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UNIVERSAL DESIGN in HOUSING

Universal design is the design of products and the built environment
to be usable by all people, to the greatest extent possible,
without the need for adaptation or specialized design
— *Ron Mace*

Description:

A home with *universal design*[1] features will have universal appeal for a wide range of individuals and families—whether young or old, tall or short, disabled or non-disabled. Sometimes called *inclusive design*, *universal design* creates homes that are convenient, comfortable, and attractive for everyone. Similar terms that may be used include *life-cycle design*, *trans-generational design*, and *design for all*.

Universal design should not be confused with legislative requirements for ADA (Americans with Disabilities Act) accessibility, which can stigmatize users as needing specialized products and equipment to accommodate a disability. Although a *universal design* home incorporates accessibility features, the items are carefully selected for universal appeal; for example, a gently sloped sidewalk, instead of a ramp, can be used to create a no-step entrance that is useful for every family member when carrying groceries or moving furniture, as well as providing easy access for wheelchair users.

A *universal design* home will include numerous features that make a home easily navigated and useable, accommodating:

- The typical variation in physical size and capability seen among family members of all ages;
- The temporary impairments people experience throughout their lifetimes and the permanent disabilities characterizing some residents; and
- The evolving physical and mental changes experienced by people as they go through the normal aging process.

For example, homes are typically designed for the "average" person; however, the standard-height bathroom sink does not work well for the family's three-year-old daughter, nor for the 6' 2" husband; the standard-height kitchen counter does not work well for a 5' housewife. A bathtub does not work as well as a walk-in shower for the teenager with a broken leg or the visiting aunt in a wheelchair. Door knobs do not work as well as lever handles for aging arthritic hands. For an elderly person who cannot stand for long periods, sit-to-work space in the kitchen lets her continue baking; and automatic shut-off features on stoves avoid tragedies for people experiencing forgetfulness. For an extensive list of universal design features, products, guidelines, and a list of resources, see *Universal Design In*

Housing,[2] a publication of North Carolina State University's Center for Universal Design.

While a *universal design* home can include a long list of products, features, and equipment—everything from lighted doorbells, to flush-to-the-floor thresholds, to hand rails on both sides of staircases—three priorities are essential:

- One no-step entrance—on an accessible path;
- Wider doorways on the main level—with at least a 32-inch clear opening;
- A bathroom on the main level—with enough space to accommodate a wheelchair.

In addition to making the home more useable by its residents, these essential features also create a *visitable*[3] home; that is, one that will be welcoming to visitors who have mobility limitations.

References:

[1] Ron Mace, architect and educator at North Carolina State University, first coined the term universal design as "the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design."

[2] Center for Universal Design (January, 2006), *Universal Design In Housing.* Raleigh, NC: North Carolina State University, College of Design. http://www.ncsu.edu/www/ncsu/design/sod5/cud/pubs_p/docs/UDinHousing.pdf.

[3] Eleanor Smith, a disability advocate in Atlanta, Georgia, founded the visitability movement that has been successful in establishing visitability laws at local and state levels across the nation.

Benefits:

- *Universal design—*
  - Makes a home convenient, comfortable, and appealing for a wide variety of individuals and families:
    - Older people
    - People of all ages with disabilities
    - Families with young children
    - Caregivers
    - Everyone
  - Facilitates the ability of frail older people and younger-aged people with disabilities to live more independently and to age-in-place for much longer periods of time—thus, increasing a sense of confidence and competence, reducing vulnerability to depression, and delaying or eliminating relocation to institutional alternatives.
  - Reduces caregiver burden by easing the physical labor and emotional stress involved in caring for a family member with a physical or mental disability.
  - Incorporates *visitability* features that allow guests who use wheelchairs and other mobility aids to feel welcome and able to visit—thereby reducing social isolation.

  - Helps individuals who have disabilities obtain employment or participate in community life, as a universal design home allows them to live independently and to come and go as they please.
  - Reduces taxpayer burden by eliminating or postponing the need for costly in-home care or institutionalization.

- Incorporating *universal design* principles when the home is *initially* built—
  - Provides a lifetime of living for all residents without the need to make subsequent expensive modifications, additions, or remodeling to accommodate changes in health or abilities.
  - Is cost-efficient, as many universal design features are low-cost or no-cost when incorporated into initial construction.

Impediments or barriers to development or implementation:

- *Consumer attitudes*: Most consumers prefer to stay in their own homes as long as possible; yet, few recognize the need to select *universal design* features that would accommodate their changing needs and abilities as they age. Thus, there may be lower consumer demand for homes with *universal design* products and equipment.

- *Builder perspectives:*
  - The National Association of Homebuilders is opposed to mandatory *visitability* laws. Their reasoning includes low consumer demand, increased construction costs, and concerns about adding regulations that some homeowners may not need.
  - If builders are not familiar with *universal design* construction methods, they may be reluctant to learn new building techniques.

- *Legislative barriers*: It takes strong advocates to get new legislation passed. Some states, such as New York, may have difficulty in adopting local *visitability* ordinances because they are restricted by law from exceeding state building construction codes.

- *Rural challenges:* While not true of New York State, many rural areas across the country have little or no inspection of home building or remodeling projects, and some do not require builders to be licensed. This removes professional oversight that might encourage consumers to include universal design features in their homes.

Resource—examples:

- *Demonstration Homes:*
  - Smart House, Goldstein Museum of Design, University of Minnesota, St. Paul, MN, 55108, (612) 624-7434; contact the Museum at gmd@umn.edu. http://smarthouse.design.umn.edu.

- Home for All Ages, Universal Design Learning Laboratory, College of Human Sciences, Iowa State University, Ames, IA, 50011, (515) 294-6568. http://www.hdfs.hs.iastate.edu/centers/udll/.
  - 30 features of the Universal Design Learning Lab: http://www.hdfs.hs.iastate.edu/centers/udll/livingroom.php.

- The Universal Design Living Laboratory, a national demonstration home, Columbus, OH, 43230; Rosemarie Rossetti: http://www.udll.com/about/the-team/profile/index.cfm?userID=F1CEBD56-C296-7651-25CAAA4902227726; contact: Rosemarie Rossetti, Universal Design Living Laboratory, 6141 Clark State Road, Columbus, OH, 43230-1913; (614) 471-6100. http://www.udll.com/.

- Utah House, a sustainable building demonstration and education center, Utah Botanical Center, Utah State University, Kaysville, UT, 84037, (801) 544-3089; contact: Jayne Mulford, Coordinator, (801) 544-3089, jayne.mulford@usu.edu. http://theutahhouse.org/.

- *New Homes:*
  - Homes Across America—A Showcase of Green Homes and Resources, MSU Extension Housing and Environmental Health, Montana State University, Bozeman, MT, 59717, (406) 994-3451, information@homes-across-america.org; an Internet site to search, by state, for resource-efficient homes across the country, organizations that support resource efficiency in your area, examples of resource-efficient construction processes, and local assistance for resource-efficient building. http://www.homes-across-america.org/index.cfm.

  - Römarchitecturestudio; contact: (206) 545-7336, carol@romarchitecture.com. http://www.romarchitecture.com/index2.php.
    - Modern Folio: http://www.romarchitecture.com/index2.php; then click on Magnolia Mid-Mod and Pioneer Square.

- *Remodeled Homes:*
  - Design for Life—Build or Renovate Your Home For All Ages and Stages of Life, Montgomery County Executive's office, Rockville, MD, 20850, 240-777-0311. www.montgomerycountymd.gov/hhstmpl.asp?url=/content/hhs/ads/DesignForLife/DesignForLifeMontgomery.asp.

  - Home for the Next 50 Years, *UniversalDesign.com,* which is hosted by Universal Designers & Consultants, Inc. (founder: John P. S. Salmen), Takoma Park, MD; this site is a showcase for how universal design can be applied to an existing home to make it more livable. http://www.universaldesign.com/index/php?option=com_content&view=article&catid=487&id=79.

- IDEA Center Home Modifications, Center for Inclusive Design and Environmental Access (IDEA), School of Architecture and Planning, University at Buffalo, Buffalo, New York; descriptions of six home-modification projects. www.ap.buffalo.edu/idea/special_interest/special.html#IDEAPortfolio.

- (January, 2003), "An On-The-Job Fall Changed Jyl Waters' Life," *AgriAbility Quarterly,* Vol. 3, No. 3; description of the modification of a rural home—a no-step entry on the front porch created by raising the driveway. http://fyi.uwex.edu/agrability/files/2010/02/SlipsFalls.pdf.

Resource—written and web:

- Rosemary Bakker (September, 2010), *Beautiful Living for the Second Half of Life: AARP Guide to Revitalizing Your Home.* New York, NY: Lark Books. www.aarp.org/entertainment/books/info-08-2010/independent_livinginbeautifulstyle.html?CMP=KNC-360I-GOOGLE-ENT-BKS&HBX_PK=aarp_guide_to_revitalizing_your_home&utm_source=Google&utm_medium=cpc&utm_term=aarp%2Bguide%2Bto%2Brevitalizing%2Byour%2Bhome&utm_campaign=G_Entertainment&360cid=SI_166879307_6659200621_1

- "Visitability," *Concrete Change:* http://concretechange.org/visitability/. http://concretechange.org/.
  - "Policy Strategies," including sample U.S. State and Local Ordinances—links to laws and ordinances on visitability in 12 locations across the country, plus the U. S. Conference of Mayors. http://concretechange.org/policy-strategies/. http://concretechange.org/policy-strategies/state-level-strategies/.

- Prince William Aging-In-Place Committee (nd), *Easy Living with Universal Design*—information on universal design, including extensive listing of features and principles, photos, examples, and list of resources. Manassas, VA: Prince William County Area Agency on Aging. http://www.pwcgov.org/docLibrary/PDF/003529.pdf.

- "Visitability Costs Affirmed," *Concrete Change*, Decatur, GA*:* http://concretechange.org/construction/visitability-costs-affirmed/.

- (June 25, 2012), "Home Modifications Every Caregiver Should Know"; (July 29, 2011), " FAQs for Kitchen Design": AARP Webinars. Washington, DC: AARP. http://search.aarp.org/browse?Ntt=universal%20design%20webinar**.**

- "Welcome to Homemods.org," *Fall Prevention Center of Excellence*—a project of the National Resource Center on Supportive Housing and Home Modification, Andrus Gerontology Center, University of Southern California. http://www.homemods.org/index.shtml.

- Jordana Maisel, Eleanor Smith, and Edward Steinfeld (2008), *Increasing Home Access: Designing for Visitability*. Washington, DC: AARP, Public Policy Institute. http://assets.aarp.org/rgcenter/il/2008_14_access.pdf.

- Wilder Research Center (June, 2002), *Practical Guide to Universal Home Design: Convenience, Ease, and Livability*. St. Paul, MN: East Metro Seniors Agenda for Independent Living. www.wilder.org/download.0.html?report=949.

- Drue Lawlor (2008), *Residential Design for Aging in Place*. Hoboken, NJ: John Wiley & Sons. http://www.amazon.com/Residential-Design-Aging-Place-Lawlor/dp/0470056142.

- Barbara Krueger and Nika Stewart (2010), *Universal Design: A Step-by-Step Guide to Modifying Your Home for Comfortable, Accessible Living.* Gilbert, AZ: Knack Publishing LLC. www.amazon.com/Knack-Universal-Design-Step-Step/dp/1599216132.

- (2001), *Universal Design Handbook*, Wolfgang F. E. Preiser and Elaine Ostroff (Eds.). New York, NY: McGraw-Hill. www.amazon.com/Universal-Design-Handbook-Wolfgang-Preiser/dp/0071376054.

- *Universal Design and Home Accessibility*—principles, features, examples, and information. Iowa State University Extension: http://www.extension.iastate.edu/pages/housing/uni-design.html.

- Mary Yearns (May, 2004), *Universal Design for Better Living—Better Tools for Everyday Tasks*. Ames, IA: Iowa State University. http://www.extension.iastate.edu/NR/rdonlyres/D1D8781D-0EA2-46D0-81D6-DE90DBCAD237/96870/HandoutBetter1.pdf

- Wendy A. Jordan (2008), *Universal Design for the Home: Great-looking, Great-living Design for All Ages, Abilities, and Circumstances*. Beverly, MA: Quarry Books. www.amazon.com/Universal-Design-Home-Abilities-Circumstances/dp/1592533817.

- Center for Universal Design (2006), *Universal Design IN Housing*. Raleigh, NC: North Carolina State University. http://www.ncsu.edu/www/ncsu/design/sod5/cud/pubs_p/docs/UDinHousing.pdf

- (December, 2007), *Universal Design Ideas for Style, Comfort & Safety;* Norwell, MA: R. S. Means, Reed Construction Data. http://www.amazon.com/Universal-Design-Ideas-Comfort-Safety/dp/0876290918/ref=sr_1_1?ie=UTF8&qid=1309371683&sr=8-1.

- Mary Yearns (2001), *Update Your Home for a Lifetime of Living*. Ames, IA: Iowa State University Extension. www.extension.iastate.edu/Publications/PM1824.pdf.

- Steven Truesdale, Edward Steinfeld, et al. (nd), *Visit-ability: An Approach to Universal Design in Housing*—extensive information, case studies, cost analysis, and resources. Rehabilitation Engineering Research Center on Universal Design, School of Architecture, University at Buffalo, Buffalo, NY. www.ap.buffalo.edu/idea/Visitability/Booklet/VisBk%20Ver3-7-03.pdf.

- Mary Yearns (2000), *The Welcoming Home*. Ames, IA: Iowa State University Extension. www.extension.iastate.edu/Publications/PM1804.pdf.

Resource (free or fee-based)—technical assistance contact names:

- Center for Universal Design
  North Carolina State University
  Campus Box 8613
  Raleigh, NC 27695
  (919) 515-3082
  cud@ncsu.edu
  http://www.design.ncsu.edu/cud/

- Center for Inclusive Design and Environmental Access (IDEA Center)
  School of Architecture and Planning
  University at Buffalo
  378 Hayes Hall
  3435 Main Street
  Buffalo, New York 14214-3087
  (716) 829-5902
  idea@ap.buffalo.edu
  www.ap.buffalo.edu/idea/

- Institute for Human Centered Design
  200 Portland Street
  Boston, MA 02114
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  http://humancentereddesign.org/

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LIGHTING
FOR MAXIMAL HEALTH AND WELL-BEING

Description:
Lighting is not neutral, but has either a positive or negative effect on health. Correct spectrum and timing of lighting is essential because lighting modifies brain neurotransmitters and neuropeptides which, in turn, alter both mood and the human immune response. Proper lighting can improve health and well-being while poor lighting can alter mood and increase stress and the risk of disease.

All life, including humans, evolved being exposed to a different spectrum of light in the morning, afternoon and evening; and human health and well-being is profoundly affected by the different spectrums of morning, afternoon and evening light. Natural day lighting offers a smooth spectrum of visible light with a high intensity of light in the blue visible range (400 – 500 nm).[1] However, as the day progresses, blue visible light is scattered and lost from the incoming sunlight, and as the sun sets it emits visible light in the orange and red range (600-700 nm). At night, there is natural darkness with the exception of starlight, although the full moon releases significant blue visible light. Because of the significant impact of lighting, when developing homes, health care facilities, public buildings, and public spaces, it is important to maximize natural lighting and, when designing artificial lighting, it is important to mimic the spectrum and timing of natural lighting.

Until ten years ago, it was thought that the only function of the visible light received by the eye was for sight. It was known that light received by the human eye was transmitted to the retina and received by the rods and cones, which then sent a signal through the optic nerve to the visual cortex in the brain to "translate" an image. It is now known that visible light in the long blue range (480nm +/- 20 nm) triggers a circadian response—which is the body's roughly 24-hour cycle or rhythm of waking and sleeping in synchronization with the sun rising and setting.[2]

This blue visible light is transmitted to the eye's retina, received by melanopsin in the intrinsic photosensitive Retinal Ganglion Cells, and a signal passed through the

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[1] Wave Express, "What is Light" (2012): For the most part, visible light is discussed in terms of wavelengths—with the unit being nanometers (nm)—rather than frequencies. Our brains recognize these wavelengths as different colors, where 750 nm is approximately the longest wavelength of red light and 380 nm is approximately the shortest wavelength of violet light, with all the other visible colors in between these two wavelengths.
http://library.thinkquest.org/C005705/English/Light/light1.htm

[2] The Free Dictionary (2012): The term "circadian" refers to the body's cyclical daily biological functions (for example, sleep-wake cycle or eating at a certain time) and psychological processes (such as mental alertness), which are influenced by regular variations in the environment such as the alternation of night and day.

http://www.thefreedictionary.com/circadian+rhythm

optic nerve to the brain's hypothalamus—which triggers the production of a cascade of neurohormones.[3] Equally important is the lack of this circadian blue light in the evening. In darkness, a completely different set of neurohormones is produced.

Proper blue visible lighting in the morning and lack of circadian blue visible light in the evening modulates the sleep/wake cycle, growth, blood pressure, reproduction, stress, and metabolism. If the body's circadian rhythm is balanced, there is maximum morning alertness and productivity, and deep (delta) restorative sleep in the evening. If circadian rhythm is disrupted, this can lead to behavioral problems such as depression, agitation, and/ or psychosis.

Biological age is an important risk factor for impaired vision, making proper lighting to insure health and well-being particularly important for those over 50 years of age. Because of the age-related changes in the human lens, there is less visible light transmitted to the human retina of older adults. This not only results in visual impairments but disruptive circadian responses. In addition, at middle age the eye's natural antioxidant protection against light and ultraviolet-radiation-induced damage is lost, while, at the same time, there is an increase in production of the photochemically active pigments in the human lens and retina that damage the eye when activated by light. These changes in the lens lead to enhanced sensitivity to glare and eventual cataract (clouding of the lens) formation, and accumulative retinal damage leads to transient or permanent blindness (macular degeneration). Thus, lighting in individuals' homes, apartment buildings, assisted living facilities, nursing homes, and other health care settings must be specifically designed to compensate for the decrease in visible light reaching the retinas of those who are over 50 years old, as well as for those individuals of younger ages who have visual impairments.

Compensatory lighting for older adults and others with visual impairments:

- *Natural daylight:*
  - Increase exposure to outdoor natural daylight (for example, activity in gardens and parks and other public spaces), particularly outside morning sunlight— 6:00 am – 9:00 am is the timing for the most powerful circadian stimulation.
  - Maximize indoor natural daylight (for example, using skylights and increasing window area—using glass that filters and removes ultraviolet radiation.

- *Overall VISIBLE light levels***:** should be raised by 25% - 50%.

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[3] David Currie, East Tennessee State University (2012), "A Lecture, Higher Brain Function: Activation of the Brain and Levels of Consciousness"**:** Neurohormones are produced and secreted by neurons and act upon the nervous system. Their influence can be described in behavioral terms, such as the ability to think and the kind of thoughts we have, or can be described in terms of brain wave activity. http://faculty.etsu.edu/currie/ras.htm

- *Light levels:* should be uniform, but *NOT* directed into the eye.

- *Task lighting:* use task lighting to illuminte specific work and activity areas as a means of reducing glare and increasing vision.

- *Evening darkness:* To avoid disruption of circadian rhythms, remove or filter TV screens, computer screens, and gadget lights that contain blue visible light. After 10:00 pm, bedrooms should be in total darkness or red light (600 nm and above).

The impact of lighting affects health, achievement, and productivity in all spheres, including homes, schools, work places, health care facilities, public spaces, and public buildings. Photobiology, the study of the interactions of light and living organisms, "can be used to define threshold values for illumination in terms of spectrum, intensity, and timing of light at the human eye. The outcome of such study can be translated into goals for simulation—and ultimately for building design. Initial efforts in this direction are based on the annual Daylight Autonomy (DA) metric,[4] which was chosen to simulate the potential of daylight for human health needs. This method can be applied to study the impact of key architectural decisions for achieving prescribed stimulus of the circadian system—decisions such as building orientation, window size, and glazing material . . . but also to study the influence of human activity and viewing directions."[5]

Benefits:

For older adults and people with disabilities:

- An appropriate lighting environment enhances physical and mental health and well-being.
- Falls and other accidents due to poor lighting design are decreased.
- Proper lighting in multi-use spaces encourages strong socialization and active life-style opportunities.
- Lighting intensity and wavelength can be easily controlled for maximal comfort, depending on light sensitivity of different individuals.

For the community:

- The benefits of good lighting design can be successfully implemented in private homes, residential facilities, health and long-term care facilities, public buildings, and public spaces.
- Emphasis on natural day lighting and removing inappropriate lighting in the evening can:
  - Improve energy-efficiency without being harmful to human health.
  - Decrease health care costs that are related to circadian-related sleep and immune-system disruption.

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[4] Daylight Autonomy metric: a measurement standard for defining good and effective daylighting design.

[5] C. Pechacek, S. Gochenour, M. Andersen (on line, March 30, 2012), "Healthy Lighting," Daylighting Lab, Department of Architecture, Massachusetts Institute of Technology.

For the developer, architect, and lighting designer:
- Resident satisfaction is enhanced at no increase in cost.
- Energy efficiency is enhanced at no increase in cost.

Impediments or barriers to development or implementation:
- For development and design, emphasis is more often on energy-efficiency lumens/watt without consideration for the impact of lighting on health.

- Federal, state, and local building standards for energy efficiency do not take age and visual impairment into account, assuming that one size fits all when considering lighting for homes, buildings, and public spaces.

- There is a lack of awareness among consumers and professionals about the impact of lighting on physical and mental health.

- Laudable efforts to minimize the "carbon footprint" can sometimes lead to a poor choice of light bulbs in residential spaces—for example, compact fluorescent lamps (CFLs) work well for vision only (and, therefore, are good for non-residential areas such as closets or garages), but do not have the proper action spectrum emission for appropriate circadian rhythm.

- The lack of awareness about the differences in wavelengths emitted by different lamps, as well as lack of awareness of the direct relationship between light and the body's biological function can inadvertently lead to uninformed decision-making regarding lighting and poor choices in lamps and lighting. For example, greater education would increase awareness that the action spectra of some "cool" LED's (light-emitting diode) is appropriate for both vision and circadian morning alertness, and incandescent and "warm" LED's are appropriate for afternoon light and task lighting.

Resource—examples:
- Stella Niagara Health Center, Stella Niagara, NY 14144—a complex that includes permanent housing (convent) for 40 Sisters of St. Francis, a school for elementary-age students, a health center, and a hospitality center that hosts retreats held by diverse individuals and groups. The lighting for the Health Center (which includes 20 Sisters who are both elderly and suffering from dementia) was modified according to the principles described above in this article, including exposure to enhanced indoor and outdoor daylight during the day and red light installation for the evening. Modifications resulted in all residents, including those with dementia: sleeping through the night and staying awake longer during the day; blood pressure positively modified; and there was an overall calming effect on all residents.
  N. H. Waff, L. C. Kimberly, R. Mercier, P. Eng, B. Miller, and J. E. Roberts; Trautman Associates, Buffalo, NY: (http://www.trautmanassoc.com/); Lighting Design Innovations, Batavia, NY; Stella Niagara Health Center, Niagara, NY; Fordham University, NY.: 35th Meeting of the American Society for Photobiology, "Modified Lighting and Sleep," Providence, RI, 2010.

- *Royal Netherlands Academy of Arts and Sciences*, Amsterdam, The Netherlands—12 different health care facilities housing 189 residents (average age: 86 years), 87 per cent of whom presented with dementia. Over a three-and-one-half-year period, a research project examined the effects on residents of daily supplementation with bright light for an average of 15 months per resident. In six of the facilities, bright lighting was installed on ceiling fixtures, which were turned on every day between 9:00 am in the morning and 6:00 pm in the evening. Results showed that the bright light had a positive effect on stemming cognitive deterioration by 5 per cent compared to those without the light; depressive symptoms were reduced by 19 per cent; and functional limitations usually experienced by those with dementia were decreased by a relative 53 per cent.

  R. Riemersma-van der Lek, D. F. Swaab, J. Twisk, E. M. Hol, W. J. G. Hoogendijk, and E. J. W. Van Someren (2008), "Effect of Bright Light and Melatonin on Cognitive and Non-Cognitive Function in Elderly Residents of Group Care Facilities: A Randomized Controlled Trial," Journal of the American Medical Association, Vol. 299, pp. 2642-2655.

Resource—written and web:

Development and home/building design:

- R. W. Yeager, J. M. Halloin, et al. (1998), *Lighting and the Visual Environment for Senior Living:* IESNA RP-28-98, a review of available information on the special lighting requirements of older eyes and people with defective vision; available for purchase ($40) from the publisher: New York, NY: Illuminating Engineering Society of North America, 120 Wall Street, New York, NY 10005.

- C. S. Pechacek, M. Andersen, and S.W. Lockley (2008), "Preliminary method for prospective analysis of the circadian efficacy of (day) light with applications to healthcare architecture," *LEUKOS*, Vol. 5, No. 1, pp. 1-26.

- Gregg D. Ander, FAIA; U. S. Department of Energy (August 29, 2011), "Daylighting," *Whole Building Design Guide*. Washington, DC: National Institute of Building Sciences. Includes extensive information on strategies and resources for maximizing day lighting in homes and buildings, references to various calculating tools and models for analyzing a building's day lighting, and case studies on a range of day lighting applications: http://www.wbdg.org/resources/daylighting.php.

- C. Pechacek, S. Gochenour, and M. Andersen (on line, March 30, 2012), "Healthy Lighting: Concept, Development, Application." Cambridge, MA: Daylighting Lab, Massachusetts Institute of Technology. http://daylighting.mit.edu/research_detail.php?project=Healthy_Lighting.

- Patricia Plympton, Susan Conway, and Kyra Epstein (2000), *Daylighting in Schools: Improving Student Performance and Health at a Price Schools Can Afford.* Washington, DC: National Renewable Energy Laboratory, U. S. Department of Energy. http://www.nrel.gov/docs/fy00osti/28049.pdf.

- Kenneth J. Cooper (November 26, 1999), "Study says natural classroom lighting can aid achievement." Press release of the findings of the Heschong Mahone Group's research study: http://www.h-m-g.com/projects/daylighting/publicity%20daylighting.htm. To download copies of this research report and other research by the Heschong Mahone Group on the relationship between lighting and achievement and productivity: http://www.h-m-g.com/projects/daylighting/projects-pier.htm.

Impact of light on humans:

- Circadian Rhythm:
  - David M. Berson (2003), "Strange vision: ganglion cells as circadian photoreceptors," *Trends in Neurosciences*, Vol. 26, pp.314-320.
  - G. C. Brainard, J. P. Hanifin, J. M. Greeson, B. Byrne, G. Glickman, E. Gerner, and M. D. Rollag (2001), "Action spectrum for melatonin regulation in humans: evidence for a novel circadian photoreceptor," *Journal of Neuroscience*, Vol.21, pp. 6405-6412.
  - J. E. Roberts (2005), "Update on the positive effects of light in humans," *Photochemistry and Photobiology*, Vol. 81, pp. 490-492.

- Sleep/Wakefulness:
  - D. P. Cardinali, S. R. Pandi-Perumal (2005), *Neuroendocrine Correlates of Sleep/Wakefulness* (Editors: D. P. Cardinali and S. R Pandi-Perumal), New York, NY: Springer Publishing.
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- Disease:
  - Rheumatoid Arthritis—
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Resource—technical assistance contact names:

- Lighting for residential and assisted living facilities:
  - Norm Waff, LC, Senior Project Engineer
    Trautman Associates
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  265,251 Midpark Blvd., SE
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- Research in aging of the human eye and circadian rhythm:
  - Joan E. Roberts, Ph.D.
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- Aging in place:
  - Jerry O'Donnell, RN, MS in Gerontology
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ACCESSIBILITY / ADAPTABILITY IN HOUSING

Description:
The purpose of this section is to describe the features of a dwelling unit that are designed to provide optimal usage by an individual with a disability, whether that disability be a mobility impairment or a sensory impairment (i.e., deafness and/or blindness). Such features include: no-step entrances; sufficient width of hallways and doorways; appropriate heights for counters, appliances, and cabinets; grab-bars, or supports for grab-bars, in bathrooms; size of bathrooms and kitchens; auditory, visual, or other sensory alerts (i.e., a strobe light fire alarm as well as an auditory alarm), and others.

An accessible home is one that is designed with special *permanent* features for persons with disabilities. An adaptable home is one where these features can easily be *added or removed,* based on the individual's needs. Accessibility or adaptability requirements are determined by the law that governs each apartment unit, and two major laws are the Fair Housing Act as Amended (FHAA) and Section 504 of the 1973 Rehabilitation Act. The essential difference between these two classes of housing is that the FHAA requires adaptability while Section 504 of the Rehabilitation Act requires full accessibility.

The FHAA applies to a significant proportion of the housing in our communities. All multifamily dwellings with four or more units that were designed and constructed for first occupancy after March 13, 1991, are covered under this law. If the building has an elevator, all living units are covered; if not, all ground floor units are covered. Multistory townhouses are exempt.

The FHAA has seven basic standards, and living units falling under these standards are often defined as *adaptable* rather than *accessible*:

- The building entrance has an accessible route (no stairs!);
- Public-use and common-use areas are readily accessible and usable by people with disabilities;
- Doorways are sufficiently wide to allow passage by persons using a wheelchair;
- There is an accessible route into and through each living unit;
- Light switches, electrical outlets, and environmental controls are positioned in accessible locations (not too high);
- Bathroom walls are reinforced to allow installation of grab bars;

- Size and design of kitchens and bathrooms allow for maneuverability by persons using a wheelchair (minimum area size, adequate leg room, height of work surfaces, etc.).

Section 504 of the 1973 Rehabilitation Act applies to multiunit housing for rent or sale, commercial space, areas of employment, and areas of service or program provision that receive federal financial assistance. For multiunit housing, a minimum of five per cent of the dwelling units, or at least one unit, must be accessible to persons with mobility impairments; and an additional two per cent must be accessible to persons with vision or hearing impairments. The law also applies to renovations where alterations cost 75 per cent or more of the value of the facility.

Single-family homes and structures that have three or fewer living units have no accessibility requirements. However, increasingly, states and localities are considering requiring "universal design" and "visitability" requirements, both of which expand the concept of accessibility to maximize the usability of dwellings for people of all ages and functional abilities (see *Walkability/Visitability* and *Universal Design in Housing* in the *Resource Manual*).

Benefits:

- *For older people*:
  - Accessible and adaptable housing units allow older people to age in place rather than having to move into a more costly supportive facility when frailty compromises their ability to continue living independently.
  - Such features allow older residents to remain independent and self-managing for longer periods of time; help them retain a sense of competence and self-worth, which has an impact on mental and emotional health; reduce or delays the need for costly formal in-home services; and keep older residents active and participating in their communities.

- *For people with disabilities:*
  - Accessible and adaptable living units allow people with disabilities to live as an integrated member of the community, with greater ability to participate in employment, recreation, and civic engagement opportunities, as well as greater access to amenities and commerce venues in their communities.
  - Enhanced visibility within a community environment facilitates acceptance of people with disabilities by other community members and improves the general community's awareness of and understanding of the abilities, characteristics, and potential contributions of residents with disabilities.
  - Living as an integrated member of the community allows people with disabilities to live in a normalized, diverse environment rather than in an environment that consists only of other people with disabilities.

- *For children and families:*
  - Accessible and adaptable features are beneficial for families with young children; for example, ramps and no-step entrances allow easy navigation of strollers and carriages.
  - Positive modeling—accessible and adaptable living units in the wider community provide children with exposure to people with diverse abilities and needs, increasing their acceptance of people who are different, providing models of successful coping skills for dealing with adversity, and increasing awareness of the diversity that constitutes a normal community environment.

- *For caregivers:*
  - Accessibility and adaptability can reduce levels and intensity of hands-on care required, isolation, stress, and burn-out for caregivers when a family member with a disability (1) can negotiate their home environment more easily and, to a greater extent, by themselves, and (2) can fully access their communities.
  - For both a caregiver and her/his loved one, engaging in recreation and other activities *together* can preserve a relationship that can be more than “care giving.”

- *The wider community:*
  - Accessibility and adaptability principles are one aspect of a livable community, facilitating a community's ability to take advantage of the opportunities and creativity that are inherent in a diverse resident population.
  - Older and younger people with disabilities teach through demonstration about adapting to changes and building upon one's abilities and strengths.
  - Commercial establishments will have a larger clientele, leading to greater economic development.
  - People with disabilities constitute a non-traditional labor pool, from which employers find individuals who are a motivated, dedicated, and skilled workforce.

Impediments or barriers to development or implementation:

The development and implementation of accessible and adaptable housing in our communities have faced challenges and opposition from several sectors:

- While it has been shown that the additional costs of providing adaptable or accessible housing are minimal, real estate developers and real estate agents, in general, have not been supportive of changes to the State Buildings Code that increase accessibility, fearing (1) that these standards will make housing development more expensive, (2) that not all tenants or owners want or prefer the modifications required, including larger kitchens and bathrooms, and (3) that these requirements will either require greater square footage or adjustments that will lead to smaller living rooms and bedrooms.

- Developers of Federally assisted housing express concern that they sometimes cannot find eligible residents for "set-aside" accessible/adaptable apartments.

However, if developers or managers make a good-faith effort to rent a set-aside unit to an eligible applicant and are unable to do so, the federal Department of Housing and Urban Development will allow its rental to a tenant without a disability.

- Many set-aside units have a minimum required household income that is greater than many people with disabilities or seniors have available. For example, many units in New York City have minimum annual eligible-income requirements of about $25,000. Unfortunately, may low-income seniors and people with disabilities rely upon SSI-level incomes that are below $10,000 per year.

- Enforcement of accessibility/adaptability standards, particularly those of Section 504 of the Rehabilitation Act, are another challenge. New York State building codes that require adaptability are enforced locally by local Building Inspectors; however, there is no local official who is charged with enforcing the housing accessibility provisions of the Federal Section 504 law.

- Thus far, disability advocates have been unsuccessful in having the language from Section 504 incorporated into New York State Law in order to have it enforced statewide by the NYS Division of Housing and Community Renewal.

Resource—examples:

- *Apartment Seekers*—lists of available housing, in English and seven other languages. The Web site is provided by the New York City Department of Housing Preservation and Development (HPD). The site provides examples of appropriate marketing and publicity for 504 Set aside units: http://www.nyc.gov/html/hpd/html/apartment/lotteries.shtml.
  Click on "View Advertisement" for language.

- *Find Your Way Home: NYHousingSearch.gov*—a free statewide registry of accessible housing: http://nyhousingsearch.gov/. The registry is provided by the New York State Division of Housing and Community Renewal, New York State Department of Health, and the New York State Office of Mental Retardation and Developmental Disabilities. The registry's site is maintained by http://www.socialserve.com, which can be reached at (877) 428-8844.

- *Accessible Apartment Building Guide: A consumer's guide for using Westchester County's accessible buildings*—the guide is divided into five sections: summary of the guide; the accessibility Rating Scale and what it means; locating and using the database of housing developments; Fair Housing Laws and accessibility; and resources for making housing more accessible. Prepared by Westchester Residential Opportunities, Inc. for the Westchester County Department of Planning:
  http://www.westchestergov.com/pdfs/HOUSING_AccessibleApartmentBuildingGuide2006.pdf.
  Contact Ann Seligsohn, Westchester Residential Opportunities (914) 428-4507.

The database itself can be searched at: http://www.westchestergov.com/planning/housing/. Choose "search" in the top menu.

Resource—written and web:

- The Center for Universal Design, College of Design, North Carolina State University, Campus Box 8613, Raleigh, NC 27695-8613; (919) 515-3082; (800) 647-6777; http://www.ncsu.edu/www/ncsu/design/sod5/cud/.
  The Center's education program provides courses, workshops and presentations for students, advocates, builders, designers, engineers, service providers, and government agencies:
  - *Design*: we find solutions to specific accessibility needs at various levels of design—e.g., whole houses, buildings, spaces or products—and provide design development services for universally usable products, building components, and spaces.
  - *The Center*:
    - Provides concept development for new products, conducts architectural and product evaluations, plan consultation, and provides design and marketing assistance to business and industry: contact: cud@ncsu.edu.
    - Develops post-secondary curricula, conducts seminars and workshops, develops and conducts training programs, and assists in program development: contact: cud@ncsu.edu.
    - Develops materials and publications; provides telephone information and referral services; maintains a library, referral database, and comprehensive website; and provides informational presentations: contact: cud@ncsu.edu.
  - *Outreach program*: collects, develops, and disseminates information on all aspects of accessibility and universal design.

- United Spinal Association, Accessibility Services, 75-20 Astoria Blvd., Jackson Heights, New York, 11370-1177; (718) 803-3782; info@unitedspinal.org; http://www.unitedspinal.org/how-we-serve/.
  United Spinal offers its members personalized consultations with professional staff who are knowledgeable in a variety of topic areas. United Spinal provides continuing education and training to architects and building code officials on local, state, and federal access requirements; they also work with developers, owners, and operators to ensure that their facilities meet or exceed applicable accessibility codes and standards.

- New York State Buildings Code:
  http://publicecodes.citation.com/st/ny/st/index.htm.

- Accessibility Requirements for Buildings:
  http://www.hud.gov/offices/fheo/disabilities/accessibilityR.cfm.

- Model Buildings Codes:
  http://www.hud.gov/offices/fheo/disabilities/modelcodes/.

- Fair Housing Accessibility Guidelines:
  http://www.hud.gov/offices/fheo/disabilities/fhefhag.cfm.

- Questions and Answers About the Fair Housing Accessibility Guidelines:
  http://www.hud.gov/offices/fheo/disabilities/fhefhasp.cfm.

- Fair Housing Act Design Manual:
  http://www.huduser.org/publications/destech/fairhousing.html.

- Fair Housing Accessibility FIRST is an initiative designed to promote compliance with the Fair Housing Act design and construction requirements. The program offers comprehensive and detailed instruction programs, useful online Web resources, and a toll-free information line for technical guidance and support:
  http://www.fairhousingfirst.org/.

- Steven Winter Associates, Inc. (July, 2001), *A Basic Guide to Fair Housing Accessibility : Everything Architects and Builders Need to Know About the Fair Housing Act Accessibility Guidelines.* Hoboken, NJ: Wiley Publishers.

Resource (free or fee-based)—technical assistance contact names:

- *Fair Housing Accessibility First*—toll-free design and construction resource center designed to promote compliance with the Fair Housing Act design and construction requirements, offering comprehensive and detailed instruction programs, useful online web resources, and a toll-free information line for technical guidance and support. Washington, DC: U. S. Department of Housing and Urban Development:
  (888) 341-7781 (V/TTY)
  http://www.fairhousingfirst.org/.

- Center for Inclusive Design and Environmental Access (IDEA Center)
  School of Architecture and Planning
  University at Buffalo
  378 Hayes Hall, 3435 Main Street
  Buffalo, New York 14214-3087
  (716) 829-5902
  idea@ap.buffalo.edu
  www.ap.buffalo.edu/idea/
  The IDEA Center's fee-based services provide resources and technical expertise in architecture, product design, facilities management, and the social and behavioral sciences; continuing education; home modifications; model homes; post-occupancy evaluation; and universal design education online.

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SMART HOMES
(Home Automation)

Smart houses (or homes) are known by a variety of names, including intelligent homes, home networking, home automation, sensor-embedded houses, and adaptive homes.

Smart home technology refers to houses installed with monitoring systems (sensors, actuators, and biomedical monitors) and special wiring to enable residents to program, control, and operate an assortment of appliances and other household features throughout the house. Smart homes have been defined as the integration of technology and services through home networking for a better quality of life.[1] Monitoring devices, such as sensors, are small and can be installed anywhere—inside or outside the home, or worn by an individual.

Depending on the user's needs, a smart house can include a basic network of wires operated by a central control panel in the home, while others might utilize wiring that allows the user to operate the appliances and features remotely from any area of the house—or even from outside the home—using a remote-control device similar to a television remote control "clicker." Through either method, home automation provides relative ease of use. Much of the work is carried out by the system itself, where it detects activity and discerns information based on homeowner input. The key goal for home automation is to give the occupant total control over the house from anywhere in the house or from a distant location.

Home automation can range from (1) simple, fixed applications with pre-defined and pre-established operations, to (2) applications and devices that are programmable by the user, to (3) fully flexible and automated applications and networks of devices that provide information to the home consumer or that can be programmed to share the information with others.

Historical Evolution—
A major focus of this technology, which has existed since the 1980s, has been to provide convenience, personal comfort, security, and energy-conservation; for example:

- All windows and doors can be locked from a central location in the home.
- A telephone call to the house can turn on the coffee, oven, or other elements.
- Lights can be programmed to turn on and off when someone enters and leaves a room.
- Exterior sensors can turn lights on and off in response to the amount of daylight entering the home.

- Home comfort systems (heating, air-conditioning, ventilation) can be set to automatically change in response to the time of day or to external temperatures.

- Exterior video or movement detectors can alert a homeowner to unusual activity, through sensors that evaluate foot-pressure changes, breaking glass, movement, and contact with windows and doors—and, if a resident is away from home, through a cell phone.

- Stove controls can detect high temperatures and automatically shut off burners and ovens.

- Room-to-room video and audio communication systems allow viewing and talking among people in different rooms and floors of the home.

- Audio/video controls allow music to be heard in one or more rooms of the house, multiple televisions to be controlled from a central location, and multiple media sources to be interconnected and manipulated.

More advanced systems are continually being developed—for example, a smart house can electronically maintain a cat's litter box and water the household plants. Recent developments have involved the internet, whereby a home can send messages to its owner who is away from the house via e-mail and text messages—for example, door sensors can inform the owner when children have come home or if an older member of the family has stepped out of bed in the morning.

Recent Focus—
While smart house technology has primarily focused on convenience and energy-efficiency, this technology is increasingly targeted for use by people with disabilities and for the care of frail older adults—providing safety, security, and ease of self-management, as well as providing both on-site and remote monitoring and health care. Over 34 million people in the United States are aged 65 years and older and nearly 15 percent of people aged five and older have one or more disabilities.[2] This recent increase in interest is related to (1) its practicality in supporting the ability of older adults and people with disabilities to remain living independently and self-managing in their own homes for longer periods of time, supporting a major preference of all people to "age in place" in the living environment of their choice; (2) its ability to support the significant efforts of family caregivers; and (3) its cost savings through reducing the need for expensive personal aide assistance, reducing the need for in-person medical care, and through delaying or avoiding costly institutional care.

Early applications of smart home technology included devices such as LifeAlert, introduced in the 1990s, which is a pendant worn around the neck that allows a wearer to alert a central response center when he or she experiences an emergency or needs help. Today's devices expand upon such efforts—sensors can be placed

on virtually any household object, even on the floor, where it detects movement and determines issues in mobility. Sensors can now detect if an individual has fallen and is unconscious, setting off an alarm and automatically signaling for help to an agency or family member. Other recent advancements can detect when a person gets up to use the bathroom during the night, automatically switching on a light.

Sensors have been developed to detect, record, and analyze movement patterns, footfalls, and the pace at which someone has climbed the stairs or moved between rooms, alerting family members living elsewhere if there are significant deviations from the pattern or if a sudden weakness in the foot, a collapse, faint, or black-out is detected. Other sensors can detect irregular heart rhythms or blood pressure.

Smart home technology can also aid in disease prevention—for example, providing inconspicuous memory aids, such as medication reminders; or refrigerators can evaluate an inventory of contents and provide suggestions for menus, healthy choices, and a list of groceries that need to be purchased. Vibrating bracelets or audible prompters can remind people when to eat or when to go to the bathroom, and other wrist devices monitor pulse rates and skin temperature. Sensors and wireless devices are being used in homes to monitor individuals' vital signs and whether medication has been taken, with this information sent wirelessly, through a sensor in the home or on the individual, to the doctor or to family members—which is an added benefit for people who are home-bound, living in more remote rural areas, or are without immediate access to healthcare.

Much of the current smart home technology for tracking occupants uses small portable tags or badges that send and receive radio waves or infrared light—inexpensive alternatives to camera systems. Tags can be attached to a variety of items, such as lapels, bracelets, pins, key chains, or medicine bottles. Such technology is extremely useful for monitoring individuals with Alzheimer's, allowing them to remain living in their own homes safely for longer periods of time and, when relocated to a housing or health care facility, allowing them more flexibility in moving around a building or yard and staying integrated with other residents.

Telemedicine: Services that provide health and social care directly to users in their own homes is an area of care defined as telecare, which uses interactive video and audio contact between a user and care provider. Peripheral devices can also be attached to computers to aid in an interactive examination, and video-conferencing can be used when face-to-face consultation is necessary. The "real-time" consultation, diagnosis, treatment, and delivery of medical care is carried out with the user in the home, eliminating the need for frail or homebound individuals to travel to health care offices or facilities. "Store-and forward" electronic information-processing technologies transmit medical and health information, X-rays, and data between health care providers and patients and among a patient's multiple health care providers, for more efficient and accurate record-keeping on diagnoses and treatments.

Looking at the evolution of telecare, Celler, et al.,[3] find that home telecare technologies fall broadly into three generations:
(1) First-generation systems, which are designed to reduce anxiety among elderly and high-risk patients and reduce their use of primary healthcare services (for example, personal alarm systems and emergency response telephones that make a voice connection between the patient and the response center);

(2) Second-generation systems, which can continuously monitor a large number of variables that are sensitive to changes in functional health status, generating alarms *without* the intervention of the patient, on the suspicion that something may be wrong; these systems can be integrated with evolving "smart home" technology for home automation, security, and environmental control; and

(3) A third generation of telecare, which attempts to deal with issues of loneliness and patients' quality of life by creating a virtual community of clients, caregivers, healthcare providers, and other community services—connected via the telephone, interactive television, and the Internet.

The past decade has also seen renewed attention in smart house technology as academic institutions, such as the University of Florida and the Massachusetts Institute of Technology, develop their own research centers—many of them resembling actual homes—to test sophisticated home automation technologies. Despite the convenience and comfort characteristics of smart house and home automation technologies, younger generations and families have been slow to respond to their use over the past two decades. However, sophistication in infrastructure, advancements in ease of use, and an increased knowledge and familiarity with computers among the public has generated more attention; and older individuals and younger-aged individuals with disabilities have especially benefitted from such technologies, helping them live safely and independently in their own homes.

Some manufacturers and experts note that privacy issues are an important consideration in building smart homes. Nevertheless, multiple surveys have indicated that people are willing to trade-off some of these concerns for practicality, comfort, and independence.[4] As the 78 million baby boomers continue entering their elder years, and people of all ages with disabilities continue to live much longer lives, experts believe that the demand for such technology will increase significantly in years to come.

References:

[1] Tiresias.org: http://www.tiresias.org/research/guidelines/smart_home.htm, quoting Smart Homes Association, i.bierhoff@smart-homes.nl, P.O. Box 8825, 5605 LV Eindhoven, The Netherlands.

[2] United States Census Bureau (2009), “People QuickFacts,” *USA QuickFacts*: http://quickfacts.census.gov/qfd/states/00000.html.

[3] Branko Celler, Nigel Lovell, and Daniel Chan (1999), "Clinical Practice: The potential impact of home telecare on clinical practice," *Medical Journal of Australia*, Vol. 171, pp. 518-521.

[4] Anne Eisenberg (April 5, 2001), "A 'Smart' Home, to Avoid the Nursing Home," *The New York Times*: http://www.nytimes.com/2001/04/05/technology/a-smart-home-to-avoid-the-nursing-home.html?pagewanted=1.

Benefits:

- *Security*
  - Advanced technology in the area of home security has provided a convenient and safe way to keep homes and family members out of danger, with improved methods of detecting a variety of unusual activities and potentially dangerous situations—both inside and outside the house.

