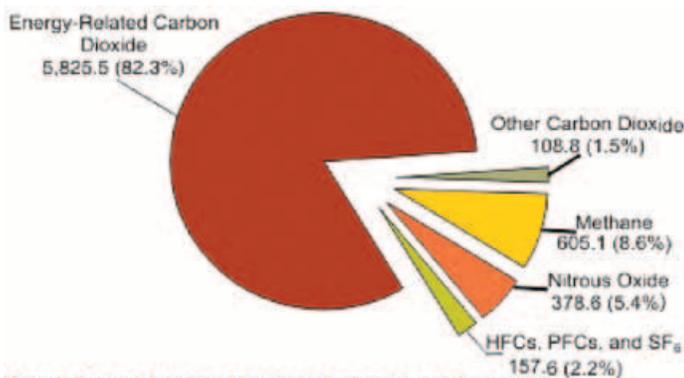
### Greenhouse Gases and Climate Change

In computer-based models, rising concentrations of greenhouse gases produce an increase in the average surface temperature of the Earth over time. Rising temperatures may, in turn, produce changes in precipitation patterns, storm severity, and sea level. These changes are commonly referred to as “climate change.”

The 2007 assessment report compiled by the Intergovernmental Panel on Climate Change (IPCC) observed that “changes in atmospheric concentrations of greenhouse gases and aerosols, land cover, and solar radiation alter the energy balance of the climate system,” and concluded that “increases in anthropogenic greenhouse gas concentrations are very likely to have caused most of the increases in global average temperatures since the mid-20th century.”

### Vehicles—a Big Part of the Problem

Vehicle emissions associated with climate change and greenhouse gases frequently appear in our daily media. Based on studies done by various private-sector entities, our commuting times are climbing, which likely increases greenhouse gas emissions. The U.S. Department of Energy’s Energy Information Administration forecasts a 48 percent increase in driving between 2005 and 2030. The forecasted increase in driving will overwhelm the improved fuel efficiency of new vehicles and the lower carbon fuel content required by the Energy Independence and Security Act of 2007 (see Jeavon’s Paradox in the reference section at end of this publication). For the United States to reduce CO<sub>2</sub>-related transportation emissions, there must be a sharp reduction in vehicle miles travelled (VMT). Pending legislation could improve mileage standards. Also, as fuel prices fluctuate, VMT trends change.



Source: Energy Information Administration, Emissions of Greenhouse Gases in the United States 2006 (Washington, DC, November 2007)

The scientific community agrees that human activities increase greenhouse gas concentrations and that these gases contribute to climate change (IPCC 2007). International and domestic climate change policy have recommended limiting overall global temperature increases to 2°C to 3°C by reducing greenhouse gas emissions by 60 to 80 percent below 1990 levels. The primary greenhouse gas is CO<sub>2</sub> and every gallon of gas burned produces about 20 pounds of CO<sub>2</sub>.

Communities investigating ways to reduce VMTs are pondering increasing parking rates, increasing tolls, monitoring miles traveled, and charging based on the miles a person travels. Some communities are considering developing more compact, mixed-use development patterns or redeveloping infill and brownfield areas. These areas typically have existing infrastructure such as parking lots and empty buildings and are located in urban environments. This type of activity goes along way towards revitalizing a downtown neighborhood.

## Negative Health Impacts

Auto-dependent development patterns have created a sedentary life style. The proportion of Americans who are alarmingly overweight has risen from 24 percent in 1960 to approximately 64 percent in 2000. Today nearly 31 percent of the population is obese. Overweight and obesity increase the rate of cancer, heart disease, stroke, high blood pressure, arthritis, and many other inflections. Obese people are more than 40 times more likely to develop diabetes. Of course, other factors such as nutrition, lifestyle, exercise, and genetics can contribute to and affect obesity. Land-use decisions can affect access to local fresh foods, local community-assisted agriculture, and community gardens, which all make positive contributions to public health today.

Our automobile-dependent society did not just happen; we subsidized and planned it through exclusionary zoning that separated different land uses. It seemed a sensible idea at the time. However, that idea has left us a century later unable to walk from homes to offices, shops, and schools. Our taxes subsidized the highways and infrastructure that focused sprawled growth and development away from the downtowns. Our streets dedicate space to the automobile and exclude transportation choices such as bicycling, foot traffic, and mass transit.

More than half of American adults are not physically active on a regular basis. In 2000, only 26 percent of adults met the federal recommendations for physical activity. One in four trips made by children 5 to 15 years of age is to and

from school. Only 10 percent of these trips are made by walking or bicycling and 25 percent of the morning rush hour traffic is composed of parents driving their children to school.

