CHAPTER THREE

Sustainability: Communities, Transportation, and Agriculture Trends

This chapter discusses three key areas of sustainability: community, transportation, and agriculture. At first glance, it may not be clear how these trends are relevant to the Army, but they are important to Army installations because of quality of life issues for those who work and live on them. Some of these issues, such as investments in transportation infrastructure, can also have cost implications. These topics are grouped together because of the interrelationships between sustainable communities, transportation, and sustainable agriculture.

We begin by discussing sustainable communities.

Sustainable Communities

In this section we discuss the activities and trends related to sustainable communities and the implications they have for Army installations. The Army has done a lot in sustainability. In fact, some Army installations are leaders in sustainable community activities. Such Army sustainability activities are discussed at the end of this section when we discuss implications for the Army.

Background: Defining a Sustainable Community

The concept of sustainable communities emerged from sustainable development and sustainability efforts across the world. The focus on sustainability activities began in the late 1980s. Different organizations and individuals define these terms differently, but the most commonly used definition for sustainable development was established by the UN's World Commission on Environment and Development (the Brundtland Commission) in its 1987 report, *Our Common Future*.[172] It defines sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Practical definitions usually recognize sustainability as a process that tries to balance and address environmental, social, and economic issues over the long term.

[172] World Commission on Environment and Development, *Our Common Future*, 1987.

Many communities and other organizations that are trying to implement sustainability at a local level use the term *sustainable community*, which emphasizes the community aspect of sustainable development. A "sustainable community" is usually defined uniquely by each community, based on its interests, needs, and culture, although there are common elements. It typically involves a long-term, integrated, systems approach to trying to develop and achieve a healthy, enduring community by jointly addressing economic, environmental, and social issues. Building consensus and fostering partnership among key stakeholders about community problems and solutions is also important to such efforts.[173]

Many communities in the United States and other parts of the world started in the 1990s to develop sustainability projects and implement more sustainable practices because of concerns about environmental, economic, and social issues. These communities recognize that many problems, such as urban sprawl, cut across many different segments of community and society. These problems cannot easily be solved using conventional approaches or traditional elements within our society. Many people feel that because such problems involve multiple disciplines, agencies, stakeholders, and sectors, it is better to address them through a collaborative and holistic systems approach. By 2008, at least 72 medium and large U.S. cities had established sustainable development as a city goal or priority.[174]

When examining community sustainability activities, it becomes clear that it is easier to set sustainability goals and start smaller initiatives than to successfully implement large-scale projects that address large-scale holistic issues, like sprawl. Large-scale projects prove to be more difficult to implement for a number of reasons, including budget and political constraints. For example, in one survey only 24 percent of respondents indicated that their city had individuals entrusted with implementing sustainability policies.[175] Portland, Oregon is one of only six cities that has created a dedicated Bureau of Planning and Sustainability that focuses on policies related to green buildings, sustainable food, clean energy, garbage and recycling, sustainable government, and climate protection.[176] Having dedicated staff that

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[173] Beth Lachman, *Linking Sustainable Community Activities to Pollution Prevention: A Sourcebook*, Santa Monica, CA: RAND Corporation, 1997, MR-855-OSTP.

[174] Devashree Saha and Robert G. Paterson, "Local Government Efforts to Promote the "Three Es" of Sustainable Development: Survey in Medium to Large Cities in the United States," *Journal of Planning Education and Research*, Vol. 28, 2008, pp. 21–37.

[175] Saha and Paterson, p. 12.

[176] See the Portland Bureau of Planning and Sustainability website at http://www.portlandoregon.gov/bps/

focus on sustainability has enabled Portland to become a pioneer in developing and implementing sustainability activities.

Portland provides a good illustration of the types of projects that sustainable community initiatives focus on. The city has been on the cutting edge of sustainability for years and has emphasized green buildings, smart growth planning, mass transit, and pedestrian-friendly city access. In 2005, Portland established its Green Investment Fund (GIF), a five-year, $2.5 million competitive grant program that supports innovative green building projects within the city. A total of $425,000 was awarded annually from 2005 through 2009, and 36 high-performance projects are either completed or still in development. Portland has also started Clean Energy Works Portland, a pilot program that will help up to 500 qualified Portland homes finance and install energy efficiency upgrades. In addition, all building projects in Portland with a permit value of $50,000 or more (including construction and demolition phases) are required to separate and recycle certain materials from the job site. Contractors must keep these materials out of the landfill: rubble (concrete/asphalt), land-clearing debris, corrugated cardboard, metals, and wood.

The issues addressed by such community sustainability efforts vary quite a bit but can include economic development, ecosystem management, sustainable transportation and mobility, social and environmental justice, environmentally sound local small businesses, new urbanism, and smart growth planning. Examples of common community sustainability projects include inner-city and brownfield redevelopment, eco-industrial parks, sustainable buildings, renewable energy projects, recycling and waste management, and pollution prevention.

Key Sustainable Community Trends

We identified several sustainable community trends that have implications for Army installations. We have grouped these trends into three categories: (1) emphasis on land use planning, transit-oriented development, growth management and community design, (2) development of industrial ecology/eco-industrial parks, and (3) improved waste management. We discuss each of these below. Some key sustainable community trends, such as transportation and ecosystem management, are not discussed here because they are discussed elsewhere in this document.

Emphasis on Land-Use Planning, Transit-Oriented Development, and Growth Management and Community Design

A key sustainable community trend is improvement through community planning, management, and design. Current trends in this area focus on traditional neighborhood

development/new urbanism, compact land use, and more sustainable transportation that focuses on community, accessibility, mobility and environmental benefits. These trends toward sustainable design and smart growth planning and development emphasize the protection of landscape ecosystems, encourage affordable green community designs, support more walkable transit-oriented neighborhoods, and revitalize neighborhoods.

The prevailing concepts in urban design are now traditional neighborhood development (TND)/new urbanism. These approaches to urban design are characterized by compact, pedestrian-oriented developments that provide a variety of uses, feature diverse housing types, and are anchored by a central public space and civic activity. The following are commonly found in TND/new urbanism: parks, schools, civic buildings, and commercial establishments located within walking distance of homes; residences with narrow front setbacks, front porches, and detached rear garages or alley-loaded parking; a network of streets and paths suitable for pedestrians, bicyclists, and vehicles; narrower streets with crosswalks, streetscaping, and other traffic-calming measures; in-scale development that fits the local context; and buildings oriented to the street with parking behind.[177]

Three examples of these types of communities are Prospect, in Longmont, Colorado; Longleaf, in New Port Richey, Florida; and Fruitvale Village, in Oakland, California.[178] In 1996 Prospect won a Governor's Smart Growth Award for its innovative alternative to suburban sprawl. The types of homes in the community include detached houses, townhouses, courtyard houses, apartments, and live/work lofts. The neighborhood is now in its fourth phase of development and will eventually have up to 585 units on 340 lots.

Longleaf was established in 1997 in New Port Richey, Florida. A paved hike-and-bike trail winds throughout the neighborhood, and there is a child-friendly park within two blocks of every home.

Fruitvale Village in Oakland, California is a 257,000 square foot "transit village" built on former Bay Area Rapid Transit (BART) parking lots. The community has 47 units of mixed-

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[177] See Peter Katz, *The New Urbansim: Toward an Architecture of Community*, New York: McGraw-Hill, 1993; Congress for the New Urbanism, "Charter of the New Urbanism," 1996; Andres Duany, Elizabeth Plater-Zyberck, and Jeff Speck, *Suburban Nation: The Rise of Sprawl and Decline of the American Dream*, New York: North Point Press, 2000; Andres Duany, Elizabeth Plater-Zyberck, et al., *Town and Town-Making Principles*, New York: Rizzoli, 1991; Douglas Farr, *Sustainable Urbanism: Urban Design with Nature*, Hoboken, NJ: Wiley, 2008.

[178] "TND Neighborhoods by State and Country," *The Town Paper*, no date.

income housing; 114,000 square feet of community services and office space; and 40,000 square feet of neighborhood retail.[179]

Development of Industrial Ecology/Eco-Industrial Parks

Another key trend is that companies have been working together to implement industrial ecology concepts through eco-industrial parks. Industrial ecology is a concept that came out of the academic and research communities. By definition:

> Industrial ecology is the study of a closed loop in which resources and energy flow into production processes, and excess materials are put back into the loop so that little or no waste is generated. Products used by consumers flow back into production loops through recycling to recover resources. Ideally the loops are closed within a factory, among industries in a region, and within national and global economies.[180]

Industrial ecology concepts have been implemented within industry, through activities like eco-industrial parks, since the 1990s.

> An eco-industrial park is a community of manufacturing and service businesses seeking enhanced environmental and economic performance through collaboration in managing environmental and resource issues, including energy, water, and materials. By working together, the community of businesses seeks a collective benefit that is greater than the sum of individual benefits each company would realize if it optimized its individual performance.[181]

An eco-industrial park is similar to a conventional industrial park because it is a contiguous property containing a number of tenants sharing a common management/ownership, infrastructure, and services and usually has a tenants association, but is different in that it focuses on continuous environmental and societal improvement.[182] The main idea is to create synergies between various industries, agriculture, and communities to convert wastes into valuable products and feed stocks for other entities, and generate a profit. Such efforts are still evolving. Communities that have tried to develop eco-industrial

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[179] The Army may find this example of a dense, urban development suitable for installations with activities such as transient student or large single-Soldier populations.

[180] White House Office of Science and Technology Policy, Environmental Technology Strategy Staff, *Technology for a Sustainable Future: A Framework for Action*, Washington, D.C.: U.S. Government Printing Office, July 1994, p. 54.

[181] The President's Council on Sustainable Development, *Eco-Efficiency Task Force Report*, Appendix B4, Washington, D.C., 1996, p. 4.

[182] Mary Schlarb, *Eco-Industrial Development: A Strategy for Building Sustainable Communities*, Washington, D.C.: U.S. Economic Development Administration, 2001.

parks in the United States include Chattanooga, Tennessee; Northampton County, Virginia; Brownsville, Texas; Burlington County, New Jersey; Skagit County, Washington; Tucson, Arizona; and Baltimore, Maryland. Companies get involved in such efforts because of the economic and community-relationship benefits from working with neighboring companies. For example, some of the industrial by-products and wastes of the Chaparral Steel Company in Midlothian, Texas, have become profitable resources and inputs for neighboring industries. The company's waste slag is being used at a neighboring cement plant. This arrangement has created a competitive advantage for Chaparral Steel, which has increased profits, saved natural resources,[183] and reduced environmental pollution.[184]

The most well-known example of an eco-industrial park is in Kalundborg, Denmark. The town's four main industries (a 1,500-megawatt coal-fired power plant; a large oil refinery; a maker of pharmaceuticals and enzymes; and a plasterboard manufacturer) and several users within the municipality make use of waste streams and energy resources, and turn by-products into raw materials. One of the industries in the park has recorded a 90–95 percent saving in oil consumption after switching to gas supplied by the adjacent refinery. In addition to these reductions, the use of the excess heat from one of the industries for household heating has eliminated the need for about 3,500 oil-burning domestic heating systems.[185] This industrial symbiosis evolved gradually over 25 years without a grand plan.[186]

More recent eco-industrial park examples include Plattsburgh Airbase Redevelopment Corp in Plattsburgh, New York and Keystone Industrial Port Complex (KIPC) in Bucks County, Pennsylvania. Fourteen years after closing, the 2,642 acres of the former Plattsburgh Air Force Base are now home to businesses, nonprofits, residential neighborhoods, community college facilities, and the new international airport.[187] In Bucks County, KIPC occupies a portion of the former U.S. Steel–Fairless Works. Tenants located at the site include companies that recycle concrete and asphalt for reuse and companies that take the

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[183]Natural resources are saved because the waste is used in place of raw natural resources.

[184] The President's Council on Sustainable Development, *Materials: A Report of the Interagency Workgroup on Industrial Ecology, Material and Energy Flows*, Washington, D.C., July 1998, pp. 22–23.

[185] International Institute for Sustainable Development, "Kalundborg," no date.

[186] Noel Brings Jacobsen, "Industrial Symbiosis in Kalundborg, Denmark: A Quantitative Assessment of Economic and Environmental Aspects," *Journal of Industrial Ecology*, Vol. 10, Issue 1, 2006, pp. 239–255.

[187] Plattsburgh Airbase Redevelopment Corporation, undated.

coal residuals from power generation and create roofing materials. Future tenants are locating a plant at KIPC to create bio-fuel from algae.[188]

As such activities become more common and have more success, it is likely that more eco-industrial parks will develop and more businesses may want to take part in their development.

Improved Waste Management

Another key trend in sustainable community activities is improving waste management so that less solid waste goes to landfills and hazardous wastes are disposed of properly. Local governments, along with many states, are doing this by focusing on pollution prevention, recycling, reuse, and composting programs; waste-to-energy projects; and proper disposal of electronic and other hazardous waste. State and local government agencies have long recognized the importance of hazardous and solid waste management because of past pollution problems that have hurt communities, such as Love Canal,[189] and the high costs of managing landfills, especially when new ones need to be built.

State and local incentive and voluntary programs, along with regulations, have helped motivate businesses, industry, communities, and individuals to implement pollution prevention, recycling, reuse, and composting activities. Such incentives and pressures by state and local governments are likely to continue, especially as many communities find their landfills filling up and encounter difficulties in building new ones.

There has been a lot of progress made by industry, communities, and Army installations in areas such as pollution prevention and recycling. Areas that are emerging trends, in which the Army has not yet done as much but that are likely to receive more emphasis in the future are: composting, waste-to-energy technologies, and electronic waste, also called e-waste. We discuss each of these below.

Composting programs offer one of the most effective ways of diverting the largest single component of the residential and municipal solid waste stream. These programs are becoming increasingly popular. Leaf and yard waste alone can represent up to 20 percent of

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[188] Environmental Protection Agency, "Bucks County Eco-Industrial Park and Two Tenants Join EPA Sustainability Initiative, Push Green Commitment Higher," 2009.

