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NOVEMBER 2008

Green Buildings + Climate Change

Sixth in a Series of Annual Reports on the Green Building Movement

What AEC Professionals + Firms Can Do to Tackle 'The Single Largest Issue Facing the Nation Today'

"To me, climate change is the single largest issue facing the nation today. We must make dramatic changes immediately in order to have hope that our quality of life will not change for the worse over the next decades due to climate change."
— Elizabeth Weiss, Managing Principal, Gorman Richardson Architects

Elizabeth Weiss speaks for the hundreds of AEC professionals who responded to our exclusive survey on climate change and who expressed deep concern about global warming. They want to do something about climate change, but may not necessarily know how they can make a difference.

In this White Paper, we provide concrete ways in which AEC professionals can have a positive role in addressing climate change. To that end, we offer:

- An analysis of the most rigorous scientific study of global warming, the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, with particular attention to the built environment.
- A review of 34 national, regional, state, and local climate change initiatives and their impact on the AEC industry.
- Practical steps AEC professionals can take to cut greenhouse gas emissions in buildings using well-known technologies and methods.

We conclude with a detailed Action Plan—eight recommendations and 22 specific action items for AEC professionals and firms to implement in their work.

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Green Buildings + Climate Change

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1. Climate Change and the Built Environment

Is there really such a phenomenon as climate change? Is it, as some have said, simply a natural occurrence over which we have no control? Or does human activity—from vehicles, buildings, power plants, industry, etc.—contribute to or even cause climate change?

Furthermore, if climate change—natural or man-made—is taking place, how serious a threat is it to humanity, the environment, the world economy? And, assuming that climate change is a threat, what, if anything, can we do to mitigate it or, if possible, eliminate it altogether? And what role, in particular, should those responsible for designing, constructing, owning, and developing homes and buildings play in such an effort?

In this, our sixth White Paper on Sustainability, the editors of *Building Design+Construction* offer what we trust is an objective overview of climate change and what it means to those who shape the built environment—architects, engineers, builders, property owners, and real estate developers. Beyond merely providing information, however, we have set ourselves the task of offering practical suggestions—an Action Plan—to engage AEC professionals and firms in addressing climate change.

Our cause has been driven by a rapidly accelerating sense of urgency, which derives from three basic facts. First, it has been established beyond a reasonable doubt that the planet is heating up at a rate that could prove disastrous to humanity and the natural world in a relatively short period of time. Further, it has become increasingly likely, based upon intense scientific review and analysis over the last 20 years, that human activity is the primary source of the problem. Finally, there is the growing sense that without timely human intervention, the situation could prove catastrophic.

It is equally clear that the built environment plays a significant role in contributing to climate change, and that those who are responsible for creating the built environment can—and must—take a leadership role in solving the climate crisis. As we shall see, no matter where you stand personally on the social, economic, political, or environmental issues related to climate change, you will soon have no choice but to factor it into your professional work. That is because federal agencies, state and local governments, Fortune 1000 corporations, real estate developers, tenant representatives, property brokers, and building owners soon will demand to know your experience and expertise in addressing climate change before awarding projects to your firm. You can also expect to see greater emphasis on climate change in building and energy codes and regulations. In many respects, these events are already starting to unfold.

The editors will support the above statements with what we believe to be the most objective information and analysis we can provide. With these consider-

1. Second Assessment Report, Summary for Policy Makers, p. 412. "Aerosols" refers to tiny particles that float in the air, including sulfur emissions from coal-fired power plants.

2. "Science Panel Calls Global Warming 'Unequivocal,'" The New York Times, 3 February 2007.

Scope and Purpose of the White Paper

Because climate change is such an extremely wide-ranging subject, the editors wish to make it clear what we hope to achieve with this White Paper, what we cannot do, and how we can most benefit our readers.

First, we are not climatologists, so we will be relying heavily on the expertise of the 1,250 scientists and 2,500 technical reviewers who contributed to the Intergovernmental Panel on Climate Change's Fourth Assessment Report. This report, known as IPCC AR4, spans three volumes totaling 2,823 pages and weighs in at over 18 pounds—plus a 73-page "synthesis" report. AR4 represents the consensus not only of the scientific community, but also of the 113 national governments (including the United States) that signed off on it. The Fourth Assessment Report is hardly perfect, but we believe it to be the most scientifically valid and politically unbiased resource on climate change available today.

We have also been scrupulous in our efforts to avoid political partisanship and to separate the social, economic, ethical, and geopolitical aspects of climate change from the scientific and technical considerations. As this White Paper goes to press, the 2008 election process will be reaching its climax. We note that both Presidential candidates indicated their support for action on climate change during the election campaign.

Even though we recognize that many AEC professionals and firms that rely on us as an information resource are doing work in the Middle East, Eastern Europe, China, India, Russia, and other parts of the world, for logistical and practical reasons we have focused our geographic perspective on the U.S. and Canada.

Practical considerations also have prompted us to limit our discussion as much as possible to climate change as it relates to the built environment. This leaves many important issues related to climate change beyond our purview, including threats to biodiversity, rampant deforestation, human health impacts, Third World poverty, economic fairness between developed and developing nations, nuclear power safety, vehicle emission standards, and national security considerations, to name a few. We encourage our readers to become engaged in these issues, of course, but we must restrict our efforts to the chief goal of inspiring them to utilize their intellect, skills, and expertise to address climate change in their daily work as designers, builders, property owners, and developers.

ations in mind, let us turn to the scientific evidence on climate change.

The IPCC Reports on Climate Change

The U.N. Intergovernmental Panel on Climate Change was established by the United Nations Environment Program (UNEP) and the World Meteorological Organization (WMO) in August 1988, toward the end of a summer marked by record heat waves, forest fires, and the first warnings by scientists of a new phenomenon they tentatively labeled "global warming." The IPCC was established to evaluate the best scientific research available and reach consensus, with the world's national governments, as to what the science said about climate change. The IPCC itself does not conduct original research.

In its first report, in 1990, the IPCC found evidence of global warming (the preferred term at the time) but could not support human intervention as a cause.

Five years later, however, in its Second Assessment Report (SAR), the IPCC issued a historic statement. The "balance of evidence," it said, "suggests a discernible human influence on global climate." The IPCC went on to say that "these results indicate that the observed trend in global mean temperature over the past 100 years is unlikely to be entirely natural in origin. More importantly, there is evidence of an emerging pattern of climate response to forcings by greenhouse gases and sulphate aerosols in the observed climate record. Taken together, these results point towards a human influence on global climate."[1] This was the first confirmation by the world's scientific community of an anthropogenic role in climate change.

The Third Assessment Report (TAR), issued in 2001, upped the ante. Earth had warmed 0.6°C (1°F) in the previous 50 years, the IPCC said, and it was now "likely" that human activity was largely responsible for the increase. In IPCC terms, a "likely" rating means a probability of 66-90%.

On 2 February 2007, in its Fourth Assessment Report (AR4), the IPCC was even more emphatic. Human influence on climate was now "very likely," meaning that the probability of an anthropogenic role in climate change was greater than 90%. "February 2 will be remembered as the date when uncertainty was removed as to whether humans had anything to do with climate change on this planet," said UNEP executive director Achim Steiner. "The evidence is on the table."[2]

Based on the IPCC Special Report on Emissions Scenarios (2000), the Fourth Assessment Report projected an increase of global GHG emissions by 25-90% between 2000 and 2030. [SYR/SPM, p. 7][3]

In terms of buildings, the Fourth Assessment Report found that between 1970 and 1990 direct emissions from buildings grew by 26% and remained at approximately 1990 levels thereafter. However, the IPCC stated, "the buildings sector has a high level of electricity use and hence the total of direct and indirect emissions in this sector is much bigger (75%) than direct emissions." [WGIII/SPM, p.3]

For North America (chiefly the U.S. and Canada), projected impacts could include the following:

- There would be more heat waves in cities that currently experience heat waves, and they would be more intense and last longer. These heat waves would bring with them the "potential for adverse health impacts," with the elderly "most at risk." [WGII/SPM, p.15]
- Warming in the mountain regions of the western U.S. and Canada would be projected to cause more winter flooding, decreased snowpack, and reduced summer stream flows. Competition for "over-allocated" water resources would be made worse.
- "Coastal communities and habitats will be increasingly stressed by climate change impacts interacting with development and pollution." Factors contributing to possible increased vulnerability of coastal areas: population growth and the "rising value of infrastructure." If the intensity of tropical storms increases, so, too, would losses. "Current adaptation is uneven and readiness for increased exposure is low," the report warned. [WGII/SPM, p. 15]
- There has been "observational evidence" of an increase in intense tropical cyclone activity [which includes hurricanes] in the North Atlantic since about 1970. This increase has been correlated with an increase in tropical sea surface temperatures. However, there has been "no clear trend" in the annual number of tropical cyclones. [WGI/SPM, p. 9]
- "Disturbances" from fire, pests, and diseases would

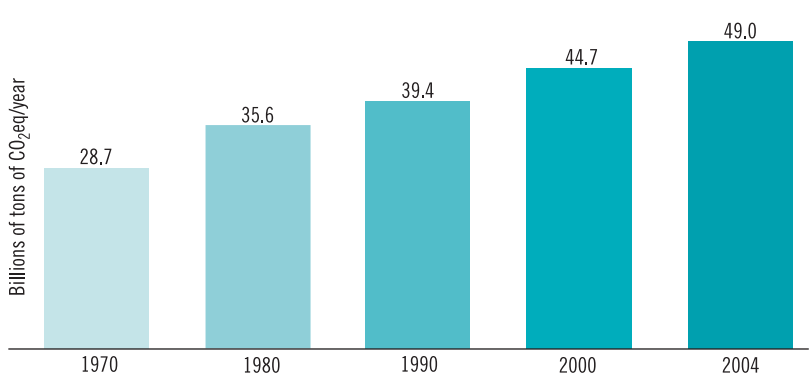
IPCC definition of climate change

Climate change in IPCC usage refers to any change in climate over time, whether due to natural variability or as a result of human activity. This usage differs from that in the U.N. Framework Convention on Climate Change, where climate change refers to a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods.

Source: IPCC Working Group II, Summary for Policy Makers, p. 6

3. We use the following abbreviations for the IPCC Fourth Assessment Report (AR4): SPM, "Summary for Policymakers"; "WGI" (Physical Science Basis), "WGII" (Impacts, Adaptation and Vulnerability), and "WGIII" (Mitigation of Climate Change) in reference to the reports of the three IPCC Working Groups; SYR, Synthesis Report.

Chart 1.1
Global Annual Emissions of Man-made Greenhouse Gases, 1970-2004



Source: Climate Change 2007: Synthesis Report, Summary for Policy Makers, fig. SPM.3, p. 5.

Global greenhouse gas (GHG) emissions due to human activities have grown since pre-industrial times (year 1750), with an increase of more than 70% between 1970 (28.7 billion tons of CO_2eq) and 2004 (49.0 billion tons).

impact forests more heavily, with "an extended period of high fire risk and large increases in area burned." [WGII/SPM, p. 14]

The Fourth Assessment Report concluded that a certain amount of warming was almost inevitable: about 0.2ºC (0.4ºF) per decade for the next two decades. Even if greenhouse gases and aerosol concentrations could be kept at year 2000 levels, a further warming of 0.1ºC (0.2ºF) per decade would be expected. [WGI/SPM, p. 12]

The IPCC warned, however, that continued GHG emissions at or above current rate would "cause further warming and induce many changes in the global climate system during the 21st century that would very likely [>90% chance] be larger than those observed during the 20th century." [WGI/SPM, p.13]

Upon release of the report in February 2007, Dr. John P. Holdren, then president of the American Association for the Advancement of Science, told the *New York Times*, "Since 2001, there has been a torrent of new scientific evidence on the magnitude, human origins, and growing impacts of the climatic changes that are under way." The Fourth Assessment Report "powerfully underscores the need for a massive effort to slow the pace of global climatic disruption before intolerable consequences become inevitable," said Holdren, director of the Woods Hole (Mass.) Research Center and Heinz Professor of Environmental Policy at Harvard's Kennedy School of Government.[5]

The Intergovernmental Panel on Climate Change did not leave the world high and dry, with no suggestion as to how to launch the "massive effort" called for by Holdren and many others. The IPCC Fourth Assessment Report includes an entire 851-page volume on *mitigation*—how to reduce GHG emissions—and another 976 pages on *adaptation*—how humankind could find ways to live with the greatest level of prosperity and health under various climatic scenarios. We'll consider some of these strategies as they relate to the built environment later in this White Paper.

Major Findings of the Fourth Assessment Report

The IPCC's Fourth Assessment Report fills nearly three thousand pages over three-plus volumes. For the purposes of this White Paper, we have consolidated the major findings of the report, known as AR4, as follows:

- Warming of the climate system is "unequivocal," based on observations of increases in average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level. [SYR/SPM, p. 2]
- Eleven of the previous 12 years (1995-2006) ranked among the 12 warmest years on record (since 1850). [SYR/SPM, p. 2]
- The 100-year linear trend of 0.6ºC (1ºF) in the Third Assessment Report (1901-2000) was revised upward to 0.74ºC (1.2ºF) in AR4 (1906-2005). [SYR/SPM, p. 30]
- Global greenhouse gas (GHG) emissions due to human activities have grown since pre-industrial times (before 1750), with an increase of 70% between 1970 and 2004—from 28.7 billion tons of CO_2eq in 1970, to 49 billion tons in 2004. Emissions of carbon dioxide, the most important anthropogenic GHG, grew by about 80% in this time frame, and by 28% just from 1990 to 2004. [WGIII/SPM, p. 3]
- "Most of the observed increase in global average temperatures since the mid-20th century is very likely [>90% chance] due to the observed increase in anthropogenic GHG concentrations. It is likely [66-90% chance] that there has been significant anthropogenic warming over the past 50 years averaged over each continent (except Antarctica)." [SYR/SPM, p. 39]
- Since the 1970s, more intense and longer droughts have been observed over wider areas, particularly in the tropics and subtropics. [WGI/SPM, p.8]
- "Heavy precipitation events" have become more frequent over most land areas. This is "consistent with warming and observed increases of atmospheric water vapor." [WGI/SPM, p.8]
- Over the last 50 years, widespread changes in extreme temperatures have been observed. "Cold days, cold nights, and frost have become less frequent, while hot days, hot nights, and heat waves have become more frequent." [WGI/SPM p.8]
- Many natural systems are being affected by regional climate changes, particularly temperature increases. These include changes in hydrological systems and snow, ice, and frozen ground (*high confidence*) and earlier timing of spring events and poleward and upward shifts in plant and animal ranges (*very high confidence*).[4] [SYR/SPM, p. 31]
- "Of the more than 29,000 observational data series, from 75 studies, that show significant change in many physical and biological systems, more than 89% are consistent with the direction of change as a response to warming." [SYR/SPM, p. 33]

Getting worse before it gets better

The Fourth Assessment Report raised the prospect that, through technologies that are currently available or in the pipeline, "stabilization" of climate change could be achieved. But what if climate conditions deteriorated beyond what the IPCC assessment of February 2007 foresaw?

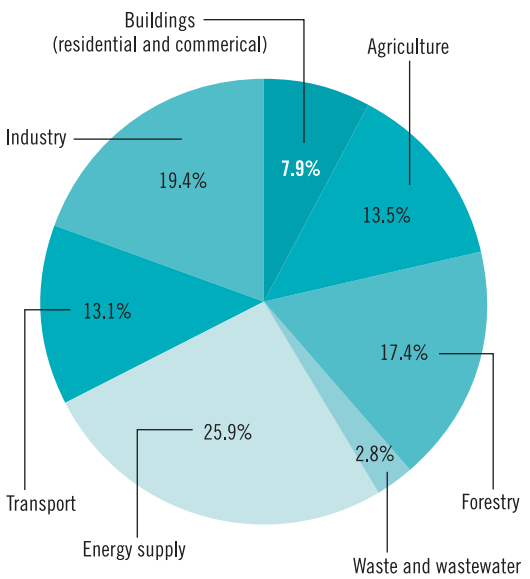
That seems to be the case. The most recent data, published 22 September 2008 in the *Proceedings of the National Academy of Sciences*, showed that the rate of greenhouse gas emissions has increased nearly fourfold since 2000. The Global Carbon Project, based in Canberra, Australia, put the growth rate of emissions from 2000 to 2007 at 3.5% per year, compared to a 0.9% per year growth rate from 1990 to 1999.

Emissions growth from 2000 to 2007 was greater than the most severe picture painted by the IPCC's Special Report on Emissions Scenarios, published in 2000.

The Global Carbon Project went on to report that:

- The annual mean growth rate of atmospheric CO_2 was 2.2 ppm per year in 2007, versus 1.8 ppm in 2006 and above the average of 2.0 ppm for the period 2000 to 2007.
- The biggest growth in emissions had taken place in developing countries, notably China and India, both of which have been building coal-fired power plants at incredible rates since 2000. By some reports, China is building one such plant every four days or so.
- China, which accounted for 60% of all growth in emissions from 2000 to 2007, has superseded the United States as the world's largest emitter of carbon

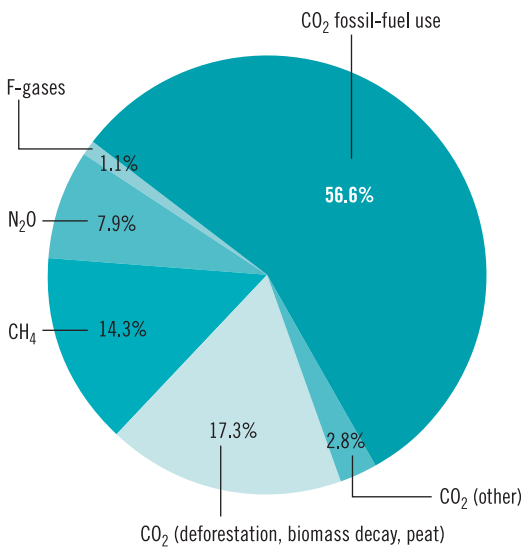
Chart 1.2
Share of Various Sectors in Total Man-made Greenhouse Gas Emissions in 2004 (CO_2eq)



Source: Climate Change 2007: Synthesis Report, Summary for Policy Makers, fig. SPM.3, p. 5.

The world's commercial and residential buildings account directly for <8% of GHG emissions, but the impact of buildings and homes is felt indirectly in every other sector, especially in energy supply (largely for electricity from power plants) and transport (cars, trucks, trains, airplanes, etc.).

Chart 1.3
Share of Various Man-made Greenhouse Gases in Total Emissions in 2004 (CO_2eq)



Source: Climate Change 2007: Synthesis Report, Summary for Policy Makers, fig. SPM.3, p. 5.

Carbon dioxide accounted for more than three-fourths (76.7%) of all anthropogenic GHG emissions in 2004. Percentages are based on carbon dioxide equivalents (CO_2eq). N_2O: nitrous oxide, from agriculture and other sources; F-gases: hydrofluorocarbons, perfluorocarbons, and sulfurhexafluoride.

dioxide. The U.S. maintains the distinction of being the largest emitter of greenhouse gases per person.

• Natural "sinks"—trees, plants, and the oceans—were becoming less efficient in their ability to absorb CO_2 emissions.

The bottom line: Atmospheric CO_2 rose to 383 ppm in 2007, putting it 37% higher than the concentration of greenhouse gases in the atmosphere at the start of the industrial revolution (280 ppm) in 1750. This was believed to be the highest concentration of greenhouse gases of the past 650,000 years and probably of the past 20 million years.

In sum, said Dr. Josep (Pep) Canadell, executive director of the Global Carbon Project, "This new update of the carbon budget shows the acceleration of both CO_2 emissions and atmospheric accumulation [is] unprecedented and most astonishing during a decade of intense international developments to address climate change."

How could this happen, and so quickly?

We put that question to Mark Maslin, head of the Department of Geography and Director of the Environment Institute at University College London.

"The key thing about the IPCC is that the 2007 report [AR4] is based on published work, which comes from early 2006 and before," said Maslin, author of the excellent primer *Global Warming: A Very Short Introduction* (Oxford University Press, 2004). "It's a long process, and every single line has to be agreed to by the co-authors, so they have to be naturally conservative. My feeling has always been that [the consensus process] will always underestimate the potential risk.

"One of the problems with the Fourth Assessment Report is that it used CO_2 increases calculated from their special report of 2000," said Maslin. "That report [Special Report on Emissions Scenarios] predicted the increase for the next 100 years and what it would look like. In 2000, this was a realistic forecast, but we've blown [that forecast] apart in the last eight years, due to China and India. In Asia, we're already above the highest predictions of the IPCC, so we're already off the curve."

In short, greenhouse gas emissions are going up faster than predicted, which makes it all the more imperative to start tackling the problem quickly. In subsequent chapters, we'll look at efforts by more than a score of organizations and entities to address climate change. We'll see how improvements to existing buildings and homes could play a crucial role in climate change mitigation. We'll review scenarios put forth by scientists, management consultants, and economists, and we'll take a brief excursion into the mysterious terrain of carbon cap and trade. Finally, as in several of our previous White Papers on Sustainability, we'll offer a detailed Action Plan for consideration by government, the private sector, and the AEC industry.

But first, let's look at where the U.S. design and construction community stands on climate change. BD+C

4. Under the IPCC confidence convention, "high confidence" means about an 8 out of 10 chance of being correct; "very high confidence" means at least a 9 out of 10 chance of being correct.

5. The New York Times, 3 February 2007.

2. Survey Shows Mixed Opinions On Climate Change Among AEC Industry Professionals

Methodology

In June and July 2008, *Building Design+Construction* conducted an online survey among 20,815 of its readers to determine their opinions, perceptions, and actions relative to climate change. The survey sample was selected on an nth-name basis from all qualified recipients of *Building Design+Construction* who had provided email addresses when subscribing to the magazine. Each of the first 100 respondents received a $25 Amazon gift certificate. All who completed the survey by 8 July 2008 were entered in a drawing to win one of two $100 American Express Gift Cheques. Of the 953 readers who completed the survey, 483 (51%) work for design firms, 244 (26%) work for build firms, and 226 (24%) work for owning firms.

Building Design+Construction's exclusive survey of 953 AEC industry professionals on climate change—arguably the first and most comprehensive such survey to date—reveals many differences of opinion among architects, engineers, contractors, building owners, and property developers about climate change and what they and the industry can or should do about it—especially among the more than 300 verbatim responses.

"To me, and many of us within my firm, this is the single largest issue that is facing the nation today," said Elizabeth Weiss, managing principal with Gorman Richardson Architects, Hopkinton, Mass. "We must make dramatic changes immediately in order to have hope that our quality of life will not change for the worse over the next decades due to climate change."

Mark Sekula CFM, LEED AP, senior facilities management consultant, Facility Engineering Associates, a national facility management and engineering consulting firm, echoed that rallying cry. "It is imperative that the United States set an example to the entire world by taking the lead in implementing measures to reverse the effects of climate change," he said. "First, we must educate our own leaders and citizens and make them aware that climate change is real and a threat to our planet and to future generations. Secondly, we must show our citizens what they can each do on an individual basis and encourage and support a grassroots ecological movement to help curtail global climate change."

Equally passionate was Sarah Major, an intern architect with Glavan Fehér Architects, Columbus, Ohio: "It is imperative for the building design and construction community to charge into a greener future RIGHT NOW. Ultimately, our profession is one of problem solving, and our solutions impact the world at every scale for years and years, if not forever."

Nathan Seney, president of Dawson Clinton & Seney Residential Design, Seattle, joined the call to action: "Across the board we need more binding actions to limit our impact on climate change. Buildings, both in their construction and use, consume huge amounts of energy. Every project, whether or not it is mandated by the client, must consider this and be as efficient as possible."

Pleading for an end to the chit-chat, Nate Gillette, AIA, an architect with Bazzani Associates, Grand Rapids, Mich., said, "If we spent as much time acting

Principal Findings of the Climate Change Survey

1. Making a personal commitment. Ninety-five percent of respondents said they had acted to reduce greenhouse gases and address climate change in their personal lives. On average (median), they took three such actions, everything from recycling at home (82%), to using public transit (25%), to bicycling to work (8%). Only a few (2%) had purchased carbon offsets for business travel.

2. Walking the walk. Similarly, 93% of respondents said the professional firms and companies they work for had taken at least one action—with a median of five such steps—to reduce global warming in their own office operations and businesses. Recycling (81%) and purchasing Energy Star-rated office equipment (61%) led the way. While only 5% of firms had achieved carbon neutrality in their businesses, another 23% said they intended to do so in the next two years.

3. Taking action in the field. Ninety-three percent of respondents reported that their firms or organizations had implemented at least one technology solution in buildings they designed, built, or owned—notably improvements to lighting, HVAC systems, building envelopes, and building insulation, as well as the use of green building products.

4. Sticking to the basics. In general, respondents rated traditional design and building techniques—insulation, windows and doors, building orientation, efficient lighting, etc.—as more effective in combating climate change than more technically complex systems, such as geothermal, solar, wind, and photovoltaic systems.

5. Keeping it simple. In ranking the effectiveness of policies or actions that address climate change, respondents gave highest marks to well-understood options: optimized building siting, water conservation, climatically appropriate landscaping and irrigation, and the reuse or renovation of existing buildings. More elaborate concepts, such as purchasing green power or renewable energy credits, labeling the carbon content of building products, carbon trading and credits, and purchasing carbon offsets—ranked lowest in terms of their perceived effectiveness in fighting climate change.

on climate change as we did talking about it, we'd have the problem solved by now. What in the world are we waiting for?"

More cautionary was Kevin Tilley, a designer with RCC Architect, Inc., Marietta, S.C., who said that while he was "not convinced that humans are having any effect on climate change," he was nonetheless distressed that the design and construction industry was not doing more on the conservation front: "Why haven't we been designing buildings to reduce energy consumption all

Table 2.1
Respondent's primary job function

Architect	36%
Engineer	19%
Construction professional	10%
Construction manager	7%
Real estate developer	3%
Corporate management	3%
Building owner	3%
Government official or staff	3%
Home builder	3%
Interior designer	2%
Property/facility manager	2%
Energy/environmental consultant	1%
Specifier	1%
Other	7%

Base: 953
Source: BD+C/Reed Research Group 2008 Climate Change Survey

Design professionals constitute the majority of survey respondents, but the "build" and "owner" segments of the AEC industry were also well represented in the study, which drew on the experience of 953 professionals.

Table 2.2
Where respondents work

Architecture firm	35%
Engineering firm	12%
General contractor	10%
Government agency	8%
Building/property owner	7%
Consulting firm	6%
Construction management firm	5%
Real estate developer	4%
Home builder	2%
Nonprofit organization	1%
Property/facility management firm	1%
Other	9%

Base: 953
Source: BD+C/Reed Research Group 2008 Climate Change Survey

The majority of the 953 survey respondents (51%) said they work for design firms, but those who said they worked for build firms (26%) and owning firms (24%) were also well represented. The resulting demographic breakdown can be viewed as broadly representative of the U.S./Canada design/construction/building owner industry.

Table 2.3
What actions do you personally engage in to reduce greenhouse gas emissions and address climate change?

Recycle at home	82%
Use Energy Star appliances and equipment at home	72%
Use energy-conservation methods at home (CFLs, more insulation, etc.)	68%
Telecommute/work remotely	25%
Use public transit	25%
Carpool to work	11%
Walk to work	10%
Bicycle to work	8%
Drive a hybrid	6%
Use shared vehicle ("I-Go," etc.)	5%
Purchase carbon offsets for air travel, etc.	2%
Other	15%
None	5%

Base: 953
Source: BD+C/Reed Research Group 2008 Climate Change Survey

Ninety-five percent of respondents said they had taken at least one action to reduce greenhouse gas emissions, with a median of three such actions. Ninety-eight percent of those at owning firms reported such activity, significantly higher (at the 95% confidence level) than those at build firms (92%). Respondents at design firms were also more active (at the 90% confidence level) than those at build firms—96% having taken at least one action, vs. 92% at build firms.

Table 2.4
What climate change programs has your firm or organization established internally? Which do you plan to implement in the next two years?

	Already implemented	Plan to implement in next 2 years	No plans to implement
Instituted office waste recycling	81%	7%	12%
Purchased Energy Star office equipment or appliances	61%	17%	23%
Installed lighting controls, CFLs, LEDs, etc.	58%	19%	23%
Encouraged/incentivized employees to use public transit	37%	14%	49%
Encouraged/incentivized telecommuting or part-time work at home	31%	18%	51%
Encouraged/incentivized carpooling	30%	18%	52%
Eliminated or restricted bottled water	30%	16%	54%
Provided education programs specifically on climate change	28%	26%	45%
Pursued or achieved LEED, Green Globes, or Energy Star certified building or interior fitout for firm's own facilities	26%	30%	43%
Encouraged/incentivized employees to bike to work	24%	14%	62%
Encouraged/incentivized use of hybrid or shared vehicles	22%	19%	59%
Provided compressed work week	22%	16%	63%
Purchased green power	13%	21%	66%
Enabled 'hoteling' in office space	12%	11%	77%
Achieved carbon neutrality for business operations	5%	23%	73%
Purchased carbon offsets (e.g., for business travel)	4%	14%	82%

Base: 953
Source: BD+C/Reed Research Group 2008 Climate Change Survey

Respondents' firms have implemented on average five actions (5.0 median, 5.3 mean) to reduce greenhouse gases in their own operations. Owning firms, at a mean of 6.1 actions, were significantly more active (at the 95% confidence level) than design firms (5.1) and build firms (4.9). In fact, owning firms pursued green building practices for their own facilities at a significantly higher rate (36%) than build firms (25%) and design firms (22%), at the 95% confidence level. They were also significantly more inclined than design or build firms to encourage car pooling and the use of public transit by their employees and to purchase Energy Star equipment for their offices.

along? Many of the green solutions should have been second nature to any good designer in the first place. It seems that it has taken a global scare to get people to use the common sense they had all along."

For a vocal segment of the AEC industry, however, climate change is, in respondents' words, either "a hoax," "a bunch of garbage," "a gimmick," "boring," "a politically inspired movement," "b.s.," "an invention of the media and Al Gore," or simply "preposterous." Their line of reasoning goes like this:

1. Climate change is "natural," part of an ongoing "normal cycle" of change. Volcanic action, solar flares, ocean thermal currents, and changes in Earth's magnetic field were cited as naturally occurring causes of climate change.

Typical of this point of view is this from Warren W. Gross, SVP/treasurer, Warren W. Gross & Associates, Glen Rock, N.J.: "Can anyone prove absolutely that we are in an irreversible global warming cycle that will continue forever? Can anyone refute with 100% certainty that what we are now experiencing is one of the normal cycles that this planet has gone through many times before?"

2. Climate change may not actually be occurring, but even if it is, there is no scientific proof that human intervention is contributing to it.

