# Green Buildings and Climate Change

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## Introduction:

Green building strategies offer significant potential for reducing energy consumption and greenhouse gas emissions. This paper discusses the impacts of green building strategies on reducing electricity use, offsetting greenhouse gas emissions, and alleviating global warming. Using the California-based GreenPoint Rating System for new single family and multifamily homes as a case study, the paper weighs the relative contribution of different green building design criteria to preventing climate change and provides a description of their potential emissions reduction impacts. This rating system is considered as a possible tool for implementing the "2030 Challenge," and is compared to other sustainability policies, such as the EPA's ENERGY STAR program and energy efficiency programs administered by utilities.

## Making the Connection Between Climate Change and Green Building

Climate change is among the most important and most publicly visible environmental problems we face as a society. It has arguably captured the public imagination and the attention of policy-makers in ways that no other contemporary environmental problem has, and local governments are finding that the issue resonates with their constituents. Establishing the direct contribution of green building practices to reducing energy consumption and mitigating climate change is critical to the continued growth of this practice.

Most of us are familiar with the "greenhouse effect," wherein $CO_2$ (carbon dioxide) in the troposphere (or upper atmosphere) traps infrared solar radiation, preventing it from escaping back into space and warming the surface of the earth. Until recently, however, it was not widely known whether the $CO_2$ released into the atmosphere as a result of human activity contributed significantly to this effect. In 1988, the United Nations Environment Programme and the World Meteorological Organization formed the Intergovernmental Panel on Climate Change (IPCC) to investigate this question. The IPCC found that the continued accumulation of greenhouse gases in the atmosphere is, most certainly, leading to measurable climate change and, in fact, recent increases in carbon dioxide concentrations in the atmosphere were attributed almost exclusively to human activity.[1]

The building industry is a major contributor to both international and US $CO_2$ emissions. Globally, the use of energy in human activities related to buildings accounts for about 25-30% of the energy-related emissions, and constitutes 19-22% of total anthropogenic $CO_2$ emissions.[2] In the United States, buildings currently account for 36% of total energy use, 65% of all electricity consumption, and 30% of all greenhouse gas emissions.[3] Moreover, buildings consume 30% of U.S. raw materials, account for 30% of

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[1] JT Houghton, GJ Jenkins and JJ Ephraums (Eds), *IPCC First Assessment Report: Scientific Assessment of Climate change*. Cambridge University Press, UK. 1990.
[2] Wiel et al. 27.
[3] "An Introduction to the U.S. Green Building Council and the LEED Green Building Rating System."

the nation's solid waste (136 million tons annually) and consume 12% of available potable water.[4]

Notably, although the transportation sector has been the single largest source of $CO_2$ emissions since 1999, emissions are currently growing fastest in the commercial and residential sectors. Commercial $CO_2$ emissions growth since 1980 has averaged 2.0% annually, and residential emissions growth has averaged 1.8% annually. From 2004 to 2005, residential growth in $CO_2$ emissions was 3.2%, the highest of all sectors. During that same time period, the commercial sector maintained its average growth rate, growth in the transportation sector flat-lined, while industrial $CO_2$ emissions actually *decreased*.[5]

Energy efficiency improvements in all sectors of the economy constitute one major strategy for combating rising carbon emissions. Through increasing the energy-efficiency of automobiles, industrial processes, and building systems, the U.S. and other nations have successfully lowered the carbon intensity, or tons of carbon emitted per dollar of trade conducted, of much economic activity – even as *overall* $CO_2$ emissions have continued to rise due to continued economic growth.

The green building industry has a foothold in the two sectors with the most rapidly increasing $CO_2$ emissions – the commercial and residential sectors. A major opportunity exists to market and promote green building by demonstrating the capacity of this building strategy to further increase U.S. energy efficiency and so mitigate the effects of future carbon emissions growth.

To achieve this, however, advocates of green building must overcome some unique hurdles. In the transportation industry, for instance, auto makers can easily incorporate carbon emission avoidance into their marketing schemes, because by law all light-duty vehicles must receive an emissions rating. In fact, hybrid vehicles have sold well partially because of their rating as "Super Ultra Low Emission Vehicles" (SULEV), meaning they contribute less than 10% of the average vehicle $CO_2$ emissions.[6] No similar, universal standard that directly measures the $CO_2$ emissions of various building strategies or building types exists.