[189] The Love Canal development of about 100 homes and a school was built in the 1950s on top of improperly buried toxic industrial waste. It became one of the first widely publicized environmental disasters when rotting drums and the dangerous chemicals they had contained began coming up through the soil in the development in the summer of 1978. For more information, see Eckardt C. Beck, "The Love Canal Tragedy," *EPA Journal,* January 1979.

the residential waste stream and can be processed in a relatively inexpensive manner. With the addition of food waste in a composting program, up to 40 percent of the waste stream potentially can be diverted.[190]

Another emerging trend is the development of waste-to-energy (WTE) technologies. WTE is the creation of heat and/or electricity from the burning of a waste source, such as scrap wood and trash. Burning municipal solid waste (MSW) to create energy is a common technique that has been in practice for a long time and that many communities in the United States and some Army installations already take advantage of. For example, most of the municipal solid waste in Harford County, Maryland is burned at the Harford Waste-to-Energy Facility, and it provides steam heat to Aberdeen Proving Ground (APG). This facility is actually located on a 13-acre parcel of leased APG land.[191]

One of the new emerging technologies in WTE is thermal depolymerization, which converts fats, bones, greases, feathers, and other wastes into renewable diesel, fertilizers, and specialty chemicals. Given the volatility of oil prices over the past several years, there is much interest in maturing this technology. Plasma arc waste disposal is another emerging technology in this area. In this process, highly ionized gas is used to dispose of waste at a very high temperature (between 3,000 and 7,000 degrees Celsius). The advantage to this type of technology is that hazardous and toxic compounds are broken down and there is little air pollution. A commercial plasma arc waste disposal facility was commissioned in 2002 in Japan and now produces steam and hot water for local industries. A facility is planned in St. Lucie, Florida, and it is estimated that the county landfill would be eliminated in 18 years.[192]

The final emerging waste disposal trend that we examine is the disposal of electronic waste, or e-waste. Disposing of the many electronic devices that are part of our daily lives is becoming an increasing problem because these devices are increasing in number, they are replaced quickly, and they contain toxic metals such as cadmium, mercury, and lead. As a result, calls for recycling programs have been increasing. The Sony Take Back Recycling Program was the first national recycling initiative in the United States to involve both a major electronics manufacturer and a national waste management company. The program began on September 15, 2007 in collaboration with a wholly owned subsidiary of Waste

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[190] Federation of Canadian Municipalities, "Solid Waste as a Resource: Guide for Sustainable Communities," 2004.

[191] For more information, see Harford County, "Waste-to-Energy," http://www.harfordcountymd.gov/dpw/envaffairs/index.cfm?ID=438.

[192] Louis Circeo, *Plasma Arc Generation of Municipal Solid Waste*, Georgia Tech Electro-Optical Systems Laboratory, 2010.

Management, Inc., and by 2010 there were 132 dropoff locations in 31 states.[193] Currently, nineteen states plus New York City have passed legislation mandating statewide e-waste recycling.[194]

What Could Change the Course of Sustainable Community Trends

There are many different things that can and are affecting sustainable community trends, including governmental policies and regulations, environmental trends, state of the economy, and technology changes.

State and local government policies and regulations, such as smart growth regulations and recycling programs, affect how much some communities invest in trends like new urbanism and compact land use and recycling. Federal agencies are also assisting in sustainable communities, which also contributes to more activities in this area. For example, the U.S. Environmental Protection Agency, the U.S. Department of Transportation, and the U.S. Department of Housing and Urban Development will use the following six principles as a foundation for interagency coordination of investments relating to sustainable communities:[195]

- Provide more transportation choices
- Promote equitable, affordable housing
- Enhance economic competitiveness
- Support existing communities
- Coordinate policies and leverage investment
- Value communities and neighborhoods.

Environmental trends like climate change, loss of biodiversity, pollution prevention, water scarcity, and loss of agricultural land and open space from sprawl pressures can cause communities to become more concerned about sustainability and implement more sustainability activities.

Economic trends can also impact such activities. As state and local government budgets get tighter, they may choose not to invest in sustainability personnel or implement certain

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[193] Sony Electronics Inc., "The Sony Take Back Recycling Program," undated. As of July 15, 2010:
http://green.sel.sony.com/pages/recycle.html

[194] Californians Against Waste, "E-waste Laws in Other States,"
http://www.cawrecycles.org/issues/ca_e-waste/other_states.

[195] Environmental Protection Agency, "HUD-DOT-EPA Interagency Partnership for Sustainable Communities," June 16, 2009.

sustainability programs. However, in the case of sustainability programs that save money or help with local jobs, such as eco-industrial parks, there may be more interest in developing and sustaining those programs. Also, in some urban areas where the exurbs have been particularly hard hit by the recent economic downturn, there may be more movement from the exurbs to urban areas[196] and more emphasis on new urbanism and compact land use and city redevelopment activities.

Technology can also impact sustainable community activities. As more technologies are developed that benefit the environment and as they become more cost competitive, communities are more likely to employ them. For instance, improvements in renewable energy technologies, especially as the purchasing costs decrease, help motivate more communities to implement programs to invest in them, as is seen in Arlington County, Virginia.[197] Advances in information and communications technologies have enabled many business and government employees to use telecommuting, which decreases reliance on the automobile and enables people to live in more distant locations.

Interrelationships with Other Trend Areas

Since sustainable community programs implement a diverse range of activities, there is significant overlap with other trend areas, especially trends having to do with the environment and sprawling communities. Sustainable community activities supporting ecosystem management and habitat protection can help mitigate biodiversity loss. Communities protecting open and green spaces, managing growth, redeveloping inner-city brownfield areas, and concentrating on new developments in compact land use can help mitigate urban growth and sprawl pressures as well as help address some environmental concerns.

Many sustainable community activities are trying to invest in energy conservation and more green buildings and renewable energy technologies. Communities are making such investments because of concerns about climate change and other environmental issues, rising energy prices, and energy security concerns. Similarly, because of water supply and

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[196] Elizabeth Kneebone and Emily Garr, *The Landscape of Recession*, Washington, D.C.: Brookings Institution, 2009.

[197] Arlington County has been investing in renewable energies, such as solar photovoltaics, for a number of years. The Arlington County Community Energy & Sustainability Task Force even recommended that Arlington County set a goal to "install 160 MW of solar photovoltaics by 2025 Countywide." Arlington County, Virginia, *Arlington County Community Energy & Sustainability Task Force Report: FINAL DRAFT*, March 4, 2011, p. 7.

quality concerns, many sustainable community activities focus on conserving water, addressing storm water runoff, and other water concerns.

Similarly, sustainable transportation is closely integrated with sustainable community activities because transportation and land use planning, policies, and use are so affected by each other. Sustainable transportation practices, like compact land use planning and transit and bike lane developments and incentives, are often part of sustainable community activities, especially because of community concerns about traffic congestion and air pollution.

Sustainable agriculture and food production practices can also be part of sustainable community programs. Communities often implement such practices to help local farmers and to address health and environmental concerns.

Implications of Sustainable Community Activities for Army Installations

Next we discuss the implications of these activities for Army installations. However, first we provide some useful context information about what Army installations are already doing in this area.

Current Army Sustainable Community Activities

Army installations have already been implementing sustainable community activities through their installation sustainability planning programs and activities. Beginning around 2000, a few installations, like Fort Bragg and Fort Hood, started developing and implementing installation sustainability plans because of the operational, financial, and environmental benefits they saw industry and communities experiencing by implementing sustainability approaches. Such plans address long-range mission, community, and environmental issues and priorities. They are developed through a strategic planning process and exist in addition to or are integrated into the installation's strategic plan. Since those first efforts, over 40 installations have been developing or implementing installation sustainability planning activities. Many other installations have been implementing sustainability-related practices, such as pollution prevention, recycling programs, and ecosystem management, because of strong, progressive environmental programs. Some installations have staff dedicated solely to sustainability or staff who spend part time on sustainability and part time on related environmental areas, like pollution prevention.

In 2004, building on this installation sustainability success, the Army issued the "Army Strategy for the Environment,"[198] which has sustainability as its foundation. This document

[198] U.S. Army, "The Army Strategy for the Environment: Sustain the Mission—Secure the Future." Washington, D.C., U.S. Army Environmental Policy Institute, 2004.

states that "a sustainable Army simultaneously meets current as well as future mission requirements worldwide, safeguards human health, improves quality of life, and enhances the natural environment." Since then, Army installations and other parts of the Army are implementing more sustainable practices to benefit the environment, mission, and community.

In fact, in many ways the Army has a stronger sustainability program than most U.S. communities because it has invested more resources than most communities have; the presence of dedicated sustainability staff being a notable example. Some installations are leaders in key sustainability areas, such as ecosystem management; recycling and waste reuse and reduction; and energy efficiency and renewable energy investments.[199] We briefly discuss some of these strengths here. As discussed early in the chapter that covers biodiversity issues, many Army installations also have strong ecosystem management programs to help protect and preserve T&ES, their habitat, and biodiversity.

Some installations, such as Fort Hood, are also leaders in recycling and waste reuse and reduction. Fort Hood has an "Every Waste a Reuse Opportunity" slogan. Materials recycled and reused have included aluminum, plastics, paints, wood, metals, batteries, paper, cardboard, asphalt, mattresses, soil, tires, motor oil, concrete, and antifreeze. In FY06, solid wastes recycled totaled over 49,710 tons and generated a total revenue of $1,738,778.[200] The combination of Fort Hood's qualified recycling program, compost recycling program, inert material management, deconstruction management, special waste management, and electronics waste recycling program saved more than $2.5 million in 2006.[201]

In 2010 the Army set ambitious goals for net zero waste installations, defined as

> an installation that reduces, reuses, and recovers waste streams, converting them to resource values with zero landfill over the course of a year. The components of net zero solid waste start with reducing the amount of waste generated, re-purposing waste, maximizing recycling of waste stream to reclaim recyclable and compostable materials, recovery to generate energy as a by-product of waste reduction, with disposal being nonexistent.[202]

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[199] For examples of the many different types of sustainability activities at Army installations, see Beth Lachman et al., 2010.

[200] Fort Hood, "Solid Waste Annual Report for FY06," Fort Hood, Texas, 2006.

[201] U.S. Army, "Army Environmental Programs Awarded for Making a Difference," *States News Service*, Washington, D.C., June 13, 2007.

[202] Army Energy Program, "Army Vision for Net Zero," no date.

More recently, in April 2011, the Army identified six installation pilots striving to become net zero waste by the year 2020:

- Fort Detrick, Maryland
- Fort Hood, Texas
- Fort Hunter Liggett, California
- Fort Polk, Louisiana
- Joint Base Lewis-McChord, Washington
- U.S. Army Garrison, Grafenwoehr, Germany

As discussed earlier, the Army also announced plans for net zero installations. "A net zero installation is one which applies an integrated approach to management of energy, water, and waste to capture and commercialize the resource value and/or enhance the ecological productivity of land, water, and air."[203] Fort Bliss, Texas and Fort Carson, Colorado were selected to be net zero installation pilots aiming to be net zero installations by 2020.

Installations like Fort Bragg, Fort Carson, and JBLM through their sustainability programs also have been leaders in energy conservation and efficiency. Some installations, such as Fort Carson, have also been leaders in implementing renewable energy projects. Fort Carson built a twelve-acre 2-MW solar array. Since 2007 this solar array has produced 3,200 megawatt-hours of power each year, which is about enough to power 500 installation homes for a year.[204]

Recommendations

Even though some installations are leaders in sustainability, the Army can still learn a lot and benefit from some of the sustainable community efforts and trends in industrial ecology/eco-industrial parks, traditional neighborhood development and compact land use, diverse mobility and transportation planning (discussed in the next section) and sustainable agriculture (discussed in the last section of this chapter). We discuss recommendations regarding the first two here and the others later.

However, first we discuss some basic information-sharing recommendations so that communities and installations can learn from other Army installations' successes, as well as

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[203] Assistant Secretary of the Army for Installations, Energy, and Environment, "Net Zero: A Force Multiplier," no date.

[204] Nancy Mann Jackson, "Fort Carson," *WasteAge*, Penton Media, Inc., September 23, 2010.

the Army learning from communities. Given the strengths of some Army installations' sustainability efforts, the Army should, first, publicize its installation sustainability efforts more. IMCOM should document in-depth case studies of installation sustainability successes and lessons learned, especially how they overcame barriers, and share them across installations. Such information transfer is needed to help other installations implement such practices more widely across the Army. Second, ACSIM and IMCOM and other Commands should ensure that installations collaborate more in regional and local sustainability community efforts. Third, the Army should participate more in other public sustainability forums, such as activities with other federal agencies like EPA.

The Army should also ensure that installation sustainability staff and programs continue despite current budget cuts because of the cost savings and other benefits that they achieve.[205] During summer 2011, some staff at different installations worried that IMCOM was planning to eliminate sustainability staff or programs. Any significant cuts to sustainability staff and programs would be short sighted and not in the long-term strategic interest of the Army.

Because of the land use trends just discussed, ACSIM and IMCOM policies should require installations to include, wherever feasible, TND principles in installation master plans and transportation planning. In 2012, OSD Master Planning guidance and Army draft guidance was starting to encourage more compact development and other sustainable community practice regarding land use.[206] In addition, installations should be required to do sustainable transportation options in growth planning (which is discussed more in the next section).

To take advantage of eco-industrial park trends, installations should try to develop and implement eco-industrial parks with neighboring industry. ASA(IE&E), ACSIM, and IMCOM should help sponsor some initial installation eco-industrial park pilots. IMCOM should also help educate and provide information about such opportunities to installations. Such parks could benefit both the installation and local communities by helping local businesses and reducing waste disposal.

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[205] For examples of cost savings and other benefits, see Lachman et al., 2010.

[206] See U.S. Department of Defense, *Unified Facilities Criteria (UFC): Installation Master Planning,* UFC 2-100-01, May 15, 2012; see also draft of Army Regulation 420-1, "Army Facilities Management," August 2012.

Lastly, ASA(IE&E), ACSIM and/or IMCOM should help installations develop some more waste-to-energy technology demonstration pilots and document and share information about such projects.

Sources for Tracking Sustainable Community Trends

Organizations That Track Sustainable Community Trends

Several government agencies, including the Department of Energy, Environmental Protection Agency, and Economic Development Agency in the Department of Commerce, track trends related to sustainable communities.