"There's a lot more to be learned re: climate change," said Bob Arguero, a senior engineer with Technologists, Inc., Arlington, Va. "Man's influence [is] still not fully understood vis-à-vis natural processes."

Matt Brooks concurred. "I am not convinced that climate change is affected by man to the degree that the alarmists are telling us," said the owner of Nisly/Brooks Construction Co., Hutchinson, Kan. "However, we should and could be more responsible in the way we build and in our consumption of energy."

3. Assuming that climate change is occurring, there's not much anyone can do about it—most certainly not the design and construction industry.

"Energy efficiency, green building practices, and recycling are all goals that we should be aiming for," said Steven Wolfe, a construction manager with Bigelow Homes, Aurora, Ill. However, "the impact these will have on global warming, if it exists, will be negligible."

Wayne Shippen, an electrical engineer in Idaho, suggested greater reliance on natural processes as the best solution to greenhouse gas reduction. "While goals to reduce energy waste are commendable, the contribution to climate change by human activities has been grossly and deliberately overstated by political activists," he stated. "The best solution to greenhouse gases, particularly CO_2, is to protect, preserve, and enhance natural CO_2 removal mechanisms, such as tropical rain forests and ocean algae, which have been impacted by development. Every volcanic eruption dumps massive amounts of gas into the atmosphere, but natural mechanisms remove it. The emphasis should be on understanding and preserving these natural processes."

4. Efforts to address climate change will cost too much, hurt the U.S. economy, put America at a competitive disadvantage, and threaten the U.S. standard of living.

Table 2.5
Which of the following actions or technology solutions has your firm or organization already implemented in buildings it designed, built, or owns? Which do you plan to implement in the next two years?

	Already implemented	Plan to implement in next 2 years	Not sure/ no opinion
Lighting efficiency improvements	78%	12%	11%
HVAC efficiency improvements	75%	13%	14%
Building envelope improvements: windows and doors	73%	13%	16%
Insulation improvements	73%	14%	15%
Plumbing improvements (low-flow toilets, waterless urinals, etc.)	70%	15%	17%
Building envelope improvements: air and vapor barriers	68%	14%	20%
Environmentally preferably building products	67%	18%	17%
Occupancy sensors and controls	67%	16%	19%
Building envelope improvements: walls and cladding	65%	15%	22%
Building envelope improvements: roofs	65%	15%	22%
Construction and demolition waste recycling	62%	18%	22%
Building automation systems	58%	18%	25%
Climatically appropriate landscaping and irrigation	58%	16%	28%
Variable-speed drives	52%	13%	35%
Daylighting/light shelves	51%	18%	32%
Water conservation, recovery, and reuse	49%	24%	28%
Building commissioning	45%	19%	37%
Passive cooling systems	33%	25%	43%
Solar (thermal)	30%	27%	44%
Green roofs	28%	27%	46%
Geothermal systems	26%	22%	53%
Underfloor air distribution (UFAD) systems	25%	18%	58%
Photovoltaic electricity generation	24%	28%	49%
Co-generation systems	24%	21%	56%
Solar (hot water)	23%	26%	52%
Harmonic canceling transformers	15%	15%	70%
Wind energy	9%	24%	67%

Summary: Mean number of implemented solutions

	Overall	Design	Build	Owner
Have implemented one or more solutions	14.2	15.4	13.0	12.8
Plan to implement one or more solutions within next 2 years	6.7	6.8	6.7	6.5

Base: 953
Source: BD+C/Reed Research Group 2008 Climate Change Survey

Respondents at design firms said their firms had implemented an average of 15 or more technology solutions, significantly greater (95% confidence level) than either build or owner firms, both at about 13 actions. The "low-hanging fruit"—lighting and HVAC improvements, windows and doors, insulation and plumbing upgrades (such as low-flow toilets), and other well-understood practices gained the highest marks. Respondents were "not sure" or had "no opinion" about using wind energy (67%) or harmonic canceling transformers (70%).

Table 2.6
How effective in combating climate change is each of the following building-related technology solutions?

	Mean	Very effective (5 of 5)
Insulation improvements	4.5	63%
Building envelope improvements: windows and doors	4.5	59%
HVAC efficiency improvements, rightsizing	4.4	56%
Lighting efficiency improvements	4.4	55%
Building orientation and siting	4.4	55%
Building envelope improvements: roofs (e.g., cool roofs, white roofs)	4.4	54%
Building envelope improvements: walls and cladding	4.4	51%
Building envelope improvements: air and vapor barriers	4.3	48%
Occupancy sensors and controls	4.3	46%
Plumbing improvements (low-flow toilets, waterless urinals, etc.)	4.2	44%
Water conservation, recovery, and reuse	4.2	42%
Building automation systems	4.2	39%
Solar (thermal)	4.2	35%
Geothermal systems	4.2	34%
Daylighting/light shelves	4.2	33%
Building envelope improvements: green roofs	4.1	35%
Solar (hot water)	4.1	32%
Passive cooling systems	4.1	30%
Variable-speed drives	4.1	29%
Photovoltaic electricity generation	4.0	29%
Wind energy	4.0	29%
Co-generation systems	3.9	20%
Underfloor air distribution (UFAD) systems	3.7	12%
Harmonic canceling transformers	3.5	6%

Base: 953
Source: BD+C/Reed Research Group 2008 Climate Change Survey

A score of 4.0 or more with a high percentage of 5's ("Very effective") indicates strong respondent support for this action.

As in Table 2.5, the "low-hanging fruit" theory holds in terms of how effectively various technology solutions can combat climate change. A further note: Respondents at build firms ranked lower than design and owning firms in virtually every category, almost always at the 95% confidence level, an indication that contractors, CMs, and home builders have a way to go to catch up to architects/engineers and owners/developers in addressing climate change.

Table 2.7
How effective is each of the following policies or actions in addressing climate change?

	Mean	Very effective (5 of 5)
Optimize building orientation and siting	4.3	48%
Water conservation, recovery, and reuse	4.3	44%
Construction and demolition waste recycling	4.2	44%
Reusing or renovating existing buildings	4.2	42%
Climatically appropriate landscaping and irrigation	4.2	41%
Using local suppliers to reduce energy use for transport of materials	4.1	35%
Locating building close to or accessible to transit	4.1	35%
Life cycle analysis of building products	4.1	32%
Building commissioning, recommissioning, and retrocommissioning	4.0	31%
Environmentally preferable purchasing of building materials	4.0	31%
Using building materials with low embodied energy	4.0	29%
Increasing density of building projects for energy-conservation purposes	4.0	27%
Reduced hours of building operation	3.8	25%
Purchasing green power	3.7	21%
Renewable energy credits	3.5	19%
Labeling carbon content of building products	3.2	9%
Carbon trading and credits	2.9	7%
Purchasing carbon offsets	2.9	6%

Base: 953
Source: BD+C/Reed Research Group 2008 Climate Change Survey

Respondents gave strong support to optimized building siting, water conservation, and C&D waste recycling. Note: Respondents gave more 1's ("Not effective at all") than 5's ("Very effective") to the three policies at the bottom of this chart: "labeling carbon content of building products" (11% 1's, 9% 5's), "carbon trading" (16% 1's, 7% 5's), and "purchasing carbon offsets" (17% 1's, 6% 5's). As in Table 2.6, build firms were ranked consistently lower than design and owning firms at the 95% confidence level, for the most part.

"The so-called environmental movement against climate change is not based on sound principles but as a means to redistribute wealth and move our civilization backwards," said James Wilson, project manager, Parkes Companies, Spring Hill, Tenn. "I am all for saving energy and building the most efficient buildings possible, but not at the expense of highly specialized products that may or may not be beneficial."

William C. Schuster, principal with DPC Architects, Cedar Rapids, Iowa, said, "Design that helps our clients promote energy reduction is and always has been important" to his firm. Earth's climate is constantly changing, said Schuster, but not due to man-made intervention. Thus, he said, "We do not accept the political agenda of wealth redistribution that the global warming issue promotes."

Added Scott Velting, president of Velting Contractors, Inc., Grand Rapids, Mich., "Without an open discussion on the issue we are dooming ourselves to higher taxes and increased costs that will not do anything to change the climate."

What about international agreements?

Nearly three-fourths of respondents (72%) said the United States should adhere to binding international

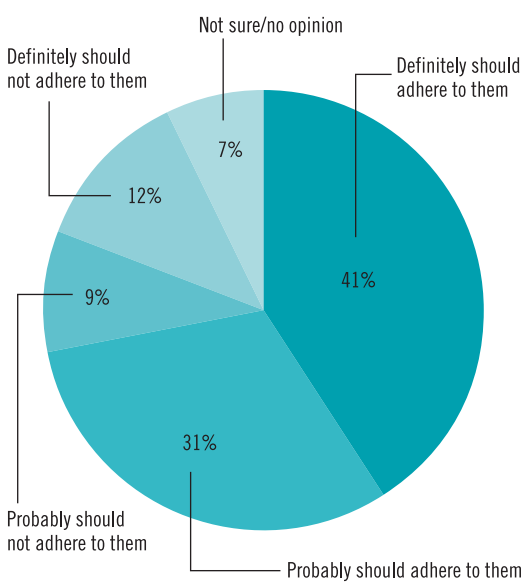
agreements aimed at mitigating climate change—with 41% saying the U.S. should "definitely" do so, and 31% saying the U.S. should "probably" do so.

Typical of those supporting U.S. adherence to such accords was Edward J. Tokarek, AIA, CSI, senior project architect with URS Corp., Grand Rapids, Mich. "As a world leader the U.S. should set the standard for the remainder of the world," he said. "When the U.S. government refuses to sign on [to] some of the energy-conservation initiatives, what type of message do we send?"

Yet more than one in five respondents (21%) said the United States should either "definitely not" adhere to such international agreements (12%) or "probably should not" (9%). (Another 7% were not sure or had no opinion.) Typical was Rick McCoy, P.E., head of McCoy & Associates, a professional engineering firm in Minneola, Fla.: "Designing more energy-efficient structures is good for our client's bottom line, but we are totally against forced participation in these global, anti-capitalist, Kyoto-type agreements that serve only to punish the USA and the EU."

Also against such international agreements was Travis Chambers, a principal with Chamberland Development, Lakeland, Fla.: "If we adhere to Kyoto and China does not, we will not be able to compete economically and should just hand over the keys." Eric P. Rogers, a mechanical engineer with McClure Engineering Associates, St. Louis, echoed this sentiment: "Unless China and India agree to limit carbon/fossil fuel usage, then what the USA does will have little or no impact."

Chart 2.1
To what extent should the United States adhere to binding international agreements aimed at mitigating climate change?



Source: BD+C/Reed Research Group 2008 Climate Change Survey Base: 953

Respondents at design firms were significantly more inclined (46%) toward the U.S. "definitely" adhering to Kyoto-type protocols than were those at build firms (35%, at the 95% confidence level) or owning firms (38%, at the 90% confidence level). Conversely, those at build firms were significantly more likely to think the U.S. "definitely should not" adhere to such agreements (18%) than were those at design firms (9%, at the 95% confidence level) or build firms (12%, at the 90% confidence level).

Scott Blankenship, an applications engineer with Southern Environmental Inc., Pensacola, Fla., said, "Although the U.S. is the major player in the climate change game, other emerging countries need to accept the same responsibility and play by the same rules."

One way to do that was suggested by Edward Troyer, an architect in Glenwood, Colo.: "At the same time that the U.S. adopts international agreements relative to climate change and/or ecological impacts, there should be a large environmental tax placed on imported goods from foreign countries where environmental/ecological standards are less stringent than our own, and to reflect the shipping and handling contribution to the carbon footprint of the goods. Those [tax receipts] should go toward mitigating the impacts."

Finally, Michael Pappas, a senior project architect with Pittsburgh-based L. Robert Kimball, said the U.S. should take a strategic approach to global warming: "Our mission should be more strategic in nature and less oriented toward global climate change," he said. "The U.S. should reduce its use of fossil fuels, more because they are finite and our economy and future are based on them, and less on any protocol or international effort rife with political subterfuge. The U.S. needs to do this to secure our future. It will take time to replace the use of fossil fuels, to retrofit existing structures, and to rebuild the way we transport goods."

New technologies, new solutions in demand

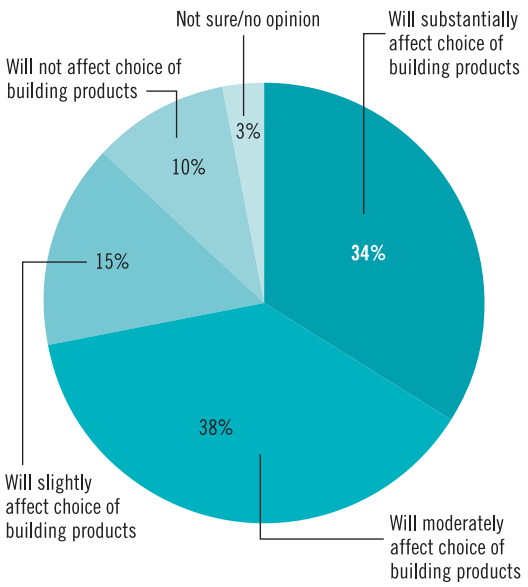
Respondents called for greater investment in new technologies to reduce greenhouse gases. "A new Manhattan Project with the same level of urgency should be instituted to develop alternative fuels that will essentially recycle the use of carbon rather than add new carbon to the atmosphere," said Richard C. Betancourt, managing partner with OPRF, LLC, New York.

Frank Jenkins, senior electrical engineer with Technology Site Planners, Plain City, Ohio, stated that the nation's "most important task" was to find a "technological solution to rising energy needs. It must not just supplement energy production, but completely replace fossil fuels."

Respondents offered specific recommendations:

• **More government incentives.** Eugene D. Ninnie, P.E., with Civil Technologies and Engineering, a consulting engineering firm in Carson City, Nev.,

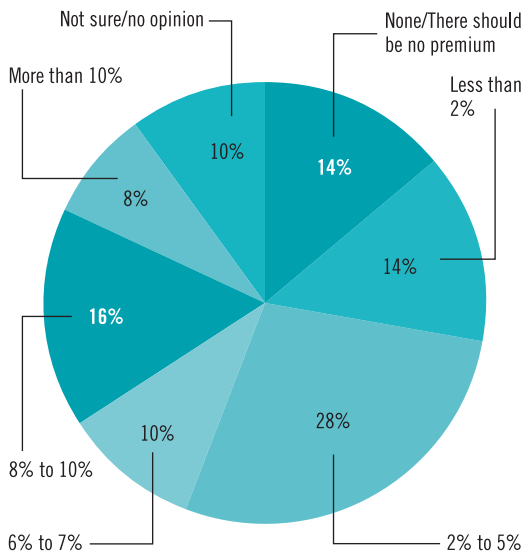
Chart 2.2
How much will addressing climate change affect your choice (or your firm's choice) of building products in the future?



Source: BD+C/Reed Research Group 2008 Climate Change Survey Base: 953

Forty percent of design firm respondents said climate change would "substantially affect" their building product choices in the future. This was significantly greater than the response from those at build firms (24%, at the 95% confidence level), as well as professionals at owning firms (33%, at the 90% confidence level).

Chart 2.3
From your experience, how much of a first-cost premium would be acceptable to your clients for building projects that effectively address climate change?



Source: BD+C/Reed Research Group 2008 Climate Change Survey Base: 953

The majority of respondents (56%) stated that a first-cost premium of 5% or less would be acceptable to their clients. These findings were statistically consistent across respondents from design, build, and owning firms, with one exception: 18% of respondents at build firms said there should be no premium to address climate change, vs. 13% of those at design firms (significant at the 90% confidence level).

called upon the federal government to "provide tax incentives for the homeowner to retrofit homes and build new homes with energy efficiency. Start at the source of consumption and work forward. Make it mandatory for building codes to have residential and commercial construction have reusable energy, i.e., geothermal, solar, to augment regular systems."

• **More government regulation.** Others called for immediate action in the form of regulations and code requirements. Milford Brinton, P.E., an electrical engineer in Tyler, Texas, said society must first reach reasoned consensus on what actions are needed, but "only regulations will promote equal sharing of the burden by all parties. Otherwise a great number will conduct business as usual because it is cheaper in the short run and the long run is meaningless to them."

James G. Woods, EVP of FGM Architects, Oak Brook, Ill., said, "If we really want to take a leadership position we should push for mandating compliance by updating building codes and providing incentives (financial and otherwise) and get out of the business of merely keeping score!"

• **Higher density projects.** Project planner E. Mack Elam, with Hammers + Partners: Architecture, Dallas, said that one solution is for developers to "promote higher densities and smaller footprints in projects," even though, in his opinion, "initial cost is still the primary factor in building projects."

• **Think globally, build regionally.** Henn Rebane, P.E., a consulting engineer in Tampa, Fla., noted that, due to regional variations in climate, population density, and related factors, "one size does not fit all. The effective initiatives will be those that are competently engineered for the geographic location and the site."

• **Go for green power.** "The way we produce and feed our power grid is the most important area for change," said Brian Beagle, a superintendent with K-Co Construction, San Diego. "Green power supplying the existing grid could change our world for the better."

• **Get the whole Building Team on board.** William Majeski, a senior electrical engineer with Kroeschell, Inc., Arlington Heights, Ill., put in a bid for M/E professionals, stating that sustainable design places a "significant emphasis" on building materials and siting, but "very little emphasis on improving the mechanical and electrical side of facility operation and the fabrica-

tion of the materials used in construction."

Kevin A. Sypher, a project manager with Pabco Construction, Farmingdale, N.Y., made the case for a bigger role for contractors in green development: "The contractors are the people who can make it happen. Until you try to purchase and install green products, you can not appreciate the problems associated with building green. We see many items specified that are either inappropriate or impractical just because they are green."

This theme also hit home with engineer Kenneth Govolko: "The idea that somehow architects alone drive the climate change [effort] is insulting to many engineers. It appears that the AIA is working to claim the architecture discipline has control alone in this initiative. I hope that they can learn to embrace engineers as their partners; otherwise meeting certain goals will take much longer."

• **Use commonsense solutions.** Don A. Smith, Jr., president of North Carolina's Rainbow Construction, advocated replacing all heating and air-conditioning units in the U.S.—perhaps funded with private donations and government grants—with more eco-friendly and efficient units. "This one step would be greater than changing all gas autos to electric," he said. "Even though solar and wind are becoming the darlings of the media left, more individuals and businesses could afford to replace or upgrade equipment with more energy-efficient units, using geothermal heat pumps as an example."

• **Give LEED a chance.** LEED tied with Energy Star for the highest rating (4.1 on a scale of 5) by respondents in terms of possible success in combating climate change (Table 2.8). "LEED has the best plan for addressing climate change," said Brad Saeger, project manager with Cleveland architecture firm ka inc. Paul

Table 2.8
From your experience, to what extent do you believe each of the following organizations and initiatives will be successful in combating climate change?

	Mean	Very successful (5 of 5)	Not successful at all (1 of 5)	Not familiar with this
U.S. Green Building Council (LEED)	4.1	39%	6%	4%
Energy Star (U.S. EPA)	4.1	33%	6%	5%
ASHRAE/IESNA/USGBC Standard 189	3.8	18%	6%	23%
American Institute of Architects	3.7	18%	7%	8%
Green Building Initiative (Green Globes)	3.7	15%	7%	23%
Construction Specifications Institute (GreenFormat)	3.6	13%	7%	19%
Architecture 2030	3.5	9%	7%	45%
STARS (AASHE)	3.5	8%	7%	38%
Associated General Contractors of America (EMS Program)	3.4	6%	7%	36%
Living Building Challenge (USGBC Cascadia Chapter)	3.4	6%	7%	54%
American Society for Healthcare Engineering	3.3	4%	7%	49%
California Global Warming Solutions Act of 2006	3.2	7%	10%	50%
Regional Greenhouse Gas Initiative (RGGI) – Northeastern States	3.2	4%	8%	54%
BOMA 7-Point Challenge	3.2	3%	7%	54%
International Council for Local Environmental Initiatives	3.1	3%	8%	55%
The Climate Project (Al Gore)	3.1	10%	17%	26%
U.S. Mayors Climate Protection Agreement	3.1	5%	10%	43%
Western Climate Initiative	3.1	3%	8%	58%
Kyoto Protocol	3.0	6%	15%	27%
Clinton Foundation Energy Efficiency Building Retrofit Program	3.0	5%	13%	47%
International Panel on Climate Change (IPCC)	3.0	4%	13%	42%
We Can Solve It	3.0	3%	8%	62%
Clinton Foundation Climate Change Initiative	2.9	5%	12%	47%

Base: 953

Source: BD+C/Reed Research Group 2008 Climate Change Survey

A score of 4.0 or more with a high percentage of 5's ("Very effective") indicates strong respondent support for this action.

Name recognition may account for high scores for the USGBC's LEED rating system and the U.S. EPA's Energy Star program, after which scores start to fall fairly precipitously. Brand loyalty may have figured in strong ratings for ASHRAE, the AIA, and the Construction Specifications Institute, but the GBI's Green Globes and STARS (from the Association for the Advancement of Sustainability in Higher Education) drew higher than expected results. In general, respondents from build firms recorded lower ratings for many of these initiatives than did those from design or owning firms. Many climate initiatives were unfamiliar to a high percentage (40% or more) of respondents.

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Sincerely,

Walter Marlowe, P.E., CSI, CAE
CSI Executive Director/CEO

P.S. Visit CSI at Greenbuild Booth #352 to learn more about GreenFormat™ and CSI's certificate and certification programs or visit us online at www.csinet.org.

GreenFormat

Fedors, of Los Angeles, noted that "LEED buildings are here to stay. Many developers demand LEED projects."

Toward a sustainable future

"In the United States the whole subject of climate change unfortunately brings with it a lot of political and industrial baggage," said Donald Briggs, AIA, president, Briggs Architecture + Design, Hamilton, Mont. "There are long-established business interests that will have to adapt in order to positively address climate change. Businesses, like people, are slow to adapt. The best way to start is with education based on nonpartisan facts."

Rather than adaptation, architect Bill Beard called for a seismic shift in values. "I believe that lifestyle and cultural expectations lie at the heart of this issue," said Beard, a faculty member at Pikes Peak Community College, Colorado Springs, Colo. "Sophisticated technologies and increasingly complex methodologies (such as USGBC commissioning) may seem like silver bullets, but I believe we will not achieve real accomplishments in net terms without disavowing the consumer evaluation standard, including shifting from a focus on Standard of Living to a focus on the Quality of Life."

Ami Daley, a construction coordinator with Evergreen Healthcare, Kirkland, Wash., argued that while climate change is "an issue of great importance," there may be more pressing global issues that require our attention. "The current cost to implement programs that may or may not effect a reduction in carbon emissions or the overall temperature is too high," she said. "There are larger issues that require the attention of the world and require less actual cost. Once larger issues such as hunger, health, poverty, and education are acted upon, the trickle-down effect [will be] less reliance on systems that pollute and tap natural resources."

We leave the last word to John McCreery, AIA, an architect with Fanning/Howey Associates, Celina, Ohio. "Good stewardship of the planet is the only way to a sustainable future," he said. "Good governance is positive, scientifically grounded people working together for a better life for all beings of our planet. It is faith in what we know, what we learn, and what we act upon that will bring about the transformation in cultures and political consciousness necessary for an equitable global future." BD+C

Table 2.9
Architecture 2030's mission is to galvanize *"both the building industry and the nation to adopt and implement … a global initiative stating that all new buildings and major renovations reduce their fossil-fuel, greenhouse gas-emitting consumption by 50% by 2010, incrementally increasing the reduction for new buildings to carbon neutral by 2030."* In your opinion, how feasible is it to achieve these targets?

The targets can be fully achieved according to Architecture 2030's target dates	10%
The targets can be largely but not fully achieved according to Architecture 2030's target dates	22%
Major greenhouse gas reductions will be made under Architecture 2030, but not as quickly as in the scheduled target dates	25%
Some greenhouse gas reduction targets will be met, but not at the level called for in Architecture 2030	27%
For the most part, Architecture 2030 will not meet its targets	17%

Base: 953
Source: BD+C/Reed Research Group 2008 Climate Change Survey

Respondents were remarkably consistent in their assessment of Architecture 2030's possible success across design, build, and owning firms, with two exceptions: 25% of those at design firms said that Architecture 2030 would "largely but not fully" achieve its goals, vs. 19% of those at owning firms (90% confidence level); and 20% of those at owning firms said Architecture 2030 would not meet its targets, vs. 14% of those at design firms (90% confidence level).

Table 2.10
From your professional experience, to what extent are the owners or controlling interests of each of the following building types supportive of or resistant to actions that combat climate change?

	Mean	Very supportive (5 of 5)
College/university buildings	4.4	35%
Government/military buildings	4.0	23%
K-12 schools	4.0	19%
Libraries	4.0	18%
Labs or research facilities	3.9	20%
Office buildings	3.9	19%
Hospitals/healthcare facilities	3.9	19%
Museums	3.9	14%
Residential (single-family homes)	3.7	14%
Mixed-use commercial facilities	3.7	10%
Airport/transportation facilities	3.6	8%
Residential (multifamily)	3.5	11%
Religious buildings	3.5	7%
Hotels/casinos/resorts	3.4	7%
Sports/entertainment/convention facilities	3.4	6%
Industrial/manufacturing buildings	3.3	8%
Retail/shopping centers	3.2	6%
Warehouse/distribution facilities	3.2	6%
Restaurants/fast-food chains	3.1	4%

Base: 953
Source: BD+C/Reed Research Group 2008 Climate Change Survey

A score of 4.0 or more with a high percentage of 5's ("Very supportive") indicates strong respondent support for this action.

It is not surprising to see owners of "college/university buildings" rated head and shoulders above all other building-type owners. Higher education facilities, along with government buildings and schools, have been the strongest performers in programs like LEED, Green Globes, and Energy Star. Note: Respondents rated owners of restaurants/fast-food chains with more 1's—"Very resistant"—(5%) than 5's—"Very supportive" (4%)

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www.oce.com/sustainability

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3. National Climate Change Initiatives

"Americans of all ages, all stations in life, and all types of disposition are forever forming associations," wrote Alexis de Tocqueville in his 1836 study of the new American nation, *Democracy in America*. One hundred seventy-two years later, Americans are still forming associations, including those devoted to climate change and the built environment.

Some of these groups come at the problem via specific types of buildings or developments—K-12 schools, retail stores, or university buildings and campuses, for example. Others target professional groups—architects, engineers, code officials. A few have been around for decades, while others are relatively new to the game. In this chapter, we look at national programs; in the next two, we examine regional and state and local initiatives.

ALLIANCE TO SAVE ENERGY

Promoting energy savings for three decades

The Washington, D.C.-based Alliance to Save Energy was founded in 1977 by the late Senators Charles Percy (R-Ill.) and Hubert H. Humphrey (D-Minn.) to promote energy efficiency through research, policy advocacy, and public outreach.

Three decades later, the bipartisan, nonprofit alliance is still pushing those goals through its coalition of more than 150 partners. ASE's partners include big-box retail outlets and other leading retailers, prominent state and local government officials, energy providers, academic institutions, national laboratories, trade organizations, and consumer groups.

ASE operates primarily within the U.S., although the organization has expanded its reach to more than 30 developing and transitional countries.

All ASE programs emphasize using energy wisely and eliminating waste. Here's a look at some of those programs that target the commercial building sector:

Alliance Data Center Program

Founded in 2006, the Alliance Data Center Program encourages energy-efficiency improvements to the nation's data centers, which consume more than 60 billion kWh of electricity a year—more than double the amount consumed in 2000—at a cost of about $4.5 billion per year. If the trend continues, energy consumption at the nation's data centers will nearly double again by 2011.

Those involved with the program continue to work on establishing data center efficiency standards and metrics and to raise awareness in Congress of data center energy use and opportunities to improve efficiency. The program contributed to the EPA-led Report to Congress on Server and Data Center Energy Efficiency (Public Law 109-431). Its report, "Data Center Energy Use: A New Energy Policy Frontier," can be downloaded at: http://ase.org/content/article/detail/4071

Appliance Standards Awareness Project

The Appliance Standards Awareness Project, a collaborative effort with the American Council for an Energy-Efficient Economy and the Natural Resources Defense Council, is dedicated to increasing support for appliance and equipment efficiency standards at the state and federal levels. Environmental NGOs, consumer groups, utilities, and state governments provide advice and technical support. More information: www.standardsasap.org

Commercial Buildings Initiative

The public-private Commercial Buildings Initiative was formed in 2006 around the idea of planning, coordinating, and implementing a comprehensive set of activities to transform energy performance in the commercial sector over the next 20-30 years. The program is aimed at creating a set of action plans that address the commercial sector by building type, climate, ownership, management, and stages in a building's life cycle. The action plans are an integral part of the national challenge to transform the energy efficiency of the built environment.

CBI's founding organizations include the ASE, the AIA, ASHRAE, Lawrence Berkeley National Laboratory, the U.S. Green Building Council, and the World Business Council for Sustainable Development.

More information: www.zeroenergycbi.org

Efficient Windows Collaborative

The goal of the Efficient Windows Collaborative is to increase market penetration of energy-efficient win-

dows in both the residential and commercial sectors. The EWC is pushing for energy performance rating and labeling among window manufacturers. It is working to educate builders, designers, and consumers about the benefits of energy-efficient windows and how to select the correct windows for various climates.

More information: www.efficientwindows.org

Government Energy Leadership Action Team

The federal government is the nation's single largest energy consumer—and energy waster. The main goal of the Alliance's Government Energy Leadership Action Team, established last year, is to develop new approaches to federal energy management in an effort to reduce the $4 billion needed to heat, cool, and power federal buildings and facilities.

More information: www.ase.org/section/program/gelat

Renewable Energy and Energy Efficiency Partnership

The Alliance serves as the North American Secretariat for the Renewable Energy and Energy Efficiency Partnership. REEEP serves as a platform for sharing energy efficiency expertise and best practices around the world. The ASE/REEEP partnership provides leadership in policies and regulations, project financing, program development, and outreach at the national, state, and local levels. More information: www.ase.org/section/program/reeep

Southeast Energy Efficiency Alliance

The Southeast Energy Efficiency Alliance, based in Atlanta, promotes energy efficiency within the southeastern U.S. SEEA is in Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, and Virginia.

SEEA partners include businesses, governments, public utility commissions, energy service companies, manufacturers, retailers, energy and environmental organizations, low-income energy advocates, large energy consumers, and universities. All partners agree to work together to promote energy-efficient policies and practices.

More information: www.seealliance.org

For more information on the Alliance to Save Energy: www.ase.org

ASHRAE, IESNA, AND THE U.S. GREEN BUILDING COUNCIL

ASHRAE Standard 189.1P

New standard would define 'green' in code language

Along with the Illuminating Engineering Society of North America and the U.S. Green Building Council, the American Society of Heating, Refrigeration, and Air-conditioning is proposing its first green building regulation, Standard 189.1P, "Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings."