This absence of a similar standard is a consequence, in part, of the green building movement's relative youth. Such standards for green building, however, may also be more difficult to formulate due to the inherent complexity of determining a particular building's impact on global warming. When rating an individual vehicle, for instance, one need only consider tailpipe emissions and measure the resulting carbon dioxide emissions that result from that vehicle's operation under a fairly limited range of operating conditions. When analyzing a building, however, global warming impacts cannot simply be measured using the utility bill. Numerous other factors with potential climate change impacts, such as the building site selection, materials choices, construction debris recycling, and various building systems (including, but not limited to, HVAC, plumbing and electrical systems) may all prove important in formulating building-centered climate change mitigation strategies. In light of these complications,

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[4] Ibid.

[5] Energy Information Administration. "U.S. Carbon Dioxide Emissions from Energy Sources 2005 Flash Estimate." June 2006. Online. http://www.eia.doe.gov/oiaf/1605/flash/flash.html

[6] 'Summary of Light-Duty Emissions Standards." EPA Green Vehicle Guide, 2006. Online. http://www.epa.gov/greenvehicles/detailedchart.pdf

multi-faceted green building rating systems may be helpful as tools to quantify individual buildings' global warming impacts.

## The GreenPoint Rating System

This paper presents the GreenPoint Rating System (GreenPoints) for single-family home construction as a case study demonstrating the potential for using a green building rating system to quantify greenhouse gas emissions reductions. GreenPoints is a green building program developed by the non-profit membership organization Build It Green (BIG), located in Berkeley, California, with assistance from Green Building In Alameda County, a municipal agency in the California Bay Area. This rating system, launched in 2006, has grown rapidly and is becoming a standard for green residential home construction and major renovation projects throughout the state of California.

The GreenPoints system is comprised of five related categories: energy efficiency, resource conservation, indoor air quality, water conservation, and community, all of which are important to the practice of green building. In order to meet the GreenPoints criteria, a home must obtain at least 50 points and meet minimum point thresholds in each of the five point categories.[7] GreenPoint Rated homes must be evaluated by independent, certified raters, ensuring the integrity and value of the system. Once a home is verified to meet the criteria for a GreenPoint home, BIG issues a certificate to the builder which can be used in marketing of the new homes. The GreenPoint system is meant to complement, not compete with, other green building rating systems such as ENERGY STAR for Homes® (which focuses on the energy efficiency of new homes) and the U.S. Green Building Council's LEED for Homes pilot program.[8] For instance, whereas GreenPoints targets multifamily developers and production home builders, LEED for Homes will likely have traction in the custom home market as well, where budgets and site-specific conditions allow for greater flexibility in design.

## Measuring Direct and Indirect Climate Change Impacts of Green Building

GreenPoints is a rigorous standard, since it encompasses not only conventional environmental concerns like energy efficiency but also considers measures like resource efficiency and water conservation, indoor air quality, and even community-enhancing building strategies. The carbon emissions effects of these different aspects of green building can be organized by impact and measurability (Table 1). The relationship between energy-efficiency and climate change is direct and easy to measure. However, indirect measures are much more difficult to quantify. For example, water efficiency strategies save water which has a link to emissions when one looks at the energy used to convey and treat water throughout California. Indoor air quality practices, like using environmentally-friendly paints and adhesives, or cycling outdoor air for indoor ventilation, help reduce pollution but do not directly affect climate change. Finally, there

[7] "GreenPoint Rated – The Program, Introducing GreenPoint Rated." Build It Green, Berkeley, CA. Available online: www.greenpointrated.org
[8] Ibid.

may be some aspects of green building, like educational displays, that have indirect effects on climate change and are difficult to measure.

"Direct and measurable" carbon emissions reduction strategies encompass energy efficiency measures that relate directly to the designed operation of a building, as well as the use of renewable sources of energy. In terms of energy efficiency, GreenPoints awards 30 points to projects that are designed to be at least 15% more energy efficient than the California Title 24 Building Efficiency Code.[9] The rating system does not specify how projects must achieve this level of energy efficiency, as long as the strategies undertaken are above and beyond code. Unlike some rating systems that have a broader or national scope, GreenPoints does not allow credit for measures that are already part of the energy or building code in California.