In addition, the Urban Institute conducts and disseminates research on sustainable communities.[207] The Urban Institute is a nonpartisan organization that gathers data, conducts research, evaluates programs, and offers technical assistance overseas on social and economic issues. Some of the topics that the Urban Institute focuses on include housing trends, economic development, mobility and transportation, cities and neighbors, and crime and justice.

The Congress for the New Urbanism (CNU) is a nonprofit organization comprised of architects, urban designers, planners, public officials, investors, and community activists that promotes walkable, mixed-use neighborhoods and is the hub of TND/new urbanism.[208] CNU was established in 1993 by architects Andres Duany, Peter Calthorpe, Elizabeth Moule, Elizabeth Plater-Zyberk, Stefanos Polyzoides, and Dan Solomon. Today, CNU has over 3,100 members in 20 countries and 49 states.

Sustainable Communities Online, formerly known as the Sustainable Communities Network, is an online resource that pools information on sustainability.[209] The site contains information related to governance, the economy, the environment, smart growth, and communities.

International Institute for Sustainable Development (IISD) is a nonpartisan, charitable organization specializing in policy research and analysis of issues related to sustainable development.[210] IISD was established in 1988 when Canadian Prime Minister Brian Mulroney announced Canada's plans to establish an international institute dedicated to advancing sustainable development at the United Nations. In addition to its head office in

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[207] See the Urban Institute's website at http://www.urban.org.

[208] See the Congress for the New Urbanism's website at http://www.cnu.org/.

[209] See Sustainable Communities Online's website at http://www.sustainable.org/.

[210] See the International Institute for Sustainable Development's website at http://www.iisd.org/.

Winnipeg, Manitoba, IISD now has branches in Ottawa, Ontario; New York, New York; and Geneva, Switzerland.

Center for Neighborhood Technology (CNT) is an organization that promotes more livable and sustainable urban communities through research and advocacy. CNT was founded in 1978 and focuses on three areas: (1) researching urban issues such as efficient use of resources, strategies for reducing pollution, or ways to improve public transportation; (2) building coalitions to advocate for public policies that can help address urban sustainability issues; and (3) designing, developing, and operating economic development demonstration projects to address urban sustainability in innovative ways.[211]

Studies and Reports

The United Nations report entitled *Trends in Sustainable Development: 2008–2009* highlights key developments and recent trends in agriculture, rural development, land, desertification, and drought: five of the six themes being considered by the UN Commission on Sustainable Development (CSD) at its 16th and 17th sessions (2008–2009). The report identifies where progress has been made in these five areas and where improvement is needed.

The Urban Institute's report entitled *Community Revitalization in the United States and the United Kingdom* (2009) presents the findings of a study that compared trends in community revitalization, community cohesion, and sustainable neighborhoods in cities in the United States and the United Kingdom.

The article entitled "Local Government Efforts to Promote the 'Three Es' of Sustainable Development: Survey in Medium to Large Cities in the United States" in the *Journal of Planning Education and Research* (2008) presents survey results of sustainable development efforts across the United States. It highlights the challenges faced by local government officials.

Sustainable Transportation

In this section we discuss the activities and trends related to transportation and how the concept of "sustainable transportation" captures many of these trends. We begin by discussing a little background about what has been driving U.S. transportation trends. Then we discuss the trends, the implications they have for Army installations, and sources of information.

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[211] See the Center for Neighborhood Technology's website at http://www.cnt.org/.

Background: Congestion and Pollution Concerns Are Driving Transportation Changes

From the very earliest days of transportation, when the invention of the wheel and axle enabled people to transport more than they could carry on their backs, progress in transportation has resulted from the need for mobility combined with technological change. The invention of rails and their deployment on continental scales, the introduction of mechanical motive power, and the linkage between transportation and telecommunications in GPS and other embodiments—to say nothing of the revolutions in transportation by sea and air—have all marked a path forward that continues to revolutionize human mobility.

Over the second half of the 20th century, the United States experienced a significant rise in personal automobile use in particular, which was both a contributor to and a consequence of sprawling cities, growth in suburbs, development of highway and road infrastructure systems, and increasing living standards. Consequently, land use patterns in the United States have become more decentralized, meaning that the proportion of jobs located in center cities declined and the percentage of the population living at fairly low densities (i.e., in suburbs) has been increasing. As cities and suburbs grew and automobiles became more widespread, people moved further from the more compact city areas and their jobs and started commuting longer distances to their workplaces. One result of these trends is an overall increase in the number of miles traveled by private vehicles, as opposed to other modes. In 2001 (the year of the last complete National Household Transportation Survey), just over 85 percent of all trips in the United States were made by car. Furthermore, 65 percent of those occurred in single-occupant vehicles (SOVs), meaning that the driver was the only occupant in the vehicle.[212]

More and more people driving more and more miles has caused congestion problems. Such auto use is responsible for high and growing levels of congestion in cities and towns across the United States, as shown in Figure 3.1. In 2005, congestion cost about $78.2 billion, compared to $73.1 billion in 2004. This includes the cost of hours wasted in delays—4.2 billion hours in 2005—and gallons of wasted fuel—2.9 billion gallons in 2005. Additionally, the average annual cost per traveler (based on wasted time and fuel) has grown, as shown in Figure 3.2. This cost was $707 in 2005, up from $680 in 2004 (using constant dollars).[213]

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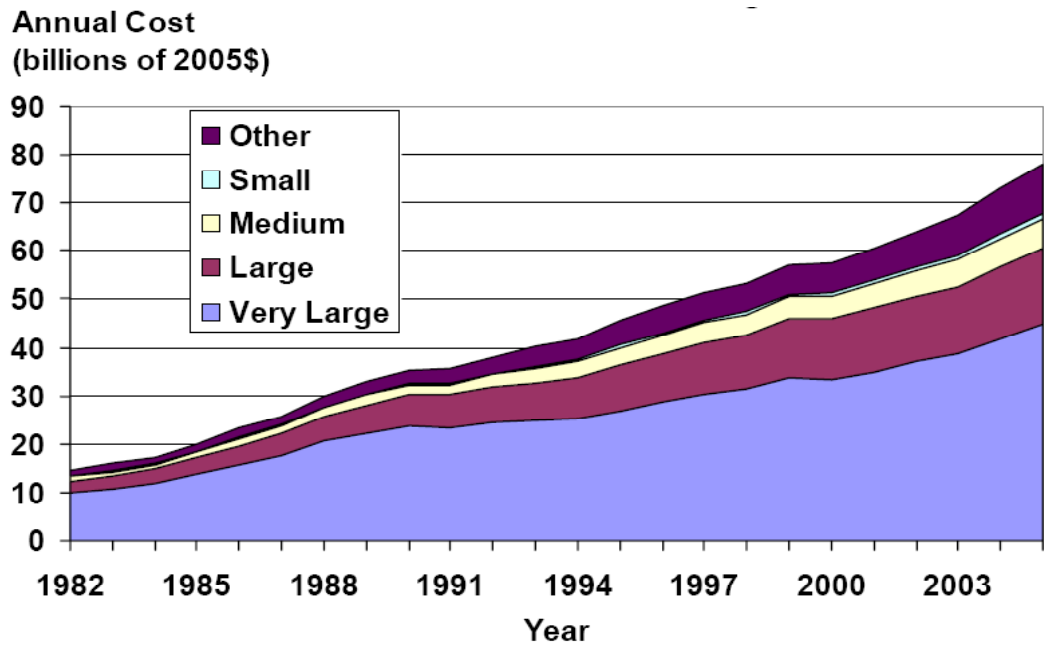
[212] Research and Innovation Technology Administration, Bureau of Transportation Statistics, *National Household Transportation Survey 2001, National Data and Analysis Tool.*

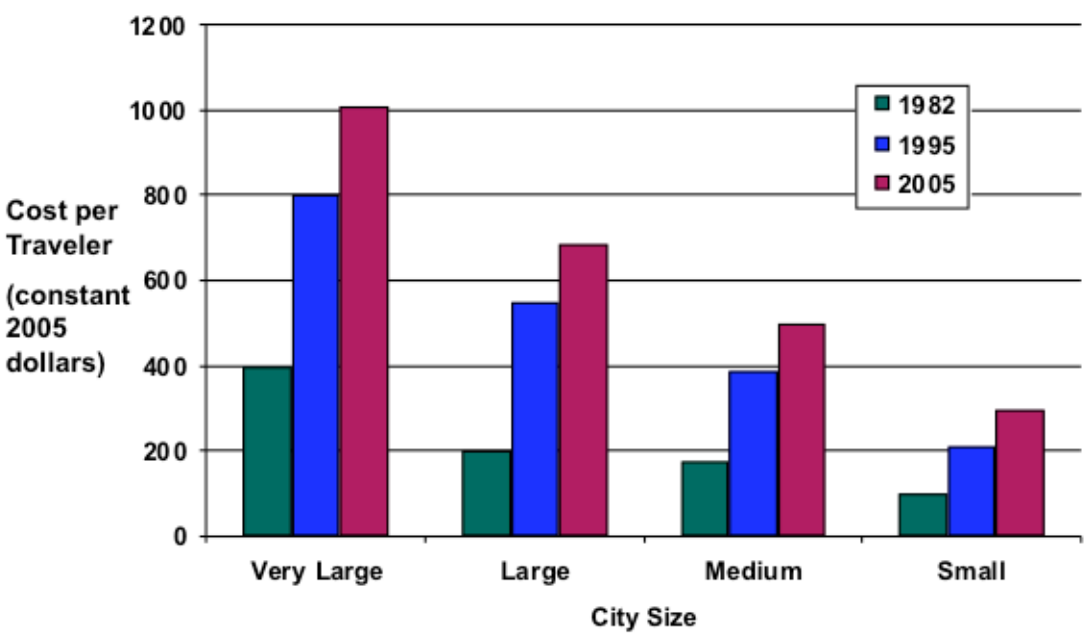
[213] David Schrank and Tim Lomax, *2007 Annual Urban Mobility Report*, College Station, TX: Texas Transportation Institute, 2007, p. B-19.

Figure 3.1
Annual Cost of Congestion Has Grown for All Sizes of Cities, from Small to Very Large



SOURCE: Schrank, 2007, p. B-20.

Figure 3.2
Congestion Costs per Traveler (in 2005 Dollars) Have Grown for Travelers, Regardless of City Size



SOURCE: Schrank, 2007, p. B-21.

This rise in personal vehicles, single-occupant vehicles in particular, is also a major contributor to air pollution and other environmental problems, including water pollution. High concentrations of carbon monoxide generally occur in areas with heavy traffic congestion. In cities, as much as 95 percent of all carbon monoxide emissions may come from automobile exhaust.[214] Other pollutants from motor vehicle exhaust include ozone (the most prevalent chemical in smog), nitrogen oxides, lead, and particulate matter (dust, soot, and other particles suspended in the air). These pollutants are associated with a wide range of health and environmental problems, including higher rates of respiratory illness, cardiovascular disease, hospital admission, and mortality. Research suggests that children and the elderly are particularly vulnerable.[215] As these pollutants and oils from vehicles are washed into storm drains and across the landscape from rain and other participation, they also contribute to water quality problems.

Such congestion and air pollution problems have led to federal, state, and local government activities to try to reduce SOV and focus on more sustainable methods of personal transportation. These efforts largely began with the first Clean Air Act (CAA) which was first passed in 1963 and subsequently amended in 1970 (at which time the EPA was also created) and in 1990. Among other things, the CAA gives the EPA the authority to set limits on key or *criteria* pollutants[216] and to identify states and regions where these limits are exceeded. These are called *nonattainment areas*. The 1990 amendment to the Clean Air Act requires nonattainment areas to develop plans to reduce air pollutants. This includes reducing pollutants from transportation, for example, by requiring employers to institute travel assistance programs to reduce the number of employees who drive to work.[217]

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[214] U.S. Environmental Protection Agency, *U.S. EPA's 2008 Report on the Environment (Final Report)*, 2008, pp. 2–11.

[215] H.S. Koren, "Associations Between Criteria Air Pollutants and Asthma," *Environmental Health Perspectives*, Vol. 103, No. Suppl 6, 1995, pp. 235–242.

Bert Brunekreef and Stephen T Holgate, "Air Pollution and Health," *The Lancet*, Vol. 360, No. 9341, 2002, pp. 1233–1242.

Jonathan M. Samet, Scott L. Zeger, Francesca Dominici, Frank Curriero, Ivan Coursac, Douglas W. Dockery, Joel Schwartz, and Antonella Zanobetti, *The National Morbidity, Mortality, and Air Pollution Study Part II: Morbidity and Mortality from Air Pollution in the United States*, Cambridge, MA: Health Effects Institute Report 94, 2000.

[216] Criteria pollutants—carbon monoxide, ozone, nitrogen oxides, lead, and particulate matter mentioned earlier, as well as sulfur dioxide—are so called because the EPA monitors these pollutants and sets criteria for permissible levels. Sulfur dioxide is the only criteria pollutant that is not produced by vehicles.

[217] Public Law 88-206, Stat. 401, Clean Air Act, 1963.

More recently, concerns about climate change and greenhouse gas (GHG) emissions have motivated people to try to focus more on sustainable transportation because most (over 60 percent) of GHG emissions associated with transportation are produced by personal vehicles: cars, pickup trucks, SUVs, and minivans.[218] Transportation actually accounts for nearly a third of the U.S. GHG emissions, and transportation as a percent of total U.S. emissions is growing—it represents 48 percent of the total increase in GHG emissions since 1990.[219]

Other effects of our current transportation system include noise pollution and urban sprawl, as well as consumption of nonrenewable energy and a high dependence on foreign oil.