The neighborhood environment is one of the strongest predictors of whether a person will be physically active (Brownson *et al.*, 2001; King *et al.*, 2000). Environments that facilitate commuting by foot, bicycle, or mass transit (most transit riders are walkers) help incorporate physical activity as a daily routine. Also, environments that locate stores, theaters, entertainment, and other destinations within walking distance of home and work offer the same potential for physical activity. Non-work trips account for the majority of trips people make today.

## Declining Social Capital

“Americans of all ages, all stations of life and all types of dispositions are forever forming associations,” according to Alexis de Tocqueville in *Democracy in America* (1835, 1840). More than a century later, the idea of psychological community has become central to the discipline of community psychology. Since then, the semblance of community is defined as “a feeling that members have of belonging, a feeling that members matter to one another and to the group, and a shared faith that members needs will be met through their commitment to be together.”



There are four aspects of the sense of community:

- membership,
- influence,
- integration and fulfillment of needs, and
- shared emotional connection.

The great observer of urban life, Jane Jacobs, focused on the most urban society “casual public contact at the local level on the streets and parks of city towns.” Due to our



built environment and exclusion of uses, we have lost personal communication and connectiveness resulting in a decline of social capital. Many suburban development designs tend to isolate and exclude people from participating in their community and with one another. Smart Growth facilitates and increases connections with compact, mixed-use environments that include walking to destinations and outside activities.

## People Want Change

Studies are finding market demand for developments that are compact, transit-oriented, and or walkable. More people want to walk to work, school, or the store.

Who are these people?

As our population ages, the numbers of empty nesters is increasing. The federal government anticipates an increase



in the empty nester population to go from 12.8 percent in 2007 to 20.8 percent in 2050. Research is finding that this segment of the population desires more compact, mixed-use development with a variety of transportation choices. Other sectors of the population interested in this type of developmental design include single adults and couples without children. The number of households without

children will account for 85 percent of the total growth by 2025. Only 28 percent of households will have children by 2025 and 34 percent will be one-person households (Nelson 2006).

Nelson (2006) has found that the Generation Xers want compact development and want to have relationships with their neighbor, but they're not finding these things.

At this time there appears to be a shortage in attached housing, such as condos and townhouses, on the real estate market versus an oversupply of large-lot, single-family homes. Market demands are expected to point towards smart growth opportunities in the future, because smart growth makes sense.

More compact, mixed-use development reduces time spent commuting, protects farmland and open space, protects water quality and air quality through the reduction of airborne pollutants, increases health benefits, and reduces road and other infrastructure costs and energy security.

Will this be the direction of real estate markets in the future? Can there be a change?

## Let's Change the Way We Grow

Smart Growth is simply rethinking the development of communities. At one time in our past, downtown was the community center. In today's environment, the downtown is greatly diminished or almost extinct. People have moved to the suburbs and created "single use developments," such as office parks, industrial parks, residential developments, and shopping malls. As a result, the public must drive to attend to daily activities such as grocery shopping, going to work, and driving to school.





Smart Growth neighborhoods are designed to have shops, offices, schools, churches, parks, and other community amenities near homes, so that residents and visitors have options of walking, bicycling, taking public transportation, or driving. A recent study found that people who have access to sidewalks are 28 percent more likely to be physically active (Brownson *et al.*, 2001). Compact, pedestrian-friendly environments strongly correlate with decreases in negative health indicators such as obesity, diabetes, hypertension, and asthma. In addition, dependence on automobiles decreases significantly in this type of environment.

## Will Smart Growth Work for Your Community?

The features that make Smart Growth work for a community vary from place to place and even project to project. The ten principles of Smart Growth are:

1. Promote mixed land use.
2. Use compact building design.
3. Increase housing choice.
4. Create walkable communities.
5. Foster distinctive and attractive communities, each with a strong sense of place.
6. Protect farms, unique natural features, critical environmental areas, and open spaces.
7. Direct new development towards existing communities and infrastructure.
8. Offer a variety of transportation choices.
9. Make development processes predictable, fair, efficient, and cost-effective.
10. Involve community stakeholders.