**Table 1:** Impact and Measurability of Green Building $CO_2$ Emissions Reduction Strategies

| | **Direct** | **Indirect** |
|---|---|---|
| **Measurable** | ·Energy-efficiency above code requirements<br>- Energy efficient fans and pumps<br>- Energy-efficient windows<br>- Advanced insulation<br>- Lighting control strategies (daylighting and occupancy sensors)<br><br>·Renewable energy<br>- PV installation<br>- Solar hot water<br>- Green power purchase | ·Transportation effects<br>- Distance from neighborhood services<br>- Proximity to public transit<br>- Bicycle storage<br>- Parking capacity<br><br>·Waste diversion & recycling<br>·Use of sustainably harvested wood<br>·Shade tree planting<br>·Green roofs<br>·High-efficiency appliances<br>·CFC lighting<br>·Low-flow water fixtures |
| **Non-measurable** | ·Recycled materials; low embodied energy<br>·Non-CFC or HCFC refrigerant | ·Educational elements |
| **Non-applicable to $CO_2$ Reduction**: ·Indoor Air Quality/Health:<br>- low-emitting insulation<br>- low/no VOC paints, finishes, adhesives<br>- reduce formaldehyde in interior finish<br>·Site, Landscaping:<br>- Brownfield redevelopment<br>- Protect native topsoil, apply compost and mulch | | |

To earn energy efficiency points, most green builders begin with passive design strategies like shading techniques, high R-value windows, and thermally-massive walls

[9] Build it Green, *New Home Construction Green Building Guidelines,* 2005. 18-21.

that insulate well and radiate absorbed heat.[10] Designers can then address remaining building energy needs with design strategies like energy-efficient furnaces, air conditioners and appropriately-sized fans and pumps to operate building HVAC and water systems. GreenPoints awards points to buildings that use these passive and active strategies. Greenpoints also rewards clean on-site renewable energy generation. Photovoltaics are awarded up to 18 points in GreenPoints, and solar domestic hot water systems earn 10 points; since these two technologies are not covered under Title 24, these points are in addition to the 30 points awarded for energy efficiency beyond code.

Another direct and measurable climate mitigation strategy often pursued by green builders or their customers is the purchase of "green power," or which charges customers the utility's marginal cost difference between generating "standard" and renewable energy. Importantly, green power purchases do not necessarily mean that the particular building in question will be supplied with renewable energy. Rather, green power purchases guarantee that renewable energy is being fed into the grid and consumed by someone *somewhere*. Builders using this strategy estimate the amount of grid energy their building will require, and purchase that amount of green power from their utility.[11] Green power is awarded under LEED, but not Greenpoints, as this rating system focuses on site-specific strategies.

These direct and measurable energy-saving green building strategies are often the only building strategies referred to when the climate change impacts of buildings are discussed. There are, however, measurable aspects of green building that mitigate climate change indirectly. "Indirect" here refers to both those strategies that require several computational steps to calculate their carbon emissions impacts, and/or those strategies that do not have a direct effect on building operation. For instance, the Multifamily Building Guidelines and GreenPoints Rating System awards points for various transportation-related strategies such as locating a building in close proximity to public transit (see Table 1). Reducing the need to drive directly reduces carbon emissions, and this effect can be (approximately) measured through reduced vehicle miles traveled (VMT) from occupants in similar buildings without such amenities.

Another indirect but measurable link to green building and climate change has been identified by the Environmental Protection Agency and relates to the amount of materials recycled from the construction and demolition process. The EPA and its Recycled Content (ReCon) and Waste Reduction Model (WARM) models can be used to quantify the up- and down-stream benefits of not sending materials to a landfill. Upstream benefits include reductions in the energy needed to transport, harvest and refine feedstock for wood, concrete, and other building materials. Downstream benefits include reduced fuel use in hauling waste materials, and the reduction in methane production from materials decomposing in a landfill.[12] Using waste and recycling data from specific building projects, it is possible to give an accurate estimate of the emissions reduction due to construction and demolition waste management.