Key Sustainable Transportation Trends

Here we discuss the main trends related to sustainable transportation, but first we provide a definition. Sustainable transportation—also called sustainable mobility—is based on the concept of sustainable development. Sustainable development, as discussed earlier, is defined by the Bruntland Commission as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Using this as a basis, sustainable transportation seeks to meet three goals simultaneously: meeting human needs for accessibility and mobility, preserving ecosystems and protecting the environment, and ensuring intra- and inter-generational equity.[220]

Given that personal vehicular traffic and the problems of congestion and pollution are key transportation concerns, sustainable transportation activities tend to focus on reducing personal driving amounts and making driving more efficient, resulting in less congestion and pollution problems. Approaches to reducing driving try to make driving less attractive through market measures (e.g., increasing or changing the costs of driving); make alternative modes (transit, pedestrian, bicycle) more attractive; promote compact land use to make alternative modes more practical; and encourage telecommuting and carpooling. Approaches

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Public Law 91-604, Stat. 1676, 1970 Clean Air Act Amendment, 1970.
Public Law 101-549, Stat. 1630, 1990 Clean Air Act Amendment, 1990.

[218] U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2006,* Washington, D.C., 2008, p. 2-24.

[219] U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2008*, Washington, D.C., 2010, p. ES-8.

[220] Erling Holden, *Achieving Sustainable Mobility,* Burlington, VT: Ashgate Publishing, 2007, pp. 61–64.

to make driving more efficient focus on better fuels that pollute less and have lower GHG emissions, and more efficient system operations (e.g., synchronized traffic signals).

Importantly, efforts to make transportation more sustainable must be considered holistically, in a broader transportation context and a still broader social context. Some actions that seem to promote sustainability may in fact have an overall neutral or negative effect when the full, life-cycle effects of the actions are considered. For example, it may seem plausible that creating more roadways would improve traffic flow. However, the phenomenon of *induced demand*—in which greater supply of an underpriced good results in greater demand and consumption of that good—means that the new capacity is quickly consumed with new drivers and vehicles.[221] Similarly, it may seem plausible that replacing all existing cars with more fuel efficient ones would reduce GHG emissions. However, if one considers the added emissions from producing new cars sooner than would otherwise be necessary, the approach may have an overall negative effect.[222]

Given such approaches, we identified four main transportation trends that have relevance for Army installations and we anticipate will continue in the future:

1. There is increasing recognition about the importance of **compact land use and less personal vehicle travel** because of the benefits to the environment, mobility, quality of life, and community livability.
2. More **electric and other alternative energy vehicles** are being developed and put into service.
3. More **transportation system planning and operations improvements** are being implemented because of the benefits they provide.
4. Increasingly many and increasingly **diverse personal mobility options** are becoming available, such as car sharing, and they are being researched, developed, and implemented.

Technology improvements, such as smart cars, constitute a fifth key transportation trend. Such trends include many of the information technology advancements we describe in Chapter Five in the discussion on pervasive computing. For example, while many technologies to assist drivers are already emerging—such as lane keeping systems that monitor lane markings and adaptive cruise control systems that keep speed with traffic—

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[221] J.J. Leeming, *Road Accidents: Prevent or Punish,* Cassell, 1969

[222] Hyung Chul Kim, Gregory A. Keoleian, Darby E. Grande, and James C. Bean, "Life Cycle Optimization of Automobile Replacement: Model and Application," *Environmental Science and Technology*, Vol. 27, 2003, pp. 5407–5413.

future technologies may include driverless vehicles and vehicles that can communicate with each other and with the surrounding transportation infrastructure. In the future, these technologies may help reduce emissions by enabling vehicles to drive more efficiently and to choose routes that are efficient as well.

These trends are not as relevant to Army installations in 2025 for several reasons. First, they may not be widely implemented by 2025. Second, the widespread implementation of infrastructure technologies depends on actions of transportation agencies like departments of transportation and metropolitan planning organizations, while the adoption of intelligent vehicles depends on the actions of consumers and manufacturers. Third, many of these technologies have high costs for infrastructure development, and the Army is only likely to adapt them after they are widely used throughout the United States. Therefore, the Army's role may be limited, outside of managing its own fleet of vehicles. Therefore, we do not discuss them further in this report, but focus on the four relevant trends.

Emphasis on Compact Land Use and Less Personal Vehicle Travel

One major trend of sustainable transportation is compact land use, which refers to areas of higher population densities and is defined as approximately 13 housing units per acre, while average residential development in the United States was 7.6 units per acre in 2003.[223] Compact land use may also involve mixed-use zoning, meaning that an area is not restricted to either residential, office, or commercial buildings but can have some mixture.

Compact land use is associated with reduced vehicular travel in a number of ways. First, when people use personal vehicles, they travel fewer miles than in low-density areas because distances, for example between a home and the supermarket, are shorter. Second, nonmotorized travel choices such as walking and cycling are also more possible, providing both health and environmental benefits. Third, transit development and use also tend to be more feasible and desirable in compact areas where large numbers of people can be served efficiently. Fourth, ride sharing or carpooling also become practical. Fifth, car sharing—a rental-car model in which participants rent vehicles on an as-needed, short-term basis instead of owning their own vehicles—is also more feasible because cars are needed less often and because enough people can share the vehicles in the same area to make the programs cost-effective and practical.

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[223] Reid Ewing, Keith Bartholomew, Steve Winkelman, Jerry Walters, and Don Chen, *Growing Cooler: The Evidence on Urban Development and Climate Change*, Washington, D.C.: Urban Land Institute, 2008, p. 8.

All of this results in a reduction in the number of miles driven in personal vehicles. Estimates suggest that doubling residential density across a region would reduce the number of miles traveled by residents in the area by about 5 to 12 percent.[224] Another study suggests that by shifting 60 percent of new residential growth across the United States to compact patterns, carbon dioxide (CO2) emissions could decline by 7 to 10 percent from current trends by 2050, or 79 million metric tons annually.[225] The other effects of fewer vehicle miles include better air quality due to lower emissions of conventional pollutants, less gasoline consumption which reduces dependence on oil, more physical activity and better health, less land requirements for roads and parking, and greater equity in mobility between the wealthy and poor. For these reasons, compact land use is a key aspect of sustainable communities in general.

Many communities are trying to encourage compact land use and other land use patterns that reduce driving and improve livability. In the 1990s, Arlington, Virginia encouraged mixed-use, high-density growth along the Washington D.C. Metro light rail line that ran through it. This area is known as the Rosslyn-Ballston Metro Corridor, and it has become a pedestrian and cycle friendly shopping, business, and residential district. Transit use in this area has also significantly increased.[226] Like many towns and cities in the United States, over the last few decades Barnstable, Massachusetts experienced tremendous growth on its outskirts while its once-vibrant downtown began to deteriorate. To combat this, in 2004, the town provided accelerated permitting for downtown developments, invested in infrastructure, and promoted walkable communities, among other measures. This has revitalized the downtown area and, according to reports, created jobs and further spurred the use of green designs.[227] More recently, the city of Palo Alto, California adopted new zoning ordinances that allow for mixed-use buildings and higher densities to increase the neighborhood's walkability.[228]

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[224] Committee for the Study on the Relationships Among Development Patterns, Vehicle Miles Traveled, and Energy Consumption, *Driving and the Built Environment: The Effects of Compact Development on Motorized Travel, Energy Use, and CO2 Emissions*, Washington, D.C.: Transportation Research Board, TRB Special Report 298, 2009, p. 63.

[225] Ewing et al., 2008, p. 10.

[226] Smart Growth Resource Library, "Smart Growth in Action: Rosslyn-Ballston Metro Corridor, Arlington County, Virginia," 2010.

[227] Smart Growth Resource Library, "Smart Growth in Action: Village of Hyannis, Barnstable, Massachusetts,: 2010.

[228] City of Palo Alto, Title 18, Zoning Code, September 11, 2007.

Policies to encourage more compact land use are complemented by efforts to reduce driving in personal vehicles—known as transportation demand management (TDM). TDM includes a wide range of policies, many of which are highlighted in Table 3.1. Here, we briefly discuss three that are diverse and that may be particularly relevant to the Army. A more complete survey of numerous methods can be found on the Federal Highway Administration's TDM website.[229]

Table 3.1
Transportation Demand Management Includes a Wide Range of Policies and Programs

Road pricing charges drivers for their use of roads. In addition to traditional toll roads, this includes distance-based fees which charge per mile driven and are not limited to highways. It also includes congestion pricing in which charges are increased during peak travel hours and reduced at other times, to combat congestion.
Parking management and pricing limits parking availability or increases the cost of parking, or both, discouraging vehicle trips.
Car sharing programs use a model in which members rent cars on a short-term, hourly basis. By charging for individual trips, car sharing programs discourage trips.
Pay-as-you-drive vehicle insurance policies have premiums that vary depending on how much a vehicle is driven. This motivates policy holders to drive less.
Ridesharing programs encourage travelers to share rides and are typically undertaken by employers to reduce commute trips.
High-occupancy vehicle (HOV) lanes are lanes specifically allocated for ridesharers. They encourage ridesharing by allowing ridesharers to avoid tolls or avoid congestion.
Transit incentives reduce transit fares and thus encourage transit use.
Transit improvements seek to encourage transit use by increasing service, improving convenience, and other measures.
Telework policies encourage employees to work from home (and encourage employers to allow employees to do so), thus avoiding commute trips.

Parking Management and Pricing. Plentiful and free parking encourages driving and in some cases is the main factor in a traveler's choice to drive.[230] Parking management and parking pricing policies try to reduce vehicle trips by reducing the number of parking spots relative to demand, by making parking more expensive, or both. The intent is to encourage people to walk, cycle, or use transit, or to carpool, instead of driving.

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[229] U.S. Department of Transportation, Office of Operations, "Travel Demand Management," 2008.

[230] R. Dowling, D. Feltham, and W. Wycko, "Factors Affecting Transportation Demand Management Program Effectiveness at Six San Francisco Medical Institutions," Transportation Research Board, Record 1321, 1991, pp. 109–117.

For example, in California, many employers offer their employees a cash-out parking option in which they receive cash and forgo the parking space or parking subsidy that their employer would otherwise have provided. One study examined these policies among eight firms—one government agency, three law firms, one accounting firm, and one health care firm. On average, the percentage of employees who drove in single-occupancy vehicles dropped by 17 percent after the cash-out program was implemented. The number of vehicle miles traveled dropped by 12 percent.[231]

Although few cities have instituted widespread paid parking, those that have undertaken it have been successful, if there are enough alternatives for travelers (namely transit). The city of Perth in Australia began charging an annual fee for almost all parking spaces and found significant declines in the percentage of people driving to work. At the same time, jobs in the city grew significantly, suggesting that the program had not caused employers to move outside the area or caused employees to seek employment elsewhere.[232]

Ridesharing. As we have noted, most trips in the United States are made in personal vehicles, and most of those trips are made with only a single occupant in the vehicle. One aphorism in transportation is that the most underutilized capacity in transportation is the three or more empty seats in every SOV. Ridesharing—in which more than one person rides in the vehicle—moves a larger number of people with the same capacity, fuel consumption, and GHGs and is an obvious way to increase efficiency. Ridesharing, of course, occurs without any policy intervention, since many people are willing to share rides for convenience, cost savings, or company. But if there are other ways to encourage ride sharing, gains could be made in congestion, air quality, GHG emissions, and other areas.

Ridesharing is generally divided into carpooling and vanpooling. In carpooling, ridesharers use their personal vehicles and the ridesharing is typically privately arranged. One way to support carpooling is to provide rideshare-matching services, which allow prospective ridesharers to find others who work and live near them. Many firms provide "dynamic ridesharing," which makes quick matches online for one-time rides (as opposed to conventional matching systems in which both ridesharers are interested in ridesharing for an extended period of time). Employers can also encourage carpooling by offering carpoolers preferred parking, cheaper parking rates for carpoolers, etc.

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[231] Donald C. Shoup, *Evaluating the Effects of Parking Cash Out: Eight Case Studies*, Sacramento, CA: California Air Resources Board, 1997, p. 3.

[232] Sinclair Knight Merz, *Review of Perth Parking Policy*, Perth, WA, Australia, 2007.

The Metropolitan Washington (D.C.) Council of Governments has had a long-running ridesharing program which includes online ride matching and kiosks for ride matching. It found that during fiscal years 2003–2005, ridesharing vehicle trips increased by 5,000 per day and reduced the number of miles traveled by 129,000 miles per day.[233] Rideshare-matching services exist in many towns and cities of varying sizes, from San Francisco[234] to Minneapolis/St. Paul[235] to Nashville.[236] And while many ridesharing programs are run by local governments or commuter assistance organizations, many private companies do so as well.

In vanpooling, on the other hand, employers or third-party companies provide group transportation in larger vans and buses. Many vanpools charge riders a fee to cover operating expenses, and federal law also provides a tax credit for vanpoolers (but not carpoolers). Google, for example, provides vanpooling services free of charge to its employees in Mountain View, California, and bills the service as a job perk. Recent estimates suggest that 1,200 employees use this service—nearly a quarter of its employees at the time.[237]

Telework or Telecommuting. Another approach to reducing transit demand for commuting is to encourage working from home or an alternative location closer to home—called telework or telecommuting. Telework affects employers and employees. Employers generally offer telework as an employee benefit (rather than as a transportation program) for those whose work can be performed away from conventional workplaces.

Surveys suggest that working from home is important to employees. A recent survey commissioned by Cisco Systems surveyed IT professionals around the world and found that 60 percent of workers believed it was unnecessary to be in the office to be productive. Most workers also said they'd take lower pay to telework.[238]

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[233] LDA Consulting, CIC Research Inc., ESTC, Elham Shirazi, and Cheryl Collier, *Transportation Emission Reduction Measure (Term) Analysis Report, FY 2003–2005*, Washington, D.C.: Metropolitan Washington Council of Governments Commuter Connections Program, 2005, p. 26.

[234] For more information about San Francisco's ridesharing program, please visit: https://www.ridematch.511.org/SanFrancisco/

[235] MetroTRansit, website, 2010.

[236] Regional Transportation Authority, website, 2010.

[237] Michael Helft, "Google's Buses Help Its Workers Beat the Rush," *New York Times*, March 10, 2007.

[238] Matt Hamblem, "Survey Shows Mobility Is Mainstream at Work," *Computerworld*, October 19, 2010.

Telework does not have to occur from home—it can occur from telework or co-working centers that are designed to allow many teleworkers to share the same office space (and resources like printers, faxes, and phone services) away from their main place of employment. The U.S. General Services Administration (GSA), for example, has opened fourteen telework centers across the Washington, D.C. metropolitan area for both federal and private employees.[239] Telework.gov is the federal government's official teleworking website for federal employees and provides resources on how to begin teleworking at these centers.