- *Healthcare*
  - *Costs:* It is more cost-effective for older adults and persons with disabilities to remain living at home for as long as possible, with assistive, supportive, and health-monitoring devices, than to be placed in healthcare institutions. One study (Chan, et al., 2008)[5] revealed that 46 per cent of "on-site nursing activities" could be replaced by technology that can supervise health status from afar. The study also found that average hospital inpatient care in the United States costs $820 per day, average nursing home care costs $100 per day, and an average house call costs $74—while a telemedicine evaluation costs $30.
  - *Staffing decline:* A study by Kevin, et al. (2003)[6] finds that the number of caregiver and direct care clinicians has declined. Appropriate and judicious use of smart house, home automation, and telecare technology can be successfully used as one strategy to address this decline.
  - *Older adults and people with disabilities*:
    - Smart-based technology, integrated into the home environment, supports the ability of older adults and people with disabilities to continue living safely in their own homes for longer periods of time.
    - Such technology increases a user's ability to be self-managing for longer periods of time—promoting feelings of competency and reducing vulnerability to depression.
  - *Caregivers-emotional and physical support*:
    The availability of smart house technology supports the substantial caregiving efforts of the nation's millions of family caregivers:
    - Caregivers' emotional and physical stress is reduced by (1) reducing the number of hours of hands-on physical assistance needed by a frail or impaired family member, and (2) allowing caregivers to monitor family members and perform tasks from a remote location.
    - A caregiver's ongoing emotional worry about the well-being of a frail or impaired family member is reduced by (1) increasing the safety and security of the family member's home environment, and (2) delaying or

eliminating the traumatic decision of relocating a family member out of his own home and into another environment.

- *Ease of use*
  - Advancements in technology, together with increasing knowledge of and experience with computers and computerized devices by the general public of all ages, has made smart home technology much easier to use and to adapt to daily routines.

- *Rural areas*
  - Smart house technology is especially attractive for use in rural areas, where lack of proximity to health care could compromise medical conditions.

References:

[5] M. Chan, D. Esteve, C. Escriba, and E. Campo (2008), "A review of smart homes—Present state and future challenges." *Computer Methods and Programs in Biomediscine,* Vol. 91*,* pp. 55-81.

[6] C. Kevin, et al. (2003), "Caregiver and Clinician Shortages in an Aging Nation," *Mayo Clinic Proceedings*, Vol. 78, pp. 1026-1040.

Impediments or barriers to development or implementation:

- *Practicality*
  - The practical design of smart home technology is extremely important for older adults and individuals with disabilities. If devices are prone to system failures (similar to those encountered on a personal computer—such as unresponsive networks or software malfunction), complex actions to fix the situation (i.e., resetting the entire system) may prove too inconvenient or even dangerous for the user.
  - Devices that assume prior computer skills or devices that are not tailored to individual needs could also prove problematic. For example, for people who are vision- or hearing-impaired, certain technologies are ineffective, such those that require video monitoring or being attentive to auditory signals.
  - These technologies also present issues for cognitively impaired individuals who might find a control panel or remote control device difficult to use.

- *Privacy*
  - Issues of privacy often surface as a major concern in smart house development. Much of the technology being devised for older adults and people with disabilities involves an element of monitoring by others that some people find obtrusive. Cameras and surveillance devices are a concern for many who value privacy. Therefore, it is important that informed consent be obtained before installing technology that could create discomfort. Developing a code of conduct for healthcare providers who monitor individuals could further prevent a compromise of privacy.

- *Intimacy*
  - Most people are accustomed to communicating with an actual person when receiving care. A replacement of human contact by technological devices can present a level of fear, discomfort, isolation, or loneliness for people receiving this type of impersonal care, which can have a major effect on both physical and emotional health.
  - Some individuals may also experience fewer visits from family members who rely too heavily on the technology to assist and respond to daily needs.

Resource—examples:

- Duke University Smart House; website includes an extensive list of links for smart homes throughout the world: http://smarthome.duke.edu/.

- Drexel Smart House, Drexel University: http://www.drexelsmarthouse.com/.

- Gator-Tech Smart House, University of Florida: http://www.icta.ufl.edu/gt.htm.

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GLOBAL UNIVERSAL DESIGN COMMISSION, INC. (GUDC)
Creating Voluntary Universal Design Standards

Description:
The Global Universal Design Commission, Inc. (GUDC) is a not-for-profit corporation established with broad bipartisan support from across the country and with the involvement of the design, development, disability, and aging communities. The Commission's purpose is to develop, promote, and accelerate the understanding and use of Universal Design in the design and development of buildings, products, and environments worldwide.

Recognizing the need to take Universal Design (UD) to the next level, Josh Heintz and his law partner, William Gilberti, of Gilberti Stinziano Heintz & Smith, P.C., agreed to fund the initial formation of the GUDC. Heintz and Gilberti collaborated with Peter Blanck, Chairman of the Burton Blatt Institute, in organizing and leading several meetings to conceptualize the GUDC and bring together experts and stakeholders to collaborate with the new Commission. The GUDC's first effort is to create voluntary consensus standards to guide designers, developers, lenders, governments, and end users to understand and apply UD Standards and certify their efforts.

GUDC is currently in the process of developing UD Standards for both new and existing commercial buildings. Modeled after the very successful Leadership in Energy and Environmental Design (LEED) standards produced by the U. S. Green Building Council, the UD Standards are intended to complement existing accessibility standards by identifying and encouraging the incorporation of features that increase usability, safety, and health for a diverse end-user population. The standards will expand access to buildings for all people, regardless of physical stature and varying abilities.

The development and approval process for creating UD Standards will include public comment and review. The approved UD standards will be available on the GUDC website to guide corporations and government entities in the creation of barrier-free facilities, providing diverse users with better access to and convenience in commerce, public services, entertainment, and employment settings. Once the standards for commercial buildings are completed, additional standards will be drafted for other components of the built environment, including housing, products, schools, etc.

A numerical rating system will be developed based on the goals of Universal Design. Depending on the type and number of Universal Design strategies

included, a project will receive a point total and be given a level of accreditation based on that total.

Benefits:
Because Universal Design seeks to make environments, products and systems safer, healthier, and more usable, adopting UD Standards has many benefits for a diverse population:

- UD increases functional independence and opportunities for social participation for the growing number of older people and people with disabilities:
  - 650 million people are living with disabilities worldwide;
  - Over 18 per cent of the U.S. population have some limitation in ability;
  - More than 40 per cent of the U.S. population over 65 years old have diminished abilities;
  - The aging of the Baby Boom generation and the obesity epidemic will increase the prevalence of disability; and
  - The population aged 65 and over will grow from about 20 million in 1994 to almost 40 million by the year 2010 and to an estimated 71 million in 2030.

- UD expands markets beyond disability and aging to include people of extreme stature, left-handed individuals, international travelers, people with chemical sensitivity and severe allergies, parents with children, and caregivers.

- UD provides a business advantage to organizations:
  - Increases a consumer base and customer loyalty;
  - Reduces operating and renovation costs;
  - Increases productivity;
  - Expands the labor pool by making the work environment useable by greater numbers of people.

Impediments or barriers to development or implementation:

- The development of the UD Standards will follow an "ANSI-Approved Process," which is both democratic and public, for developing the standards. Because this method includes maintaining balance in committee membership, public review and comment, and documenting responses to all negative ballots and comments, it requires a great deal of time and effort.

- Another potential barrier to the UD Standards is the eventual rate of implementation. As a voluntary standard, there is no guarantee that builders, businesses, or government agencies will adopt the UD Standards developed by GUDC. Nevertheless, GUDC has begun to gain international support for its Standards Development efforts. Potential early adopters of the GUDC standards include: the London 2012 Organising Committee; the government of Ecuador; and the Paralympics Committee, which is planning the design of facilities for the 2014 Winter Games in Russia.

Resource—example:

- A potential early adopter of the UD Standards for commercial buildings in New York State includes Kirkwood Senior Housing Development in Binghamton, New York (owned by 3D Development Group, LLC), which is in the planning stages of a Phase II development to expand its facilities. Lauer-Manguso & Associates Architects and the Center for Inclusive Design and Environmental Access are collaborating on this project and incorporating the draft UD Standards in their plans. Construction is scheduled to begin in spring 2009.

Resource—written and web:

- Global Universal Design Commission, Inc. (GUDC)—a not-for-profit corporation whose mission is to increase understanding and use of universal design (UD) and to accelerate adoption of UD concepts for the range of human performance and preferences in order to provide ease of use without disadvantage to any group or individuals. P.O. Box 6801, Syracuse, New York, 13217; (315) 442-0139; info@globaluniversaldesign.org; http://www.globaluniversaldesign.com.

- Center for Inclusive Design and Environmental Access (IDeA)—located at the University at Buffalo, the Center practices human-centered design through research, development, service, dissemination, and educational activities, with a primary goal of producing knowledge and tools that will increase social participation by groups (such as individuals with disabilities and older adults) who have been marginalized by traditional design practices. 378 Hayes Hall, School of Architecture and Planning, University at Buffalo, 3435 Main Street, Buffalo, New York, 14214; (716) 829-3485, Ext. 329; TTY: (716) 829-3758; idea@ap.buffalo.edu; http://www.ap.buffalo.edu/idea/.

- Burton Blatt Institute (BBI)—located at Syracuse University, the Institute's international focus is on research, education, training, technical assistance, and outreach to achieve its mission, which is to advance the civic, economic, and social participation of persons with disabilities by creating a collaborative environment and transforming policy, systems, and people through inclusive education, workforce, and communities. World Headquarters, Suite 300, Crouse-Hinds Hall, Syracuse University, 900 S. Crouse Avenue, Syracuse, New York, 13244; (315) 443-2863; Peter Blanck: pblanck@syr.edu; http://bbi.syr.edu.

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WALKABILITY / VISITABILITY

Description:
The characteristics of a home, of public buildings, and of community spaces can either enhance or impede the ability of residents to live as independently as possible and as integrated with the wider community as much as possible throughout their lifetimes. The design concepts of *walkability* and *visitability* have been found to benefit communities and to improve the quality of life of its residents.

Walkability has been defined by Dan Burden, a nationally known expert on the principles underlying this design concept, as the quality of "the overall walking and living conditions in an area—the extent to which the built environment is friendly to the presence of people who are walking, living, shopping, visiting, enjoying, or spending time in an area"[1] . . . how comfortable, convenient, and safe it is for people to do these things.

Across the country, greater attention is being focused on exercise, fitness, being active, and staying involved—for better mental and physical health. A community with good walkability features encourages walking, strolling, and biking as a strategy for achieving improved health and increased and enhanced interaction among residents. Greater attention is also being focused on walking and biking as alternative transportation strategies for reducing the use of personal cars, conserving fossil fuels, and improving air quality. There is growing awareness and appreciation of the role that walkability plays in supporting health and environmental aims, as well as growing recognition of the economic benefits accruing to a community whose walkable design characteristics attract both residents and visitors from other places.

What are some examples of elements that help make a community walkable: How comfortable is it for residents to walk around their neighborhoods? Are sidewalks needed—to make walking more enticing, safer? Are sidewalks unbroken, made of non-slip materials, free of sand and debris in the summer and snow and ice in the winter? Are there curb cuts to the street? Are there leash laws? Are there street lights, and are traffic signals timed to allow small children, elderly people, and people with disabilities enough time to safely cross the street? Are there benches for sitting and resting? Water fountains? Walking paths? Are there pathways for bicycling, skateboarding, and rollerblading separate from sidewalks and from the auto roadway? Can people walk to the bus stop? Is there a bus shelter? Are street signs, building signs, and street numbers large and visible? Are there walking trails in public parks; do they include rest stops; is there built-in equipment to engage in exercises that improve agility, stamina, and strength? Is there a mapped walking trail through town that brings walkers and shoppers to points of interest, the major amenities, and stores? Are indoor walking trails

incorporated into community centers, schools, malls, YMCAs, and senior housing developments to encourage walking and to encourage integration of different age groups? What are the distances among local amenities and stores . . . and between residential areas and routine destinations—and, thus, what is a resident's ability to easily get to the goods and services he needs and wants? Are there buffers between pedestrian walkways and moving traffic? What is the level of connectedness among streets? What is the frequency of street-crossings? What is the level of traffic volume and traffic speed? Is the neighborhood, the community, or the downtown visually appealing? Does the placement of buildings and stores instill a sense of safety . . . instead of a fear of crime? What is the quality of the air; is there sun; is there shade?

A number of tools, checklists, and audit workshops have been developed to help residents, local leaders, and planners understand the elements of walkability and to gauge just how walkable their own communities are. Increasingly, such measures are making their way into formal and informal community planning efforts. As an initial informal measure, "one of the best ways to quickly determine how walkable a block, corridor, or neighborhood is is to count the number of people walking, lingering, and enjoying a space—the diversity of people, and especially the presence of children, seniors, and people with disabilities, denotes the quality, completeness, and wholesomeness of a walkable space."[2]

Visitability refers to the design of a home so that it can be easily entered and exited by the home's residents, easily visited by other people, and easily used by residents and visitors, including those with frailties and disabilities. The principles of visitability also apply to public and commercial buildings. What are the primary features that make a home or building visitable: (1) There is at least one no-step entrance; (2) there is a bathroom on the first floor, capable of being negotiated by a person who is using a wheelchair or who has a temporary or permanent physical limitation; (3) exterior and interior doorways are wider to accommodate a wheelchair or walker; and (4) in public buildings, an elevator is available to access upper floors.

How critical are visitability features? A 2007 study[3] by the University of Florida's Bureau for Economic and Business Research estimated that up to 60 per cent of new houses built today will, at some point, have a resident with a long-term mobility impairment. Many people with permanent or temporary mobility issues are 'trapped' in their homes because they cannot negotiate stairs to the outside. Just as they may not be able to get out of their homes, many of their friends and family who are just as frail or mobility-impaired are not able to get in—or, once inside the home, have no access to the bathroom . . . so they stop visiting. It is important for frail older people and people with limited mobility conditions to maintain their social relationships. Social isolation is strongly related to depression; staying involved with family, friends, and others in a social network is strongly related to positive health and well-being.

Initially, the concept of visitability was recognized as an aspect of home design that was crucial to the ability of elderly people to successfully age in place.

Increasingly, however, the benefits of visitability—easy and safe access and maneuverability—became clear for people of all ages: small children; people in wheel chairs; those with walkers and canes; those in a temporary leg cast; those with permanent physical limitations; and those with reduced strength, agility, and balance due to health conditions or aging.

Walkability* and *visitability—both concepts are aspects of *universal design*, affecting how useable and how safely and easily negotiable residents will find their neighborhoods, communities, and homes to be—throughout their lifetime. The extent to which communities and homes are walkable and visitable affects residents' health and well-being, as well as their satisfaction with their homes and community . . . and, thus, both their *ability* to remain living in their community and their *willingness* to continue living in their community.

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[1] Dan Burden, Walkable Communities, and Glatting Jackson Kercher Anglin, Inc. (September, 2008), *Walkability Sault Ste.Marie:* http://www.sault-sainte-marie.mi.us/docs/walkabilityaudit.pdf.

[2] David Herron (January 18, 2009), "Walkability and Walkable Cities," *Seven Generational Ruminations Newsletter.*

[3] Stanley K. Smith (University of Florida), Stefan Rayer (University of Florida), and Eleanor A. Smith (Concrete Change) (October 11-13, 2007), *Aging and Disability: Implications for the Housing Industry, and Public Policy in the United States.* Gainesville, FL: University of Florida, Bureau of Economic and Business Research. Paper presented at the annual meeting of the Southern Demographic Association, Birmingham, AL.

Benefits:

Walkability:

- Provides easy opportunities for improving fitness, strength, and agility among all residents—(1) helping older people remain independent and self-managing for longer periods of time, and (2) countering obesity trends among all age groups.

- Incorporating walkability features in and around one's home and throughout the community is a preventive and wellness strategy for better health and reducing the need for long-term care services.

- A walkable community encourages interaction and communication among the various age groups and cultural groups. This is particularly critical for frail older people and people with disabilities, both of whom have a greater vulnerability to social isolation.

Visitability:

- For frail older people and people of all ages with mobility impairments, visitable homes and public buildings encourage socialization and involvement with family, friends, and the wider community—countering social isolation and depression.

- Visitable homes increase the ability of residents to be self-managing, thereby lessening the need for costly personal care.

- Designing a new home to be visitable reduces or eliminates the need for expensive renovations when a resident incurs a frailty or mobility impairment.

For the community:

- The outcome of walkable and visitable homes and communities is greater interaction and communication among residents, which strengthens community-building and a "sense of community" among residents.

- Both walkability and visitability are critical aspects of a livable community (see "Livable Communities" in the *Resource Manual).*

- The more walkable a community is, the lower the crime rate.

- Walkable communities reduce reliance on the personal car, conserve fossil fuels, and help improve air quality.

- Communities that are walkable have improved economies.

Impediments or barriers to development or implementation:

Visitability:

- Developer/planner misperceptions—*v*isitability features may be dismissed because of untrue convictions, such as:
  - A mistaken idea that a building's lot must be flat to accommodate a zero-step entrance;
  - An unproven belief that a home built with accessible and visitable features will be marketable only to people with disabilities;
  - An inaccurate view that only a few people need the benefits of visitability or universal design features; and
  - An incorrect assumption that the cost of incorporating visitability features in new construction is prohibitive.

- There is a lack of knowledge among many homeowners and developers about the choices and décor possibilities in architectural features, products, and designs for visitability features, leading to a conviction that visitability features "cannot be attractive." This conviction leads both homeowners and developers to fear that such features will be "too noticeable" and will stigmatize the residents as being disabled.

Walkability:

- The movement promoting smart growth principles, which supports walkable, more compact communities and less reliance on the use of personal automobiles, is in its beginning stages. While such principles are being incorporated into newly planned communities, a greater "culture change" is

required to prompt widespread attention to making substantial walkability changes to existing communities.

- Creating a walkable community requires a collaborative, cross-sector planning effort among disparate agencies responsible for transportation, housing, parks and recreation, commercial building, services, education, and others. Many communities have had little or no experience in using such a planning approach; they are unaware of planning tools available to help communities implement such an approach; and smaller agencies are often fearful of losing their place in the community if they are part of a larger endeavor.

Resource—examples:

- Dan Burden, *How Can I Find and Help Build a Walkable Community?* Excellent article providing descriptive and explanatory information about a list of successfully walkable communities, written by the country's foremost expert on the topic: http://www.walkable.org/assets/downloads/How%20Can%20I%20Find%20and%20Help%20Build%20a%20Walkable%20Community.pdf.

- "What are some examples of existing walkable communities? "*Walkable.org:faq.* http://www.walkable.org/faqs.html.

- "America's Most Walkable Neighborhoods," *Walk Score*: http://www.walkscore.com/rankings/. http://www.walkscore.com/walkable-neighborhoods.shtml. http://www.walkscore.com/rankings/New_York. Explanation of the methodology *Walk Score* uses to score and rank the walkability of neighborhoods: http://www.walkscore.com/rankings/ranking-methodology.shtml.

Resource—written and web:

- Center for Inclusive Design and Environmental Access (2009), *Visitability—an inclusive design approach to housing:*
  - Extensive information, examples, photos, and guidelines;
  - Summary of the new section (C units) of the ICC/ANSI A117.1 standards, which stipulates technical design criteria for visitability.

  Buffalo, NY: The IDEA Center at Buffalo, School of Architecture and Planning, University at Buffalo, Buffalo, New York. http://www.udeworld.com/visbooklet/visitabilitybooklet.pdf. http://www.ap.buffalo.edu/idea/.

- Jennifer Perry, (nd), "ANSI Endorses 'Visitability' Criteria: the American National Standards Institute Includes Criteria to Make New Homes Visitable by People with Disabilities," *Action Online—Magazine of the Spinal Association*. Includes summary of criteria for Type C units: http://www.unitedspinal.org/publications/action/2008/04/08/ansi-endorses-%E2%80%9Cvisitability%E2%80%9D-criteria/.

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- *Walkable Communities*—the Web site of Dan Burden, nationally recognized authority on bicycle and pedestrian facilities and programs, with 25 years experience developing, promoting, and evaluating alternative transportation facilities, traffic calming practices, sustainable community design, and specializing in research and implementation of pedestrian, bicycle, and street improvement projects: http://www.walkable.org/.
  - Dan Burden, *Walkable Communities—Twelve Steps for an Effective Program:* Florida Department of Transportation: http://www.walkable.org/assets/downloads/12STEPS.pdf. "What Makes a Community Walkable"—the 12 steps: http://www.walkable.org/faqs.html.
  - Dan Burden, *Bicycle Network Planning*—video presentation*:* http://www.slideshare.net/rendo/dan-burden-presentation. For community planners: Dan Burden, *Building Livable, Walkable Communities*—video presentation: http://fora.tv/2008/07/14/Dan_Burden_Building_Livable_Walkable_Communities#Dan_Burden_on_Educating_City_Planners_and_Engineers.

- "Walkability Audit Tool," *Healthier Worksite Initiative*. Developed by the U. S. Department of Health and Human Services' Centers for Disease Control and Prevention: http://www.cdc.gov/nccdphp/dnpao/hwi/toolkits/walkability/audit_tool.htm. http://www.cdc.gov/nccdphp/dnpao/hwi/downloads/walkability_audit_tool.pdf.

- *Walkability Checklist—How Walkable Is Your Community?* Developed by the Safe Routes, Pedestrian and Bicycle Information Center, U. S. Department of Transportation, and the U. S. Environmental Protection Agency: http://katana.hsrc.unc.edu/cms/downloads/walkability_checklist.pdf.

- Jordana Maisel, Eleanor Smith, and Edward Steinfeld (August, 2008), *Increasing Home Access: Designing for Visitability.* Washington, DC: Public Policy Institute, AARP. http://assets.aarp.org/rgcenter/il/2008_14_access.pdf.

- Center for Livable Communities (1999), "The Economic Benefits of Walkable Communities," *Focus on Livable Communities.* Sacramento, CA: Local Government Commission. http://www.lgc.org/freepub/docs/community_design/focus/walk_to_money.pdf.

- U. S. Environmental Protection Agency (on line, 2011), *Aging Initiative*, "Building Healthy Communities for Active Aging Awards"— The principal goal of the awards program is to raise awareness across the nation about healthy

synergies that can be achieved when communities combine and implement the principles of smart growth with the concepts of active aging. Applicants are evaluated based on the overall effectiveness of their programs, level of community involvement and outreach, use of innovative approaches, and overall environmental and health benefits of the project. Description of the four 2010 award-winning projects and three prior award-winning projects, including contact information: http://www.epa.gov/aging/bhc/awards/2010/index.html.

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BROADBAND SERVICE PROVISION

Description:

Broadband service is high-speed internet connection through wires. The goal of universal broadband access is to provide a high-speed internet connection to everyone, even in rural areas, regardless of economic status. Basic broadband delivers data to the customer at least five megabits per second downstream, and at least one megabit per second upstream. Advanced broadband delivers data at least 45 megabits per second downstream and at least 15 megabits upstream per second. Advanced wireless broadband delivers data at least three megabits per second downstream and at least one megabit per second upstream over an internet protocol wireless network.

Two keys to the success of broadband service are its availability and its use by community residents, including older people and people with disabilities—for example, internet technologies have an impact on both these populations socially, economically, and with health care issues. Educating older adults and younger people with disabilities about the benefits of broadband internet use is key to their adoption and use of current technologies. Access can be through the home, the senior center, community center, or the public library. In addition, the availability of broadband service supports the provision of health care services in rural areas. For example, rural providers rely heavily on the Internet for health and medical information, and rural nurse practitioners use the Internet for clinical information and for taking needed educational courses through on-line learning venues.

The federal economic stimulus plan included nearly $179.9 million to upgrade New York's internet broadband services in areas not currently covered. The focus of the New York State Universal Broadband Initiative is to ensure that every New Yorker has access to affordable, high-speed broadband. This also includes infrastructure development, digital literacy, economic development, and online government services. The U.S. Department of Agriculture's Rural Utilities Service program included $2.5 billion in loans and grants to target rural areas. The National Telecommunications Information Administration administers the Broadband Technology Opportunities Program, and has approximately $4.7 billion targeted to assist vulnerable populations (such as frail elderly persons and unemployed individuals of all ages).

Benefits:

For older people and younger-aged people with disabilities:

- When older adults and people with disabilities are educated about the personal benefits of broadband-enabled technologies, they can use these resources to live

healthier and more independent lives, stay connected to families and friends, and have greater access to amenities, supportive services, and medical care.

- Internet use can enhance social and civic engagement and decrease social isolation. Communicating via the internet can be cheaper and more convenient than long-distance phone calls. Web-cams can allow both a visual and audio connection, to enhance the experience of visiting and communicating with family and friends.

- Using the internet for reading daily papers, composing emails, working crossword and Sudoku puzzles, engaging in on-line brain-building exercises, doing personal research, playing games, and many other activities stimulates the brain, promotes mental sharpness, and helps maintain cognitive abilities throughout the aging process.

- High-speed broadband access will support the ability of older adults and younger individuals with disabilities to maintain or extend their working careers. For example, those who are semi-retired or who engage in freelance work (as a first or second career) can enjoy the benefits of telecommuting with increased flexibility.

For caregivers:

- Internet use provides an affordable, effective tool for caregivers to communicate regularly with their elderly or impaired family members—regardless of the geographic distance between them. Such regular contact helps caregivers keep abreast of the physical, emotional, and cognitive status of their family members, thereby reducing the daily worry about the safety and well-being of those family members.

For the wider community:

- The internet can have an impact on small-business creation, as the associated start-up and operating costs of web-based businesses are dramatically lower than traditional bricks and mortar businesses.

- Using the internet for personal financial management tasks and for conducting routine daily activities can have a positive personal economic impact for community residents, including older adults and people with disabilities[1]—for example, residents can monitor retirement accounts, track investments in stocks and bonds, conduct online banking, and pay bills. Without leaving their homes, residents can research and purchase prescription drugs, manage health care benefits, choose doctors and hospitals, research symptoms and treatments of illnesses, and communicate with their health care professionals. They can do their grocery shopping, make appointments, arrange travel plans, download books and videos, and many other activities from the comfort and security of their homes—and at any hour of the day or night.

- High-speed broadband service offers the potential to significantly enhance the provision and efficiency of health and long-term care services, as well as reduce costs—for example, replacing traditional record-keeping methods with electronic medical record-keeping, and taking advantage of new health care technologies such as telemedicine and in-home monitoring technologies, which are transforming how diagnoses are made, services are provided, patients are monitored, and communications are increased between patients and health care providers.
  - Many of these changes allow residents to take a much more active role in their own health care, including personally interacting with health care providers directly from their own homes. Patients of all ages and disabilities whose conditions require daily monitoring are now able to download the data from their monitoring equipment from the privacy and comfort of their homes, reducing the hours and cost of in-home aides or saving the cost of nursing home care.
  - Telemedicine and in-home care technologies have three important, and increasing, audiences: the older adult or person with a disability, who can enjoy prolonged independence; families or caregivers, who want the security of knowing their loved one is in good hands; and the health care staff, who can monitor the patient continually to identify concerns.[2]

- Broadband service can keep a community's residents safer; for example:
  - Real time information and intelligence can be shared with first responders by adding wireless computers to patrol cars to improve emergency and day-to-day communications.
  - Emergency 911 services can be extended to rural or remote areas that formerly were without coverage.

- Internet use provides an effective means for a community's residents to follow and have an impact on politics at the local, state, and federal levels. State and local governments can provide better and more cost-efficient services through internet access so that all "e-citizens," including older adults, people with disabilities, and homebound individuals, can be full participants in the information age and can be more fully active and involved in their communities.

Impediments or barriers to development or implementation:

- Service gaps:
  - There are gaps in broadband service provision across New York State, especially in the rural regions.
  - Vision and leadership are required to make the right business decisions to bring broadband service to rural and remote areas, where the cost of extending the necessary infrastructure is prohibitive. For example, a service company would not see a good return on their investment in rural areas with small populations.

- Limited resources:
  - State and local governments may have insufficient resources to dedicate to closing the "digital divide"; collaborations between public and private entities can be successful and should be encouraged.

- "Gray gap":
  - Internet awareness and use are higher among younger seniors compared to older seniors (the so-called "gray gap"). Older seniors, particularly those who do not live in their own homes, remain more skeptical of the internet's use and benefits and they are less likely to own their own computer. The relative high cost of computer hardware and software, coupled with broadband service availability, also impedes internet usage.[3]

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[2] Ibid, pp. 20-23.

[3] Ibid, pp. 9-10.

Resource—statutory authority:

The Federal *American Recovery and Reinvestment Act of 2009*: for the fiscal year ending September 30, 2009 supplemental appropriations were made for job preservation and creation, infrastructure investment, energy efficiency and science, assistance to the unemployed, and state and local fiscal stabilization. http://www.recovery.gov/Pages/home.aspx.

Resource—examples:

- The Veteran's Administration (VA) has been using telemedicine services for over 30 years for in-home and outpatient settings, using VOIP (voice over internet protocol), internet, and broadband. The VA's home telehealth program cares for 35,000 patients and is the largest of its kind in the world. A recent study[4] by the VA of 17,025 of its home telehealth patients found a 25 per cent reduction in the average number of days hospitalized and a 19 per cent reduction in hospitalizations for those patients using home telehealth. Findings also showed that, for some patients, the cost of telehealth services in their homes averaged $1,600 a year – much lower than in-home clinician care costs.

- Today, between 700-800 telemedicine networks are functioning. In Binghamton, New York, telemedicine is used in virtual pediatrics in Binghamton, New York, and is used for diabetes control in Ohio, Virginia, and Pennsylvania. Within the next five years, major hospitals will be conducting their internal "in-

take to discharge" functions electronically, using patient-carried "Smart Health Cards" (which is now being done in Europe).

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PEDESTRIAN-FRIENDLY COMMUNITY DESIGN

Description:

In the 19th and early 20th centuries, most cities and villages were developed in a dense grid pattern—easily serviceable by streetcar, rail, and bus systems. Those tightly developed communities were, *by design*, pedestrian-friendly—built on a scale that permitted residents to easily walk from their homes to merchants and, sometimes, to their places of work. In addition, if those destinations were not within an easy walk, transit stops often were.

Most housing developments, shopping centers, office complexes, and industrial parks built since the 1950s have been oriented toward facilitating easy automobile travel and parking, while separating residential and commercial uses by distances that almost mandate the use of a car to make even short trips. For example, even if the distance between a housing development and a shopping center is a short one, walking along roads without sidewalks, crossing a highway, and traversing a large parking lot is less attractive, and often dangerous, for most people compared to driving in such an environment.

Typically, land-use arrangements since the 1950s do not provide an environment conducive to walking, biking, or jogging, thus placing constraints on residents' mobility and social interaction. Residents, including older adults and individuals with disabilities, are more inclined to use alternative mobility modes in a tightly built neighborhood with sidewalks and other pedestrians and where there are no highways, traffic on local streets moves slowly, and parking lots are small. Very recent planning trends have returned to valuing places that accommodate walking, biking, and public transportation as alternatives to driving personal cars. People of all ages and abilities are discovering the many benefits of pedestrian-friendly communities, including physical fitness and greater opportunities for interactions with other people.

Benefits:

- *Placement of Land Uses*—
  Compact development (density) reduces the distance required for travel between residences, employment, commercial and retail establishments, and services. Mixed-use zoning places a variety of life's daily needs—home, work, school, recreation, retail, health, civic, others—within close and/or accessible proximity via travel modes other than the car. The combination of density and mixed-use creates a built environment that is more conducive to walking, as well as to using bicycles, roller-blades, wheel-chair travel, small motorized vehicles, and mass transit—all to the benefit of older adults, children, people with mobility impairments, and individuals with and without disabilities—who prefer or require alternatives to the automobile. Both density and mixed-use

require zoning codes that accommodate these pedestrian-friendly design attributes.

- *Street and Streetscape Design*—
  Streets and streetscapes can be designed to create a safe and comfortable pedestrian experience, which is important to people of all ages and abilities. In many cases, poor design entirely precludes walking or any other mode of travel but the automobile.

  Pedestrian-friendly street and streetscape design includes wide sidewalks, narrower streets, cross-walks, landscaped medians, street trees and planting strips, and generous bike lanes. In addition to creating a safe and comfortable physical environment for pedestrians and bicyclists, these design elements also calm traffic (see *Safe Driving Strategies: Traffic Calming* in the *Resource Manual*). Drivers respond to their surroundings and most often adhere to the speed that streets were designed to be driven; if those streets are designed for slower travel, drivers will respond accordingly; if their surroundings signal pedestrian activity and set boundaries to their driving, drivers slow down—for their own safety and that of the pedestrians.

- *Grid-Style Street Connectivity*—
  "Street connectivity is a measure of how well the roadway network connects what planners call origins and destinations. Good street connectivity means providing a *variety* of ways to get from Point A to B. The traditional grid-style street layout of older towns provides excellent connectivity—streets are interlinked at numerous points, intersections are closely spaced, and there are few dead-ends."[1] The goal is to narrow the gap between the *actual* distance from Point A to Point B and the *real travel* distance between the two destinations, which is accomplished by connecting homes and land uses in a more gridded, inter-connected pattern. Greater street connectivity and linkages between land uses offer more travel route options, quicker and easier access to daily destinations, and reduced traffic congestion and traffic bottle-necks created when all residential streets converge on single, over-loaded arterials.

  Public trails can also be used to connect land uses; trail and street connections to parks and other public spaces are particularly important because they allow residents of all ages and abilities to walk or bike to outdoor areas for recreation, exercise, and social interaction (see *Complete Streets* in the *Resource Manual*).

- *Neighborhood Scale*—
  Many experts agree that the ideal size for a pedestrian-friendly neighborhood with an accessible town/urban center is a quarter-to-a-half-mile radius; this is the distance that people will walk to access daily amenities and destinations. The author/planner, Leslie Kettren, broke down this analysis as follows: “A five-minute walk (one-quarter mile) is as easy as a trip by car. A 10-minute walk (one-half mile) is easily achieved and is a good basis for planning a compact neighborhood or village. A 20-minute walk (one mile) is a reasonable distance to walk for exercise when the area is pleasant.”[2]

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COMPLETE STREETS
Street and Streetscape Design Reforms

Description:
The "Complete Streets" movement, spearheaded by the National Complete Streets Coalition, most fully embodies the principles of safe and comfortable pedestrian, bicycle, and transit travel. Complete Streets takes a holistic approach to community mobility; that is, rather than addressing street and streetscape reform piecemeal, Complete Streets ordinances offer a comprehensive toolbox for street and streetscape design that is age-sensitive (older people and children), and that also responds to the great diversity that typifies a community's overall population—diversity of abilities, both temporary and permanent impairments, and health conditions. This movement is growing across the country, and several states and localities have passed Complete Streets ordinances (see Resources, below).

Complete Streets are designed to provide safe, comfortable streets for all users—pedestrians, bicyclists, motorists, transit riders, and users of other modes of mobility. Complete Streets combine elements of Smart Growth and walkable communities in a way that promotes safety, exercise, outdoor recreation, access to amenities, and social interaction for seniors, young and middle-aged adults, individuals with disabilities and mobility limitations, and children.

Complete Streets are characterized by a variety of elements; following are descriptions of seven specific tools in the Complete Streets toolbox:

More sidewalks: According to architect Mark Hinshaw,[1] sidewalks should be located on both sides of the street; if located on only one side, adequate street-crossing measures should be implemented. In a typical suburban residential neighborhood, sidewalks should be wide enough to accommodate two people walking side-by-side or passing each other—approximately five feet; in a more dense, mixed-use residential neighborhood, wider sidewalks are necessary to accommodate three people waking side-by-side, or two side-by-side and one passing—approximately seven feet; and in areas of heavy pedestrian circulation (downtowns, Main Streets, traditional business districts), sidewalks should be wide enough to accommodate two people passing each way—10 feet or more. To the greatest extent possible, sidewalks should be continuous and should inter-connect different neighborhoods, destinations, and land uses.

Neighborhood trails: Where sidewalks are not feasible, neighborhood connector trails serve as a worthwhile substitute—connecting homes, subdivisions, parks, open space, and other amenities. Connector trails can be used in low-density subdivisions (particularly ones with a predominance of cul-de-sacs and dead-ends) to connect areas that may be close "as the crow flies," but require long, circuitous and often dangerous routes to actually navigate by foot or bicycle.

Street widths: For decades, traffic engineers recommended wide streets to accommodate more cars and higher speeds. Even in traditional downtowns, which were originally designed primarily for pedestrians, streets were widened to accommodate automobile travel, rendering them unsafe to walk or bike—particularly for seniors, children, and others with mobility restrictions. Recently, however, traffic engineers have found that road widenings are little more than a temporary salve. In referring to Mark Hansen's 1995 study (*Do New Highways Generate Traffic?)*, Anthony Flint[2] reports that every one per cent increase in lane miles leads to a one per cent increase in congestion within five years. This phenomenon is called "induced demand"—the more roads you build, the more cars you will attract.

Counter-intuitively, narrower streets are actually safer—safer to cross on foot and bike, and safer to drive on. Citing a study in Longmont, Colorado, by Swift, Painter, and Goldstein[3] on the correlation between street design and traffic accidents, Girling and Kellett[4] report that a 36-foot-wide street had 1.2 collisions per year, while a 24-foot street had .32. The Longmont study found that 24-foot-wide streets are the safest; 36-40-foot-wide street are the most dangerous.

Typical post-war suburban streets are 34-36 feet wide, with total rights-of-way of 50-60 feet. This width invites unsafe speeds, which, in turn, discourages pedestrian and bicycle mobility. Some recent national standards (American Society of Civil Engineers: National Association of Home Builders; Urban Land Institute), however, are recommending streets as narrow as 22 feet for neighborhoods with low-traffic volumes.[5]

Several alternatives to road-widening are available to land use and transportation planning professionals; for example:

- Use extra road space (shoulder) for bike lanes—well-marked lanes actually make the road itself appear narrower and feel safer, while signaling to drivers that they should slow down and drive more cautiously;

- Create nearby alternative routes—parallel roads close by will disperse the traffic among several routes, while preserving pedestrian accessibility and safety on each of them; and

- Expand a pedestrian area into traditional street areas—providing a pedestrian "safety zone" promotes safety and comfort.

Shorter blocks / more inter-connections: Most traditional, walkable neighborhoods designed in the late 19th and early 20th centuries have 300-600-foot blocks; that is, cross routes/intersections exist at regular and frequent intervals. For example, the Portland, Oregon, Green Streets Ordinance[6] requires through-streets no more than 530 feet apart and pedestrian connections every 330 feet, where feasible. Such requirements offer advantages for all residents, but especially for older adults with frailties, small children, and other individuals with mobility impairments; for example:

- More linkages that access different land uses and amenities;
- More opportunities for walking and outdoor exercise;
- A more interesting pedestrian or bicycle trip;
- A greater feeling of safety;
- More direct and, thus, shorter routes to destinations; and
- A greater sense of place.

In addition, neighborhood connector trails can be located at areas where sidewalks are absent, in order to supplement a continuous and frequent system of inter-connections. Also, restrictions on the length and number of cul-de-sacs and dead-ends in a conventional suburban subdivision offer connectivity improvements. For example, the Metro Portland, Oregon, metropolitan region sets a maximum length of 200 feet for cul-de-sacs, which are only permitted where street and trail connections are not possible.[7]

"Green streets": Street landscaping and vegetation (street trees, planting beds, landscaped medians and sidewalks, pervious natural draining areas, etc.) provide human, as well as environmental, benefits: shade and cooling in the summer; aesthetic appeal; traffic-calming; and a sense of place. Researchers at the U. S. Federal Highway Administration and Canada's Victoria Transport Policy Institute even found that drivers drive slower on green streets, thus creating a safer and more enjoyable pedestrian experience.[8]

Cross-walks: Cross-walks provide clearly designated pedestrian areas for street-crossing—areas where people come first, and cars second. Cross-walks signal to drivers (more effectively than a sign) that they should slow down and be aware of pedestrian activity.

Protective barriers: Green areas between the street and sidewalk, on-street parking, and street trees provide a protective barrier between pedestrian areas and traffic, creating a greater sense of safety, security, and comfort for pedestrians.

Benefits:

For all residents:

- Complete Streets promote physical and mental health by:
  - Providing greater exercise and mobility options;
  - Improving pedestrian and driver safety; and
  - Creating opportunities for socializing and community activity.

For older adults and individuals with disabilities:

- Complete Streets allow frail older people and younger people with disabilities to continue to independently navigate their environment, thereby maintaining a sense of competency and reducing vulnerability to depression.

For the community:

- As a critical aspect of a livable community, Complete Streets :
  - Help create a healthier and more sustainable living environment;
  - Help generate a greater sense of place and community identity for residents and encouraging them to remain living in the community rather than relocating to other areas.
  - Make both commercial and residential areas more attractive, creating increased resident activity which, in turn, generates increased business activity by community establishments and stores.

Impediments or barriers to development or implementation:

- Existing zoning and development patterns have created an environment almost exclusively conducive to automobile travel, which makes mobility alternatives (walking, bicycling, alternative transit use) unsafe and uncomfortable, if not entirely impossible.

- Retro-fitting existing communities with green street amenities can be expensive.

- Planning for various community elements (housing, parkland, commercial, mobility and transportation, etc.) is often conducted independently of each other, thereby reducing the opportunity of coordinating the application of a Complete Streets approach to the overall community.

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STREET CONNECTIVITY

Description:

Connecting land uses, neighborhoods, and districts through a well-planned, inter-connected road network provides manifold benefits to seniors. Citing Professional Traffic Engineer, James Daisa, authors Handy, Paterson, and Butler[1] define street connectivity as ". . . a system of streets with multiple routes and connections serving the same origins and destinations . . . . An area with high connectivity has multiple points of access around its perimeter as well as a dense system of parallel routes and cross-connections within the areas . . . . The connectivity of the street network has important implications for travel choices, emergency access, and, more generally, quality of life." Connectivity is also an element of the Complete Streets framework (see *Complete Streets* in the *Resource Manual*).

Street connectivity was the rule in most late 19th and early 20th century communities. A gridded system of streets with regular access and exit points offered several travel options for drivers, thus dispersing traffic and avoiding congestion and bottle-necks. This system complemented the more prevalent compact, mixed-use built environment of the time.

After World War II, however, connectivity gradually became the exception. Instead, suburban communities were planned and built on a hierarchical system of roadways—partly as a rejection of the urban neighborhood form from which many families fled, and partly to accommodate the proliferation of automobile travel and ownership. The hierarchical system functioned (or not) like this: wide, local neighborhood roads connected isolated subdivisions (many dominated by cul-de-sacs and dead-ends) to a limited number of neighborhood collector streets; these collector streets delivered cars to minor and major arterials, usually at a limited number of access points; and these arterials then connected to freeways and highways. The system also included wide, winding neighborhood roads with no sidewalks, which made pedestrian, bicycle, and transit travel nearly impossible.

In its earlier stages, this system functioned well. But as the suburbs became more crowded, traffic problems worsened—bottlenecks at peak hours (and throughout the day, in some instances) became commonplace, and traffic congestion on arterials increased. Drivers stuck in traffic had no, or limited, alternative routes.

This approach to street design and traffic management was bolstered by the Institute of Transportation Engineers (ITE) manual, which set road standards that most municipalities simply adopted in full. The ITE manual, for example, recommended minimum street widths of 32-34 feet, and rights-of-way of 60 feet. Additionally, the Federal Highway Administration set neighborhood design standards based on this system of roadway design as a condition of eligibility for the long-term, low-interest mortgages that allowed many families to afford

suburban homes. Cul-de-sacs were treated by these authorities as the most desirable street layout for suburban communities.[2]

This road system accommodated the market for housing at the time—the American Dream of a large house on a large lot, secluded from other homes and buildings (this housing preference still dominates the home-buying market). This system reduced through-traffic, thus providing the privacy and isolation sought by families leaving the cities; and cul-de-sacs were seen as the safest environment for raising children. The downside was increased traffic congestion, decreased walkability/bikability, limited or no transit options, and complete reliance on the automobile.

But times are changing; many land use and transportation planning professionals are advocating for a more inter-connected street design system that promotes walking, biking, transit, slower car speeds, and greater quality-of-life. As a sign of the times, the ITE teamed up with the Congress for the New Urbanism and Smart Growth America to develop pedestrian- and neighborhood-friendly street and streetscape designs.[3] And, the American Society of Civil Engineers, the Urban Land Institute, and the National Association of Home Builders have worked together to promote integrated land use and transportation planning to create more livable communities.

References:

[1] Susan Handy, Robert Paterson, and Kent Butler (2003), *Planning for Street Connectivity: Getting from Here to There*, pp. iii and iv. Chicago, IL: American Planning Association.

[2] Michael Southworth and Eran Ben-Joseph (June 27, 2003), *Streets and the Shaping of Towns and Cities,* p. 84. Washington, DC: Island Press.

[3] Institute of Transportation Engineers (January, 2005), *Context-Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities.* Washington, DC: Institute of Transportation Engineers. Electronic version: http://www.ite.org/css/.

Benefits:

- Connecting land uses, neighborhoods, and districts through a well-planned, inter-connected road network provides multiple benefits to older adults, families, and people with disabilities, as well as the overall community:
  - A more active and social community life, increasing communication and connections among residents of all ages and cultures and, thereby, strengthening a community's social capital and its community identity;
  - Safer, more direct, and more varied routes to destinations;
  - Mobility alternatives to the car, thereby saving energy costs;
  - Traffic-calming and traffic safety, thereby reducing accidents;
  - More access points for emergency vehicles; and
  - A greater "sense of place."

Impediments or barriers to development or implementation:

- Wholesale adoption of a street-connectivity framework may not be supported by all community residents, or may not adequately respond to the needs of all relevant stakeholders. For example, residents who still prefer the privacy and less traffic associated with non-connected residential street systems may resist efforts for greater street connectivity. This emphasizes the need for community-wide discussions to identify the areas of the community in which street-connectivity principles will benefit residents and those areas that should remain the same.

- Street-connectivity often induces more neighborhood through-traffic, which may be undesirable. This can be minimized by including traffic-calming strategies (see Traffic Calming section in the Resource Manual) can result in slower, calmer traffic, or even deter through-traffic, because such measures eliminate the driver-convenience of cutting through neighborhoods.

Emergency access/response – benefits *and* impediments:

- Both the conventional, disconnected road system *and* the inter-connected approach embodied in the Complete Streets approach have benefits and shortcomings for emergency vehicle access and response times. Because emergency services are such an important part of a community, planning efforts should actively consult and engage fire and emergency professionals to strike a workable balance between the two interests:
  - Generally, emergency responders prefer greater connectivity because it provides greater, quicker and more direct access to an incident. The Raleigh, NC, Transportation and Planning Department studied fire and Emergency Management System efficiencies in three different area neighborhood types: (1) older, traditional, gridded development; (2) neighborhoods built in the 1970s and 1980s with limited connectivity and few dead-ends; and (3) developments from the late 1980s and 1990s with very limited connections and many cul-de-sacs and dead-ends. According to the City of Raleigh Department of Transportation, "In all cases, the analysis showed far greater service efficiencies for those older neighborhoods with greater street connectivity. Even when discounting the density of development in these areas, the raw acreage covered in each case confirmed the greater efficiency in fire response coverage for areas with better street connectivity."[4]
  - At the same time, emergency responders prefer wider streets for increased vehicle mobility. Wide roads with no curbs and wide turning radii can better accommodate large emergency response vehicles, such as fire trucks. But research shows that these roads result in more accidents. In addition, cul-de-sacs and dead-ends present dangers for emergency response services—the first vehicle in may be blocked in by subsequent vehicles; subsequent vehicles may be prevented from getting closer to the incident; and, if a single access point is blocked, no alternative routes exist.

Reference:

[4] Susan Handy, Robert Paterson, and Kent Butler (2003), *Planning for Street Connectivity: Getting from Here to There*, p. 56. Chicago, IL: American Planning Association.