The proposed standard will set minimum requirements for the design of new commercial buildings, major renovation projects, and new systems in existing buildings, addressing energy efficiency, a building's impact on the atmosphere, sustainable sites, water efficiency, materials and resources, lighting and daylighting, and indoor environmental quality. Based loosely on the USGBC's LEED green building rating system, Standard 189.1P has completed its second public comment period.

Proposed Standard 189.1P will essentially define minimum requirements for the design of high-performance buildings in code-intended language. Its sponsors hope that states, cities, and municipalities will adopt the standard (once it has passed) into their building codes, which would have an enormous impact on the number of new and renovated green buildings in the U.S.

The minimum recommendations currently in the draft standard 189.1P lead to site energy savings ranging from 10% to 41% over ASHRAE Standard 90.1 (2007), including plug and process loads and all other energy consumption for a building, with an average of 24.95% energy savings for all climates. The most recent version of the proposed standard also calls for indoor water savings of 35% for office buildings and 26% for multifamily buildings. Efforts have been made to coordinate the indoor air quality criteria with ASHRAE's IAQ Design Guide, and the commissioning criteria have been more closely aligned with ASHRAE's commissioning guidelines.

"It is not a rewriting of LEED into code language," said USGBC board member Mark MacCracken, vice chair of the standard committee and CEO of a thermal energy storage equipment maker in Fair Lawn, N.J. "It certainly has many fundamental elements of the USGBC and LEED in it, but there was a concerted effort to consider other elements of green building, and we've taken those comments quite seriously."

MacCracken said that later this year the committee plans to approve an independent substantive change (ISC) to the standard, which came out of the hundreds of comments that were received during the standard's second public review period. Changes are being made to the committee to bring more resources to bear on the complex challenges of a code-intended sustainability standard and another public review likely will be released in early 2009.

ASHRAE is an international organization of 50,000 engineers and professionals in 133 countries. IESNA, the recognized technical authority on illumination for more than 100 years, has 10,000 members; it is chiefly involved in the lighting and daylighting aspects of the proposed standard. The USGBC, with more than 17,000 member organizations, is the developer of LEED.

More information: www.ashrae.org

AMERICAN COLLEGE & UNIVERSITY PRESIDENTS' CLIMATE COMMITMENT
ASSOCIATION FOR THE ADVANCEMENT OF SUSTAINABILITY IN HIGHER EDUCATION
STARS – Sustainability Tracking, Assessment, and Rating System

Higher education tackles climate change

The American College & University Presidents' Climate Commitment (ACUPCC) provides the first framework for U.S. colleges and universities to go climate neutral. The sectorwide commitment recognizes higher education institutions that are developing plans to become carbon neutral and training students to develop the social, economic, and technical solutions to reverse global warming.

Presidents and chancellors who sign the commitment are pledging to reduce their campuses' greenhouse gas emissions. The institutions must:

- Complete an emissions inventory a year after signing
- Set a target date and interim milestones for becoming climate neutral
- Take immediate steps to reduce greenhouse gas emissions
- Integrate sustainability into the curriculum
- Make the inventory, action plan, and progress reports publicly available to ensure credibility

The implementation process takes about two years, but each institution sets its own timeframe to go carbon neutral. There are also educational, research, and service components to the commitment. Some schools might research solar panels; others might look at biofuels or efficient electricity generators. While ACUPCC provides guidelines, each institution decides the most effective approach to track its greenhouse gas emissions and evaluate whether the program has succeeded educationally.

"We don't want to dictate a particular approach," says Julian Dautremont-Smith, associate director of the Association for the Advancement of Sustainability in Higher Education (AASHE), which has been coordinating the program. "We need diversity."

How will ACUPCC affect Building Teams? Dautremont-Smith expects that signatory institutions are going to demand the most efficient buildings possible from their Building Teams. "New buildings obviously have a huge implication for carbon emissions," he says. "I would expect these schools to be looking at everything they could do to reduce energy consumption."

ACUPCC is developing a variety of resources to support signatory institutions. An online reporting tool allows each school to see how it compares to peer institutions in terms of energy usage. The Clinton Climate Initiative is also providing access to its bulk discounts with performance-contracting companies, financers, and energy-efficient products.

Since March 2007, when "The Call for Climate Leadership" was issued to all U.S. colleges and universities, more than 550 presidents or chancellors have signed the climate change commitment. After submitting its one-year greenhouse gas inventory, each institution will start working on its own action plan. ACUPCC aims to have 1,000 signatories by December 2009.

More information: www.presidentsclimatecommitment.org

STARS shine bright on AASHE campuses

STARS is the new climate change initiative from AASHE, the Association for the Advancement of Sustainability in Higher Education, a coalition of nearly 600 two-and four-year colleges and universities in the U.S. and Canada (as of 19 September 2008). STARS, which stands for "Sustainability Tracking, Assessment, and Rating System," is a comprehensive framework for gauging sustainability performance at colleges and universities. In contrast to LEED or Green Globes, STARS looks beyond greening campus buildings and addresses everything from food services, investment decisions, and academic courses to faculty and staff training, community services, and co-curricular education, such as holding sustainable freshman orientations.

The rating system was designed specifically to:

- Provide a guide for advancing sustainability in all sectors of higher education
- Establish a common standard of measurement for sustainability
- Create incentives for continual improvement toward sustainability
- Facilitate information sharing about sustainable practices and performance

"It's not just a green rating system," says Laura Matson, STARS program manager for AASHE. "We're looking at the triple bottom line—social, economic, and environmental dimensions."

The program has been in its pilot phase since February 2008, gathering feedback from over 90 participating campuses on how to tweak the credits and improve the rating system. Some credits are based on designing buildings to LEED standards, while others focus on generating electricity and on-site combustion, like biomass, from renewable sources. STARS hopes to create a rating system that can be applied fairly to all campus building types, including labs. Credits last for three years and must be updated.

STARS does not use third-party certification, so AASHE is taking extra precautions to ensure its credibility. First, every submission must be accompanied by a letter verifying its accuracy from the institution's president or chancellor. Then, a responsible party, such as a dining services manager, facilities manager, or campus engineer, has to sign off on each credit. Lastly, most of the data must be made public.

The pilot will end in December 2008, after which STARS will compile feedback and start the revision process with the hope to go live in the second half of 2009.

More information: www.aashe.org/about/programs.php

BUILDING OWNERS AND MANAGERS ASSOCIATION INTERNATIONAL
BOMA 7-Point Challenge
BOMA Energy Efficiency Program (BEEP)
BOMA Energy Performance Contract Model

BOMA seeks 30% energy savings in member buildings

The Building Owners and Managers Association International's climate change initiative focuses on energy efficiency in commercial office buildings, which account for 18% of GHG emissions in the U.S., according to the EPA. BOMA's 7-Point Challenge sets a goal for its members to reduce energy consumption by an average 30% across their property portfolios by 2012. That could save members $7.2 billion a year and remove 120 billion pounds of CO_2 from the atmosphere annually, BOMA says.

The objective was to set a goal high enough to have a significant impact on energy use and emissions while making it a realistic target for BOMA members, says Karen Penafiel, BOMA's VP of advocacy. BOMA officials believe the goal can be achieved at relatively modest expense to members, and that most costs can be offset by lower energy bills.

The 30% goal was derived from the EPA's Energy Star rating for commercial buildings. The energy reduction target was pegged to a building with a 50 Energy Star rating. (A 50 rating indicates that a building performs better than 50% of all comparable commercial buildings from an energy use perspective.) This scale was devised based on data from the national Commercial Building Energy Consumption Survey (CBECS), which is conducted every four years by the Energy Department's Energy Information Administration. A building with a 50 rating can reduce energy use by 30% "with the implementation of proven no- and low-cost strategies for optimizing equipment, people, and practices," Penafiel says.

In order to account for such factors as the age of buildings in a portfolio, local climate, and building occupancy, BOMA made the goal pertain to a company's entire holdings rather than to each building. Generally, Penafiel says, newer buildings tend to be more energy efficient, thus giving their owners an advantage. Properties in more temperate climates would be expected to use less energy, as would those with less than full occupancy.

The 7-Point Challenge includes a provision to conduct energy audits or retrocommissioning of properties. This is essential in order for a building's energy usage to be accurately benchmarked. Retrocommissioning can itself achieve considerable reductions in energy use (see Chapter 6).

As of 1 October 2008, 100 endorsers—45 private companies, 51 local BOMA associations, two state coalitions (California and Florida), and two public-sector members (EPA Energy Star and the Omaha-Douglas [Neb.] Public Building Commission) out of about 16,500 total had accepted the challenge. Penafiel said the effort is still in its early stages and that many of BOMA's biggest members in terms of square footage totals have committed to the challenge (see list).

Historically, one of the barriers to reducing energy usage in commercial buildings has been that many developers hold property only for a short time, which takes the incentive out of investing in highly efficient buildings and systems. BOMA is trying to change that mindset by emphasizing low- and no-cost strategies with a three- to-five-year payback, as well as more long-range

Key Points of BOMA's 7-Point Challenge

BOMA members who participate in the 7-Point Challenge pledge to:

1. Decrease energy consumption by 30% across their portfolios by 2012, as measured against an average building rated a 50 on the Energy Star benchmarking tool in 2007.
2. Benchmark energy performance and water usage at least once a year, through EPA's Energy Star benchmarking tool.
3. Provide education to managers, engineers, and others involved in building operations, to ensure that equipment is properly maintained and utilized.
4. Perform an energy audit or retrocommissioning (or both) of their buildings, and implement low-risk, low-cost, and cost-effective strategies to improve energy efficiency with high returns.
5. Extend equipment life by improving the operations and maintenance of building systems and ensuring equipment is operating as designed.
6. Help reduce their industry's contribution to global warming.
7. Position themselves as leaders and solution providers to owners and tenants seeking environmental and operational excellence.

BOMA 7-Point Challenge Private-Sector Endorsers

Advance Realty Group
Akridge
The Ashforth Company
Brookfield Properties
California Plaza
Carr Services
CB Richard Ellis
CNL Commercial Real Estate
Colonial Properties Trust
Cousins Properties
Coventry Health Care
Crescent Real Estate
Crescent Resources LLC
Crimson Services LLC
Cushman & Wakefield
Eastman Management Corp.
Glenborough LLC
Granite Properties Inc.
Hallmark Partners Inc.
Harbor Group Management Co.
Hines
The Irvine Company
LBA Realty
Liberty Property Trust
Lincoln Property Company
Lowe Enterprises Real Estate Group
Merritt 7 Venture LLC
MetroNational
Opus
Parkway Properties Inc.
Parmenter Realty Properties
PM Realty Group
RiverRock Real Estate Group
RREEF
Ryan Companies US Inc.
Shorenstein Properties LLC
Stream Realty Partners LP
Thomas Properties Group
Transwestern
Unico Properties LLC
USAA Real Estate Co.
Washington Real Estate Investment Trust
Wealth Capital Management Inc.
Wells Real Estate Funds
Zimmer Real Estate Services LC

strategies with seven- to 10-year paybacks, Penafiel said. "We recommend starting with lower-cost things and then using the savings to invest in longer-term things," she said. The association also offers the BOMA Energy Efficiency Program (BEEP) to educate members on how to build and operate greener buildings.

Tenant cooperation is crucial in order for building owners to meet the 7-Point Challenge. Since tenants typically control their office thermostats, light switches, computers, and other equipment, owners may have to provide them with incentives to reduce energy consumption. One such tool is BOMA's green lease, which includes language allowing building owners to pass through energy-efficiency improvements as operating costs to tenants if the improvements result in lower costs for tenants.

In June, BOMA joined the Clinton Climate Initiative in the development of a BOMA Energy Performance Contract Model to allow building owners to perform major energy retrofits in existing buildings. A pilot project with BOMA, CCI, and USAA Real Estate Company on two USAA buildings used a financial model developed by investment bank Hannon Armstrong to use the assets in the building as collateral and the guaranteed energy savings from the project to pay for the loan.

BUSINESS COUNCIL FOR SUSTAINABLE ENERGY

Group favors federal climate policy on energy efficiency

The Business Council for Sustainable Energy was created in 1992 by building product manufacturers, utility companies, and trade groups in the energy efficiency, natural gas, renewable energy, independent power, and electricity-generating field.

In terms of federal climate change policy, the BCSE's position is that:

- A federal program would be preferable to the current patchwork of state and regional programs, both regulatory and voluntary.
- Any such program should require use of alternative energy resources from clean energy and energy-efficient technologies.
- It should reward energy efficiency in existing and replacement energy infrastructure to fully maximize market-driven incentives for energy and environmental improvements.
- It should include a cap-and-trade or project-based approach that achieves both energy and climate objectives.
- Such a program should set near- and long-term targets to signal the marketplace and drive technology investment and innovation.
- The federal program should establish international linkages and allow for permit trading with comparable cap-and-trade and project-based initiatives in other parts of the world.

More information: www.bcse.org

CLINTON CLIMATE INITIATIVE

Energy Efficiency Building Retrofit Program

Climate initiative accelerates market for energy retrofits

Using a $5 billion financial commitment from lenders as seed money, the Clinton Climate Initiative (CCI) plans to double the global market for energy-saving building retrofits within 18 months.

In most cities, buildings account for 50% of GHG emissions, and as much as 70% in older cities, according to CCI. However, it is estimated that less than 1% of the energy retrofit market is being tapped in the U.S., and even less in European Union nations and Japan. The CCI program aims to change that by streamlining the approvals process, shortening project life cycles, concentrating work in target cities, staging projects, and reducing the cost of energy-efficient products used in the retrofits.

CCI's Energy Efficiency Building Retrofit model is based on performance contracting. After conducting an audit, an energy service company (ESCO) proposes a turnkey, energy-saving retrofit and a performance standard that the retrofit will achieve. The maximum cost and the energy savings for the retrofit are guaranteed by the ESCO, which agrees either to compensate the building owner for any shortfalls or to do additional retrofitting in order to achieve the specified performance targets. The energy savings are guaranteed for a period of time longer than that needed to pay back any loans made to fund the retrofit's costs.

The model allows building owners to receive up to 100% financing for the initial capital costs. Energy sav-

ings of 20-50% are targeted for the retrofits.

The retrofit initiative, which former President Clinton's foundation launched in 2007, works with the C40 Large Cities Climate Leadership Group, a partnership of 40 cities worldwide that are working together to address climate change. Five U.S. cities are members: Chicago, Houston, Los Angeles, New York, and Philadelphia.

CCI initially partnered with five global financial institutions—ABN AMRO, Citi, Deutsche Bank, JPMorgan Chase, and UBS—that agreed to lend funds to cities and private owners for retrofits. The institutions each pledged $1 billion toward a $5 billion pool.

CCI is also working with a number of global energy service companies—including Honeywell, Johnson Controls, MCW Custom Energy Solutions, Schneider Electric, Siemens, and Trane—which have agreed to scale up their capacity to do retrofits across the participating cities. CCI hopes to expand the program to local energy companies and banks in each C40 city.

CCI and BOMA are also collaborating on a new BOMA Energy Performance Contract Model. Earlier this year, BOMA, CCI, and USAA Real Estate Company conducted a pilot energy program on two USAA buildings, which enabled them to reduce the time and complexity required by the model contract. Working with investment bank Hannon Armstrong, a CCI partner, a financial structure was developed that uses

Advocacy groups push for energy-efficient codes

Building and energy codes are one dimension of the climate change discussion that directly affects designers, builders, building owners, and developers. Several code-related initiatives currently under way focus heavily on energy conservation's contribution to mitigating climate change.

ENERGY EFFICIENT CODES COALITION

The 30% Solution

One of the quickest paths to an energy-efficient future for America's built environment just may be through more-stringent building codes. That's the mantra of the Energy Efficient Codes Coalition (EECC), a Washington, D.C.-based advocacy group formed in mid-2007 to push for the greening of the nation's major building codes.

EECC's initial campaign, called "The 30% Solution," aimed to achieve a 30% boost in residential energy efficiency in the 2009 version of the International Code Council's International Energy Conservation Code (IECC)—the nation's predominant model energy code governing new home construction. EECC's plan, which was backed by a number of government agencies and trade groups, including the U.S. Department of Energy and the U.S. Conference of Mayors, called for the adoption of a comprehensive package of energy-efficiency amendments to the 2006 version of IECC. These proposals would:

- Lower U-factors and solar heat gain coefficients in southern climates to improve window efficiency
- Improve R-value requirements in ceilings, floors, and walls that are tailored to the needs of specific climate zones
- Revise ceiling, frame wall, and floor U-factor requirements
- Increase hot water heater efficiency
- Call for more specific thermal bypass, air sealing, and insulation installation requirements
- Require validation testing to make homes tighter and more efficient
- Eliminate excessive trade-off credit for low-performing HVAC equipment
- Require energy-efficient lighting

In late September 2008, the International Code Council voted on all proposed amendments to the 2009 IECC at a final action hearing in Minneapolis. The results were both bitter and sweet for the EECC, according to EECC Director William Fay.

"Our comprehensive proposal to meet the 30% goal fell just a few votes shy of the two-thirds needed for adoption," said Fay. Principal opponents argued that now isn't the time to adopt the 30% Solution because it would be too costly to homeowners, technologically unachievable, and burdensome to code officials.

But there's a silver lining, said Fay: More than 60% of those participating voted in favor of the EECC package, and a majority of code and other governmental officials consistently backed individual proposals representing an unprecedented increase in new home energy efficiency. Thanks in part to EECC efforts, the 2009 IECC will have several significant new provisions to boost energy efficiency in new residential buildings:

- Increased insulation in basements, floors, and walls
- Improved window efficiency
- Reductions in wasted energy from leaky heating and cooling ducts
- Reductions in tradeoffs that fail to capture energy savings from efficient heating and cooling equipment
- High-efficiency lighting
- Improved air sealing within the building envelope

What's next for EECC? EECC and its partners already are planning for 2012—the next code update cycle. "We will continue to expand our coalition so that when the time comes for a new code cycle, we'll have even better proposals and, hopefully, an even broader consensus," said Fay.

In the meantime, the coalition will make the 30% Solution available for states that want to go beyond the 2009 IECC.

More information: http://thirtypercentsolution.org

BUILDING CODES ASSISTANCE PROJECT

A project of the Alliance to Save Energy, the Natural Resources Defense Council, and the American Council for an Energy-Efficient Economy, the Building Codes Assistance Project (BCAP) promotes the adoption, implementation, and utilization of energy-efficient building codes and standards in the U.S. Funded primarily by the U.S. Department of Energy, BCAP provides on-site assistance to state and local government officials, customizes adoption and implementation strategies to state needs, and promotes education and technical support for energy code compliance.

More information: www.bcap-energy.org

RESPONSIBLE ENERGY CODES ALLIANCE

Administered by the Alliance to Save Energy, the Responsible Energy Codes Alliance (RECA) is a consortium of energy-efficiency professionals, product and equipment manufacturers, and trade associations that urges states and local jurisdictions to adopt and implement the most recent International Energy Conservation Code.

More information: www.reca-codes.org

the assets in the building as loan collateral, rather than the building itself.

Other partners in the CCI energy-efficiency retrofit program include GE Real Estate, which has a portfolio of 385 million sf in 31 countries. The company is identifying retrofit opportunities among its buildings in the participating C40 cities.

CCI education programs. The Clinton Climate Initiative is working with the U.S. Green Building Council in the development of a Green Schools Program to reduce energy use in K–12 schools. A similar CCI program with the American College and University Presidents' Climate Commitment is addressing energy retrofits in hundreds of higher-education buildings. ASHRAE is partnering with CCI to develop local training programs in the participating cities. The training will focus on installation and maintenance of energy-saving and clean-energy products.

CCI purchasing consortium. The CCI's purchasing consortium, which pools the buying power of the C40 cities, has negotiated discounts with more than 25 manufacturers of energy-efficient products, including lighting, chillers, solar control films, and cool roofing. Discounts range from 5% to 40%.

The CCI is also working to create common measurement and information flow tools that will allow cities to establish baselines and track the effectiveness of their emissions reduction efforts. Microsoft is partnering with CCI to develop Web-based tools for monitoring emissions. The software, which will be supplied at no cost to the cities, will provide a universal and uniform methodology to track the cities' emissions from their fuel and electricity consumption.

"The businesses, banks, and cities partnering with my foundation are addressing the issue of global warming not only because it's the right thing to do, but also because it's good for their bottom line," Clinton said at the retrofit program's launch last year. "They're going to save money, make money, create jobs, and have a tremendous collective impact on climate change all at once."

More information: www.clintonfoundation.org; buildingretrofit@clintonfoundation.org

COLLABORATIVE FOR HIGH PERFORMANCE SCHOOLS (CHPS)

CHPS green schools program goes national

Founded in 2000 by the California Energy Commission, several other state agencies, and five major utilities as part of an effort to reduce energy usage in California's K-12 school buildings, the Collaborative for High Performance Schools (CHPS) has quietly blossomed into one of the green building movement's more influential and productive initiatives.

Its CHPS Criteria, the nation's first green building rating system for K-12 schools, has been mandated for use in 30 school districts in California for all new school projects, and a half-dozen more formally reference the CHPS Criteria and technical resources when building high-performance schools. To date, 90 CHPS-designed schools have been completed, and 300 are under way.

"We really don't know how many projects are going on, because not all school districts register their projects with us," said Kristin Heinen, CHPS assistant director. Because CHPS is largely a free, self-certification system (the organization unveiled a third-party review option in 2007), many school districts use the program criteria and Best Practices Manual as a framework for designing high-performance schools. "They're not looking for recognition," said Heinen. "All we know is that the actual number of CHPS schools is a lot more than 390."

While the lion's share of CHPS projects are located in California, the San Francisco-based nonprofit has expanded its reach into 10 other states—Colorado, Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, Texas, Vermont, and Washington, with Arizona, Florida, and Oregon also considering formal partnerships.

The development of the LEED for Schools program by the USGBC will probably have an impact on possible national adoption of the CHPS Criteria. Ohio, for instance, mandates LEED Silver for all public K-12 schools. Heinen said the CHPS board is just fine with that. "As long as every [child] is in a high-performance school, whether it be CHPS, LEED, or Green Globes, we're here to help them," she said.

CHPS revises its criteria every three years. The 2009 edition, due out early next year, will include 30 new credits, covering everything from planning school gardens to creating safe routes of passage to schools. CHPS is also adding a Climate category that will award points for schools that measure and report GHG emissions through the California Climate Action Registry, as well as schools that are net-zero energy performers.

With funding from the U.S. EPA and the U.S. Department of Energy, the organization is also developing a green products database for K-12 schools and an online, interactive program for benchmarking and improving the performance of existing schools.

More information: www.chps.net

CONSTRUCTION SPECIFICATIONS INSTITUTE

GreenFormat

GreenFormat: A new tool in green product evaluation

After more than two years of planning, development, and testing, the Construction Specifications Institute will launch version 1.0 of its much-anticipated GreenFormat product sustainability information reporting guide this month at Greenbuild in Boston. The guide will offer a free searchable database of hundreds—and eventually thousands—of green building products and systems for the construction market.

Like its MasterFormat system, GreenFormat is not a product evaluation system. Rather, it is a framework for organizing products and systems based on individual properties—in this case, sustainable properties.

"What drove the development of GreenFormat is the fact that so many designers are trying to gather information on green products by submitting questionnaires to manufacturers asking about their products," said Roger Grant, CSI technical director. The goal, said Grant, is to "collect and organize that basic information to make it more efficient for specifiers and designers to research and evaluate green products."

The database will be open to any manufacturer that wants to list its products, not just those that have been handpicked because their products meet specific standards. The submission process is designed to be simple and straightforward. As a result, CSI anticipates a high level of participation from building product manufacturers (150 of which participated in beta testing), as well as a steady stream of users who are already familiar with CSI's MasterFormat system.

To submit a product, product manufacturers will complete an online questionnaire that collects all pertinent sustainable information and organizes it into 14 searchable categories. For instance, categories 1-3 will list general information like product name and manufacturer by MasterFormat number, while categories 6-12 will organize products by key sustainable attributes, such as the product's composition, embodied energy, life cycle properties, and operations-related performance.

The system is designed to provide manufacturers with a consistent, easy-to-use platform for defining the sustainable attributes of their products. It will give specifiers a method for evaluating green products that's more efficient and thorough than wading through product brochures and spec sheets.

GreenFormat will not require third-party testing to validate the manufacturers' green claims. Instead, CSI, with the help of BuildingGreen Inc., Brattleboro, Vt., will perform random information checks on product listings. The database tool will also feature a feedback loop for users to report questionable information and a process for investigating claims.

More information: www.csinet.org; www.greenformat.org

GREEN BUILDING INITIATIVE

Green Globes

GBI develops ANSI standard, new Web tools

In 1996 the Building Research Establishment's Environmental Assessment Method (BREEAM) was brought to Canada and became the basis of the Green Globes assessment and benchmarking tools in use today. In 2004 the Green Globes tools were licensed by the Portland, Ore.,-based nonprofit Green Building Initiative and introduced to the U.S. market a year later. The GBI also promotes the use of the National Association of Homebuilders' (NAHB) Model Green Home Building Guidelines.

Green Globes is an online tool that can be customized by project phase and the role of the user in the design team (architect, mechanical engineer, building owner, and others). Environmental impact is assessed on a 1,000-point scale in these categories: energy, indoor environment, site impact, water, resources, emissions, and project/environmental management. Ratings are given as one Green Globe (36% of available points), two (56%), three (71%), or four (86% or more).

Green Globes has two separate modules: New Construction and Green Globes for Continual Improvement of Existing Buildings. Both are Web-based and require no consultants or training. The GBI also offers products to enhance Green Globes, such as a life cycle assessment calculator tool available for free at the Green Globes website.

"We have a very different product offering from any other green building rating system out there," said Vicki Worden, the GBI's VP of commercial programs and business. "Our tools can be used by facilities managers, building owners, and anyone involved in the construction or operation of a commercial building."

The online system keeps all project documentation in a central database, so the GBI can track certified projects and individual users that might have more than one certified project. The system integrates the Environmental Protection Agency's Target Finder program for design and operation of green buildings based on operational performance data.

An early reporting mechanism determines—during schematic design and when construction documents are created—if projects are on track for certification. The reports also summarize achievements and provide recommendations for improvement.

Eighteen states have recognized Green Globes as an accepted green building rating system or have folded it into green building legislation. There are 19 Green Globes-certified commercial buildings in North America. To date, 323 homes have been certified under Green Globes, with 832 more scheduled for completion by the end of 2008.

American National Standard 01-200XP: Green Building Assessment Protocol for Commercial Buildings will incorporate several new elements developed by the GBI ANSI Standards Committee and subcommittees, Worden said. These include a requirement to achieve a minimum number of points in each of Green Globes' seven areas of assessment (rather than a percentage).

This past July, real estate management firm Jones Lang LaSalle acquired EDC Energy and Environment Canada, which developed Green Globes and licensed it to the GBI. According to GBI executive director Ward Hubbell, "The GBI will continue to oversee and administer Green Globes, and our work with ANSI … will continue unchanged."

With regard to climate change, the standard proposes a change to the energy section of Green Globes where CO_2 will be used as the basis for calculating the performance path of a building instead of relying solely on projecting kBtu/sf per year of energy consumed. The standard will continue to rely on the Energy Star's Target Finder program, as Green Globes does now, but will require the calculation of CO_2eq and the achievement of a minimum number of points. Hubbell said the group hopes to have the new standard approved by the end of the year.

More information: www.thegbi.org; www.greenglobes.com

RETAILER ENERGY ALLIANCE

Retail giants ally to promote energy efficiency

Retail buildings in the U.S. account for about 20% of commercial sector energy consumption and represent a major subsector of the commercial building market. Because major retailers build multiple buildings using essentially the same or very similar designs, they can quickly adopt energy-efficient and renewable energy strategies for their stores, supermarkets, and big-box outlets.

The Retailer Energy Alliance is one of four commercial buildings alliances created by the U.S. Department of Energy. (The DOE is a sponsor of this White Paper.) Each alliance is managed by the stakeholders of their respective industries. The REA was the first to convene a meeting of its members, in February 2008; the other three alliances (commercial real estate, commercial building industry, and institutional) have not yet had any meetings.

The REA steering committee is composed of representatives from such key retailers as Best Buy, Food Lion, Home Depot, Kohl's, McDonald's, Safeway, Target, Wal-Mart, and Whole Foods Market, as well as the American Society of Heating Refrigeration and Air-conditioning Engineers (ASHRAE) and the Illuminating Engineering Society of North America (IESNA). The alliance promotes the use of energy-efficient technologies and management best practices for retail operations. The DOE coordinates and supports REA programs and initiatives and provides technical expertise through its national laboratories.

On 5 June 2008, the REA held a supplier summit in Golden, Colo., site of the DOE's National Renewable Energy Laboratory, to identify the energy-efficiency needs of retailers and challenge suppliers of HVAC and refrigeration, lighting, and other retail equipment to find ways to meet those needs.

The REA steering committee has identified several areas of interest for further research:

- Rightsizing HVAC and refrigeration equipment and systems
- Rooftop HVAC equipment
- Refrigerated display cases
- Interior and exterior lighting systems
- Process and plug loads, including maintenance equipment, electronic displays, and cooking equipment
- Building-integrated renewable energy supply systems
- Central or building-level energy management systems

More information: www1.eere.energy.gov/buildings/retailer/

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As one of the largest public real estate organizations in the world, the U.S. General Services Administration's Public Buildings Service is a leader in sustainability and green design. GSA is the landlord for the federal civilian government, and its portfolio of more than 8,600 owned and leased properties totals 352 million rentable square feel of workspace. In managing these assets, GSA is committed to excellence in energy conservation and sustainable design.

Consider these facts:

- GSA's first green roof was installed in 1975
- The first renewable energy purchase occurred in 1991
- GSA's first LEED certified building dates back to 2002
- In 2007, GSA saved $46 million through recycling
- Today, GSA has 25 LEED certified buildings in its inventory
- Today, GSA has 118 Energy Star-labeled buildings
- To date, GSA has reduced energy use by 8 percent since 2003
  That is on top of a 30 percent reduction since 1985!

Energy conservation and environmental stewardship are among the agency's highest priorities. All new GSA construction and major renovation projects must be LEED certified, ideally at the LEED Silver level or better. This is also the case for lease construction projects. The Energy Independence and Security Act of 2007 requires federal agencies, beginning in 2010, to lease space in Energy Star-labeled buildings. It also stipulates a fossil-fuel-generated energy reduction of 55 percent in federal buildings in 2010 with further reductions in five-year increments so that, by 2030, federal buildings use no fossil fuels. The private-sector design and construction industry will play a key role in helping the government meet these goals.