Teleworking generally reduces driving. A pilot program in Los Angeles found that after two years, teleworkers worked from home on average 8 days per month.[240] Another California study of telework centers found that on teleworking days, employees avoided on average 38 miles of driving each.[241]

Cash-out parking, ridesharing, and telework are all examples of commuter assistance or commuter choice programs in which employers offer a wider range of commuting options and incentives to their employees. Commuter assistance includes employer-based transit benefits that allow employers to provide tax-free financial assistance toward employees' transit fares. Commuter choice also includes modified or flexible work schedules in which the typical five-day, 8-hour work week may be replaced, for example, by a four-day, 10-hour week. Other examples include bike and car sharing programs which we discuss later.

Growth in Electric and Other Alternative Energy Vehicles

Another major trend is to change fuels or type of vehicle to reduce the emissions. The aim is to reduce the amount of fuel consumed to travel the same distance and to reduce the air and water pollution and other effects of consuming the same quantity of fuel. Such changes in fuel use mainly affect the emissions of traditional pollutants and greenhouse gases and the dependence on oil, rather than land use, exercise, and other effects associated with less driving. Fuel *improvements* typically involve making changes to traditional fuels, for example by blending ethanol with gasoline to reduce the amount of carbon emitted when the fuel is burned. Alternatively, new types of fuels, such as biofuels and electricity, may be created that potentially pollute less and have lower GHG emissions than conventional fuels. However,

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[239] U.S. General Services Administration, *GSA-Sponsored Telework Centers*, 2010.

[240] Jack M. Nilles, *City of Los Angeles Telecommuting Project: Final Report*, Los Angeles, CA: JALA International, Inc., 1993, p. 19.

[241] Prashant N. Balepur, Krishna V. Varma, and Patricia L. Mokhtarian, "The Transportation Impacts of Center-Based Telecommuting: Interim Findings From the Neighborhood Telecenters Project," *Transportation*, Vol. 25, No. 3., 1998, p. 1.

the full environmental and sustainability costs of individual alternative fuels used would need to be assessed to ensure true environmental benefits, such as less pollution and GHG emissions. For example, corn ethanol production can potentially cause a range of environmental problems, including: soil erosion; large water use; water and soil pollution from the fertilizers and pesticides used to grow the corn; large uses of land, potentially resulting in habitat and biodiversity loss; increasing grain and food prices throughout the world; and even, potentially, increased carbon dioxide emissions from the energy inputs to grow the corn.[242]

Importantly, the development of improved fuels must be accompanied by significant infrastructure investments that make it possible to deliver fuels to consumers, e.g., at the gas pump, and consumers' vehicles must be able to make use of those fuels.

Implementation examples of this trend can be seen with the growing availability and popularity of hybrid electric vehicles (HEVs) and plug-in electric vehicles (PEVs). HEVs combine a traditional combustion engine with an electric propulsion system to improve fuel economy. Newer HEVs typically also take advantage of technologies such as regenerative braking—in which some of the vehicle's kinetic energy is converted back to electricity rather than being lost as heat—in order to further boost fuel economy. The newest model of the Toyota Prius has a combined city and highway fuel economy of 50 mpg,[243] while the newest Honda Civic Hybrid has a combined fuel economy of 41 mpg.[244]

PEVs are just emerging on the market and rely solely on electricity. The environmental effects of PEVs depend on their source of electricity, which is currently coal in much of the United States. However, if electricity can be produced renewably, then PEVs may offer significant environmental benefits.

More Transportation System Planning and Operations Improvements

Another key trend in reducing the effects of driving is to improve how the transportation system is planned, built, maintained, and operated. There are a number of methods by which the transportation system—roads, signals, materials—can be improved.

Very low speeds, rapid acceleration, and very high speeds (above 60 miles per hour) all generally reduce vehicles' fuel efficiency and lead to greater emissions. This can be mitigated

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[242] William Schulz, "The Cost of Biofuels," *Chemical & Engineering News*, December 17, 2007, and Gerrit Buntrock, "Food Prices: Cheap No More," *The Economist*, December 6, 2007.

[243] Toyota, *Prius 10*, specifications, 2010.

[244] Honda, *The 2011 Civic Hybrid*, 2010.

by approaches that make traffic smoother and enable vehicles to travel at speeds that result in less emissions.

Traffic Signal Optimization. Signal optimization, for example, involves careful timing of traffic signals along a traffic corridor so that traffic flows smoothly, with less stop-and-go at each intersection. Traffic signal optimization has been used for decades to combat congestion and save fuel. In 1983, for example, 41 California cities retimed 1,535 signals, and field studies found that fuel use was cut by 6 percent from these signals. They saved approximately 6.4 million gallons of fuel.[245] This equates to 56,898 metric tons of CO2. Given advancements in signal technology and traffic models in the last 25 years, this may be lower than the reductions that would possible in the same scenario today. Much more recently, as part of the Clinton Climate Initiative (2009), the City of Portland optimized traffic signal timing at 135 intersections on 16 streets in Portland. This optimization work has saved motorists over 1,750,000 gallons of gas each year.[246]

Speed Reduction and Enforcement. More efficient speeds may be achieved by reducing and enforcing lower speed limits on highways, for example to 45–55 mph. This also improves safety. Few regions have reduced speed limits, in part because there is a culture of driving faster. However, the National Research Council estimated that the former U.S. national 55 mph speed limit reduced national highway fuel consumption by about 2 percent, and that it also probably saved 2,000 to 4,000 lives per year, due to lower fatality rates in highway crashes.[247]

Green Materials. The transportation system can also be made more efficient by the way in which it is built and maintained. Many recycled pavement materials, for example, are both better for the environment and can cost less than traditional materials.[248] Fly ash, a by-product of the combustion of coals to generate electricity at coal-fired power plants, can be used to replace Portland cement in concrete. Portland cement is the binder material in traditional concrete that is associated with numerous environmental impacts ranging from mining the raw material to the large amount of energy required for extraction and

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[245] California Energy Commission, "Fuel-Efficient Traffic Signal Management: Results from the 1983 Program," 1984.

[246] C40 Cities, Climate Leadership Group, Clinton Climate Initiative, *Transport: Portland, United States of America*, 2009.

[247] D.L. Greene and A. Schafer, *Reducing Greenhouse Gas Emissions from U.S. Transportation*, Pew Center on Global Climate Change, Arlington, VA, May 2003.

[248] U.S. Environmental Protection Agency, *Using Coal Ash in Highway Construction: A Guide to Benefits and Impacts*, Report EPA-530-K-05-002, 2005.

manufacture of the raw product, to the emission of CO2 during actual cement production. Fly ash allows the use of locally available materials, reduces costs, increases energy efficiency, and produces a more durable mixture.[249] Such materials have been used by departments of transportation around the country.

Increasing Number of Diverse Shared and Personal Mobility Options

Another key trend is the growth in shared transport and personal mobility options. Shared transport in the broadest sense refers to any situation in which people share a vehicle. Ridesharing is an example of this: people share a car at the same time. Here, however, we focus on shared transport programs in which members do not privately own their cars or bicycles; instead they share the use of these vehicles over an extended time. Personal mobility refers to different ways that individuals can get around whether by car, bike, or other new vehicle alternative. Often personal mobility refers to new types of vehicles that are designed for efficiency, compactness, and travel in congested or urban environments, such as the Segway, as discussed later.

Such options offer a number of benefits, including reduced personal transportation costs, reduced emissions and other environmental impacts, reduced need for space for parking in urban areas, reduced congestion, and the sharing of transportation assets. Importantly, they are most feasible in high-density areas such cities and college, industrial, and other campuses.

Vehicle Sharing. Owning a car involves many "sunk costs"—the purchase price, registration fees, insurance, maintenance, etc.—that are fixed regardless of how much the owner drives the vehicle. For people who drive less, car sharing programs may offer an important, lower-cost alternative. In car sharing programs, members rent vehicles by the hour or day. This differs from conventional rental cars in several ways: it is marketed to residents and businesses in a city, rather than visitors; it provides hourly rates, while most rental car firms charge by the day or week; it positions vehicles throughout an area so that members can walk to them in their neighborhoods; and it emphasizes quick booking when a vehicle is needed. There are numerous examples of car sharing programs, such as Zipcar,[250] Connect by Hertz,[251] and U Car Share[252] by U-Haul.[253]

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[249] U.S. Environmental Protection Agency, *Using Coal Ash in Highway Construction: A Guide to Benefits and Impacts*, Report EPA-530-K-05-002, 2005.

[250] Zipcar, website, 2010.

[251] Hertz Car Rental, website, 2010.

[252] U Car Share, website, 2010.

[253] U-Haul, website, 2010.

Zipcar has been implemented in numerous cities and universities, and we use it to illustrate the impact of car sharing. Zipcar members pay an annual fee and thereafter pay for car usage on an hourly basis. This rental fee includes gas, insurance, maintenance fees, and some mileage. Zipcar claims that each Zipcar takes 15–20 vehicles off the road, while also costing less per mile than owning and maintaining a personal vehicle.[254]

Zipcar is currently located in over 50 U.S. cities in 24 states and D.C., and also in Canada and the UK. Zipcar also has partnerships with more than 100 universities across North America, where it reduces the number of on-campus cars while simultaneously giving members access to off-campus activities or jobs. It additionally offers students reduced membership rates. Some companies also use Zipcar for business travel or as an employee benefit to relieve congestion and parking problems. Zipcar also offers a "FastFleet," a spin-off program that replaces traditional fleets with car sharing fleets. This system is currently being used by the District of Columbia and has replaced the municipal fleet of 360 vehicles with only 58 vehicles. The D.C. mayor predicts savings of $6.6 million over 5 years.[255]

Car sharing's subtle effects may be as or more important than the obvious benefits of cost and reducing the number of privately owned vehicles. When choosing whether to drive or use transit or other means of travel, the immediate costs of the trip play a significant role in the decision. For example, travelers compare the cost of gas, tolls, and parking to the cost of bus or train fare. Because most of the costs of driving are fixed, driving appears cheaper than other transportation modes on a per-trip basis. In car sharing, these costs are variable and incurred largely per-trip, so drivers are more likely to consider the total costs and make fewer trips overall. For example, a study of four car sharing programs—two in Portland, one in San Francisco, and one in Arlington—found that the number of miles that car sharers traveled fell on average by 7 to 43 percent after joining the program. This accounts for both the increase in vehicle travel by those people who otherwise could not travel by car, as well as those people who gave up vehicle ownership, suggesting that the overall effect is positive.[256]

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[254] Zipcar, "Green Benefits," 2010.

[255] Nikita Stewart, "Zipcar to Manage System for Employee Vehicle Fleet," *The Washington Post*, April 28, 2009. As of November 1, 2010: http://www.washingtonpost.com/wp-dyn/content/article/2009/04/27/AR2009042703376.html?hpid=sec-metro

[256] Adam Millard-Ball, Gail Murray, Jessica Ter Schure, Christine Fox, and Jon Burkhardt, "Car-Sharing: Where and How It Succeeds," in *Transit Cooperative Research Program Report 108*, Washington, D.C.: Transportation Research Board, 2005.

Car sharing can also reduce fuel consumption and GHG emissions if the vehicles in the program have higher fuel economy than privately owned vehicles, or if members have the flexibility to choose the size of vehicle that meets their needs for each particular trip—meaning that large and less fuel efficient vehicles may be chosen only when needed. A recent study based on survey responses from over 6,200 car sharing members in North America found that car shared vehicles had higher fuel economies by up to 10 mpg than the vehicles that car sharers had previously owned (32.8 mpg versus 23.3 mpg).[257]

Other shared personal mobility options include bicycle sharing programs that follow a similar model: members pay an annual fee and then can rent bicycles on an hourly basis, picking them up and returning them to stations equipped with technology to secure and pay for the bikes. The SmartBike bicycle share program is one such example and exists in Paris, Barcelona, and Washington, D.C.[258] New York City is currently considering and evaluating bike share options.[259] Low-tech bicycle sharing programs are also possible. These systems use a simple coin-operated mechanism to unlock the bikes.[260]

Bicycle sharing can also be free. Nashville Bike Share in Nashville, Tennessee offers free bikes to all residents and students to improve health, reduce environmental impacts, and improve livability. Renters simply sign up online and provide proof of residence.[261] Free (or very low cost) bike sharing is particularly popular on college campuses where demand among students is high.[262]

There also are multi-modal shared vehicle concepts being considered so users have the flexibility to match vehicle type to each trip purpose. For example, researchers at MIT have been developing concepts and analytical approaches for how such a system might function in their work on mobility-on-demand systems:

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[257] Susan A. Shaheen, Adam P. Cohen, J. Darius Roberts, "Carsharing in North America: Market Growth, Current Developments, and Future Potential," *Transportation Research Record: Journal of the Transportation Research Board*, Issue 1986, 2006, p. 65.

[258] SmartBike, website, 2008.

[259] New York City Department of City Planning, "Bike Share opportunities in New York City 2009," 2010.

[260] The different generations of bike sharing programs are described at the City of Portland's Office of Transportation website.
Portland Bureau of Transportation, "Welcome to the City's Bicycle Sharing Page," 2010.

[261] Bike Share Nashville, website, 2009.

[262] Didi Tang, "Bike-Sharing Programs Spin Across U.S. Campuses," *USA Today*, September 22, 2010.

> Mobility-on-demand systems may use a single vehicle type. However, a more attractive option in larger and more sophisticated systems is to employ multiple vehicle types—providing users with choices among combinations of cost, comfort, and functionality. For example, a user might choose to ride a bicycle to the supermarket, leave it there, and bring back a car to carry the bags of groceries.[263]

Neighborhood Vehicles. Neighborhood vehicles are examples of personal mobility options and are designed for low-speed, short-distance travel. Neighborhood electric vehicles (NEVs) are plug-in vehicles designed for "neighborhood use," with a maximum speed of 20–25 mph, a gross vehicle weight of less than 3,000 pounds, and a typical range of 30 miles. NEVs are substantially more energy efficient than traditional vehicles because of their size, and therefore can reduce GHG emissions from the short-distance trips for which they are designed.[264] For example, it costs two cents to drive one mile in the Chrysler Peapod,[265] in comparison to twelve cents per mile for a 25 mpg vehicle and $3.00 per gallon of gas (fuel economy is not an appropriate measure for comparison, since the vehicle is electric).