Resource—examples and ordinances:

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- Division of Planning (March, 2009), *Street Connectivity: Zoning and Subdivision Model Ordinance.* Frankford, KY: Kentucky Transportation Cabinet (the state agency charged with overseeing the highway, rail, and aviation infrastructure). http://transportation.ky.gov/Congestion-Toolbox/Documents/KYTC%20Street%20Connectivity%20Model%20Ordinance.pdf.

- *Street Connectivity*, New Jersey State Department of Transportation: http://www.state.nj.us/transportation/works/studies/rt57/pdf/StreetConnectivity..pdf.

- *Emergency Response and Street Design*, Congress for the New urbanism: www.cnu.org/emergencyresponse.

- *Westfield Connections: The Westfield Community Planning & Design Initiative,* Village of Westfield, New York: www.villageofwestfield.org/WestfieldConnections081004.htm.

Resource—written and web:

- Tom Kloster, James Daisa, and and Rich Ledbetter (1997?), *Linking Land Use and Transportation Through Street Design*, a Metro-Portland, Oregon, Planning Street Design Study: http://onlinepubs.trb.org/Onlinepubs/circulars/ec019/Ec019_b4.pdf.

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- Michael Southworth and Eran Ben-Joseph (1996), *Streets and the Shaping of Towns and Cities.* Columbus, Ohio: McGraw Hill Publishers.

- *Roadway Connectivity: Creating More Connected Roadway and Pathway Networks*, Victoria Transport Policy Institute, Victoria, BC, CA: www.vtpi.org/tdm/tdm116.htm.

- *Context-Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities.* American Society of Civil Engineers, Urban Land Institute, and the National Association of Home Builders.

- *Interconnected Street Systems*, City of Raleigh, NC, Department of Transportation, accessible at www.raleigh-nc.org/planning/interconnected.htm.

- Dan Burden and Paul Zykofsky (December, 2000), *Emergency Response, Traffic Calming and Traditional Neighborhood Streets.* Sacramento, CA: Center for Livable Communities: available on-line: http://www.lgc.org/freepub/docs/community_design/guides/emergency_response_manual_2001.pdf.

- Local Government Commission, Sacramento, CA: http://www.lgc.org/issues/communitydesign.html.

- *Walkable Streets and the Fire Department*, Center for Livable Communities: http://www.lgc.org/issues/communitydesign.html.

- Reid Ewing, et al (August, 2007), *Skinny Streets and Fire Trucks*, Urban Land Institute.

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Recreation—Parks and Other Outdoor Spaces

Description:

In 1900, most Americans lived in rural areas and on farms and had plenty of fresh air, ready opportunities for exercise, and easy access to greenery as part of their daily routines. Today, more than 80 per cent of Americans live in metropolitan areas, and the growing population in many of these areas carries with it increased demands on existing parks and outdoor recreational facilities. Many community leaders understand the benefits of planning for parks and outdoor areas, and community gardens flourish in many urban places, providing a park-like setting for visitors and a place for urban dwellers to garden.

Recreation has physical, psychological, economic, and environmental benefits, all of which help people stay mentally and physically fit. Park and outdoor recreation areas located close to home or to other often-used amenities are the most beneficial, as people are more likely to incorporate a visit or a stroll into a daily routine if parks and trails are close to home or to other community resources such as senior centers, libraries, and shops. The farther away parks, trails, camps, fishing, and natural areas are from home, the less likely people are to visit them.

Municipalities can relatively easily make a variety of recreational options available to a community's various members (including older adults and individuals with disabilities), all of whom might enjoy walking, bird watching, bocce ball, golf, shuffle board, tennis, swimming, tai chi, boating, gardening, or many other activities.

Benefits:

For residents of all ages:

- Improved physical and mental health—
  - Regular physical activity improves fitness, lowers blood pressure, and is a tool in the arsenal to combat obesity and diabetes.
  - Exercise can be a mood-elevator, alleviating depression and anxiety, which is especially important for frail older adults and younger individuals with disabilities, as both groups are vulnerable to social isolation and limited social networks.
  - Parks and other green recreational areas that provide comforts and amenities, such as benches, tables, games such as chess or checkers, exercise and fitness paths, public restrooms, telephones, lighting, first aid stations, water fountains, and accessibility features will foster an increased sense of security and attract greater use of these areas by residents of all ages, especially young children, older adults, people with special needs, and individuals with disabilities. This encourages a balance of resident-users, which promotes a greater sense of community.

For residents and communities:

- Community gardens transform vacant lots into productive and beautiful neighborhood spaces, which can beautify the neighborhood, give residents a sense of accomplishment, improve community members' access to fresh fruits and vegetables, and reduce food budgets.

For communities:

- Social benefits:
  - Recreation areas are an element of a livable community, providing areas for residents of all ages to meet socially and interact—strengthening community identity and a vibrant sense of community.
  - Well-maintained recreation areas within neighborhoods provide good socializing and activity opportunities for children and teenagers, helping to mitigate undesirable behaviors that can emerge from "having nothing to do."
  - "Nature Centers" serve as an in–park community center for public education, recreational activities, resident-socialization, and volunteer opportunities for residents of all ages and abilities.

- Environmental benefits:
  - In parks and other outdoor recreational areas, trees and shrubs absorb air pollution, improving the quality of the air we breathe.
  - Trees provide shade and cool the earth, which is nature's version of natural air conditioning.
  - Trees and bushes provide a filter system for the pollutants in storm water run-off, helping to keep such pollutants from entering storm drains and going into rivers and streams.
  - Parks provide an effective habitat for wildlife, especially for migrating birds in urban areas. Waterfront areas are rich ecosystems.

- Economic benefits:
  - Homes and businesses that are in close proximity to parks and outdoor recreation areas have shown increased property values.
  - Parks and waterfront developments featuring walking paths and trails promote tourism and bring local tax dollars to the community.

- Social benefits:
  - Parks and open-spaces recreational areas provide places for all socio-economic groups to mix and socialize, promoting interaction and helping to stabilize neighborhoods, which, in turn, can engage the interest of multiple resident groups in community planning and community efforts, and reduce crime.

Impediments or barriers to development or implementation:

- During trying fiscal times, the decision to expend scarce resources to upgrade parks and purchase land to dedicate to open space becomes increasingly challenging. In some places, parks close; in others, maintenance is deferred.

- Park and recreational areas that are not well-maintained (and, therefore, not used by many people) can attract vandalism and other crimes.

- Existing parks may lack necessary comforts, amenities, and ADA accessibility compliance. They may be older and designed only for passive recreational needs, and do not meet today's recreational and fitness preferences and options among all age and ability groups, such as bicycling, swimming, Tai Chi, trekking, and others.

- Paths and trails may not be connected between municipalities, reducing recreational choices that regional trail systems would provide.

- Assembling parcels to create new parks in developed areas is complex and expensive and, even when done successfully, is a very long process.

Resource—statutory authority:

- Reservation of park land on site plans containing residential units:
  - Town Law §274-a(6);
  - Village Law §7-725-a(6);
  - General City Law §27-a(6).

- Reservation of park land on subdivision plats containing residential units:
  - Town Law § 277 (4);
  - Village Law §7-730 (4);
  - General City Law §33 (4).

Resource—examples:

- *Universal Access Program*—highlights recent improvements to recreational facilities on New York State lands for accessible camping, fishing, boating, bird watching, and exploration of natural areas. Albany, NY: New York State Department of Environmental Conservation. http://www.dec.ny.gov/environmentdec/39010.html.

- *Hudson Valley Greenway Act of 1991*—authorized the planning of a 150-mile greenway from Battery Park in Manhattan to Troy, New York. The Hudson River Valley Greenway promotes a voluntary regional strategy for preserving scenic, natural, historic, cultural, and recreational resources. http://www.hudsongreenway.ny.gov/Libraries/PDF_s/GreenwayAugust2008.sflb.ashx.

- *New York City policy*—leashed dogs are welcomed in New York City parks, and unleashed dogs are allowed in certain designated areas. http://www.nycgovparks.org/facilities/dogruns.

- *Capital District Community Gardens*—manages 46 cooperative neighborhood food gardens in New York's Capital Region. The organization organizes annual

street tree-plantings in the Capital District municipalities of Troy, Cohoes, Green Island, and Rensselaer, and operates the Veggie Mobile, a mobile produce market that makes fresh produce more affordable and accessible for low-income, inner-city residents. http://www.cdcg.org/.

- *San Antonio River Walk*, San Antonio, Texas: www.thesanantonioriverwalk.com.

Resource—written and web:

- *Local Open Space Planning Guide* (2004; reprinted May, 2007), Albany, NY: New York State Department of State. A collaborative project of the New York State Department of State; New York State Department of Environmental Conservation; New York State Department of Agriculture and Markets; New York State Office of Parks, Recreation and Historic Preservation; and the Hudson River Valley Greenway—which sets forth a simple step-by-step process for preparing a local open space conservation plan, recommends specific strategies and techniques for conserving open space, and includes useful sources of information.
  http://www.dos.ny.gov/LG/publications/Local_Open_Space_Planning_Guide.pdf.

- Paul Sherer (2006), *The Benefits of Parks: Why America Needs More Parks and Open Space, the Benefits of Parks.* San Francisco, CA: The Trust for Public Land. www.childrenandnature.org/uploads/parks_for_people_Jul2005.pdf.

- The Nature Conservancy—its mission is to preserve the plants, animals, and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive.
  National Office: Arlington, VA: http://www.nature.org.
  Nature Conservancy—New York State Office:
  http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/newyork/.
  Nature Conservancy—New York City office:
  http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/newyork/placesweprotect/newyorkcity/.

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COMMUNITY-BASED ALTERNATIVE FOOD SOURCE MODELS
(Achieving Food Security)

Description:
A community's "food security" is an important factor in determining its livability. The U. S. Department of Agriculture (USDA) defines food security as "access by all members [of a community] at all times to enough food for an active, healthy life."[1] Individuals and families experience food *insecurity* when their diets are of reduced quality or variety—because they cannot afford balanced meals, or lack knowledge of nutritious foods, or when, because of accessibility or cost, they run out of food, cut the size of their meals, miss meals, are hungry but do not eat, or they lose weight because of a lack of sufficient food.[1]

Readily available, nutritive food is vital for thriving human habitats. Upon superficial assessment of communities in the United States, it would seem that there is plenty of food to go around. However despite the ubiquity of supermarkets, grocery stores, convenience stores, and restaurants, inadequate food security remains an issue among many of our residents.

In its analysis of the 2009 Current Population Survey, the USDA found that approximately 15 per cent of households in the United States (17.4 M households—over 50 M people, including over 17 M children) were food insecure at some time during 2009—that is, were uncertain of having, or were unable to acquire, enough food to meet the needs of all their family members because of insufficient money or other resources for food.[2]

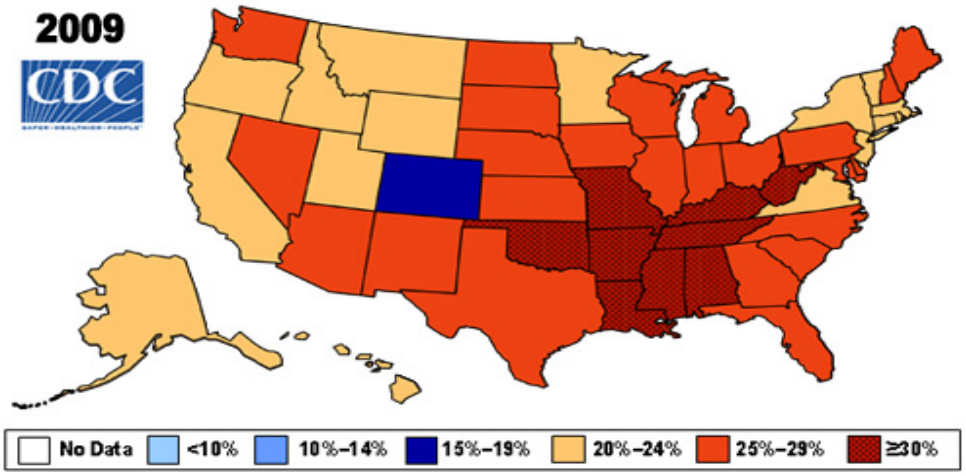
Source: United States Department of Agriculture, Economic Research Service, based on Census Bureau, Current Population Survey, Food Security Supplemental Data.

http://www.ers.usda.gov/Briefing/FoodSecurity/stats_graphs.htm[2]

Food insecurity and obesity—
Obesity and overweight are fast becoming characteristics associated with those who do not have enough money for higher quality food or who make poor food choices due to economic hardship.[3] It is estimated that one in three adults over age 20 is overweight or obese, and approximately one in five children ages 2 through 19 is overweight or obese.[4, 5]

Some communities are virtual food deserts, where convenience stores and fast food restaurants are relied upon for relatively more expensive, less nutritive food. Both zoning ordinances and food code regulations can, without meaning to, increase access to those foods, promoting overweight and obesity. Often, zoning restrictions governing allowable locations for alternative food sources can inadvertently increase demand for lower quality food by requiring extensive travel by consumers to access more nutritious alternative sources.[6] However, food security is not just an issue of accessibility (location, cost); the *types* of foods that fill conventional food outlets are also a significant food security problem. Whereas alternative food source models (see below) tend to provide a variety of fresh fruits and vegetables (foods that are associated with both weight control and the prevention of chronic illnesses, such as diabetes), consumption of these nutritive foods tends to be low among people experiencing food insecurity.[7] Instead, those who are food insecure tend to consume foods that are inexpensive, convenient, energy-rich (high in sugar), but nutrient-poor; and this pattern has been linked to the increased prevalence of obesity.[8] Some food code regulations may have also inadvertently increased demand for lower quality, factory-packaged foods, as factory-packaged or heavily processed foods may be seen by consumers as safer because of the stringent public health laws that govern their development.[6, 9]

Percent of Obese Adults (BMI ≥ 30) in the U.S.[10]



http://www.cdc.gov/obesity/data/trends.html#State10

2009 State Obesity Rates[10]							
State	**%**	**State**	**%**	**State**	**%**	**State**	**%**
Alabama	31.0	**Illinois**	26.5	**Montana**	23.2	**Rhode Island**	24.6
Alaska	24.8	**Indiana**	29.5	**Nebraska**	27.2	**South Carolina**	29.4
Arizona	25.5	**Iowa**	27.9	**Nevada**	25.8	**South Dakota**	29.6
Arkansas	30.5	**Kansas**	28.1	**New Hampshire**	25.7	**Tennessee**	32.3
California	24.8	**Kentucky**	31.5	**New Jersey**	23.3	**Texas**	28.7
Colorado	18.6	**Louisiana**	33.0	**New Mexico**	25.1	**Utah**	23.5
Connecticut	20.6	**Maine**	25.8	**New York**	24.2	**Vermont**	22.8
Delaware	27.0	**Maryland**	26.2	**North Carolina**	29.3	**Virginia**	25.0
Washington DC	19.7	**Massachusetts**	21.4	**North Dakota**	27.9	**Washington**	26.4
Florida	25.2	**Michigan**	29.6	**Ohio**	28.8	**West Virginia**	31.1
Georgia	27.2	**Minnesota**	24.6	**Oklahoma**	31.4	**Wisconsin**	28.7
Hawaii	22.3	**Mississippi**	34.4	**Oregon**	23.0	**Wyoming**	24.6
Idaho	24.5	**Missouri**	30.0	**Pennsylvania**	27.4		

http://www.cdc.gov/obesity/data/trends.html#State10

Alternative food source models—
Alternative food sources are methods of achieving food security that can supplant or supplement a community's conventional methods of accessing food. Alternative food sources can be grouped into four categories:

- Producers as consumers[11] (those growing the food consume what they produce, such as in a community garden);
- Producer-to-consumer partnerships[11] (growers develop a direct, private relationship with specifically identified consumers of their food products, as in community supported agriculture (CSA) programs);
- Direct-sell initiatives[11] (growers sell directly to the general public, such as roadside food stands, mobile grocers, or farmers' markets); and
- Specialist retailers[12] (growers/producers of a specialized product privately sell directly to select consumers, such as online grocers and tourist programs).

Examples of alternative food source models—
Mobile grocers: Not your typical street vendor, mobile grocers (also called veggie mobiles and mobile farm trucks) are a relatively new way to sell fresh fruit and produce from a converted truck or school bus, which may or may not be refrigerated. They are typically operated by a community organization, and they differ from farm stands because mobile grocers usually target food deserts. The

mobile grocer generally operates on a fixed schedule year round and stops at specific sites that have been disclosed to the public in advance. Most mobile grocer operators are able to sell their produce for lower prices than supermarkets as the nature of their business typically requires them to purchase foods that are in season and locally produced. Mobile grocers tend to be middle men in the food system since the food they sell is usually not produced by the mobile grocer operator. Whatever is sold is first purchased by the mobile grocer from local farmers. Those operating mobile grocers typically must have a special permit to operate.

Farm stands (roadside/street-side): This is a temporary, small retail space where a commercial or part-time farmer sells his produce and other wares at a stand on the street or roadside. This is done on a much smaller scale (e.g., one or two farmers) than a farmers' market (multiple vendors). Those operating roadside or street-side farm stands usually have special permits to operate and may be required to move after so many hours of operation.

Farmers' markets: This alternative food source model allows many farmers to gather in one location, set up individual stations, and sell their produce and other wares to the public for an extended period of time. Farmers' markets are similar to open air markets and bazaars in other countries. Farmers' markets are usually held outdoors but can be held indoors during winter months or inclement weather. The markets operate weekly, monthly, quarterly, or seasonally; and vendors must have permits to operate.

Collective kitchens: Collective kitchens are also known as community kitchens and are unlike any other alternative food source model. Collective kitchens allow a group of people to come together at designated times (e.g., weekly, fortnight, monthly) to prepare meals.[13, 14, 15, 16] Usually conducted in the kitchens of schools and churches,[13] collective kitchens allow participants to share the costs of food and food preparation, as well as provide a means for socializing with other community members. In addition, participants learn about meal planning and how to become better food-purchasers and cooks. Meals are relatively inexpensive per participant when compared to the cost of independent meal preparation, and participants also enjoy more variety in their diets. Participants report feelings of increased social support, decreased social isolation, and increased feelings of group and individual empowerment,[13, 14, 15, 16] with participants often indicating that the social interaction and support are what compel them to continue to participate.[17] In addition to this model's attributes as a sustainable food system and an anti-poverty method of "pooling resources and labor to produce large quantities of food," it is also less stigmatizing for community members with food security issues than going to a food bank.[13, 14, 15]

The collective kitchen model appears to have originated in Peru in the 1960s and 1970s, where *comedores populares* (people's kitchens) arose as a survival strategy among many residents as urban settlements grew around major cities in that country.[14, 18] In 1985, two women in Montreal started cooking together to share

food costs, and today networks of collective kitchens are found in all provinces in Canada.[13, 14, 15] While the social, health, economic, and community-building benefits of collective kitchens stress their value as an element of community livability, a scan of the literature produced no evidence of them in the United States.

Community gardens: These are plots of land cultivated by a specific cohort of community residents. Community gardens are usually grassroots efforts, made up of volunteer community residents; gardens vary in size and in their location within a community; the garden's available plot of land originates from diverse private or public sources; the number of participating member gardeners can vary significantly; and members are responsible for developing, maintaining, and harvesting the garden's produce. Produce can be edible foods, non-edible flora, or a blend of both; and the gardeners consume/use what they grow and are encouraged to share what is produced with others. A primary benefit and goal of community gardens is the social support and interaction among the participating members. See "Community Gardens" in the *Resource Manual* to learn about the various types of community gardens and the diverse livability benefits derived from this alternative food source mode.

Community supported agriculture (CSA) programs: A CSA program comprises "a community of individuals who pledge their support to a farm operation so that the farmland becomes, either legally or spiritually, the community's farm, with the growers and consumers providing mutual support and sharing both the risks and benefits of food production."[19] Participating community members contract financially (or via physical labor or other assistance) with a local farmer to receive, on a weekly basis, shares of what is produced throughout the growing season. Consumers pick up their shares at designated times and places in the community. Consumers either pay for the entire season in advance or via a payment plan, assuming the risk/benefit of a poor or very productive season. CSA programs can vary—for example, some operate in combination with mobile farm trucks; some farmers will allow members to come to the farm to observe operations or to pick their own produce (a U-Pick or Pick-Your-Own program); and some farmers will supplement their CSA program by opening their U-Pick operations to the general public.

Trend—increasing support of alternative food source models—
At earlier times in history, what we now consider alternative food sources (street-side markets, farmers' markets, and other methods of obtaining locally produced and fresh food) were the norm. Street-side markets were the "cornerstones of food security in rural areas and in rapidly urbanizing areas";[6] and many of these alternative models served as places of social congregation for community members. However, over time, evolving zoning ordinances stressed the separation of residential, commercial, and other community functions, restricting or completely prohibiting easy access to various alternative food source models by a community's population core and forcing these alternatives to be located in areas of suburban sprawl and beyond the reach of population centers.[6, 7, 20] Simultaneously, evolving

public health and food regulations focused on regulating food safety and consistency on a grander scale.[6] Both these trends helped promote what is now the conventional food system.

However, the tide is turning; in response to greater concerns about health, obesity, and the impact of pollutants, as well as a growing focus on walkable communities, sprawl containment, organic farming, and the economic savings of "buying locally," growing support is evident among local, state, and national organizations and governing authorities for utilizing alternative food sources. For example, both the U. S. Department of Agriculture (USDA) and the New York State Department of Agriculture and Markets provide resources on their web sites that allow viewers to locate farmers' markets in defined geographical areas of interest.[21, 22] Today, increasing numbers of communities have at least one community garden organization, and the American Community Garden Association maintains a list of community gardens in the United States and Canada.[23] Collective kitchen initiatives have expanded across all provinces in Canada. New York City has long been a model of street-side groceries, with fresh fruits, vegetables, baked goods, and other foods available to residents and visitors alike. The Supa' Fresh Veggie Mobile operates on the streets of St. Louis, Missouri,[24] and the Capital District Community Gardens in Albany, New York, operates a Veggie Mobile that travels to areas of the community to provide fresh, healthy food options that may otherwise be unavailable to people in those communities. The New York State Office of General Services hosts a farmers' market at both the Empire State Plaza and at the Harriman State Office complex in Albany, New York, throughout the calendar year; and a farmers' market operates in the middle of downtown Schenectady, NY—outside the Mayor's office in the summer and inside a main street theatre mall during the winter. The USDA offers grants to make farmers' markets, food stands, and other direct-sell initiatives more accommodating for people who utilize those programs.[22] Local Harvest's[25] web site lists 315 Community Supported Agriculture Programs in New York State. And, many public and private schools, universities, and even healthcare facilities have begun to participate in or utilize alternative food sources.[26]

Various tactics can help ensure that alternative food source models are affordable for greater numbers of households. Although alternative food networks may help support the vitality of our food systems, it is important to ensure that they remain options for everyone.[27] Operators of alternative food source models can participate in benefit programs such as WIC (Women, Infants, and Children Food and Nutrition Program), Farmers Market Nutrition Program, SNAP (Supplemental Nutrition Assistance Program), and SFMNP (Senior Farmers Market Nutrition Program). A number of discounted memberships per season can be offered for some alternative food source models, and tax-deductible charitable donations of produce can be made to members of the community who are food insecure or to organizations that provide free food and meals. A variety of other strategies, including incentive zoning, mixed-use zoning, special use permits, and more flexible public health regulations that consider the overall community-livability contexts of alternative food operations, can help improve food security, as well as overall community well-

being. (See Section II.2, *Zoning*, in the *Resource Manual* for more detailed information on zoning regulations.)

"Food security" is driven by many local conditions and many global variables such as world food markets and government policies. Amid those conditions and variables, alternative food sources are a vital tool in helping achieve food security. The economic, ecological, and social benefits of alternative food networks[28] can make communities more livable for all residents.

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Benefits:

- *For Residents:*
  - Alternative food source models utilize food from local sources, resulting in benefits associated with a shorter food-supply chain (relatively shorter time from harvest to table:
    - Energy conservation—commodities travel fewer food miles to reach consumers.
    - Fresher, more nutritive food—a shorter food-supply chain lessens the loss of freshness and nutrients that can occur in longer time travel periods between harvest and consumer.
    - Cost-savings—locally grown commodities do not have to be flown, shipped, or driven long distances in refrigerated trucks; in addition, there is less or no need to use costly means of altering locally grown foods as a means of preserving or restoring the look of freshness.
  - Alternative food sources allow consumers to have increased knowledge of the origin, source, and seasonality of food.
  - The availability of a combination of conventional and alternative food sources in a community has been associated with improved health—a decrease in the prevalence of obesity and food insecurity among community residents.

- *For the Community:*
  - Improved Communities:
    - Diverse alternative food sources provide communities with greater opportunities to improve food security among populations in the community's various neighborhoods, including low-income neighborhoods.
    - Alternative food source models can be established more quickly than conventional food sources and can, therefore, have a positive impact on the various aspects of community food security more quickly.
  - Strengthened Community-Building:
    - The physical, as well as philosophical, environment of alternative food sources promotes greater engagement among community members; some models serve to restore public meeting/gathering places.
    - Alternatives can also help restore a sense of community cohesiveness and a sense of place among its members;[1] these food source models are often

more interactive than conventional food sources, allowing participants to get to know each other and the producers of their food.
- Alternative food sources often put money directly back into the local economy.

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Impediments or barriers to development or implementation:

- *For Residents:*
  - Community members may not be aware that alternative food sources exist.
  - Unlike many conventional supermarkets, alternative food sources are not one-stop shopping centers, thus requiring more conscious effort and planning by consumers.
  - Hours of operation may be more limited compared to conventional supermarkets.
  - Participation in some alternative food sources (such as Community Supported Agriculture (CSA) programs) can be expensive.
  - Many alternative food sources are unable to accept public benefits from programs such as WIC, SNAP, and SFMNP.

- *For the Community:*
  - Zoning and public health laws may restrict operation of alternative food sources in some areas.
  - If there are no alternative food source models in a community, residents may have to travel farther to access these sources.
  - Members of the community may oppose operation of alternative food sources for fear of attracting people from outside the community or large crowds.

Resource—examples:

- **Farmers' Market:** *New York State Farmers' Markets*, New York State Department of Agriculture and Markets, Albany, NY. Web site provides a listing of farmers' markets throughout the State, by county: http://www.agmkt.state.ny.us/AP/CommunityFarmersMarkets.asp.

- **Community Supported Agriculture (CSA) Farms:** Local Harvest, Santa Cruz, CA, web site:
  - Search tool for locating CSA farms in the U.S., by state: http://www.localharvest.org/csa/.
  - List of CSAs in New York State: http://www.localharvest.org/search-csa.jsp?scale=&lat=&lon=&x=&y=&ty=6&zip=&st=34&but.x=18&but.y=8.

- **Collective Kitchen:** The Regroupement des Cuisines Collectives du Québec (Quebec Collective Kitchens Association). The website of the largest and oldest functioning network of collective kitchens in Canada: http://www.rccq.org/en/collective-kitchens.html.

- **Mobile Market/Mobile Grocer:** *The Veggie Mobile*, a program of the Capital District Community Gardens, Albany, NY. Operates a produce-market-on-wheels that sells wholesale fruits and vegetables to low-income communities and independent senior living communities in New York's Capital Region: http://theveggiemobile.blogspot.com/.

- **Community Garden:** *Capital District Community Gardens,* Albany, NY. Helping residents of Albany, Rensselaer, and Schenectady Counties in New York State to improve their neighborhoods through community gardening, healthy food access and urban greening programs: http://www.cdcg.org/.

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- Economic Research Service, U. S. Department of Agriculture, Washington, DC:
  - *Your Food Environment Atlas*—get a spatial overview of a community's ability to access healthy food and its success in doing so. Assemble county-level data on: food choices, health and well-being, and community characteristics: http://www.ers.usda.gov/data-products/food-environment-atlas.aspx.
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COMMUNITY GARDENS

Description:

Community gardens are plots of land that contain edible or non-edible plant life (or a combination of the two) and that are typically cultivated or landscaped by a grassroots social network in a designated geographical area.[1, 2] These plots can be communal, or they may be separated into smaller plots that are managed by individuals within the network.[3, 4] In the most common variety of community garden, gardeners are allowed and encouraged to consume and/or share what they produce in the community garden. Because of their inherent social, economic, health, and community-building benefits, community gardens are a valuable element of a livable community.

Community gardens can serve many purposes, but a universal function is to garner and nurture a sense of fellowship among its members, as well as to provide collectively organized, well-maintained green spaces. For example, the Cleveland Cultural Gardens within Rockefeller Park in Cleveland, Ohio, are a collection of gardens following an ethnic theme that demonstrates just that.[5]

It is possible that community gardens have been in existence since the beginning of agriculture, but the formal concept of the community garden seems to have been established sometime during the 19th century in the United States—interest in community gardening is evident during the late 1800s.[3, 6] History also shows that during periods of drastic change or instability (and sometimes food insecurity), people turn to gardening to ease the psychological, sociological, and financial burdens that come along with these changes;[3, 6] for example, involvement increased during the Great Depression in the 1930s, and during World Wars I and II.[3, 6]

Interest continues today, particularly in areas where green spaces are limited. According to the American Community Garden Association (ACGA),[7] there are at least 18,000 gardens in the United States and Canada, with at least one community garden in all 50 U.S. states and most of the Canadian provinces; and ACGA has been holding annual conferences in the United States and Canada since 1978.

Members of community gardens are as diverse as the communities in which they live. Membership often includes children and adolescents, adults of all ages including elderly persons, people in wheelchairs, immigrants, celebrities, and people with a variety of special needs. Additionally, community gardens attract members across income levels and with a wide range of gardening experiences.

Categorizing community gardens—
There are several ways to categorize community gardens—by characteristics of flora grown in the garden, the garden's overall function, the location of the garden, and the media used for cultivation:

Flora: Community gardens contain plant life, or flora, which can be edible or non-edible. Edible gardens are more utilitarian in that they are developed for consumption, and produce often includes fruits, vegetables, and herbs. Although soil testing is recommended for all gardens, this is a mandatory requirement for gardens producing edibles. Non-edible gardens are primarily produced for aesthetics, and flora includes flowers, small shrubs, and trees. Often, community gardens are of a blended type, consisting of both edible and non-edible flora.

Many community gardens in the United States and Canada are primarily of the edible or blended type,[7] while gardens in some places—such as Germany, specifically Berlin—tend to be for aesthetic purposes only.[8] In Ireland and throughout other areas of Europe, edible gardens are often identified as allotment gardens, and non-edible gardens are considered community gardens.[9] Therefore, it is important to understand that what is considered a garden consisting of edibles in one area of the world may be referred to as something totally different elsewhere.

Function: There are typically six functions of a community garden: donations, market, neighborhood, therapy, education and training, and multi-functional.

- Donation gardens allow all products of the garden to be donated to individuals and organizations.[10]
- Market gardens require all products of the garden to be sold for a profit.[10]
- Neighborhood gardens are probably what most people think of when they hear the term community garden. In this type, garden plots are individually or communally tended, and gardeners are allowed to keep what is produced.[10]
- Therapy gardens are found in places such as hospitals, elder care and other special-care homes, and occupational health clinics. The therapy garden is intended for mental, spiritual, and physical rehabilitation.[10, 11]
- Education and training gardens, located in schools and other locations, are used to teach others about the environment and how to garden successfully.[10, 12]
- A multi-functional garden can serve any combination of the previously mentioned functions.

Location: Community gardens can be further classified by location. Generally, gardens can be found in urban, rural, or suburban areas. Gardens in all of these areas can be placed wherever soil or other growing media are found—including empty lots, backyards, rooftops, planters, work places, places of worship, schools, and others.

Medium: Additionally, community gardens are identified by the medium in which they are cultivated. Most gardens are soil-based, but there are gardens grown in mediums other than soil, due to the type of flora the gardener has chosen to

produce, climate conditions, lack of available land for cultivation, or for personal convenience. These are called hydroponic gardens, and they have been in use for many years.[13, 14, 15] Examples of these alternative media for plant growth include moss, peat, woodchips, gravel, and even liquids fortified with nutrients vital for plant growth.[13, 15] Such alternative media can be vital in areas where soil, space/land, and even water are issues.[16] The essence of a hydroponic garden is evidence of the special attention and knowledge required to maintain this type of garden. While not required for hydroponic gardens, soil-based gardens must have the soil tested, as previous land uses may have resulted in retention of contaminants in the soil.

Starting a garden: Community gardens typically begin as grassroots efforts, and the American Community Gardening Association identifies six steps in starting a community garden:[7]

- Development of a planning committee;
- Selection of a site for the garden;
- Preparing and developing the site;
- Organizing/designing the garden;
- Liability insurance for the garden; and
- Setting up a new gardening organization.

Once a planning committee is formed, identification of usable land is a very important step. Land tenure (the right to hold land/property) is a major issue;[17] thus, prior to breaking ground for establishing a community garden, the planners must determine whether a garden is to be cultivated on public, private, or semi-private land. Once a usable plot of land is identified and access is obtained, other resources—such as funding for tools, irrigation, media, seeds, and seedlings, as well as any skilled people required to run/maintain the garden and organize members—are needed to prepare and develop the site. Liability insurance is also recommended in order to start a community garden responsibly.[7]

To add to the livability of a community, the process of developing and maintaining a community garden should reflect the community's membership. For example, gardens can be planned and designed to accommodate people in wheelchairs, those with other special needs, and people of various ages; and the garden should also be named in a way that best suits the garden and the community. The most valuable required resource is the members of the community that are mobilized to sustain and maintain the garden on an on-going basis. Whether the garden is initiated by a well-established neighborhood organization or a group of motivated citizens, other members of the community must be identified and encouraged to participate.

Throughout the six steps for establishing a community garden, coalitions can be formed with local businesses, government agencies, and other organizations. Such collaborations foster community-building support for the establishment and maintenance of the community garden and are valuable resources for in-kind contributions of equipment, volunteers, and other essentials. In addition, support

from local officials and leaders can promote the success of a garden by helping to establish community gardening as a norm.[18]

What community gardens are not—
Occasionally there is confusion among community gardens and urban farms, food cooperatives (food co-ops), community supported agriculture (CSA), and farmers' markets.

- *Urban farms:* Urban farms are full scale farms operating in a metropolitan area. They can be plant- or animal-focused and are dependent on a sole farmer or a group of farmers working together. Compared to community gardens, cultivation and harvest are much more structured in urban farming; typically, what is produced is sold for profit; and operations run via paid labor.

- *Food co-ops:* Food co-ops exist when a collective, for the purpose of lower food costs, pools its resources to obtain food for the members of the collective. Usually set up like a grocery store, food co-ops require membership dues to maintain operations, and they pay the people who run the co-op for the members. The co-op may also allow non-members, who are required to pay slightly higher prices for purchasing goods. Money made by the co-op is invested back into the co-op.

- *Community supported agriculture (CSA)*: CSA involves a contract between consumers and a local farmer, which allows a consumer to receive a package of produce—and sometimes animal products such as meat and dairy and other goods—on a regular basis. Selection is limited to what the farmer successfully produces, so participating consumers assume this collective risk. Packages of produce and other goods can be delivered to the consumer or picked up from a set location, such as the local farmer's operation, at defined intervals over the production season. The consumer pays a flat fee to the farmer for this service. The fee is typically expected up front, but some farmers allow participation in payment plans.

- *Farmers' markets*: Farmers' markets are typically designated sites where a single farmer or a group of farmers gather on a specified day and time to sell their wares to members of the public.

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Benefits:

- *For Residents:*
  - Food Security: Edible community gardens can improve the food security of community members, particularly in low-income areas or areas considered a "food desert." Food deserts are found in both urban and rural areas.[6, 7, 8]
  - Physical Health:
    - Gardening is considered moderate-to-heavy physical activity, which contributes to overall health and fitness.
    - Gardeners are more likely to have increased consumption of the food they produce, which is predominantly fruits and vegetables; in addition, easy access to locally grown fruits and vegetables increases the potential for introducing diversity into the diet.[7]
  - Mental Health:
    - Community gardens can increase feelings of empowerment and a sense of community ownership among community members.[1, 2, 3] This is particularly important in communities where people do not own property or residents' lives may involve circumstances they cannot control, which can lead people to feel alienated and powerless.
    - Much empirical evidence shows that activities such as gardening help sustain mental capacity and improve mental well-being.[1, 2, 3, 9, 10]
- *For the Community:*
  - Improved Communities:
    - Property values: Evidence shows that property values in areas where a garden is located increased in value, as did property values of surrounding areas.[5]
    - Residents' perception of community quality: Community gardens provide green spaces in communities where green space is lacking,[1, 2, 3] making neighborhoods more aesthetically pleasing and improving residents' attitudes about the quality of their communities.
    - Environment: Added flora to an area can improve air quality, provide shade, and mediate the temperature of the area.[1, 2, 3]

- Strengthened Communities:
  - Sense of community: Community gardens can serve as "public squares" for the community,[3, 4] providing natural meeting spaces for greater socialization opportunities among residents.
  - Social capital: Community gardens have the ability to increase community engagement and cohesiveness, providing participating residents, who may otherwise not interact, with greater opportunities to get to know their neighbors.[1, 2, 3, 11,12] This increase in social capital allows community members to feel more comfortable in their own communities and to better address other issues in the community.[13]

References—Benefits Section:

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Impediments or barriers to development or implementation:

- Community gardens can be seen as temporary solutions to otherwise worthless land. Once property values improve and if the land is not owned by the community garden organization, the owner of the land may find other uses for the area.[1, 2, 3]

- As the value of the property where the garden is located and the property surrounding the garden increases, gentrification of the area can occur, affecting the affordability of housing for current residents. This is often seen in certain urban areas.[2]

- Soil contamination from previous land use can make starting a community garden in a specific area difficult or impossible.[2]

- Members of the community are often afraid the garden will attract vandalism or worsen current safety and security issues in the neighborhood.[2]

- Lack of support from community leadership and lack of funding for the garden can prevent a community garden from thriving.[2]

- Although a major purpose of community gardens is to encourage fellowship, some residents of the neighborhood may feel that the garden leads to exclusivity, as evidenced by fencing or rules limiting access to the garden.[4]

- In communities with low social capital, feelings of fear or mistrust within the community can keep people from participating in the community garden.[5]

- Lack of participation and maintenance of the garden by members can yield an eyesore instead of an aesthetically pleasing space.

- Most community gardens require some sort of skilled participation and management. Lack of either can prevent a garden from achieving its maximal potential.

References—Impediments or Barriers Section:

[1] H. Okvat and A. Zautra (2011), "Community Gardening: A Parsimonious Path To Individual, Community, and Environmental Resilience," *American Journal of Community Psychology*, Vol. 47, No. 3-4, pp. 374-387.

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Resource—examples:

- Cleveland Cultural Gardens, Rockefeller Park, Cleveland, OH: A cluster of gardens following an ethnic theme and highlighting some of the history of the United States. http://culturalgardens.org/education-faq.aspx.

- Capital Area Community Gardens, New York State: A network of community gardens based in the Capital District area of Albany, New York. http://www.cdcg.org/.

- P-Patch Trust, Washington State: A community garden network based in Seattle. http://www.ppatchtrust.org/.

- Greenest City, Canada: A network of community gardens based in Toronto. http://www.greenestcity.ca/about-us.

- American Community Gardening Association: Lists many of the community gardens within the United States and Canada and allows community gardens to connect with other community garden organizations. http://communitygarden.org/.

Resource—tool kits:

- University of Missouri Cooperative Extension *Community Gardening Toolkit*: A how-to guide for community garden startup and management. http://extension.missouri.edu/publications/DisplayPub.aspx?P=MP906.

- Atlanta Regional Commission *Community Garden Manual*: A manual developed by the Atlanta Urban Gardening Program and the University of Georgia, providing information on how to start and maintain a community garden. http://documents.atlantaregional.com/aging/ascommunitygardensummitmanual2.pdf.

- Wisconsin Department of Health Services *Got Dirt Gardening Initiative*: State of Wisconsin initiative to increase number of community gardens throughout the state; includes a tool-kit. http://www.dhs.wisconsin.gov/health/physicalactivity/gotdirt.htm.

Resource—written and web:

- *Community Gardens*—a brief fact sheet about community gardens, Centers for Disease Control and Prevention, Atlanta, GA. Provides information, resources, and case studies. http://www.cdc.gov/healthyplaces/healthtopics/healthyfood/community.htm.

- RUAF Foundation and Resource Centres on Urban Agriculture and Food Security, The Netherlands—an international network of seven regional resource centres and one global resource centre on Urban Agriculture and Food Security. Provides extensive information and resources; serves as a site for the documentation and exchange of research data and practical experiences on urban agriculture. http://www.ruaf.org/; http://www.ruaf.org/node/512.

- Growing Power, Inc., Milwaukee, WI—a non-profit organization focusing on providing "healthy, high-quality, safe, and affordable" food to communities. http://growingpower.org/ .

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URBAN FORESTRY

> The time has come for urban communities to stop seeing trees and start *looking at the forest.*
> — John P. Rousakis, Mayor, Savannah, GA
> 1st National Urban Forestry Conference, 1978

Description:

Among leaders in both the public and private sectors, there is growing recognition of the significant and very diverse benefits of urban forests, leading to an expanded understanding of the value and the role of the urban forest in creating livable communities.

Urban forestry is the term used to describe the planning, care, and management of urban forests (community greenery) in order to create or add value to a community.[1, 2] While many definitions for *urban forest* exist within the literature, the one we will use here, a combination of several prominent definitions, is "the trees, shrubs, flowers, and other vegetation growing intentionally and unintentionally in the areas within and around the places people live and where human influences and settlements may be concentrated, such as cities, towns, villages, and hamlets."

This definition broadens the term *urban forestry* to encompass all vegetation in urban locations as well as in areas that might not traditionally be considered urban, such as suburban subdivisions, rural populated areas, and even rural land being considered for development.[3, 4]

History of Urban Forestry

Urban forestry, in its most basic sense, has existed for thousands of years,[5, 6] as the intentional presence of trees existed even in the earliest of cities, including Rome and Babylon.[7] Worldwide, the purpose of the urban forest takes on numerous forms—including trees used to supply firewood in China; fruit-bearing trees to supplement urban diets in Africa; rooftop trees and bushes providing shade and social spots upon hotels in New York; the Elm-lined streets of the American mid-west providing shade for pedestrians; trees and greenery as part of Sacramento's strategy to meet the Environmental Protection Agency's clean air requirements; Lady Bird Johnson’s tree- and flower-planting “Beautification” campaign, which was motivated by her belief that beauty can improve the mental health of a society; the use of trees, bushes, and flowers as a component of community “complete street” designs to create buffer zones between motorists and pedestrians; the use of greenery to promote retail trade along downtown streets; and others. For all these reasons, urban forests are a significant element of a livable community—providing neighborhoods with much more than simply aesthetic value, and requiring management and care long after the day they are planted.

Urban Forestry in the United States: The geography of the United States has changed much in the past couple hundred years, as have its communities. Early settlers cut the virgin lumber to create settlements, and it was not until the late 1700's and early 1800's that residents of those settlements began to replant trees within their communities, with the earliest community forest established in Newington, NH, in 1710.[8] Initially, the trees that Americans chose for their communities were species they had brought with them from their European origins: the Norway Maple, the English Elm, and the Lombardy Poplar; and their intentions were purely aesthetic. It was not until the mid-1800's that planting indigenous trees, for both aesthetic reasons and practicality, became popular.[8] Currently, about 80 percent of the US population has contact with the various elements of an urban forest on a daily basis,[9] though not as many cities have effective urban forestry programs (including planning, maintenance/care, and replacement) as have urban forests.

Urban Forestry within Communities: More often than not, urban trees/greenery are intentional parts of a community, carefully planned and managed by both residents and local officials. The job of urban forester in the United States falls upon many different types of individuals, from local municipal government officials to professional arborists, to informal groups of community residents.

Problematically, green spaces and urban forests are sometimes seen by public officials and policy-makers as amenities rather than necessities. The benefits of urban forests are often mistakenly valued as strictly aesthetic, and, frequently, the measurable health and economic outcomes of urban trees/greenery are not recognized when planning a community. However, the positive health, ecosystem, financial, social, and aesthetic benefits of urban forestry are widespread; and the fact remains that all members of a community—young or old, poor or wealthy, with a disability or not, business or residential—benefit from the presence of well-managed trees and other vegetation. See "Benefits" below for an extensive review of the benefits most often associated with urban forests.

A lesson learned by many communities is that planning and the upkeep on maintenance is essential—all trees and other greenery need care, and older plantings may need repair or replacement. Management possibilities now include computerized inventory programs that will organize and analyze data simply and effectively—the most important lesson learned by urban forestry planners (anyone from local officials to Non-Governmental Organizations to professional arborists) has been to avoid collecting more data than is needed—effectiveness of a management system becomes negligible when data is collected only to sit on a shelf.

Four Principles of Urban Forestry:[10] In planning, maintaining, and altering an urban forest, four basic principles of urban forestry can be very helpful to the urban forester, be it a community organization, municipality, individual land owner, or group of residents working together:

(i) All trees/greenery within the community environment are contributors to the ecosystem and should be managed as one unified resource. This includes trees and other greenery under both public and private ownership, both planned and unintentional growths.

(ii) Trees and other greenery should be treated as a multi-purpose resource with a range of potential goals, including enhancement of the community landscape, solutions for environmental issues, wildlife conservation, food sources, improvement of recreation experiences, and the production of timber. Trees and greenery should be managed to optimize these resources, thereby improving the quality of life within the community environment.

(iii) A community-based approach to tree/greenery management is necessary; thus, the owners of trees and other vegetation, both public and private, should be encouraged to contribute to the management of their local urban forest, taking part in both management and maintenance discussions and execution.

(iv) Adequate planting to counteract tree losses and to enhance the total urban forest resource must be performed to maintain the forest in a healthy state.

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Benefits:

For Residents—

- Psychological and Social Benefits:
  - Studies show that those who experience green spaces and urban forests in their environment on a regular basis have lower rates of stress and higher rates or productivity.[11, 12]
  - Patients with views of trees from their hospital beds recovered faster and had fewer post-surgical complications than did those without tree views,[11] thus reducing medical costs and burdens.
  - Prisoners living in cells with views of trees and other green space were shown to utilize "sick call" less often than those without views, which ultimately saves money for the prison system and for taxpayers.[13]
  - Viewing urban trees and vegetation and playing among greenery have been shown to increase academic performance, decrease symptoms of Attention Deficit Hyperactivity Disorder (ADHD), and increase skills and cognitive abilities in schoolchildren.[14, 15, 16]
  - In areas with trees and vegetation, lower levels of driving frustration, aggression, and domestic violence have been observed compared to areas without green space.[17. 18]
  - In communities with trees and vegetation, residents tend to have a greater sense of well-being and higher reported levels of satisfaction and pride in their neighborhoods.[19, 20]

- Presence of trees/greenery encourage healthier behaviors and activities:
  - Trees and other greenery make areas more conducive to walking, bicycling, and socializing within the community by creating cooler, shady areas and blocking wind, and by promoting calmer driving by automobiles along roadways that may be shared with cyclists or pedestrians.[17]
  - More foot and cycling transport and time spent outdoors translates to reduced fossil fuel emissions, promotion of healthy exercise, and increased social interactions among members of a community.

For Residents and the Community—

- The presence of trees and vegetation in community areas is correlated with lower crime rates:
  - Donovan and Prestemon[21] report that trees can reduce crime by signaling to would-be criminals that a house or neighborhood is well-cared for and thus subject to more effective authority and enforcement. The authors report that trees in the public right-of-way are associated with lower crime rates,

while the relationship between crime and trees/greenery on a residential lot is mixed—with smaller, view-obstructing trees/greenery associated with increased crime on private lots, whereas larger trees are associated with reduced crime.
    - A study by Kuo and Sullivan[22] of 98 different apartment buildings found that the more green space surrounding the building, the fewer property and violent crimes were reported. In addition, residents in these areas experienced less fear, violence, and aggressive behavior.