Recent projects demonstrate GSA's success in sustainability and green design:

- The San Francisco Federal Building is a model of sustainable design with natural light in 85 percent of the offices and natural ventilation cooling the 18-story tower from the sixth floor up.
- The Environmental Protection Agency's Regional Headquarters in Denver uses one-third less energy and water than buildings of comparable size and boasts downtown Denver's first green roof.
- The Binghamton Federal Building in New York State is the first federal facility to be powered by 100 percent renewable energy, from a wind farm in nearby Fenner, New York.

San Franciso Federal Building

Regional Headquarters,
Environmental Protection Agency, Denver

WaterSense promotes water efficiency

Launched in 2006, WaterSense is designed to promote water efficiency and enhance the market for water-efficient products, programs, and practices. Sponsored by the U.S. Environmental Protection Agency in partnership with manufacturers, retailers, distributors, and utility companies, the program rates more than 100 WaterSense-labeled faucets and faucet accessories (which are about 30% more efficient than standard faucets) and 170 toilets (which are about 20% more efficient than standard toilets). All products are independently tested and certified to meet EPA criteria for efficiency and performance. More information: www.epa.gov/watersense

U.S. ENVIRONMENTAL PROTECTION AGENCY AND U.S. DEPARTMENT OF ENERGY
Energy Star

Energy Star: 40 million tons of GHG reductions

Energy Star, a joint venture of the U.S. Environmental Protection Agency and the U.S. Department of Energy, was founded in 1992 to create national guidelines for rating energy efficiency. The program supports the position that improved energy efficiency in buildings is one of the most cost-effective ways to reduce GHG emissions.

Last year alone, Energy Star's list of energy-efficient products, practices, and policies eliminated 40 million metric tons of GHG emissions—equivalent to the annual emissions from 27 million vehicles—and saved more than $16 billion in utility costs.

To date, more than 62,000 buildings representing 7.5 billion sf have earned the Energy Star rating, putting them in the top 25% of energy efficiency in their class. The DOE reports that Energy Star-qualified buildings in the U.S. include 55% of hospital space, 52% of supermarket space, 31% of office space, 24% of school space, and 24% of hotel space.

One program aimed squarely at the nonresidential construction market is the Energy Star Challenge, which calls for businesses and institutions to reduce energy use by at least 10%. So far, more than 800 entities, including 150 local governments, the National Association of Counties, and the U.S. Conference of Mayors, have accepted the challenge.

Some 5,000 residential builders are constructing new Energy Star–qualifying homes. To date, more than 840,000 new homes are Energy Star-compliant.

More than 550 utilities in more than 40 states leverage Energy Star programs, as well as hundreds of energy service providers, home energy raters, financial institutions, architects, and engineers committed to energy-efficient buildings.

More than 2,000 product manufacturers collectively make 40,000 products (in more than 50 categories) that bear the Energy Star label. The ratings are designed to serve as validation that a product is anywhere from 10% to 25% more efficient than equivalent products that do not bear the Energy Star label.

More information: www.energystar.gov

U.S. GREEN BUILDING COUNCIL
LEED 2009

LEED 2009 targets climate change impacts

The U.S. Green Building Council's Leadership in Energy and Environmental Design rating system is just completing its most exhaustive rewrite since LEED was launched a decade ago—and climate change figures prominently in this revision.

LEED 2009, the technical rating portion of LEED Version 3 (LEED v3), will go from its current point system to a 100-point scale (plus 10 "bonus" points). LEED 2009 puts its greatest emphasis on Sustainable Sites (26 points) and Energy & Atmosphere (35 points). In earlier versions of LEED, Sustainable Sites accounted for 14 of 64 "base points" (not counting Innovation & Design Process), or less than 22%; in LEED 2009, it represents 26% of the 100 base points. E&A credits in LEED 2009 count for 35% of base points, versus 27% in previous versions.

This was no arbitrary decision. The LEED Steering Committee, under chair Scot Horst and vice-chair Joel Ann Todd, put LEED through a rigorous evaluation to determine the human and environmental impacts of LEED credits. This process, developed by the U.S. Environmental Protection Agency and known as TRACI (for "Tool for Reduction and Assessment of Chemical and Other Environmental Impacts"), enabled the LEED Steering Committee to rank "impact categories"—such as resource depletion, ecotoxicity, smog formation, indoor air quality, etc.—in terms of human and environmental considerations.

From that exercise, the Steering Committee named climate change the number one TRACI impact category as far as LEED 2009 was concerned.

Once that determination was made, the Steering Committee went through a "weighting" process developed by the National Institute of Standards & Technology which enabled the committee to put greater "weight" on those parts of LEED that could most readily impact climate change. This led to 61% of the base points going to Sustainable Sites and Energy & Atmosphere.

As for the 10 "bonus" points, up to six may be awarded for innovation and design. The other four will come from a list suggested by local USGBC chapters and alliances. In drought-stricken regions, for example, extra points might be given for water conservation.

More information: www.usgbc.org/displaypage.aspx?cmspageid=1849

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As the nation's leading utility in energy efficiency, renewables and electric transportation, Southern California Edison (SCE) is always looking for ways to provide reliable service to our customers as we "green" the electricity grid.

Energy efficiency is the most practical approach to greenhouse gas reductions, and it is among the most cost-effective, near-term approaches available to us. At SCE, we've spent the last 25 years building our energy-efficiency programs to help our customers save energy and reduce their bills. During the past five years, our energy-efficiency programs have saved more than five billion kilowatt-hours – that's enough energy to power 700,000 homes for an entire year, and the equivalent greenhouse gas reduction of removing 375,000 cars from the road. From 2009-2012, we will install 5.3 million new "smart" communicating meters for our residential and small-business customers. Our Edison SmartConnect program is just another way we help empower those we serve to become smarter energy consumers.

SCE also leads the nation's utilities in renewables, with 16 percent of the energy mix it delivers to its customers from solar, wind, small hydropower, biomass and geothermal sources. In 2007, SCE bought nearly 13 billion kilowatt hours of renewable energy on behalf of its customers. As our renewable portfolio increases, we're looking for ways to bring that power to our customers. We've embarked on SCE's Tehachapi Renewable Transmission Project, the nation's largest wind project of its kind, to tap new renewable energy resources. When completed, the project will deliver as much as 4,500 megawatts of wind energy to SCE customers, enough to serve nearly three million households.

Our latest innovation has been the world's largest utility photovoltaic project, which eventually will cover two square miles of industrial rooftops with solar panels. The result will be up to 250 megawatts of emission-free power flowing through the grid.

SCE is also at the forefront of technology, as it operates the nation's largest private fleet of electric vehicles – about 300 – and partners with major automakers to help ready the plug-in hybrid electric vehicle for the mass market.

We are thrilled to partner with *Building Design+Construction* in this white paper. Together, we can find even more solutions in the quest for a cleaner, greener future.

Sincerely,

Gregg D. Ander, FAIA, Chief Architect
Southern California Edison

www.sce.com

ARCHITECTURE 2030

Mazria challenges his fellow architects: zero emissions from buildings by 2030

In January 2006, the nonprofit, nonpartisan Architecture 2030 organization issued its global "2030 Challenge," calling on the building industry to reduce fossil fuel consumption and greenhouse gas emissions and make all new construction and major renovations carbon neutral by 2030.

The Challenge, along with the organization's "2030 Blueprint" and "2010 Imperative," lays the groundwork for a comprehensive, 24-year-long program to make commercial and residential buildings carbon neutral.

Architecture 2030 is the brainchild of architect Edward Mazria, AIA, who founded the Santa Fe, N.M.-based organization in 2003 in an effort to rally the building industry around a measurable program to address climate change.

Buildings are the single largest contributor to global warming. According to the U.S. Energy Information Administration, buildings account for 48% of all energy consumption and greenhouse gas emissions annually, and they use 76% of all electricity produced by power plants.

The fact that the U.S. building stock is constantly in flux presents a huge opportunity for change, according to the Architecture 2030 organization. Each year approximately 1.75 billion sf of the nation's 300 billion sf of building space is razed and replaced with approximately five billion sf of new building space. Add to that the fact that about five billion sf of building space is remodeled each year, and that means by 2035, three-quarters (75%) of the built environment will be either new or significantly renovated. The building industry has a historic opportunity to rebuild itself in environmentally responsible ways that ultimately lead to carbon neutrality.

Meeting the 2030 Challenge

The ambitious 2030 Challenge calls for an immediate 50% reduction in fossil fuel consumption and GHG emissions in both new buildings and those undergoing major renovations (50% reductions are based on averages for the building type and location, information that's available through the EPA's Target Finder[1]). Equally important, the challenge calls for additional 10% reductions every five years, targets that the building industry needs to meet in order to reach the 2030 goal.

The targets for 10% reductions in fossil fuel consumption and GHG emissions are:

- 60% reduction by 2010
- 70% reduction by 2015
- 80% reduction by 2020
- 90% reduction by 2025
- Carbon neutrality (no greenhouse gas emissions) by 2030

Architecture 2030 recommends that the initial 50% reduction be achieved through design (building shape; orientation; natural heating, cooling, ventilation, and daylighting; proper shading; and off-the-shelf energy-efficiency measures), use of renewable energy technology, and the purchase of energy from renewable sources (maximum 20%). Helpful reduction strategies are also available through the American Institute of Architects, through its 50to50 program (Table 3.1).

Because Architecture 2030's role is primarily one of research and education, the success of the 2030 Challenge depends on its adoption—and enforcement—by key members of the building sector who are responsible for tracking and monitoring how successfully its members meet the challenge goals. Major organizations that have adopted the challenge include:

- American Institute of Architects
- American Society of Heating, Refrigeration and Air-Conditioning Engineers
- California Public Utilities and Energy Commission
- Congress for the New Urbanism
- Department of Energy
- Environmental Protection Agency
- International Council for Local Environmental Initiatives
- National Association of Counties
- U.S. Conference of Mayors
- U.S. Green Building Council (which is moving toward reissuing its LEED certification to incorporate the targets)
- Various state and local governments, including California, Illinois, Minnesota, and New Mexico (Oregon and Washington are recommending adoption) and the cities of Albuquerque, N.M.; Richmond, Va.; Santa Barbara, Calif.; and Seattle

The 2030 Challenge was also recently adopted by the nation's largest building owner: the U.S. government, which included the targets in the Energy Independence and Security Act of 2007, which became law on 19 December 2007. While the law puts the government on track to making all federal buildings carbon neutral by 2030, the government's targets call for meeting a 55% reduction (rather than 60%) in fossil fuel consumption and greenhouse gas emissions by 2010. Then, incrementally, all government buildings will achieve carbon neutrality by 2030.

Last year, Architecture 2030 developed a baseline against which organizations can establish reduction targets (Table 3.2). The measurements are based on the 2003 Commercial Building Energy Consumption Survey and the Residential Energy Consumption Survey, and include "code equivalents," which outline additional reductions needed beyond the requirements of a particular code, standard, or rating system to meet or exceed the Challenge's initial 50% reduction targets.

The 2030 Blueprint

Designed to work in conjunction with the 2030 Challenge, the 2030 Blueprint is a five-step action plan that recommends additional—some might say radical—steps for reaching carbon neutrality.

One of the Blueprint's main targets is coal-fired power plants, which, according to the U.S. Energy Information Administration, produce about half the nation's electricity and are responsible for 81% of the energy sector's CO_2 emissions.

The Blueprint's first recommendation is aimed squarely at the coal industry:

1. Place a moratorium on the construction of new coal-fire power plants, and gradually phase out all existing conventional coal plants by 2030. This would result in an immediate cap on coal plant emissions that would provide breathing space to retrain coal workers for new jobs.

2. Require that all building projects using federal funds meet the 2030 Challenge targets, creating additional building energy-efficiency models for the marketplace.

3. Upgrade the National Energy Conservation Code Standard to 2030 Challenge targets for residential and commercial buildings, which would immediately stabilize and then begin reducing energy demand in the building sector.

4. Invest $21.6 billion each year for five years in building efficiency measures through existing federal programs (new market tax credits, low-income housing tax credits, and a five-year extension and

increased funding for efficiency in the Energy Policy Act) and new energy-efficiency incentives, tax credits, and programs to:

- Stimulate building construction
- Reduce annual building sector energy consumption by 5 quadrillion Btu
- Reduce annual CO_2 emissions by 433.5 billion tons
- Save consumers $128 billion (to cover the cost of this solution)
- Create more than one million new jobs in the building industry and related fields

5. Fund and implement a joint labor-management job training program for displaced coal industry workers based on successful models developed over the past two decades in the tire/rubber, steel, automotive, and communication industries.

The 2010 Imperative

The 2010 Imperative is aimed at educating the next generation of design and construction professionals in the importance and fundamentals of creating carbon-neutral buildings. Architecture 2030 found that that ecological literacy—which should be a central tenet of design education—was lacking in many architecture school curricula, so they challenged the academic design community to transform their programs by adopting one of two program paths:

Path A

Beginning this year, adopters of Path A commit to adding to all design studio problems the requirement that:

- The design engage the environment in a way that dramatically reduces or eliminates the need for fossil fuel
- Students achieve complete ecological literacy in design education by 2010, including design/studio, history/theory, materials/technology, structures/construction, and professional practice/ethics

Path B

Adopters of Path B commit to Path A and agree to:

- Achieve a carbon-neutral campus for the design school by 2010 by implementing sustainable design strategies (optional LEED Platinum/2010 rating), generating on-site renewable power, and purchasing green renewable energy or certified renewable energy credits (RECs, green tags; 20% maximum) or a combination of renewable energy and energy credits.

1. www.energystar.gov/index.cfm?c=new_bldg_design.bus_target_finder

Table 3.1
AIA's 50to50 Program

1. Active solar thermal systems	26. Integrated project delivery
2. Alternative energy	27. Life cycle assessment
3. Alternative transportation	28. Mass absorption
4. Appropriate size and growth	29. Material energy and embodied energy
5. Building form	30. Natural ventilation
6. Building monitoring	31. Open, active daylit spaces
7. Building orientation	32. Passive solar collection
8. Carbon offsets	33. Photovoltaics
9. Cavity walls for insulating airspace	34. Preservation/reuse of existing facilities
10. Cogeneration	35. Radiant heating and cooling
11.Conserving systems and equipment	36. Renewable energy resources
12. Construction waste management	37. Rightsizing equipment
13. Cool roofs	38. Smart controls
14. Deconstruction and salvage materials	39. Space zoning
15. Daylighting	40. Staff training
16. Earth sheltering	41. Sun shading
17. Efficient artificial lighting	42. Systems commissioning
18. Efficient site lighting systems	43. Systems tune up
19. Energy modeling	44. Thermal bridging
20. Energy source ramifications	45. Total building commissioning
21. Energy-efficient appliances and equipment	46. Vegetation for sun control
22. Environmental education	47. Walkable communities
23. Geoexchange	48. Waste-heat recovery
24. Green roofs	49. Water conservation
25. High efficiency equipment	50. Windows and openings

Source: www.aia.org/fiftytofifty

The American Institute of Architects created its 50to50 resource to give architects and others aligned with the industry 50 strategies for achieving the 50% reduction in fossil fuel consumption and greenhouse gas emissions called for in the 2030 Challenge.

Table 3.2
Architecture 2030 Challenge Interim Code Equivalents

Code/Standard	Commercial	Residential
ASHRAE 90.1-2004	30% below	
ASHRAE 90.1-2007	25% below	
ASHRAE 189 (in progress)	0	
IECC 2006	30% below	30% below
California Title 24 2005		15-20% below
California Title 24 2008	10% below	
Oregon Energy Code	25% below	30% below
Washington Energy Code	25% below	25-30% below
RESNET HERS Index		65 or less
LEED NC 2.2/Home	New: EA credit #1: 6 pts Renovations: EA credit #1: 8 pts	HERS Index 65
LEED 2009 (in progress)	New: EA credit #1: 7 pts Renovation: EA credit #1: 9 pts	
GBI Standard	PATH A, 8.1.1.1: 150 pts	
EECC Option (prescriptive path)		EC: 154
NBI Option (prescriptive path)	New: core performance with enhanced measures	

Source: Architecture 2030

The "code equivalents" table can be used by organizations to determine what additional reductions beyond the requirements of a particular code, standard, or rating system can help them meet or exceed the challenge's initial 50% reduction target. The table uses the 2003 Commercial Building Energy Consumption Survey and the Residential Energy Consumption Survey as a baseline.

4. Regional Climate Change Initiatives

MIDWESTERN REGIONAL GREENHOUSE GAS REDUCTION ACCORD

Midwest leaders form accord, stewardship platform

The Midwest region of the United States and Canada has the most intensive manufacturing sector in North America. Sixty percent of the region's electricity is generated by coal-fired electricity plants. If the Midwest were an independent country, it would be the seventh-largest emitter of greenhouse gases in the world.

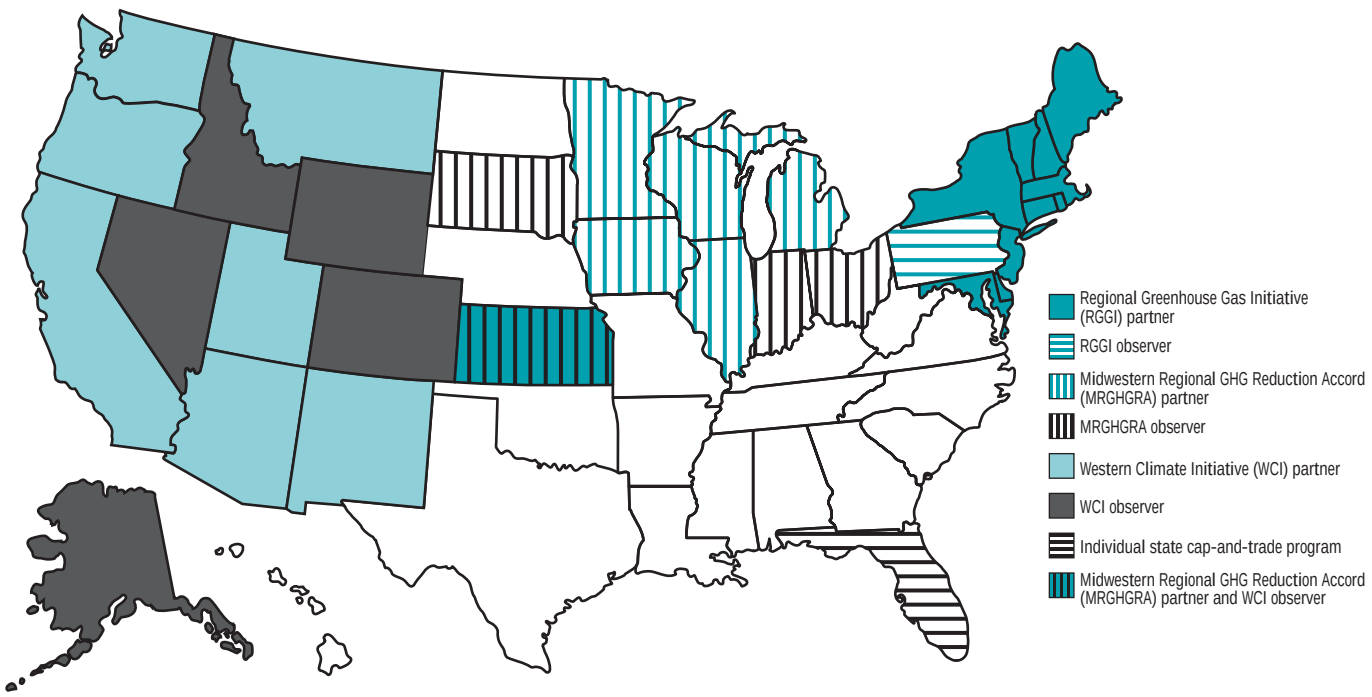
On 15 November 2007 the governors of six states—Illinois, Iowa, Kansas, Michigan, Minnesota, and Wisconsin—and the province of Manitoba agreed to establish the Midwestern Regional Greenhouse Gas Reduction Accord to slice emissions in their states. Indiana, Ohio, and South Dakota and the province of Ontario signed on as observers.

The accord commits the partners to:

- Establish GHG reduction targets and timeframes consistent with member entities' targets
- Develop a market-based, multi-sector cap-and-trade mechanism to help achieve those reduction targets
- Establish a system to enable tracking, management, and crediting for entities that reduce greenhouse gas emissions
- Develop additional steps as needed, such as low-carbon fuel standards and regional incentives and funding mechanisms

The GHG registry will be managed by The Climate

Figure 4.1
Regional Climate Change Initiatives (U.S. states only)



Source: Pew Center on Global Climate Change:

The three major regional initiatives are the Northeast's Regional Greenhouse Gas Initiative, the Midwestern Greenhouse Gas Reduction Accord, and the Western Climate Initiative. The Northeast's RGGI held the nation's first mandatory cap-and-trade auction on 25 September 2008, selling $38.5 million in emissions credits. Note: Kansas is both a Midwestern Accord member and a WCI observer.

Registry, which also manages the Regional Greenhouse Gas Initiative's plan (see below).

The partners have set a deadline of 1 January 2009 to establish targets for emission reductions and complete the development of the cap-and-trade system. Indiana, Ohio, and South Dakota agreed to participate as observers in the formation of the cap-and-trade system. The accord requires reduction targets to be consistent with the 60-80% cuts recommended by the Intergovernmental Panel on Climate Change.

In addition to the accord, 12 Midwestern states and one Canadian province have established the Energy Security and Climate Stewardship Platform.

The platform, adopted in November 2007, lays out six cooperative regional agreements. These resolutions establish a carbon management infrastructure partnership, a Midwestern biobased product procurement system, coordination across the region for biofuels development, and a working group to pursue a collaborative, multijurisdictional transmission initiative. Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin, along with the province of Manitoba, adopted all or part of the platform.

The platform establishes shared goals for the region, including specific timelines for improving energy efficiency, the promotion of biobased products, the production of renewable electricity, and the development of advanced coal and carbon capture and storage (CCS) technology.

To support these goals, the participants launched cooperative regional initiatives to address:

- CO_2 management to create a regional transportation and storage infrastructure
- Electricity transmission adequacy to support thousands of new megawatts of wind energy
- Renewable fuels corridors and coordinated signage to promote renewable fuel usage across the Midwest
- Advanced bioenergy permitting to assist states with the latest technologies
- A low-carbon energy transmission infrastructure that will provide a cost-effective way to supply the Midwest with sustainable and environmentally responsible energy

More information: www.midwesternaccord.org; www.midwesternaccord.org/platform.pdf

REGIONAL GREENHOUSE GAS INITIATIVE

RGGI leads the way in cap and trade

The Regional Greenhouse Gas Initiative (RGGI) is a cooperative effort among 10 Northeastern and Mid-Atlantic states (Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont) to cap and reduce the amount of CO_2 that large power plants are allowed to emit, limiting the region's total contribution to atmospheric greenhouse gas levels.

On 25 September 2008, RGGI (pronounced "Reggie") conducted the first GHG emissions allowance auction in the nation, putting more than 12.5 million emissions allowances on the market and raising $38.5 million. The $3.07 per allotted ton of emissions was 65% more than the minimum set price of $1.86. This first auction was limited to allowances from six of the RGGI states: Connecticut, Maine, Maryland, Massachusetts, Rhode Island, and Vermont. A second auction will be held in December after Delaware, New Hampshire, New Jersey, and New York finalize their regulations.

As the nation's first cap-and-trade program covering greenhouse gas emissions, RGGI was designed as a modest first step in carbon reduction, said Mark Lowery, Climate Partnership Coordinator in the Office of Climate Change at the New York State Department of Environmental Conservation. While it focuses solely on the power sector, Lowery said RGGI has been driving innovation in how best to design a cap-and-trade program for carbon since it got off the ground.

In April 2003, then-New York Governor George E. Pataki invited 11 governors from Maine to Maryland to have their states participate in developing a regional cap-and-trade program within two years. Eight states responded within 90 days, and representatives from each state's environmental and energy regulatory agencies formed the RGGI Staff Working Team.

The cornerstone of the program is a multi-state cap-and-trade program with a market-based emissions trading system, with each state participating through a linked CO_2 budget-trading program. The CO_2 Budget Trading Program is based on the Model Rule, which was developed in December 2005 to provide guidance and consistency to states that signed the RGGI Memorandum of Understanding (MOU).

The RGGI MOU calls for regional emissions to be capped at 121.3 million tons of CO_2 through 2014 and to 10% below this level in 2018. The initial cap is approximately equivalent to 1990 emissions. Power plants of greater than 25 MW capacity must purchase one emissions allowance for every ton of CO_2 they emit.

The compliance requirements go into effect on 1 January 2009, and each regulated compliance entity must, by 1 March 2012, hold enough allowances to cover all of its emissions during the 2009-2011 control period. Because CO_2 allowances issued by participating states will be usable across all state programs, the 10 individual state CO_2 Budget Trading Programs will, in aggregate, form one regional compliance market for carbon emissions.

Participating states plan to auction nearly the entire annual regional emissions budget—188 million tons of CO_2—at uniform regional auctions for the allowances. The September and December 2008 auctions are being held as pre-compliance events to facilitate market price discovery.

Extensive modeling conducted by RGGI states projects CO_2 allowance prices of $2-3 a ton through 2015. The cost of allowances may increase the wholesale price of electricity, but modeling analysis estimates that price impacts will be modest. Revenues from allowance auctions will be used to reduce the cost of achieving CO_2 emission reductions; participating states will invest these revenues to accelerate adoption of energy-efficient and renewable energy technologies.

Lowery said that a cap-and-trade system built around a market mechanism will drive demand for new, clean energy technologies and that cap-and-trade programs like RGGI let the market, rather than government, determine the most cost-effective way of achieving the emissions reductions.

Impact on the AEC industry. Because RGGI regulates only large power plants, Lowery said it technically will not directly affect the design and construction industry. However, the cost of allowances, although modest, will be passed to electricity consumers. He predicts that the demand for energy-efficient homes and commercial buildings would then likely go up along with the cost of energy.

Investment of auction revenue to expand state efforts to improve end-use energy efficiency and reduce electricity demand is expected to reduce the potential for "emissions leakage." Leakage is the concept that electricity providers will turn to states not included in RGGI as sources of power for customers within participating states; thus total emissions would not decrease, but would take place outside the RGGI states.

The RGGI states plan to keep an eye on potential emissions leakage through monitoring protocols put in place by the administrators of the wholesale electricity markets in the region. If at any point after the launch of the program there is a significant increase in emissions from electricity-generating units outside RGGI states, participating states may implement appropriate additional measures to mitigate such emissions.

"Climate change is the most significant problem for our generation," said Pete Grannis, the chair of RGGI and commissioner of the New York State Department of Environmental Conservation. "Absent federal leadership, the Northeast and Mid-Atlantic states of RGGI are taking action to cut greenhouse gas emissions and reduce their impact on the environment."

More information: www.rggi.org

WESTERN CLIMATE INITIATIVE

Western states seek 15% cut in emissions

The Western Climate Initiative (WCI) is a cap-and-trade program that aims to reduce emissions 15% compared to 2005 levels by 2020 in its partner jurisdictions. Originally implemented by the governors of Arizona, California, New Mexico, Oregon, and Washington as a response to perceived federal inaction to reduce greenhouse gas emissions, the initiative now includes the five founding states plus Montana and Utah and three Canadian provinces (Manitoba, Quebec, and Ontario) as partners. Six U.S. states (Alaska, Colorado, Idaho, Kansas, Nevada, and Wyoming), the province of Saskatchewan, and six Mexican states are observers.

According to Patrick Cummins, a WCI project director and program director for the Western Governors' Association, the WCI proposes "to cover almost all of the greenhouse gas emissions, from electricity, transportation, residential, and commercial, and other process-type emissions. It's a very comprehensive approach to regulating and reducing greenhouse gas emissions through a cap-and-trade program."

The WCI will regulate emissions of carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, and sulfur hexafluoride. Emissions of these gases through electricity generation, combustion at industrial and commercial facilities, and industrial process emission sources such as oil and gas process emissions will be the first to be included under the cap-and-trade program. Emissions from residential, commercial, and industrial fuel combustion at facilities below original emission thresholds, as well as transportation fuel combustion from gasoline and diesel, will enter the program at a later date.

Facilities or entities that would fall under the program are those that emit 25,000 metric tons or more

of CO_2eq. Industrial process and combustion emission sources will be regulated at the point of emission, while electricity sources will be regulated at the "first jurisdictional deliverer"—a power generator within any WCI jurisdiction, and the first entity over which a partner has regulatory authority that delivers electricity generated outside the WCI into the jurisdiction for consumption there.

Residential, commercial, industrial, and transportation fuel combustion sources eventually will be regulated where the fuel enters commerce in a WCI partner jurisdiction.

Starting in 2012, the WCI will implement three three-year compliance periods in which it will issue emission allowances to each partner, which will distribute the allowances by auction. Allowances will be based on a cap that the program will set in advance; the cap will decline each compliance period in accordance with the 2020 goal. Partners may hold some allowances in reserve, but the entire allowance must be allocated or retired by the end of each compliance period.

Allowances may be allotted any way the partner sees fit, but the WCI encourages each partner to consider objectives such as reducing consumer impacts, providing for worker transition and green jobs, providing transition assistance to industries, adapting to climate change impacts, recognizing early actions to reduce emissions, and promoting economic efficiency. A minimum percentage of the value of each allowance budget may also be dedicated to a public purpose that benefits the jurisdiction, such as achieving energy efficiencies or the promotion of emission reductions in uncapped sources such as forestry and agriculture.

The WCI will also include an offset system, which allows entities covered by the program to offset their emissions by purchasing emission reduction credits from projects that include emissions not covered by the cap, such as forestry, agriculture, and waste management. By including the offset system, the WCI hopes to lower compliance costs for the program while maintaining its environmental integrity.

A methodology is currently being designed to specify each partner's allowance budget, based on such factors as production and consumption of electricity, projected population growth, and economic activity in each jurisdiction. Once allowance budgets are set for each compliance period, they will not change unless an error is discovered in the system or the partner roster changes.

Impact on the AEC industry. Cummins said the building industry within the WCI partner jurisdictions will be affected by its policies because Building Teams will have to design and construct projects for improved sustainability. "It's very important that all new construction be as energy efficient as possible," he said. "That's going to be a good thing for people owning the buildings because it's going to reduce their energy costs, and it's going to be a good thing for the people who are going to be subject to regulation because it will make it easier for them to comply and hold down costs."

Effective date for the WCI to formulate specific program designs and enforcement procedures: 1 January 2012.