Other personal mobility options include the Segway, a two-wheeled self balancing vehicle for individual riders.[266] Segways have had success primarily in police departments, corporate campuses, and industrial sites. Smart cars are on the higher-performance end of the efficient mobility spectrum. The Smart car is a "micro" version of traditional automobiles, typically seating two people, reaching a maximum speed of 90 mph, and with a fuel economy of 33 mpg in the city and 41 mpg on the highway.[267]

Universities are conducting research in technology development and deployment to develop even more diverse personal mobility options. The RoboScooter is a folding electric scooter developed by an MIT-led team of researchers and developers. They are simpler, cheaper, and greener than traditional scooters.[268] Similarly, GreenWheel is an electric-assist bicycle wheel that can be attached to any standard bicycle for easier and more comfortable

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[263] Smart Cities, *Mobility on Demand: Future of Transportation in Cities*, Cambridge, MA: MIT Media Laboratory, June 2008.

[264] An overview of NEVs can be found on the U.S. Department of Energy's website at http://www1.eere.energy.gov/vehiclesandfuels/avta/light_duty/nev/index.html .

[265] Mike Celizic, "Chrysler's Peapod: 2 Cents Per Mile Plus a Smile," *Today*, April 22, 2009.

[266] Segway, website, 2010.

[267] Smart USA, "Pure Coupe Technical Specs," 2010.

[268] Erik Sofge, "With Electric Scooter, MIT Hopes to Rev Up Practical Transport," *Popular Mechanics*, October 1, 2009.

riding.[269] The CityCar is a prototype electric vehicle that weighs less than 1,000 pounds and is expected to get the equivalent of 100 to 200 mpg. CityCar also folds to minimize the space needed to park.[270]

These advances suggest that the number of personal mobility vehicles will continue to grow and allow travelers to choose a vehicle that more precisely meets their needs—reducing fuel consumption, GHG emissions, congestion, and other externalities in the process.

Interrelationships with Other Trends

While the lack of sustainable transportation is a growing concern, its importance may be accelerated by general concerns about sustainable development and sustainable communities, which are all intimately related. For example, the trend toward communities that facilitate healthy living and exercise is challenged by the role that vehicular travel traditionally plays in providing mobility. Compact land use may provide a way of facilitating both sustainable mobility and healthy communities.

The need for sustainable transportation may also accelerate as concerns about biodiversity loss, encroachment, air pollution, water scarcity, and GHG emissions grow. For example, some states have already implemented policies recommending or requiring that transportation agencies address climate change. As concerns over climate change grow, it is expected that new federal legislation may require state departments of transportation and metropolitan planning organizations to address climate change by assessing emissions, setting targets for reductions, and developing ways to mitigate emissions and meet those targets.[271] Federal, state, and DoD requirements to reduce energy use in vehicles are likely to increase because of such environmental concerns and because of energy security concerns regarding the importation of overseas oil.

Information technology trends, such as pervasive computing and online community trends, may have a complex role in sustainable transportation. On one hand, information

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[269] Domenick Yoney, "MIT GreenWheel: Simply an Electric Bicycle Revolution," *Autobloggreen*, February 19, 2009.

[270] William J. Mitchell, Christopher E. Borroni-Bird, and Lawrence D. Burns, *Reinventing the Automobile: Personal Urban Mobility for the 21st Century*, Cambridge, MA: MIT Press, 2009.

[271] Michael Grant et al., *Assessing Mechanisms for Integrating Transportation-Related Greenhouse Gas Reduction Objectives into Transportation Decision Making*, Transportation Research Board, National Cooperative Highway Research Program, Web-Only Document 152, January 2010, provides a summary of recent policy efforts to require transportation decision making to include climate change considerations.

technologies may reduce the demand for transportation by making virtual meetings and telework more effective substitutes for in-person communication. Such advances in telework can decrease transportation needs, but may also promote more sprawling communities because people no longer need to drive into the office for meetings and can live out in the countryside more, which in turn could cause more declines in biodiversity.

Pervasive computing may also be used for vehicle-to-infrastructure or vehicle-to-vehicle communication and coordination, for example to improve transportation flow by dynamically setting speed limits and to enable better vehicle routing through the system. Such advances in general may make the transportation system more efficient and could promote sustainable transportation. On the other hand, the ability to be constantly connected to the Internet and to others while traveling, e.g., with wireless Internet on airplanes, may make it easier to continue working while traveling. This reduces the cost of travel in terms of lost work hours or lost productivity, and therefore may make travel *more* appealing and increase demand.

Implications of Sustainable Transportation Trends for Army Installations

Next we discuss the implications of these transportation trends for Army installations. However, to help set the context we first provide some background information about transportation issues at installations today and how some are starting to implement sustainable transportation activities.

Army Context with Respect to Transportation Issues

As was discussed earlier in the section on urbanization and sprawling communities, many Army installations have seen the growth of communities around them already, and this trend is likely to continue. With this growth has also come the growth of traffic and traffic congestion at an increasing number of installations. In fact, today many Army installations, especially those that are growing or near urban areas, face transportation-related pressures of traffic congestion and/or air quality concerns. Installations that have or will see significant operational and population growths from 2005 BRAC changes, such as Fort Belvoir and Fort Bliss, contribute to growing transportation concerns and problems. At many installations, the traffic concerns have to do with getting on and off the installation. Because of security concerns, limited entry points and access gates limiting access to installations, security policies at such entrance gates, standard work hours for installation Soldiers and civilian employees, and the fact that more and more Soldiers live off post, many installations experience rush hour traffic congestion at installation entry and exit points.

Policy and regulatory pressures from air quality, energy, GHG emissions, and other environmental concerns from transportation can also affect installation operations. For example, JBLM is within a nonattainment area for air quality under the Clean Air Act Amendments and the air quality restrictions limit this post's ability to operate new smoke generators. Such pressures are likely to increase in the future and affect more Army installation operations. It is more cost-effective, especially when transportation infrastructure is involved, to strategically plan and address such issues now rather than later. In addition, federal and Army policies and requirements to reduce energy use in transportation and increase renewable energy use are likely to occur in the future because of GHG and energy security concerns.

Land use concerns and constraints at Army installations are increasing. Installation land is a finite resource with many competing interests that need to be strategically managed. Compact land use and TND concepts enable more efficient use of land. Growth management and transportation planning are key parts of land management. Some Army installations already recognize the need to implement such concepts and are starting to try to do so. For example, Fort Belvoir has been implementing new urbanism principles with pedestrian-friendly mixed-use development in new housing projects. They have a main street with small shops that are walking distance from many homes, and above the shops are about two dozen two-story apartments.[272]

Installations also recognize the need to try to reduce personal vehicle travel, such as installing more bike lanes, facilitating commuter vanpools, providing post buses, and facilitating more use of public transit. We provide several installation examples. Aberdeen Proving Ground (APG) staff, given their anticipated employee growth from BRAC and growing transportation concerns, is working with Maryland state, county, and transit authorities to enable commuter train access to APG. Fort Bragg incorporates both pedestrian and bicycle facility elements into all new construction projects as part of its sustainability program because they are in the installation design guide requirements.[273] Some installations, such as Fort Bragg and JBLM, have post bus systems, though ridership is sometimes low, especially when the hours of operation and frequency of the buses are not

[272] For more information, see Natural Resources Defense Council, "Smart Growth in Uniform: Fort Belvoir's Example," *Natural Resources Defense Council Switchboard Staff Blog*, July 15, 2008, at http://switchboard.nrdc.org/blogs/kbenfield/smart_growth_in_uniform.html.

[273] Lachman, et al., 2010, pp. 26–27.

convenient enough.[274] To deal with such low ridership on bus routes, some installations, such as Fort Bragg and Fort Carson, have conducted studies about the reasons why and have changed the bus routes to improve ridership. At White Sands Missile Range, over 70 vanpools help commuters share the ride to work each day.[275] At Fort Bliss in 2009, an Energy Security Tiger Team recognized growing transportation and congestion concerns and recommended incentives and activities to reduce single occupancy vehicle trips on the installation.[276] One of the most successful Army examples of reducing SOV travel and using mass transit occurred at USAG Presidio Monterey, California, which partnered with Monterey-Salinas Transit (MST) in 2009 to implement a Presidio Express bus line for commuters. By spring 2011, an estimated 600 cars were taken off of the road and there had been a reduction in 3 million privately owned vehicle miles of travel.[277] Because of such results, this effort won an Exemplary Practice award in 2011 as part of the Army Communities Excellence Awards.

Starting in late 2011, some installations, such as Forts Bragg, Carson, and Shafter, have begun car sharing programs through their Army and Air Force Exchange Service (AAFES) contract affiliate Enterprise Rental Car's WeCar program.[278] This Zipcar type of service is designed to provide convenient low-cost cars to Soldiers, Families, and other people on post and also provide revenue back to Soldier and Family programs.

Some installations, especially those already dealing with traffic concerns, are also implementing transportation system planning and operations improvements. Such installations have implemented changes in security gate policies, road infrastructure, and number of security entryways, among other things, to help facilitate more efficient movement of traffic. For example, Fort Bliss recognizes the need to implement more traffic

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[274] Some Soldiers, spouses, and service providers brought such post bus concerns up in the RAND study looking at Soldier and Family problems and installation support needs from frequent deployments. The Soldiers and Families wanted to use post buses but did not find them convenient enough. For more information on this study, see Appendix B.

[275] For more information, see http://www.militaryvanpool.com/White_Sands_Missle_Range.html

[276] U.S. Army, Office of the Deputy Assistant Secretary for Energy and Partnerships, *Energy Security Tiger Team Assessment—Fort Bliss, Final Report*, Washington, D.C., April 14, 2009, p. 19.

[277] The Army Chief of Staff, "Army Communities Excellence Awards 2011," U.S. Army, 2011.

[278] For more information, see http://www.enterpriseholdings.com/press-room/army-and-air-force-exchange-service-enterprise-rent-a-car-bring-car-sharing-to-us-military-bases.html.

optimization measures and "new access control points to keep traffic moving efficiently and alleviate congestion."[279] In addition, some installations are implementing more green practices in building roads, most notably, reusing concrete demolition waste in gravel roads to garner waste disposal cost savings. For example, Fort Campbell successfully grinds concrete from demolished structures into gravel for reuse in road and other projects. Grinding concrete results in a significant increase in waste diversion from demolition projects. This process cost $5.86 per ton of concrete and saved $30 per ton. As of September 2007 it resulted in an annual cost avoidance of $600,000.[280]

Electric vehicles already have a role at Army installations. The National Defense Authorization Act of 2010 and Executive Order 13514 build on prior federal requirements to reduce non-combat-vehicle petroleum through the procurement and use of renewable fuels and alternative fuel and flex-fuel vehicles and electric or hybrid vehicles. The Army currently has 40,000 alternative fuel vehicles, but a lack of fueling stations has limited their impact.

In 2009, the Army committed to leasing 4,000 neighborhood electric vehicles over three years, which promises to offer a number of benefits. The cost for all the charging infrastructure necessary for the vehicles was estimated at $800,000 or $200/vehicle[281] based on one to two vehicles garaged at the same location using 110V outlets for an overnight charge. The total cost savings over six years was projected at $45.8 million[282] and with resulting energy savings of $740 per car per year. It was estimated that this would also reduce oil consumption by 11.5 million gallons and eliminate 115,000 tons of CO2 over 6 years.[283] However, the U.S. Department of Energy (DOE) changed the cost estimates, and future charging station infrastructure costs will be significantly higher based on charging station level, location, wiring requirements, electric grid capability, and desired charge duration per

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[279] U.S. Army, Office of the Deputy Assistant Secretary for Energy and Partnerships, *Energy Security Tiger Team Assessment—Fort Bliss, Final Report*, Washington, D.C., April 14, 2009, p. 19.

[280] Fort Campbell, "Army Installation Success Stories: Demolition Concrete Waste Diversion," fact sheet, undated.

[281] U.S. Department of Energy, Federal Management Program, *U.S. Army Charges Ahead in Using Electric Vehicles*, 2009.

[282] Jeremy Hsu, "Who Killed the Electric Car? Not the Army," *Popular Science*, January 15, 2009.

[283] Paul Boyce, "Army Announces Historic Electric Vehicle Lease," United States Army Press Release, January 12, 2009.

number of vehicles.[284] Unfortunately, in 2012 because of increased cost considerations and budget constraints, such neighborhood electric vehicles are no longer affordable at most Army installations.

Recommendations

Given this Army context and the trends just discussed, we have some sustainable transportation recommendations in each of the four relevant trend areas.

First, installations should do more strategic transportation and land use growth planning and management that involves compact land use and efforts to decrease SOV travel. Specifically, ACSIM/IMCOM should encourage installations in master and transportation planning to engage in more compact land use and TND practices, and promote policies that encourage decreased personal vehicle travel. In 2012, both OSD and Army master planning policies have started to emphasize such items more.[285] Such policies can include more incentives for biking, using buses, and other transit. Large installations should have free or low cost and convenient post buses to encourage some Soldiers and Family members to forgo personal vehicle travel to commute to work or to run errands during the day. Convenient locations, frequencies, and hours of operation are needed to ensure use. More efforts should be made to partner with local governments and communities on providing transit, like the USAG Presidio of Monterey did. In fact, this experience should be analyzed and written up as an in-depth case study to help other installations learn from this USAG's success. Designing bike lanes and bike racks for bike parking in key cantonment areas is another important activity.

Installations that face significant population growth because of BRAC and other Army installation population changes especially need to ensure that strategic planning of land use and transportation infrastructure, such as compact land use, is conducted sooner rather than later, because once the infrastructure—namely, the roads and buildings—,is in place, it cannot easily be changed. It will be much more costly to do such things later or the opportunity may be lost altogether.