- Urban forests save money and conserve energy:
    - Shading and wind-stopping by trees/greenery help modify extreme temperatures and winds in all seasons, thereby helping municipalities, individuals, and businesses save money by saving energy.
    - Trees/greenery can curb urban heat-island effect (the phenomenon describing why urban areas have hotter ambient temperatures due to the predominance of concrete and metal material) by increased shade and humidity evaporation.
    - A single mature tree can provide cooling energy that is equivalent to five average room air conditioning units running for 20 hours a day.[23]
    - McPherson, et al.,[23] report that the city of Chicago will save 5-10 per cent in electric costs due to its expanded tree canopy. See "Resources" below to see how much your community could save.

- Trees/greenery increase air quality by releasing oxygen and removing air pollution:
    - A single mature tree can absorb carbon dioxide at a rate of 48 lbs./year and release enough oxygen into the atmosphere to support two human beings.[24]
    - Trees/greenery absorb or intercept airborne particulates on their branches, trunks, and leaves, thus removing these pollutants from the air.
    - By encouraging walking and decreasing heating and cooling needs, trees/greenery reduce energy consumption and fossil fuel emissions—leading to less pollution.
    - The USDA Forest Service describes Sacramento's strategic use of trees in that city's plan to meet the Federal Clean Air Act requirements (see "Resources" below).

For the Community—

- Stormwater control and water decontamination:
    - In communities of all sizes, the roots of trees/greenery aid in the absorption of water, thereby limiting street-flooding and polluted runoff into surrounding lakes and streams. Non-point source pollution from run-off over impervious materials, such as asphalt, leads to drinking water contamination and the buildup of harmful chemicals such as heavy metals and pesticides in seafood. By reducing runoff into storm drains and ultimately into groundwater supplies, surface water, lakes, and streams, trees and other vegetation limit pollution into these resources.

  - Stormwater drain-flooding poses a risk of damage to infrastructure and is a public health hazard. After heavy rains, there are high microbial levels in standing and backed-up water, and pooling water leads to increased insect breeding, thereby increasing the risk of vector-borne illnesses such as West Nile Virus.

- Reduction in Noise and Light Pollution; Increased Privacy:
  - Trees and other greenery along streets make communities more comfortable and conducive to productivity and enjoyment for visitors and residents, by:
    - Absorbing, refracting, and dissipating the noise caused by the heavy traffic characteristic of urban areas.
    - Blocking light from streets and surrounding buildings.
    - Providing privacy from the street or neighboring buildings.

- Increased Community Involvement: Community involvement is promoted, as planting, maintaining, and enjoying urban forests fosters social interactions and the formation of social capital.

- Increased Job Opportunities: Planting, maintenance, and repair of urban forests can produce jobs for both skilled and unskilled laborers—both year-round permanent positions and per diem employment.

- Increased Land and Home Values: The presence of trees and other greenery has a positive impact on land and home values. For example, Donovan and Butry[25] report that in East Portland, OR, street tree presence increased the sale price of homes by an average of $8,870 and reduced "time on the market" by nearly two days; having a tree directly in front of a house increased its sale price by an average of $7,130; and, citywide in Portland, street trees add over $1B in property value, or about $47 million annually.

- Increased Revenue to the Local Economy:
  - Consumer Spending: Wolf's[26] research showed that consumer purchasing in retail stores is positively correlated with the presence of urban trees and greenery on retail streetscapes. Shoppers demonstrated greater patronage, time spent shopping, and a willingness to pay, on average, 11 per cent more for an item when trees/greenery were present. Wolf[27] also found that trees/greenery on commercial streets were also correlated with a better patron perception of a retail district.
  - Revenue from Urban Forest Waste and Bi-Products: Wood removed for maintenance purposes can be used for firewood, woodchips, or other necessities. This material can either be sold for profit or donated to the community's members.

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Impediments or barriers to development or implementation:
Comments by community members and local officials include:

- "Tree limbs fall down; they cause damage to homes and telephone lines. It all costs so much money to fix that it's not worth the trouble."
  - Dangerous hazards and property damage may be created by mismanaged or poorly maintained tree branches and limbs, especially after natural disasters or severe weather events.
  - The maintenance required for urban forestry does indeed have significant financial costs; however, proper management, together with the various economic values derived from urban forests, does allow for a net profit to be made from urban forests.
  - Proper planning and maintenance is essential to reap the economic and social benefits of urban forestry. Maintenance has become easier as computerized inventory management systems have been developed that allow one to select specific trees/vegetation in an urban forest and detail their health, condition, and history. The program can specify the maintenance plan for varying spending levels and predict the future financial impact of improper maintenance. See "Resources" below for information on such software.

- "Tree roots can push up the pavement, ruining sidewalks and damaging roads."
  - Damage done to paved surfaces, such as streets and sidewalks, by expanding roots leads to unpleasant aesthetics, safety liability issues, infrastructure damage, and accessibility problems. However, root barriers (both physical and chemical) can control the path of root growth and prevent pavement damage. See "Resources" below for information on root barriers.

- "I've heard of cities where half of their trees were wiped out from one bug. We can't afford that risk."
  - Monoculture planting (planting lots and lots of the same species of tree) has proven to be a problem in the past. When one tree species is susceptible to an infection, pest, or climate condition, all trees in that species are wiped out or damaged, destroying the integrity and the benefits of the community's urban forest. This problem can, however, be avoided by planting a diverse urban forest and keeping track of affected trees and areas when an outbreak does occur.
    - Dutch Elm Disease (DED) is a fungus that has killed millions of American Elms. Solutions have been found, including DED-resistant strains of Elm tree. See "Resources" below for more information.

- "More trees and greenery will increase the presence of allergens, insects, and other pests in our communities."

  - It's true that trees provide more habitat for insects. However, trees also provide habitat for birds and other animals that not only add to the diversity and aesthetics of an area, but also consume insects and create a better balanced local ecosystem.
  - Trees actually show a net removal of pollutant particulates from the air, which helps reduce allergies.
  - Most communities and individual property owners continue to choose trees and greenery based on characteristics other than their allergy-producing traits, thereby creating a burden for allergy sufferers. However, after many years of work and research Thomas Leo Ogren, a gardener, author, and USDA consultant, has identified which trees and other greenery do not trigger allergies. According to Ogren, "It is quite possible now to produce fine gardens and landscapes that do not trigger any allergies, but by and large this isn't being done."[28]

- *"Hiring urban foresters can be costly, and our community cannot afford it."*
  - While planning, planting, maintaining, and repairing trees and greenery involves an expense for the community, costs can be reduced by:
    - Hiring part-time employees with a private contractor to carry out urban forestry tasks.
    - Coordinating a cadre of volunteers—community residents, high school and university students, members of community service clubs, and others—to carry out the various tasks.
    - Sharing urban forestry employees, equipment, and inventory-maintenance software with nearby communities.

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Energy
INTRODUCTION

We shape our buildings and afterwards they shape us
— Winston Churchill

Across the country, growing numbers of citizens, community leaders, professionals in a variety of disciplines, and public policy makers are increasingly aware of the impact of environmental factors on the health of individuals and on communities. Citizens and professionals alike are taking active steps to address significant concerns about the environmental quality of our homes, our public buildings and spaces, our oceans, our food, and our drinking water and air. The condition of these factors is directly related to a person's health and quality of life, and directly affects the state of a community's level of livability.

The following paragraphs are taken from a document published by the United States Department of Energy.[1] People live the greater part of their lives in residential homes and other buildings. Throughout history, buildings have changed to address social needs, and this change is often advanced by innovative technologies. An example is the advent of the skyscraper a century ago, which allowed builders to take advantage of the transformative new steel-framing technology to overcome real-estate scarcity in crowded American cities by enabling extraordinary growth in a contained footprint. Today's building industry is entering another era of change, with a view toward minimizing a different kind of footprint—the energy, carbon, and environmental footprint of commercial and residential buildings. This time, change is being driven by a need to optimize and conserve resources — clean air, potable water, land ... and energy. And, once again, transformative technologies are holding the key to meeting the challenges in these areas.

As designers, developers, and owners search for ways to minimize the operating costs and the environmental impacts of buildings, while also increasing their functionality and appeal to occupants, "green building" trends have become increasingly observable in the marketplace. Energy-efficiency, energy conservation, and energy alternatives to fossil fuels are critical elements of green building. Across the country, both innovations and social needs are key drivers in green-energy trends in the construction of homes, commercial buildings, and civic facilities. For example, such trend-drivers include:

Energy consumption—
Energy consumption in buildings has been growing in aggregate over time. Today, the nation's 114 million households and more than 4.7 million commercial buildings account for nearly 40 per cent of total energy use in the United States, consuming

more energy than the transportation or industry sectors. The total utility bill for energy used by buildings topped $369 billion in 2005.

Population growth—
Energy use is driven by population growth, and changes in population profiles. Growth in the number of people drives the number of homes, schools, and other community buildings that are developed; increases in the number of older people drives the development of specialized senior housing and assisted living facilities.

Economic growth—
Growth in Gross Domestic Project is a major factor in energy-use, driving the amount and size of new floor space in offices and retail buildings, in the size of new homes, service demands (lighting, space conditioning, electronics, process loads), and real energy prices.

Energy innovations in the building sector—
Improvements in technologies and practices over the past three decades (in lighting fixtures, windows, insulation, building controls, and appliances, as well as whole-building design and construction) have made it possible to significantly improve the efficiency with which energy service demands are met, delivering many building services with lower energy intensity.

Section IV.2 of the *Resource Manual* is devoted to "energy" as an aspect of environmental health, green building, and a livable community.

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CARBON NEUTRAL HOMES and BUILDINGS

Description:

Carbon is essential to all life on the planet Earth. To be classified as organic, a molecule must contain the element carbon in the form of a carbon-hydrogen bond. As a greenhouse gas, carbon bonds with oxygen to form CO (carbon monoxide, ozone) and CO_2 (carbon dioxide, necessary for photosynthesis). During the day, carbon helps stop solar ultraviolet radiation from baking the surface of the Earth and at night helps reflect heat back so that we do not freeze. Carbon is also a critical part of the water cycle, which regulates the earth's temperature and weather.

The Earth's climate is constantly changing. Before humans inhabited the Earth, there were ice ages, hot ages, wet ages, and the age of the dinosaurs. We are now entering a period of increasing atmospheric temperature, the likes of which humankind has never seen. The debate over whether or not humans are causing these changes is not over. However, there is no debate that increased carbon levels in the atmosphere will result in increased atmospheric temperatures. This is commonly referred to as the greenhouse effect.

In the United States there has recently been an increased focus on becoming energy-efficient and decreasing carbon emissions into the atmosphere. The reasons for interest in energy efficiency include everything from national security to personal financial security. People are also concerned for future generations of humans. There is great concern that an increasingly warm climate will result in polar ice melting, deserts expanding, sea levels raising, infectious disease rates increasing, and many other depressing phenomena. While some might argue that humans are not causing the increasing temperature, no one argues that energy efficiency and carbon emission reduction is a bad thing.

"Driving" is the most common factor people think of when considering ways to decrease their carbon footprint, and it is true that motorized transport through driving and aviation is one of our largest contributions of carbon into the atmosphere. However, in the United States, emissions from energy use in homes and buildings make a much larger contribution of carbon into the atmosphere than does transportation.[1, 2] Many people forget that the electricity our homes use must be generated by an electric plant somewhere else; in the United States, this electricity usually comes from burning oil, coal, natural gas, or some other fossil fuel.

The concept of a carbon neutral home or building is relatively new and the specifics of an agreed-upon definition is still in the works. However, some groups have taken the effort to standardize the definition:

- **Carbon Neutral - Operating Energy**

This basic definition for Carbon Neutral Design in homes and buildings is taken from www.architecture2030.org. Carbon neutral, with respect to operating energy, means using no fossil fuels that emit greenhouse gases to operate the building (operation includes heating, cooling and lighting). These targets may be accomplished by implementing innovative sustainable design strategies, generating equal on-site renewable power, and/or purchasing (20 per cent maximum) renewable energy and/or certified-renewable energy credits. At the present time, it is estimated that operating energy accounts for approximately 70 per cent of the carbon emissions associated with a building. The other 30 per cent is described below.

- **Carbon Neutral - Operating Energy + Embodied Energy**

This definition for Carbon Neutrality builds upon the definition above and also adds the carbon that is a result of the initial and recurring *embodied energy* associated with the materials used to construct a home or building. This value is far more difficult to calculate.

As described by Canadian Architect,[3] "The *initial embodied energy* in homes and buildings represents the non-renewable energy consumed in the acquisition of raw materials, their processing, manufacturing, transportation to site, and construction. This initial embodied energy has two components:

- *Direct energy*— the energy used to transport building products to the site, and the energy used to construct the building.
- *Indirect energy*— the energy used to acquire, process, and manufacture the building materials, including any transportation related to these activities.

"The *recurring embodied energy* in homes and buildings represents the non-renewable energy consumed to maintain, repair, restore, refurbish, or replace materials, components, or systems during the life of the building.

"As buildings become more energy-efficient, the ratio of embodied energy to lifetime consumption increases. Clearly, for buildings claiming to be 'zero-energy' or 'autonomous,' the energy used in construction and final disposal takes on a new significance."

While, currently, design and implementation of carbon neutral homes and buildings is still in its infancy, with only scattered demonstration projects occurring worldwide, active interest is growing. For example, (1) SpringLeaf Boulder, which is in the planning stage in Colorado, will consist of 12 homes that are designed for LEED Platinum certification, will be fully powered by photovoltaic systems, and are very close to shops and restaurants—creating a little eco-community within Boulder, CO; (2) the Central Dallas Community Development Corporation's winning design has been chosen by *Urban Re:Vision—Dallas* to take a vacant inner-city block behind City Hall and transform it into a carbon-neutral, sustainable community that will run off the grid in Dallas TX; and (3) in 2010 in New York City,

Solar One expects to begin construction of Solar Two, an 8,000 sq. ft. Green Arts and Education Center that will be the City's first carbon-neutral, net-zero-energy building. As renewable power technologies, advanced construction techniques, HVAC (heating, ventilation, air conditioning) equipment, appliances and lighting, and consumer awareness all move towards increased efficiency and effectiveness—and as more new projects come on-line—the dream of carbon neutral homes will become a reality.

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[3] Measures of Sustainability," *Canadian Architect:* http://www.canadianarchitect.com/asf/perspectives_sustainibility/measures_of_sustainablity/measures_of_sustainablity_embodied.htm.

Benefits:

For consumers

- Zero energy bills—makes homeownership and renting more affordable for all residents, and supports business operations.

- Decreased or zero use of fossil fuels—makes the home living environment healthier (cleaner indoor air) for all residents, and, in particular, supports the ability of frail older people and younger-aged people with disabilities to successfully age-in-place.

- Off-the-grid houses are not susceptible to black outs or power failure.

For the community

- Decreased carbon footprint.

- Decreased load on electricity distribution infrastructure (the electric grid).

- Decreased emissions from power generation plants due to decreased demand.

- State and Federal programs to help in construction.

Impediments or barriers to development or implementation:

- Among the public, common misconceptions remain about renewable power and carbon neutral homes—many feel modern comforts must be sacrificed, thus decreasing market acceptance.

- Building construction techniques, renewable technologies, and workforce infrastructure is still young, decreasing availability and affecting cost-effectiveness of completing homes.

- Up-front development/installation costs can be large.

- Service can be costly or difficult to obtain if the technology breaks down.

- Not all utilities are set up to handle net metering, thus removing the option of selling energy back to the utility to offset times of drawing from the grid.

- Not all utilities offer clean energy source options.

- Homes must use electricity as a source of air heat and hot water, or else they have to offset those energy draws with increased electricity generation. Offsetting the fossil fuel draws is typically difficult to achieve.

- Local municipalities may not allow the installation of tall towers for wind power or photovoltaic cells on building roofs.

Resource—examples:

- United Kingdom: Lighthouse, the UK's first zero-emission, carbon-neutral home, was completed in 2008 and is a fine example of form and function: http://www.jetsongreen.com/2008/02/lighthouse-uks.html.

- United States: zHome, in Issaquah, WA, is the first multifamily zero energy, carbon neutral community in the United States. zHome is a revolutionary, ten-unit townhome development that uses smart design and cutting edge technologies to radically reduce its environmental impacts. zHome aims to prove that homes can use zero net energy and 60 per cent less water, emit net zero carbon emissions, have clean indoor air, and use only low-toxicity materials. It will also show that these goals and building techniques are attainable and scalable to mainstream home production. http://www.z-home.org/.

Resource-written and web:

- *The 2030 challenge* is an effort by Architecture 2030, a non-profit, non-partisan, independent organization established in Santa Fe, NM, in 2002 by Edward Mazris (architect, author, researcher, and educator) in response to global warming; Architecture 2030's aim is to achieve a reduction in greenhouse gas emissions among the building sector by changing the way buildings, homes, and developments are planned, designed and constructed. http://www.architecture2030.org/2030_challenge/the_2030_challenge. http://www.architecture2030.org/.

- United States Department of Energy, Energy Efficiency and Renewable Energy Department: http://www1.eere.energy.gov/buildings/building_america/.

- United Kingdom: The British government has recently opened the comment period on a major plan to revise the building code, phasing in regulations to ensure that all new homes are built carbon-neutral by 2016. http://www.2people.org/pub/page/show/article/10596. http://webarchive.nationalarchives.gov.uk/+/http://www.communities.gov.uk/planningandbuilding/theenvironment/.

- Australia: The government's guide to environmentally sustainable homes—*Technical Manual: Design for lifestyle and the future,* Section 1.4: "Carbon neutral"—extensive definitions, descriptions, and resources*:* http://www.yourhome.gov.au/technical/fs14.html.

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CHOOSING AN ENERGY SUPPLIER

Description:
A few years ago the New York State Public Service Commission initiated a process called “deregulation.” This restructuring of the electric and natural gas utilities is intended to allow for greater competition and more options for customers. The resulting program is named *Power to Choose* and is sometimes referred to as *Energy Choice*.

A consumer's utility bill typically consists of two major charges: (1) *a supply* charge, which is the cost of the electricity or natural gas that the customer uses, and (2) a *distribution* charge, which is the cost to deliver electricity or natural gas to the customer's home or business.

In the past, a single utility typically provided all supply and distribution to a designated region. Under *Power to Choose* a consumer can now choose his energy supplier—sometimes called an Energy Services Company (ESCO)—and has the freedom to find the best deal. In addition, some suppliers offer consumers "green power" (electricity supplied in whole or in part from renewable energy sources, such as wind, solar, geothermal, hydropower, and various forms of biomass), which benefits the environment through reduced use of fossil fuels. According to the U. S. Department of Energy, more than 50 per cent of retail customers in the United States now have the option of purchasing a green power product directly from their electricity supplier.

Regardless of which energy supplier is used, the distribution charge to the customer remains the same and responsibility for distribution remains with the geographic service area's traditional utility. By law, the traditional utility is required to provide distribution, emergency response, and other services in the same manner regardless of which supplier has been chosen. When an alternative supplier-choice is made, the alternative supplier's billing may be included as part of the consumer's utility bill from the traditional utility, or may be billed separately by the alternative supplier.

Customers may or may not pay a reduced rate for their energy use when choosing an alternative energy supplier. An alternative supplier might consistently supply energy at a lower cost than the traditional supplier, or may offer sign-up discounts or reduced rates for a specified period of time, after which rates may rival or exceed the traditional supplier. If a customer chooses an alternative supplier and changes his mind at a later date, a return to the traditional utility is always an option.

"Green Energy" is one aspect of a *livable community*, and the use of alternative sources of green energy by homeowners and businesses is increasing across the country in response to concerns about health related to poor air-quality, depletion of the world's finite supply of fossil fuels, and environmental issues.

Benefits:

For residents:

- Greater choice of energy suppliers:
  - Potentially a reduced cost for energy usage, supporting affordability for both homeowners and renters and promoting the ability of residents to remain living in their communities and to age in place.
  - Consistent service and delivery charges regardless of which supplier is chosen.

- Green power options provide health benefits through better air quality.

For the community:

- Green options benefit the community's overall well-being through improving air quality, reducing use of fossil fuels, and addressing a variety of environment issues.

- Contributes to a community's livability status:
  - Supports a stable resident base through the availability of consumer choice among optional suppliers.
  - Supports a stable business base through the business-marketing aspects inherent in the publicized use of green energy.

Impediments or barriers to development or implementation:

- Consumers are often unaware of the alternative options available in their energy service areas and sometimes do not understand the process for making a different choice.

- Consumers often are not sufficiently well-informed to make the most appropriate decision when choosing an alternative supplier. For example:
  - Suppliers may offer new customers sign-up gifts, lower fuel prices for a limited time, or other incentives, which may be confusing or not completely understood.
  - Consumers may not fully understand the components of their current fuel bills and may not be able to make a meaningful comparison between their current costs and an alternative supplier's costs.
  - Consumers may not know to ask about such items as the terms of the contract; whether the prices are fixed or changeable; whether the supplier will bill you separately; and whether there are other fees, such as security deposits, cancellation charges, or other fees.

- Consumers may be pressured into a decision by aggressive marketing tactics before they have all the information needed.

Resource—example:

- 2009 Green Power Leadership Awards, an awards program co-sponsored by the U. S. Environmental Protection Agency, U. S. Department of Energy, and Center for Resource Solutions—recognizing the actions of organizations, programs, and individuals that significantly advance the development of green power sources: http://www.epa.gov/grnpower/awards/index.htm.

Resource—written and web:

- *Power to Choose (Energy Choice) Program*: Information is available from the New York State Public Service Commission: 1-888-Ask-PSC1; http://www.askPSC.com.

- Local utilities: For information about choosing alternative energy suppliers, contact your local utility. By law, utilities are required to provide consumers with objective information; and their websites typically provide the names and contact information of ESCOs available in their service territory, as well as other information to assist consumers in making the best choice.

- For a list of Energy Service Companies (ESCO) in New York State: http://flap.tv/ESCO_NY.php. For specific questions regarding an individual ESCO's policies, contact the individual ESCOs directly.

- *Residential Rights and Responsibilities* (March, 2009), a booklet developed by New York Electric and Gas (NYSEG), which summarizes service policies, energy supply choices, and your rights under the New York State Public Service Commission's rules and the Home Energy Fair Practices Act Rules (Title 16 of the New York Codes, Rules and Regulations – Part II), which are based on New York State Public Law: http://www.nyseg.com/MediaLibrary/2/5/Content%20Management/NYSEG/YourAccount/PDFs%20and%20Docs/NYSEGResRightsBrochure.pdf.

- U. S. Department of Energy, Energy Efficiency and Renewable Energy, "Buying Green Power: Can I Buy Green Power in My State?" Web site provides information, by state, on organizations that offer green power, including utility green pricing programs, retail green power products offered in competitive electricity markets, and renewable energy certificate (REC) products sold separate from electricity: http://apps3.eere.energy.gov/greenpower/buying/buying_power.shtml.

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COMBINED HEAT AND POWER

Description:

The New York State Energy Research and Development Authority (NYSERDA) defines Combined Heat and Power (CHP) as the simultaneous generation of two or more forms of energy from a single fuel source. Across the country, this technology is also known as Cogeneration, but more recently has been rebranded Combined Heat and Power. The most common use of this technology is the generation of electricity by means of an engine-driven generator while, at the same time, capturing and recycling the heated combustion exhaust, or thermal energy, to produce domestic hot water.

Thomas Edison's Pearl Station in 1882 is the first commercial recorded use of CHP in the United States. The waste heat produced from the generation of electricity was used to heat the neighboring buildings. With the rural electrification policies of the 1900's, central power plants and regional utilities became the norm. This structure discouraged decentralized power generation until 1978 when the Public Regulatory Policies Act (PURPA) was established. This act promoted renewable technologies and allowed non-utilities to provide power. Today, with concerns about the environment, dependence on foreign fuels, and the escalating cost of energy, efficiency of the fuel being used has become more important than ever.

Although we are beginning to see the deployment of micro-CHP in single family homes, most CHP systems currently available work best in larger facilities or multifamily buildings that have one hundred units or more.

In addition to the engine-driven generator, several variations of CHP technology include micro-turbines, steam turbines, and fuel cells. Natural gas is the most common fuel source; however, other fuels, such as digester gas, landfill gas, or even wood scrap from sawmills have been used when available and cost-effective. All CHP systems rely on the common principle of capturing two or more forms of energy in order to maximize fuel efficiency.

Other uses of CHP technology include recycling waste heat for industrial usage or manufacturing processes or to produce refrigeration by means of an absorption chiller. In the case of an absorption chiller, what was previously considered waste heat is now converted to refrigeration through an absorption process, often providing air conditioning for a large facility. CHP systems can also be configured to provide emergency power during power outages in order to allow occupants to remain where they are (shelter in place) during power outages. Sheltering in place in lieu of evacuation may be the preferred option, especially with frail older people or individuals of any age with disabilities. Dumping of thermal energy during emergency conditions in order to maximize electricity generated is considered an

acceptable practice, but it is not recommended during normal operation as it reduces fuel efficiency.

Traditional fossil-fueled power plant generation often results in the loss or dumping of exhaust heat as a waste product. Thermal dumping, combined with transmission and distribution losses, can greatly reduce overall fuel efficiency to about one-third or less. As CHP systems avoid these losses, they have a significant environmental benefit over utility-based centralized power generation and distribution. The combined increased fuel efficiency results in an overall decrease in harmful emissions of carbon dioxide (CO2), sulfur oxides (SOx), and nitrogen oxides (NOx).

A CHP system is designed to generate energy in close proximity to where it will be used and is therefore not used for long-distance transmission and distribution. As such, CHP is part of a larger group of technologies known as Distributed Generation (DG). CHP is often the most economic DG technology. In order to successfully use this technology, a preliminary assessment or feasibility study can determine if the characteristics of the electrical load can be successfully matched with a corresponding thermal load. This matching of the electrical and thermal loads can demonstrate overall fuel efficiency and thus avoid the costly dumping of the excess thermal energy.

The addition of a CHP system adds to overall generating capacity and can have a significant impact on the utility grid or network by reducing peak demand on the grid. The utility grid system's peak demand usually occurs during the hottest part of the summer when the electric cooling load is running at the maximum. In the past, this peak demand event has been responsible for brown-out or black-out conditions.

Benefits:

For consumers, including older adults and younger people with disabilities—

- The higher fuel efficiency results in a lower operational cost of energy (kWh for electricity and Btu's for thermal), thereby lowering household expenses.

- Investment in CHP provides long-term stabilization of energy rates, making energy rates more predictable and less subject to commodity market fluctuations.

- CHP units can be configured to operate independent of the local utility company, thus providing on-site power generation during emergency conditions and allowing for sheltering in place.

For the community—

- There are environmental benefits of reduced CO2, NOx, and SOx by using the fuel's energy twice and reducing the total amount of fuel consumed. This becomes a more important benefit in areas of poor air quality.

- On-site generation reduces the geographical strain or need for additional transmission and distribution systems.

- Financial incentives are often available.

Impediments or barriers to development or implementation:

- Investment in CHP Technology is a long-term commitment, and the owner is responsible for all maintenance (check with the manufacturer for service agreements and warranties).

- There may be a lack of fuel availability— is natural gas available or another fuel such as landfill gas?

- There may not be adequate space available within a building for the equipment and exhaust flue.

- The building's electrical distribution system and metering needs to be configured to support CHP.

- The cost-effectiveness of the project needs to be determined. The cost comparison of electricity to natural gas is often referred to as the spark spread. CHP becomes more economical the larger the cost differential between electricity and natural gas becomes.

Resource—examples :

- According to the NYSERDA CHP Program Guide, "As of mid-2008, NYSERDA programs support and fund over 110 projects for the installation of CHP at customer sites, and over 150 feasibility studies for CHP technologies, as well as numerous product development projects and technology transfer studies. Collectively, these projects represent a NYSERDA funding contribution of over $85 million, and at full-build these systems will produce 153 MW of electricity. As of mid-2008, 54 projects are operational, producing over 30 MW of electricity."

- Information is available from NYSERDA about specific examples of CHP projects in New York State. For example:
  - Fonda-Fultonville Central School District, where the entire K-12 school is operating independent of the utility grid, producing its own electricity and recycling the heat for hot water and cooling through the absorption process. Located on high ground along the Mohawk River, this self-contained school could also be used as a place of refuge during any community emergency.

  - The Emerling Dairy Farm in Perry, NY, where the manure from 1,100 cows is processed by an anaerobic digester, thus reducing odor and producing the methane used to generate electricity and hot water from the farm's CHP system.

- River Point Towers, a multifamily building in Bronx, NY, which uses a natural gas CHP system to produce electricity, with the waste heat recycled to produce domestic hot water, and with surplus energy used to heat the outdoor swimming pool.

Resource—written and web

- **New York State Energy Research and Development Agency (NYSERDA):**
  - Thomas G. Bourgeois (Pace University Energy Project) (June 25, 2004), *DG and CHP Siting & Permitting Guidebook*—CHP in New York State Two Years Later. An overview of NYSERDA's CHP *Guidebook.* Albany, NY: New York State Energy and Research Development Agency. http://www.nyserda.ny.gov/~/media/Files/EIBD/Industrial/DG%20Codes%20and%20Siting%20and%20Permitting%20-%20Tom%20Bourgeois%20-%20Pace%20Read-Only%20Compatibility%20Mode.ashx?sc_database=web
  - NYSERDA DG/CHP Integrated Data System **–** The Monitored Hourly Performance Data allow users to view, plot, analyze, and compare performance data from one or several different DG/CHP sites in the NYSERDA portfolio: http://chp.nyserda.org/home/index.cfm.

- **NYSERDA CHP Projects Performance Data –**The Monitored Hourly Performance Data allow users to view, plot, analyze, and compare performance data from one or several different DG/CHP sites in the NYSERDA portfolio: http://chp.nyserda.org/home/index.cfm.

- **Northeast Clean Energy Application Center, U. S. Department of Energy –** The Center serves as a focal point for communication among key stakeholders in seven states within the Northeast (CT, ME, MA, NH, NY, RI, and VT) regarding Combined Heat and Power, Waste Heat Recovery, and District Energy. The Center provides services for Education and Outreach as well as Technical Assistance: http://www.northeastcleanenergy.org/home/home.php.

- **US Environmental Protection Agency CHP Partnership Program –** This program was established as a voluntary program seeking to reduce the environmental impact of power generation by promoting the use of CHP. The Partnership works closely with energy users, the CHP industry, state and local governments, and other clean-energy stakeholders to facilitate the development of new projects and to promote their environmental and economic benefits: http://www.epa.gov/chp/index.html.

- **US Department of Energy Distributed Energy Program –** This program supports cost-effective research and development aimed at lowering costs, reducing program emissions, and improving reliability and performance in order to expand opportunities for the installation of distributed energy equipment today and in the future: http://www.eere.energy.gov/de/.

- **US Clean Heat & Power Association –** USCHPA's mission is to create a regulatory, institutional, and market environment that fosters the use of clean,

efficient local energy generation, including but not limited to combined heat and power, recycled energy, bio-energy, and other generation sources that lead to a demonstrable reduction in global greenhouse gas emissions: http://www.uschpa.org/i4a/pages/index.cfm?pageid=1.

- **ASERTTI National DG/CHP Performance and Testing Program –** ASERTTI's purpose is to remove a barrier to the increased use of distributed generation technologies - namely, the unavailability of uniform and documented information on the electrical, environmental, and mechanical performance of distributed generation (DG) and distributed generation/combined heat and power (DG/CHP) systems: http://www.dgdata.org/.

- **Environment Technology Verification Program Greenhouse Gas Center -** The Greenhouse Gas Technology Center is operated in cooperation with Southern Research Institute (SRI). This center verifies the performance of commercial-ready technologies that produce, mitigate, monitor, or sequester greenhouse gas emissions. This center is also part of the Air Pollution Prevention and Control Division, which is under EPA's National Risk Management Research Laboratory: http://www.epa.gov/nrmrl/std/etv/center-ggt.html.

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EMERGING INSULATION PRACTICES for RESIDENTIAL USE: DEEP ENERGY RETROFIT

Description:

In 2008, residential homes accounted for 22 per cent of the annual energy consumption in the United States.[1] Out of the total energy consumption in an average household, 50 per cent goes to space heating, and four per cent goes to air conditioning.[2] There are 94 million homes in the United States that were built before 1991, which is when energy codes of any sort took effect—needless to say, there is great opportunity to improve the energy-efficiency of existing housing stock across the country. Of particular interest is housing stock in the Northeast United States, due to the area's high dependence on space heating.

The Northeast is vulnerable to high space-heating needs due to colder-than-average winter seasons. In addition to this high need, many Northeast communities are rural in nature and do not have natural gas pipeline supplies as an energy source. By default, then, fuel oil becomes the energy source of choice, and fuel oil is the most vulnerable to price fluctuations because of its connection to the cost of a barrel of crude oil on the open market as well as its place in a global economy and political environment. Performing a "deep retrofit" and eliminating a heating system that relies on fuel oil can reduce a homeowner's vulnerability to price swings.

Deep energy retrofitting will drastically improve the energy performance of an existing home, providing multiple benefits and a significant, long-lasting solution to rising energy costs. The term "*deep*" energy retrofit refers to a practice that goes well beyond the current common practice of performing energy-efficiency work. This practice involves:

- Substantially improving the exterior building envelope with aggressive, emerging insulating practices (*e.g.* installing polyurethane rigid panel insulation, or applying open-cell polyurethane spray foam insulation after build-out),
- Installing new, energy-efficient windows or relocating existing ones,
- Sealing the building's below-grade foundation to the wall connections, and
- Sealing the roof to the wall connections with insulation that also provides an air barrier.

The following mechanical practices are then implemented to complete the overall retrofit:

- Incorporating whole-house ventilation, and

- Down-sizing the mechanical plant (HVAC, etc.) typically found in residential buildings.

Performing this retrofit comprehensively, with attention to detail, will typically reduce the whole-building energy load by 40 – 60 percent.

References:

[1] Energy Information Administration (June, 2009), "Energy Consumption by Sector Overview," Figure 2.1a, *Annual Energy Review 2008*. Washington, DC: U. S. Department of Energy. http://www.eia.doe.gov/aer/pdf/aer.pdf.

[2] Energy Information Administration (June, 2009), *Annual Energy Review—2008*, #DOE/EIA0384(2008). Washington, DC: U. S. Department of Energy. http://www.eia.doe.gov/aer/pdf/aer.pdf.

Benefits:

For consumers, including older adults and younger individuals with disabilities:

- A well-insulated building, with detailed air-sealing:
  - Enhances residents' comfort-level and is effective in controlling the conditioned space (both heating and cooling operations); that is, the home's shell will maintain a stable temperature within the home over a greater period of time.
  - Reduces dependence on the home's mechanical systems (HVAC, fans, etc.) to provide heating and cooling, thereby saving household expenses.
  - Maintains the embodied energy of the existing building.

- Whole-house ventilation provides a healthier living environment for residents by providing constant air-exchange, eliminating stale air, and providing better respiratory activity.

For the community:

- Reduces the need for energy-generation; when such generation uses fossil fuels, less use of such fuels reduces carbon emissions, creating a cleaner, healthier outdoor environment.

- Deep energy retrofitting builds local economies by utilizing labor and skill rather than expensive technology.

Impediments or barriers to development or implementation:

- There is limited understanding by the workforce of newer insulation methods and materials, or of the synergy between envelope improvements and reduced dependence on mechanical systems.

- Deep retrofit work and materials are perceived by homeowners to be cost-prohibitive, with a long time-period for a return on the initial investment perceived.

- Lending institutions often lack appraisers who have the knowledge or experience to value a deep retrofit improvement project, and there are too few financed deep retrofit projects available that can serve as comparables for appraisers.

- Providing these retrofitting services requires a significant investment in training and education, requiring a longer lead time to develop contractor-capacity than is required to develop contractor-capacity for equipment (widget) based programs.

- Workforce-capacity includes training the entire network: contractors performing the work, mechanical suppliers, building code officials/inspectors, lending institutions, etc.

- Typically, energy-efficiency solutions that are offered do not even consider the elements of deep energy retrofitting work in their strategies—for example, the burden of mechanical over-sizing of new systems, or replacement window salesmen that are energy raters, so every offered solution involves a window.

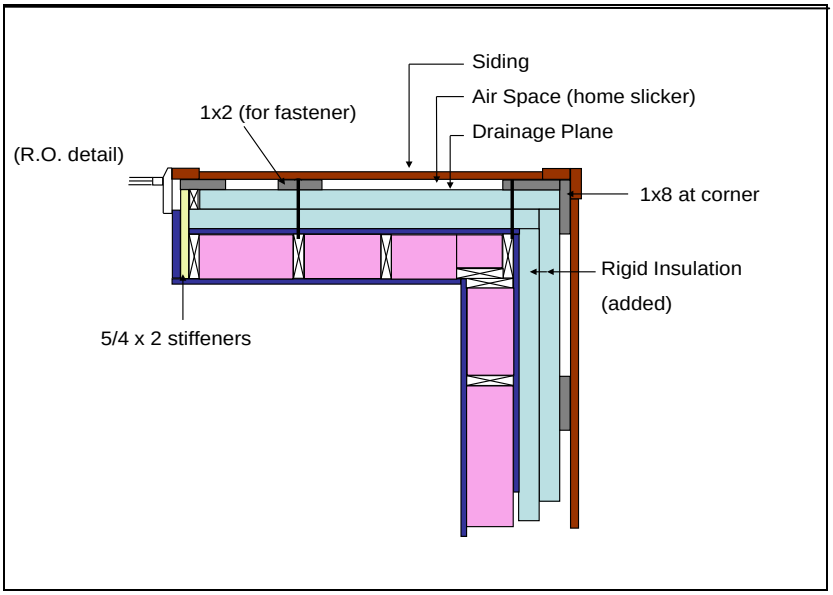
Resource—examples:

- *Cador-Price-Jones project, Somerset, Massachusetts*—a retrofit of a 4,066 sq. ft. 1914 two-family wood frame house, including original windows, siding, and trim. Total Annual Energy Use before the retrofit: 205,500 KBtu/yr (includes heat, hot water, electricity); Project objective: with work performed, reduce this total by 65–70 per cent, or 61,600 KBtu/yr.

Framing using 2x's laid flat is built to create an insulation/air barrier cavity. 5" cavity is sprayed using closed cell foam improves R-value, air sealing, and structural integrity.

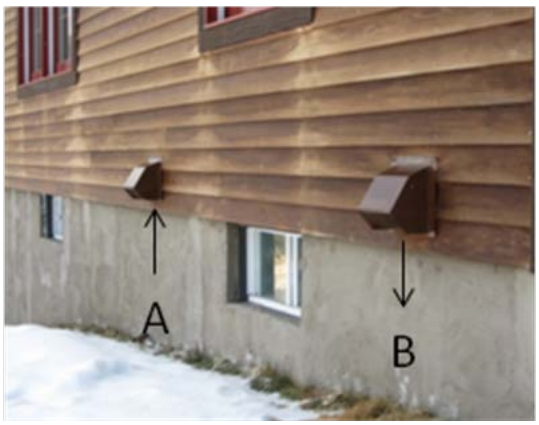
- *Application of rigid polyisocyanurate insulation to the exterior of a residential building:*

2" Polyurethane rigid panel is applied to the exterior of the building sheathing, overlapping the seams of previous layered application, providing a thermal barrier and eliminating "bridging" from the wood material to exterior. Window and door rough openings are trimmed with 5/4 material for finish. Siding is reapplied, leading to drastically improved insulation (R-value) and reduced air infiltration.



Detail for application of the two (2" each) rigid polyurethane panels applied to the exterior sheathing of the building. Note the strapping detail for fasteners and drainage plane. Window and door openings are handled with 5/4 material installed for stiffening the structure and plane.

- *Whole house ventilation installed, in this case using a 300 CFM Energy Recovery Ventilation (ERV) Unit:*



Energy Recovery Ventilator installation includes unobstructed fresh air inlet (A) and return-air outlet (B), with dual core exchange for continuous whole house ventilation, moving 5 CFM constantly throughout the home. Individual timers in high moisture return areas (*e.g.,* bathrooms, kitchens) allows for system to be switched into high speed (30 CFM) to clear the area. This strategy eliminates the need for individual bath fans and exhaust hoods by including these returns into the ERV system. Providing continuous exchange of fresh air into the "tightened" building is mandatory in terms of building and occupant health.

Resource—written and web:

- *Deep Energy Reductions: Links to a series of articles, white papers, presentations, and other resources on deep energy reductions, by Linda Wigington, Director, Deep Energy Reduction Initiatives, Affordable Comfort, Inc., Moon Township, Pennsylvania.* *http://www.affordablecomfort.org/content/deep-energy-reductions*.

- Now House Project, Windsor Near Zero Energy Homes—retrofitting both privately owned and public buildings in World War II era communities across Canada: http://www.nowhouseproject.com/news.php.
  http://www.nowhouseproject.com/.
  Now House Windsor 5: http://www.nowhouseproject.com/news.php.

- Betsy Petit (Spring, 2009), "A Home for the Next 100 Years," *High Performing Buildings*, Vol. 2. A case study of a deep energy retrofit of a Sears Roebuck Kit Home (a staple in American communities between 1908 and 1940). To view online: http://www.buildingscience.com/documents/digests/bsd-139-deep-energy-retrofit-of-a-sears-roebuck-house-a-home-for-the-next-100-years.

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ENERGY MODELING—for energy efficiency

An *energy model* is a mathematical representation of a building in a specialized computer program. The representation is composed of thousands of equations created by the program from the inputted design specifications for the building—such as location, size, orientation, materials, equipment, operating schedules, and use. With this information, the program can calculate an estimation of the building's energy usage when constructed.

Description:

In many respects, designing an energy-efficient building appears to only involve choosing better materials and equipment. For example, to achieve better energy efficiency, a building needs 12 inches of insulation in the roof instead of 10 inches, south and west facing windows with low shading coefficients, and a condensing furnace with a variable speed blower. Such design choices will improve the energy efficiency of most buildings.

What is not obvious, though, is how these design choices were made— *why* was 12 inches of roof insulation selected and not 16 inches; *why* were windows with low shading coefficients chosen on both the south and west sides of the building? These decisions, and many more, were made using a design tool called an energy model.

Energy modeling programs have been available for more than 25 years. The early program tools were very difficult to use and, as a result, very few buildings were designed using energy modeling. Typically, those early tools required six months or more of training before a user could effectively model a building. Models were also very time-consuming to create because the building's design specifications needed to be entered in a command-line computer-programming environment (e.g., not a Microsoft Windows™ user-friendly environment with pull-down menu items). At that time, an energy model for an average building could take two weeks or longer to create. Today, an experienced building design engineer or architect can learn how to use many energy modeling programs in less than a week and can produce high quality energy models in a few days. Most of today's programs can be run on a laptop computer, further increasing the ease of their use.

There are many energy modeling programs available. Some of the more well-known programs are DOE 2.1, EnergyPlus, eQuest, Energy10, and TREAT. Many of the available programs have unique features that may make each of them more suitable to a specific project. For example, EnergyPlus and Energy10 allow some renewable energy systems to be included in a design. EnergyPlus has the ability to include indoor air quality analyses in a project. TREAT, eQuest, and Energy10 have

graphical user-interfaces that are easier to use. TREAT and Energy10 are well-suited for use on residential building projects.

Like many other products, modern buildings are very complex systems to design and construct. For many products, the design teams usually get to try several full-sized prototypes before the final design is selected and commercialized. However, buildings differ from many other complex products in this one important respect. The nature of building construction rarely lends itself to trying several full-sized prototypes before selecting the design to use. For this reason, every reasonable effort is made, *before* a building is constructed, to determine if it will operate properly. Usually there are no second chances for a building's design; once the building is constructed, any design flaw can be very costly to address.

This reality is equally true for a building's energy systems. If the installed energy systems do not operate together as intended, the cost to repair any design flaw can be large. Energy modeling is the most powerful tool a design team can use to ensure a building's specified energy system will operate as intended and deliver the performance expected by the owner. The resulting energy savings from improved design decisions and the potential avoidance of costs from design flaws can easily offset the small added expense of the energy modeling process. With the recent advances in energy modeling programs and computers, it is very easy to justify the use of some type of energy model during the design of any building that will have significant energy usage.

Benefits:

- Energy models can estimate the energy usage of a building before it is constructed, based on its design specifications; this information can be useful to a building owner for planning the building's operating expenses.

- An energy model can evaluate and compare the energy impacts of many different design decisions. For example, the orientation of a building can be easily rotated in an energy model to determine how solar energy increases or decreases the building's overall energy consumption for different positions on the project site.

- An energy model can optimize the interactive factors in a building's design. For example, if better wall insulation and windows are being considered, the energy model's results can be used by the design team to determine if a smaller heating system can be specified. The design team can then determine if the dollar savings from the smaller heating system will offset a significant portion of the increased expense of the better insulation and windows. The design team can determine the specific combination of insulation, windows, and heating system that minimizes the building's life-cycle cost (e.g., construction costs plus operating expenses during its life).

- Using an energy model can be beneficial for a project attempting to achieve a LEED certification from the U. S. Green Building Council—using an energy model is one option for showing compliance with EA 1 Credit: Optimize Energy

Performance. It should also be noted the energy-model-compliance approach is the only option that allows design teams to potentially earn the maximum points allowed for this credit (10 points vs 1 or 4 points for other compliance approaches) on a high-performing building.

Impediments or barriers to development or implementation:

- Energy modeling will modestly increase the design cost of a project. This cost increase varies from project to project, based on the building's size, envelope design, and HVAC system design. However, for average buildings with construction costs in the range of $150 to $200 per square foot, a very rough energy-modeling-cost estimate would be less than $0.50 per square foot.

- The accuracy of the energy model is dependent on the quality of the design information/specifications inputted into the modeling computer program. If crude design information is used, the energy model's results will be less likely to represent the final performance of the constructed building. "Garbage-In, Garbage-Out" or "GIGO" is a computer-modeling rule that succinctly explains the importance of having accurate design information to input into the energy model.

- It is unlikely the energy model will *exactly* predict the building's actual energy usage, as the energy model's results are based on *typical* weather data for a location; and typical weather conditions are rarely encountered by real buildings. Energy models also assume that building occupants behave in well-defined ways, such as always setting the thermostat to the modeled temperature, arriving and departing at the same times every day, and using equipment with expected patterns. Real occupants rarely behave as assumed in energy models. Even an experienced energy modeler, using an advanced program, can be off by as much as 10 per cent in their prediction because of these weather and occupant assumptions.

Resource—example:

- *The Solaire* , 20 River Terrace, New York City—a 27-story, 293-unit, glass-and-brick residential tower. The final wall design selected was based in part using energy models created in DOE 2.1. (http://eere.buildinggreen.com/overview.cfm?ProjectID=273).

Resource—written and web:

- Marc Rosenbaum, Energysmiths (2003) "Understanding the Energy Modeling Process: Simulation Literacy 101," *The Pittsburgh Papers; BuildingGreen.com.* http://www.buildinggreen.com/features/mr/sim_lit_101.cfm.

- Richard Paradis, Steven Winter Associates (June 15, 2007), "Energy Analysis Tools," *National Institute of Building Scientists—Whole Building Design Guide.* http://www.wbdg.org/resources/energyanalysis.php?r=minimize_consumption.

- D. Crawley, J. Hand, M. Kummert, and B. Griffith (July, 2005), *Contrasting the Capabilities of Building Energy Performance Simulation Programs*, Version 1.0.

Washington, DC: U. S. Department of Energy. http://apps1.eere.energy.gov/buildings/tools_directory/pdfs/contrasting_the_capabilities_of_building_energy_performance_simulation_programs_v1.0.pdf.