Implementation of Smart Growth principles will depend on the value the public places on local, natural, and cultural resources and existing social networks. Current land-use decisions are heavily influenced at the local level by economic and political forces, special interest groups, and local government leadership. The success of Smart Growth patterns will depend on updated comprehensive land-use plans and ordinances by local planning commissions and boards. Additional Smart Growth implementation strategies for communities will ultimately depend on the engagement and influence of local citizens on local land-use decision-makers and leadership. For additional information on stakeholder involvement, see publications: “How to Get Started: Protecting Your Community from Polluted Runoff” from the *Planning with POWER* Web site: [www.planningwithpower.org/pubs/id\\_259.pdf](http://www.planningwithpower.org/pubs/id_259.pdf) and “Citizen Participation in Land Use Planning” from the Purdue Land Use Team Web site: [www.extension.purdue.edu/extmedia/ID/ID-226.pdf](http://www.extension.purdue.edu/extmedia/ID/ID-226.pdf)

## References

- Brownson, R., et al., 2001. “Environmental Determinants of Physical Activity in the United States,” *American Journal of Public Health*, 91, 12, 1995-2003.
- Energy Information Administration, Official Energy Statistics from the U.S. Government. May 2008. [www.eia.doe.gov/bookshelf/brochures/greenhouse/Chapter1.htm](http://www.eia.doe.gov/bookshelf/brochures/greenhouse/Chapter1.htm).
- Ewing, R., K. Bartholomew, S. Winkelman, J. Walters, and D. Chen. 2008. *Growing Cooler: The Evidence on Urban Development and Climate Change*. Urban Land Institute, pg. 170.
- Frumkin, H., L. Frank, and R. Jackson. 2004. *Urban Sprawl and Public Health: Designing, Planning, and Building for Healthy Communities*. Island Press, pg. 338.
- Intergovernmental Panel on Climate Change. 2007. *Climate Change 2007: Synthesis Report, Summary for Policymakers*. Pg. 5. [www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4\\_syr\\_spm.pdf](http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf)
- Jacobs, J. 1961. *The Death and Life of Great American Cities*. Random House, pg. 494.
- King, A., C. Castro, S. Wilcox, A. Eyler, J. Sallis and R. Brownson. 2000. “Personal and environmental factors associated with physical inactivity among different racial/ethnic groups of U.S. middle and older aged women,” *Health Psychology*, 19:354.

Nelson, A.C. 2006. "Leadership in a new era," *Journal of the American Planning Association*, Vol. 72, 4, 393-407.

U.S. Department of Transportation, Federal Highway Administration. 2009. "Reducing Highway Fatalities," *FWA Safety*. [http://safety.fhwa.dot.gov/ped\\_bike/univcourse/swless06.htm](http://safety.fhwa.dot.gov/ped_bike/univcourse/swless06.htm)

York, Richard, 2006. "Ecological Paradoxes: William Stanley Jeavons and the Paperless Office," *Human Ecology Review*, Vol. 13, No. 2. [www.humanecologyreview.org/pastissues/her132/york.pdf](http://www.humanecologyreview.org/pastissues/her132/york.pdf)

## For More Information

ID-255 *Protecting Our Water and Environmental Resources*

ID-256 *Nonpoint Source Pollution: A Threat to Our Waters*

ID-257 *Impacts of Development on Waterways*

ID-258 *Strategies for Coping with Runoff*

ID-259 *How to Get Started: Protecting Your Community From Polluted Runoff*

ID-260 *The Relationship Between Land Use Decisions and the Impacts on Our Water and Natural Resources*

FNR-245 *Brownfields: A Rural Community Problem*

FNR-255 *Stormwater Runoff*

FNR-256 *Stormwater and Non-Point Source Pollution*

FNR-257 *Open Space Planning*

FNR-409-W *Smart Growth and Protection of Natural Resources*

*Planning with POWER* Presentation module Model Ordinances are available.

These publications are available on the *Planning with POWER* Web site: [www.planningwithpower.org](http://www.planningwithpower.org)

Also, a new Web-based GIS planning tool and decision support system is now available at: [www.purdue.edu/ldm](http://www.purdue.edu/ldm)

If you are interested in pursuing the Smart Growth Principles, the protection of natural resources and natural resources based planning, contact Robert McCormick at (765) 494-3627 and or [rmccormi@purdue.edu](mailto:rmccormi@purdue.edu).

## PURDUE AGRICULTURE

New 10/09

It is the policy of the Purdue University Cooperative Extension Service that all persons have equal opportunity and access to its educational programs, services, activities, and facilities without regard to race, religion, color, sex, age, national origin or ancestry, marital status, parental status, sexual orientation, disability or status as a veteran. Purdue University is an Affirmative Action institution. This material may be available in alternative formats.

**PURDUE**  
UNIVERSITY

Purdue Extension  
**Knowledge to Go**  
1-888-EXT-INFO

Order or download materials at the *Purdue Extension Education Store* • [www.extension.purdue.edu/store](http://www.extension.purdue.edu/store)