Second, ACSIM/IMCOM should encourage installations in their transportation planning to do more transportation system planning and operations improvements to ensure efficient

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[284] For more details, see DOE cost estimates briefed at the 2012 FEDFLEET conference, June 25–28, 2012, in Louisville, Kentucky.

[285] See U.S. Department of Defense, *United Facilities Criteria (UFC): Installation Master Planning*, UFC 2-100-01, May 15, 2012; and draft of Army Regulation 420-1, "Army Facilities Management," August 2012.

flow and management of traffic and other transportation infrastructure. Such planning is especially needed regarding issues with on- and off-post traffic access points.

Third, IMCOM should help implement more car sharing pilots (like what was started in 2011 at Fort Bragg and Fort Carson) by encouraging car sharing implementation experiments at other large posts with population growth and transportation problems, like Fort Bliss. Such car sharing pilots should be at a low cost or even free and need to be available at convenient locations to benefit Soldiers and their Families. Lessons learned from the initial pilots at places like Fort Bragg and Fort Carson should be used to improve other installations' implementation of such car sharing programs. University campus programs can also be models for such implementation. IMCOM should also explore doing a free or fee-based shared bicycle system or even a multi-model system installation pilot that involves bicycles and cars. Such personal mobility options are an opportunity for Army installations to provide alternative transportation options that could help with quality of life issues, post congestion and parking issues, air quality concerns, GHG emissions, and other environmental concerns. Potential quality of life benefits include total transportation cost savings to Soldiers, reduced commute times, and better mobility. Single and younger Soldiers are likely to experience significant benefits given the high cost of automobile ownership. In addition, many Soldiers often sell personal vehicles before deploying or moving to a new post and may go days or weeks without vehicle access. This transportation issue has been mentioned as a problem by Soldiers and Families at installation Army Family Action Plan conferences. A car sharing program at low or no cost would be very useful for such Soldiers.

Fourth, the Army should do several things to ensure the effective and efficient use of electric vehicles. The Army should compare costs and benefits of electric, hybrid, plug-in hybrid, and alternative fuel vehicles for different uses, and plan for electric charging infrastructure, including appropriate locations, metering, and voltage. As more and more electric vehicle options are developed in the future, this charging infrastructure will become more and more important.

Lastly, the Army should consider the costs and benefits of bundling renewable power and distributed generation with charging infrastructure. Obviously, the benefits will vary by installation given the availability of renewable resources. For example, solar power provides more opportunity at places like Fort Irwin, Fort Carson, and Fort Bliss, which have strong solar resources, than installations in the Northeast.

To summarize, such strategic installation transportation planning and investments now can help save costs; save valuable installation land space; improve installation quality of life; reduce traffic congestion, reduce air pollution and other environmental problems; help

preserve installation operational flexibility from air quality and other regulations; and help meet future federal, OSD and Army energy requirements.

Sources for Tracking Sustainable Transportation Trends

A number of studies and reports track trends in sustainable transportation. The Texas Transportation Institute publishes an *Annual Urban Mobility Report* that tracks traffic patterns and changes in congestion and mobility in the Unites States.[286] The American Association of State Highway and Transportation Officials published a report, *Transportation Invest in Our Future: Future Needs of the U.S. Surface Transportation System.* This report assesses transportation needs today and in the future, and presents the demographic and economic changes that will shape that future.[287] *Mobility on Demand: Future of Transportation in Cities* explores the future of personal mobility options, including car and bike sharing, with new vehicles and new models of use.[288] The Intergovernmental Panel on Climate Change (IPCC) published a report on mitigating climate change which includes a chapter on the GHG emissions from the transportation sector globally, as well as strategies for mitigating those effects.[289] These are only a few of the many recent studies. Given the pace of research in this area, it is particularly important to ensure that new research is included in future assessments of transportation sustainability trends.

Numerous organizations and institutions also conduct transportation research or track trends. The U.S. Department of Transportation provides a wide range of information on transportation trends and houses the Federal Highway Administration, the Bureau of Transportation Statistics, and a number of other relevant divisions.[290] The Transportation Research Board is one of the six major divisions of the National Research Council and

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[286] Texas Transportation Institute, *Urban Mobility Information*, 2009.

[287] American Association of State Highway and Transportation Officials, *Transportation Invest in Our Future: Future Needs of the U.S. Surface Transportation System*, Washington, D.C., 2007.

[288] Smart Cities, *Mobility on Demand: Future of Transportation in Cities*, Cambridge, MA: MIT Media Laboratory, 2008.

[289] Suzana Kahn Ribeiro, Shigeki Kobayashi, Michel Beuthe, Jorge Gasca, David Greene, David S. Lee, Yasunori Muromachi, Peter J. Newton, Steven Plotkin, Daniel Sperling, Ron Wit, and Peter J. Zhou, "Transport and Its Infrastructure," in B, Metz, O.R. Davidson, P.R. Bosch, R. David, and L.A. Meyer (eds.), *Climate Change 2007: Mitigation*. Contribution of Working Group III to the Fourth. Assessment Report of the Intergovernmental Panel on Climate Change, New York: Cambridge University Press, 2007.

[290] U.S. Department of Transportation, website, 2010.

finances research, holds annual meetings of the transportation research community, and provides a variety of resources related to transportation trends.[291]

There are a number of university or university-affiliated transportation research institutes. The Texas Transportation Institute, affiliated with Texas A&M University, conducts research in all areas of transportation. TTI publishes the *Annual Urban Mobility Report* discussed earlier. The Institute of Transportation Studies[292] at the University of California Berkeley also conducts research on all aspects of transportation and houses a number of specific research centers such as the Transportation Sustainability Research Center[293] and the UC Berkeley Center for Future Urban Transport.[294] The University of Michigan Transportation Research Institute also conducts transportation research and largely focuses on issues of safety and efficiency.[295] MIT conducts research to develop and analyze new transportation technologies and transportation concepts.[296]

Sustainable Agriculture

In this section we discuss some of the key sustainable agriculture trends and their implications for Army installations. Some readers may wonder why we even examined agriculture trends. However, there are some interesting developments from sustainable agriculture trends that have the potential to help improve Soldier and Family health at very little cost and may even help improve some encroachment and community relationship issues with local farmers and ranchers. Also, given the rise in U.S. obesity trends (which are discussed later in this section), some U.S. Army installations and MEDCOM have already started to look at some agricultural issues because of weight, nutrition, and health concerns. Because of all these reasons we present sustainable agriculture trends.

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[291] Transportation Research Board of the National Academies, website, 2010.

[292] Institute of Transportation Studies, Berkeley, website, 2010.

[293] University of California, Berkeley, "Transportation Sustainability Research Center," 2010.

[294] Institute of Transportation Studies, Berkeley, "UC Berkeley Center for Future Urban Transport," 2009.

[295] University of Michigan, "Transportation Research Institute," 2010.

[296] MIT, "Intelligent Transportation Research Center," website.

Background: Definition of Sustainable Agriculture

Sustainable agriculture is an emerging U.S. and international trend. The Food, Agriculture, Conservation, and Trade Act of 1990 (U.S. Public Law 101-624) defines sustainable agriculture as:

> An integrated system of plant and animal production practices that enhances environmental quality and the natural resource base upon which the agricultural economy depends; makes the most efficient use of nonrenewable resources and on-farm resources; integrates, where appropriate, natural biological cycles and controls; sustains the economic viability of farm operations; and enhances the quality of life for farmers and society as a whole.[297]

Sustainable agriculture also integrates three main goals—environmental health, economic profitability, and social and economic equity[298]—and it includes the concept of minimizing the distance that food must be transported to the consumer.[299]

Sustainable agriculture offers many benefits. In particular, the food can be healthier because fewer pesticides and fertilizers are used, no hormones are used to raise the animals, and, since the food is grown locally, it can be delivered to the consumer fresher. Sustainable agriculture can also help to protect and preserve the environment by helping to conserve topsoil, improve water quality, protect native biodiversity, and reduce waste. Lastly, sustainable agriculture can potentially help improve quality of life because it provides consumers wider access to healthier produce, and can help facilitate the economic viability of family farms.

Organic food is often a central part of sustainable agriculture as well. The USDA's National Organic Program regulates organic agricultural products in the United States.[300] Organic production is a system that is managed in accordance with the Organic Foods Production Act (OFPA) of 1990 and regulations in Title 7, Part 205 of the Code of Federal

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[297] See U.S. Public Law 101-624, Title XVI, Subtitle A, Section 1603.

[298] Patricia Allen, Debra Van Dusen, Jackelyn Lundy, and Stephen Gliessman, "Integrating Social, Environmental, and Economic Issues in Sustainable Agriculture," *American Journal of Alternative Agriculture*, Vol. 6, 1991, pp. 34–39.

[299] About 80 percent of energy used in the U.S. food system goes to processing, packaging, transporting, storing, and preparing food. On average, produce in the United States travels 1,300–2,000 miles from farm to consumer. See National Sustainable Agriculture Information Service, "Reducing Food Miles," April 26, 2012.

[300] See U.S. Department of Agriculture, "National Organic Program," website.

Regulations.[301] To be sold or labeled as an organically produced product, an agricultural product must:[302]

1. Have been produced and handled without the use of synthetic chemicals.
2. Not be produced on land to which any prohibited substances, including synthetic chemicals, have been applied during the previous three years preceding the harvest of the agricultural product.
3. Be produced and handled in compliance with an organic plan agreed to by the producer and handler of such product and the certifying agent.

Prior to the establishment of this legal definition in 1990, there was much confusion and controversy over what could or could not be considered "organic."

Key Sustainable Agriculture Trends

Like many of the other trends we have discussed, sustainable agriculture is an emerging trend both internationally and domestically in the United States.

Global Trends in Sustainable Agriculture

Sustainable agriculture is a key component in the global trend toward sustainable development. There has also been a global rise in organic farming, an 118 percent increase since 2000.[303] In 2007, farmers in about 140 different countries managed 32.2 million hectares of agricultural land organically, which is 5 percent more land area than in the previous year.[304] Consumer demand led to $46 billion of global sales of organic food and drink products in 2007.[305] The European Union (EU) accounts for 54 percent of this revenue,[306] and the United States accounts for 43 percent of the global revenue stream.[307]

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[301] See Organic Foods Production Act of 1990 [As amended through Public Law 109-97, November 10, 2005].

[302] See Organic Foods Production Act of 1990, Section 2105 [7 U.S.C. 6504].

[303] Alice McKeown, "Organic Agriculture More than Doubled Since 2000," *Vital Signs*, Washington, D.C.: Worldwatch Institute, 2010.

[304] McKeown, 2010.

[305] Organic Monitor, "Organic Monitor Gives 2009 Predictions."

[306] Amarjit Sahota, "The Global Market for Organic Food and Drink," in Helga Willer and Lukas Kilcher (eds.), *The World of Organic Agriculture Statistics and Emerging Trends 2009,* Bonn: Research Institute of Organic Agriculture (FiBL), International Federation of Organic Agriculture Movements (IFOAM), and International Trade Centre (ITC), 2009, pp. 59–60; Susanne Padel, Diana Schaack, and Helga Willer, "Development of the Organic Market in Europe," in Willer and Kilcher (eds.), p. 156.

In addition, there has been a growing international movement toward sustainable agriculture labeling. The Social Accountability in Sustainable Agriculture (SASA) project as a major effort designed to improve social auditing processes in agriculture. It was a collaborative effort between Sustainable Agriculture Network (SAN), Social Accountability International (SAI), Fair Trade Labelling Organizations (FLO), and International Federation of Organic Agriculture Movements (IFOAM).

U.S. Sustainable Agriculture Trends

In addition to the sustainable agriculture trends noted above, we identified three other current trends in the United States: community supported agriculture (CSA) has been increasing; restaurants are increasingly buying locally grown food and supporting community and sustainable agriculture; and local and community gardens are a growing trend. We discuss each below.

Support for CSA has also been increasing in the United States. CSA farms provide a weekly delivery of sustainably grown produce to consumers who pay a subscription fee. Some CSA farms also expect members to work on the farm at least once during the season. CSAs ensure that fresh and diverse local produce is accessible, and the trend also helps to save small, family farms. In 2007, 12,549 U.S. farms marketed their products through CSAs.[308]

Another trend in the United States is that some restaurants are buying locally grown food and supporting community and sustainable agriculture. Some restaurants are marketing the fact that they use only sustainable agricultural products or only what is in season and available locally.

Community gardening is also a current U.S. trend. This was spurred by concerns about costs and nutrition and has received attention as more people want to buy fresh and therefore buy local.[309] Michelle Obama's vegetable garden at the White House has also increased the visibility of community gardens. In addition, other potential benefits of community gardens are: helping improve the quality of life for people in the community; providing a catalyst for neighborhood and community development; beautifying

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[307] Organic Trade Association (OTA), *2009 Organic Industry Survey*, Executive Summary, Greenfield, MA: May 2009, p. 2; Helga Willer, "Organic Agriculture Worldwide," FiBL, March 10, 2009.

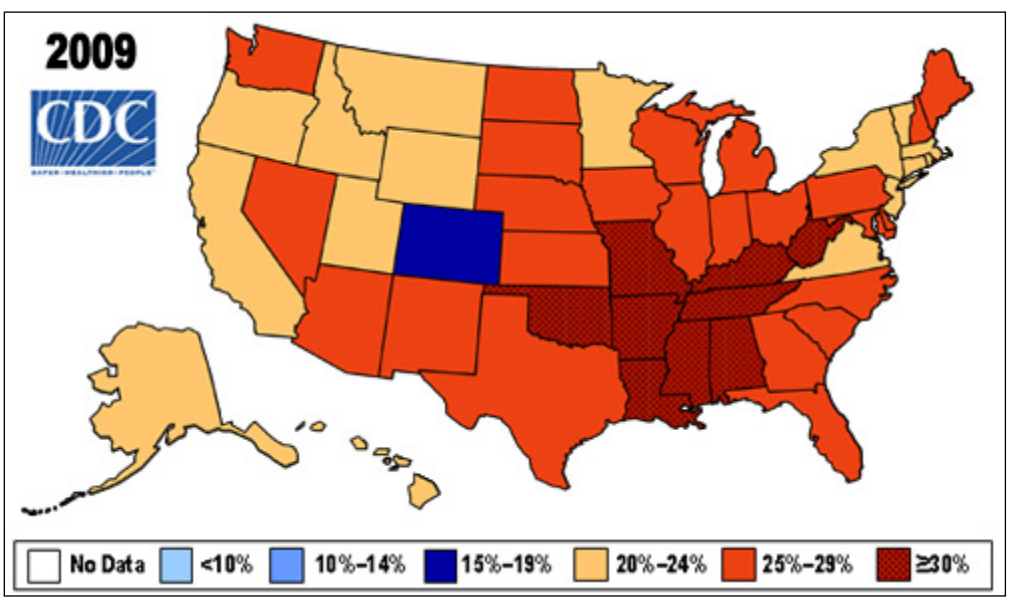
[308] U.S. Department of Agriculture, National Agricultural Statistics Bureau, *USDA Census of Agriculture-State Data*, 2007.