- U. S. Department of Energy, "Building Energy Software Tool Database," *Building Technologies Program.* "A directory providing descriptions and information on 380 building software tools for evaluating energy efficiency, renewable energy, and sustainability in buildings; each tool listed includes databases, spreadsheets, component and systems analyses, and whole-building energy performance simulation programs, as well as information on the expertise required, users, audience, input, output, computer platforms, programming language, strengths, weaknesses, technical contact, and availability": http://apps1.eere.energy.gov/buildings/tools_directory/.
  Among the 380 tools described, included are:
  - DOE 2: http://apps1.eere.energy.gov/buildings/tools_directory/software.cfm/ID=34/pagename=alpha_list.
  - EnergyPlus: http://apps1.eere.energy.gov/buildings/tools_directory/software.cfm/ID=36/pagename=alpha_list.
  - Energy 10: http://apps1.eere.energy.gov/buildings/tools_directory/software.cfm/ID=36/pagename=alpha_list.
  - TREAT: http://apps1.eere.energy.gov/buildings/tools_directory/software.cfm/ID=430/pagename=alpha_list.

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  NYSERDA has programs that may support energy modeling for new or existing buildings. Most projects are cost-shared by NYSERDA on a 50/50 basis.

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ENERGY STAR

Description:

The U.S. Department of Energy (DOE) and the U. S. Environmental Protection Agency (EPA) created the Federal ENERGY STAR® program in 1992 in order to promote energy-efficient products and practices. DOE and EPA have partnered with over 15,000 private- and public-sector associations to develop the best, most energy-efficient management practices and implementation strategies in order to save both energy and money. By increasing energy-efficiency, the program reduces energy-usage and the greenhouse gas emissions that result when obtained from non-renewable sources. In the United States, with the help of ENERGY STAR,® Americans saved enough energy in 2008 alone to avoid greenhouse gas emissions equivalent to those from 29 million cars , while saving $19 billion on their utility bills.[1]

This program sets forth strict energy-efficiency and quality standards on products for both the residential and commercial sectors—producing a rating system by which consumers can compare products and, thus, make educated decisions based on their efficacy. The program offers consumers a dependable label of energy-efficiency and performance on over sixty product categories, with thousands of models, as well as home and building assessment tools. The goal of the ENERGY STAR® program is to offer consumers energy-efficient choices and savings on greenhouse gas emissions without sacrificing features, style, or comfort, as well as provide consumers with the technical tools and management guidance to best utilize the qualified technologies.

In the residential sector, ENERGY STAR® ratings are given for household products, new home construction, and existing home retrofitting. Implementation of these rating qualifications can save the average family as much as one-third of their annual energy costs and greenhouse gas emissions.[1] In the business sector, a multi-faceted approach to implementing an energy management strategy is used, including measuring energy performance, setting business goals, tracking savings, and rewarding improvements. Thus far, through the ENERGY STAR® public/private partnerships, over 96,000 buildings in businesses throughout the United States have benefited from energy-efficiency applications.[1]

Reference:

[1] U. S. Environmental Protection Agency, "About Energy Star," *Energy Star*: http://www.energystar.gov/index.cfm?c=about.ab_index.

Benefits:

For older adults, individuals with disabilities, families, and children:

- *Reduced home expenses:* ENERGY STAR® qualified improvements reduce energy-usage without sacrificing convenience in the living environment, making homeownership and rentals more affordable for families. In addition, increased affordability:
  - Is a critical factor in supporting the ability older people and people with disabilities to successfully age-in-place in their own homes and apartments.
  - Supports the efforts of New York State's substantial number of caregivers of older adults and younger-aged individuals with disabilities by reducing the financial aid many family members contribute for those they provide care for.

- *Healthier living environment:* Reduced energy-usage reduces emissions of greenhouse gases—creating healthier living environments for all residents. Children have the added benefit of inheriting a cleaner, more sustainable environment in the future.

For the community:

- ENERGY STAR® program qualifications exist for every aspect of living and for all walks of life—from residential homes, to public, industrial, and commercial applications.
  - *Public and commercial budgets:* The reduced energy bills resulting from implementation of ENERGY STAR® qualifications in public and commercial buildings saves the community money and helps support the business environment.
  - *Livable communities:* Reduced greenhouse gas emissions results in a less-polluted, healthier ecosystem in which to live—which is an important component of a livable community.
  - *Geographic area:* The benefits of ENERGY STAR® qualifications are applicable to rural, suburban, and urban dwellers and geographic areas.

Impediments or barriers to development or implementation:

- *Consumer cost:* In general, the testing, research, and quality-assurance procedures associated with obtaining ENERGY STAR® qualification result in a cost increase when compared to products, practices, and applications that are produced with no energy-efficiency-use or quality standards. However, as the use of ENERGY STAR® has continued to increase, the price differential between ENERGY STAR® and non-ENERGY STAR® products continues to diminish. Nevertheless, currently, this cost differential for some products is significant enough for some consumers to opt to purchase a less expensive, more inefficient product—this is often true for those who could benefit most from products that use less energy and reduce annual energy bills, including:
  - Lower-income households, typically in rural and urban settings;
  - Smaller/independently owned retailers and manufacturers, who struggle with the higher initial purchase price and adoption of such technology, even though it will save them money in the long run.

Resource—examples:

- "Success stories," *ENERGY STAR for Affordable Housing: More Energy Efficient, Livable, Sustainable Communities*, U. S. Environmental Protection Agency and U. S. Department of Energy: http://www.energystar.gov/index.cfm?c=affordable_housing.affordable_housing

- U. S. cities with the most *Energy Star* certified commercial buildings and manufacturing plants—by facility type, city, and state—U. S. Environmental Protection Agency, U. S. Department of Energy, Washington, DC.: http://www.energystar.gov/index.cfm?fuseaction=labeled_buildings.locator
  - (3-14-2011), "EPA Announces U.S. Cities with the Most Energy Star Certified Buildings—Third annual list shows dramatic growth, savings of energy efficient buildings," Press Release by U. S. Environmental Protection Agency, U. S. Department of Energy. For further information: Stacy Kika, kika.stacy@epa.gov, (202) 564-0906, (202) 564-4355. http://yosemite.epa.gov/opa/admpress.nsf/d0cf6618525a9efb85257359003fb69d/db40ab7277269d15852578530052c495!OpenDocument

- Several homes receiving the Federal government's *Energy Star for Homes Leadership in Housing Award*: Hathmore Technologies, LLC, 14220 East 42nd Street, Independence, MO 64055, (816) 224-5550, green@hathmore.com. http://yosemite.epa.gov/opa/admpress.nsf/0/6AF501EC6D02C7BF852575A1006BEEC4.

- Paul and Rabia Nagin's 6,800 square foot home (built for about $150/sq. ft.) in Skyview Acres, an intentional community, in Pomona, Rockland County, New York, 35 miles north of New York City—called "the third most energy-efficient home in New York state, according to Energy Star, achieving nearly zero net carbon emissions": http://www.naturalhomeandgarden.com/article.aspx?id=8684.

Resource—written and web:

- *Energy Star*—U. S. Environmental Protection Agency, U. S. Department of Energy, Washington, DC: http://www.energystar.gov/.
  - "Frequently Asked Questions," *Energy Star:* http://energystar.supportportal.com/ics/support/default.asp?deptID=23018.
  - *"The Energy Star for Buildings and Manufacturing Plants,"* Energy Star certification for commercial buildings and manufacturing plants: http://www.energystar.gov/index.cfm?c=business.bus_bldgs.

- U. S. Environmental Protection Agency, *New York State Energy Research and Development Authority (NYSERDA), Albany, New York*—received the "ENERGY STAR Award for Sustained Excellence": http://www.energystar.gov/index.cfm?fuseaction=pt_awards.showAwardDetails&esa_id=587.

- New York State Energy Research and Development Authority (NYSERDA):
  New York Energy $mart[SM]: http://www.getenergysmart.org/.
  To locate ENERGY STAR Builders:
  http://www.getenergysmart.org/Resources/FindPartner.aspx?t=1.
  To locate ENERGY STAR Retailers:
  http://www.getenergysmart.org/Resources/FindPartner.aspx?t=2.

Resource—technical assistance contact names:

- New York State Energy Research and Development Authority
  17 Columbia Circle
  Albany, New York 12203-6399
  1-866-NYSERDA or (518) 862-1090

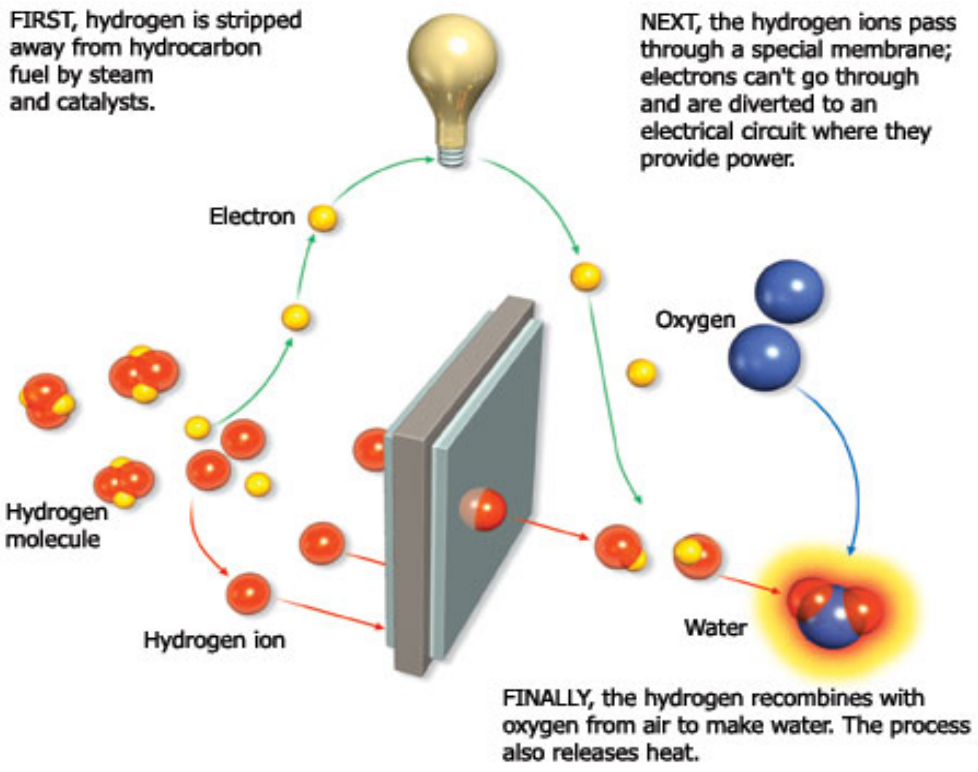
Marci Brunner, Project Coordinator
New York State Energy Research and Development Authority
Albany, NY

FUEL CELLS

Description:

Fuel cells are an emerging technology that continues to evolve rapidly. Fuel cell systems offer the potential for clean, reliable energy by generating electricity from a chemical reaction rather than from combustion (burning a fuel).

In a fuel cell, hydrogen and oxygen are combined to produce electricity and water. Hydrogen (fuel) is fed into the anode of the fuel cell, and oxygen (from air) is fed into the cathode side. Encouraged by a catalyst, electrons are stripped from the hydrogen atom; freed of the electrons, the protons pass through the electrolyte, while the electrons are forced to take a different path to the cathode. As the electrons travel their separate path, they create an electric current that can be utilized. At the cathode, another catalyst rejoins the hydrogen atom, which then combines with the oxygen to create a molecule of water.



Producing electrical power for a working application requires more than just the fuel cell stack. A fuel cell system may include fuel processing, thermal management, power conditioning, electric grid connection, and energy storage modules; the

power conditioning system provides regulated DC or AC power appropriate for the application. Successful integration of an entire fuel cell system is critical to achieving optimal performance. While hydrogen is the primary fuel source for fuel cells, the process of fuel-reforming allows for the extraction of hydrogen from many widely available fuels, such as natural gas and propane, or any other hydrogen-containing fuel.

Fuel cell systems offer commercially viable alternatives to existing power sources because they have higher efficiency compared with conventional power generation, emit little or no pollution, and have greater flexibility in installation and operation. These systems are appropriate for all geographic areas of the State and can be deployed to operate in parallel with the electric grid (as independent energy sources) or to complement solar and wind generating systems. The space needed to house a fuel cell is equivalent to an ordinary refrigerator. A system for a single family residence could be located in the basement or backyard.

Fuel-cell-based MicroCHP (combined heat and power)—
As the cost of energy increases and the need to reduce greenhouse gas emissions becomes more urgent, the need for clean, high-efficiency distributed generation solutions becomes increasingly important.

CHP systems, at all capacities—industrial, commercial, and residential—remain a top choice for solving America's energy constraints. A recent study by Oak Ridge National Laboratory concludes that "the energy efficiency benefits of CHP offer significant, realistic solutions to near- and long-term energy issues facing the Nation." Co-generation (heat and electricity) solutions make the most sense in regions where the cogenerated heat can be put to good use (for example, in the colder climates like New York and throughout the northeast).

Fuel-cell-based CHP systems represent a solution for residential or light commercial, grid-connected, stationary power requirements. In addition, they also offer energy efficiency and environmental benefits, as well as an economic/cost advantage to the end user.

The use of fuel cell systems for a variety of applications is increasing across the world. For example, in Japan, Toyota has built fuel cell hybrid buses; drivers in Southern California are testing Honda's Fuel Cell Electric cars; Germany created the world's first fuel cell boat and uses fuel-cell systems in submarines; a Chinese company will use PEM fuel cells to power their electric bicycles for China's extensive, growing e-bike market; Manhattan's new Twin Towers are expected to be partially powered by 12 hydrogen fuel cells; and, according to the U. S. Department of Energy, in the United States there are major fuel cell programs in New York (NYSERDA), Connecticut (Connecticut Clean Energy Fund), Ohio (Ohio Development Department), and California (California Energy Commission).

While fuel cell technology in private homes and multiunit housing has not yet reached the level of use in large buildings, commercial spaces, and other applications, residential use is increasing. Japan is in the forefront, with 2,200

homes getting their heat and electricity through fuel-cell generation. In the United States, interest in residential usage is now increasing. For example, in 2002, the York State Energy Research and Development Authority (NYSERDA) partnered with the National Fuel Gas Distribution Corporation in Western New York to install fuel cell systems in two residential homes; in 2007, the Governor's mansion in Florida became powered through a hydrogen fuel cell system; in 2009 NYSERDA partnered with Plug Power, Inc.,[1] to install fuel cell systems in three New York State homes. Several manufacturers across the country are currently working on installing residential fuel cells, including ClearEdge Power in California and Oregon, McCutcheon Construction in California, and Plug Power, Inc., in Albany, New York. While cost continues to be an issue in the implementation of fuel cell systems, the U. S. Department of Energy has been working steadily to bring down the cost to be competitive with other forms of energy-generation.

Reference:

[1] Plug Power, Inc., Albany, New York; home page: http://www.plugpower.com/; commercial fuel cell products: http://www.plugpower.com/AboutUs/SiteSearch.aspx?IndexCatalogue=Plug%20Power%20Website%20Pages&SearchQuery=commercial%20fuel%20cell%20products

Benefits:

For consumers:

- Up to 85 per cent overall efficiency.
- 25–35 per cent reduction in emissions from household energy use.
- Zero emissions.
- Low noise and vibration.
- Low operating and maintenance requirements— less down- time (*100x more reliable than the average power supply for data centers—three seconds of down time per year versus an average of five minutes).*
- Less variation in efficiency across variable loads, with clean water and heat as the only by-product.
- There are federal tax credits for multiple-dweller residential developments.

For communities:

- Transitioning to a hydrogen-based economy can deliver three main benefits:
  - Energy Security: Hydrogen can be produced from a variety of fuel sources, including renewables, which can help diversify our energy supplies and lessen our dependence on foreign oil.
  - Economic Growth: Hydrogen can contribute to economic growth through job creation in a developing industry and investment opportunities.
  - Environmental Health: Hydrogen can be produced and used in ways that improve health-related air quality and reduce greenhouse gas emissions.

- Hydrogen is the lightest of all elements. This causes it to be buoyant and to rapidly disperse when released in air, so a leak is quickly diluted and harmless.

- Hydrogen is colorless, odorless, and has no taste. It is non-toxic and non-poisonous, and there are no significant environmental hazards associated with accidental discharge.

- A hydrogen fire radiates very little heat compared to a petroleum fire. For a flammable mixture to exist, a four times higher concentration of hydrogen is required than that of gasoline (four per cent versus one per cent). An electrostatic spark from the human body is just as likely to ignite gasoline as hydrogen at these minimum concentrations.

- Hydrogen has been mass-produced for more than 50 years. Eight million tons are produced annually in the U.S. alone.

Impediments or barriers to development or implementation:

- Fuel cells have the potential to be a very clean source of energy if the hydrogen-generation process uses renewable fuel sources; however, current government-funded research requires the use of fossil fuels to produce the vast majority of hydrogen for fuel cells. Without a trend towards increased use of renewables for hydrogen production, this technology's environmental benefits will continue to be somewhat offset by its reliance on fossil fuels.

- There are also concerns that, in a large-scale hydrogen economy where hydrogen is used to power fuel cells and related technologies in a variety of applications, manufacturing, storing, and transporting hydrogen would result in leaks that could accumulate in the upper atmosphere, potentially depleting polar ozone layers. Infrastructure designs that carefully eliminate the potential for leaks can minimize this risk.

Resource—examples:

- Lewiston, New York (Niagara County): In 2002, the first fuel cell system to power a single-family home in Western New York was created through a partnership of business and government entities , including the New York State Energy Research and Development Authority (NYSERDA), National Fuel Gas Company (NYSE: NFG), Plug Power Inc. (NASDAQ: PLUG), ATSI Engineering Services (ATSI), Integrated Building And Construction Solutions, Inc. (IBACOS), and the United States Department of Energy (DOE).
  ZPEnergy.com (April 23, 2002), "Paving the Way" (Press Release):
  http://www.zpenergy.com/modules.php?name=News&file=print&sid=96;
  http://www.zpenergy.com/modules.php?name=News&file=article&sid=96.

- Plug Power (July 7, 2009), "Plug Power Receives Award to Operate Residential GenSys Fuel Cells in New York State Homes" (Press Release):

http://www.plugpower.com/News/PressReleases/09-07-07/PLUG_POWER_RECEIVES_AWARD_TO_OPERATE_RESIDENTIAL_GENSYS_FUEL_CELLS_IN_NEW_YORK_STATE_HOMES.aspx.
Also: NASDAQ OMX—Globe Newswire (July 7, 2009): http://www.globenewswire.com/newsroom/news.html?d=168467.
Plug Power, Inc., has received a $1.4 million award from the New York State Energy Research and Development Authority (NYSERDA) to install and operate three combined heat and power (CHP) GenSys fuel cell systems in New York State homes. These systems will allow Plug Power to validate and enhance product features in preparation for broad scale product commercialization. The first system is scheduled to be installed in mid-2009, with all three units expected to be operational by the end of 2009.

A residential GenSys unit will be installed in the basement of each home and will operate in conjunction with the electric grid, running on natural gas. The fuel cell will produce electricity and high-quality heat to satisfy the home's heating and domestic hot water demands. Plug Power estimates that the GenSys unit is expected to achieve an overall combined efficiency of 85 per cent (currently, homes utilizing grid electricity and typical heating systems average 44 per cent household efficiency), and is expected to save the homeowners approximately 30 per cent on their monthly utility bills.

Residential GenSys is a grid-parallel system, with two sources of power available— the grid and GenSys. During normal operation, GenSys is designed to satisfy all the cooling, heating, and hot water requirements of a typical home. As the home calls for cooling/heat or hot water, GenSys produces electricity; the more cooling/heat you need, the more electricity that is produced. Homes with large space conditioning or hot water demands may produce excess electricity, which can be sold back to the grid. Conversely, during periods of peak usage, homes with very high electrical demands may also consume some electricity from the grid. GenSys delivers between $1.60 and $1.80 worth of energy (heating, cooling, and electricity) for each $1 of natural gas processed. The economic benefit varies with specific energy demands and regional energy prices, but typically results in a 20-40 per cent reduction in monthly energy bills.

Resource—written and web:

- U. S. Fuel Cell Council, *About Fuel Cells—How Do They Work*: http://www.usfcc.com/about/how.html.

- U. S. Department of Energy: Enter "U. S. Department of Energy—Fuel Cells" into Google's search engine to see an extensive list of links to the Department's information on fuel cells and fuel cell programs.

- New York State Energy Research and Development Authority: http://www.nyserda.ny.gov/ (enter "fuel cells" in the Department's Web site search engine for extensive information on fuel cells); or,. for a direct link: http://www.nyserda.ny.gov/SearchResults.aspx?searchvalue=fuel%20cells&sort=0&pagetype=0&pagenumber=1&page=1.

- Karl V. Kordesch and Guenter R. Simader (January, 1995), "Environmental Impact of Fuel Cell Technology," *Chemical Reviews*, Vol. 95, No. 1.

- Smithsonian Institution—National Museum of American History (2008), *Fuel Cells:* http://americanhistory.si.edu/fuelcells/index.htm.
  "Fuel Cell Basics": http://americanhistory.si.edu/fuelcells/basics.htm.

Resource (free or fee-based)—technical assistance contact names:

- Dana Levy, D.Eng., P.E.
  Program Manager for Industrial Research
  New York State Energy Research and Development Authority
  17 Columbia Circle
  Albany, New York 12203
  518-862-1090, ext. 3377
  DLL@NYSERDA.org

Namrata Shringare, M.D., MPH
Schenectady, NY

Bloom's Energy Server™
Fuel Cell Technology for Green Innovation

Description:

Bloom's Energy Server™ (commonly referred to as a Bloom Box) is a privately owned technology for producing energy from solid oxide regenerative fuel cells.

Bloom Energy[1] (originally called Ion America) is a privately owned company founded in 2001 and based in Sunnyvale, CA. The principal Co-Founder and Chief Executive Officer of Bloom Energy, K. R. Sridhar, and his team worked on NASA's Mars space program at the University of Arizona in the 1990s and built a device capable of producing air and fuel from electricity and, reversibly, producing electricity from air and fuel. In 2001, after the NASA project was over, the team continued its research, which led to the formation of an innovative device—Bloom's Energy Server™—that serves as a clean, reliable, and affordable energy source.

The initial servers were made with the capacity to generate 5kW of electricity and were tested at a field trial site at the University of Tennessee in Chattanooga. Several other units were then tested in California and Alaska to validate the technology. The commercial (100kW) servers were shipped to the company's first customer, Google, in July, 2008.

As this alternative is still in its early development stage, Bloom Energy manufactures the commercial servers manually. The other early customers include FedEx, Coca-Cola, Staples, and Wal-Mart. Mass-manufacturing of small household units of the Bloom Energy Server™ is expected in the future, and it is expected that this will be an affordable option for energy production in domestic settings (private homes).

Technology and architecture of the Bloom Energy Server™:

Energy server: An energy server is an electricity generator that has the capacity to store the generated power. Bloom Energy uses its patented solid oxide regenerative fuel cell technology for its Energy Server™. Each server consists of thousands of Bloom's solid oxide regenerative fuel cells.

Fuel cells: Fuel cells are devices that convert fuel into electricity through a clean electro-chemical process without any combustion. This conversion technique gives much higher conversion efficiencies than conventional thermo-mechanical methods. The operating principles of fuel cells are similar to those of batteries; i.e., includes an electro-chemical combination of reactants to generate electricity—a combination of a gaseous fuel (hydrogen) and an oxidant gas (oxygen from the air) through electrodes and via an ion-conducting electrolyte. However, unlike a battery, a fuel cell does not run down or require recharging. A fuel cell operates as long as both fuel and oxidant are supplied to the electrodes, and the influence it exerts on the

surrounding environment is negligible (see Resources section for links to more information on fuel cells).

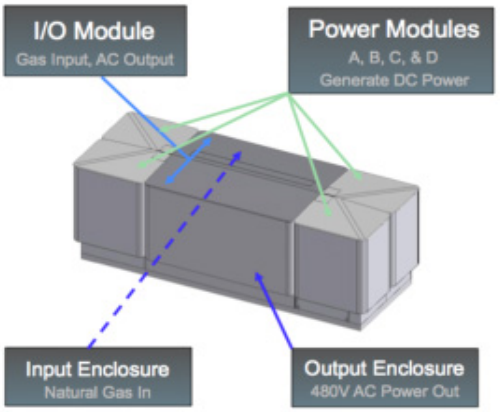
Solid oxide fuel cell (SOFC)[1,2,3]*:* A SOFC is a type of fuel cell valued for its potential market competitiveness, with high efficiency in fuel input and electricity output. A SOFC is like a rechargeable battery that always runs. It consists of three parts: an electrolyte, an anode, and a cathode. In Bloom's SOFC, the electrolyte is a solid ceramic square made from a common sand-like "powder." According to Bloom's patent description, these thin white ceramic plates are Scandia stabilized Zirconia (ScSZ). The anode and cathode are made from special inks that coat the electrolyte on each side. One side of the ceramic electrolyte plate is coated with a green nickel oxide-based ink that works as an anode; the other side, which works as a cathode, is coated with black ink (most probably Lanthanum Strontium Manganite—a non-radioactive substance). The Bloom server does not require chemicals, such as the corrosive acids used in conventional fuel cells. Instead, it uses inexpensive metal alloy plates for electric conductance between the two ceramic fast-ion conductor plates, as opposed to the use of costly precious metals like Gold or Platinum that are used for high conductance in other fuel cells.

The electro-chemical process within SOFC (http://www.bloomenergy.com/products/solid-oxide-fuel-cell-animation/):

SOFC requires a high operating temperature (600-1000^{0}C) for its reactions to take place. At a high temperature, warm air enters the cathode side of the fuel cell. The resulting steam mixes with the fuel to produce reformed fuel; this reformed fuel enters the anode side, and a chemical reaction takes place. As the reformed fuel crosses the anode side, it attracts oxygen ions from the cathode. Oxygen ions combine with the reformed fuel to produce electricity, water, and a small amount of carbon dioxide gas. Water is recycled into the cell to produce steam to generate reformed fuel, and this process also generates the heat required for the functioning of fuel cells. The continuous supply of fuel, air, and heat constantly generates the electricity from the cell.

Each Bloom Energy fuel cell is capable of producing about 25W of energy, which is enough to power a light bulb. For more power, multiple cells are mounted together, along with metal interconnect plates, to form a fuel cell stack. A few stacks together (about the size of a loaf of bread) are enough to power an average U.S. home. In an Energy Server™, multiple stacks are aggregated into a "power module"; and multiple power modules, along with a common fuel input and electrical output, are assembled as a complete system. When more power is required—for example, for commercial or industrial sites—multiple Energy Server™ systems can be deployed side by side. The current Energy Server™ in the market has the capacity to generate 100kW of electricity, which would power a 30,000 sq. ft. office building or 100 average-sized U.S. homes.

Bloom Energy Server™ Unit Design[4]



Cost of Bloom Energy Server™:

The current 100 kW Bloom Energy Server™ costs approximately $700,000–$800,000. The high cost is the result of the factors associated with manual production, and these production costs are expected to come down once mass-manufacturing starts and widespread commercial and domestic use becomes routine practice. Bloom Energy estimates the size of a home-sized server as 1 kilowatt, and it is expected to cost under $3000.

End-use is more cost-effective compared to other sources of generated electricity. Bloom's servers produce significantly more electricity for the same fuel costs of conventional energy sources, and the Bloom server's ability to generate the electricity on-site eliminates the need for costly transmission and distribution infrastructure. Thus, savings typically provide a three-to-five-year payback on a user's initial capital investment.

While individual commercial or industrial sites or individual homeowners can purchase their own servers to generate electricity on site and, thereby, put control directly into the consumer's hands, Bloom Energy suggests an alternative means of achieving the cost-savings of the Bloom Energy Server™— selling the electricity produced by the server (named Bloom Electrons℠) rather than selling the server itself. Both small energy suppliers and big energy industries can invest in a Bloom server and make their generated electricity available to individual consumers. This shifts the cost of infrastructure management from individual consumers to the suppliers.

Industry comparisons:

The Bloom Energy Server™ is a relatively recent entry into the field of "green and affordable energy"; it is not yet available for home use, and mass-production has not yet been achieved for commercial use. Thus, comparison claims with other green energy alternatives (such as wind, solar, and other types of fuel cells) are difficult to substantiate. In addition, continued progress in research and

development continues to improve technology and output and to reduce costs for a variety of green energy alternatives, including the Bloom Box. When comparing this innovative model with other modes of green energy, professionals note that insufficient "use-time" has elapsed for evaluations of the Bloom server equipment's long-term durability and reliability, the model's aggregated carbon dioxide emissions once mass-production is achieved, its comparative electricity-generation conversion efficiency, and its potential to surpass other models' production and operation costs.

References:

[1] Bloom Energy: http://www.bloomenergy.com/.

[2] Wikipedia (April 12, 2011), "Bloom Energy Server": http://en.wikipedia.org/wiki/Bloom_Energy_Server.

[3] A. B. Stambouli and E. Traversa (October, 2002), "Solid oxide fuel cells (SOFCs): a review of an environmentally clean and efficient source of energy," *Renewable and Sustainable Energy Reviews;* Vol. 6, Issue 5, Pages 433-455.

[4] Bloom Energy (retrieved April, 2011), "Energy Server Architecture," *Bloomenergy*: http://www.bloomenergy.com/products/architecture/.

Benefits:

Multipurpose use:

- SOFCs have been successfully used for military purposes and for U. S. space programs. Following Bloom's development of the energy server system at the University of Arizona for NASA's Mars Space Mission, Bloom has brought SOFC technology into commercial and industry use, and development for domestic use as a portable energy source is expected in the future.

- Urban, suburban, and rural use: The Bloom server's modular architecture, solid state construction, portability, and easy-to-install units allow for flexible assembly and make the systems suitable for any geographic area.

For the overall community and the environment:

- A green energy alternative:
  - With the Bloom Energy system, Carbon Dioxide (CO_2) emissions are reduced by 40%-100% compared to the U.S. grid (depending on their fuel choice), leading to a reduction in the nation's carbon footprint in affordable ways.
  - There is virtual elimination of all harmful gases (SOx, NOx, etc.) and other harmful smog-forming particulate emissions.
  - Bloom Energy systems emit pure CO_2, which allows for easy and cost-effective carbon sequestration (separating the CO_2 from the other effluents).
  - The system does not use any harmful chemicals, such as acids or alkalis, which are used in other fuel cells.
  - Bloom's servers produce no noise pollution, which can be present in other energy production facilities.

- Local decision-making:
  - Multiple local production and distribution options: Individual companies or homeowners can choose to individually own a server to generate their own electricity, or a municipality or generation facility can own a server system to generate and distribute electricity (Bloom Electrons℠) to multiple business and homeowner customers.
  - The Bloom Energy system puts energy-generation control into the customers' hands, allowing them to manage their energy sources more effectively.

- Financial incentives, subsidies, and tax credits may be available to green energy users, depending upon a state's energy policies and available federal programs.

For commercial, industrial, and domestic consumers:

- Production and distribution efficiency:
  - Solid Oxide Fuel Cells (SOFCs) are the most efficient in fuel input and electricity output due to their high operating temperature (800^0C). SOFC technology in Bloom's servers is about twice as efficient in energy production compared to standard power sources.
  - On-site power generation and storage allows for an efficient power supply, eliminating the costs, complexities, interdependencies, and inefficiencies associated with conventional transmission and distribution systems, and also reducing the geographical strain.

- Lower cost:
  - Bloom's servers do not use expensive noble metals like Platinum or Gold, thus reducing production constraints and costs.
  - Reverse backup and high return on investments: For businesses using Bloom's servers, the system works as the primary source of their energy supply, with other conventional sources, such as grid power, acting as a backup to supplement energy output when necessary. This increases asset utilization, gives a high return on investment, and reduces the cost of purchasing and maintaining expensive generators and other backup applications.
  - The servers produce significantly more electricity for the same fuel costs compared to conventional sources, due to the efficient conversion of fuel to electricity.
  - The servers can operate with multiple fuel options, such as renewable fuels (e.g., biogas) or fossil fuels (e.g., natural gas). Depending on the availability of the local fuel source, customers can choose the cheapest fuel to maintain the system's economy.

- Reliability and durability:
  - Since Bloom systems are capable of running on a wide range of pipelines and locally stored fuels and can automatically detect an interruption, they can cut over from a primary to a backup fuel source and maintain a continuous power supply.

- The system generates perfect waveform (voltage or electrical flow) at the point of consumption, eliminating volatility and allowing perfect power quality without variations in voltage, intermittent brown-outs, or black-outs.
- Long term use: SOFCs have a potential life expectancy of 40,000–80,000 hours.
- Bloom's energy systems work 24*7*365, for a continuous production and supply of energy.
- Independence from natural resources: SOFC technology and Bloom Energy Servers™ do not depend on natural resources (such as wind, sunlight, or the force of water currents) for the production of electricity, which allows quick access to the power supply with uninterrupted service.
- The heat produced within the server's electro-chemical process is recycled within the cell and external loss of heat is minimized by the strong protective shield.

Impediments or barriers to development or implementation:

- Criticism and skepticism have been expressed by members of conventional energy industries that are using standard practices.

- The current manual production of Bloom server systems requires significant start-up time.

- Currently, the server systems are marketed only for commercial use, with mass production for domestic units expected as a future market.

- The present high cost of equipment (because of manual production) is currently affordable to big industries only.

- Economic and other technical analyses are needed to establish market standards.

- Evaluation of the aggregate level of CO_2 emissions will be needed when mass-energy production for wider use takes place.

- Technical challenges:
  - Requires very high operating temperature.
  - Highly sensitive to operating temperature variation.
  - High temperature demands significant thermal shielding to protect personnel and to retain heat.

Resource—examples:

- *Coca-Cola Company, Atlanta, GA:* The Coca-Cola Company installed 500kW capacity Bloom Energy Servers at their Odwalla Production Facility at Dinuba, CA, in February 2010. Coca-Cola's "2020 Vision" is to double revenue and increase margins using sustainability approaches throughout their company. Through their servers, Bloom Energy has provided a flexible solution that can provide constant, reliable power to Coca-Cola's around-the-clock bottling and manufacturing operations, provide a power-dense solution to large office

buildings, and make a major contribution to reducing greenhouse gas emissions in the company's facilities. Coca-Cola's objective is to operate on renewable biogas, providing a 24/7/365 renewable solution at its Odwalla Production Facility and reducing over 5 million pounds of CO_2 annually.
  - Odwalla Facility: http://www.thecoca-colacompany.com/dynamic/press_center/2010/02/the-coca-cola-company-takes-important-step-toward-clean-power-in-us.html.
  - Elizabeth Delmont, Jennifer Gangi, and Sandra Curtin (November, 2011), *The Business Case for Fuel Cells: Energizing America*'s *Top Companies:* http://www.werc.org/assets/1/Publications/941%20BusinessCaseforFuelCells2011.pdf, see page 20 for profile of the Coca Cola Company.

- *Walmart, Bentonville, AR*: Walmart has installed two 400kW capacity Bloom servers, generating approximately 3.4 million kWh annually at their two facilities—Lancaster, CA, in December, 2009, and Hemet, CA, in January, 2010. Each of these sites has the potential to eliminate one million pounds of CO_2 annually when powered by biogas. Walmart's goal in using Bloom's servers is to achieve sustainability in its operations through the use of renewable energy sources and a reduction in greenhouse gases, and the company expects a reduction in energy expenses along with a reliable, continuous power supply. http://www.bloomenergy.com/customers/customer-story-walmart/.
  - The Walmart Community Action Network website blog attests to the installation of another server at its Dinuba, CA, location. http://www.walmartcommunity.com/two-dinuba-firms-rely-on-fuel-cells-coca-colas-odwalla-walmart-using-bloom-boxes/.

- *Cypress Semiconductor Corporation, San Jose, CA:* Cypress Corporation installed 300kW capacity Bloom Energy Servers at its San Jose, CA, headquarters in July 2010. These servers, combined with existing rooftop solar panel installations, supply approximately 75 percent of Cypress's electric needs. The company expects to be independent of the public utility grid by the year 2015, with a five-year payback period on its initial investment in three Bloom servers. http://investors.cypress.com/releasedetail.cfm?ReleaseID=484848.

- *Additional Bloom Energy industrial customers*: Information about the following customers of Bloom Energy's technology can be viewed on Bloom Energy's web site at http://www.bloomenergy.com/customers/#:
  - Google Inc., Mountain View, CA
  - California Institute of Technology (Caltech), Pasadena, CA
  - Staples, Framingham, MA
  - Abode Systems Incorporated, San Jose, CA
  - Kaiser Permanente, Oakland, CA
  - eBay Inc., San Jose, CA
  - FedEx Corporation, Memphis, TN
  - Bank of America Corporation, Charlotte, NC
  - Becton, Dickinson and Company (BD), Franklin Lakes, NJ
  - The University of Tennessee, Chattanooga Sim Center, Chattanooga, TN
  - COX Enterprises, Atlanta, GA

- Sutter Home Winery, St. Helena, CA
- Safeway, Inc., Pleasanton, CA

Resource—written and web:

- Bloom Energy*: Bloomenergy*: http://www.bloomenergy.com/.

- "Bloom Energy Server," *Wikipedia* (retrieved April 12, 2011), Wikipedia Foundation, Inc.: http://en.wikipedia.org/wiki/Bloom_Energy_Server/.

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- Frank Mace (2010), "Renewable Energy and Distributed Generation," Article IV.2.m, *Livable New York Resource Manual,* Albany, NY: New York State Office for the Aging. http://www.aging.ny.gov/LivableNY/ResourceManual/Index.cfm.

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- News coverage:
  - CBS New.com, *60 Minutes* (February 18, 2010), "The Bloom Box: An Energy Breakthrough?" video and news report: http://www.cbsnews.com/stories/2010/02/18/60minutes/main6221135.shtml.

  - Todd Woody (April 29, 2010), "The Greening of Silicon Valley: It Looks Like the Next Big Thing," *Report; environment360*, published by the Yale School of Forestry & Environmental Studies and Yale University, an online magazine offering opinion, analysis, reporting and debate on global environmental issues: http://e360.yale.edu/content/feature.msp?id=2269.

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GEOTHERMAL HEAT PUMPS

Description:

The term *geothermal* means, "relating to the earth's natural internal heat." A geothermal heat pump system uses the relative warmth, as well as the coolth, of the earth to provide efficient heating and cooling for buildings. A geothermal heat pump system differs from a system that directly provides heat by piping water from underground geothermal hot springs directly into buildings and homes. Such systems are common in countries such as Iceland and Turkey. In contrast, geothermal heat pumps use water which is heated or cooled by the earth, in conjunction with the action of heat pumps inside the building or home, to deliver heating or cooling.

According to the New York State Energy Research and Development Authority, "Throughout New York State, the temperature below the surface of the earth remains in the low 50°F range throughout the year. This stable temperature provides a source for heat in the winter and a means to reject excess heat in the summer. Geothermal heat pumps transfer heat between the constant temperature of the earth and a building, maintaining the temperature conditions in the building's interior space. Water is circulated between the building and the "ground-loop" piping buried in the ground. In the winter, the water picks up heat from the ground and moves it to the building (heating the building). In the summer, it works in reverse—the water picks up heat from the building (cooling the building) and delivers this heat to the geothermal water. Heat pumps make the collection and transfer of this heat to and from the building possible."[1]

The underground, stable-temperature geothermal water can be a natural source of ground water (an open-loop system), or it can be water that is circulated through a set of pipes in the ground (an approach referred to as a closed-loop system). The current trend is toward using closed-loop systems, to avoid water quality problems that are associated with open loop systems.

Within a building, heat pumps most commonly deliver heating and cooling through forced air systems (fans and ductwork). A less common option is to use a heat pump to deliver heating only, by supplying hot water to heat the space. A flexible feature of a geothermal heat pump system is that portions of a building can be heated while other portions are cooled. For example, on a spring day, a room with a large window and full sun exposure might need cooling, while a north-facing room needs heating. As long as the building has been zoned with multiple heat pumps, one heat pump can cool a room, and a separate heat pump can heat another room.

Because of their positive impact on the environment and their affordable and efficient delivery of heat and coolth, the use of heat pump systems is increasing

across the country for use in residential homes and public and commercial buildings. "In New York State, installations have ranged from single family homes, to hotels, to 500,000-square-foot office buildings."[2] In addition, they are a particularly high-efficiency heating option for rural areas, which often do not have access to natural gas.

These systems' capability of heating and cooling different parts of a home or building simultaneously make their use particularly attractive for buildings with fluctuating usage schedules (such as schools, hotels, or offices) or widely varying heating and cooling requirements within individual zones (such as senior housing apartments, single-family homes, or museums), which are difficult to meet efficiently with conventional systems.

Geothermal heat pumps are sometimes viewed as a renewable energy option. However, while geothermal heating from hot springs (such as Iceland's and Turkey's systems) can be considered a renewable energy alternative, geothermal heat pumps are not renewable, and depend on electricity. Only if the electricity is 100 per cent generated by renewable sources (solar photovoltaic, wind, hydroelectric, etc.) can geothermal heat pumps be fully viewed as being a renewable option.

References:

[1, 2] New York State Energy Research and Development Authority, Albany, NY.

Benefits:

For older people, people with disabilities, and families:

- Supports aging in place by increasing the affordability of home ownership and of rental charges.

- The green aspects of this option promote health for all community residents.

- The flexibility of simultaneously heating and cooling different areas of a home or building:
  - Allow for greater responsiveness to the comfort and health needs of different populations, such as older people, bed-bound individuals, babies, both physically active and sedentary workers, and people of varying sizes and tolerances.
  - Saves money by reducing energy usage in areas of a home or building where heating or cooling is not needed.

For homeowners and building operators:

- Contrary to a conventional heating or cooling system, installation of a heat pump system can be carried out incrementally – allowing an owner of a home or building to install heat pumps one by one.

- Systems are space-saving:
  - Smaller equipment—no large boiler, chiller, or cooling tower.

- Pumps can often be installed above ceilings or in closets—no need for a large mechanical room.

For communities:

- Higher efficiency, reduced operating costs, and low maintenance costs:
  - Support the viability of the business community.
  - Result in a lower budgets for:
    - Public buildings, such as schools and public offices;
    - Religious facilities and service agency buildings.

- Rural areas—these systems are a high-efficiency heating option for rural areas, which do not have access to natural gas.

- The green aspects of this option contribute to a community's livability:
  - While heat pumps themselves rely on electricity, the overall system is automatically partially renewable; if the electricity used is generated by a renewable source (wind, hydroelectric, etc.), the entire geothermal heat pump system can be viewed as a totally renewable energy option.
  - The reduced need for electricity use has various environmental benefits.
  - Geothermal heat pumps are a path to zero-energy buildings.

- There are environmental benefits of reduced electricity use.

- Financial incentives are often available for implementing geothermal heat pump systems.

Impediments or barriers to implementation:

- While there is typically a good payback for new buildings, geothermal heat pump systems often have a higher installation cost than conventional systems, especially if closed-loop wells are used.

- Heat pumps can be noisy; if located indoors, they should located where the noise is not objectionable—for example, avoid locating heat pumps close to or above bedrooms, offices, or other areas where noise is objectionable.

- If open-loop systems are used, minerals in the water can foul heat exchangers and cause problems.

Resource—examples :

- For specific examples of geothermal projects in New York State, see the New York State Energy Research and Development Authority Web site: http://www.nyserda.org/programs/geothermal/default.asp. Including:
  - Tannery Pond Community Center—the entire building is operating on a geothermal heating and cooling system, saving over $24,000 per year in energy costs: http://www.nyserda.ny.gov/en/Programs/Renewables/~/media/Files/EERP/Residential/Geothermal/tannery-pond-community-center.ashx.

- Albany Molecular Research, Inc.: http://www.nyserda.ny.gov/en/Programs/Renewables/~/media/Files/EERP/Residential/Geothermal/albany-molecular-research.ashx.
- Bard College: http://www.nyserda.ny.gov/en/Programs/Renewables/~/media/Files/EERP/Residential/Geothermal/bard-college.ashx.
- Indian River School District: http://www.nyserda.ny.gov/en/Programs/Renewables/~/media/Files/EERP/Residential/Geothermal/indian-river-central-school-district.ashx.

Resource—written and web:

- New York State Energy Research and Development Authority (NYSERDA)—provides extensive information, examples, and resources on geothermal heat pumps, as well as a list of some companies that provide geothermal heat pump studies and some that have experience with design and installation of ground loops and mechanical systems in New York State. http://www.nyserda.ny.gov/~/media/Files/EERP/Residential/Geothermal/geothermal-manual.ashx?sc_database=web.

- Geothermal Heat Pump Consortium, Washington, DC (February, 2004; revised July, 2007). *Understanding and Evaluating Geothermal Heat Pump Systems: Information for Evaluating Geoexchange Applications*. 64-page technical assistance manual prepared for the New York State Energy Research and Development Authority, Albany, New York: http://www.nyserda.ny.gov/en/Programs/Renewables/~/media/Files/EERP/Residential/Geothermal/geothermal-manual.ashx.

- P. A. Collins, C. D. Orio, and S. Smiriglio (August, 2002). *Geothermal Heat Pump Manual*. New York City: New York City Department of Design and Construction. The handbook was created for project managers and consulting engineers who were working for the Department of Design and Construction, and includes definitions and benefits of geothermal heat pumps, as well as extensive information on the entire process of installing geothermal heat pumps: http://home2.nyc.gov/html/ddc/downloads/pdf/geotherm.pdf.

- U. S. Department of Energy, *Geothermal Technologies Blog*: http://www.eereblogs.energy.gov/geothermaltechnologies/post/A-Look-Inside-Our-Recovery-Act-Projects.aspx.

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HYDROPOWER and HYDROELECTRIC POWER

Description:

Hydropower, also called water power or hydraulic power, is derived from the energy embedded in moving water.

History is full of examples of water wheels or water mills with associated mill ponds. These systems functioned for thousands of years and provided power for the production of flour, lumber, and textiles. Hydropower also provided power for irrigation and cranes for loading and unloading cargo ships.

Most of us, however, associate hydropower with the production of electricity or hydroelectricity—for use in homes, public buildings, and commercial establishments.

Hydroelectric generation stations, such as the one located at Niagara Falls, which was completed in 1886, take advantage of the natural falls. However, most hydroelectric projects require a dam and an associated reservoir to provide what is called the "head." The head is simply the pressure exerted by the weight of the water, based upon elevation (or distance) between the top of the water and the generating equipment. When the water is released and allowed to flow, it provides the power necessary to drive the turbines.

The 1930's saw large scale projects, such as the construction of Hoover Dam (creating Lake Mead), which was completed in 1936 on the Arizona/Nevada border, and also saw the creation of the Tennessee Valley Authority (TVA) in 1933. The TVA constructed dams and reservoirs for flood control and hydroelectric power in seven states. In addition, these projects provided much-needed employment during the Great Depression. The TVA also advanced efforts in reforestation and malaria control and trained farmers in techniques for improving crop yield and soil conservation.

The U. S. Army Corps of Engineers provides a historical perspective on hydropower:

> "Unlike the West, where irrigation became the focus of attention, the East was more concerned over hydropower development. Beginning in the early 1880's, when a plant in Appleton, Wisconsin, first used falling water to produce electricity, the construction of hydroelectric dams on the nation's waterways proliferated. These private dams threatened navigation and forced Congress, acting through the Corps of Engineers, to regulate dam construction. The Rivers and Harbors Acts of 1890 and 1899 required that dam sites and plans be approved by the Secretary of War and the Corps of Engineers before construction. The General Dam Act of 1906 empowered the

federal government to compel dam owners to construct, operate, and maintain navigation facilities without compensation whenever necessary at hydroelectric power sites." See: U. S. Corps of Engineers: http://www.usace.army.mil/About/History/BriefHistoryoftheCorps/MultipurposeWaterwayDevelopment.aspx.