Some green building strategies have a direct effect on carbon emissions, but cannot easily be quantified. For instance, the GreenPoints program awards points for using materials with a high recycled content. This strategy lowers the embodied energy

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[10] Greenpoints does not currently give credit for building orientation.
[11] Green power is awarded points in LEED, but not in GreenPoints.
[12] Please see: http://yosemite.epa.gov/oar/globalwarming.nsf/WARM?OpenForm

of materials, meaning the total energy consumed in the extraction, manufacture, transport, construction and assembly of building materials. Another green building strategy that is difficult to measure is the use of HFC (hydrofluorocarbon) as opposed to HCFC (hydrochlorofluorocarbon) or CFC (chlorofluorocarbon) refrigerants in air conditioners, heat pumps, and other appliances. CFC and HCFC are greenhouse gases, and contribute to global warming to the extent that they are released into the atmosphere during a building's lifecycle. HFCs have a much shorter life cycle, and consequently do not remain in the atmosphere and contribute to global warming. However, the degree to which HFCs reduce global warming impacts is not easily quantifiable, since HCFC and CFC refrigerants are only a greenhouse gas problem once they have leaked out during building operation, and such leaks are very difficult if not impossible to measure.

Finally, many green buildings have educational components that may indirectly contribute to carbon emission reduction. For instance, the Adam Joseph Lewis Center for Environmental Studies in Oberlin, Ohio, has an interactive web display in the building that explains to visitors how the building is using energy and other systems. This building is not only a local resource for students and visitors, but has also been referenced in countless national and international conferences for its various innovative design features and building systems.[13] While these kinds of educational components and demonstration sites may lead to improvements in future buildings, the climate change impacts are indirect and clearly difficult to measure. Under both the GreenPoints and LEED systems, buildings such as this would be awarded for "innovation."

If we concentrate only on direct and measurable global warming impacts of buildings, we will overlook potentially significant climate change mitigation strategies. GreenPoints already awards designers for climate change mitigation strategies beyond energy efficiency. In fact, approximately the same number of points are available for indirect and non-measurable as for direct and measurable strategies. Clearly, GreenPoints could become the type of metric used to measure *whole building* climate change impact, as opposed to simply the impact of energy-efficient design approaches.

**Baselines in Green Building**

Agreeing on which green building strategies to use in measuring a given facility's carbon emissions, and agreeing on how to measure the direct and indirect impacts of these green building techniques, are not the only difficulties we face in establishing the relationship between green building and climate change. Another challenge associated with measuring a building's emissions lies in choosing an appropriate baseline for comparison. Fuel mix, or the energy sources used by a utility to generate electricity, and climate differ across geographical areas, making it difficult to estimate both a building's energy use and its resulting emissions, even if the building type is held constant. (Paradoxically, the cleaner a given utility's fuel mix, the lower the avoided emissions from green building will be since the electrical generation offset through efficiency and other measures will be cleaner in the first place.) When comparing the climate change impacts of different building types, of course, the problem is even more pronounced since design differences that affect energy usage, and consequently emissions, will also vary.

[13] "Adam Joseph Lewis Center for Environmental Studies." www.oberlin.edu/ajlc

To assess the climate change impacts of the GreenPoints system, Green Building In Alameda County has teamed with the International Council on Local Environmental Initiatives (ICLEI) to compare the carbon dioxide emissions generated by an "average" GreenPoint Rated home with the emissions created by an "average" non-green home in Alameda County.[14] While the study will likely not be complete until the end of this year, it may prove difficult, even for an organization with ICLEI's resources and talent, to find or to generate a solid benchmark for emissions reductions based on green building practices. While some data is relatively easy to obtain, like average energy use in new homes, finding comperable data for waste diversion, water energy intensities, and other aforementioned intangible emissions are difficult.