More information: www.westernclimateinitiative.org

BD+C

CASCADIA REGION GREEN BUILDING COUNCIL
Living Building Challenge

Creating buildings that give back to the environment

The Cascadia Region Green Building Council (CRGBC), one of the U.S. Green Building Council's three original chapters, is hoping to raise the bar for sustainable design with its Living Building Challenge. Launched in 2006, the certification program guides AEC professionals and property owners toward creating buildings that not only are completely self-sustaining, but may even replenish the environment.

"A lot of good things happen when you're willing to push the boundaries," said Jason McLennan, CRGBC's CEO and a *Building Design+Construction* "40 Under 40" winner. "The Living Building Challenge blazes new trails for technologies, shows new applications that people can understand, and is helping to overcome code barriers."

To become LBC-certified, buildings must meet 16 prerequisites across six performance areas: site, energy, materials, water, indoor quality, and beauty and inspiration. There are no credits to be earned, only mandatory prerequisites that can be met only after a year of operation so that performance can be verified.

Two prerequisites limit development to brownfield or greyfield sites that are at least 50 feet from wetlands and sensitive ecological habitats. Another states that every occupied space must have operable windows. Yet another prerequisite calls for building ventilation systems that deliver air exchange rates in compliance with California Title 24.

A significantly more daunting prerequisite calls for 100% onsite renewable energy. Another dictates that all occupant water use come from captured precipitation or reused water that is purified without the use of chemicals. The program also prohibits the use of materials that contain any ingredient that can be considered a toxin—added formaldehyde, mercury, lead, or polyurethane—as well as products that are manufactured or stored more than 1,000 miles from the jobsite. In addition, construction must be carbon neutral through material choices and the purchase of carbon offsets.

The CRGBC insists that all facets of the Living Building Challenge have been successfully implemented in numerous projects around the world. The true challenge is bringing all 16 goals together to create one truly sustainable project.

While no projects have been LBC-certified to date, as many as 60 projects, including 12 projects in CRGBC's home base of Portland, Ore., are implementing the guidelines in some way, according to McLennan. One of the first to come on line will be a living building at the Phipps Conservatory and Botanical Gardens in Pittsburgh, Pa., due to open at the end of 2009.

"Once people see that it's possible, others will figure out how to do it cheaper, and the barriers will start to drop away," said McLennan. "It's not hard to imagine that, because of what we're doing today, within the next five to 10 years living buildings will be like LEED Gold buildings in terms of how hard they are to achieve."

More information: www.cascadiagbc.org/lbc

5. State and Local Climate Change Initiatives

There's not a state in the Union that isn't taking steps to deal with energy conservation and climate change (see Table 5.1). At the county and municipal level, 884 mayors have signed the U.S. Conference of Mayors Climate Protection Agreement. Four cities—first Portland, Ore. (and Multnomah County), and subsequently Seattle, Pittsburgh, and Chicago—have developed model plans for climate change mitigation and adaptation.

CITY OF PORTLAND AND MULTNOMAH COUNTY, ORE.

Local Action Plan on Global Warming

Portland adopted its first plan to target global warming in 1993, and later updated that modest initiative in 2001 when the city, in partnership with surrounding Multnomah County, drafted the "Local Action Plan on Global Warming." The goal: reduce emissions 10% by 2010 from 1990 levels. To reach that standard, the plan outlines 150 action items.

The action plan is being implemented by the Portland Office of Sustainable Development and the Multnomah County Sustainability Initiative. They report several successes:

- Emissions per capita dropped 17% below 1990s levels, despite significant population growth.
- Per capita building energy use has declined 10%. Much of the credit for this goes to the creation of the Energy Trust of Oregon, which administers energy efficiency and renewable energy programs for customers of Portland General Electric, Pacific Power, and Northwest Natural.
- The area has experienced 75% growth in public transit use since 1990. Two major light rail lines and city streetcars have been added since 2001. Both the city of Portland and Multnomah County have a fleet of hybrid vehicles. All diesel-powered city-owned vehicles and equipment run on a 50% biodiesel fuel blend.
- The city purchases 12% of its municipal electricity from renewable sources and is looking for ways to purchase 100% of its electricity from renewable sources.
- Portland's recycling program diverts 63% of total waste from landfills. The next plateau: 75% diversion by 2015.

More information: www.portlandonline.com/osd

CITY OF SEATTLE

Seattle Climate Action Plan

In February 2005, Seattle Mayor Greg Nickels launched the Seattle Climate Protection Initiative, which the city followed up a year-and-a-half later with the much more comprehensive Seattle Climate Action Plan. The plan's 18 recommendations for combating climate change respond to the Kyoto Protocol's call for a 7% reduction in greenhouse gas emissions by 2012. For Seattle, that means the city's emissions need to be reduced by 680,000 total tons.

Nickels has acknowledged that reaching those reduction levels will be a heady task, but he remains confident that if the city follows through on its recommendations, emissions could be reduced by 686,600 tons, thus exceeding the 2012 target.

Reducing Seattle's dependence on cars could cut emissions by 170,000 tons. To do so, the city plans to:

- Improve public transportation
- Expand the bicycling and pedestrian infrastructure
- Lead a regional partnership to develop and implement a road pricing system
- Implement a new commercial parking tax
- Expand efforts to create compact, green, urban neighborhoods

Increasing fuel efficiency and use of biofuels could reduce emissions by 200,600 tons by:

- Improving the average fuel efficiency of the city's fleet of cars and trucks and of privately owned and operated vehicles
- Substantially increasing the use of biofuels
- Significantly reducing emissions from city and private diesel trucks, trains, and ships

Achieving more efficient and cleaner energy for homes and businesses should reduce emissions by 316,000 tons if the city:

- Maintains its city-owned electric utility, Seattle City Light, at zero net greenhouse gas emissions, and meets load growth through conservation and renewable energy resources
- Substantially increases natural gas energy conservation
- Strengthens the state's energy code
- Reduces Seattle Steam's use of natural gas

The city hopes to build on its leadership in the green building movement by creating a Seattle climate partnership and leveraging regional and state

Table 5.1
State-by-state Climate Change Initiatives

	Regional initiatives	Climate action plan completed or in progress	Climate change commission or advisory group	GHG targets	GHG inventory	GHG registry	Appliance efficiency standards	State government purchasing green power	Residential building energy code	Commercial building energy code
Alabama		✓			✓	✓				
Alaska	✓	✓	✓						✓	
Arkansas		✓	✓						✓	✓
Arizona	✓	✓	✓	✓	✓	✓	✓	✓		
California	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Colorado	✓	✓			✓	✓		✓		
Connecticut	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Delaware	✓	✓			✓	✓			✓	✓
Florida		✓	✓	✓	✓	✓		✓	✓	✓
Georgia					✓	✓			✓	✓
Hawaii	✓	✓		✓	✓	✓		✓	✓	✓
Idaho	✓	✓			✓	✓			✓	✓
Illinois	✓	✓	✓	✓	✓	✓		✓		✓
Indiana	✓				✓			✓	✓	✓
Iowa	✓	✓	✓		✓	✓		✓	✓	✓
Kansas	✓	✓	✓		✓	✓			✓	✓
Kentucky		✓			✓				✓	✓
Louisiana					✓				✓	✓
Maine	✓	✓		✓	✓	✓		✓		✓
Maryland	✓	✓	✓		✓	✓	✓	✓	✓	✓
Massachusetts	✓	✓		✓	✓	✓	✓		✓	✓
Michigan	✓				✓	✓			✓	✓
Minnesota	✓	✓	✓	✓	✓	✓			✓	✓
Mississippi					✓					
Missouri		✓			✓	✓				
Montana	✓	✓	✓		✓	✓			✓	✓
Nebraska	✓								✓	✓
Nevada	✓	✓	✓		✓	✓	✓		✓	✓
New Hampshire	✓	✓		✓	✓	✓			✓	✓
New Jersey	✓	✓		✓	✓	✓	✓	✓	✓	✓
New Mexico	✓	✓	✓	✓	✓	✓			✓	✓
New York	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
North Carolina		✓	✓		✓	✓			✓	✓
North Dakota	✓									✓
Ohio	✓				✓	✓			✓	✓
Oklahoma	✓				✓	✓			✓	✓
Oregon	✓	✓	✓	✓	✓	✓	✓		✓	✓
Pennsylvania		✓			✓	✓		✓	✓	✓
Rhode Island	✓	✓		✓	✓	✓	✓	✓	✓	✓
South Carolina		✓	✓			✓			✓	✓
South Dakota	✓									
Tennessee		✓			✓	✓			✓	
Texas	✓				✓	✓			✓	✓
Utah	✓	✓	✓		✓	✓		✓	✓	✓
Vermont	✓	✓	✓	✓	✓	✓	✓		✓	✓
Virginia		✓	✓		✓	✓			✓	✓
Washington	✓	✓	✓	✓	✓	✓	✓		✓	✓
Washington, D.C.									✓	✓
West Virginia					✓	✓			✓	✓
Wisconsin	✓	✓	✓		✓	✓		✓	✓	✓
Wyoming	✓					✓				

Source: Pew Center on Global Climate Change, updated 25 March 2008

State governments have taken the lead in developing climate policies and initiatives, including setting targets for greenhouse gas emissions, mandating investment in renewables and energy efficiency, and developing commercial and residential building energy codes. States often function as "policy laboratories," developing initiatives that serve as models for future federal actions.

action for climate solutions.

More information: www.seattle.gov/climate

PITTSBURGH CLIMATE INITIATIVE

Pittsburgh Climate Action Plan, Version 1.0

Introduced this past June, the Pittsburgh Climate Action Plan, version 1.0, calls for the city, the business community, and Pittsburgh's institutions of higher learning to pitch in to help reduce greenhouse gas emissions. The plan was co-managed through the Pittsburgh Climate Initiative, consisting of the city's Green Building Alliance (a USGBC affiliate) in collaboration with environmental NGO Clean Air–Cool Planet. It was written by the Green Government Task Force of Pittsburgh, a coalition that was co-chaired by Pittsburgh Mayor Luke Ravenstahl, City Councilman William Peduto, and State Senator Jim Ferlo.

The plan calls on the three sectors—the city, Pittsburgh's business sector, and higher education—to reduce municipal greenhouse gas emissions by 20% from 2003 levels by 2023.

In 2003, 247,605 tons of CO_2eq were released into the atmosphere by municipal sources, which accounted for 4% of the total 6.6 million tons of CO_2eq released in Pittsburgh that year, according to the Pittsburgh greenhouse gas inventory.

The city's action plan outlines specific strategies that the municipal, business, and higher education sectors can follow to meet the 20% emissions reduction goal. Recommendations within each sector are classified into six categories: general; energy; recycling and waste management; transportation; green building practices (higher education only); and student engagement and education (higher education only).

Municipal recommendations. Recommendations for city government itself include:

- LEED construction standards for municipal buildings
- Energy audits of city-county buildings and implementing updates and retrofits
- Incentives for renovation of existing buildings
- Construction and demolition debris recycling
- Incentives or requirements for green roofs
- Planning and zoning incentives for green development
- Purchasing renewable energy
- Updating and replacing all traffic signals with high-efficiency LED fixtures
- Incentives for solar use
- Using biodiesel for public transportation

Business-sector recommendations. Actions for businesses operating in the city include setting up a carbon clearinghouse for businesses, greenhouse gas inventories, energy audits and building recommissioning, creating incentives for employees to use public transportation, using green leases and sustainable procurement practices, and pursuing Energy Star and LEED ratings for their building projects.

Higher education recommendations. Major recommendations include:

- Establishing a higher education climate coalition and best practices guide
- Developing greenhouse gas inventories
- Exploring carbon offsets
- Developing real-time energy monitoring

More information: www.pittsburghclimate.org/index.htm

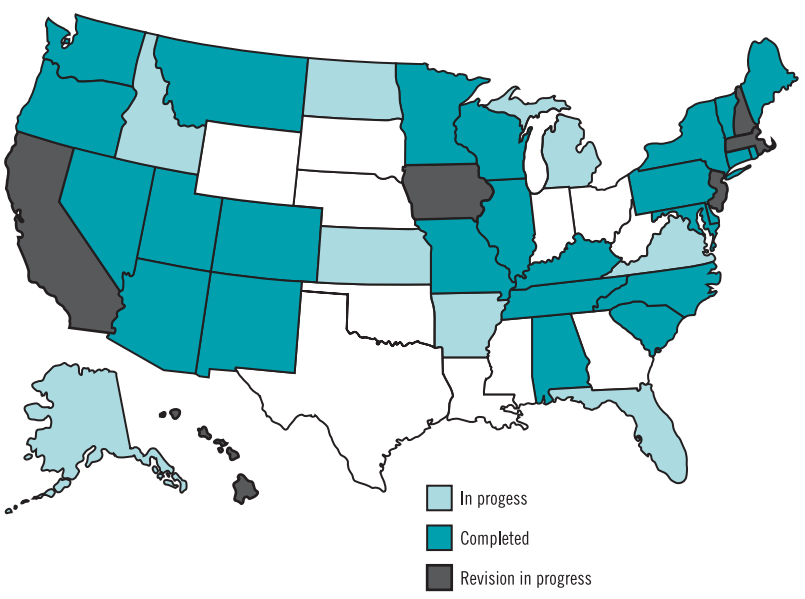
CITY OF CHICAGO

Chicago Climate Action Plan

On 19 September 2008, Mayor Richard M. Daley unveiled the Chicago Climate Action Plan, which outlines 26 action items to reduce the city's greenhouse gas emissions by 25% from 1990s levels by 2020, with an 80% reduction by 2050. The plan also includes nine adaptation actions to help prepare for climate change.

In 1990, Chicago was responsible for releasing 32.2 million metric tons of CO_2; in 2005, the city released

Figure 5.1
Mapping the State Climate Change Initiatives



Source: Pew Center on Global Climate Change:

Most states have completed climate action plans or are in the process of revising or developing plans. The economy, resource base, and political structure of each state provide different opportunities and challenges, but the planning process allows state governments to identify ways to reduce greenhouse gas emissions that work for them.

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U.S. DEPARTMENT OF ENERGY

Today, buildings consume more total U.S. energy than any other sector—more than transportation, more than industry. That's why advanced building technologies are key to greater American energy independence. Energy-efficient residential and commercial buildings not only save costs for individual homeowners and businesses, they also yield vital returns for our nation as a whole, paying recurring dividends in enhanced energy security, in lower carbon emissions, in a cleaner environment, and in the prosperity of future generations.

The Department of Energy's goal of market-ready commercial net-zero energy buildings by 2025 and residential net-zero energy buildings by 2020 through the Building Technologies Program supports not only our nation's wish for energy independence but also our world's need for a greener, more sustainable future.

Net-zero energy buildings are grid-integrated buildings capable of generating as much energy as they consume by using cutting-edge technologies and on-site generation systems such as solar power and geothermal energy. Producing these high-performance buildings and making them the standard in tomorrow's marketplace will require unprecedented collaborations among the nation's best and brightest scientific, business, and marketing minds from the public and private sectors. The Department of Energy is forging and sustaining these collaborations through initiatives such as the Commercial Building Energy Alliances, EnergySmart Schools, EnergySmart Hospitals, Commercial Lighting Solutions, Building America Best Practice Guides, Builders Challenge, and Energy Efficient Building Technologies Application Centers.

To learn more about these and other initiatives of the Department of Energy's Building Technologies Program, visit **http://buildings.energy.gov.**

36.2 million metric tons of CO_2. In order to reach its 25% reduction by 2020, the city needs to reduce greenhouse gas emissions by 15.1 million tons of CO_2.

The Chicago Climate Action Plan, which was developed by a task force convened by Mayor Daley in 2007, is organized into five categories:

1. Buildings

Chicago's building stock includes about 23,000 commercial, industrial, and institutional buildings and more than one million residential units. Buildings account for about 70% of all city emissions. The plan calls for a 30% reduction in emissions, or about 4.6 million metric tons of CO_2. This goal will be met by:

- Retrofitting commercial and residential buildings for improved energy efficiency
- Replacing old appliances with more efficient units
- Conserving water
- Updating city energy codes
- Establishing guidelines for renovations
- Planting more trees and building more green roofs (Chicago is the nation's leader in vegetated roofs)

2. Clean and renewable energy sources

Electricity, natural gas, and transportation use are major emission sources contributing to climate change. The action plan calls for a 34% reduction in these uses, which would cut emissions of CO_2 by 5.3 million metric tons. This will be achieved by:

- Upgrading power plants
- Improving power plant efficiency
- Building renewable electricity infrastructure
- Increasing distributed generation
- Promoting household renewable power

3. Transportation

Under the plan, Chicago's transportation network is expected to account for a 23% reduction, or 3.6 million metric tons of CO_2. Action items include:

- Promoting transit-oriented developments
- Supporting intercity rail
- Improving walking and biking options
- Improving the city's fleet efficiency
- Improving freight management

4. Waste and industrial pollution

As much as 62% of Chicago's annual waste (about 3.4 million tons) ends up in landfills. The city's goal is to trim waste and industrial pollution by 13%, which would result in emissions reductions of 2.0 million metric tons of CO_2. This will be achieved by improving the city's recycling program, shifting to alternative refrigerants, and capturing stormwater runoff.

5. Adaptation

Adaptation action items include pursuing innovative cooling systems, managing stormwater, implementing urban green design, and preserving the city's inventory of plants and trees (the city has planted more than 500,000 trees in the last 15 years or so).

More information: www.chicagoclimateaction.org

California heads the pack on climate change laws

California has made two huge legislative thrusts, first with its climate change law, AB 32, and more recently with a revolutionary land use law (SB 375) that addresses climate change by linking transportation, housing, and land development.

CALIFORNIA GLOBAL WARMING SOLUTIONS ACT

Assembly Bill 32

It may seem audacious for a single state to believe it can make an impact on global climate change—unless that state is California. The Golden State, the nation's most populous, with the world's 10th-largest economy, is aiming to reduce its greenhouse gas emissions by 30% from 2008 to 2020—a return to 1990 levels.

Even though California is the 12th-largest carbon emitter in the world, achieving this goal will have only a modest impact on overall global emissions. Nevertheless, state officials are hoping a new climate initiative will spark similar measures nationally and internationally that would produce additional GHG reductions. The plan focuses largely on power plant and vehicle emissions, but also has significant implications for the AEC and real estate development industries.

The Global Warming Solutions Act of 2006 (AB 32) foresees a cap-and-trade program to cover 85% of the state's emissions. This program, to be developed with the Western Climate Initiative (see Chapter 4), will create a regional carbon market covering the transportation, electricity, natural gas, and industrial sectors. This system will require greenhouse gas emitters to buy credits on an open market in order to continue to release emissions into the air.

Companies that reduce emissions would be able to sell their surplus credits. This would provide a strong financial incentive for power plants, manufacturing facilities, refineries, and other businesses to cut emissions. The working draft plan also proposes that utilities produce one-third of their energy from renewable sources, including wind, solar, and geothermal.

The draft plan further calls for full implementation of the California Clean Car law that aims to provide a wide range of less polluting, more efficient cars for the consumer market. Another AB 32 provision calls for implementation of the Low Carbon Fuel Standard that

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NORTH AMERICAN INSULATION MANUFACTURERS ASSOCIATION

Insulation: A Proven Strategy to Mitigate Climate Change

In this year's *BD+C* Green Buildings + Climate Change White Paper, there seems to be some skepticism about climate change, and whether the AEC community can make a meaningful difference. Nevertheless, when AEC respondents were asked what technology solutions they had already implemented, almost 75% indicated they had made design improvements in the areas of both insulation and building envelope.

Insulation matters as a key building system component. But it is often overlooked as a first-choice, lowest-cost factor in a design to optimize energy efficiency. The fact is that fiber glass, rock wool and slag wool insulation products help significantly to reduce energy demand and greenhouse gas (GHG) emissions associated with climate change.

Buildings are likely to provide the greatest energy reduction, and in many cases, will be the most economical option. The study, *A Cost Curve for Greenhouse Gas Reduction*, by McKinsey Quarterly estimated in 2007 that demand-reduction measures with no net cost could almost reduce by half the projected growth in global electricity demand. These efficiency gains are critical. The buildings sector accounts for about 40% of primary energy consumption, 70% of electricity use, and 40% of atmospheric emissions in developed countries. The total U.S. building envelope energy loss is reported by the D.O.E. at 14.1 Quads and represents 14.1% of energy in the U.S. economy and about 3.5% of the world. To meet projected energy demands, America will need between 1,300 and 1,900 new electric power plants by 2020. (China, meanwhile, is already building enough power plants every year to meet all the energy needs of Spain [*China Shakes the World* by James Kynge]!) Taken together, power generation accounts for almost one-quarter of total emissions of CO_2, and is the main culprit in global warming (*ScienceDaily*, 2007).

While focusing on green building to reduce energy consumption and greenhouse gas emissions, the building industry is also using various green rating systems and regional programs that take into account the production processes of building materials. NAIMA recently reported that its members' plants have diverted almost 33 billion pounds of recycled materials from the waste stream with the use of glass cullet and blast furnace slag during 2006 and 2007. NAIMA members are committed to preserving the environment by using recycled materials to produce quality energy-saving insulation products, specifically products that improve a building's energy efficiency and minimize its environmental impact.

2008 marks NAIMA's 75th anniversary — 75 years of commitment to continuous improvement and industry stewardship in making fiber glass, rock wool and slag wool insulation some of the most researched and thoroughly tested, and therefore proven materials available in the pursuit of green building objectives.

Making a difference in climate change through green building design can be summed up in a simple formula, one that reduces energy demand and the greenhouse gases that accelerate climate change. To help mitigate that change, we must understand that the overarching goal is to design buildings for net zero energy. We're gratified that NAIMA member products are part of that formula: Buildings + Insulation = Energy Efficiency affecting the end goal of greenhouse gas reduction.

Ken Mentzer
President and CEO
North American Insulation Manufacturers Association

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will require oil companies to make cleaner domestically produced fuels. California officials say AB 32 will spark technological innovation and investments and create new "green" jobs.

Impact on AEC and real estate industries

According to a 2008 report by the California Air Resources Board, residential and commercial buildings were directly responsible for 9% of the state's GHG emissions from 2002-2004. An estimated 60% of the state's building stock—commercial and residential—is "below necessary energy efficiency standards," says board spokesman Stanley Young.

AB 32 proposes to expand and strengthen existing energy-efficiency programs and building and appliance standards. According to Gov. Arnold Schwarzenegger's office, these standards "have already saved Californians $50 billion over the past 30 years in reduced energy costs." Building codes are likely to be updated with more-stringent energy-efficiency measures. A change of property ownership could lead to upgrade requirements, Young says. AB 32 also hopes to spawn more smart growth development "to make more livable, walkable cities, and shorten commutes." Cement and glass manufacturers may be subject to new regulations aimed at emissions reductions; this could increase costs. The details are still under deliberation.

In June 2008, the state released a proposed scoping plan—a framework for implementing AB 32—that was followed by a 45-day environmental review. By 1 January 2009, the state will adopt a plan spelling out how emissions reductions will be achieved from significant GHG sources via regulations, market mechanisms, and other actions. Mandatory caps will begin in 2012 for significant sources and ratchet down periodically in order to meet the 2020 goals. Young says the specifics, including building code upgrades, are scheduled to be finalized by the end of 2011.

Senate Bill 375

On 30 September 2008, Governor Schwarzenegger signed into law SB 375, a smart growth bill that directly addresses goals laid out in AB 32. It has been called the most significant piece of land-use legislation in the Golden State since the 1976 Coastal Act.

The new law, sponsored by State Sen. Darrell Steinberg (D-Sacramento), calls for the development of regional growth plans with the goal of reducing passenger vehicle miles and emissions. Cities and counties still have the power to approve any development they want. But only projects that qualify as "smart growth" in the regional plans would be eligible for a share of the $15 billion in transportation money the state allocates annually.

These funds can be used to support infrastructure such as road, sewer, and water improvements on projects that are located near rail lines, bus stops, and bike lanes, and would favor high-density and in-fill housing projects. Smart growth projects would face less red tape and could be greenlighted by state and local environmental agencies much faster than projects of similar size and scope that don't meet smart growth standards.

In a perceptive analysis, a team at the California law firm Morrison & Foerster note that SB 375 is, at the very least, "an ambitious—and complex—law that seeks to tackle one of the most challenging sources of greenhouse gas emissions: the private automobile. This is a key issue for California's efforts to meet AB 32's GHG emissions reduction mandate because the Air Resources Board [which oversees emissions] has found that, even if cars become more efficient and run on cleaner fuels, the target levels cannot be met without also reducing vehicle miles traveled."[1]

The centerpiece of SB 375 is a requirement for a new type of planning document, the "SCS," or "sustainable communities strategy." As the Morrison & Foerster team has noted, this is a regional transportation "blueprint" that will allow the state's Air Resources Board to certify whether each of the 18 regions it supervises throughout California is meeting its GHG reduction goals. Transportation projects and regional housing allocations must be consistent with the SCS to get state funding. The Air Resources Board has until 30 September 2010 to set emissions levels for the various regions, and each region's "metropolitan planning agency" must prepare the SCS document. "Both processes are likely to be contentious and potentially subject to litigation," the Morrison & Foerster lawyers note.

The golden bullet in SB 375 is CEQA relief. CEQA refers to the California Environmental Quality Act, which sets emissions standards for the state. Under SB 375, certain mixed-use and infill residential projects could benefit from a streamlined review that would circumvent ARB analyses for GHG emissions impacts, growth-inducing impacts, and cumulative traffic impacts. "Transit priority projects"—defined as eight acres or less in size with a 50% residential component (less than 200 units), meeting minimum density requirements, and located within a half-mile of a major transit stop or "high-quality transit corridor"—would also be eligible for ARB exemption. In short, the law gives a green pass to dense, multi-use, transit-oriented kinds of development.

It is still too early to tell how California's recent legislation will fare in the real world, especially given the vagaries of California politics. Together, though, AB 32 and SB 375 represent two of the most far-reaching climate change laws in the country. We'll return to them in Chapter 9. BD+C

1. "SB 375 Becomes Law, Pushing Greenhouse Gas Reduction to the Forefront of California Transportation, Economic and Land Use Planning," David A. Gold, Zane O. Gresham, Mitchell S. Randall, and Miles H. Imwalle, in LUEL Briefing, Morrison & Foerster LLP, 2 October 2008. Sourced at: www.mofo.com/news/updates/bulletins/14541.html

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As one of the largest cement manufacturers in North America and a long-time leader in sustainable development, we recognize our responsibility to present viable building solutions for future generations. Keeping this commitment requires a thoughtful balance of economic growth, environmental stewardship, and social responsibility.

Climate change is an issue of global importance that carries significant environmental and financial consequences for the cement industry. Concrete is the second-most-used resource in the world after water, and its use is growing. Currently, there is no practical substitute for this versatile and durable product in most applications. Additionally, concrete infrastructure has a number of characteristics that reduce energy consumption and greenhouse gas emissions from society's use of buildings and roads. This is an important factor when one considers that buildings account for almost 40% of greenhouse gas (GHG) emissions in the United States.

As an essential ingredient in concrete, cement is a key requirement of modern society. While the manufacture of cement is a resource- and energy-intensive process, accounting for 1.5 percent of man-made emissions of carbon dioxide (CO_2), it makes up only 10% of the volume of concrete, an eco-efficient building material.

Emission reductions can be achieved in the manufacturing process by substituting some amount of clinker (the output from the kiln) with other suitable mineral components to produce the cement, improving energy efficiency, and substituting fossil fuels with biomass and waste materials. Innovation has enabled us to create products such as Envirocore™, a family of lower carbon intensity products developed to help architects, builders, and ready-mix producers deliver high-performance concrete with a lower environmental footprint. These efforts enable us to produce more cement while using fewer resources.

Globally, Holcim has made a voluntary commitment to reduce our CO_2 emissions per ton of product by 20% by 2010. We work proactively to assist with practical policy development through our engagement in groups such as the Business Environmental Leadership Council (BELC) of the Pew Center on Global Climate Change, the International Emissions Trading Association (IETA) and, through our parent company, the Cement Sustainability Initiative of the World Business Council for Sustainable Development (WBCSD).

In all respects, Holcim is committed to transparency, ethical conduct, and the well-being of society.

Sincerely,

Bernard Terver

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6. How Existing Buildings Figure In the Climate Change Scenario

Buildings represent a golden opportunity for cutting greenhouse gas emissions. "Energy efficiency options for new and existing buildings could considerably reduce CO_2 emissions *with net economic benefit*," according to the IPCC Fourth Assessment Report. "By 2030, about 30% of the projected GHG emissions in the building sector can be avoided *with net economic benefit*" (emphasis added).

The IPCC report further remarks that it is "*often more cost-effective* to invest in end-use energy efficiency improvement than in increasing energy supply to satisfy demand for energy services"—in other words, making buildings more energy-efficient would reduce the need to build more coal-fired power plants. [WGIII/SPM, p. 13; emphasis added]

In the U.S., this opportunity has been squandered for the most part. Despite the well-meaning efforts of the U.S. Green Building Council, the Green Building Initiative (GBI), Energy Star, the National Association of Home Builders, and others, only a small percentage of new commercial buildings, and an even smaller percentage of new homes, get any kind of green treatment. Meanwhile, millions more "conventional" buildings and homes are being added to the nation's building inventory.

The situation is even more distressing when it comes to existing buildings, which represent about 98% of the square footage in place in any one year. The USGBC's LEED for Existing Buildings: O&M just hasn't caught on with building owners; nor has the GBI's existing buildings module.

Perhaps the fault lies in our infatuation with the new. After all, it's a lot more exciting to talk about, say, the super-LEED Platinum-plus Bank of America building in Manhattan—a magnificent project, to be sure—than it is to extol the virtues of a small office building rehab job in Flatbush that produced 38% energy savings. We in the "green" media are as guilty as anyone of falling under the spell of the new.

The fact remains, however, that to have any impact on cutting emissions, the U.S. design and construction industry is going to have to address two agendas in tandem: first, to make new buildings and major reconstructions as energy efficient as possible; and, second, to upgrade much of the nation's existing stock of buildings and homes.

Both efforts have to be done on the basis of cost effectiveness. It may be, for example, that making many low-cost improvements to millions of existing buildings and homes may be more effective than trying to achieve zero or near-zero emissions in a relatively few new buildings and homes.

Further, this effort will require AEC professionals to recognize (perhaps to their chagrin) that most buildings in the U.S., even the newest, rarely function at their optimal or designed efficiency. And because most commercial buildings (and homes) are built to last 50 or even 100 years, their inefficiencies—and preventable GHG emissions—could endure for a century.

According to Tudi Haasl, associate director of commercial services at Portland Energy Conservation Inc. (PECI), the six biggest energy wasters in buildings are:

1. Equipment running more than needed
2. Cooling or heating air more than needed
3. Cooling or heating water more than needed
4. Heating and cooling at the same time
5. Moving too much air
6. Moving too much water[1]

1. "Real Reasons for Optimizing Building Performance," Tudi Haasl, National Conference on Building Commissioning, Newport Beach, Calif., 21 April 2008.