The U. S. Army Corps of Engineers also offer this explanation of the process of hydroelectric power:

"A hydraulic turbine converts the energy of flowing water into mechanical energy. A hydroelectric generator converts this mechanical energy into electricity. The operation of a generator is based on the principles discovered by Faraday. He found that when a magnet is moved past a conductor, it causes electricity to flow. In a large generator, electromagnets are made by circulating direct current through loops of wire wound around stacks of magnetic steel laminations. These are called field poles and are mounted on the perimeter of the rotor. The rotor is attached to the turbine shaft and rotates at a fixed speed. When the rotor turns, it causes the field poles (the electromagnets) to move past the conductors mounted in the stator. This, in turn, causes electricity to flow and a voltage to develop at the generator output terminals." See: The U.S Department of the Interior, Bureau of Reclamation: http://ga.water.usgs.gov/edu/hyhowworks.html.

Dams and reservoirs are expensive, create challenges to navigation and aquatic life, and take up valuable real estate. More recently, we have seen the development of tidal power, or dam-less power. One example of tidal power is located in the East River in New York City. A New York State Energy Research and Development Authority (NYSERDA) publication explains this process:

"Capturing the natural ebb and flow of the tides has always been a challenge filled with potential benefit. For the past century, hydropower was created by building dams to channel water through powerhouses, where giant turbines captured the power of the falling water. Recently, increased attention to hydrogeneration has centered around a kinetic method of hydropower. By using dozens of small generators in a section of the East River off of Roosevelt Island, near midtown Manhattan, a project is demonstrating kinetic generation. The Roosevelt Island project features tri-bladed turbines capable of turning on their horizontal axes to capture both the ebb and flow of the East River. Submerged prototypes have shown positive results, and regulatory approval is underway for a section of river covering a little over one acre. The potential is to generate 5 to 10 MW of electricity by 2010." See: NYSERDA: *General Reports,* "Renewal—Tidal Power," p. 13: http://www.nyserda.ny.gov/en/Publications/NYSERDA-General-Reports/~/media/Files/Publications/NYSERDA/05-06%20Section%201.ashx.

Hydroelectric stations are appropriate for any geographic location that has moving water. This form of power is the most common renewable energy source worldwide and accounts for almost half of all renewables in the United States. According to The Need Project (2008), hydropower produces 20 per cent of the world's electricity; and in the United States, New York ranks third in the use of hydropower for the generation of electricity: http://www.need.org/needpdf/infobook_activities/IntInfo/HydroI.pdf. Hydropower is the cheapest way to generate electricity in the United States—cheaper than coal or nuclear plants—and produces no air pollution because it does not burn fuel.

Benefits:

For consumers

- Hydroelectric power produces no air pollution, promoting a healthier living environment for community residents.

- The lower cost of hydroelectric power makes homeownership and rental costs more affordable for older people, individuals with disabilities, and families, supporting their ability to remain living in their communities.

For the community

- The lower cost of hydroelectric power supports the activities of the business community and lowers the operating costs of other community sectors, such as health care facilities and schools.

- Hydroelectric power is a renewable energy source, reducing reliance on traditional non-renewable fuels.

- Hydroelectric power avoids fuel costs in the production of electricity, and, therefore, stabilizes the cost of energy over the life of the plant.

- The avoidance of fossil fuels makes hydroelectric power more environmentally friendly and reduces greenhouse gas emissions.

- Lakes created by hydroelectric dams can also contribute to flood control, irrigation, recreation, and wildlife.

Impediments or barriers to development or implementation:

- Hydroelectric power is dependent upon rainfall for the supply of flowing water.

- Hydroelectric stations must be sited in areas with moving water.

- Hydroelectric generation is a long-term investment.

- Hydroelectric generation may require the construction of a dam and reservoir.

- Hydroelectric projects may have an impact on aquatic life.

Resource—examples:

- Higley Hydroelectric Station, Lower Raquette River, St. Lawrence County, NY—as part of NYRSERDA's Renewable Portfolio standard, this station was re-powered to increase output from 4.5Mw to 6.2 Mw: http://www.nyserda.ny.gov/Page-Sections/Energy-and-Environmental-Markets/Renewable-Portfolio-Standard/Project-Gallery.aspx.

- Katie Horner (January 13, 2011), "Could East River Tides Help Power NYC," *Water Matters—News from the Columbia Water Center,* State of the Planet On Line: http://blogs.ei.columbia.edu/2011/01/14/could-east-river-tides-help-power-nyc/.
  - NYSERDA, *General Reports,* "Tidal Power," p. 13: http://www.nyserda.ny.gov/en/Publications/NYSERDA-General-Reports/~/media/Files/Publications/NYSERDA/05-06%20Section%201.ashx.

Resource—written and web:

- U.S. Army Corps of Engineers: http://www.usace.army.mil/Pages/default.aspx.
  - Hydropower - Renewable, Reliable, Energy Independence for America: http://www.usace.army.mil/Portals/2/docs/civilworks/budget/strongpt/2012sp_hydropower.pdf.

- The U. S. Department of the Interior, Bureau of Reclamation, "Managing Water in the West": http://www.usbr.gov/.

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LIGHTING, VISUAL QUALITY, and ENERGY EFFICIENCY

Description:
Lighting has a significant effect on how we perceive our world, and maintaining visual quality is an important factor in aiding our perception. Maintaining visual quality means being mindful of the type, color, and quantity of light provided in a given space or area and encompasses a range of issues for both general and special populations, such as assuring that enough light reaches the eye, maintaining even lighting levels across the floor, and heightening security. Lighting also uses a significant amount of energy in buildings, which can contribute to how the above issues are managed; but there are steps that can be taken to promote energy efficiency and ensure that the public is healthy and safe.

Visual Quality: One aspect of maintaining visual quality is assuring that there is enough light for users to see and perform their daily tasks without eye strain. The impact of low visual quality negatively affects people with normal vision, but is particularly challenging for the older population and people of all ages with vision loss.

> *The Aging Eye:* Eyesight weakens over time. Glare is poorly tolerated by older people, as are extreme differences in lighting levels. With age, the pupil decreases in size and the lens thickens. The eye of a typical 60-year old lets in only one-third of the light that is received by a typical 20-year old's eye.
>
> *General Public:* Many of the lighting designs that are beneficial for older people also help younger-aged people with vision loss. The Web site, Better Medicine (http://www.localhealth.com/article/vision-loss/causes) lists numerous causes of vision impairment among people of all ages; and the American Foundation for the Blind reports that "more than 25 million Americans report experiencing significant vision loss," including 57,696 legally blind children (http://www.afb.org/default.asp).

These demographics, tied with an overall aging of the general population, including people with vision loss, call for awareness to eyesight issues and visual quality in both newly-constructed buildings and existing spaces that serve all populations.

Energy Efficiency: According to the U. S. Environmental Protection Agency,[1] in the average U.S. home, lighting accounts for about 20 per cent of the electric bill; and the U. S. Energy Information Administration[2] reports that lighting accounts for 21 per cent of overall electricity use in commercial buildings in the United States. Improving lighting efficiency has both direct and indirect benefits. For example,

"over 23 per cent of the electricity used in California is for lighting; in commercial space, five percent of the electricity used for air conditioning eliminates heat that is generated by lighting."[3] As a significant source of energy use, lighting presents an opportunity for capturing energy savings through the use of energy-efficient equipment. High-quality, energy-efficient lighting is possible if the proper equipment is used for a given application and if the characteristics of the affected population are considered.

Most facilities are phasing out the use of inefficient incandescent lighting, using fluorescent, LED (light-emitting diode), and metal halide technologies in its place. More efficient versions of existing fluorescent lighting are available as well. However, not all types of lighting are appropriate for every application. For example, the best form of lighting for a cafeteria in a senior housing complex is different from what is best for a bedroom in a single-family home. Thus, it is important that a project's design staff be familiar with *both* lighting quality and energy efficiency.

Natural daylight is an important consideration from both a lighting-quality and energy-efficiency perspective. The use of daylight to minimize internal lighting needs is a common strategy in reducing a building's overall energy use. In addition, the use of daylight in both residential and commercial facilities can help maintain circadian rhythms and overall health.

Exterior lighting systems support both navigation and security. Visual quality for exterior systems assures that pedestrians and vehicles can identify points of entrance and exit from a facility, and that potential hazards (for example curbs and stairs) are lit well enough to either negotiate or avoid. Exterior lighting can also discourage criminal activity and allow security surveillance systems to function properly.

The quest for security should not result in over-lit exteriors which show light trespass (where lighting spills over property lines) and contribute to sky glow (night brightening of the sky caused by outdoor man-made lighting and natural atmospheric and celestial factors). Local municipalities may also have legislation addressing sky glow, especially in rural or recreational areas.

As with interior lighting, older technology (such as mercury vapor systems) in exterior lighting can be replaced with more efficient systems, such as metal halide or LED, which use equipment that precisely directs light to ground level where it is needed.

References:

[1] U. S. Environmental Protection Agency, *Lighting Products*: http://www.energystar.gov/index.cfm?c=lighting.pr_lighting.

[2] Energy Information Administration—Independent Statistics and Analysis, "Energy Use in Commercial Buildings, 2003," Use of *Energy in the United States Explained:* http://www.eia.gov/energyexplained/index.cfm?page=us_energy_commercial.

[3] California Energy Commission, *Public Interest Energy Research (PIER) Program*: http://www.archenergy.com/lrp/default.htm.

Benefits:
There are numerous benefits to maintaining visual quality and energy efficiency in lighting systems:

For consumers:
- Health, safety, and self-care:
  - Maintaining appropriate levels of lighting, as well as the elimination of glare:
    - Reduces the risk of falls, missteps, and other accidents for people of all ages and functional levels, including older adults, younger people with visual loss, children, and others.
    - Supports the ability of all people to be self-caring and self-managing.
    - The use of daylight, in place of artificial light, contributes to the maintenance of healthy circadian rhythms.

For the community:
- High quality lighting reduces the number of maintenance call-backs.

- Energy-efficient lighting systems reduce energy costs and demand on the electrical grid.

- High-quality exterior lighting promotes site safety and security.

- Exterior lighting that minimizes "sky glow" nighttime light pollution has positive implications for the environment and individuals' health.

Impediments or barriers to development or implementation:
Obstacles to achieving a space with a high quality, but energy-efficient, visual environment include lack of information, funding, and misconceptions:
- In designing new spaces, the design team may not be aware of the special lighting needs of the older adult population or of other population groups with visual impairments. However, numerous design guides and information exist on how to improve lighting to meet the needs of individuals with visual impairments.

- Homeowners, as well as building and facility operators, are not sufficiently knowledgeable about the cost differences between conventional lighting options and newer energy-efficient lighting options. However, the incremental cost of installing a high-quality, energy-efficient lighting scheme is minimal; using high-efficiency lighting fixtures typically has an attractive payback and will pay for itself over time.

- Fluorescent and compact fluorescent lamps contain a small amount of mercury, and the fear of mercury keeps some users from adopting this option. In addition, disposal of these lamps must be treated with care; and all facilities should comply with the requirements of federal, state, and local legislation regarding the disposal of lamps and ballasts. However, compact fluorescent lamps are a relatively simple energy-efficiency retrofit, and many retailers have implemented take-back programs to properly recycle and dispose of spent lamps.

- Some individuals believe that fluorescent lamps (both linear and compact) give poor light quality by casting the room in a greenish glow. However, great improvements have been made in fluorescent lighting in the past ten years, including an improved array of colors available and minimization of flicker and hum from fluorescent ballasts.

- Some consumers have had poor experiences with compact fluorescent screw-in lamps and feel they do not provide high enough lighting levels. Manufacturer packaging for screw-in compact fluorescent lamps tends to recommend a 4:1 wattage reduction (for example, a 14-watt compact fluorescent light bulb to replace a 60-watt incandescent light bulb), which often results in under-lit spaces for older adults and others with visual impairments. Instead, a 3:1 ratio (i.e., 20-watt compact fluorescent bulb to replace a 60-watt incandescent) is recommended to ensure that enough light is available and to assure that the lamp is not replaced with a higher-wattage incandescent lamp out of frustration.

Resource—examples:

- South Mall Towers, Albany, New York: "Lighting Case Studies," *Delta Portfolio—Demonstration and Evaluation of Lighting Technologies and Applications,* Vol. 2, Issue 4: http://www.lrc.rpi.edu/programs/delta/pdf/Vol-2-4-SouthMallTowers.pdf. "This high-rise urban residence for low- to moderate-income seniors and disabled adults uses new and retrofit age-sensitive lighting to provide a safe and comfortable environment. The lighting makes the most of the visual capabilities of seniors at minimal cost for maintenance and energy use. Designs include lighting for one-bedroom and alcove apartments, as well as common areas such as the lobby, community room, and corridors." http://www.lrc.rpi.edu/publicationDetails.asp?id=187.

- Illuminating Engineering Society of North America—2009 illumination awards for interior lighting design, outdoor lighting design, and energy and environmental design, as well as a list of projects receiving merit awards: http://www.iesna.org/PDF/Awards/ia/2009%20Recipients.pdf.

Resource—written and web:

- Illuminating Engineering Society of North America: http://www.iesna.org/.

- Illuminating Engineering Society: *Lighting Education Fundamentals,* a seven-module instructional course: http://www.iesna.org/edoppts/instructional_materials.cfm.

- Lighting Research Center, Rensselaer Polytechnic Institute , Troy, New York: www.lrc.rpi.edu/programs/lightHealth/AARP/index.asp.

- Mariana Gross Figueiro (2001), *Lighting the Way: A Key to Independence.* Troy, New York: Lighting Research Center, Rensselaer Polytechnic Institute. "This publication answers common questions about vision and lighting posed by older adults, and offers practical solutions to them, their families, and their caregivers": http://www.lrc.rpi.edu/programs/lighthealth/aarp/pdf/aarpbook1.pdf.

- Lighthouse International, New York City: "an organization dedicated to preserving vision and to providing critically needed vision and rehabilitation services to help people of all ages overcome the challenges of vision loss through clinical services, education, research, and advocacy." www.lighthouse.org.

- International Dark-Sky Association: an educational and environmental nonprofit organization dedicated to advocating for natural night skies and understanding the impact of nighttime light pollution on nocturnal animals, astronomers, circadian rhythms, physical health, and other factors; preserving the nighttime environment through quality outdoor lighting; providing leadership concerning the problems and solutions related to light pollution: www.darksky.org.

- *Residential Energy Consumption Survey* (RECS), RECS Public Use Microdata Files. Washington, DC: U. S. Energy Information Administration, Independent Statistics and Analysis. A national survey that collects energy-related data for occupied housing units; analysis produces estimated consumption and expenditures data for the country's 111.1 M occupied housing units. http://www.eia.gov/emeu/recs/recspubuse05/pubuse05.html.

- *Lighting Research and Technology,* international peer-reviewed journal that publishes high-quality, original research on the subject of light and lighting. Published by SAGE Publications in association with The Society of Light and Lighting: http://www.sagepub.com/journalsProdDesc.nav?prodId=Journal201818.

- The Society of Light and Lighting, the largest professional organization representing the worldwide interests of those involved in the art, science and engineering of light and lighting: http://www.cibse.org/index.cfm?go=page.view&item=68.

- American Foundation for the Blind: extensive information and resources about vision loss. http://www.afb.org/.

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MUNICIPAL (PUBLIC) POWER

Description:

A municipal power provider is one that purchases electricity in bulk from a power producer and/or generates electric power at a municipally owned power plant. The municipal provider sells the electric power service to the end-users (homeowners, businesses, public buildings, community organizations, etc.) and maintains the distribution network to these customers. For many cities and towns, public power represents both an ideal of local people working together to meet local needs, and the many revenue, environmental, and quality-of-life benefits inherent in local control of the power system. A municipal power distribution system supports a community's livability status. In particular, (1) the lower electricity rates increase the ability of older people and younger people with disabilities to affordably age in place in their own homes, (2) local employment opportunities support community stability, and (3) efficiency through the integration of all utility operations helps sustain a community's viability over time.

The process of forming a municipal power utility typically includes the following elements: a feasibility study, legal analysis, facilities valuation, consumer educational campaign, citizen referendum, price negotiation and/or condemnation proceedings, petition to the New York State Public Service Commission, power supply arrangements, and start-up operations. The American Public Power Association provides information and materials for municipalities interested in pursuing public ownership of their local distribution system.

New York State has a long history of municipally instituted public power systems, and usage has grown over time. Many cities and towns in New York State, such as Tupper Lake, Fairport, and Westfield, began generating their own electricity to power streetlamps, as well as some homes and businesses, at the turn of the 20th century. The Village of Fairport's electric utility began operating a small steam generator to power 12 streetlights and 40 homes—today, the Fairport system serves 15,000 customers over 27 square miles. Similarly, four rural electric cooperatives were formed in the 1940's to establish electric service in areas of the State not yet serviced by surrounding utilities.

In 1931, a commission established to study the hydroelectric potential of the St. Lawrence River called for the creation of an Authority to build generating facilities on the river. On April 27 of that year, Governor Franklin D. Roosevelt signed the Public Power Authority Act into law "to give back to the people the waterpower which is theirs," forming the New York Power Authority (NYPA). Even as work on the St. Lawrence River project proceeded, the New York Power Authority prepared for an even more complex power project, to be located on the lower Niagara River, about five miles downstream from Niagara Falls. Congress passed the Niagara

Redevelopment Act in 1957, paving the way for the Power Authority to obtain a license and begin construction on the Niagara Power Project to fully develop the United States' share of the Niagara River's hydropower potential.

The 1957 Niagara Redevelopment Act also gives "preference power" to municipal and rural electric cooperative systems in New York and bordering states, which is 50 per cent of the Niagara Project's capacity. The low cost hydropower from the Niagara Power Project and the St. Lawrence River is delivered and sold to existing municipal power providers throughout the state, at a greatly reduced cost than they would otherwise be able to generate or purchase.

Municipal power providers that have been established following the Niagara Power Project have predominantly done so as an alternative to Investor Owned Utilities. For example, Messina Electric was formed in 1981 to create a local commitment to low rates, reliability, and environmentalism. Today, the majority of municipal power providers in New York State purchase all or a substantial portion of their power from the New York Power Authority. Only four public power utilities in the State generate their own power supply to augment the low-cost hydropower received from NYPA—Jamestown Board of Public Utilities, Green Island Power Authority, and two plants on Long Island. Other municipalities, whose need extends beyond their NYPA allocation, supplement their supply through a contract with the New York Municipal Power Agency (NYMPA), which is a joint action agency made up of 31 municipal utilities from around the State that purchases power on behalf of its members through the New York Independent System Operator (NYISO).

Benefits:

The benefits of municipally owned power often depend on the way the community has structured that particular system, as a public power utility is owned by, and accountable to every citizen of the municipality. For many, the benefits for families, businesses, and community organizations include:

- Lower electricity rates.
- Equal or greater reliability of services.
- Responsiveness to customer concerns.
- Emphasis on long-term community goals.
- Quick response from crews located in the community, which is especially beneficial for frail older adults, younger individuals with disabilities, and those who rely on home health care.
- Revenues that stay within the community.
- Local employment opportunities.

- Access to tax exempt financing for capital projects.

- Opportunity for efficiency through integrated utility operations (e.g. electric, water, sewer, garbage, cable, telecommunications, gas).

- Local control over special programs (energy conservation, rate relief for certain customer classes).

Impediments or barriers to development or implementation:

- *Market and price fluctuations:* A municipality looking to form a public electric utility is not currently able to access low-cost hydropower through the New York Power Authority, as NYPA's power capacity has been allocated through long-term contracts with existing utilities. Thus, municipalities would need to purchase their power on the open electricity market through NYISO or on a contract with NYMPA. Purchasing power through this competitive process is subject to market fluctuations, and prices cannot be guaranteed.

- *Exit fees:* The Public Service Commission (PSC) established Rule 52 in 1998 to determine monetary exit fees to compensate utilities for the portions of their distribution networks that are being bypassed due to municipalization. Under the Rule 52 formula, an exit fee is equal to (1) the net present value of 'the revenues the utility would have received from departing customers located in the municipality that is exiting from the utility's network' had those customers continued to take retail service from the utility, (2) plus the value of the distribution and street lighting plant that will be taken, (3) minus the costs the utility will avoid by not serving the departing customers, (4) minus revenues the utility will receive by selling the capacity and energy that is no longer needed by departing customers to other customers. However, according to the PSC, the process of municipalization can be regarded as economic only if it produces net savings even after payment of the exit fee.

Resource—examples:

- Messina, New York: http://www.med.massena.ny.us/.

- Fairport, New York: http://www.village.fairport.ny.us/Fairport_ElectricWater.cfm.

Resource- written and web:

- American Public Power Association: http://www.appanet.org/.

- New York Power Authority: http://www.nypa.gov/default.htm.

- Municipal Electric Utilities Association of New York State: http://www.meua.org/.

- New York Independent System Operator: http://www.nyiso.com/public/index.jsp.
- New York Municipal Power Agency. http://nympa.org/.
- NYS Public Service Commission: http://www.dps.ny.gov/.

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RENEWABLE ENERGY and DISTRIBUTED GENERATION

Description:

Renewable Energy and *Distributed Generation* often share the same technologies and, therefore, are included in the same discussion.

Renewable Energy (RE):
RE, often called renewable power, includes those technologies that derive power without the use of nuclear or fossil fuels. Renewable technologies can generate energy from the sun, wind, biomass, tides, moving water, or geothermal sources. These technologies produce little or no emissions and result in minimal environmental impact.

The use of renewable energy sources is not new. Pre-Columbian examples of renewable energy can be found in the southwestern United States, where the Anasazi culture took advantage of solar gain for heating in the winter, when the sun was low on the horizon. Similarly, they utilized the shade of the cliffs to provide cooling in the summer, when the sun was high in the sky. Long before electricity, our ancestors used wind to power the pumps that provided water to farms. In the 1930s, hydroelectric projects provided not only cheap reliable power and flood control, but also created jobs for a nation experiencing the Great Depression.

New York State Renewable Portfolio Standard — In 2004, New York State adopted a Renewable Portfolio Standard. Within the total amount of electricity used by retail customers, this policy set a goal to increase the proportion of *renewable-generated* electricity to 25 per cent by 2013. Renewable systems include solar photovoltaic cells, wind turbines, and energy storage systems. The New York State Energy Research and Development Authority (NYSERDA) is tasked with achieving 24 per cent of the new policy's goal. The remaining one per cent is anticipated to come from utility customers willing to pay a premium to support this effort. The Renewable Portfolio Standard comprises two sections:

- The Main Tier, which is designed for participation by large-scale generators.
- The Customer-Sited Tier, which is designed for on-site generation and use.

These applications have been referred to as “behind the meter” renewable systems.

Distributed Generation (DG):
DG is simply the on-site production of energy. It may also be referred to as dispersed generation, embedded generation, or decentralized generation. DG systems can include continuous prime power and standby generators, combined heat and power (CHP) systems, solar photovoltaic cells, wind turbines, and energy storage systems; this list is increasing with the deployment of new technologies. Renewable systems that are Customer-Sited would be considered distributed generation.

DG systems can be configured to operate in synchronization with the electrical utility grid, or can be independent of the utility grid and continue to supply power during utility power outages. Synchronized systems can often sell excess-generated power back to the grid through a process known as net-metering.

The most common DG systems are those used for backup power generation, which are often used in hospitals and municipal buildings or to supply standby power for other utilities, such as telecommunications or water systems. Because DG systems add to overall generating capacity, they can have a significant impact on reducing peak demand on the utility grid or network. Peak demand, which has been responsible for brown-out or black-out conditions, usually occurs during the hottest part of the summer, when the electric cooling load is running at a maximum.

Renewable Energy Distributed Generation (REDG) systems can be purchased or leased, depending on the type of system and the vendors. In all cases, REDG systems are considered a long-term investment, and the initial cost of a system and its payback and benefits are calculated over the life of the system. This long-term approach to energy tends to stabilize or hedge the cost of power over the life of the system and is less impacted by the commodity-market fluctuations common to fossil fuels.

Benefits:

For consumers

- REDG can be configured to operate with or independent of the local utility company, providing on-site power generation during emergency conditions, allowing for sheltering in place, as opposed to evacuation, in the event of a power failure . . . which is particularly beneficial for frail older adults and people with disabilities of all ages.

- Systems using renewable energy sources provide a healthier environment for residents and building tenants.

- Investment in REDG provides long-term stabilization of energy rates, making energy rates/expenses for homes and buildings more predictable and less subject to commodity market fluctuations—which is an important factor in supporting the ability of residents to age-in-place.

- Financial incentives and tax credits are often available—keeping housing costs affordable.

For the community

- Depending on the type selected, there can be environmental benefits because of reduced or no carbon emissions.

- On-site generation reduces the geographical strain or need for additional transmission and distribution systems.

- REDG can also be used to reduce peak kilowatt demand, thereby avoiding brown-outs and black-outs.

Impediments or barriers to development or implementation:

- Investment in REDG Technology is a long-term commitment, and the owner is responsible for yearly maintenance.

- There may not be adequate space or a good location for the equipment.

- The building's electrical distribution system must be configured to support REDG.

- The project may not be cost-effective. A home or building owner can calculate the Savings to Investment Ratio (SIR) by taking the annual savings in energy costs ($), multiplied by the life expectancy (years) of the system; then, dividing that answer by the initial cost of the system ($). The result is the SIR. If the SIR is 1.0 or greater, the project is considered to have a positive payback.

Resource—written and web:

- *NYSERDA Renewable Portfolio Standard*—a New York State policy, being implemented by the New York State Energy Research and Development Authority, which seeks to increase the proportion of renewable electricity used by retail customers. New York State's goal is to reach 25 per cent by 2013.
  - New York Renewable Portfolio Standard Program Evaluation Report (2009): http://www.nyserda.ny.gov/~/media/Files/EDPPP/Energy%20and%20Environmental%20Markets/RPS/RPS%20Documents/rps-evaluation-final.ashx?sc_database=web.

- NYSERDA DG/CHP Integrated Data System—NYSERDA's web-based DG/CHP data system includes monitored performance data and operational statistics for NYSERDA's Distributed Generation (DG)/Combined Heat and Power (CHP) demonstration projects. http://chp.nyserda.org/home/index.cfm.

- *NYSERDA CHP Projects Performance Data*—provides performance data, monitored hourly, which allows users to view, plot, analyze, and compare performance data from one or several different DG/CHP sites in the NYSERDA portfolio: http://chp.nyserda.org/home/index.cfm.

- *Northeast CHP Applications Center (NAC)*—focused on all aspects of combined heat and power applications, this Web site serves as a focal point for communication among key stakeholders in seven states in the Northeast (CT, ME, MA, NH, NY, RI, and VT). NAC provides services for education and outreach, as well as technical assistance: http://www.northeastcleanenergy.org/home/home.php.

- *U. S. Environmental Protection Agency CHP Partnership Program*—a voluntary program that seeks to reduce the environmental impact of power-generation by promoting the use of combined heat and power (CHP) systems. The partnership works closely with energy users, the CHP industry, state and local governments, and other clean-energy stakeholders to facilitate the development of new projects and to promote their environmental and economic benefits: http://www.epa.gov/chp/index.html.

- *U. S. Department of Energy Distributed Energy Program*—a program that supports cost-effective research and development aimed at lowering costs, reducing program emissions, and improving reliability and performance of distributed energy systems in order to expand opportunities for the installation of distributed energy equipment today and in the future: http://www.eere.energy.gov/de/.

- *U. S. Clean Heat & Power Association*—a nonprofit membership organization of businesses, energy industry groups, individuals, and others, whose mission is to create a regulatory, institutional, and market environment that fosters the use of clean, efficient local energy generation, including but not limited to combined heat and power, recycled energy, bio-energy, and other generation sources that lead to a demonstrable reduction in global greenhouse gas emissions: http://www.uschpa.org/i4a/pages/index.cfm?pageid=1.

- *Association of State Energy Research and Technology Transfer Institutions' (ASERTTI) National DG/CHP Performance and Testing Program*—an association whose purpose is to remove a barrier to the increased use of distributed generation technologies—namely, the unavailability of uniform and documented information on the electrical, environmental, and mechanical performance of distributed generation (DG) and distributed generation/combined heat and power (DG/CHP) systems: http://www.dgdata.org/ and http://www.dgdata.org/about.html.

- *Greenhouse Gas Technology Center (Environment Technology Verification Program)*—a Center operated in cooperation with Southern Research Institute (SRI), whose purpose is to verify the performance of commercial-ready technologies that produce, mitigate, monitor, or sequester greenhouse gas emissions. The Center is part of the U. S. Environmental Protection Agency's (EPA) Air Pollution Prevention and Control Division, which is under EPA's National Risk Management Research Laboratory: http://www.epa.gov/nrmrl/std/etv/center-ggt.html.

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SOLAR ELECTRIC – PHOTOVOLTAIC (PV)

Description:

Solar electric power is generated from the conversion of sunlight into electricity through a photovoltaic (PV) or solar cell. Compared to the environmental impact of energy produced using fossil fuels (such as oil, gas, or coal), solar electric—or PV—technology makes use of the abundant energy of the sun and has little negative impact on our environment. PV cells can be used in a wide range of products, from small consumer items to large commercial solar electric systems. Commonly known as solar cells, individual PV cells are electricity-producing devices made of semiconductor materials (materials—such as silicon and germanium—that conduct electricity in a limited way). PV cells come in many sizes and shapes—from smaller than a postage stamp to several inches across—and these cells are often connected together to form PV modules. A typical PV module measures three feet wide by five feet long, but they can range from two to four feet wide and four to six feet long. Modules can be combined and connected to form PV arrays (panels) of different sizes and power output, and these connected systems integrate easily with existing energy supplies.

PV panels need to see the sun to make energy; they are often mounted on the roof of a building, facing south at an angle, so the modules receive the maximum amount of sunlight. There are many tools that can calculate the available sun-hours that will be available for a system—the same hours that give a person the fastest tan will also generate the most energy from a PV system. The ideal angle for harvesting sunlight is about 10 degrees less than latitude, but an angle between 20 and 45 degrees will provide a great deal of electricity. Due South is also ideal, but plus or minus 25 degrees will have only a minimal effect on energy production. A site-specific analysis should be completed before any site is ruled out.

A four-kilowatt PV system generates enough electricity to meet about half of the electrical needs of an average home, with additional needed electricity purchased from the local utility from the electric grid. When excess energy is produced by the PV system, the local utility will "buy back" this power—if net-metering is available. Some local utilities are not equipped to handle net-metering. If it is equipped to handle net-metering, the utility will provide a credit for the excess electricity generated by the PV system and apply it to the bill for the grid-electricity that the consumer must purchase. Typically, the consumer's account is reconciled annually, and the utility will buy any excess electricity at their wholesale rate.

A typical feature of a PV system is the inverter, which changes electricity from direct current (DC) to alternating current (AC) so that it can be used by most standard appliances and computers. Batteries may also be added for emergency

backup in the event of power outages or in cases where your PV system is not connected to utility power lines and cannot access electricity from the grid.

While PV systems are often mounted onto a roof, an exterior wall, or another part a building, a Building-Integrated Photovoltaic (BIPV) system can be incorporated into the building, replacing conventional building materials (such as roofing and siding) and blending into the look of the building.

Benefits:

For the community and the environment:

- The electricity generated by a PV system is typically used where it's generated, eliminating load on the local utility's distribution system (electric grid).

- Solar energy promotes a healthier living environment because energy produced through solar power is pollution-free—creating a more livable, attractive community for residents.

- The overall use of fossil fuels is reduced because energy from the sun is a sustainable resource—essentially infinite.

For the consumer— cost-savings and convenience:

- A properly installed PV system requires little maintenance over its lifetime.

- Most solar panels carry a 25-year warranty; inverters can carry a 10-year warranty.

- If batteries are included in the PV system as a backup, the system can provide electricity during a black-out.

- Solar electricity is generated for the consumer during times of peak demand on the electric grid, when purchased power from the utility is most expensive.

- If the cost of connecting to the utility grid is excessive or impossible, solar power can be a very economic alternative.

- Financial incentives and tax credits are often available that subsidize the cost of installing a PV system.

- The cost of PV systems has been decreasing and the cost of purchased electricity has been increasing. Many predict that grid-parody (where the cost of purchased electricity equals the cost of the electricity generated by a PV system) will occur around 2015.

- For installations that are eligible for net-metering, the local utility purchases the excess electricity that is generated by the PV system but unused by the consumer.

Impediments or barriers to development or implementation:

- Currently, the initial cost of a PV system is expensive—costs range from $6/kW to $10/kW. However, costs have been decreasing, and most predict that cost will continue to decrease for the foreseeable future.

- PV systems can only generate electricity when the sun is shining. During the night, or when it is cloudy, or when the panels are shaded, the system will produce very little or no power. The ability of a solar array to produce energy is only as good as the weakest-performing panel; if one panel is completely shaded, all the panels in that array will not generate any energy.

- A PV installation requires a large area for the system to be effective in providing electricity. An area the size of a sheet of plywood (32 square feet) is needed for 500 watts of generating capacity. Thus, 260 square feet of area (8 sheets of plywood) would be necessary for a 4 kW system.

- Panels may need to be cleaned—although, in New York State, if the panels are installed at an angle, rain generally does a pretty good job.

- The location of solar panels can affect long-term performance—trees grow and buildings get built which can obscure the panel's view of the sun.

- Batteries must be included in the system to provide continued generation of electricity during a blackout. Without batteries, when there is an electrical blackout, the PV system will not generate electricity, as the inverter needs the electricity from the grid to synchronize the AC power it is producing.

Resource—examples:

- *PV Awning*, New York State Energy Research and Development Authority (NYSERDA), 17 Columbia Circle, Albany, New York—a two-tiered, photovoltaic awning that helps power NYSERDA's headquarters. The awning system is both active and passive, meaning it will generate electricity while also providing shade to the building's lobby and second floor meeting room, reducing cooling requirements for those areas. The PV Awning is an example of a building-integrated PV system. The awning consists of 45 solar modules, 80 watts each, for a total capacity of 3.6 kilowatts. The system supplies enough AC electricity to meet one-half of NYSERDA's computer-driven power load. The system was also designed to allow testing of new inverters, which are manufactured by New York companies working in NYSERDA's Research & Development program. In addition, the system includes a data-acquisition system that displays real-time weather and system-performance data in the lobby of the NYSERDA building. http://www.powernaturally.org/About/documents/NYSERDAPVAwning.pdf.

- *Town Hall,* Town of Greenburgh, Westchester County, New York— a 5.6 kW PV system, comprising 34 PV modules, installed on a south-facing, sloped, standing-seam roof of the Town Hall, and occupying approximately 479 square feet on the roof. A monitor in the lobby displays real-time data about the

system's performance; and the Town also benefits from the electricity produced by the system, as well as from a reduction in their peak demand. The Town Hall functions as the center of government for the Town of Greenburgh, the largest town in Westchester County. The Town has been an Energy $mart Community since February, 2003, and actively conducts outreach to educate its residents and businesses about energy efficiency and renewable energy. Town officials sought to install a photovoltaic system in the Town Hall primarily as a demonstration system to increase public awareness of the need for and benefits of renewable energy, as the Town Hall's central location, high visibility, and large number of visitors make it an ideal setting for this purpose. For Town Supervisor: http://www.greenburghny.com/Cit-e-Access/webpage.cfm?TID=10&TPID=1750.

- *Happy Haven Farm*, Mooers, Clinton County, New York—a 300-acre dairy farm that is home to 85 dairy cows and 55 young stock. The owners decided to install a PV system to gain control over their energy costs, contribute towards protecting the environment, and make the farm more attractive to future generations of farmers. The system's layout covers approximately 1,000 square feet and is divided into six tracking arrays, which allows the system to receive more direct sunlight throughout the day than would a traditional, fixed array. The system includes 72 photovoltaic panels, each rated at 175 watts, and total AC power generated is estimated at 10.1kW. The total installed system costs are approximately $125,000, but a NYSERDA incentive and a grant from the US Department of Agriculture's Rural Development program reduced that cost by 65 per cent. http://www.powernaturally.org/publications/Happy%20Haven%20Farm.pdf.

Resource-written and web:

- *American Solar Energy Society (ASES)*, a national organization dedicated to advancing the use of solar energy for the benefit of U.S. citizens and the global environment. Their Web site provides information about the use of solar energy as an alternative power source, has links to many programs that promote the use of solar power, and is a good site for general information: http://ases.org/.

- *Florida Solar Energy Center*, which provides general information pertaining to the use of solar energy. Their Web site provides links to different types of applications and uses of solar energy and links to additional sources of information: http://www.fsec.ucf.edu/en/.

- *New York State Solar Energy Industry Association*, a New York trade association for solar energy companies. Their Web site contains information about joining the group, which allows participation in the many programs aimed at enhancing the use of solar energy. For non-members, there are many links that outline the benefits of solar energy, as well as a listing of New York State programs that offer incentives to users of solar energy systems: http://www.nyseia.org.

- *North Carolina Solar Center,* an organization that serves as a clearinghouse for solar and other renewable energy programs, information, research, technical assistance, and training. Their Web site contains links outlining the different uses of renewable energy, from cars to homes to major corporations, as well as links for teachers and students wishing to gain knowledge about renewable energy. The site also contains news that pertains to various renewable energy programs around the world: http://ncsc.ncsu.edu/.

- *Solar Electric Power Association*, a collaboration of utility companies, energy service providers, and the photovoltaic industry that works together to promote the use of renewable energy resources. Thieir Web site contains information on state/local agencies and utilities that offer incentives for the use of renewable energy resources: http://www.solarelectricpower.org.

- *Solar Energy Industry Association (SEIA)*, the national trade association of solar energy manufacturers, dealers, distributors, contractors, installers, architects, consultants, and marketers. Their Web site provides links to various conferences and events focusing on solar energy. Also included on the site are new developments and general news about solar energy policy developments in the national and state governments: http://www.seia.org.

- *Solar Rating and Certification Corporation (SRCC)*, an organization that administers a certification, rating, and labeling program for all solar systems. Their Web site is useful for companies wishing to have a system design certified by the corporation. The site offers a set of standards and ratings that will be used to certify the design as well as companies that are participating in the program: http://www.solar-rating.org.

- *Power ... naturally,* New York State Energy Research and Development Authority—an extensive list of links on Renewable Energy, including General Renewable Energy, Entrepreneurial Networks and Incubators, Buying Green Power, Connecting to the Grid, Staying Off the Grid, Solar Electric (PV), PV Systems for Agriculture, PV Performance Data, Solar Water Heating Systems, Wind Energy, Large Wind Energy Applications, Wind Energy Projects in New York, On-Site Small Wind Applications, Biomass Resources, Oil/Natural Gas/Minerals, and Educational Resources: http://www.powernaturally.org/about/HelpfulLinks.asp.

- *Information on Making Your Own Energy— U.S. Department of Energy,* general information about PV systems, connecting to the utility grid, operating a PV system off-grid, codes and requirements, and more: http://www.energysavers.gov/renewable_energy/.

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SOLAR THERMAL SYSTEMS — FOR DOMESTIC HOT WATER

Description:

Solar thermal applications cover a wide range of products and technologies. However, all are designed to capture solar energy in the form of heat. A home owner can use the sun for cooking, heating hot water for a home, warming a swimming pool, radiant heating, and even as an alternative to air conditioning.

Typically, residential solar thermal applications include either a passive collector design that incorporates a thermal mass with no mechanical systems, or an active design that includes electronic controls and circulating pumps. A thermal mass is any material that stores solar energy during the day and releases the energy in the form of heat at night, when the temperature is cooler. Common thermal masses include concrete, natural stone, and water. Both passive and active designs offset the amount of energy required by a household.

While the combinations of using solar thermal systems are endless, the most common application in use today centers around the production of domestic hot water, which is the focus of this paper. An average solar domestic hot water system can produce up to half the hot water required by a typical household in New York State. A typical system includes a solar thermal collector, a medium (such as anti-freeze or similar fluid) to transport heat from the collector, a heat exchanger, and a reservoir (collection) tank. Many systems include a secondary hot water tank to supplement heat and ensure hot water is always available.

In northern climates, including New York, where below-freezing temperatures are normal during the winter months, a flat plate collector or an evacuated tube collector—in combination with a non-freezing heat transfer fluid (medium)—is the solar thermal collector of choice. Both collector types are designed to be roof-mounted and can be linked together to form a thermal collection array that balances the hot water production needs of the household with installation costs.

Solar domestic hot water systems can be installed in any geographic area of the State, on any household or building with optimal sun exposure—reducing the cost of heating water and saving both energy and money. Using the sun as a clean, abundant, reliable, affordable, renewable energy source, solar thermal systems are considered a valuable element of a livable community.

Benefits:

For homeowners

- The reduced cost of heating water with a solar thermal system makes homeownership more affordable for older people, people with disabilities, and families—supporting successful aging in place and supporting the efforts of family caregivers.

- The application of solar thermal systems for apartment buildings contributes to the affordability of rents for lower-income older people, people with disabilities, and families.

- A solar system may extend the life of a secondary hot water tank (if included in the system).

For the community

- Reduction in the annual amount of carbon dioxide and other greenhouse gases produced by conventional water heaters improves air quality in homes and across the community, creating a more healthy living environment.

- Use of solar thermal systems reduces use of costly conventional heating methods such as electricity (as well as reduces the drain on the country's electrical grid) and reduces the use of non-renewable fossil fuels.

Impediments or barriers to development or implementation:

- *Climate:*
  - Certain types of solar domestic hot water systems cannot be installed in climates that experience freezing temperatures.

- *Cost:*
  - Although installation costs are recouped over time through operational savings, the upfront cost to install a solar domestic hot water system is high. On average, a typical residential system costs approximately $5,000 for materials, plus the cost of installation by a professional.
  - Solar domestic hot water systems require regular maintenance, which on average costs $100 annually.

- *Codes:*
  - Zoning and building codes relating to the installation of solar domestic hot water systems are established at the local level and may vary from community to community.

Resource—law:

- Recording of solar energy easements, including solar hot water, is governed by New York State Real Property Law, Article 9: NY CLS Real P § 335-b (2008): http://www.dsireusa.org/documents/Incentives/NY01Ra.htm.

Resource—example:

- Jeffrey Perlman and Andrew McNamara (August, 2008), *Solar Domestic Hot Water Technologies Assessment: Final Report 08-09.* Albany, New York: New York State Energy Research and Development Authority. http://www.nyserda.ny.gov/en/Publications/Research-and-Development/~/media/Files/Publications/Research/Other%20Technical%20Reports/report%2008-09%20solar%20domestic%20hot%20water%20-%20web.ashx

Resource—written and Web:

- DSIRE SOLAR—Established in 1995, DSIRE is an ongoing project of the North Carolina Solar Center and the Interstate Renewable Energy Council and is funded by the U.S. Department of Energy. DSIRE is a comprehensive source of information on state, local, utility, and federal incentives and policies that promote renewable energy and energy efficiency: http://www.dsireusa.org.

- U.S. Department of Energy, National Renewable Energy Laboratory (NREL):
  - **NREL's Mission:** NREL develops renewable energy and energy efficiency technologies and practices, advances related science and engineering, and transfers knowledge and innovations to address the nation's energy and environmental goals.
  - **NREL's Strategy:** NREL has forged a focused strategic direction to increase its impact on the U.S. Department of Energy's (DOE) and on our nation's energy goals by accelerating the research path from scientific innovations to market-viable alternative energy solutions. www.nrel.gov.

- Office of Energy Efficiency and Renewable Energy (December, 2003), *A Consumer's Guide: Heat Your Water with the Sun*. Washington, DC: U.S. Department of Energy. http://www.nrel.gov/docs/fy04osti/34279.pdf.

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SUB-METERING FOR ELECTRICITY

Description:

There are two different methods by which multifamily buildings are metered for electricity: direct metering and master metering. Single-family buildings are direct metered.

Direct metering: In a direct-metered building (also known as individually metered), the utility owns the meter and supplies electricity to each living unit (single-family home; individual apartment). Each householder receives his living unit's electric bill from the utility at the residential retail rate; in a multiunit building, the building owner receives an electric bill for electric usage in the common areas, typically at a commercial retail rate.

Master metering: In a master-metered building, the utility supplies electricity to the entire building, and one utility-owned meter serves the building. The building owner receives one electric bill, often at a rate that results in a bill significantly lower than the retail residential rate. Individual apartments are not metered, and actual apartment consumption cannot be determined or used as the basis for billing electric charges.

In a direct-metered building, residents pay for the amount of electricity they consume. In a master-metered building, the cost of the total electric consumption for the building is divided among apartments, not taking into account actual consumption per household. Billing for each apartment can be handled in various ways; for example, divided evenly among all apartments, or based on the size of the apartment or where it is located in the building, or based on the numer of residents in an apartment. Submetering combines the best of both direct- and master-metering systems.

Submetering: Submetering is used with master-metered buildings. It permits the measurement of electric use in individual apartments via a building-owned meter installed for each apartment (these are submeters and are owned by the building and not the utility). The building continues to purchase its electricity on the less expensive commercial or bulk residential rate basis, but the owner is able to bill electric-use to individual apartments on an actual-consumption basis. The building owner continues to receive one bill from the utility; the owner allocates the utility costs across apartments based on the usage recorded by the apartment submeters; residents pay the building owner, not the utility; and the building owner continues to be responsible for the portion of the utility bill that covers the building's common areas.

There are many benefits to electrical submetering in master-metered buildings—both the owner and the residents reap the benefits of lower energy costs, current technology facilitates the reading of submeters without entry into individual apartments (preserving residents' privacy), and available software systems enable automated billing procedures. In addition, electrical submetering is a successful energy-conservation strategy, reducing energy use among residents. Often, property owners do not bill residents separately for utilities, but incorporate those charges into the rental charge. When property owners do not charge for utilities separately, residents have little reason or incentive to conserve energy; and they are unable to compare how much energy they are saving when they do decide to take energy-saving steps. When a building undergoes a typical energy-conservation measure (installation of a new boiler, etc.), consideration should be given to including submetering as a beneficial component of the new installation.

Benefits:

- *Energy savings*—a change from traditional master-metering to submetering has been shown to reduce residents' consumption of electricity in apartments by 10-26 per cent.[1]

- *Lower utility costs*—building owners continue to reap the benefits of less expensive commercial or bulk-buying electric rates, which are passed on to apartment dwellers.

- *Fairer allocation of energy costs*— Submetering restores the "pay for what you use" concept. Data reveals that 20-25 per cent of total apartment usage is consumed by only 10 per cent of the residents;[2] yet, under traditional master-metering, these excessive users pay the same as other residents. Sub-metering restores fairness. Approximately 60-70 per cent of residents benefit from submetering. The only residents who fare worse under submetering are those who use excessive amounts of electricity; however residents who find that their electric bills are excessive have the ability to reduce cost by reducing consumption.

- *Benefits to owners*— Submetering largely eliminates a volatile, variable, and difficult-to-control factor from a building's operating budget—apartment electric usage costs. Whether the building is a rental, cooperative, or condominium, owners can better predict costs when the only electric usage to be considered is for common areas, which are under management control.

- *Benefits to utilities and society*— Submetering benefits utilities and society in the same way: by reducing the waste of energy and deferring the need to site, build, or otherwise acquire electric generating capacity, as well as by reducing the use of fossil fuels (e.g., oil), which are still the primary source of power-generation in New York State. Reducing the use of fossil fuels is a giant step toward enhancing the environment by improving air quality.

References:

[1, 2] "Sub-metering," *Energy Conservation Services Corporation,* New York City: http://enconcorp.com/index.php?option=com_content&task=view&id=38&Itemid=77.

Impediments or barriers to development or implementation:

- Inplementing submetering involves an investment of about $500 per submeter point (tenant space), and the owner is responsible for all maintenance and billing to the tenants.

- Some residents may refuse to pay any additional charges related to the implementation of the sub-metering syistem.