If one focuses only on household energy use as an indicator of global warming impact, it is possible to create a reasonable benchmark for comparison between California homes. KEMA, Inc. conducted a study for the California Energy Commission to find the average energy use for single and multifamily California homes. From 2002-2003, 21,920 residential customers were surveyed on their energy equipment and energy-use behaviors. Results of this project were organized by type of home, climate zone, and utility service area. For Alameda County, which straddles at least three climate zones, the average single-family home uses between 7,415 kWh and 8,139 kWh of electricity and between 226 and 317 therms of gas annually.[15]

Moreover, the fuel mix for Pacific Gas and Electric (PG&E), the utility that serves Alameda County, is known, as well as the pounds of $CO_2$ generated per kWh for coal, petroleum, gas, and other non-renewable fuels in PG&E's fuel mix. By multiplying the average number of number of kilowatt hours consumed by a typical Alameda County home by the percentage of various fuels in PG&E's fuel mix, it is therefore possible to create a set of weighted averages and to estimate the average pounds of $CO_2$ generated annually by a typical Northern California (or Alameda County) home in PG&E's service territory. A similar methodology, which extrapolates from readily available data sources, could be used by other utilities or government agencies interested in creating benchmarks from which to compare avoided $CO_2$ emissions attributable to green building programs.

**The "2030 Challenge"**

While ICLEI's partnership with Green Building in Alameda County appears to be the first of its kind, this is not the first or the only organization to posit a link between climate change and green building. In January of 2006, acclaimed Los Angeles-based architect Edward Mazria issued an open international challenge to builders and building policy makers to commit to carbon neutrality, meaning that buildings should consume no fossil fuel and emit no greenhouse gasses in their operation, by 2030.

The "2030 Challenge" specifies that the architecture and building community adopt three specific targets: (1) all new buildings and developments be designed to use half the fossil fuel energy they would typically consume (half the national average for that building type); (2) at a minimum, an equal number of existing building be renovated annually to meet that same target (through design, purchase of renewable energy and/or

[14] This is ongoing research; results of this study will be available later this year.

[15] "California Statewide Residential Appliance Saturation Study: Final Report." Prepared for the California Energy Commission by KEMA-XENERGY, Itron, and RoperASW. June 2004.

the application of renewable technologies); and (3) the fossil fuel reduction standard for all new buildings be increased to 60% in 2010, 70% in 2015, 80% in 2020, and 90% in 2025. By 2030, the Challenge mandates that buildings should be carbon-neutral.[16]

Mazria argues that these goals are well within reach, and his program is gaining momentum quickly. The American Institute of Architects (AIA) adopted the Challenge immediately, and the Conference of Mayors also voted to follow the "2030" guidelines at their June, 2006 meeting. By July, the Rocky Mountain Institute had also publicly embraced the initiative.[17] At the November 2006 Greenbuild Conference, The U.S. Green Building Council announced a mandate, inspired by the 2030 Challenge, to reduce $CO_2$ emissions by at least 50% in all new commercial projects, beginning in 2007.[18]

Mazria is hopeful that, with these organizations standing behind his challenge, the carbon reduction goals he has stipulated will soon be incorporated into standard building codes.[19] For Mazria's challenge to become the basis of nationwide building codes, the *real* challenge will be agreeing on a metric or metrics to determine a building's global warming impact. The US Conference of Mayors writes, "[We] urge mayors … to join in this effort by developing plans to fully implement the above mentioned targets … and by establishing policies to insure compliance and measure results."[20] Specifically, this Conference will work with ICLEI and other, similar organizations to meet the 2030 targets.[21]

In some respects, the "2030 Challenge" is *more* environmentally stringent, and has a greater potential to reduce $CO_2$ emissions, than GreenPoints and similar green building rating systems, but the challenge is substantially tougher as well. Under the GreenPoints system, a building need only beat California's Title 24 energy code (currently about 10% more stringent than most other state building energy codes) by 15% in order to earn 30 points, whereas Mazria's challenge encourages buildings to reduce energy usage by a *minimum* of 50% from the outset. Moreover, GreenPoints and other such systems do not contain explicit, future energy efficiency targets whose stringency is "ratcheted up" in a pre-determined manner.