Table 6.1
Adobe Towers: Payback from Retrocommissioning and Upgrading

Project Description	Cost	Rebate	Annual savings	Payback	ROI
Installed dimmers in alcoves and stairwells	$83,034	$21,108	$46,853	1.4 years	73%
Retrofitted variable-frequency drives on main supply fan	$73,000	$29,400	$12,000	3.6 years	28%
Installed automated drip irrigation system	$3,610	$0	$9,001	0.4 years	249%
Reduced run-time on parking garage fans to 10 minutes in a.m./p.m. rush hours without sacrificing air quality	$200	$0	$98,000	Immediate	48,204%
Installed waterless urinals	$35,374	$5,396	$6,338	4.7 years	21%

Source: "Building Optimization: The Value Proposition," George Denise, National Conference on Building Commissioning, Newport Beach, Calif., 21 April 2008.

Cushman & Wakefield achieved relatively short payback periods and high returns on investment from well-known technologies for client Adobe Systems. Nineteen lighting projects alone produced $729,185 in annual energy savings on a $445,248 investment. With a $205,437 utility rebate, the lighting projects produced an ROI of 304%. Commissioning has helped reduce operating costs at Adobe Systems' headquarters site by $1.2 million.

Mistakes abound even in the newest buildings:

- Fans in air-handling units running backwards
- Temperature sensors placed in direct sunlight, making their readings inaccurate and unreliable
- Vibration isolation components in the shipping position instead of in the operating position
- Missing gauges
- Setpoints not inputted[2]

One of the most cost-effective ways to overcome "discrepancies" like these is through the process of building commissioning.[3] At Adobe Systems in San Jose, Calif., building manager Cushman & Wakefield retrocommissioned two towers and trimmed operating costs $1.2 million a year on a $1.4 million investment (mostly on energy-related systems) and received $389,000 in rebates (mostly from the local utility).

The simple payback period of the project was nine-and-a-half months, with a 121% ROI. Electricity use was cut 37%, and GHG emissions were directly cut by 17%; another 19% in GHG reductions came from the purchase of renewable energy credits (Table 6.1).[4]

How commissioning benefits buildings

Only about 1% of buildings are commissioned, according to the U.S. Department of Energy, probably because most building owners are wary of the up-front cost of commissioning and the cost of fixing the problems that have been identified in the process.

To put solid numbers on the costs and benefits of commissioning, Evan Mills, PhD, and colleagues at Lawrence Berkeley National Laboratory (LBNL), Portland Energy Conservation Inc. (PECI), and Texas A&M University (Energy Systems Laboratory) reviewed published and unpublished data on 224 buildings in 21 states, representing 30.4 million sf of commissioned space—73% in existing buildings, 27% in new ones.[5] Total commissioning costs for these buildings were $17 million (2003$), an average $0.55/sf. Among their findings:

- An average 11 deficiencies were found in existing buildings, 28 in new buildings. HVAC systems represented the bulk of the problems.
- For existing buildings, median commissioning costs were $0.27/sf; energy savings came to a median 15% (18% average); payback times were less than nine months (0.7 years).
- For new buildings, commissioning costs were $1.00/sf (0.6% of total construction costs), yielding a median payback of 4.8 years.
- Reduced change orders and other non-energy benefits accounted for $0.18/sf savings in existing buildings and $1.24/sf for new construction—for new buildings,

2. Gretchen Coleman, Engineering Economics, National Conference on Building Commissioning, 22 April 2008.

3. For an excellent review of the forms of commissioning, see "Casting call for Cx," Ronald Wilkinson, Consulting-Specifying Engineer, September 2008, pp. 44-50. At: www.csemag.com/article/CA6596632.html

4. "Building Optimization: The Value Proposition," George Denise, National Conference on Building Commissioning, Newport Beach, Calif., 21 April 2008.

5. Mills, E., N. Bourassa, M.A. Piette, H. Friedman, T. Haasl, T. Powell, and D. Claridge. "The Cost-Effectiveness of Commissioning New and Existing Commercial Buildings: Lessons from 224 Buildings," Proceedings of the 2006 National Conference on Building Commissioning. Lawrence Berkeley National Laboratory Report No. 56637. At: http://eetd.lbl.gov/emills/EMillspubs.html

Commissioning helps Marriott cut emissions by 68,000 tons in its U.S. hotels

Five years ago, at the National Conference on Building Commissioning, Marriott International's E.J. Hilts put the participants to the test: How many "deficiencies" in energy use and guest comfort could they find in the very building where the conference was being held, Marriott's Rancho Las Palmas Hotel in Palm Springs, Calif.?

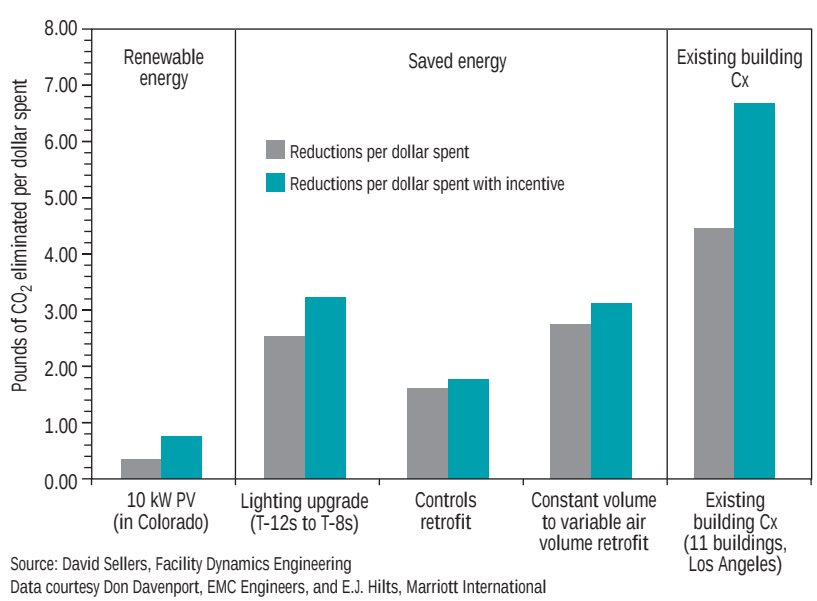
The answer: 27. Hilts, regional director of energy for the hotel management firm's properties in the western U.S., invested $100,000 in the most cost-effective ones and wound up with $150,000 in savings and incentives from the California Public Utility Commission's Statewide Building Tune-up Program.

Hilts has also recommissioned the San Diego Marriott Hotel & Marina, two 25-story towers built in 1984 and 1987 with a total 1,362 rooms, at a cost of $195,304. The project resulted in 8.4% energy savings and energy cost savings of $272,500 a year, for a simple payback of nine months.

A retrocommissioning project at the Newport Beach Hotel & Spa led to 11 interventions that are saving $56,000 a year in energy costs, with less than a one-year payback.

Marriott's retrocommissioning program is saving the hotel management firm more than $4.5 million a year and cutting emissions in the hotels it operates by 68,000 tons annually.

Chart 6.1
CO_2 Emissions Saved per Dollar Spent for Different Types of Projects



Source: David Sellers, Facility Dynamics Engineering
Data courtesy Don Davenport, EMC Engineers, and E.J. Hilts, Marriott International

Analysis of various strategies used to reduce emissions in existing buildings shows building commissioning to produce the most cost-effective results, followed by lighting upgrades and retrofitting to variable air volume HVAC. Installing PVs proved the least cost-effective in terms of emissions reductions per dollar spent.

enough to cover the entire cost of commissioning, the researchers note.

The authors conclude that "commissioning is one of the most cost-effective means of improving energy efficiency in commercial buildings." While not a panacea, they admit, it is "one of the most cost-effective and far-reaching means of improving the energy efficiency of buildings."

Obstacles to Building Commissioning

Why aren't more building owners taking advantage of commissioning? One reason is inertia. Many building owners just accept higher energy costs as a fact of life—and either absorb them or pass them on to their tenants. The fact that only 45 public-sector companies of BOMA's 16,500 members have taken up the 7-Point Challenge is a sign that building owners would rather live with the problem than address it.

Building size is another limiting factor. According to the USDOE's Energy Information Administration, 98% of commercial buildings in the U.S. are less than 100,000 sf in size. They comprise about two-thirds of total floor area and consume about 60% of the energy used by buildings in the U.S. Since the "fixed costs" (mostly labor) of hiring a commissioning resource provider are roughly the same regardless of building size, the cost of retrocommissioning smaller buildings—estimated at $.40-.60/sf—is greater than for large buildings ($.27/sf for the median 151,000-sf building in the LBNL study). [6, 7]

Another obstacle has to do with insulation. Adding insulation to a building is one of the most cost-effective ways to cut energy and reduce GHG emissions, but it can be physically impossible to do in many existing commercial, retail, hospitality, multifamily, and healthcare buildings, unless they are undergoing a major renovation. However, tens of millions of existing homes could benefit from insulation improvements.

Many building owners are also apparently unaware of the rebates available to them from utility companies for making energy-saving building improvements. These can be substantial, and experienced commissioning agents report that they often make the difference in whether a property owner goes ahead with a recommissioning project.

The final hurdle has to do with what those in the commissioning field call "persistence." Many owners, even enlightened ones who have commissioned their buildings, fall into the trap of thinking that it's a one-time event. In fact, building systems, particularly HVAC systems, are forever falling "out of tune," even in new buildings. This raises the question of the need for more and better training of facilities personnel to get them to carry out the commissioning on a day-to-day basis, as well as the need for periodic (some even advocate "continuous") recommissioning.

One last thought about commissioning, from PECI's Tudi Haasl. "There's a myth that recommissioning is a cheap and easy way to get your building running happily," she says. "In reality, it's a mix of some really complex things with other easier things. But owners like it because the paybacks for some parts can be so quick, and when you bundle it all together, recommissioning gives you quick payback for the whole building."[8] BD+C

6. "Think Small: The Key to Unlocking the Existing Buildings Market," Tim Kensok and Jim Crowder, AirAdvice Inc., National Conference on Building Commissioning, Newport Beach, Calif., 23 April 2008.

7. A study of existing buildings >25,000 sf by Portland Energy Conservation Inc. found that unit costs ranged from $0.32/sf to $0.47/sf based on average building size and depending on market sector. "Final Report: California Commissioning Market Characterization Study," PECI, November 2000. At: http://resources.cacx.org/library/holdings/018.pdf

8. Additional resources on commissioning:
- *Building Commissioning Association, www.bcxa.org*
- *California Commissioning Collaborative, "California Commissioning Guide: New Buildings" and "California Commissioning Guide: Existing Buildings," http://www.cacx.org*
- *Northwest Energy Efficiency Alliance, www.betterbricks.com*
- *PECI Commissioning Library, http://peci.org/CxTechnical/resources.html*
- *"A Retrocommissioning Guide for Building Owners," http://peci.org/Library/EPAguide.pdf*

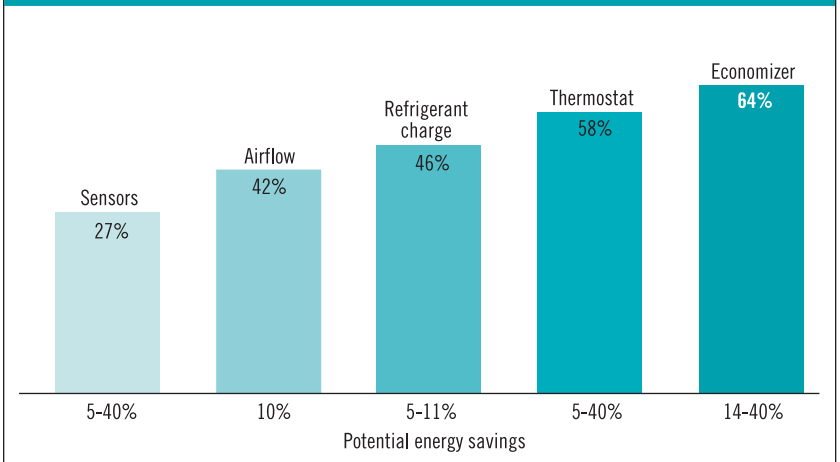
Table 6.2
Typical Deficiencies Found in Commissioning School Buildings

Excessive play or gap in dampers
Malfunctioning power exhausts
Inoperative dampers and actuators
Malfunctioning economizer controls
Incorrect programmed sequence of operations
Oversized fans
Unapproved field modifications
Direct-wired exhaust fans always on
Dirty filters and coils
Improper setpoints
Water leakage on electrical equipment
Improper CO_2-based purge operation
Improper flue exhaust
Malfunctioning exhaust fans

Source: "Evolution of Commissioning within a School District: Provider and Owner/Operator's Perspectives," Vivek Mittal, Enovity Inc., and Mike Hammond, Folsom Cordova (Calif.) Unified School District, National Conference on Building Commissioning, 23 April 2008.

Commissioning of 10 campuses (more than 500,000 sf) of the Folsom Cordova Unified School District in the Sacramento, Calif., metro area identified more than 700 systems deficiencies: 26% were associated with energy systems, 37% with comfort and IAQ, 32% with O&M, and 6% with safety.

Chart 6.2
Potential Energy Savings from Commercial HVAC System Components



Source: "Review of Recent Commercial Roof Top Unit Field Studies in the Pacific Northwest and California," A. Cowan, National Buildings Institute, October 2004. Cited in AirAdvice State of Building Performance Report 2007.

HVAC systems are a frequent source of discrepancies found in the commissioning process. Replacing or adjusting malfunctioning HVAC components can lead to significant energy savings and GHG emissions reductions.

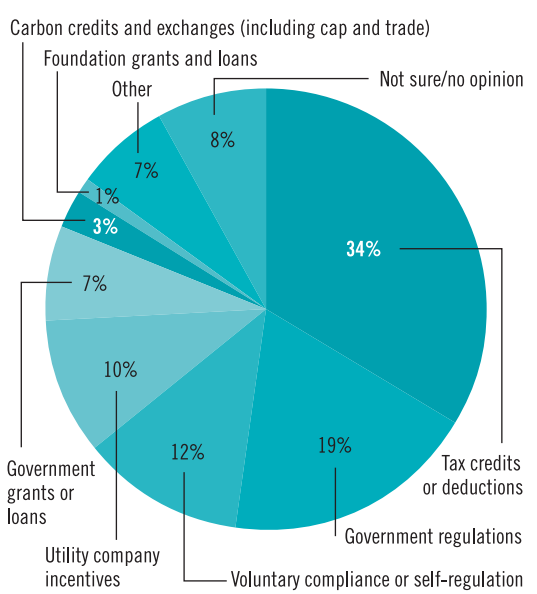
7. Cap and Trade: Solution, Gimmick, or Giveaway?

Carbon capping. Cap and trade. Emissions trading. All these terms have been bandied about in Congress and state legislatures in the last few years. At this writing (just ahead of the November 4 election), both Presidential candidates have stated that they back some form of national carbon cap-and-trade system to mitigate greenhouse gas emissions. In the Congress, Senators Barbara Boxer (D-Calif.) and Arlen Specter (R-Pa.) have proposed such programs, and a bill by Senators Joseph Lieberman (I-Conn.) and John Warner (R-Va.) has already been tested—unsuccessfully—in the Senate.

Despite the defeat of the Lieberman-Warner plan, cap and trade is still breathing, at least in parts of the U.S. In late September, a consortium of 10 states in the Northeast kicked off the country's first mandatory cap-and-trade regional market on GHG emissions. Similar regional programs are currently under development in the Midwest and in the western states (see Chapter 4).

Clearly, a growing number of our nation's leaders view cap and trade as an important tool for mitigating climate change. But how exactly do these systems work? How effective are they in reducing emissions? How will they affect the U.S. economy and the design and construction sector?

Chart 7.1
From your experience, which of the following would have the greatest impact in combating climate change?



Source: BD+C/Reed Research Group 2008 Climate Change Survey Base: 953

Across the board, respondents at design, build, and owner firms expressed support for tax credits or deductions as the most effective tool for combating climate change. Various forms of carbon credits—a relatively new concept in the U.S.—drew minimal response (3%).

At its most basic, cap and trade is a market-driven system for reducing or limiting greenhouse gas emissions on a massive scale. A central authority, such as a government agency, sets an absolute limit on emissions across an industry (e.g., power plants) or geographical region. The cap total is then divided into allowances, or permits, which are allocated (via auction or giveaway) to participating entities based on their current emission levels.

Every year, the cap and the number of allowances are ratcheted down, thus forcing the participants to either cut their emissions or purchase unused permits from others in the program to offset their pollution level (hence the "trade" in cap and trade).

Ideally, this would result in a system that provides a financial incentive for companies to reduce emissions. Polluters can keep on polluting, but they'll have to pay much more for the right to pollute year after year as the number of permits goes down and the cost of those permits goes up. Theoretically, at some point it should become cheaper for a company to trim its emissions than to buy surplus permits.

By creating incentives to develop cost-effective technologies and techniques for reducing emissions, such a market-driven approach, proponents argue, will cut emissions faster and at lower costs than traditional "command-and-control" alternatives, such as an emissions tax.

One of the most successful cap-and-trade systems to date has been the Acid Rain Program of the Clean Air Act of 1990. The program placed a descending cap on sulfur dioxide emissions from roughly 420 coal-burning power plants in the U.S. to combat acid rain formation. Since its inception in 1995, the ARP has reduced annual

Little support for carbon cap and trade

When asked, "Which of the following would have the single greatest impact in combating climate change?" carbon credits and exchanges, including cap and trade systems, drew support from only 3% of respondents (Chart 7.1). Apparently, many agreed with W. Steve Perry, owner of Steve Perry Construction, Provo, Utah, who said, "The cap and trade plan will ultimately end up with Big Money and Big Energy controlling most of it and any smaller interests will be eliminated." Instead, he favors "an all-out effort for creating and using alternative energy" as our number one national priority.

Scott Schaefer, CEO of Lexington Luxury Builders, Dallas, a self-described "avid New Urbanist," said that, even though he did not believe in climate change, he did support green building and sustainable practices. As for carbon credits, however, Schaefer called them "a sham."

SO_2 emissions by more than 40% from 1990 levels.

This result vastly exceeded the program's goals, at a fraction of the cost the EPA originally projected. In fact, a 2005 study by the EPA put the total annualized cost of the SO_2 emissions cap-and-trade program in 2010 at about $2 billion (2000$), with an average annual cost per ton of SO_2 of about $250—55% below the average cost per ton estimate in a 1990 EPA assessment.[1]

The Acid Rain Program has been praised as a model of cap and trade for its relatively low cost of compliance, stringent monitoring and quality assurance, and ability to spur innovation in clean coal technologies—notably flue gas desulfurization systems and low-sulfur coal.

Implementing cap and trade for greenhouse gases, however, may not be as simple as it is for acid rain.

Unlike SO_2, which stems from a relatively few sources, CO_2 is everywhere. It spews forth from cars and trucks, from manufacturing and power plants, from planes and boats. It's also embodied in imported products.

The ubiquity of CO_2 creates issues of fairness and practicality in implementing cap and trade. Do you cap the entire economy, down to every Mom-and-Pop grocery store and single-family bungalow? Or do you cap only big coal-fired power plants? Do you focus on the "first sellers" of carbon-based fuels, primarily coal-mining and petroleum companies? How, then, do you encourage downstream users to conserve energy?

As the EPA learned from the Acid Rain Program, the *scope and coverage* of the cap-and-trade program should capture the lion's share of emissions but still be relatively easy to administer. For this reason, most of the early GHG cap-and-trade programs have focused on the largest emitters. For instance, the nation's first mandatory GHG cap-and-trade program, the Regional Greenhouse Gas Initiative (RGGI), a cooperative effort among 10 northeastern and mid-Atlantic states, caps emissions only from the region's largest (>25 MW capacity) fossil fuel-burning power plants (see Chapter 4).

The European Union's EU Emissions Trading System (EU-ETS) is much more extensive in scope, capping CO_2 emissions from all energy generators as well major industries like cement, brick, and paper production. Launched in 2005 to help meet the EU's GHG-reduction obligations under the Kyoto Protocol, the program involves more than 12,000 emitting facilities across EU member countries. Despite its multinational scope, however, the program covers just 40% of total EU emissions.

Access to *accurate emissions data* on which to base the initial cap limit is another critical factor in cap and trade. The EU learned this the hard way during the initial three-year phase of the ETS. The EU overestimated the total CO_2 emissions by the participating companies at the launch of the program, which led to the over-allocation of the program's free, tradable permits. "Companies were hedging their bets and hiding how many permits they had," says Mark Maslin, director of the Environment Institute at the University College London and author of *Global Warming: A Very Short Introduction*.

Many firms simply banked their extra permits for use in the next allocation phase of the program; this devalued the allowances and led to a sharp drop in price. Permits worth upwards of $30 per ton of CO_2 emissions suddenly became nearly worthless. Prices also dropped when actual emissions for the first year of the program turned out to be much lower than predicted. Yet after a bumpy start, the ETS is largely responsible for most of the $30 billion in the global carbon market as of 2006.

For the U.S., the question remains whether a national cap-and-trade system would hurt the economy. In general, under such schemes, as the cost of carbon permits rises, more costs are passed on to the consumer in the form of higher energy and fossil fuel prices.

A March 2008 report by the American Council for Capital Formation (ACCF), a conservative Washington, D.C., think tank, and the National Association of Manufacturers stated that a carbon trading scheme like that envisioned in the Lieberman-Warner bill would cost the typical American family $1,760 more in energy costs per year in 2020, including 49% more for natural gas, 30% more for gasoline, and nearly double for electricity.[2]

A variation of the traditional cap-and-trade system, called cap and dividend, comes from policy analyst Peter Barnes. Under cap and dividend, permits would be sold to polluters on an annual basis, with the revenue being distributed among U.S. taxpayers to help reduce the burden of higher energy prices.[3]

Whether it's cap and trade, cap and dividend, or some variant, the economists and policy experts generally agree that a national cap-and-trade program likely would increase energy costs.

Given this background, what are the prospects for cap and trade in the U.S.? For one thing, there is general agreement that Lieberman-Warner was merely a dress rehearsal for a more extensive debate on cap and trade when the 111th Congress takes office in 2009. There is also the sense that some form of cap and trade will be necessary if the U.S. hopes to address climate change.

Finally, it is important to make clear that carbon markets are not a magic bullet. As the World Bank noted in 2007, "the enormity of the climate challenge … will require a profound transformation, including in those sectors that 'cap-and-trade' markets cannot easily reach."[4]

Due to their sheer volume, nonresidential buildings and single-family homes constitute markets that cap and trade won't easily reach. That makes it all the more incumbent upon the nation's AEC professionals and owners/developers to reduce energy consumption—and greenhouse gas emissions—in future projects. BD+C

1. *"A fresh look at the benefits and costs of the US acid rain program," Lauraine G. Chestnut and David M. Mills, Journal of Environmental Management 77 (2005) 252–266A, available at: http://www.epa.gov/airmarkt/presentations/docs/jemarpbenefitsarticle.pdf*

2. *"Analysis of the Lieberman-Warner Climate Security Act (S. 2191) Using the National Energy Modeling System (NEMS/ACCF/NAM)," conducted by Science Applications International Corp., March 2008. http://www.accf.org/media/dynamic/1/media_190.pdf*

3. *"Carbon Capping: A Citizen's Guide," Peter Barnes, Tomales Bay Institute, 2007, p. 6. http://www.capanddividend.org/files/CarbonCapping_CitizensGuide.pdf*

4. *"State and Trends of the Carbon Market 2007," Karan Capoor and Philippe Ambrosi, World Bank Institute, May 2007. http://carbonfinance.org/docs/Carbon_Trends_2007-_FINAL_-_May_2.pdf*

8. Holding at 450 ppm and 2ºC—But at What Cost?

As we have noted, the most reliable scientific information available on climate change comes from the 2007 Fourth Assessment Report of the Intergovernmental Panel on Climate Change. AR4 put global warming since the pre-industrial era at 0.9ºC (1.5ºF). There is further agreement among scientists that Earth will heat up at least another 0.6ºC (1ºF) no matter what we do.[1]

That takes us perilously close to 2ºC (3.5ºF), a figure that has become a red flag in the scientific community. As Gabrielle Walker and Sir David King have noted, this threshold was viewed as early as 1995 as a "dangerous" maximum temperature marker by the German Advisory Council on Global Change.[2] In a follow-up study in 2003, this group, known as the WBGU, confirmed a 2ºC increase as a cautionary top limit. In 2005, the International Climate Change Taskforce, whose members included Sen. Olympia Snowe (R-Maine), also settled on 2ºC as a tipping point. Later that year, the European Union adopted a 2ºC cap as its official policy.

Two degrees Celsius doesn't sound like much, but as the IPCC's AR4 report shows, this seemingly slight increase would impact huge areas of the world and billions of people.[3] Heat waves, droughts, hurricanes, and fires would intensify in many areas of the world. Violent rainfall events would become more pronounced, with consequent flooding. Drought and declining water availability would put as many as 1.7 billion in danger of water scarcity. Tens of millions of poor people, those most vulnerable to disaster, would be driven to migrate; human health problems worldwide would be exacerbated. Ironically, the higher latitudes would likely have greater crop yields, but farming in the tropics would suffer, and another 10-30 million of the world's poorest would go to bed hungry or starving every night.[4]

Unfortunately, the above scenario is probably the most optimistic projection that can be assumed from the IPCC report. The current level of CO_2 alone in the atmosphere is most likely about 385 or 386 ppm; add in the other greenhouse gases, and you quickly reach an equivalent CO_2 content of at least 430 ppm. At 450 ppm CO_2eq, global temperature would likely rise somewhere between 2ºC (3.5ºF) and 4ºC (6.5ºF), with 2.7ºC (4.5ºF) the likeliest prospect.

That means there's a very small margin of error between where we already are (430 ppm CO_2eq) and where we would be at the low end of the projections, 2ºC (3.5ºF), if we hit 450 ppm CO_2eq. At 550 ppm CO_2eq—a level we could reach as early as 2035, should we fail to do anything[5]—the most likely temperature increase would be 3.5ºC (6ºF); at 650 ppm, the likeliest value would be 4ºC (7ºF). At these levels, the human and environmental consequences are likely to become ever more frightening: at 3ºC (5.4ºF), as many as three million more people would be at risk of flooding, another 10 million threatened by hunger, and 20-30% of all natural species at risk of extinction.[6] And the misery index goes up from there.

These projections may sound bleak, but the future is not hopeless—provided we take action quickly on a local, national, and global scale. One positive sign is the growing number of initiatives that have sprung up in the U.S. in just the last few years to address climate change (see chapters 3-5). Many of these efforts are beginning to find their sea legs, and, collectively, they represent a step in the right direction.

Another sign of hope is a growing sense of confidence among experts from a number of disciplines suggesting that the means to combat climate change may already be at hand, or nearly so. Many of the necessary technologies are well-known and proven, and others with great potential for positive impact are "expected to be commercialized in coming decades," according to the IPCC Fourth Assessment Report. [SYR/SPM, p. 20]

Two approaches provide a game plan for society to consider how to tackle the "450 ppm challenge." One comes from professors Stephen W. Pacala and Robert H. Socolow, who head the Carbon Mitigation Initiative at Princeton University; the other comes from management consultants McKinsey & Co.

The Wedge Strategy

In August 2004, Pacala, a biologist/ecologist, and Socolow, a mechanical/aerospace engineer, published a paper in the peer-reviewed journal *Science* laying out what would come to be known as their "wedge strategy."[7] They took the current rate of emissions, 7 billion tons of carbon per year—they used tons of carbon, rather than CO_2, and set their target at 550 ppm CO_2—and projected that emissions would double to 14 billion tons of carbon per year in 50 years if nothing was done. To hold carbon emissions steady at 7 billion tons a year, therefore, 7 billion tons of "new" carbon emissions a year would have to be eliminated.

They then divided the new emissions into billion-ton "wedges"; together, the 7 wedges form what the authors called a "stabilization triangle" (Figure 8.1). Each wedge starts at zero and gradually ramps up the amount of

1. Cited in The Hot Topic, pp. 81-82.

2. The Hot Topic, 85-87.

3. The Hot Topic, 82ff., based on IPCC Fourth Assessment Report, Working Group II, Tables 19.1 and 20.7.

4. The editors are indebted to Gabrielle Walker and Sir David King for their useful condensation of the IPCC's technical findings. See The Hot Topic, pp. 82-85.

5. Stern Review, Chapter 7, cited in The Hot Topic, p. 91.

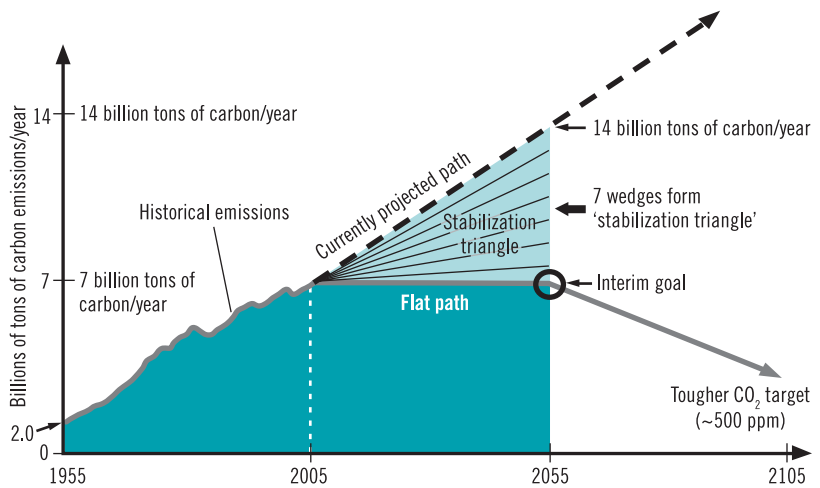
6. The Hot Topic, pp. 83-86.

7. "Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies," Science, 13 August 2004, pp. 968-972. www.science.org
See also: "A Plan to Keep Carbon in Check," Scientific American, Vol. 295, No. 3, September 2006, pp. 50-57; available at: www.princeton.edu/~cmi/research/Integration/Papers/A%20Plan%20to%20Keep%20Carbon%20in%20Check.pdf.

carbon emissions reduced to 1 billion tons a year in the 50th year; over the course of 50 years, each wedge would "redirect" a total 25 billion tons of carbon (Figure 8.2). The wedge strategy shows how to break down the task into more "digestible" chunks.