- Some residents may object to a change in billing procedures, or may object to any increase in charges due to their higher individual consumption patterns. The owner is responsible for any dispute-resolution process to resolve such issues. Such a process is designed to establish procedures in the event a resident does not agree with the meter reading, billing, or other aspects of the electric charges.

- Some tenants may lobby others in the building to convince them that submetering is bad for everyone; it is usually the tenants who use the most energy who become most vocal.

Resource—examples :

- *Aguilar Gardens*, Flushing, New York—conversion of a master-metered system to a master-metered/advanced-submeter system for 256 apartments in two buildings just outside of Manhattan. The cost of the advanced-submetering system was $104,560; projected annual electric savings was $25,011; and annual electric-consumption savings was projected to be 264,800 kWh. http://www.getenergysmart.org/Files/aguilargardens.pdf.

- *Southern Connecticut State University*, New Haven, Connecticut - U. S. Environmental Protection Agency—New England (January, 2007), "Sub-Metering Campus Buildings," *Energy.* http://www.epa.gov/region1/assistance/univ/pdfs/bmps/SCSUSubmetering1-8-07.pdf.

Resource—written and web:

- Herbert Hirschfeld, Joseph Lopes, Howard Schechter, and Ruth Lerner (1997; revised 2001), *Residential Electric Submetering Manual,* a report prepared by the Project Team of Applied Energy Group, Inc., in the course of performing work sponsored by the New York State Energy Research and Development

Authority (NYSERDA), Albany, New York. Contracts #4483-IABR-BR-97 and #5037, Project Manager: Mary Ann Bowers. http://www.submeteronline.com/pdf/subman2001.pdf.

- Lou Mane (Summer, 2005), "Submetering—A Practical Approach," *GE ESL Magazine*: http://www.geindustrial.com/Newsletter/fall05_submetering.pdf.

- Daryl Cowie (December, 2009), "The Business Case for Sub-Metering," *Sub-Metering 101,* AutomatedBuildings.com: http://www.automatedbuildings.com/news/dec09/articles/wescon/091127105404wescon.htm.

Resource—technical assistance and contact names:

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WATER-USE-EFFICIENCY IN HOMES and BUILDINGS

Description:

Across the country, a growing population is putting stress on available water supplies. Between 1950 and 2000, the U.S. population nearly doubled. However, in that same period, public demand for water more than tripled. Each American now uses an average of 100 gallons of water each day[1]—enough to fill 1,600 drinking glasses! This increased demand has put additional stress on water supplies and distribution systems, threatening both human health and the environment.

There is a reason why water has become a national priority. A recent government survey showed that at least 36 states are anticipating local, regional, or statewide water shortages by 2013.[2] But, by using water more efficiently, we can help preserve water supplies for future generations, save money, and protect the environment.

The average household spends as much as $500 per year on its water and sewer bill; by making just a few simple changes to use water more efficiently, that house could save about $170 per year.[3] If all U.S. households installed water-efficient appliances, the country would save more than three trillion gallons of water and more than $18 billion dollars per year.[4] Also, when water is used more efficiently, there is a reduced need for costly water supply infrastructure investments and new wastewater treatment facilities.

It takes a considerable amount of energy to deliver and treat the water that is used in homes every day. For example, letting a faucet run for five minutes uses about as much energy as letting a 60-watt light bulb run for 14 hours. American public water supply and treatment facilities consume about 56 billion kilowatt-hours (kWh) per year—enough electricity to power more than five million homes for an entire year.[5]

There are many ways to save water in residential buildings, and all of them are cost-effective over a very short time-horizon, making their implementation an economic home-run almost every time. The Federal Energy Policy Act of 1992 (EPAct 1992) issued performance standards for residential water-efficient fixtures and appliances, which are now federal law. These appliances and fixtures include toilets, faucets, showerheads, clothes washers, and dishwashers. The standards are expressed in tables below.[6]

In addition to federal standards, the U. S. Environmental Protection Agency (EPA) has developed certifications to help consumers identify the most energy- and water-efficient products on the market. These certification labels are WaterSense®

and ENERGY STAR®; WaterSense® products use less water than the standards developed for EPAct 1992. The performance characteristics of fixtures and appliances for WaterSense® and Energy Star® are listed in the tables below.[6]

Environmental Protection Agency
WaterSense

National Efficiency Standards and Specifications for
Residential and Commercial Water-Using Fixtures and Appliances

Fixtures and Appliances	EPAct 1992, EPAct 2005 (or backlog NAECA updates)		WaterSense® or ENERGY STAR®		Consortium for Energy Efficiency	
	Current Standard	Proposed/Future Standard	Current Specification	Proposed/Future Specification	Current Specification	Proposed/Future Specification
Residential Toilets	1.6 gpf[1]		WaterSense 1.28 gpf with at least 350 gram waste removal[2]		No specification	
Residential Bathroom Faucets	2.2 gpm at 60 psi[3]		WaterSense 1.5 gpm at 60 psi (no less than 0.8 gpm at 20 psi)[4]		No specification	
Residential Showerheads	2.5 gpm at 80 psi		No specification		No specification	
Residential Clothes Washers	MEF ≥ 1.26 ft^3/kWh/cycle *No specified water use factor	Proposed to DOE Asst. Sec. jointly by AHAM and efficiency advocates to be effective in 2011 MEF ≥ 1.26 ft^3/kWh/cycle WF ≤ 9.5 gal/cycle/ft^3	ENERGY STAR (DOE) MEF ≥ 1.72 ft^3/kWh/cycle; WF ≤ 8.0 gal/cycle/ft^3	ENERGY STAR (DOE) Effective July 1, 2009: MEF ≥ 1.8 ft^3/kWh/cycle WF ≤ 7.5 gal/cycle/ft^3 Effective January 1, 2011: MEF ≥ 2.0 ft^3/kWh/cycle WF ≤ 6.0 gal/cycle/ft^3	**Tier 1:** MEF ≥ 1.80 ft^3/kWh/cycle; WF ≤ 7.5 gal/cycle/ft^3 **Tier2:** MEF ≥ 2.00 ft^3/kWh/cycle; WF ≤ 6.0 gal/cycle/ft^3 **Tier 3:** MEF ≥ 2.20 ft^3/kWh/cycle; WF ≤ 4.5 gal/cycle/ft^3	

[1]EPAct 1992 standard for toilets applies to both commercial and residential models.
[2]See WaterSense HET specification at http://www.epa.gov/watersense/docs/spec_het508.pdf.
[3] EPAct 1992 standard for faucets applies to both commercial and residential models.
[4]See WaterSense specification for lavatory faucets at http://www.epa.gov/watersense/docs/faucet_spec508.pdf.

DOE: Department of Energy
EPA: Environmental Protection Agency
EPAct 1992: Energy Policy Act of 1992
EPAct 2005: Energy Policy Act of 2005
EF: energy factor
ft^3: cubic feet
gal: gallons
gpm: gallons per minute
gpf: gallons per flush
kWh: kilowatt hour
MEF: modified energy factor
MaP: maximum performance
NAECA: National Appliance Energy conservation Act
psi: pounds per square inch
WF: water factor

Updated Sept. 29,2008

Environmental Protection Agency
WaterSense

National Efficiency Standards and Specifications for
Residential and Commercial Water-Using Fixtures and Appliances

Fixtures and Appliances	EPAct 1992, EPAct 2005 (or backlog NAECA updates)		WaterSense® or ENERGY STAR®		Consortium for Energy Efficiency	
	Current Standard	Proposed/Future Standard	Current Specification	Proposed/Future Specification	Current Specification	Proposed/Future Specification
Residential Dishwashers[5]	*Standard models:* EF ≥ 0.46 cycles/kWh *Compact models:* EF ≥ 0.62 cycles/kWh *No specified water use factor (Energy independence & Security Act of 2007: As of Jan. 1, 2010 *Standard models:* 355 kWh/year WF ≤ 6.5 gallons/cycle *Compact models:* 260 kWh/year WF ≤ 4.5 gallons/cycle)	New standards under development: DOE scheduled final action: March, 2009; Stakeholder meeting held 4/27/2006 Proposed to DOE Asst. Sec. jointly by AHAM and efficiency advocates to be effective in 2010 *Standard models:* 355 kWh/year (.62 EF + 1 watt standby) WF ≤ 6.5 gallons/cycle *Compact models:* 260 kWh/year WF ≤ 4.5 gallons/cycle	ENERGY STAR (DOE) *Standard models:* EF ≥ 0.65 cycles/kWh *Compact models:* EF ≥ 0.88 cycles/kWh *No specified water use factor	Proposed to DOE Asst. Sec. jointly by AHAM & efficiency advocates to be effective in 2009 *Standard models:* 324 kWh/year (0.68 EF + 1 watt standby) WF ≤ 5.8 gallons/cycle *Compact models:* 234 kWh/year WF ≤ 4.0 gallons/cycle Phase Two (Proposed by DOE): July 1, 2011 *Standard models:* 307 kWh/year 5.0 gallons/cycle *Compact models:* 222 kWh/year 3.5 gallons/cycle	*Standard models:* **Tier 1:** EF ≥ 0.65 cycles/kWh; maximum 339 kWh/year **Tier 2:** EF ≥ 0.68 cycles/kWh; maximum 325 kWh/year *Compact models:* **Tier 1:** EF ≥ 0.88 cycles/kWh; maximum 252 kWh/year *No specified water use factor	In December 2006, CEE announced they will consider adding a water factor in future dishwasher specifications

[5] *Standard models:* capacity is greater than or equal to eight place settings and six serving pieces; *Compact models:* capacity is less than eight place settings and six serving pieces

DOE: Department of Energy
EPA: Environmental Protection Agency
EPAct 1992: Energy Policy Act of 1992
EPAct 2005: Energy Policy Act of 2005
EF: energy factor
ft^3: cubic feet
gal: gallons
gpm: gallons per minute
gpf: gallons per flush
kWh: kilowatt hour
MEF: modified energy factor
MaP: maximum performance
NAECA: National Appliance Energy Conservation Act
psi: pounds per square inch
WF: water factor

Updated September 29, 2008

It is important to keep in mind that low-flow fixtures (like showerheads and faucet aerators) do not just save water, but save energy, too, because the less hot water a person uses to wash his hands or shower, the less energy is needed to heat water in the home. It is common for people to install faucet aerators that use as little as 0.5 gallons per minute in the bathroom sink, because most people actually use very little water to brush their teeth and wash their faces. In places like New York City, where water is over $7 per 1,000 gallons, changing from a 2.5 to a 0.5 aerator pays for itself in only 50 minutes of use.

Another easy way to save water includes landscaping your property with native plants, which will not require constant watering. The National Wildlife Federation maintains a Web site containing a list of all plants that are native to New York: http://www.nwf.org/Get-Outside/Outdoor-Activities/Garden-for-Wildlife/Gardening-Tips/Using-Native-Plants.aspx?CFID=16918117&CFTOKEN=d0d062feb45740dd-720202C4-5056-A84B-C36EF1A5FFE32A5D.

More advanced concepts in water-efficiency include the limited reuse of "greywater." Greywater is water that has been used for some purpose and is no longer potable. However, it could be used for other activities; for example, some developers have implemented systems where water that has been used to wash hands is subsequently used to flush toilets or water lawns. A similar idea to recycling greywater is the collection and reuse of rainwater. Instead of letting rainwater get washed away from the gutter to the sidewalk, many buildings contain a cistern to capture the water and store it for use at a later date. The primary use for such water is irrigation, which requires little engineering or effort; but there is also the potential to use rainwater for non-potable applications in a building, such as flushing toilets.

Finally, as was discussed earlier, energy and water use are often inextricably linked. Heating systems in the Northeast tend to be either steam or hydronic. In steam systems, water is heated in a boiler and distributed through pipes to radiators, which, in turn, heat the building. The steam turns into hot water after giving off its heat and returns to the boiler to start the cycle again. Hydronic systems circulate hot water through the pipes rather than turning it into steam first. The New York State Energy Research and Development Authority has studied the water use in steam and hydronically heated buildings, and findings show that hydronic systems use dramatically less water (and energy) than most steam systems. Thus, if there is an opportunity to install a hydronic system rather than a steam system in a building, it should be pursued. In conversions from steam to hydronic, it is important to ensure that the pipes are sealed to avoid water leaks throughout the building. Whatever the configuration of a heating system, the amount of water being used by the system should be regularly checked, because excessive water use can be a good indication that something is wrong with the system. A system that is kept in good working order will extend the life of the equipment, save money on utilities, and save the State's resources.

References:

[1, 2] U. S. Environmental Protection Agency, "Water Efficiency," *WaterSense—an EPA Partnership Program:* http://epa.gov/watersense/our_water/what_you_can_do.html.

[3, 4, 5] U. S. Environmental Protection Agency, "Benefits of Water Efficiency," *WaterSense—an EPA Partnership Program:* http://www.epa.gov/watersense/water_efficiency/benefits_of_water_efficiency.html.

[6] U. S. Environmental Protection Agency, *National Efficiency Standards and Specifications for Residential and Commercial Water-Using Fixtures and Appliances*: http://www.epa.gov/watersense/docs/matrix508.pdf.

Benefits:

For consumers:

- Water- and energy-efficient appliances and features save significant household expenses—making homeownership and rental properties more affordable for greater numbers of householders and allowing greater numbers of individuals to remain living in the community.

- Grants and rebates are available for Energy STAR® and other water-saving appliances.

For the community:

- By reducing household water use, householders not only help reduce the energy required to supply and treat public water supplies but also can help address climate change. For example, according to the U. S. Environmental Protection Agency (*http://water.epa.gov/infrastructure/sustain/waterefficiency.cfm*):
  - If one out of every 100 American homes were retrofitted with water-efficient fixtures, about 100 million kWh of electricity per year would be saved—avoiding 80,000 tons of greenhouse gas emissions. That is equivalent to removing nearly 15,000 automobiles from the road for one year.
  - If one per cent of American homes replaced their older, inefficient toilets with WaterSense®-labeled models, the country would save more than 38 million kWh of electricity—enough to supply one month's electricity for more than 43,000 households.

Impediments or barriers to development or implementation:

- Some efficiency strategies are too advanced for "do-it-yourself" applications and require the skills and knowledge of professionals; for example:
  - The use of greywater is an advanced strategy, requiring engineering and some level of filtration, and should be pursued only after all of the nuts-and-bolts technologies have been implemented.
  - Rainwater collection and use is a much more advanced application and would require some level of filtration and engineering.

- Hydronic heating systems require some design and engineering work and may not be appropriate for every application.

Resource—examples:

- U. S. Environmental Protection Agency, Office of Water (July, 2002), *Cases in Water Conservation: How Efficiency Programs Help Water Utilities Save Water and Avoid Costs* (EPA832-B-02-003). This publication documents the efforts and achievements in strategic water-efficiency programs in 17 municipalities across the country (including New York City), including resources and contact names for further information: http://www.epa.gov/watersense/docs/utilityconservation_508.pdf.

Resource—written and web:

- Portfolio Manager,® a tool developed by the U. S. Environmental Protection Agency, tracks water-use in homes and buildings, across portfolios, over time—which can help owners determine which buildings or fixtures are high-users and how the intensity of their energy- and water-use ebbs and flows over time. Available free online at: http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager.

- United States Energy Policy Act of 1992 (EPAct 1992): http://thomas.loc.gov/cgi-bin/query/z?c102:H.R.776.ENR:.

- U. S. Environmental Protection Agency: http://www.epa.gov/.
  Laws, Regulations, Guidance and Dockets: http://www.epa.gov/lawsregs/.
  Links to resources related to *WaterSense*®:
  http://nlquery.epa.gov/epasearch/epasearch?areaname=&areacontacts=http%3A%2F%2Fwww.epa.gov%2Fepahome%2Fcomments.htm&areasearchurl=&result_template=epafiles_default.xsl&action=filtersearch&filter=&typeofsearch=epa&querytext=WaterSense.

- New York State Energy Research and Development Authority (NYSERDA): http://www.nyserda.ny.gov/.
  Links to resources related to *Energy Star:*
  http://www.nyserda.ny.gov/Programs/Residential/Energy-Efficient-and-ENERGY-STAR-Products.

IV.2.r

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WEATHERIZATION

Description:
The primary goal of all "weatherization" efforts is to modify a home or building to reduce its energy consumption and optimize its energy efficiency. In particular, publicly supported weatherization programs are designed to assist needy householders (including older adults, individuals of all ages with disabilities, and families with children) reduce their energy bills and achieve both economic and environmental savings. While publicly supported programs assist low-income householders, weatherizing homes and other types of buildings has rapidly become attractive to people of all income levels because, if done properly, it will permanently reduce energy bills by making existing homes and buildings more energy-efficient. According to the United States Department of Energy,[1] weatherization reduces heating bills by an average of 32 per cent and overall energy bills by about $350 per year at current (2009) prices.

Across the United States, existing buildings use one-third of all energy consumed in the country and two-thirds of all electricity. Due to their high energy usage, existing buildings are a major source of the pollution that causes air quality problems; and they supply pollutants that directly contribute to climate change. The practice of weatherizing a home or building offers a long-lasting solution to the many inefficient homes and buildings in country, as it directly addresses the cause through energy efficiency.

The movement to weatherize homes and buildings has grown over the years in conjunction with rising concerns about fuel costs and environmental issues. As weatherization has evolved, there has been increasing emphasis on looking at how each individual building performs as a whole system. This more current approach extends traditional weatherization activities to also include the installation of recently developed, energy-saving heating and cooling equipment, as well as the repair of old, inefficient equipment.

Although weatherization packages vary to best suit each individual home or building, some common weatherization procedures include:

- Sealing—which is done using materials such as caulk, foam sealant, weather-stripping, window film, door sweeps, and electrical receptacle gaskets to reduce air infiltration:
  - Seal bypasses (cracks, gaps, holes), especially around doors, windows, pipes, and wiring that penetrate the ceiling and floor, and other areas with high potential for heat loss.
  - Seal air ducts, which can account for 20 per cent of heat loss, using fiber-reinforced mastic.

- Provide proper ventilation to unconditioned spaces to protect a building from the effects of condensation.

- Protect pipes from corrosion and freezing.

- Weather-strip doors and windows.

- Clean and tune existing heating mechanical systems.

- Install:
  - Storm doors and storm windows.
  - Low-flow showerheads and faucet aerators.
  - High-efficiency water heaters.
  - Insulation in walls, floors, and ceilings; around ducts, pipes and water heaters; and near the foundation and sill.

- Replace:
  - Old drafty doors with tightly sealed, foam-core doors.
  - Older windows with low-energy, double-glazed windows.
  - Older, inefficient heating systems.
  - Older, inefficient refrigerators.

- Install/replace dampers in exhaust ducts to prevent outside air from entering the house when the exhaust fan or clothes dryer is not in use.

Federal Weatherization Assistance Program (WAP)—
Through a nationwide weatherization network of 900 agencies, the U. S. Department of Energy's (DOE) Federal Weatherization Assistance Program provides for the installation of energy efficiency measures in single-family and multiunit homes of income-qualifying homeowners. WAP is administered in each state by a state government agency. Since its inception in 1976, more than 6.2 million low-income families have been assisted with weatherization procedures that are long-lasting and effective, providing energy savings that pay for the upgrades within a few years. WAP's Technical Assistance Center provides guidance for program operations and fosters community partnerships to advance weatherization.

Through its Oak Ridge National Laboratory, DOE conducts regular evaluations of the WAP program to verify energy savings and to maximize service to weatherization clients. Evaluations have shown that each dollar of DOE investment in weatherization returns $2.69 in energy and non-energy-related benefits.
The WAP program was greatly expanded as part of the American Recovery and Reinvestment act (ARRA) of 2009, with eligibility qualification now raised to 200 per cent of the Federal poverty income guidelines. Many techniques that are currently standard procedure in the country's larger weatherization industry were first developed and tested under the Federal Weatherization Assistance Program; and, through this program, DOE continues to develop and test new advances in the field of home energy science.

Reference:

[1] Hawaii State Department of Labor and Industrial Relations, *U. S. Department of Energy—Energy Efficiency and Renewable Energy: Weatherization Assistance Program"*: http://hawaii.gov/labor/ocs/pdf/DOE%20Weatherization%20Assistance%20Program%20-%20Technologies.pdf.

Benefits:

Economic impact—for the consumer:

- The energy savings from employing weatherization measures saves consumers money. For example, efforts through the Federal Weatherization Assistance Program bring a return of $1.83 in direct energy savings to the homeowner for every $1 spent on weatherization; and taking both energy-related benefits and non energy-related benefits together, the combined return per dollar spent is $2.69.

Economic impact—for the community:

- Workers—
  - Across the country, both public and private weatherization efforts have helped spawn an energy-efficiency industry for residential housing. This industry today employs thousands of people who work in low-income weatherization alone, and many times that number who work in companies that help homeowners increase their energy efficiency through low-cost measures. For example, according to Weatherize.org,[2] 52 jobs are directly created for each million dollars invested into the Federal Weatherization Assistance Program.

- Local economy—
  - Weatherizing homes directly provides work for *local* contractors and revenue for the businesses that supply the materials necessary for weatherization procedures.
  - Through increased household spending on weatherization activities (generation of jobs and purchasing of materials), money is spent by families for goods and services *within the community*.
  - *housing stock*

- Upgrades and modifications made to homes and buildings through weatherization activities help maintain the community's housing and building stock and improve their value.

Environment:

- Weatherization measures—
  - Reduce carbon dioxide output by nearly a metric ton per weatherized home (carbon dioxide is often cited as a likely contributor to global climate change).
  - Reduce overall energy demand, which decreases power plant emissions and associated air pollution.

- Reduce energy consumption on a national scale and, therefore, reduce demand on the nation's electrical grid as well as dependency on imported oil.

Social:

- Weatherization measures—
  - Create safer living environments for those who inhabit a home or building by emphasizing the importance of measures such as installing smoke alarms and carbon monoxide detectors.
  - Create healthier, more comfortable living environments for inhabitants through reduced drafts and higher air quality.
  - Provide a long-term household-expense solution against rising energy prices for all householders (including older adults and younger individuals with disabilities), but particularly for low-income individuals and families. Lower-income families typically spend around 20 per cent of their total annual income on energy; during recessionary times, these families cut back on other necessities of life to cover the cost of energy.
  - Help stabilize a community's resident population by:
    - Supporting the ability of older adults and younger-aged people with disabilities to successfully age in place in their own homes and apartments.
    - Helping all families to affordably remain living in the community.

- Weatherization measures lead to community education and outreach, because residents and tenants are frequently encouraged to take part in the efforts.

Reference:

[2] Weatherize.org (2009). "Weatherization Works!" *Weatherization Program 2009*: http://www.weatherize.org/roi.html.

Impediments or barriers to development or implementation:

- Energy-efficient upgrades and modifications are costly and, too often, are unattainable for many low- and middle-income individuals and families.

- Funding through public weatherization programs for low-income households is inadequate to meet the need/demand.

- Many consumers resist weatherization upgrades because (1) they fear that they will be unable to use the new equipment, or (2) they are worried about false claims about the effectiveness of newer weatherization equipment that has not been in the market long-enough to have been proven.

- When not properly completed, weatherization practices may result in health problems (for example, if weatherization measures are installed by untrained workers, over-tightening of the building could occur, which would lead to health problems due to lack of proper ventilation and air flow).

Resource—written and web:

- Weatherize.org, 2009—provides extensive information about the U. S. Department of Energy's *Weatherization Assistance Program (WAP),* including eligibility guidelines and updates, technical assistance information and resources, and a list of WAP agencies by state and county: http://www.weatherize.org/.
  For the list of county-based WAP agencies in New York State: http://www.weatherize.org/statelist/statelistNY.html.
  For a discussion of the economic and other benefits of employing weatherization measures: *Weatherization Works!:* http://www.weatherize.org/roi.html.

- U. S. Department of Energy, *Weatherization Assistance Program (WAP)*—provides extensive descriptive information about the program, weatherization technologies, and links to government agencies in each state that administer the Federal WAP program: http://apps1.eere.energy.gov/weatherization/.

- New York State Homes and Community Renewal, *Weatherization Assistance Program (WAP)*—extensive eligibility and descriptive information about the WAP program in New York State: http://www.nyshcr.org/Programs/WeatherizationAssistance/.

- Ted Collins—New Technology Demonstration Program (September, 1998), *Technology Focus: Single-Family Residential Building Weatherization.* Washington, DC: U. S. Department of Energy; Oak Ridge, Tennessee: Oak Ridge National Laboratory. http://c0133311.cdn.cloudfiles.rackspacecloud.com/Report%20-%20DOE%20Single-Family%20Residential%20Building%20Weatherization%20Fact%20Sheet.pdf..

- Larry Kinney, Tom Wilson, and Michael MacDonald (September/October, 1995), "Profiles of Multifamily Weatherization Projects: A Tale of Five Cities," *Home Energy Magazine Online:* http://www.homeenergy.org/archive/hem.dis.anl.gov/eehem/95/950915.html.

Resource—technical assistance and contact names:

- Weatherization Program
  Energy and Rehabilitation Services
  New York Homes and Community Renewal
  38-40 State Street
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WEATHERIZATION

Description:
The primary goal of all "weatherization" efforts is to modify a home or building to reduce its energy consumption and optimize its energy efficiency. In particular, publicly supported weatherization programs are designed to assist needy householders (including older adults, individuals of all ages with disabilities, and families with children) reduce their energy bills and achieve both economic and environmental savings. While publicly supported programs assist low-income householders, weatherizing homes and other types of buildings has rapidly become attractive to people of all income levels because, if done properly, it will permanently reduce energy bills by making existing homes and buildings more energy-efficient. According to the United States Department of Energy,[1] weatherization reduces heating bills by an average of 32 per cent and overall energy bills by about $350 per year at current (2009) prices.

Across the United States, existing buildings use one-third of all energy consumed in the country and two-thirds of all electricity. Due to their high energy usage, existing buildings are a major source of the pollution that causes air quality problems; and they supply pollutants that directly contribute to climate change. The practice of weatherizing a home or building offers a long-lasting solution to the many inefficient homes and buildings in country, as it directly addresses the cause through energy efficiency.

The movement to weatherize homes and buildings has grown over the years in conjunction with rising concerns about fuel costs and environmental issues. As weatherization has evolved, there has been increasing emphasis on looking at how each individual building performs as a whole system. This more current approach extends traditional weatherization activities to also include the installation of recently developed, energy-saving heating and cooling equipment, as well as the repair of old, inefficient equipment.

Although weatherization packages vary to best suit each individual home or building, some common weatherization procedures include:

- Sealing—which is done using materials such as caulk, foam sealant, weather-stripping, window film, door sweeps, and electrical receptacle gaskets to reduce air infiltration:
  - Seal bypasses (cracks, gaps, holes), especially around doors, windows, pipes, and wiring that penetrate the ceiling and floor, and other areas with high potential for heat loss.
  - Seal air ducts, which can account for 20 per cent of heat loss, using fiber-reinforced mastic.

- Provide proper ventilation to unconditioned spaces to protect a building from the effects of condensation.

- Protect pipes from corrosion and freezing.

- Weather-strip doors and windows.

- Clean and tune existing heating mechanical systems.

- Install:
  - Storm doors and storm windows.
  - Low-flow showerheads and faucet aerators.
  - High-efficiency water heaters.
  - Insulation in walls, floors, and ceilings; around ducts, pipes and water heaters; and near the foundation and sill.

- Replace:
  - Old drafty doors with tightly sealed, foam-core doors.
  - Older windows with low-energy, double-glazed windows.
  - Older, inefficient heating systems.
  - Older, inefficient refrigerators.

- Install/replace dampers in exhaust ducts to prevent outside air from entering the house when the exhaust fan or clothes dryer is not in use.

Federal Weatherization Assistance Program (WAP)—
Through a nationwide weatherization network of 900 agencies, the U. S. Department of Energy's (DOE) Federal Weatherization Assistance Program provides for the installation of energy efficiency measures in single-family and multiunit homes of income-qualifying homeowners. WAP is administered in each state by a state government agency. Since its inception in 1976, more than 6.2 million low-income families have been assisted with weatherization procedures that are long-lasting and effective, providing energy savings that pay for the upgrades within a few years. WAP's Technical Assistance Center provides guidance for program operations and fosters community partnerships to advance weatherization.

Through its Oak Ridge National Laboratory, DOE conducts regular evaluations of the WAP program to verify energy savings and to maximize service to weatherization clients. Evaluations have shown that each dollar of DOE investment in weatherization returns $2.69 in energy and non-energy-related benefits.
The WAP program was greatly expanded as part of the American Recovery and Reinvestment act (ARRA) of 2009, with eligibility qualification now raised to 200 per cent of the Federal poverty income guidelines. Many techniques that are currently standard procedure in the country's larger weatherization industry were first developed and tested under the Federal Weatherization Assistance Program; and, through this program, DOE continues to develop and test new advances in the field of home energy science.

Reference:

[1] Hawaii State Department of Labor and Industrial Relations, *U. S. Department of Energy—Energy Efficiency and Renewable Energy: Weatherization Assistance Program"*: http://hawaii.gov/labor/ocs/pdf/DOE%20Weatherization%20Assistance%20Program%20-%20Technologies.pdf.

Benefits:

Economic impact—for the consumer:

- The energy savings from employing weatherization measures saves consumers money. For example, efforts through the Federal Weatherization Assistance Program bring a return of $1.83 in direct energy savings to the homeowner for every $1 spent on weatherization; and taking both energy-related benefits and non energy-related benefits together, the combined return per dollar spent is $2.69.

Economic impact—for the community:

- Workers—
  - Across the country, both public and private weatherization efforts have helped spawn an energy-efficiency industry for residential housing. This industry today employs thousands of people who work in low-income weatherization alone, and many times that number who work in companies that help homeowners increase their energy efficiency through low-cost measures. For example, according to Weatherize.org,[2] 52 jobs are directly created for each million dollars invested into the Federal Weatherization Assistance Program.

- Local economy—
  - Weatherizing homes directly provides work for *local* contractors and revenue for the businesses that supply the materials necessary for weatherization procedures.
  - Through increased household spending on weatherization activities (generation of jobs and purchasing of materials), money is spent by families for goods and services *within the community*.
  - *housing stock*

- Upgrades and modifications made to homes and buildings through weatherization activities help maintain the community's housing and building stock and improve their value.

Environment:

- Weatherization measures—
  - Reduce carbon dioxide output by nearly a metric ton per weatherized home (carbon dioxide is often cited as a likely contributor to global climate change).
  - Reduce overall energy demand, which decreases power plant emissions and associated air pollution.

- Reduce energy consumption on a national scale and, therefore, reduce demand on the nation's electrical grid as well as dependency on imported oil.

Social:

- Weatherization measures—
  - Create safer living environments for those who inhabit a home or building by emphasizing the importance of measures such as installing smoke alarms and carbon monoxide detectors.
  - Create healthier, more comfortable living environments for inhabitants through reduced drafts and higher air quality.
  - Provide a long-term household-expense solution against rising energy prices for all householders (including older adults and younger individuals with disabilities), but particularly for low-income individuals and families. Lower-income families typically spend around 20 per cent of their total annual income on energy; during recessionary times, these families cut back on other necessities of life to cover the cost of energy.
  - Help stabilize a community's resident population by:
    - Supporting the ability of older adults and younger-aged people with disabilities to successfully age in place in their own homes and apartments.
    - Helping all families to affordably remain living in the community.

- Weatherization measures lead to community education and outreach, because residents and tenants are frequently encouraged to take part in the efforts.

Reference:

[2] Weatherize.org (2009). "Weatherization Works!" *Weatherization Program 2009*: http://www.weatherize.org/roi.html.

Impediments or barriers to development or implementation:

- Energy-efficient upgrades and modifications are costly and, too often, are unattainable for many low- and middle-income individuals and families.

- Funding through public weatherization programs for low-income households is inadequate to meet the need/demand.

- Many consumers resist weatherization upgrades because (1) they fear that they will be unable to use the new equipment, or (2) they are worried about false claims about the effectiveness of newer weatherization equipment that has not been in the market long-enough to have been proven.

- When not properly completed, weatherization practices may result in health problems (for example, if weatherization measures are installed by untrained workers, over-tightening of the building could occur, which would lead to health problems due to lack of proper ventilation and air flow).

Resource—written and web:

- Weatherize.org, 2009—provides extensive information about the U. S. Department of Energy's *Weatherization Assistance Program (WAP),* including eligibility guidelines and updates, technical assistance information and resources, and a list of WAP agencies by state and county: http://www.weatherize.org/.
  For the list of county-based WAP agencies in New York State: http://www.weatherize.org/statelist/statelistNY.html.
  For a discussion of the economic and other benefits of employing weatherization measures: *Weatherization Works!:* http://www.weatherize.org/roi.html.

- U. S. Department of Energy, *Weatherization Assistance Program (WAP)*—provides extensive descriptive information about the program, weatherization technologies, and links to government agencies in each state that administer the Federal WAP program: http://apps1.eere.energy.gov/weatherization/.

- New York State Homes and Community Renewal, *Weatherization Assistance Program (WAP)*—extensive eligibility and descriptive information about the WAP program in New York State: http://www.nyshcr.org/Programs/WeatherizationAssistance/.

- Ted Collins—New Technology Demonstration Program (September, 1998), *Technology Focus: Single-Family Residential Building Weatherization.* Washington, DC: U. S. Department of Energy; Oak Ridge, Tennessee: Oak Ridge National Laboratory. http://c0133311.cdn.cloudfiles.rackspacecloud.com/Report%20-%20DOE%20Single-Family%20Residential%20Building%20Weatherization%20Fact%20Sheet.pdf..

- Larry Kinney, Tom Wilson, and Michael MacDonald (September/October, 1995), "Profiles of Multifamily Weatherization Projects: A Tale of Five Cities," *Home Energy Magazine Online:* http://www.homeenergy.org/archive/hem.dis.anl.gov/eehem/95/950915.html.

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WIND ENERGY

Description:

Wind energy is the world's fastest-growing energy technology. Wind energy—or wind power—is the process by which wind turbines convert the kinetic (motion) energy in wind into mechanical power or into electricity. The wind turbine captures the wind in its blades (or rotor) and converts the wind energy to rotational or mechanical energy. The rotor drives an attached shaft, gearbox, and generator to produce electrical energy. Wind turbines can be used to produce electricity for a single home or building, or they can be connected to an electricity grid for more widespread electricity distribution to multiple homes and buildings.

A wind turbine produces alternating current (AC), which must be converted into direct current (DC) and then back into AC to add consistency to the energy produced. Output from a wind turbine is always changing, since the wind is not constant. Wind speed is very important to the output of a turbine. A doubling (2X) of the wind speed will increase output eight-fold (8X). Newer technologies are making the extraction of wind energy much more efficient and allow for energy production at lower wind speeds.

Wind power is not a new technology. In various areas of the world, harnassing the energy of the wind for tasks such as pumping water and grinding grain has existed since before 200 B.C.; and settlers brought windmill technology to the United States in the late 1800s to pump water for farms and ranches and, later, to generate electricity for homes and industry.[1] Across the world, industrialization led to a gradual decline in the use of windmills, but interest in this technology has always risen and waned in response to the price of fossil fuels. Current growing interest is related to the high cost of fossil fuels, concern about the unsustainability of using finite non-renewable fossil fuel sources, and mounting concerns about the significant environmental impact of the carbon emissions associated with these fossil fuel resources.

In contrast to fossil fuels, wind power produces no environmental pollutants; is a sustainable, renewable energy-generating resource; and the wind, itself, is free. In addition, the use of wind power is also growing as a result of technology improvements, cost reductions, laws, and incentives. According to a U. S. Department of Energy report,[2] the U.S. wind power market surged in 2007—with 5,329 MW of new capacity added and $9B invested in wind project installations, for a cumulative total of nearly $28B since the 1980s. The Union of Concerned Scientists,[3] reported that the use of wind power across the world grew at an average annual rate of 32 percent between 1998 and 2002, and reported that the

U.S. Department of Energy's (DOE) "Wind Powering America" initiative has set a goal of producing five per cent of the nation's electricity from wind by 2020.

The New York State Energy Research and Development Authority (NYSERDA) has supported the construction and operation of 41.5 megawatts (MW) of wind energy in New York State. NYSERDA currently supports extensive wind resource development and prospecting efforts to identify promising new sites for wind development. These projects could result in the development of over 425 MW of wind energy, having the potential to satisfy increasing consumer demand for green energy and various green energy purchase mandates in neighboring states.

References:

[1] U. S. Department of Energy, "History of Wind Energy," *Technologies*: http://www1.eere.energy.gov/windandhydro/wind_history.html.

[2] Ryan Wiser and Mark Bolinger, et al. (May, 2008), *Annual Report on Wind Power Installation, Costs, and Performance Trends—2007,* Washington, DC: U. S. Department of Energy, Energy Efficiency and Renewable Energy: http://www.nrel.gov/docs/fy08osti/43025.pdf.

[3] Union of Concerned Scientists, "Farming the Wind: Wind Power and Agriculture," *Clean Energy:* http://www.ucsusa.org/clean_energy/technology_and_impacts/impacts/farming-the-wind-wind-power.html.

Benefits:

For communities and the environment:

- A sustainable, renewable resource—the supply of wind energy is inexhaustible.
- Wind energy reduces reliance on foreign petroleum and other fossil fuels.
- Wind turbines do not produce air or water pollution and require very little disturbance of land or soil.
- Modern wind turbines are very quiet and can be located within 300 feet of residential structures.
- The footprint of a wind turbine is fairly small and the unit is compatible with mixed land use, such as grazing or agricultural (crops can be grown right up to immediate proximity of a turbine, and turbines can be located within grazing areas—with little impact on crops or stock).
- Agricultural and residential wind turbines can be located in remote areas where connecting to the utility grid may be too excessive or impossible.
- Wind power is a growth industry, stimulating economic development and job opportunities.

- Wind turbines have been successfully used in rural, suburban, and urban areas.

- A commercial wind farm can increase a municipality's tax base, offsetting residents' tax bills.

For consumers:

- Provides a cleaner, healthier living environment for residents.

- *Reduced housing costs:* Wind power has increasing potential for reducing housing costs—making homeownership and rental charges affordable for more people, thereby supporting their ability to remain living in the community. While some reports indicate that the cost of building turbines increased recently, increasing numbers of agencies and reports indicate that the cost of wind power continues to decrease and will shortly become competitive with conventional sources of energy-generation; for example, see:
  - European Wind Energy Association, *Wind Directions:* http://www.ewea.org/fileadmin/ewea_documents/documents/publications/wind_benefits/Windpower_is_expensive.pdf. Also: http://www.ewea.org/index.php?id=60&no_cache=1&tx_ttnews[tt_news]=1832&tx_ttnews[backPid]=1&cHash=50e9c38dd50cae65d176ebb0b4508e31. Also: http://www.energyboom.com/wind/new-study-shows-wind-power-reduces-electricity-prices.

  - American Wind Energy Association, "Wind energy keeps electric rates affordable": http://www.awea.org/learnabout/publications/factsheets/upload/Consumer-Benefits-Fact-Sheet.pdf.

  - Staff and Press Association (April 23, 2012), "US and UK to collaborate on 'floating' wind turbines," *The Guardian* on line: http://www.guardian.co.uk/environment/2012/apr/23/us-uk-floating-wind-turbines.

- Through lease agreements, commercial wind turbines provide a potential second income for landowners and farmers.

Impediments or barriers to development or implementation:

- Environmental aspects of wind technology have an impact on market and community acceptability:
  - *Aesthetics:* While many people think the modern designs of wind turbines are elegant, many others feel they present an aesthetic blight on the landscape.
  - *Noise:* Residents often object to the noise generated by wind turbines. While wind turbines are not silent, they are not excessively loud—producing sounds that are typical to a rural environment. However, advancing technology continues to reduce, and may even eliminate, any noise from wind turbines.

- In many areas, wind strength is too low to economically support the installation of a wind turbine. However, newer technologies are creating wind turbines that efficiently generate power at lower wind strengths than were traditionally required.

- Too much wind is as bad as not enough. Excessive wind can damage the gearbox—reducing a turbine's output or completely stopping a turbine in high-wind conditions.

- The installation of wind systems can involve the use of heavy equipment, which can cause temporary negative impacts to the area near the installation. Control of erosion around a site must be mitigated.

- Wind speed is critical to the viability of a wind turbine, and taller towers may be necessary to achieve the necessary wind resource. However, a local municipality may not allow the installation of tall towers (typically considered greater than 80 feet tall), or may require getting a variance from a local law.

- There is a big difference between a large wind project and a small wind project (number of turbines, land space occupied, noise, geographic location, site location); however, laws created to restrict the development of large wind farms often catch small wind projects in the same net, including a single turbine for a single residence.

- Migratory birds and bats may collide with rotor blades.

- Shadow flicker is created when rotor blades cast a moving shadow over nearby windows during daylight.

- New York State has great wind-power potential in the Adirondacks and Catskill Mountains, but lacks access to transmission lines.

Resource—examples:

- *Alfred State College Farm*, Alfred, New York—a 10 kW turbine on a 100' guyed lattice tower was installed to produce energy for the milking barn and to allow students to monitor power production. The average annual wind resource at this site is about 12mph and the annual output is about 11,000 kWh.

- *Steel Winds Wind Farm,* Lackawanna, New York—the first wind farm in a city, Steel Winds is located right outside of Buffalo on 30 acres of the old Bethlehem Steel Mill along the shores of Lake Erie. It is one of the first wind farms in the nation constructed on a brownfield and is a 2007 *Power Engineering* magazine Best Renewables Project of the Year winner: http://www.epa.gov/oswercpa/docs/success_steelwinds_ny.pdf. http://www.chattanoogachamber.com/newsandvideo/businesstrend/2008spring/page25.asp.

http://www.renewableenergyworld.com/rea/news/article/2007/06/steel-winds-project-achieves-full-commercial-operations-48803.

- *Wind Power Law Blog, "*New York State Wind Projects"*:* provides a list of links to operational wind energy projects in New York State: http://windpowerlaw.info/wind-power-law-resources/new-york-state-wind-projects/: scroll down to "New York State Wind Projects."

- *Amy Wilson's single-family home*, Oklahoma City, Oklahoma: http://www.earthtechenergysystems.com/news.asp.

Resource—written and web:

- *New York Wind Maps*—developed under NYSERDA funding, these Web sites contain updated maps of New York's wind speeds. The maps have a horizontal resolution of 200 meters; and tools such as zoom in, zoom out, pan, wind resource report, and more are located above the maps. Various overlays can be selected as well.
  NYSERDA *Small Wind Explorer:*
  - Press release: http://www.nyserda.ny.gov/About/Newsroom/2009-Announcements/2009-10-23-AWS-Truewind-Launches-NY-Small-windExplorer-to-Support-NYSERDA-Small-Wind-Initiatives.aspx?sc_database=web .
  - New York State *Small Wind Explorer*: http://nyswe.awstruepower.com/.
  - *Small Wind Explorer*—Frequently Asked Questions: http://nyswe.awstruepower.com/SWEFrequentlyAskedQuestions.pdf.

- U. S. Department of Energy: *Wind Powering America*—a program with specific focus on the use of wind power generation as a source of income for American farmers, Native Americans, and rural landowners. The site provides helpful links to various state agencies that deal with renewable energy, and also gives information as to what is needed to start one's own wind farm. http://www.windpoweringamerica.gov/.
  - Success Stories: http://www.windpoweringamerica.gov/success_stories.asp.
  - Utility-Scale Land-Based 80-Meter Wind Maps: http://www.windpoweringamerica.gov/wind_maps.asp.
  - *New York Wind Map and Resource Potential:* http://www.windpoweringamerica.gov/wind_resource_maps.asp?stateab=ny.

- Ryan Wiser and Mark Bolinger (Lawrence Berkeley National Laboratory) (June 29, 2011), *2010 Wind Technologies Market Report.* Washington, DC: U. S. Department of Energy. This annual report provides a comprehensive overview of trends in the U.S. wind power market in 2010; analyzes trends in wind power capacity, industry, manufacturing, turbines, installed project costs, project performance, and wind power prices; describes trends among wind power developers, project owners, and power purchasers; and discusses financing issues.

http://www.windpoweringamerica.gov/pdfs/2010_annual_wind_market_report.pdf. Also: http://www.windpoweringamerica.gov/filter_detail.asp?itemid=3207.

- *American Wind Energy Association*—a National trade organization that promotes the use of wind energy. The Web site includes contact information for developers, consultants, equipment suppliers, and other members. It also provides details on large and small wind technology, policy initiatives, locations of installed wind projects, and links to other information. http://www.awea.org.

- *AWS Truewind*—an organization made up of meteorologists, engineers, and environmental specialists, offering a full range of technical services from feasibility studies to wind plant design. The Web site provides good information on the weather and atmospheric conditions of an area for use in the development of an alternative energy system at a particular location. Also included on the site are wind maps and meteorology maps for specific areas of the world (including New York). http://www.awstruepower.com/.

- *National Renewable Energy Laboratory/National Wind Technology Center*—as part of the U.S. Department of Energy, this laboratory focuses on wind energy research and development. The Web site includes extensive information on the Laboratory's technology and associated research activities, as well as publications, photos, and links to other wind energy related sites. http://www.nrel.gov/wind/.

- *Small Wind Certification Council*—an independent certification body that will certify small wind turbines if they meet or exceed the performance, durability, and safety requirements of the Small Wind Turbine Performance and Safety Standard. This certification will provide a common North American standard for reporting turbine energy and sound performance, and help small wind technology gain mainstream acceptance. http://www.smallwindcertification.org/.

- *U.S. Department of Energy Wind Program*—a program that is leading the efforts across the United States to improve wind energy technology so that it can generate competitive electricity in areas with lower wind resources. The Web site contains detailed information about the program, including the types of technologies being developed and additional publications. It also provides information on the Department of Energy's hydropower program. http://www1.eere.energy.gov/windandhydro/pdfs/43025.pdf.

- *Wind Energy Technologies*—a Web site containing links that describe the different types of wind turbines, as well as the difference between windmills and wind turbines. http://www1.eere.energy.gov/windandhydro/wind_how.html.

- *Wind Power Law Blog*—a Web blog that focuses on wind energy legal developments, especially regarding land use and zoning law, environmental

concerns, and judicial and regulatory actions. The site also links to sites of numerous New York wind plants. http://windpowerlaw.info.

- *Windustry*—a non-profit organization that promotes wind energy through outreach, educational materials, and technical assistance to rural landowners, local communities and utilities, and state, regional, and nonprofit collaborations. The Web site contains links to help rural landowners understand wind energy opportunities. http://www.windustry.org.

- Western Resouirce Advocates, *Green Power Links—Wind Energy*: a web site providing numerous links and resources on wind energy and other green energy alternatives. http://www.westernresourceadvocates.org/greenpower/links.php/.

- *Wind Energy Toolkit: Community Resources for Wind Development*—a tool kit designed to provide information on all aspects of wind energy development and to help communities prepare for wind development. The reports and documents in the tool kit are intended to provide objective information necessary for everyone concerned with wind development in a community—from the farmer or landowner who wants to lease his land—to the local officials charged with zoning, planning and permitting—to interested members of the public. The tool kit houses information about the process for siting wind energy facilities in municipalities in this state, and all the considerations that go into the decision-making effort. http://www.powernaturally.org/Programs/Wind/toolkit.asp.

- Steve Lindenberg, et al. (July, 2008), *20% Wind Energy by 2030—Increasing Wind Energy's Contribution to U. S. Electricity Supply*, #DOE/GO-102008-2567. Washington, DC: U. S. Department of Energy, Energy Efficiency and Renewable Energy. http://www1.eere.energy.gov/wind/pdfs/wind_manuf_wkshp_proceedings_05-19-09.pdf.