In other ways, however, the "2030 Challenge" is less stringent than the GreenPoints system, and may offset a smaller amount of carbon emissions. Despite its ambition, the Challenge is fairly energy-centric: all three of its principal mandates center on energy use. While the Challenge specifically permits the use of renewable generation as a means of reaching the goals it lays out, it lacks the resource efficiency, siting concerns, and embodied energy benefits of GreenPoints. The USGBC is working to develop a metric that not only measures carbon offsets in the energy category, but also in the water, transportation, and materials categories.[22] Clearly the USGBC recognizes

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[16] Edward Mazria, "The 2030 Challenge," Archived Open Letter, January 2006. Online. http://www.architecture2030.org/open_letter/index.html

[17] Cameron M Burns, "RMI Adopts the '2030 Challenge," *Rocky Mountain Institute Newsletter,* Fall/Winter 2006.

[18] "USGBC Unveils 8 Climate Actions; Goal is to more closely align USGBC with Climate Initiatives." USGBC News Release, 15 Nov 2006, Online. Internet.

[19] Edward Mazria, telephone interview 10/13/06.

[20] US Conference of Mayors. "Adopting the 2030 Challenge for all buildings." 74th Annual Conference. Las Vegas, 2006. 108..

[21] Ibid, 109.

[22] "USGBC Unveils 8 Climate Actions; Goal is to more closely align USGBC with Climate Initiatives."

“indirect” contributors to carbon emissions and climate change. Mazria’s Challenge, GreenPoints, and other green building rating systems can all play a role in offsetting $CO_2$ emissions, depending on the building type, willingness and financial ability of each builder.

**ENERGY STAR as a Climate Change Impact Metric**

ENERGY STAR the widespread federal building program, has also recently incorporated greenhouse gas reduction as an aspect of its commercial building rating system. In this program, buildings receive an EPA energy performance rating on a 1-100 point scale. Those buildings receiving a rating of 75 or higher can display the “Designed to Earn the ENERGY STAR” graphic on architectural drawings. Once operating, they must perform in the top 25% of US buildings, in terms of energy efficiency.[23]

The Energy Star program now acknowledges an American Institute of Architects (AIA) goal of a 50% reduction in fossil fuel use in building design and performance by 2010 (this is 10% less than the “2030 Challenge” goal for that year, which reflects an earlier AIA position statement). Builders can log on to the ENERGY STAR website and use a “target finder” to estimate their project’s greenhouse gas contribution. The “target finder” works by allowing users to choose a building type, enter facility characteristics, and set an energy target; users are then asked to enter a zip code for the design project, so that the appropriate climate conditions and fuel mix can be used in the calculations. (Users may also enter their own fuel mix if it differs from that of their zip code.)

Once this information has been inputted, the target finder generates an estimate of the building’s EPA energy performance rating, the AIA Fossil Fuel Reduction percentage based on an average building as comparison, source and site energy use intensity and annual energy use intensity (based on the fuel mix), and finally, total annual energy cost for the building. This EPA tool implicitly assumes that greenhouse gas emissions are directly proportional to fossil fuel consumption, which, as we have seen, may overlook more subtle and indirect drivers of building CO2 emissions.

This tool can be used throughout the design process, whether the objective is to achieve a certain energy use reduction percentage, or to achieve an ENERGY STAR rating greater than 75%. The EPA notes that the 50% energy reduction target is equivalent to an ENERGY STAR rating of 90, meaning that these buildings will be in the top 10% of all US buildings. Notably, the ENERGY STAR for Homes program does not yet have a tool like the Target Finder. Instead, certified homes must be at least 15% more energy efficient than homes built to the 2006 International Energy Conservation Code (IECC).[24] ENERGY STAR for Homes is thus a far less stringent standard than the commercial ENERGY STAR building rating, and is not nearly as ambitious as the “2030 Challenge” goal.

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[23] “Energy Star Target Finder.” Energy Star Buildings & Plants, Online. http://www.energystar.gov/index.cfm?c=new_bldg_design.bus_target_finder This source was consulted for all information relating to the EnergyStar program for commercial buildings in the following paragraphs.