Pacala and Socolow described 15 wedges, each of which had "passed beyond the laboratory bench and demonstration project; many are already implemented somewhere at full industrial scale"—in other words, no pie-in-the-sky technical fantasies (Table 8.1). Any combination of seven would be enough to "fill" the stabilization wedge and hold carbon emissions at their current level; obviously, successfully implementing more than seven wedges could actually start to reduce carbon emissions compared to current levels.

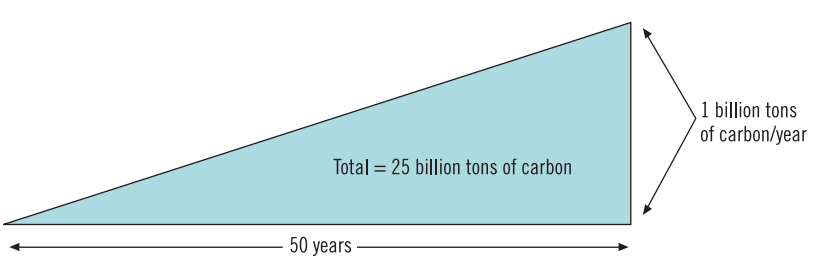
Figure 8.1
Wedge Strategy For Stabilizing Emissions at 550 ppm CO_2



Source: Based on Pacala and Socolow, *Science*, 13 August 2004. In "Stabilization Wedges and the Management of Carbon for the Next 50 Years: A Primer for the Physicist as Researcher and Teacher,"Robert Socolow, at Fermi National Accelerator Laboratory, 18 April 2007.

Each "wedge" is a strategy to reduce carbon emissions by a total of 25 billion tons over 50 years, starting at zero the first year and increasing to 1 billion tons/year (capping at 550 ppm CO_2) in the 50th year. The strategy must have been commercialized at scale somewhere to be considered a valid wedge. Seven wedges constitute the "stabilization triangle." Achieving a more rigorous CO_2 target (e.g., ~500 ppm) would require additional wedges.

Figure 8.2
What Is a 'Wedge'?



Source: "Stabilization Wedges and the Management of Carbon for the Next 50 Years: A Primer for the Physicist as Researcher and Teacher," Robert Socolow, at Fermi National Accelerator Laboratory, 18 April 2007.

A wedge is a strategy that starts at zero and grows in 50 years to reducing 1.0 billion tons of carbon emissions per year. Over a 50-year period, each wedge will account for a total 25 billion tons of carbon reduction.

Many of the wedges, such as those to "increase efficiency at 1,600 coal-fired plants to 60% instead of 40%" and "replace 1,400 50%-efficient coal plants with gas-fired plants," are beyond the immediate scope of the design and construction industry. Three wedges would require the application of carbon capture and storage, which involves trapping CO_2 emissions from power plants and burying them under the sea or under the ground. "CCS" has seen limited successful application in the real world, in Norway and, quite recently, in eastern Germany, but there are gnawing safety questions that have yet to be fully answered. Another wedge calling for a doubling of nuclear power output could also prove controversial and politically unfeasible due to the inherent waste disposal and international security issues.

Yet another group of wedges, while huge at the macroscopic level, fall within the realm of Building Teams, building owners, and real estate developers. For example, replacing (or at least supplementing) coal power with wind and solar power is already feasible for Building Teams to implement at the project level. As for "stopping all deforestation," Building Teams can contribute to the solution by specifying wood products from certified forests—although most deforestation is the result of land clearance for palm oil production (in Indonesia) for cooking or sugar cane planting (in Brazil) for biofuels, not for architectural wood.

Similarly, several of the transportation-related wedges fall within the purview of AEC professionals and firms. While primary responsibility for doubling the fuel mileage of the next two billion cars must fall to the automobile manufacturers, individuals and AEC firms could make it a policy to purchase the most fuel-efficient vehicles currently available for personal and business use.[8] They could also start cutting annual business mileage in half by, for example, using video-conferencing or online webcasts to exchange information between offices instead of holding face-to-face meetings that require people to drive or fly.

The wedge with the most direct application to the U.S. design/construction industry is, of course, the one that calls for cutting electricity use by one-fourth in buildings, home appliances, and office equipment. In their *Science* article (published in 2004, before the IPCC's Fourth Assessment Report), the authors point to a 1996 IPCC study which stated that "known and established approaches" to energy-efficient HVAC systems, water heating, lighting, and refrigeration in residential and commercial buildings could reduce

Table 8.1 Wedge Stabilization Strategy: 15 Ways To Make a Wedge
End-user efficiency and conservation
1 Increase fuel economy of 2 billion cars from 30 to 60 mpg
2 Drive 2 billion cars 5,000 miles a year, not 10,000 miles a year (at 30 mpg)
3 Cut electricity use in homes, offices, and stores by 25%
Power generation
4 Raise efficiency at 1,600 large (1 GW) coal-fired plants from 40% to 60%
5 Replace 1,400 large 1 GW, 50%-efficiency plants with gas-fired plants
Carbon capture and storage (CCS)
6 Install CCS at 800 large coal-fired power plants (90% of CO_2 captured)
7 Install CCS at coal plants that produce hydrogen for 1.5 billion vehicles (60 mpg equivalent, 170 kg of hydrogen/year/vehicle)
8 Install CCS at coal-to-syngas plants (30 million barrels of synfuels/day)
Alternative energy sources
9 Add twice today's nuclear output to displace coal
10 Increase wind power 40-fold to displace coal
11 Increase solar power 700-fold to displace coal
12 Increase wind power 80-fold to make hydrogen for cars
13 Drive 2 billion cars on ethanol, using one-sixth of world cropland
Agriculture and forestry
14 Stop all deforestation
15 Expand conservation tillage to 100% of cropland

Source: "A Plan to Keep Carbon in Check," *Scientific American*, Vol. 295, No. 3, September 2006, p. 53; available at: www.princeton.edu/~cmi/research/Integration/Papers/A%20Plan%20to%20Keep%20Carbon%20in%20Check.pdf.

Each of these 15 strategies is a "wedge" that would abate 25 billion tons of carbon emissions over 50 years. Note on deforestation: Carbon emissions from deforestation are currently at ~2 billion tons a year. About half that total would be assumed to be abated under business as usual and to zero in the flat path scenario.

emissions from buildings by one-fourth by the middle of the 21st century. Half the potential savings could come from buildings in the developing world.[9]

Energy conservation in commercial and residential buildings could have a double benefit. In their 2006 *Scientific American* article, Socolow and Pacala wrote, "Efficiency in electricity use is the most obvious substitute for coal. Of the 14 billion tons of carbon emissions projected for 2056, perhaps six billion will come from producing power, mostly from coal. Residential and commercial buildings account for 60% of global electricity demand (70% in the U.S.) and will consume most of the new power."

They continue: "So cutting buildings' electricity use in half—by equipping them with super-efficient lighting and appliances—could lead to two wedges"—that is, a reduction of 50 billion tons of carbon emissions over a 50-year period, contributing to two-sevenths (nearly 30%) of reduced emissions needed to achieve stabilization.[10] It should be noted that Pacala and Socolow do not even mention the benefits that could be derived from readily available solutions like improving insulation in homes and buildings.

Pacala and Socolow end their *Science* article by emphasizing what they see as the technological feasibility of their plan: "None of the options is a pipe dream or an unproven idea. Today, one can buy electricity from a wind turbine, PV array, gas turbine, or nuclear power plant. One can buy hydrogen produced with the chemistry of carbon capture, biofuel to power one's car, and hundreds of devices that improve energy efficiency. … Every one of these options is already implemented at an industrial scale and could be scaled up further over 50 years to provide at least one wedge."[11]

The McKinsey Cost Curve

The second conceptual approach to mitigating GHG emissions comes from the international consulting firm McKinsey & Co. In 2007, three McKinsey consultants based in the firm's Stockholm office wrote an article describing "a cost curve for greenhouse gas reduction."[12] The authors took what the IPCC refers to as a "mitigation potential" approach: They set out by examining numerous possible abatement measures, none of which could exceed a "marginal cost" of 40 euros per ton in 2030, to see which would yield the biggest bang for the euro.[13] They then examined three emission targets—400 ppm, 450 ppm, and 550 ppm—each of which would have to result in at least a 50% improvement in what they called the "global economy's greenhouse gas efficiency"—its volume of emissions relative to the size of the gross domestic product (GDP) compared with business as usual.

The goal: keep the average global temperature from rising by more than 2ºC. For discussion purposes, they chose the mid-range scenario (450 ppm), which they determined would require greenhouse gas abatement of 26 billion tons of CO_2 a year by 2030.

After studying a couple of hundred possible abatement measures, the McKinsey team came up with two dozen that met their requirements, which they plotted on what they called a "global cost curve" (Figure 8.3). Those measures at the low end of the curve would actually result in financial savings over time; those above zero on the vertical scale would never cost more than 40 euros a ton of CO_2 per year to abate.

As Figure 8.3 (p. 52) shows, several of the most cost-effective measures in the McKinsey cost curve relate to buildings: building insulation, lighting systems, air-conditioning, and water heating. Their projections show that buildings (residential and commercial) and related appliances could account for 3.7 billion tons in

8. At this writing, General Motors said that it had reached preliminary agreement with the U.S. Environmental Protection Agency to certify the Chevrolet Volt as the first 100-mpg car. The four-passenger Volt, an electric vehicle with a battery range of 40 miles, can be powered with its 1.4-liter gasoline engine. GM said the Volt will go on sale in November 2010. "Volt to be certified first 100 m.p.g. car," Chicago Tribune, 27 September 2008, Section 2, p. 2.

9. Science, 13 August 2004, p. 969. See IPCC, Climate Change 2001: Mitigation, B. Metz et al., Eds., at: www.grida.no/climate/ipcc_tar/wg3/index.htm

10. Scientific American, September 2006, p. 52.

11. Science, 13 August 2004, p. 971.

12. "A cost curve for greenhouse gas reduction," Per-Anders Enkvist, Tomas Nauclér, and Jerker Rosander, McKinsey Quarterly 2007, Number 1, pp. 35-46. www.mckinseyquarterly.com/home.aspx (free download with short registration).

13. The IPCC defines mitigation potential as "the scale of GHG reductions that could be made, relative to emission baselines, for a given level of carbon price (expressed in cost per unit of carbon dioxide equivalent emissions avoided or reduced)." [Working Group III, p. 7]

reduced emissions—14% of the 26 billion tons needed to stabilize at 450 ppm. In total, six billion tons—almost a fourth (23%) of the 26 billion-ton goal—could be achieved through measures that had zero or negative life cycle cost.

The McKinsey team put the price tag for fulfilling the 450-ppm scenario at 500 billion euros in 2030, or 0.6% of projected GDP, provided all the "40 euros and under" abatement measures could be captured. This could rise to 1.1 trillion euros, or 1.1% of GDP, if more expensive approaches were required.

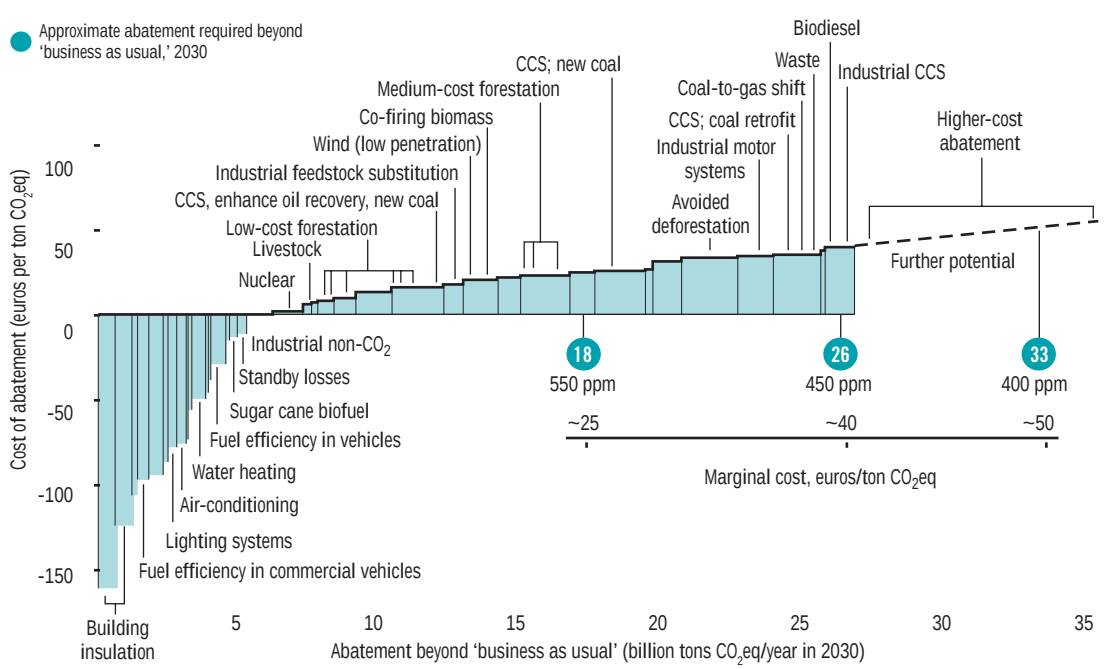
The good news, according to the McKinsey team, is that 70% of possible "40-and-under" abatements—things like energy-efficient lighting, small-scale hydropower, and nuclear power—would not depend on any major technological developments. The other 30% would require new technologies or lower costs for existing technologies, such as photovoltaics, wind power, biofuels, and carbon capture and storage. Moreover, according to the McKinsey report, simple measures like improving the insulation in new buildings (and, we would add, in existing homes and buildings), coupled with some measures in transportation and manufacturing, could cut future growth in global electricity demand to about 1.3% a year, from the current 2.5% annual growth.

It is important to note that well more than half the potential "40-and-under" abatements would come from developing economies, notably China (4.6 billion tons, or 18% of the 26 billion-ton target) and "other developing countries" (11.1 billion tons, or 43% of the target). This is due to three factors: 1) their large populations, 2) the relatively lower cost of abating new emissions vs. current emissions (especially for manufacturing and power generation in high-cost markets), and 3) the potential for reducing up to 6.7 billion tons of emissions from deforestation in Africa, Latin America (primarily Brazil), and Asia (primarily Indonesia).

What about the United States? Following the "mitigation potential" example of their Swedish colleagues, a U.S.-based team of McKinsey consultants partnered with the Conference Board, environmental nongovernmental organizations, and academic experts to answer the question "How much at what cost?" to bring U.S. greenhouse gas emissions in line with projected economic growth.[14]

Relying on data from the U.S. Energy Information Administration, McKinsey's American team deter-

Figure 8.3
McKinsey Cost Curve For GHG Reduction



Source: "A cost curve for greenhouse gas reduction," McKinsey Quarterly 2007, Number 1, p. 38.

The McKinsey cost curve shows several readily available building technologies at the low end of the curve—building insulation, lighting systems, air-conditioning, and water heating—reduce emissions by lowering demand for power. These technologies actually produce savings over time. Three scenarios are shown—550, 450, and 400 ppm—each increasingly greater in terms of marginal cost. Note: "Standby losses" refers to wasted energy from household appliances and office equipment left to run on standby power.

mined that U.S. greenhouse gas emissions would rise 35% over a 25-year period, from 7.2 billion tons a year in 2005, to 9.7 billion tons in 2030, under a business-as-usual scenario. They then analyzed 250 abatement measures to see which of these could yield the most cost-effective results. Only "tested approaches" and "high-potential emerging technologies" were considered, at a marginal cost of $50 a ton (2005$).

Narrowing down 250 possible measures to a few dozen, they found that the U.S. could reduce yearly greenhouse gas emissions by as much as 3.0 billion tons in the mid-range case (which would require "concerted action across the economy") to 4.5 billion tons in the high-range case (requiring "urgent national mobilization") by 2030. These reductions would bring U.S. emissions down 7-28% below 2005 levels compared to reference case projections, and could be made at a marginal cost of less than $50 per ton, while maintaining what the authors called "comparable levels of consumer utility," i.e., quality of life.

As in the earlier McKinsey study, the U.S. "cost curve" showed that almost 40% of U.S.-based GHG abatement could be achieved at "negative" marginal costs, meaning that they would more than pay for their original cost in energy savings over the 25-year life of the plan.

Once again, energy efficiencies in buildings, home appliances, and office equipment could be a major factor in the success of the plan—for the mid-range case, savings here could amount to 710 million tons, or 24% of the total 3.0 billion tons. Most of this could be accomplished through well-established means: lighting retrofits, HVAC system improvements, tighter building envelopes, building control systems, and higher-performance consumer and office electronics and appliances.

According to the McKinsey/Conference Board report, improving energy efficiency in buildings, appliances, and certain industrial sectors could offset 85% of the projected incremental demand for electricity in 2030, *"largely negating the need for the incremental coal-fired power plants assumed in the government reference case"* (emphasis added).

Other findings of the U.S. report:

• **Abatement potentials and costs vary geographically.** Based on $50 and under per ton, the Northeast would only abate 330 million tons of GHG emissions, while the South could abate 1,130 million tons.

• **The question of who pays and who gains could affect results.** Who benefits more from energy-efficiency improvements in a new condo, the builder or the purchaser? Most homeowners expect a fairly quick payback period, 2-3 years, whereas some technologies take much longer than that to start paying dividends.

• **It costs less to abate from scratch.** Echoing the report by their Swedish colleagues, the American team noted that "the cost of building energy efficiency into an asset when it is created is typically a fraction of the cost of retrofitting it later, or retiring an asset before its useful life is over." (Editor's note: Significant energy and emissions savings could also be achieved by improving the energy efficiency of existing buildings.)

The McKinsey experts put the incremental capital cost of the mid-range case (450 ppm) at $50 billion a year through 2030, for a cumulative net new investment through 2030 of $1.1 trillion, or about 1.5% of the $77 trillion in real investment the U.S. economy is expected to make through 2030.

They, too, sounded a clarion call for quick action: "Many of the most economically attractive abatement options we analyzed are 'time-perishable': every year we delay producing energy-efficient commercial buildings, houses, motor vehicles, and so forth, the more negative-cost options we lose." Yet another set of voices chanting the theme that the longer we wait, the more costly it will be to reduce carbon emissions.

Nicholas Stern's 1% Solution

Thus far, we have heard from scientists and management consultants. What about the proponents of the dismal science? What do the economists have to say about the cost of addressing climate change?

That is the question Britain's then-Chancellor of the Exchequer (now Prime Minister), Gordon Brown, posed to Sir Nicholas Stern, in July 2005. Could Stern, the former chief economist of the World Bank and current head of the Government Economic Service, come up with a credible cost for combating climate change?

On 30 October 2006, Stern reported back to Brown with a 600-page document, the "Stern Review on the Economics of Climate Change." Basing his assessment of impacts and risks chiefly on the IPCC's Third Assessment Report (the fourth would not be published for another year), he concluded that there was at best a 50/50 chance of keeping global warming below 2°C from pre-industrial levels: "450 ppm is already nearly out of reach," he said.[15]

The more likely path, said Stern, was that CO_2 emissions would peak at 550 ppm in the next 10-20 years, with emissions reductions of 1-3% a year after that. This would require "strong action," such as "decarbonizing" the global power sector at least 60% by 2050, with the world's rich countries having to absorb a greater share of this effort. At 550 ppm, he put the chances of keeping below 3°C at 50/50. He did state, however, that it was unlikely that global warming would exceed 4°C at 550 ppm, unless we did nothing; in that case, there would be a 50/50 chance of an eventual temperature rise of 5°C. This could be devastating, said Stern, who warned Her Majesty's Government that "the last

14. "Reducing U.S. Greenhouse Gas Emissions: How Much at What Cost?" John Creyts, Anton Derkach, Scott Nyquist, Ken Ostroski, and Jack Stephenson, McKinsey & Co. and The Conference Board, December 2007. www.conference-board.org/publications/describe.cfm?id=1384 (free registration).

15. The Stern Review can be downloaded at: www.sternreview.org.uk

Ice Age was 5°C below where we are today—such differences are transformational."

In terms of the direct human cost of "business as usual," Stern pointed to the inequity that "poor countries will be hit hardest and earliest, when it is the rich countries responsible for three-fourths of greenhouse gases currently in the atmosphere."

Up to this point, Stern was covering well-trod ground. It was when he started moving beyond the scientific literature into economic forecasting that things got interesting.

The Stern Review posited two fresh—and hugely controversial—sets of numbers. The first had to do with the "damages" to the world's economy that would result from failing to address climate change. "Business as usual" damages would "be equivalent to at least 5% and up to 20% of consumption a year, depending on the types of risks and effects included." That is, do nothing, and the populace of 2050 could be paying as much as 20 cents on every dollar to overcome the negative effects of climate change.

The second figure had to do with getting to 550 ppm or below. Stern put this cost at "around 1% of GDP per year," although it could range from -1% to 3.5% of GDP. "This is the equivalent of paying on average 1% more for what we buy—the price rise for carbon-intensive goods would be higher and for low carbon-intensive goods would be lower—it is like a one-off increase by 1% in the price level."

A 1% GDP cost would, in Stern's view, be "manageable." Moreover, he told British officials, "We can grow and be green." Markets for low-carbon technologies could reach $500 billion by 2050, he said. Further, the Stern Review priced the damage caused by each ton of CO_2 emissions (most of it hidden) at $85, whereas cutting emissions could cost less than $25 a ton. "According to one measure," the report stated, "the benefits over time of actions to shift the world onto a low-carbon path could be in the order of $2.5 trillion each year."

Stern summarized the cost/benefit analysis in this way: "Tackling climate change is the pro-growth strategy; ignoring it will ultimately undermine economic growth." To which he added, "Economically speaking, mitigation is a very good deal. Business as usual, on the other hand, will eventually derail growth."

Sir Nicholas proposed several policies to British officials: more R&D to promote technology; a more concerted international effort to reduce deforestation, which accounts for an estimated 18% or more of global emissions; and establishing a carbon price via tax, trade, and regulation. The European Union's Emissions Trading Scheme, now in its third phase, was "leading the way" in this regard, he said.

It was not Stern's policy recommendations that grabbed the headlines but his projection of a 5-20% future cost penalty for doing nothing that caused a "seismic shift" (in the words of University College London's Mark Maslin) in British public opinion in favor of taking more aggressive action on climate change. The Stern Review also produced a minor temblor in the world of economics. Although Stern had support from several prominent fellow economists, others criticized him for setting the discount rate too low in his calculations of future costs; this, the critics said, had the effect of making the costs of global warming in 2050 appear to be greater than they should be, thus calling into question the underlying assumptions and resulting conclusions of the entire report.[16]

Two conclusions can be drawn from Pacala and Socolow's wedge strategy, the McKinsey cost curve, and the Stern Review's 1% solution.

The first, as has been noted throughout this White Paper, is that it would cost much less in the long run to deal with climate change today than in the future. As UCL's Maslin has noted, the faster we start taking action, through increased energy efficiency, reducing demand for energy, and switching to low-carbon technologies for heat, power, and transportation, the less it will cost us down the road.

This point was underscored last April, when, after a careful review of the 2007 IPCC Fourth Assessment Report, Sir Nicholas—only having just been elevated to the title Lord Stern of Brentford—admitted that his commission had "underestimated the damage associated with temperature increases" and "underestimated the probabilities of temperature increases."[17] Greenhouse gas emissions, he told a press conference, "are growing much faster than we'd thought, the absorptive capacity of the planet is less than we'd thought, the risks of greenhouse gases are potentially bigger than more cautious estimates and the speed of climate change seems to be faster."[18]

Last June, Lord Stern recalibrated his emissions target downward from 550 ppm to 500 ppm and scaled up the cost to reduce carbon to 2% of GDP.[19] How quickly the price can go up!

The second conclusion comes from Gabrielle Walker and Sir David King. "There's little need to worry about how much climate damage might cost us in the future," they write, "when its effects are already being felt today."[20] Their advice: ignore what they call the "uncertain economic predictions" and "listen instead to the science." The best "prediction" of the future comes from the 3,750 scientists and expert reviewers who contributed to the IPCC Fourth Assessment Report. Both the science and common sense say, start now. Tomorrow may be too late. BD+C

16. For example, see The Hot Topic, pp. 147-151, and "Yale Symposium on the Stern Review," Yale Center for the Study of Globalization, February 2007, at: www.ycsg.yale.edu/climate/forms/fulltext.pdf

17. "Stern takes a bleaker view on warming," Financial Times, 17 April 2008.

18. "I underestimated the threat, says Stern," The Guardian, 18 April 2008. www.guardian.co.uk/environment/2008/apr/18/climatechange.carbonemissions

19. "Cost of tackling global climate change has doubled, warns Stern," The Guardian, 16 June 2008. www.guardian.co.uk/environment/2008/june/26/climatechange.scienceofclimatechange

20. The Hot Topic, p. 150.

9. Climate Change Action Plan

How can the AEC industry contribute to the goal of stabilizing CO_2 levels at 450 ppm by 2030? The editors of *Building Design+Construction* offer eight general recommendations and 22 specific action items for AEC professionals and firms to consider.

1. Get on board the Climate Change Express.

Our exclusive survey found that 95% of AEC respondents have taken at least one action to reduce greenhouse gas emissions in their personal lives (Table 2.3, p. 9). Their firms have implemented at least five actions to reduce emissions in their business operations (Table 2.4, p. 9) and had pursued an average 15 such practices in their projects (Table 2.5, p. 10).

Nonetheless, there is still skepticism among some architects, engineers, contractors, building owners, and developers about climate change and whether they can do anything to stop it.[1]

This much is clear: Whether or not you "believe" in climate change, you will not be able to ignore it, at least not in your professional life. Events are taking place around you that will force you and your firm to respond to climate change directives from government, Corporate America, and your clients.

Two years ago, California's AB 32 established a goal of trimming GHG emissions 25% to 1990 levels by 2020. Starting next January, California's AB 1103 (approved in 2007) will require annual reporting of energy use for all nonresidential buildings; in 2010, owners of commercial buildings will have to reveal each property's energy usage and Energy Star rating to prospective buyers, financiers, and lessees. This past July, California became the first state to mandate a statewide green building code. In the words of Governor Arnold Schwarzenegger, "California is again leading the way to fight climate change and protect the environment."[2]

California is not alone in taking action on climate change. On 7 August 2008, for example, Massachusetts passed the Global Warming Solutions Act (S2540), which requires the Commonwealth to reduce its GHG emissions 80% below 1990 levels, by 2050. According to the Pew Center on Global Climate Change, as of September 2008, 24 states had completed climate action plans; nine have such plans in progress; six more are revising their plans.

In fact, there is not a single state that has not taken at least one action to address climate change (Table 5.1, p. 41).[3] Multi-state efforts are also in the works: the Regional Greenhouse Gas Initiative in the Northeast, the Western Climate Initiative, and the Midwestern Regional GHG Reduction Accord.

The nation's cities are also responding to climate change. Some 884 mayors have signed the U.S. Conference of Mayors Climate Protection Agreement (www.usmayors.org/climateprotection/agreement.htm). As noted (Chapter 5), several cities (most recently Pittsburgh and Chicago) have issued elaborate plans to address climate change. ICLEI – Local Governments for Sustainability (www.iclei.org) reports hundreds of such initiatives around the world.

Look, too, for the words "climate change" to start showing up in building codes as well. The Energy Efficient Codes Coalition (www.thirtypercentsolution.org) has proposed changes to the International Energy Conservation Code to boost its residential energy-efficiency targets by 30% (and, later, 50%) for building codes.

U.S. cities and states may soon latch on to a British import, Energy Performance Certificates. These documents, which provide details on a property's energy consumption for prospective tenants or purchasers to scrutinize, have been used in the U.K. for several years. On 1 January 2009, the European Union will impose energy performance standards on all new construction and reconstruction of existing buildings over 1,000 square meters, with a "full feasibility assessment" of alternative HVAC systems required for all new buildings over 1,000 square meters.[4]

But there's no need to limit ourselves to examples from across the pond. Just look to the nation's capital. Under its new Clean and Affordable Energy Act, the District of Columbia will (starting in 2010) require private buildings over 200,000 sf to submit their energy use data (based on the Energy Star Portfolio Manager tool) to the city; this mandate will be ratcheted down until it reaches buildings of 50,000 sf or more in 2013. The data will be made available to the public, which means that real estate brokers will have access to it.[5]

At the federal level, the U.S. Supreme Court's April 2007 ruling in *Massachusetts v. EPA* confirmed the U.S. Environmental Protection Agency's authority to regulate carbon dioxide as a pollutant. On 25 August 2008, 12 states took this verdict to heart and sued the EPA for allegedly violating the Clean Air Act by failing to regulate GHG emissions from oil refineries. And, although at this writing the outcome of the presidential election is unknown, both candidates have expressed support for federal action on climate change.

In the private sector, the Business Council for Sustainable Energy (www.bcse.org) has been pushing

1. For a useful report on U.S. building-sector emissions reductions scenarios through 2050 (prepared for the Presidential Climate Action Project), see "Reducing Carbon Dioxide Emissions Through Improved Energy Efficiency in Buildings," Joe Loper, Steve Capanna, Selin Devranoglu, Nils Petermann, and Lowell Ungar, Alliance to Save Energy, May 2008. At: http://www.ase.org/files/4816_file_co2_emissions_pcap.pdf
See also: "Vision for 2025: Developing a Framework for Change," National Action Plan for Energy Efficiency, November 2007. This group, representing more than 60 utilities, manufacturers, energy NGOs, and related organizations, is co-chaired by Marsha Smith, Commissioner of the Idaho Public Utilities Commission and president of the National Association of Regulatory Utility Commissioners, and James E. Rogers, chair, president, and CEO of Duke Energy. At: www.epa.gov/cleanenergy/documents/vision.pdf

Footnotes 2-5 on page 56

for energy conservation for most of two decades (see Chapter 3). And the U.S. Climate Action Partnership (www.us-cap.org), whose members include Alcoa, BP America, Caterpillar, Dow Chemical, Duke Energy, Exelon, Ford, GE, GM, Johnson & Johnson, PepsiCo, Shell, Siemens, and Xerox, as well as environmental NGOs, has been lobbying the federal government for mandatory emissions limits because they believe such limits reduce uncertainty (i.e., risk) and are therefore in the self-interest of their companies![6]

In fact, a study for the Pew Center on Climate Change revealed that 28 of the 31 major U.S. corporations surveyed believed that government will be regulating emissions by 2015.[7] In the real estate sector, BOMA is taking a leadership position on climate change among building owners with its 7-Point Challenge, and the new version of LEED, LEED 2009, purposely "weights" the majority of its 100 base points toward climate-related categories (see Chapter 3).[8]

All this points to one conclusion: Climate change will impact your business and professional life. In RFPs, project interviews, and competition entries, you're going to be asked what your firm is doing about climate change. You'd better be ready to respond.

Look at it this way: Ten years ago, few AEC professionals had any idea what "LEED" meant. Today, few firms would dare to go into a presentation without talking up their green building capabilities. Pretty soon, clients are going to want to know how you can help them reduce their GHG emissions—if they're not already asking for that information.