- Wind and Water Power Program (May, 2011), *Building a New Energy Future with Wind Power*, #DOE/GO-102011-3278. Washington, DC: U. S. Department of Energy, Energy Efficiency and Renewable Energy. http://www1.eere.energy.gov/wind/pdfs/51240.pdf.

- U. S. Department of Energy (May 29. 2008), "U.S. Continues to Lead the World in Wind Power Growth": http://www.id.doe.gov/news/PressReleases/PR080530-Wind/080530Wind.pdf.

Resource—technical assistance contact names:

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ZERO-NET-ENERGY HOMES

Description:

Anyone who has ever paid a utility bill has inevitably thought to himself, “What if I didn’t have to pay this bill?” There are two simple ways to achieve such a goal. The first is to live in a home that does not use any energy—unfortunately, this means not having electricity, heat, or hot water. This does not sound like a home anyone would want to live in. Now imagine living in a home that contains all the modern amenities, but there is still no utility bill—such a home would need to generate all of the power it needs to operate through a "zero-net-energy" approach.

Zero-net-site-energy homes typically use electricity to heat the air and water of the home—no use of gas or oil needs to be considered. In such a home, the amount of energy provided by *on-site renewable energy* sources (for example, wind, solar, biomass, geothermal) is equal to the amount of energy used by the home. These homes are connected to the electric grid and may draw electric power when needed, but will also give back to the grid when producing more than the home needs. By definition, the amount of electricity put back into the grid must equal the amount used from the grid.

Two major trends are resulting in zero-net-energy homes becoming more and more of a reality: (1) The progress of new construction technologies and techniques, as well as the commercialization of advanced renewable/sustainable technologies; and (2) the development of zero-net-energy home projects throughout the world, providing academic researchers and public policy designers with great insight into the most effective and least costly paths to achieving their goals.

Although this section focuses on zero-net-energy *residential homes*, this approach is beneficial for a variety of buildings, which is evident in the several definitions of what a zero-net-energy approach means in practice. Below are brief descriptions of some of the nuances of this concept:

Net-zero-site-energy use—
This describes a home or other type of building in which the amount of energy provided by on-site renewable energy sources is equal to the amount of energy used by the building.

Net-zero-energy emissions—
Outside the United States and Canada, a zero-net-energy home is generally defined as one with zero-net-energy emissions—also known as a zero-carbon building or a zero-emissions building. This definition also considers the carbon emissions generated from on-site or off-site fossil fuel uses, which need to be balanced by the

amount of on-site renewable energy production. In addition to considering the carbon emissions generated by the building while in use, true net-zero-energy-emissions homes also consider the emissions generated during the construction of the building, as well as the energy required to make the building materials for the structure. Over the life of the home, the clean on-site energy produced must make up for these other emissions. Homes that use natural gas or some other fossil fuel to heat its air and water must consider the emissions from combusting these materials and make up for it through clean energy generation.

Off-the-grid—
Off-the-grid buildings are stand-alone zero-net-energy homes that are not connected to an off-site energy generation facility. They require distributed renewable energy generation and energy storage capability (for when the sun is not shining, the wind is not blowing, etc.). These homes are the most difficult to design and construct and are also more costly than grid-connected homes. True off-the-grid homes require great dedication from their owners.

In the United States, the concept and general definition of net-zero-energy homes is understood to be the point where all electricity demands from the home are met through on-site renewable power generation. Great care is taken through advanced building techniques to decrease the power-demand of the homes, while not sacrificing functionality or comfort. Items that need to be combined for a successful zero-net-energy home include:

- Passive solar designs
- Advanced insulation and air sealing techniques
- Energy-efficient appliances and lighting
- High-efficiency heating, cooling, and hot water systems
- Renewable power generation through wind, solar, or biomass
- Net metering with the utility
- Consumer education

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Benefits:

- *For homeowners and building owners:*
  - Year-round reduced or zero energy bills.
  - Off-the-grid houses and buildings are not susceptible to black-outs, brown-outs, or power failures.
  - Healthier living environment because of decreased or no emissions.
  - As the use of this concept expands—bringing installation and service costs down—the health benefits and reduced operating costs will help make homeownership and rental more affordable—supporting the ability of residents to continue living in the community.

- *For communities:*
  - Decreased load on the electricity distribution infrastructure (electric grid).
  - Reliable, renewable, sustainable energy sources.
  - Decreased emissions from power generation plants due to decreased demand provide environmental benefits.
  - Reduced operating costs support businesses.
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- Building construction techniques, renewable technologies, and workforce infrastructure are still young, decreasing their availability and affecting the cost-effectiveness of completing homes.

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- U. S. Environmental Protection Agency, ENERGY STAR® Program: www.energystar.gov.

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ZERO-NET-ENERGY HOMES

Description:

Anyone who has ever paid a utility bill has inevitably thought to himself, “What if I didn’t have to pay this bill?” There are two simple ways to achieve such a goal. The first is to live in a home that does not use any energy—unfortunately, this means not having electricity, heat, or hot water. This does not sound like a home anyone would want to live in. Now imagine living in a home that contains all the modern amenities, but there is still no utility bill—such a home would need to generate all of the power it needs to operate through a "zero-net-energy" approach.

Zero-net-site-energy homes typically use electricity to heat the air and water of the home—no use of gas or oil needs to be considered. In such a home, the amount of energy provided by *on-site renewable energy* sources (for example, wind, solar, biomass, geothermal) is equal to the amount of energy used by the home. These homes are connected to the electric grid and may draw electric power when needed, but will also give back to the grid when producing more than the home needs. By definition, the amount of electricity put back into the grid must equal the amount used from the grid.

Two major trends are resulting in zero-net-energy homes becoming more and more of a reality: (1) The progress of new construction technologies and techniques, as well as the commercialization of advanced renewable/sustainable technologies; and (2) the development of zero-net-energy home projects throughout the world, providing academic researchers and public policy designers with great insight into the most effective and least costly paths to achieving their goals.

Although this section focuses on zero-net-energy *residential homes*, this approach is beneficial for a variety of buildings, which is evident in the several definitions of what a zero-net-energy approach means in practice. Below are brief descriptions of some of the nuances of this concept:

Net-zero-site-energy use—
This describes a home or other type of building in which the amount of energy provided by on-site renewable energy sources is equal to the amount of energy used by the building.

Net-zero-energy emissions—
Outside the United States and Canada, a zero-net-energy home is generally defined as one with zero-net-energy emissions—also known as a zero-carbon building or a zero-emissions building. This definition also considers the carbon emissions generated from on-site or off-site fossil fuel uses, which need to be balanced by the

amount of on-site renewable energy production. In addition to considering the carbon emissions generated by the building while in use, true net-zero-energy-emissions homes also consider the emissions generated during the construction of the building, as well as the energy required to make the building materials for the structure. Over the life of the home, the clean on-site energy produced must make up for these other emissions. Homes that use natural gas or some other fossil fuel to heat its air and water must consider the emissions from combusting these materials and make up for it through clean energy generation.

Off-the-grid—
Off-the-grid buildings are stand-alone zero-net-energy homes that are not connected to an off-site energy generation facility. They require distributed renewable energy generation and energy storage capability (for when the sun is not shining, the wind is not blowing, etc.). These homes are the most difficult to design and construct and are also more costly than grid-connected homes. True off-the-grid homes require great dedication from their owners.

In the United States, the concept and general definition of net-zero-energy homes is understood to be the point where all electricity demands from the home are met through on-site renewable power generation. Great care is taken through advanced building techniques to decrease the power-demand of the homes, while not sacrificing functionality or comfort. Items that need to be combined for a successful zero-net-energy home include:

- Passive solar designs
- Advanced insulation and air sealing techniques
- Energy-efficient appliances and lighting
- High-efficiency heating, cooling, and hot water systems
- Renewable power generation through wind, solar, or biomass
- Net metering with the utility
- Consumer education

On-site power generation is the most costly and unreliable portion of the zero-net-energy home. Because of this, it is advantageous to design a home so that it does not require excessive amounts of electricity in the first place. A highly efficient home is much easier to make zero-net-energy. As more research occurs and more demonstration projects are undertaken, the process for achieving this goal will become clearer.

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Green Building
INTRODUCTION

Green building (also called sustainable building, or high performance design, or healthy building practices) seeks to reduce negative environmental and health impacts of buildings through better design, siting, construction, operation, maintenance, and removal practices—without compromising aesthetic appeal or budget criteria. There is a focus on increasing the efficiency of energy, water use, and materials resources, as well as on reducing negative human health impacts throughout a building's life cycle. Green building is often called sustainable building because its practices make use of ecosystems and their resources in a way that meets the current needs of people and communities without compromising the needs and options of future generations.

Across the country, the trend of incorporating green principles in houses and communities is growing. The U. S. Green Building Council,[1] a national trade association established in 1993, held its first national convention in 2002 with just a few hundred people in attendance. In the fall of 2008, there were nearly 30,000 in attendance from all over the world. In the opening plenary, Bishop Desmond Tutu told attendees that we “are a remarkable people” and can do what we need to do if we set our minds and hearts to it; and the final plenary included a statement from E. O. Wilson, eminent biologist: “We will either settle down, achieve sustainability and do it right, or completely wreck the planet.” This conference reflected a growing movement to create more healthy living environments through building greener homes, buildings, and communities.

As the movement has matured, the earlier perception that "greening" is about *sacrifice* has evolved into an awareness that it is really about *excellence* and *appropriateness*. This evolution reflects a greater understanding that *all* elements of our living environment have an impact on the health and well-being of people and their surroundings. At all levels of society—national, state, and local—many aspects and issues have emerged to compel this movement to "build green"—for example, the responsibilities associated with environmental stewardship; the impact of the environment on health and productivity; the future status of non-renewable energy resources; the economic potential of green building, including new products and local jobs for services, manufacturing, and renewable energy production; and the willingness to redefine growth beyond conventional definitions.

Following are examples of real-world situations that are driving the global development of green building expertise as a means of sustaining the health and well-being of both the planet and its residents.

Planetary Health: There are many aspects of the living environment that can be positively influenced by a more respectful, sustainable use of our planet and its resources; for example:

- *Water*— The Earth's supply of potable water is limited. According to the U. S. Department of the Interior,[2] only three per cent of the Earth's total water is non-saline freshwater (two per cent locked up in glaciers and icecaps and one per cent available as surface and ground water). Practices that use potable water for throw-away systems (such as toilet flushing) are a questionable use of a critically limited resource. According to the Water Research Foundation, daily indoor per-person water use in the United States is 69.3 gallons,[3] about twice the per-person use in Europe.

- *Air*— Every place on the planet is interconnected, and harmful substances emitted in any one country will come to the others, affecting people and regions well beyond the point of origin. Reducing or avoiding those emissions benefits *all* people; in addition, innovative development can strive to identify a healthful use for those "waste" products.

- *Soil*— Various actions can have significant unintended impacts on the sustainable quality of the earth's soil, and these impacts are often not recognized or not taken into account. For example, removing older-growth trees and brush that replenish the soil with their leavings, destroys soil. Or, when outmoded farming methods or climate changes deplete the soil's nutrients, it becomes harder or impossible to obtain healthful food from the earth. Other actions, such as building roads, dumping waste, logging, re-routing waterways, and aerial spraying affect the quality of the soil on a long-term basis.

- *Diversity of species*— Many species of plants and animals have become extinct and others are endangered—due to several reasons, including the increasing sprawl of humans, a general unawareness of or indifference to these plants and animals, and a lack of knowledge of the critical role that *variety* in plants and animals plays in sustaining the environment and the critical balance of nature. In many ways, true (closed) cycles (which encourage creation of diversity in some species to balance a loss in others) are declining because of activities and behaviors; for example, farming systems in the United States encourage huge farms of single crops, together with engineering to make one crop variation dominant.

Health and Performance of People:

Environment-related decisions—both unintended and calculated—have direct, often long-lasting impacts on health and well-being; for example:

- People spend an average of 90 per cent of their days and nights in their homes and public buildings; but the materials used for construction and for furnishings are often toxic, sometimes intentionally planned to achieve a laudable purpose. For example, electronics and clothing are produced with fire retardants to

protect users from fire, but with the knowledge that those substances can increase the risk of cancer or endocrine disruption.

- Coal miners and workers in other hazardous jobs are exposed to health hazards that are unsupportable.

- While tens of thousands of chemicals have been created, basic toxicity information is publicly available for only 43 per cent of HPV[4] chemicals and full information on toxicity is publicly available for only seven per cent.[5]

Increasing incidence of many health conditions have been associated, to one degree or another, with environmental toxicity, including lung disorders, contact illnesses, bioaccumulation of toxins, and poor performance; for example:

- According to the American Academy of Allergy Asthma and Immunology,[6] an estimated 300 million people worldwide suffer from asthma; 250,000 annual deaths are attributed to the disease; workplace conditions, such as exposure to fumes, gases, or dust, are responsible for 11 per cent of asthma cases worldwide; and about 70 per cent of asthmatics also have allergies. The prevalence of asthma increased 75 per cent between 1980 and 1994, and asthma rates in children under the age of five increased more than 160 per cent during that time period.

- Eczema, various skin disorders, and other allergy-related sensitivities have increased.[7]

- Nearly 16 per cent of women of childbearing age have mercury levels above what is considered safe.[8]

- Buildings with little or no natural daylight have resulted in eye strain, depression, and decreased productivity. Children in schools that were well-lit with natural light were found to do better academically.[9] Poor air quality can cause migraine headaches, dizziness, lack of focus on tasks at hand, and can even potentially cause heart strain. Nationwide, the number of children in special education programs with learning disabilities increased 191 per cent between 1977 and 1994.[10]

Economics: Green buildings, even those that use the LEED[11] rating system, do not need to cost more than “conventional” buildings to construct; for example:

- The use of passive solar gain, controlled day-lighting, and cross-ventilating breezes are natural systems that have their basis in things that are free, giving a building an economic leg-up on operational costs.

- Builders can choose to work with the landscape in which the building is situated. Common green areas with indigenous plantings can reduce chemical-use, as well as the energy and money spent on lawn care.

When green-building adds to initial construction costs, this can be viewed within the overall costs of operating and maintaining the building over the long term. Green buildings are typically built better, with more durable materials and more efficient products; thus, they last longer, perform significantly better in monthly operating costs, and recoup any initial additional costs in a reasonable period of time. However, decisions can be difficult to make when considering only the initial construction-cost feasibility. For example, if a project is green (no toxins, much recycled content, materials made locally)—in response to the homeowner's heightened sensitivities to chemicals or to a mission directive to support local businesses—but costs 20 per cent more, tough choices have to be made to accommodate the additional project cost within the established budget.

The three topics above illustrate *Triple Bottom Line* (TBL) thinking, where each decision is weighed against the benefit or cost to the people affected, to the planet we all inhabit, and to the bottom line of the organization, individual, or community. Employing TBL considerations in each decision can result in a stable and reasonable understanding of the long-term success of a project.

The general movement in green design and planning relates to the TBL approach and employs Integrative Design—pulling the concerned parties into the mix early and working very hard to understand the needs, prioritize the goals, and design with long-term benefits in mind—while balancing the budget, schedule, and program. While such an approach sounds complex, it quickly becomes a less linear, more comprehensive approach to design and planning, resulting in projects that involve fewer changes in construction because more questions are asked and answered early on . . . all opportunities for discussion and benefits are brought up earlier . . . and more, creative alternatives are considered. Two examples can illustrate this:

- No longer is the engineer brought in once a building's “architecture” is set and the engineer then plugs in standard one-size, one-type systems to heat and cool the building. Instead, there is greater understanding that such systems affect the design, and the design should support the parameters and potential of the systems used by the engineer.

- If a building is disturbing the portion of the site that is near the road, consideration can be given to adding sidewalks for the community and water-retention to keep local streams cleaner. Keeping other pieces of the TBL equation in mind, how could the cost of this alternative solution be addressed? Perhaps the city will reduce taxes on the project because the sponsor is engaging the town and supporting its infrastructure beyond the code requirements, and that tax break will make the sidewalk an affordable project cost. Or, an alternative suggestion might be to use permeable concrete for the sidewalks, reducing or eliminating the need for a water-retention system. Or, perhaps a trade can be made with a neighbor—the project includes the sidewalk, but the neighbor agrees to maintain it. Following an Integrative Design approach, discussions such as these allow the project an opportunity to become a positive choice for the people, the community, and the planet.

While an Integrative Design process is often not easy, national organizations are moving forward to support its adoption. The National Charrette Institute[12] specializes in training people to manage the large-scale and long-term planning sessions that must be employed for community projects; the American Institute of Architects[13] promotes this approach and is educating its professionals in this communication skill; and the United States Green Building Council (USGBC)[14] is striving to create rating systems to measure successful application of the process and case studies to inspire users. These three organizations are leaders in understanding sustainability in design and construction and are excellent resources for community planning, green building design, and the tools and processes to achieve green building and sustainability goals.

Inclusive, integrative planning and design, and using a TBL approach, is applicable to any project, be it a neighborhood feasibility study, retirement housing, adaptations to local zoning, a community center project, changes to town infrastructure, or a new kiosk in the town center. For any project, the end result is a more universally accepted, understood, and supported project throughout its design, construction, and implementation. Initial construction and long-term maintenance and operation costs are understood; more people are on board and will work to ensure the success of the project; more people feel that their concerns are addressed and understood; success is more certain; the triple bottom line is clearly understood; and the project works to sustain the health, comfort, and safety of the people and the wider community.

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http://ga.water.usgs.gov/edu/earthwherewater.html.

[3] Water Research Foundation, Denver, Colorado:
http://www.waterrf.org/Pages/WaterRFHome.aspx.

[4] HPV (High Production Volume): According to the U. S. Environmental Protection Agency, HPV chemicals are "classified as those produced or imported in the United States in quantities of one million pounds or more per year." http://www.epa.gov/HPV/.

[5] Janelle Sorenson (July 28, 2009), "80,000 Chemicals in Everyday Products, but Who's Counting (No one)," *MomsRising.org:* http://www.momsrising.org/blog/80000-chemicals-in-everyday-products-but-whos-counting/.

[6] American Academy of Allergy Asthma and Immunology (AAAAI), *Asthma Statistics.* Milwaukee, WI: AAAAI http://www.aaaai.org/about-the-aaaai/newsroom/asthma-statistics.aspx.

[7] Science Daily (January 8, 2008), "Eczema Still On the Increase Across the Globe," *Science News*. http://www.sciencedaily.com/releases/2008/01/080107112729.htm.

[8, 10] State Environmental Leadership Program and The Institute for Agriculture & Trade Policy (nd), *Mercury and Developmental Disabilities in Minnesota's Children,* Briefing Paper. Minneapolis, MN: The Institute for Agriculture & Trade Policy. http://www.healthobservatory.org/library.cfm?refID=37024.

[9] Karen Stephenson (August 13, 2009), "Student Success Includes Natural Lighting," *Suite 101.com*. http://suite101.com/article/student-success-includes-natural-lighting-a138865.

[11] LEED (Leadership in Energy and Environmental Design), an internationally recognized green building rating and certification system established by the U. S. Green Building Council, which provides third-party verification that a building or community has been designed and built using strategies that improve performance in energy savings, water efficiency, CO_2 emissions reduction, improved indoor environmental quality, and stewardship of resources and sensitivity to their impacts: http://www.usgbc.org/DisplayPage.aspx?CategoryID=19.

[12] National Charrette Institute, Portland, Oregon: http://www.charretteinstitute.org/.

[13] American Institute of Architects, Washington, DC: http://www.aia.org/.

[14] United States Green Building Council (USGBC), Washington, DC: http://www.usgbc.org.

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LEED®

Description:

The Leadership in Energy and Environmental Design (LEED) Green Building rating System™ is a nationally accepted benchmark for the design, construction, and operation of high-performance, healthy, sustainable, energy-efficient buildings. Developed in 1999 by the U. S. Green Building Council, LEED is voluntary, point-based certification system that measures and certifies how well a building performs as a green building.

LEED promotes a whole-building approach to sustainability by recognizing performance in five key areas of human and environmental health:

- *Sustainable Site Development:*
  - LEED encourages selecting sites that are close to community resources, maximizing quality of life and reducing time and energy expended in travel.
  - LEED buildings avoid destructive construction practices and have landscaping and other elements that protect the building site.
- *Water Conservation:*
  - LEED buildings use innovative strategies to reduce a building's water consumption and to find creative ways to recycle/reuse water.
- *Energy Efficiency:*
  - LEED buildings use 20-60 per cent less energy than buildings built to current codes. Less energy means lower utility bills every month for the life of the building.
- *Materials and Resources Selection:*
  - LEED buildings use locally produced, recycled, reclaimed, and responsibly obtained materials as much as possible.
- *Indoor Environmental Quality:*
  - LEED buildings are designed to maximize replenished fresh air and minimize exposure to toxins and pollutants.

The level of performance achieved in the above categories is separated into four performance tiers: Certified, Silver, Gold, and Platinum, based on the number of points the project achieves in the rating system. A LEED Accredited Professional (LEED AP) can assist in determining the most practical level of LEED certification, as applicable to a particular project and budget parameters.

LEED certification in new construction and renovation is growing nationwide among all types of structures, including private homes, multiunit rental housing, schools,

health care facilities, commercial buildings, and corporate offices. Residents, building occupants, workers, and investors seek the health, productivity, and financial benefits of creating green, healthy living environments. For example, according to the U.S. Green Building Council, green schools cost less to operate, freeing up resources to improve students' education; their carefully planned acoustics and abundant daylight make it easier and more comfortable for students to learn; their clean indoor air cuts down sick days and gives children a head start for a healthy, prosperous future; and their innovative design provides a wealth of hands-on learning opportunities.

USGBC recently teamed with the Congress for New Urbanism and Smart Growth America to create LEED for Neighborhood Development (LEED-ND). LEED-ND emphasizes Smart Growth planning and zoning principles in a larger, co9mmunity context.

Benefits:

- For architects, developers, builders, and owners: LEED is a checklist used to set targets and track progress during the design and construction of a green building.

- For homebuyers: LEED is a scorecard—like a nutrition label—that gives a clear, concise picture of all the ways a green home performs at a higher level.

- For residents: LEED is a seal of quality, third-party verification providing peace of mind that they are living in a truly healthy, efficient home environment.

- For older people and families (especially relevant to those on fixed incomes): a LEED building is assurance of continued long-term reduced utility costs, and a healthy indoor living environment.

- For the wider community: a LEED building means reduced long- and short-term impacts on the local environment, reduced emissions, reduced burdens on the local infrastructure, reduced pollutants, and a reduced carbon footprint.

- Although LEED building characteristics/priorities will vary with geographic area and building type, the LEED process accommodates these variations, with the end result of a sustainable green building being just as viable in any location.

Impediments or barriers to development or implementation:

Impediments to implementation of LEED-certified buildings include lack of public awareness, and misconceptions about the additional up-front development and construction costs of LEED buildings vs. payback benefits:

- *Public Awareness:*
  - Although LEED has been around for some ten years, it is only in the past few years (due in part to widely fluctuating oil prices, economic conditions, and increasing awareness of climate change) that we have seen the LEED movement slowly gain traction. As more LEED buildings are developed, and

with continued information-dissemination such as this document, this impediment becomes minimized.

- *Added Costs of LEED Buildings:*
  - Although there are some added development and construction costs associated with LEED buildings (typically 3-10 per cent), because of the reduced operating costs and increased efficiency of a LEED building (typically 30-70 per cent), the payback, including reduced utility costs, increased resale value, increased marketability, etc., more than offsets the increased up-front costs. The desired level of LEED certification also has a direct impact on the added costs; i.e., a building certified at the lowest LEED level will cost less than a LEED platinum-level certification, although there will be a corresponding difference in the level of efficiency.

Resource—examples:

- Affordable Green Housing, City of Schenectady, Schenectady, New York; 14 affordable, 4-bedroom urban infill houses, LEED certified at Gold and Platinum levels (includes 1st New York State LEED Platinum house); contact: Ann Petersen, APetersen@schenectadyny.gov.

- U.S. Green Building Council's web site includes examples of successful LEED-certified green homes and buildings, including Morrisania Homes in The Bronx, New York State's first LEED-certified (Silver level) affordable housing project: http://greenhomeguide.com/search/phrase/morrisiana+homes%2C+in+the+bronx.

- The Solaire, 27-story, 293-unit rental housing development, 20 River Terrace, Battery Park City, New York, LEED-certified at the Gold level: http://www.thesolaire.com/documents/green_building.html. and http://www.cement.org/buildings/buildings_green_solaire.asp.

- Jeff Rogers' private home, 9 Sunset Road, North Truro, MA, Southern New England's and Massachusetts' first home certified at the Platinum level: http://www.blog.thesietch.org/2007/12/21/new-englands-first-leed-platinum-certified-home/ and http://www.negreen.com/.

- Living Homes' model home, a zero-energy, zero-water, zero-waste, zero-carbon, Zero-emissions residence with LEED certification at the Platinum level. LivingHomes makes LEED-certified, prefabricated homes available to consumers nationwide. According to the U. S. Green Building Council, this model home is expected to demonstrate that incorporating sustainable design into the construction process will help to lower operating costs, increase home value, reduce maintenance issues, and improve indoor environmental quality in the long-term. http://www.treehugger.com/sustainable-product-design/livinghomes-awarded-leed-for-homes-platinum.html.

- AMD Lone Star Campus, Austin Campus, Austin, Texas, 860,000 sq. ft. corporate development with the entire facility LEED-certified at the Gold level; facility consists of four office buildings, three parking garages and the Lone Star

Commons Building, which will include an employee cafeteria, fitness center, and conference facilities: http://www.austin-ind.com/commercial/experience/browse-projects/projects/amd-lone-star-campus.

- Fossil Ridge High School, Poudre School District, Fort Collins, Colorado, 290,000 sq. ft. building with capacity for 1,800 students, LEED-certified at the Silver level: http://www.fmlink.com/article.cgi?type=Sustainability&title=Case%20Study%3A%20Building%20a%20LEED-Certified%20School%20without%20Spending%20More%20%26%23151%3B%20Through%20Energy%20Savings&pub=USGBC&id=40633&mode=source .

- M. Landman Communications and Consulting (January, 2011), "LEED Platinum Certified Buildings," a list of all building projects worldwide that have the LEED Platinum certification (by U.S. state and by country), compiled from the U. S. Green Building Council's searchable Certified Projects database. http://www.mlandman.com/gbuildinginfo/leedplatinum.shtml.

- Green Project Exchange™, a web-based, user-driven site that showcases replicable, environmentally focused projects from communities across New York State. Posts to the Exchange are contributed by project leaders interested in sharing success stories, best practices, and tested solutions that work: http://syracusecoe.org/gpe/.

Resource—written and web:

- U. S. Green Building Council—New York Upstate Chapter: http://www.greenupstateny.org/.

- U. S. Green Building Council, 2101 L Street, NW, Suite 500, Washington, DC, 20037, 1-800-795-1747: http://www.usgbc.org/.

- Green Building Certification Institute, 2101 L Street NW, Suite 650 Washington DC 20037, 1-800-795-1746: http://www.gbci.org/homepage.aspx.

- *LEED Green Building Certification System*: *frequently asked questions*—web site of the U.S. Green Building Council—description of the LEED rating system: http://www.usgbc.org/ShowFile.aspx?DocumentID=3330.

- *LEED Version 3*, launched in April, 2009, by the U. S. Green Building Council. This web site provides information about the latest version of the LEED rating system; information on how to obtain the 2009 editions of LEED reference guides on "Green Building Design and Construction," "Green Interior Design and Construction," and "Green Building Operations and Maintenance"; and information on LEED rating systems for new construction, healthcare, schools, retail, commercial and retail interiors, core and shell, and existing buildings and schools: http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1970.

- *Playbook for Green Buildings and Neighborhoods*—web site of a consortium of more than 20 local governments, non-profit organizations, government agencies, and utilities, whose intent is to promote the goals set out in the U.S. Conference of Mayors' Climate Protection Agreement. The *Playbook* provides local governments with guidance, tools, and resources to advance green buildings, neighborhoods, and infrastructure: http://www.greenplaybook.org.

- *Build Green Schools*—web site of the U. S. Green Building Council—extensive information and examples of green and LEED-certified school buildings: http://www.centerforgreenschools.org/home.aspx.

- *ReGreen*—web site of the American Society of Interior Designers Foundation and U. S. Green Building Council—extensive information on best practice guidelines, educational resources, and case examples for sustainable residential renovation and improvement projects: http://www.regreenprogram.org.

- *Green Communities Tools,* Enterprise Green Communities, Columbia, MD: http://www.greencommunitiesonline.org/tools/resources/index.asp.

- U. S. Green Building Council (January, 2008). *LEED for Homes Rating System,* 114-page document describing all aspects of the LEED rating process and rating system for homes: http://www.usgbc.org/ShowFile.aspx?DocumentID=3638.
  LEED for Home Certification Program—Green Home Guide: http://greenhomeguide.com/program/leed-for-homes.
  Local Green—New York: http://greenhomeguide.com/city/new-york-ny.

- Beth Anderson (December 3, 2007). "LEED Certification Program Leads to Potential Profits: property investors seek LEED certification for improved efficiency, better returns," *NuWire Investor*. http://www.nuwireinvestor.com/articles/leed-program-leads-to-potential-profits-51367.aspx.

Resource—technical assistance contact names:

- *Volunteer basis:*
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  New York Upstate Chapter
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INTEGRATIVE DESIGN: INDOOR ENVIRONMENTAL QUALITY

Description:

When designing, constructing, and maintaining a building, it is important to take a holistic view of how people interact with the building and how the building itself affects the occupants. There are elements in a building that can be uplifting and there are elements that can be toxic. Steps can be taken to make sure that the building is a safe and healthy place for people of all ages.

As we design, build, and maintain housing for families, multiunit senior housing, care facilities, or housing for people of all ages with disabilities, the buildings themselves should not make the residents ill. Elements within a building can lead to what is called Sick Building Syndrome (SBS)—a condition where an occupant's comfort and health are negatively affected by the building systems, materials, or both. Symptoms can range from sensitivity to odors to dizziness, headaches, and nausea. According to the Environmental Protection Agency, SBS can be caused by inadequate ventilation, chemical contaminants from indoor or outdoor sources, or biological contaminants, to name a few. Identifying and eliminating the source of the pollutants can solve most of these issues.

On the other hand, there are elements in a building that can have a positive impact on its users, by improving morale, health, and productivity. For example, providing natural day lighting and views to the outdoors has a beneficial effect on building occupants, and can decrease electricity load. Using light color paint can help decrease the lighting load, but can also help people who have difficulty seeing in low light. There are many opportunities to create a synergy between green building and universal design—everything from reducing water use to allowing individuals to control their own thermostats—which can be seen as opportunities to preserve the environment as well as make someone's life more comfortable.

As we learn more about how people are affected by certain chemicals and other external factors, it is important to keep the following factors in mind when making decisions about building design:

IAQ (Indoor Air Quality) during construction: During construction, keep all new ductwork sealed and safely stored. To protect from mold growth, protect all stored or installed materials from absorbing moisture.

Flush out: After the completion of any project but before occupation, set all the ventilation systems to run at full capacity for several days. At the end of the

several days, replace all of the filters. This will help remove potential smells, dust, and air-borne toxins left from construction and new finishes.

Insulation: Using blown-in insulation can greatly reduce energy consumption, but it also helps with noise pollution, especially for those with hearing issues. Insulating between rooms is also important where individual spaces have their own temperature controls.

Individual controls: Allowing individuals to adjust the temperature of their own localized areas helps reduce the need to heat all spaces at once. It also helps with an occupant's sense of comfort and autonomy.

Adequate ventilation: Design the Heating Ventilating and Air Conditioning (HVAC) system to provide adequate fresh air ventilation to all regularly occupied spaces.

HVAC: Specify energy-efficient Heating Ventilating and Air Conditioning systems (HVAC), with ducts that are insulated and sound-attenuated. Insulated duct systems reduce the vent noise that can create problems for those with hearing loss.

Air intake: By making sure that air filters are regularly cleaned, and by locating air intake vents away from cars and other motorized vehicles, smokers, trash receptacles, and other noxious sources, fewer pollutants will enter the building.

Fresh air: Installing a mechanical system that increases air circulation and makes most windows operable allows stagnant air to leave and permits fresh air to enter.

Indoor pollutants: When specifying building and finishing materials, choose products that do not off-gas toxins. Specify materials that do not contain urea formaldehyde, Polyvinyl chloride (PVC), or Volatile Organic Compounds (VOC).

Walk-off mats: Much of the dust in a building comes in on the soles of our feet. By providing walk-off mats at all regularly used entrances, dust can be collected before it enters the building. Be sure to clean the walk-off mats on a weekly basis.

Cleaning products: Using nontoxic cleaning products and storing them away from residents helps with indoor air quality. Create a storage room that has a continuous vent directly to the outdoors.

Carbon dioxide sensors: Install carbon dioxide sensors for the health and safety of the occupants.

Smoke free building: Institute a policy forbidding smoking inside the building to prevent issues caused by second-hand smoke. Locate a designated smoking area outdoors away from operable windows, doors, or fresh-air intakes.

Lighting: Replace old light bulbs with more efficient fluorescent and compact fluorescent bulbs, which are more energy-efficient and have a better color range.

Design the lighting to accommodate low-vision difficulties by sizing the light fixture correctly and using up-lighting techniques.

Occupant Sensors: Occupant sensors on the market today are more sophisticated than their predecessors. They are more energy-efficient because the lights turn on only when someone enters a space, and they turn off if no motion or sound is made for a certain period of time.

Fenestration: The use of natural day lighting can help those with light-vision difficulties and can help with the overall health and wellbeing of the residents. It is imperative that glare be minimized.

Window type: Use casement windows instead of double-hung windows. Casement windows allow for greater ventilation and egress. In addition, casement windows are opened with a single handle, making them easier to open.

Water efficiency: Installing water faucets with sensors helps reduce the amount of water consumption by portioning the amount of water that is provided. Water faucets with sensors are also a good universal design feature because everyone can operate them.

Front load washers: Front-load washers reduce the amount water and energy it takes to wash a load of laundry. In addition, front-load washers are easier to use by individuals using a wheelchair.

Monitoring: Staff in facilities and multiunit housing, as well as residents in single family homes, should continuously monitor the indoor environment to make sure that systems are functioning as originally intended.

Benefits:

- Residents' well-being and quality of life are improved:
  - Residents' physical and mental health are not adversely affected by the elements of their living environment.
  - Incidences of specific chronic illnesses, such as asthma, chronic fatigue, migraine headaches, allergies, and others are reduced.
  - Productivity by children and adults of all ages is improved.

- Environmental elements that support the ability of residents to see and hear well allow both older people and younger-aged people with vision and hearing loss to retain a sense of competency and autonomy, two traits that are associated with emotional, mental, and physical health status.

- Environmental elements, such as individual-room-based temperature adjustment, support an individual's sense of control over his living environment. Perceived personal control over one's daily life is a major factor associated with mental and emotional health status.

- In a time of limited and costly resources, water and energy are conserved and used more efficiently**.**

- When indoor environmental quality standards are integrated into a building's design from the outset, many benefits are realized with little or no increases in construction and maintenance costs.

Impediments or barriers to development or implementation:

- Many builders, homeowners, and facility operators are unaware of:
  - The impact of environmental factors on the health, safety, and mental and physical well-being of residents.
  - The impact that the quality of the living environment has on costs to the health care system, the educational system, and the work place.

- Many builders, homeowners, and facility operators are not knowledgeable about specific ways or tactics to improve the quality of the living environment, or of the availability of specific appliances, equipment, building materials, furnishings, products, etc., that can replace traditionally used methods and items.

- Retrofitting a building or home to improve environmental quality, such as adding new windows or upgrading a mechanical system, can be costly. During times of economic hardship, even though the pay-off in health and safety is great, homeowners or facility operators may find themselves unable to argue for incurring the added tangible cost.

Resource—examples:

- The Patrick H. Dollard Discovery Health Center in Harris (Sullivan County), New York, is a diagnostic and treatment facility providing primary care, specialty medical care, and dental care to 250 residents with profound neurological and developmental impairments. It is the first medical center in New York State to implement green building standards that meet the State Department of Health's requirements. It is estimated that the building will save 30 per cent in energy use and expense over time, and the building is considerably more healthful and comfortable for the children and adults who use its critical and everyday health care services. http://leedcasestudies.usgbc.org/overview.cfm?ProjectID=233.

- Solidarity House Housing Cooperative, Tivoli (Dutchess County), New York, is an affordable, 11-resident cooperative; is extremely environmentally responsible; uses safe, nontoxic, and sustainable materials; makes very efficient use of water and energy; and is being certified as the “Greenest Building in the Eastern United States.” http://www.commonfire.org/community/coopwelcome.html.

- Mirabella Portland, Portland, Oregon, is a 30-story high-rise Continuing Care Retirement Community that will open in the South Waterfront area of Portland in 2010. The South Waterfront area is "one of the 'greenest' and most energy-efficient neighborhoods in the nation . . . striving to achieve a 'Leadership for Energy and Environmental Design (LEED) for Neighborhood Development'

certification, which is a rating system that integrates smart growth, urbanism, and sustainability, and that encourages healthy living." Mirabella Portland is designed to achieve LEED Platinum certification; residents will benefit from water savings, energy conservation, high indoor air quality, and access to alternative modes of transportation.
http://www.mirabellaretirement.org/portland/
http://www.mirabellaretirement.org/portland/community.htm.

Resource—written and web:

- The U.S. Environmental Protection Agency (EPA): http://www.epa.gov/iaq/.
- Occupational Safety and Health Administration (OSHA): http://www.osha.gov.
- American Lung Association: http://www.lung.org/#.
- Centers for Disease Control and Prevention: http://www.cdc.gov.
- Center of Design for an aging community: http://www.centerofdesign.org.

Resource (free or fee-based)—technical assistance contact names:

- Phinney Design Group
  142 Grand Avenue
  Saratoga Springs, New York 12866
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  www.phinneydesign.com

- Donald F. Minnery, AIA, NCARB
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INTEGRATIVE DESIGN: GREEN BUILDING

Description:
Green building, also known as sustainable design, is the practice of safely fulfilling the needs of today's generation without jeopardizing the needs of future generations. Across the country, today's youths, our families, and the new crop of senior citizens are much more environmentally conscious compared to previous generations; and all are increasingly aware of the interactive impact of environmental elements. Declining natural resources, health factors, and volatile economic conditions have converged to sustain an interest in green design. From regional transportation, to cleaning products, to housing, green design is a growing trend that has touched all aspects of our daily lives.

Housing alternatives for older people, for families, and for people with disabilities; health care facilities; commercial structures; and public buildings can benefit greatly from green building techniques. The demand for buildings that are environmentally sensitive and healthy for their inhabitants will naturally increase as the emphasis on green, sustainable design grows. Several organizations have created rating systems to implement and evaluate the green building process. The most prestigious is the United States Green Building Council's *Leadership in Energy and Environmental Design* (LEED) Certification. Projects that are LEED certified must achieve a set number of points based on six topics: sustainable sites, water efficiency, materials and resources, indoor environmental quality, and innovations and design process.

The New York State Department of State continuously adjusts the State's building code to incorporate new findings on subjects such as energy use, water efficiency, indoor air quality, fire prevention, factory-manufactured buildings, and the removal of toxic materials. Organizations, such as the New York State Energy Research and Development Authority (NYSERDA), can provide technical and financial assistance for green building design and construction.

From heating bills to food costs, the fluctuation of energy prices affects all aspects of our lives, and a major goal is to reduce our dependence on fossil fuels without significantly decreasing our standard of living. By increasing the energy efficiency of a building and reducing demand, we can create comfortable places for people of all ages. Some steps for creating a more environmentally sensible and energy-efficient building include:

Site planning:

- *Reuse of building*: Reusing an existing building, rather than constructing a new one, saves natural resources and energy.

- *Building location:* Not locating the building in a wetland, an endangered habitat, or on prime farmland can help preserve natural features for future generations.

- *Solar orientation:* Orienting the building in the East-West direction allows the building design to take advantage of full southern sun and provides the opportunity for passive solar heating and cooling.

- *Vegetation:* Specifying native species and drought-resistant plants allows the site to be a habitat for animals, while reducing the amount of water and pesticides typically needed.

- *Trees:* Planting native deciduous trees around the property allows sun to penetrate into the building in the winter and provide shade in the summer, offsetting energy costs. Coniferous trees on the west side of the building block winter winds.

- *Water:* Installing silt fences and restrictions on the use of pesticides prevent the contamination of the local drinking water. Decisions made during construction and the grounds-maintenance policy should take the local water quality into consideration.

Materials:

- *Regional materials:* Choosing building and finish materials that are harvested and/or manufactured locally saves on energy for transportation and helps the local economy. Local materials that are aesthetically pleasing can create a "sense of place."

- *Sustainable harvest:* Forests that are certified by the Forest Stewardship Council (FSC) are sustainably managed to conserve animal habitat, reduce stormwater contamination, and preserve logging traditions.

- *Rapidly renewable products:* Specifying building materials that are rapidly renewable, such as bamboo and cork, decreases the need to consume old-growth forests.

- *Recycled Content:* Specifying building materials with recycled content completes the cycle and extends the life of a product; if recyclable materials are not reused, most will be sent to the landfill.

Energy:

- *Overhangs:* By using sunshades or overhangs, the sun can be used to heat the building in the wintertime and shade the building in the summer time.

- *Fenestration (the design and placement of windows in a building):* Placing high-performance windows in the right locations can greatly reduce energy consumption and help individuals who have vision difficulties in areas with low-light.

- *Insulation:* Using high-performance, blown-in foam insulation reduces energy consumption.

- *HVAC (heating, ventilating, and air conditioning):* Specify an energy-efficient HVAC system. Make sure the ducts are insulated and that the filters are changed regularly. Consider a radiant floor system that, if used properly, is more efficient and can aid with indoor air quality. Energy star ceiling fans effectively reduce air-conditioning use and increase air circulation.

- *Lighting:* Replace old light bulbs with more-efficient fluorescent and compact fluorescent bulbs. Fluorescent bulbs also have a better color range for individuals with poor vision. Design the lighting to accommodate low-vision difficulties by sizing the light fixture correctly and using up-lighting techniques to avoid glare.

- *Energy Star:* Energy cost can be greatly reduced if all appliances are Energy Star© rated.

- *Individual controls:* Allowing individuals to adjust the temperature in their own environments helps reduce the need to heat all spaces at once, and helps with the occupants' sense of comfort.

- *Renewable energy:* On-site renewable energy sources, such as photovoltaic (solar) panels and small wind turbines, can provide continuous energy. The use of ground source heat pumps, which adjust indoor ambient temperature by using the constant ground temperature, are also energy-efficient technologies.

Waste:

- *Construction and demolition waste:* By reducing, reusing, and recycling construction and demolition waste, fewer natural resources are extracted from the earth and fewer materials go to the landfill.

- *Recycling location:* Locating recycling bins in a convenient location within the building increases the practice of recycling by residents.

Benefits:

- Recycling and re-using materials and products reduce waste and reduce the use of land-fills.

- Over the long run, sustainable building practices are economically beneficial, saving energy costs, utility costs, and rehabilitation costs.

- Green, sustainable practices—
  - Conserve the use of limited, costly, non-renewable natural resources, such as oil and gas.
  - Conserve the use of the world's increasingly limited amount of potable water.
  - Maximize the use of renewable natural resources, such as wind, sun, and non-potable water.
  - Preserve natural (increasingly endangered) plant and wildlife.
  - Reduce the use of pesticides and other contaminants and pollutants.

  - Improve the health and well-being of residents in homes and workers and staff in the workplace, which, in turn, has a positive impact on costs associated with the health care system.

- State and federal government agencies provide technical assistance, grants, and tax credits to offset the initial cost of employing green building products, materials, and techniques.

Impediments or barriers to development or implementation:

- Many builders, developers, and homeowners are unfamiliar with available green building products, materials, and technologies, which can lead to improper installation and use, user frustration, or a resulting contrary effect. Taking the time to understand the issues, asking questions, and having patience will rectify most issues. In the end, *asking* if a particular product is harmful to a resident's health or has any other consequences is the quickest way to understand its environmental impact.

- For some materials or products, there may be an increase in upfront construction cost to incorporate green techniques into a project. While these will be offset in the long run (with energy savings and better health and satisfaction for the building occupants), short-term financial considerations often win over a longer-term perspective.

Resource—examples:

- ***The Patrick H. Dollard Health Center***, Harris (Sullivan County), New York, is a diagnostic and treatment facility providing primary care, specialty medical care, and dental care to 250 residents with profound neurological and developmental impairments. It is the first medical center in New York State to implement green building standards that meet the State Department of Health's requirements. It is estimated that the building will save 30 per cent in energy use and expense over time, and the building is considerably more healthful and comfortable for the children and adults who use its critical and everyday health care services. http://leedcasestudies.usgbc.org/overview.cfm?ProjectID=233. Characteristics of this sustainable development include:
  - U.S. Green Building Council LEED-NC, v.2/v.2.1--Level: Certified.
  - The green measures safeguard already fragile health of residents and build a foundation for high-performance healing environments.
  - The building is 48% more efficient than a building minimally compliant with ASHRAE 90.1 standards, due to a ground-source heat-pump system; a tight, high-performance envelope; extensive day-lighting; and efficient products and equipment.
  - A staggered, narrow building footprint and bold fenestration pattern allow public spaces the benefit of day-lighting during normal operating hours and reduces artificial lighting use.
  - Structural shading devices and a reflective metal roof are expected to reduce heat gain and air conditioning demands during the summer.
  - In selecting this site, the Center avoided prime agricultural land, opting instead to infill on a previously abandoned industrial agricultural site. A

bucolic pedestrian path system, open pasture, native plants, and farming fields occupy the site.
  - Environmental health goals that apply directly to healthcare operations were considered at a structural level. Lifecycle assessments for finish materials and furnishings considered downstream health effects in addition to cost and durability.

- ***Mission Creek Senior Community***, located in the Mission Bay area of San Francisco, CA. Collaboration between Mercy Housing California, San Francisco Housing Authority, San Francisco Redevelopment Agency, San Francisco Public Library, and others. A mixed-use development that includes apartments and services for very-low-income seniors, seniors transitioned from long-term institutionalization in Laguna Honda Hospital, and homeless seniors; Adult Day Health Center; 7,500 sq. ft. Mission Bay public library branch; coffee house; and community room. An EPA-award-winning development that includes many green, sustainable features, including:
  - Brownfield remediation project
  - Solar panels
  - Many energy-efficient features, including energy-efficient lighting and large windows to increase day-lighting
  - Low-flow fixtures
  - Reclaimed water use
  - Landscaping designed for low-water use
  - Long-lasting, low-maintenance interior finishes
  - Rapidly renewable and recycled-product content finishes
  - 25 feet away from a San Francisco Municipal street car stop
  - Two blocks from a region train line station (CalTrain)
  - Two blocks from a Bus stop

  http://www.housingfinance.com/ahf/articles/2007/aug/MISSION-CREEK0807.htm.
  http://www.epa.gov/piedpage/awards/sg_awards_publication_2008.htm#equitable For more information: Rick Sprague, Regional Director, Resource Development, Mercy Housing California, 916-414-4429, rsprague@mercyhousing.org.

Resource—written and web:

- Sandra F. Mendler and William Odell (2000). *The HOK Guidebook to Sustainable Design*. New York, NY: John Wiley & Sons.

- Bradford Perkins, with J. David Hoglund, Douglas King, and Eric Cohen (2004). *Building Type Basics for Senior Living*, Hoboken NJ: John Wiley & Sons.

- U.S. Green Building Council (USGBC) (October, 2007). *LEED-NC Reference Guide Version 2.2,* 3rd ed. Washington, DC: USGBC.

- New York State Energy Research and Development Authority: *http://www.nyserda.ny.gov/*.

- United States Green Building Council: www.usgbc.org.
- Green Home NYC: www.greenhomenyc.org.
- Forest Stewardship Council: www.fscus.org.

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