[309] Mary Reid Barrow, "Community Gardens a Growing Trend," *The Virginian-Pilot*, July 12, 2009; Monte Whaley, "Community Gardens a Hot Trend in Recession," *Denver Post*, May 4, 2009.

neighborhoods; reducing family food budgets; conserving resources; creating opportunity for recreation, exercise, therapy, and education; preserving green space; and reducing city heat from streets and parking lots.[310]

Many of these sustainable agriculture trends have arisen in response to the growing obesity problem among children and adolescents in the United States. Results from the 2007–2008 National Health and Nutrition Examination Survey, using measured heights and weights, indicated that an estimated 16.9 percent of children and adolescents aged 2–19 years are obese.[311] Currently, 66 percent of U.S. adults (ages 20 years or older) are overweight or obese; 16 percent of children (ages 6–11) and adolescents (ages 12–19) are overweight, and 34 percent are at risk of overweight. Obesity is also a problem for adults (see Figure 3.3). By 2015, 75 percent of U.S. adults ages 20 years or older will be overweight or obese, and 41 percent will be obese.[312]

Figure 3.3
Percent of Obese (BMI ≥ 30) in U.S. Adults



SOURCE: Centers for Disease Control and Prevention, "Behavioral Risk Factor Surveillance System, 2009."

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[310] American Community Gardens Association, "What Is a Community Garden," website.

[311] Cynthia Ogden and Margaret Carroll, "Prevalence of Obesity Among Children and Adolescents: United States, Trends 1963–1965 Through 2007–2008," June 2010.

[312] Youfa Wang and May A. Beydoun, "The Obesity Epidemic in the United States—Gender, Age, Socioeconomic, Racial/Ethnic, and Geographic Characteristics: A Systematic Review and Meta-Regression Analysis," *Epidemiological Reviews*, May 17, 2007.

Emerging Future Sustainable Agriculture Trends

In addition to the current trends discussed above, there are four emerging future sustainable agriculture trends: urban agriculture, vertical farming, sustainable food systems, and food security.

Urban agriculture entails producing food in the urban environment. Namely, food is grown in urban places, such as vacant lots, patios, and rooftops. In 2000, the city of Chicago installed a rooftop garden on top of City Hall.[313] Advocates of urban agriculture argue that it reduces energy costs and pollution from transport and storage, reduces packaging and spoilage, offers a viable use for urban waste (such as wastewater for irrigation), creates economic development, and improves availability of food in poor communities. For example, rooftop gardens, once reserved for flower gardening only, have started focusing on agricultural production and may do so more in the future.[314]

Another emerging trend is vertical farming, which is the visionary idea of growing food in skyscrapers.[315] Advocates for vertical gardening argue that it is a better way to farm because it is a closed loop system, crops are protected from weather and bugs, and food is not transported great distances.

A third emerging trend is a movement toward sustainable food systems. Such systems take into consideration the entire life cycle of producing, preparing, serving, consuming, and disposing of food. Sustainable packaging issues and composting are key components of any sustainable food system. Some restaurants, including Otarian in New York City and London, are taking sustainability into account in every aspect of the food cycle, including restaurant design and waste disposal.[316]

Lastly, since 9/11 there is more concern over protecting the food supply, sometimes referred to as food security. Unlike large agrobusiness farming that often produces monoculture crops, sustainable agriculture helps maintain genetic diversity because it calls

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[313] See City of Chicago, "City Hall's Rooftop Garden," no date.

[314] Unlike green roofs, rooftop gardens are specifically engineered to conform to heavier load requirements (e.g., more soil and people walking around on them). See American Planning Association, *Planning and Urban Design Standards*, Hoboken, NJ: John Wiley & Sons, 2006, p. 106.

[315] Dickson D. Despommier, "A Farm on Every Floor," *New York Times*, August 23, 2009.

[316] See Otarian's website at http://www.otarian.com/love-the-planet/environmental.html.

for integrated pest management, crops to be rotated, and for fields to lay fallow.[317] Methods used to increase crop yield (including planting crops closely, soil tilling, and planting the same crop year after year in the same field) can deplete the soil nutrients available for uptake and therefore lower crop nutritional quality. Conventional farmers typically use seeds bred for high yield, pest resistance, and other qualities rather than for nutritional value.[318]

Due to the fact that it is isolated, Hawaii is particularly concerned about food security issues.[319] For instance, Hawaii only has one milk processor; the stakes are high if it would need to shut down for some reason. Given its vulnerability to invasive species that may be transported onto the islands aboard boats and planes, Hawaii heavily monitors cargo for invasive species that may devastate native food sources.

What Could Change the Course of Sustainable Agriculture Trends

The biggest factor that could change the course of sustainable agriculture trends are consumer preferences and buying habits. If consumers demand more products that are grown in a sustainable manner, producers will respond to that market demand.

Environmental trends like loss of biodiversity, water scarcity, and loss of agricultural land and open space from sprawl pressures could also cause communities to become more concerned about sustainability and implement more sustainable agriculture activities.

Interrelationships with Other Trend Areas

Sustainable agriculture trends intersect with other trends that we discuss in this report including loss of biodiversity, water scarcity, energy, and transportation. Sustainable agriculture can help prevent the loss of biodiversity, improve water quality and quantity, and decrease the amount of energy required to transport agricultural products. This could also decrease pollution. Transportation miles would decrease as well. Societal trends related to nutrition and obesity problems also relate to sustainable agriculture. Namely, some of the sustainable agriculture activities, like community gardening, have the potential to help provide healthier food and help some people avoid or fix their obesity problems.

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[317] Jean M. Rawson, *Sustainable Agriculture*, Congressional Research Service Report No. 95-1062, 1995.

[318] American Public Health Association, "Policy Statement No. 200712: Toward a Health, Sustainable Food System," November 6, 2007.

[319] See Governor of Hawaii, "Protecting Our Food Security," fact sheet.

Implications of Sustainable Agriculture Trends for Army Installations

Installation sustainability efforts are starting to consider and even implement sustainable agriculture and food production activities. For instance, Joint Base Lewis-McChord has started providing community garden plots on post. In fact, Soldiers of the 23rd Chemical Battalion, 555th Engineer Brigade, are growing and eating vegetables and fruits in a small "Victory Garden" near their headquarters building. 23rd Chemical Battalion commander Lieutenant Colonel Sean Kirschner said about the garden, "I think it's the right thing to do for the environment, for health, for nutrition."[320] In addition, Fort Hood, Fort Carson, JBLM, and other installations are implementing composting projects and programs to compost organic wastes. Again JBLM is a leader, with a 21,600 square foot facility that composts food and yard waste. In fact it produces about 5,000 yards of compost per year.[321] Concerns about the food life cycle were also identified at the Sustainability IPR held at Fort Bragg January 12–14, 2010. MEDCOM staff have also considered Army-wide options for having on-post farmers' markets because of the potential health benefits.

Sustainable agriculture is also an opportunity to help improve Soldier and Family health, given U.S. obesity trends. During the past 20 years there has been a dramatic increase in obesity in the United States.[322] In 2009, only Colorado and the District of Columbia had a prevalence of obesity less than 20 percent (see Figure 3.3). This increase in obesity rates is impacting military recruits as well as Army Soldiers and Families and will become more significant in the future.[323] As Major General Thomas Bostick of the Army Recruiting Command stated, obesity will be "a bigger [recruiting] challenge for us in the years ahead" than other problems that restrict young people from entering the Army, including lack of high school diplomas, misconduct, criminal behavior, and other health problems.[324] To address such problems, more and more parts of the Army are looking at improving nutrition and fitness for Soldiers and Families. For example, the Army had a registered dietitian review

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[320] Marisa Petrich, "Soldiers Leave Legacy of Sustainability," *Northwest Guardian*, August 18, 2011.

[321] Diane Mettler, "Making Compost Military Style," *WHEN, Waste Handling Equipment News*, September 2011.

[322] Centers for Disease Control and Prevention, "U.S. Obesity Trends," no date.

[323] For detailed data on overweight and obese 18 year old applicants over time, see Lucy L. Hsu et al., "Trends in Overweight and Obesity Among 18-Year-Old Applicants to the United States Military, 1993–2006," *Journal of Adolescent Health*, Vol. 41, Issue 6, December 2007.

[324] Susan M. Schafer, "Top Army Recruiter Weighs Fat Camp for Recruits," *Army Times*, January 12, 2009.

the Army food system at a basic training post, Fort Leonard Wood, and she was "appalled by what the Army was serving young soldiers." The Army has since redesigned its food system for training posts. Now there "are still eggs, bacon and gravy, but all of the deep-fried stuff is gone, replace by whole grains, low-fat yogurt and sliced fruit. It's a complete dietary reversal."[325] Sustainable agriculture activities could potentially help play a role in such nutrition programs by providing more local fruits and vegetables at installations.

Some individual installations are also starting nutrition programs. For example, at Fort Hood, the Resiliency Campus (which operates to ensure wellness for its Soldiers, Families, and Retirees) includes a facility that teaches Soldiers and their Families about nutrition and provides nutritious cooking classes.[326] Some installations are also exploring buying more local produce because of nutritional benefits and to help local farmers.

Lastly, sustainable agriculture helps support local farms and ranchers surrounding installations and can also help address sprawl and encroachment concerns. By supporting local farmers and ranchers, they are less likely to sell their land to developers, helping keep open space near installations. It also helps improve community relationships.

Recommendations

There are a number of steps that installations could take related to community agriculture. First, ACSIM/IMCOM should help installations participate in community supported agriculture (CSA) and purchase more produce from local growers. This could be done by encouraging the food services on installations to explore CSA opportunities and to purchase more produce and other food produces from local farmers and ranchers. These food services include the commissary, on-post restaurants, and food vendors. ACSIM/IMCOM would need to work with other organizations to begin such a process, such as the Defense Commissary Agency (DeCA) regarding commissaries and the Army and Air Force Exchange Service regarding their fast food restaurants and other stores that they manage onpost that provide food. A good way to start such a process is to have a few installations do demonstration projects in CSA or buying local produce and have them work with their local DeCA and AAFES staff. Another option is to have some of the local day care centers on posts begin to purchase local produce or participate in CSA. If day care centers participate in

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[325] Frank Morris, "Army Boot Camp Embraces New-Age Fitness," National Public Radio from KCUR, December 28, 2010.

[326] For more information, see Fort Hood, "Fort Hood Resiliency Campus," undated. As of September 27, 2011:
http://www.hood.army.mil/resiliencycampus/

CSA, the post could get the military families involved and also make the effort into an educational opportunity about nutritious food and where food comes from. Any such pilot projects should be documented and shared across installations to help encourage others to do the same.

Second, installations could facilitate on-post farmers markets and facilitate military families and staff participating in CSA and on-post community gardens. ACSIM/IMCOM should issue a policy encouraging installations to do on-post farmers markets, to offer CSA to military families and staff on post, and to provide community garden plots to Soldier and Military Families on post, as JBLM has done. Again ACSIM/IMCOM could begin by having a few installations do demonstration projects and then share the lessons learned with other installations. They should also document and share the current JBLM experience to help encourage other installations.

Last, installations should compost most of their organic wastes. Composting is part of the net zero waste process, which is a good way to help some installations focus more on composting. However, to ensure wider implementation of compost projects, ACSIM/IMCOM should encourage installations to compost and to use the compost on post. They should discuss the benefits to such composting. It is important that installations include food wastes in this process, not just landscape, training, and packaging waste.

The types of recommendations suggested here could, with very minimal investment of installation resources, help improve the nutrition and health of Soldiers and their Families; help prevent encroachment; help to support the local community, local farmers, and the local economy; and help improve community relationships.

Sources for Tracking Sustainable Agriculture Trends

Organizations That Track Sustainable Agriculture Trends

The *U.S. Department of Agriculture (USDA)* is the primary U.S. government department that tracks domestic sustainable agriculture trends. The *U.S. Agency for International Development (USAID)* is the primary U.S. government agency that tracks global sustainable agriculture trends.

The *National Sustainable Agriculture Information Service* is funded under a grant from the U.S. Department of Agriculture's Rural Business-Cooperative Service and managed by the National Center for Appropriate Technology (NCAT).[327] It provides information and other

[327] See the National Sustainable Agriculture Information Service website at http://attra.ncat.org.

technical assistance to farmers, ranchers, Extension agents, educators, and others involved in sustainable agriculture in the United States.

Worldwatch Institute is a key nongovernmental organization that tracks global sustainable agriculture trends.

Studies and Reports That Track Sustainable Agriculture Trends

One of the best studies that examines current trends related to food and agriculture is Worldwatch Institute's *Vital Signs 2010*. This report also specifically examines trends in organic agriculture, both globally and in the United States.

The *2009 Survey of Community Supported Agriculture Producers* was conducted by the Cooperative Extension Service, College of Agriculture, at the University of Kentucky. The findings of this survey on business and marketing practices of 205 CSA farms in Illinois, Indiana, Kentucky, Michigan, Missouri, Ohio, Pennsylvania, Tennessee, and West Virginia can be found at http://swroc.cfans.umn.edu/organic/csasurvey.pdf.

In 1995, the Congressional Research Service issued a report titled "Sustainable Agriculture." While dated, this report provides a good overview of the emergency of sustainable agriculture in the United States in the 1980s and 1990s.[328]

[328] See Rawson, 1995.