[24] “What are EnergyStar Qualified New Homes?” EnergyStar New Homes, Online. http://www.energystar.gov/index.cfm?c=new_homes.hm_earn_star

## Climate Change Benefits of Utility Energy Efficiency Programs

While green building strategies can mitigate climate change on multiple levels – by reducing energy consumption, increasing resource efficiency, and expanding the market for renewable energy systems, to name a few – it would be a mistake to ignore the contribution that standard utility energy efficiency programs have made and will continue to make to mitigating climate change. Many states have been operating such programs for years (in some cases for decades), and these programs have an excellent track record of not only achieving energy savings, but in making effective fiscal use of ratepayer dollars. For example, the California Public Utility Commission (CPUC) estimates that, on average, efficiency programs can make available a given kilowatt of required energy for about half the cost of installing new generating capacity.[25] In Nevada, Sierra Pacific Power and Nevada Power's Sure Bet program, which targets non-residential customers, saved an estimated 70 million kWh of electricity in 2005 alone. [26] The program exceeded its savings targets by 12% and was so popular with ratepayers that, among other reasons, it is being expanded by more than 60% in the coming year.

In some important respects, such utility programs are *less* effective as climate-change mitigation strategies than green building programs. They do not address, or at least do not address directly, issues like resource efficiency, renewable energy, and the transportation effects of sprawl, all of which affect $CO_2$ emissions levels and therefore climate change. Efficiency programs have the important benefit of being highly cost-effective with clearly measurable $CO_2$ impacts.

Moreover, and of arguably greater importance, such programs can address inefficiencies in *existing* building stock, and not just in new construction projects. While new construction in certain fast-growing locations is an important driver of emissions growth (such as in Las Vegas, where the population increased by a massive 83% between 1990 and 2000[27]), even in these locations the sheer size of the existing building stock makes the savings potential in older facilities larger than those in new construction projects. This holds true for green building initiatives and for "standard" new construction energy efficiency programs alike. Furthermore, the largest and frequently most cost-effective opportunities for savings often exist in older buildings, which were constructed before the existence of stricter building energy codes. Green building programs cannot address this "low-hanging fruit," and therefore miss this important opportunity to reduce future $CO_2$ emissions.

## Conclusion

Green building programs, as we have seen, can play an important role in offsetting $CO_2$ emissions and in mitigating future climate change. Given the rapid growth of emissions in the commercial and residential sectors, such programs are especially well-positioned to make this contribution. Moreover, ambitious green building guidelines

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[25] California Public Utilities Commission (CPUC), "Energy Action Plan 2006." http://www.cpuc.ca.gov/static/energy/electric/energy+action+plan/index.htm

[26] "Sure Bet Program Year 2005 Final Report," prepared for Sierra Pacific Power/Nevada Power, Las Vegas, Nevada.

[27] "Fast Times Ahead for Las Vegas?" Las Vegas Review-Journal, June 28, 2005.

like the GreenPoint Rating System address the global warming problem on multiple levels: from the traditional perspective of building energy efficiency, to be sure, but also from the standpoint of resource efficiency, renewable energy, and by encouraging compact and sustainable urban planning and infrastructure. Making the connection between these green building practices and their climate change mitigation potential can serve as a powerful marketing tool for organizations and governments hoping to promote their own green building programs.

If there are drawbacks to understanding and marketing green building programs in terms of their climate change benefits, they are likely of two kinds. First, as we have seen, it can be difficult to *quantify* the carbon dioxide offset by green building programs, both because a number of green building strategies have only indirect climate change effects or even no effect on climate change at all, and because the carbon emissions offset by green building programs will vary according to building type and usage patterns in question, will vary according to climate, and will also vary according to the relevant utility fuel mix.

Second, as we have seen, individuals and organizations looking to mitigate climate change should keep in mind a number of other methods, including (but not limited to) alternative green building mandates like the "2030 Challenge," federal energy efficiency programs like ENERGY STAR for buildings, and existing energy efficiency programs operated by utilities. While these programs need not replace or compete directly with green building programs like GreenPoints and LEED, they nonetheless have the benefit of possessing more easily-quantifiable, energy-driven carbon offsets and – especially in the case of ENERGY STAR and utility energy efficiency programs – have an established track record of cost-effective program success. While policy-makers have traditionally marketed these programs in terms of their cost-savings potential, it would not be difficult to emphasize their climate change benefits as well.

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