What, then, can you do? For starters, a few basics.

Recommendation 1A: Assign a Web-savvy go-getter to be your firm's "climate change expert." This person would have primary responsibility to monitor climate change activities—reports, documents, press releases, etc.—online on behalf of the entire firm.

Recommendation 1B: Periodically issue a short internal "Climate Change Update"—a memo or report, maybe even an internal blog by your above-named expert—to keep everyone up to date on new developments. This document can be repurposed for email distribution to clients and prospects and posted on your public website.

Recommendation 1C. Create a searchable, interactive space on your firm's intranet to serve as your "Climate Change Best Practices" microsite. A number of progressive firms have been doing this for their green building efforts; the concept can be extended to take in climate change as well. Make sure staff members can easily post comments and share ideas and best practices on the site.

2. Integrate climate change mitigation and adaptation into your business operations.

As noted in our survey (Table 2.4, p. 9), professional firms report taking an average of five actions to address climate change in their daily business operations. These efforts can mount up. For example, recycling a single aluminum can produces the equivalent energy savings (and emissions reduction) of turning off your television set for three hours, or not using a compact fluorescent lamp for 30 hours.

Here are several additional ways you can take positive action:

Recommendation 2A. Write out your firm's position and action on climate change and highlight this information in RFPs, in posters in your lobby, and in all your marketing and public relations materials. You're probably already doing something like this to promote your expertise in, say, BIM or green building. Do the same for climate change. No exaggeration or greenwash, of course.

Recommendation 2B. Fit out your own offices to reduce GHG emissions. Make the facts of your improvements known to visitors, clients, and prospects via tasteful, informative signage, charts, videos, and similar display materials. For example, you could put up a chart in your reception area showing how new lighting controls or Energy Star-rated copying equipment has reduced GHG emissions in your office.

Recommendation 2C. Quantify and document the emissions your firm has mitigated in client projects. "Performance" and "measurement" are the new mantras of client relations. Use hard numbers, not generalities, to tell your story—total CO_2eq mitigated, CO_2eq reduction per project or square foot, etc. Make sure to keep your clients informed about your performance, and keep updating your marketing materials on your website to promote your success.[9]

3. In your projects, do the simple things first, and do them right.

One stumbling block in confronting climate change is that the problem is so enormous in physical scope (the whole planet!), so far-reaching and long-range (2030? 2050? 2100?), and so complex (the IPCC's Fourth Assessment Report alone is nearly three thousand pages long) that it looks hopeless for any individual (you) or entity (your firm) to make sense of it, no less to do anything about it.

Don't despair. You can start to reduce GHG emissions just by doing your job and taking care of the basics: proper building orientation, maximized insulation, energy-saving lighting, well-designed daylighting systems and controls, effective building automation systems, efficient cool roofs and green roofs, tightly

2. Other initiatives include the California Long Term Energy Efficiency Strategic Plan (http://docs.cpuc.ca.gov/efile/PD/86800.pdf), which provides a strategy for integrating energy-efficiency efforts, including recommendations for more aggressive codes and standards along with the goal of making all new residential construction reach zero net energy by 2020, with commercial new construction doing so in 2030. In addition, the Commissioner of the California Public Utilities Commission has issued a proposed decision outlining a Final Opinion on Greenhouse Gas Regulatory Strategies (http://docs.cpuc.ca.gov/word_pdf/AGENDA_DECISION/90810.pdf) that emphasizes the need for both programmatic and market-based mechanisms to reduce emissions in the electricity and natural gas sectors through significant increases in energy efficiency, renewable energy, and the development of a cap-and-trade-program.

3. For the most up-to-date catalog of state initiatives, see Pew Center on Global Climate Change, "State Action Maps": www.pewclimate.org/what_s_being_done/in_the_states/state_action_maps.cfm

4. According to analyst Jens H. Laustsen, International Energy Agency, Paris, a European directive on energy performance in buildings in force since January 2003 requires all member states to have a "mandatory claim for certificates" for the construction, sale, and rental of buildings. This was to have been implemented by 2006 but, due to a lack of trained experts, most European countries have chosen an additional transposition period of three years. Starting 1 January 2009, this directive must be implemented in all European member countries. See www.managenergy.net/products/R1272.htm; www.managenergy.tv/metv/portal/_vi_wm_300_en/player/index_player.html?id=2004&pId=2001

5. "D.C. Requires Building Owners to Report Energy Use," Environmental Building News, 1 September 2008, and "Energy-Use Reporting Mandated in California," EBN, October 2008.

sealed building envelopes (air and vapor barriers, low-e glass, well-insulated doors and windows), etc. As our survey shows (Table 2.5, p. 10), most AEC firms are already routinely using energy-saving technologies and systems in their building projects.

Simple measures, using known technologies, can have tremendous impact and relatively fast payback. According to the McKinsey "cost curve for GHG reduction" (Chapter 8), known technologies such as insulation and lighting improvements plus some improvements in manufacturing alone could reduce global emissions by six billon tons of CO_2eq a year of the total 26 billion tons a year needed to hold global temperature gain to 2ºC by 2030.

Further, Princeton University's Steven Pacala and Robert Socolow have identified reducing emissions in buildings and appliances by about one-fourth using known technologies, such as energy-efficient HVAC, water heating, lighting, and refrigeration in homes and commercial buildings, as one of their 15 "wedge" options for slashing GHG emissions.

And the Intergovernmental Panel on Climate Change cites "key mitigation technologies and practices *currently commercially available*": efficient lighting and daylighting; more-efficient electrical appliances and heating and cooling devices; … improved insulation; [and] passive and active solar design for heating and cooling." [WGIII/SPM, p. 10; emphasis added]

The Fourth Assessment Report also lists "intelligent meters that provide feedback and control" and "solar PV integrated in buildings" as among several technologies to be commercialized by 2030; in fact, intelligent meters (and building automation systems) are already available, as are building-integrated PVs, although more development is needed to bring down their costs.

In short, the proverbial low-hanging fruit is waiting to be picked. By doing just this much, you'll be making a valid contribution to emissions reduction. Of course, you'll want to do more.

Recommendation 3A. For more ideas on energy savings and emissions reduction, use the numerous sources that are readily available online. For starters, consult the AIA's 212-page "50to50" guide (www.aia.org/fiftytofifty), a helpful primer on everything from building orientation and low-e windows to more sophisticated techniques and technologies, such as active solar systems, cogeneration, and waste-heat recovery. Each three- to four-page entry comes with links to useful resources as well as links to other strategies. For example, in the Passive Solar Collection Opportunities section, there are links to Building Form, Daylighting, Sun Shading, and other strategies.

The Whole Building Design Guide (www.wbdg.org) is an incredibly rich (and free!) information resource. And the recent report "Energy Efficiency and Durability of Buildings at the Crossroads," by the National Institute of Building Sciences (NIBS), the Building Enclosure Technology and Environment Council (BETEC), and the Building Enclosure Council (BEC), points out the energy savings (and resulting emissions reduction) that can be achieved from a properly designed and constructed building envelope.[10]

The point is, you don't have to reinvent the wheel. Many of the less well-known but highly effective technologies, such as variable-speed drives (which can cut HVAC energy use in half) or ultraviolet germicidal radiation and electronic air cleaners (which reduce energy usage by cleaning out dust and microbial contamination in air ducts), have proven track records in cutting energy usage and, consequently, reducing emissions.

We Americans tend to think about solving difficult national or international issues in a somewhat linear fashion. We fall back on the model of the Manhattan Project or President Kennedy's call to put a man on the moon, particularly when there's a scientific or technological dimension to the problem; and we call upon a relatively small cadre of high-tech geniuses to solve the problem. This is not to disparage the heroic nature of the Manhattan Project or the Apollo mission. Both were monumental scientific and engineering achievements, of course, but frankly, climate change is not rocket science. It's more complex than that.

When it comes to climate change, we need a fresh approach, one that involves all of us directly. Writing in the October 2007 issue of *National Geographic*, Bill McKibben framed the climate change challenge in the context of the moon mission. "Now we need almost the opposite: a commitment to take what we already know how to do and somehow spread it into every corner of our economies, and indeed our most basic activities. It's as if NASA's goal had been to put all of us on the moon."

Or, as Edward Mazria, AIA, founder of Architecture 2030, has said, "We tend to rush toward the complex when trying to solve a daunting problem, but in this case, simplicity wins. Better buildings, responsible energy use, and renewable energy choices are all we need to tackle both energy independence and climate change."

Recommendation 3B. Leverage your supply chain to achieve GHG reductions. Major construction, engineering, and property development companies have—or should have—a lot of clout with their suppliers. For example, Turner Construction, the largest construction management firm in the U.S. (>$10 billion in construction in 2007), makes many of its building product and major equipment purchases—everything from light fixtures to entire mechanical/electrical equipment systems—through a wholly

6. The Carbon Disclosure Project, a voluntary carbon disclosure and reporting system for corporations, has the largest corporate greenhouse gas emissions database in the world. Its annual reports provide a detailed analysis of how the world's largest companies are responding to climate change. See www.cdproject.net.

7. "Getting Ahead of the Curve: Corporate Strategies That Address Climate Change," Andrew J. Hoffman, The University of Michigan (for the Pew Center on Global Climate Change), October 2006. www.pewclimate.org/docUploads/PEW_CorpStrategies.pdf

8. For more on the climate change aspects of LEED 2009, view the AIA/CES-certified webcast "LEED 2009: What It Means to You": www.loginandlearn.com/course/overview.php?courseid=1082

9. The GHG Protocol can help you quantify and report your firm's emissions. www.ghgprotocol.org/files/ghg-protocol-revised.pdf

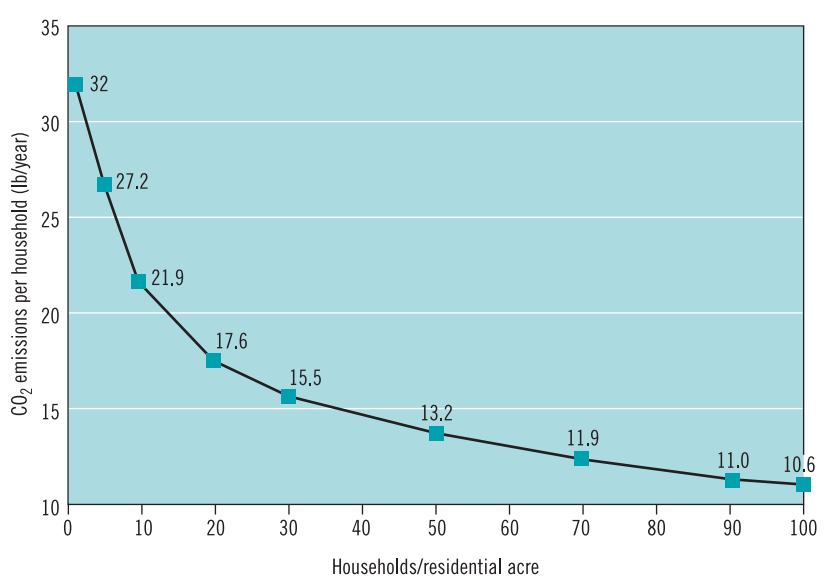
10. "Energy Efficiency and Durability of Buildings at the Crossroads," NIBS, BETEC, and BEC, 2 September 2008. At: www.aia.org/SiteObjects/files/BEST1_White_paper.pdf
For more ideas, see "24 No-brainers for Your Next Green Project," based on the advice of B. Alan Whitson, RPA, a principal with Corporate Realty, Design & Management Institute, Portland, Ore. At: www.bdcnetwork.com/article/CA6395252.html?industryid=42784

owned subsidiary, Turner Logistics, whose clients reap the cost savings from volume purchasing, better project scheduling, greater assurance of product availability and delivery, and enhanced product choice.

Presumably a number of the giant construction and engineering firms—among them AECOM Technology, Arup, Black & Veatch, Bovis Lend Lease, CH2M Hill, Clark Group, Fluor, Gilbane Building Co., Hill International, Heery, Jacobs Carter Burgess, Parsons Brinckerhoff, PCL Construction Enterprises, Skanska USA Building, Stantec, Structure Tone, Tishman Construction, and URS—as well as states, counties, and big cities, could use their purchasing power to encourage—or require—suppliers to post the carbon emissions of their products and systems online or in their purchase orders. That would give Building Teams valuable information to factor into their specifying decisions.

Recommendation 3C. Look at climate change as a challenge to your firm, and develop a business strategy to make the most of it. The primary motivation for you and your firm to be engaged in battling climate change should, of course, be altruistic, serving the common good. Without compromising this noble goal—in fact, making it even more practicable—it is possible to think about climate change as a business opportunity, much as the early adopters of LEED benefited from getting the jump on the green building market. High-quality design and construction that produces energy savings and cuts emissions benefits your clients, the environment, and your bottom line. Instead of waiting to react to greater regulation or policy directives on GHG emissions, get your firm out front and make a name for yourself as a climate change leader.

Chart 9.1
How Residential Density Affects Travel-related CO_2 Emissions



The San Francisco League of Conservation Voters calculator shows the hypothetical impact of residential density on travel-related greenhouse gas emissions. A study by M. J. Burer and others for the American Council for an Energy-Efficient Economy found that GHG emissions could be reduced as much as 10% (vs. 2001 levels) in the U.S. within 10 years through "locational efficiency" measures such as greater density.

4. Be prepared to take action to meet heightened demands from state and local governments for land use, zoning, and building code reforms to mitigate and adapt to climate change.

California's new SB 375 sets the tone for future action by state governments throughout the country to address the land use factors that impact climate change.

As we saw in Chapter 5, the new law encourages regional growth planning through "sustainable communities strategies" whose purpose is to reduce passenger vehicle miles and GHG emissions. Smart growth developments that meet their regional "SCS" targets will be rewarded with a slice of the state's transportation infrastructure dollars.

SB 375 also cuts through state and local government red tape for smart growth projects and gives certain mixed-use and infill housing projects the benefit of a streamlined review by the state's Air Resources Board, which sets regional emissions limits. In fact, SB 375 makes certain "transit priority projects" exempt from Air Resources Board oversight.

This is the first state legislation that overtly connects the dots between the location of housing and vehicle miles traveled in an effort to reduce greenhouse gas emissions. It would not be surprising to see other states pick up on the SB 375 theme, especially those states where suburban sprawl is reaching the tipping point.

Recommendation 4A. Where feasible and appropriate, increase project density through transit-oriented development, mixed use, and more compact site planning.

The goal here is to trim vehicle miles traveled, thus reducing greenhouse gas emissions. In general, total emissions from buildings in the city portion of the typical metropolitan are twice the total emissions from buildings in the surrounding suburbs; for travel-related emissions, however, it's usually the reverse: Travel-related emissions in the suburbs are about twice that of travel-related emissions in the city. This seems logical: City dwellers generally have fewer cars, take shorter trips, and use public transit more often than their suburban counterparts.[11] In general, greater population density reduces average trip length, which trims GHG emissions (Chart 9.1).

The editors of *Environmental Building News* have calculated that, for the average office building in the U.S., the energy used by office workers to commute back

and forth is 30.2% more than the energy the building itself uses (Table 9.1). They refer to this factor as the "transportation energy intensity" of buildings.[12] The *EBN* analysis puts some hard numbers on the impact of employee commuting on the total emissions that can be attributed to buildings.

Recommendation 4B. Give much greater attention to special threats to waterfront developments and buildings in severe-weather zones.

The IPCC's Fourth Assessment Report suggests that if CO_2 emissions continue as foreseen, by 2100 sea levels will rise by one to one-and-a-half feet.[13] A recent paper in the peer-reviewed journal *Science* puts sea level rise under "plausible" but "still accelerated conditions" at 0.8 meters (~ 2.5 feet) in that time frame.[14] And the Dutch, who have to worry more about sea levels than any other people, are planning for a 55-110 cm (1.8-3.7 feet) rise by 2100.[15]

There is also the question whether climate change is having an effect on storm violence. As noted in Chapter 1, there has been "observational evidence" of an increase in intense tropical cyclone activity (including hurricanes) in the North Atlantic since about 1970, although thus far there has been "no clear trend" in the annual number of tropical cyclones. [WGI/SPM, p. 9]

In the U.S., states and local jurisdictions have been generous—some would say overly generous—in permitting development along the nation's coastlines. Tighter restrictions on coastal development will not be easy for states and localities to implement, given the tension between stricter land-use controls and private property rights. But such restrictions may become more politically and legally acceptable over the next few decades if the one-two punch of rising sea levels and more violent storms hits their shorelines.

Coastal states, especially those in hurricane zones, are going to have to use their police powers more effectively to apply stricter standards to waterfront developments in the future. Outright bans may run into the buzz saw of the "taking clause" of the U.S. Constitution, but states can certainly impose tighter restrictions and more formidable mitigation requirements (seawalls, higher construction and code standards, etc.) on such developments.

Recommendation 4C. Use effective land-use planning, zoning, and transportation design to promote safe bicycling and walking and reduce vehicle trips.

This may sound like New Urbanism apple pie, but many suburban jurisdictions, for example, either prohibit or do not require sidewalks or do not provide bicycle lanes in residential areas. This makes it difficult or unsafe for children to walk or bike to school; as a result, parents wind up driving their children to and from school. Again, the goal is to reduce vehicle trips and the resulting emissions.

5. Address existing buildings, not just new construction or major reconstruction.

In any given year, new construction represents less than 2% of the total infrastructure of buildings and homes in the U.S. Therefore, while we certainly advocate that new construction and major reconstruction be done to the highest feasible degree of sustainability, the real chance to cut GHG emissions in the built environment lies with the millions of energy-consuming, emissions-spewing buildings and homes that are already in the ground. That is why an effort like the Clinton Climate Initiative, which is investing $5 billion to upgrade existing buildings and schools in five cities (Chapter 3), make sense to us, and why we encourage additional efforts to promote energy savings and emissions reductions in the existing built environment.

Recommendation 5A. Step up commissioning efforts in America's commercial, industrial, institutional, and multifamily building stock. A minuscule 1% of buildings in the U.S. ever undergo commissioning, according to the U.S. Department of Energy,

11. The magazine Wired reported that the average U.S. household could reduce its GHG emissions by 30% if one member were to take public transit to work instead of driving. See "Inconvenient Truths," Wired, June 2008, p. 158.

12. "Driving to Green Buildings: The Transportation Energy Intensity of Buildings," Alex Wilson with Rachel Navaro, Environmental Building News, Vol. 16, No. 9, September 2007, p. 11. News release at: www.buildinggreen.com/press/transportation_energy_intensity.cfm

13. Cited in The Hot Topic, p. 76.

14. "Kinematic Constraints on Glacier Contributions to 21st-Century Sea-Level Rise," W. T. Pfeffer, J. T. Harper, S. O'Neel, Science, 5 September 2008, Vol. 321, No. 5894, pp. 1340-1343.

15. "How much will sea level rise?", RealClimate, 4 September 2008. At: www.realclimate.org/index.php/archives/2008/09/how-much-will-sea-level-rise

Table 9.1
Comparing Transportation and Operating Energy Use for an Office Building

Average U.S. one-way commute[a]	12.2 miles
U.S. average fuel economy (2006)[b]	21.0 mpg
Work days	235/year
Annual fuel consumption	273 gal/year
Annual fuel consumption per automobile commuter[c]	33,900 kBtu/year
Transportation energy use per employee[d]	27,700 kBtu/year
Average office building occupancy[e]	230 sf/person
Transportation energy use for average office building	121 kBtu/sf
Operating energy use for average office building[f]	92.9 kBtu/sf-year
Operating energy use for code-compliant office building[g]	51.0 kBtu/sf-year
Percent transportation energy use exceeds operation energy use for an average office building	30.2%
Percent transportation energy use exceeds operation energy use for an average office building built to ASHRAE 90.1-2004	137.2%

Source: "Driving to Green Buildings: The Transportation Energy Intensity of Buildings," Alex Wilson with Rachel Navaro, Environmental Building News, Vol. 16, No. 9, September 2007, p. 11. News release at: www.buildinggreen.com/press/transportation_energy_intensity.cfm

a. U.S. Department of Transportation, Transportation Energy Data Book 26th Edition, 2007, Table 8.6.

b. U.S. EPA Light-Duty Automotive Technology and Fuel Economy Trends: 1975 Through 2006.

c. Assumes 124,000 Btu/gallon of gasoline, DOE Energy Information Administration data.

d. Assumes 76.3% commute in single-occupancy vehicle, 11.2% carpool (2 per car) and no other energy use (commuting transportation modes from U.S. DOT Transportation Energy Data Book 26th Edition, 2007, Table 8.14.

e. U.S. General Services Administration.

f. This includes site energy only, not source energy. U.S. DOE Energy Information Administration Commercial Building Energy Consumption Survey (CBECS) data for 2003, published June 2006.

g. Bruce Hunn, ASHRAE, personal communication.

For the typical U.S. office building, the "transportation energy intensity"—the energy associated with getting people (commuters, visitors, shoppers, vendors, etc.) to and from a building is more than 30% greater than the energy used to heat, cool, and light the building itself. Note: According to *EBN*, this analysis uses only site energy. If compared to source energy, the differences would be smaller, due to the high level of electricity use in office buildings.

although LEED's commissioning prerequisite may have boosted this figure up a bit in the last few years. This is disheartening because, as we saw in Chapter 6, the numbers show that commissioning pays off very quickly. According to the Lawrence Berkeley National Laboratory study by Evan Mills and colleagues, median commissioning costs for existing buildings were $0.27/sf (2003$); energy savings came to a median 15% (18% average); and the payback time was less than nine months.

Think of what that means: Every dollar that an owner invests in commissioning a building would be paid back in nine months; and every nine months thereafter, the owner would save $1 in energy costs. Where in today's investment market can you get a deal like that?

We encourage the Building Commissioning Association, in conjunction with such organizations as the Association of Energy Engineers, BOMA, the California Commissioning Collaborative, CoreNet Global (the international association of corporate real estate executives), the National Environmental Balancing Bureau, the U.S. Department of Energy, utility companies, and state environment departments to find ways to make the case to building owners of the incredible benefit that commissioning can have on their bottom lines—and on their public image as energy conservators.

Recommendation 5B: Create in-house expertise to track the availability of rebates from utility companies, federal tax benefits, and tax and financial incentives in the states where your firm does work.

Your firm should assign a staff member to become the firm's guru on tax incentives and utility rebates for energy conservation. This person need not be an AEC professional, but should be someone with a strong finance background and good communications skills. By helping clients save money and energy, this person would be helping them reduce their greenhouse gas emissions.

There is money to be had for energy conservation. The national economic recovery package that was approved by Congress and signed into law 3 October 2008 by President Bush extended many of the tax incentives for energy-efficient building upgrades, home appliance and office equipment purchases, and renewable energy.

The law extends the Commercial Building Tax Deduction for five years, through 2013. This allows building owners to claim a deduction of up to $1.80/sf for HVAC, lighting, or envelope upgrades resulting in 50% savings over ANSI/ASHRAE/IESNA Standard 90.1-2001. The law also creates new credits for combined heat and power system property, small wind energy property, and geothermal heat pump systems through 2016.

Other energy provisions in the new law include:

- Extending the Renewable Energy Production Credit for wind to 2010, and for biomass, geothermal, solar, and hydroelectricity to 2011. It adds a marine/tidal renewable energy credit through 2012.
- Extending residential tax credits for energy-saving appliances, energy-efficient homes, and on-site renewables.
- Extending credits for solar energy property, fuel cell property, and microturbines through 2016.
- Adding an accelerated depreciation period for smart meters and smart grid systems.
- Extending a program providing tax-exempt bond designation to designated green building and sustainable design projects on brownfields.[16]

To be competitive in today's market, your firm needs to be on top of all the national, state, and local energy-related incentives that can benefit your clients. Capitalizing on such tax incentives and utility rebates could make the difference in whether a project gets the green light.

Recommendation 5C: Work with your clients to encourage them to use the most energy-efficient products and systems in their projects.

Every day, you get pushback from clients on first costs. "Why can't we go with the cheaper system?" they ask. That's why it's important to make break down the costs of new equipment and building systems that are going into their projects, so that you can make the case for using the most energy-efficient products.

As Jens H. Laustsen, energy efficiency policy analyst with the International Energy Association, points out, the cost of shipping, installation, and other onsite work for a piece of inefficient HVAC equipment is roughly the same as that for the most highly efficient system you could specify. This is particularly true in reconstruction projects, where much of the budget comes from labor costs—taking out the old air handlers, hauling in the new ones, and so on—and not so much from the new product or system itself.

Engineers, designers, contractors, home builders, installers, and consultants need to lay out the energy savings of high-performance systems in discussions with clients, says Laustsen. They must be able to demonstrate to their clients that the most energy-efficient equipment or product may be only marginally more costly, when other more or less fixed costs are accounted for. They must be prepared to prove that the greater energy savings of the high-performance system will more than make up for the marginal cost differential of a cheaper, less efficient system in a relatively short period of time. The end result will be a greater reduction of GHG emissions.

Recommendation 5D. Create a new category of paraprofessional to assist commissioning service providers in their work.

One reason why more buildings aren't getting

commissioned is that there simply aren't enough MEP engineers and other qualified technical professionals to do the job. Moreover, the number of students in university engineering and architecture programs is on the decline, and there is no assurance that graduates of these programs necessarily will choose building commissioning for their careers.

Historically, gaps in human resource needs like this have been filled by creating a new category of individuals to assist highly educated, highly paid professionals that are either in short supply or could be more productive with the support of technical staff. Thus, lawyers have paralegals. Physicians have nurse practitioners. Dentists have dental hygienists. Why not "commissioning associates"?

Such persons would receive two years of training at a community college, including an internship with an MEP firm or commissioning service provider, leading to an associate's degree. Upon matriculation, commissioning associates would work under the direct supervision of commissioning service providers to handle many of the day-to-day tasks, paperwork, phone calls, and client services associated with completing commissioning projects, thus "extending" the AEC professional's time and labor. Of course, the commissioning service provider would be responsible for overseeing and signing off on all work from start to finish.

This is the kind of well-paid, prestigious green job that would help fill "the forgotten middle" of the labor market—the millions of high school graduates who may never get a four-year college degree but who, with post-secondary training and education, could succeed in technical, "middle-skill" jobs.[17]

Such a program also would represent a new growth opportunity for the nation's two-year colleges. (This model could also help fill many other emerging green job needs, such as PV system and wind technology installers.) The Building Commissioning Association and other commissioning and building owner organizations should partner with one or more community colleges to develop an appropriate curriculum and initiate a pilot program to educate and train "commissioning associates."

6. Support client and consumer education on what climate change means to them and how they can respond to it.

Architects, engineers, and construction professionals should take the lead in promoting energy conservation and the attendant GHG emissions reductions to their clients, building occupants and users, students, real estate developers, and financiers.

Recommendation 6A: AEC firms should educate their commercial, institutional, and industrial clients in how considerations related to climate change need to be incorporated into future building projects.

Your clients are busy running their businesses, so they'll be looking to you for advice and information about climate change: "How will climate change affect our business? What can we do with our current buildings and future projects to reduce emissions? How much will it cost? What can you do to help us?"

You're going to be on the firing line, and it will be your responsibility to keep your clients informed about new laws, prospective regulations, building and energy code changes, and other factors related to their properties that fall under the broad heading of energy efficiency and greenhouse gas emissions.

You need to make the case for early action, which will save your clients money in the long run and make their buildings more capable of adapting to any increase in global temperatures. This will also help preserve the value of their properties.

Recommendation 6B: Home builders, remodelers, and AEC firms serving residential clients should inform homeowners, apartment renters, and condominium owners of opportunities to mitigate and adapt to climate change that are available to them.

One handy resource is the U.S. Department of Energy's Energy Efficiency and Renewable Energy Consumer's Guide: Your Home, at: http://apps1.eere.energy.gov/consumer/your_home. The website provides valuable tips related to energy savings for appliances and electronics, home design and remodeling, electricity use, energy audits, insulation and air sealing, landscaping, lighting, daylighting, HVAC heating and cooling, water heating, and windows, doors, and skylights.

You can also challenge your consumer clients to take the new "$800 Savings Challenge" on the Chicago Climate Action Plan website: http://climate.mightysite.com/pages/take_the__700_challenge/59.php. The interactive calculator not only gives the annual cost savings from specific actions ("reduce heating temperature by three degrees," $129), but also supplies the CO_2eq impact per participant (in this case, 0.522 metric tons). In short, a good way to get potential home buyers and current homeowners talking about how to make their properties more energy efficient and therefore reduce their contribution to climate change.[18]

Recommendation 6C. If your firm does work in the education field, you should get involved in campus organizations devoted to sustainability and climate change.

America's four thousand-plus colleges and universities are hotbeds, so to speak, of climate change action. If your firm does campus work and is not a member of AASHE, the Association for the Advancement of Sustainability in Higher Education (www.aashe.org),

16. See "Congress Extends Energy Tax Incentives through Economic Recovery Package," ASHRAE, 6 October 2008, at: www.asbrae.org/pressroom/detail/16911

17. See "Greener Pathways: Jobs and Workforce Development in the Clean Energy Economy," Saran White and Jason Walsh, Center on Wisconsin Strategy, the Workforce Alliance, and the Apollo Alliance, March 2008. At: www.cows.org/pdf/rp-greenerpathways.pdf
Also "Filling the 'forgotten middle,'" Barbara Rose, Chicago Tribune, 22 September 2008, Section 3, p. 1, at: www.chicagotribune.com/classified/jobs/chi-mon-middle-skill-jobs-sep22,0,5504222.story

18. One way consumers can help is to turn off computers at night. The International Energy Agency estimates that standby mode could account for 1% of global GHG emissions—almost as muchas the entire aviation industry. The Hot Topic, pp. 101-102.

you should join right away. Also addressing energy issues and climate change: SCUP, the Society for College and University Planning (www.scup.org), APPA (www.appa.org), which represents the nation's college facilities directors, and CEFPI, the Council of Educational Facilities Planners International (http://www.cefpi.org), which covers K-12 schools.

High-performance buildings are even becoming laboratories for experimentation in energy efficiency and GHG emissions. At Duke University, Durham, N.C., the Home Depot Smart Home, a 10-person LEED Platinum residence hall, serves as a live-in R&D lab where Duke students and faculty can perform research on rooftop photovoltaics and other green building technologies. Stanford is designing a similar experimental residence facility.[19]

7. Be more cognizant of the relationship between water usage, energy conservation, and emissions reduction.

It is a little known fact (even among AEC professionals) that for most cities, the biggest single user of electricity is the municipal water and sewer department. About a third of electricity consumption in most cities goes to pumping fresh water and treating stormwater and sewer waste. The electricity needed to move water is largely a hidden cost, as is the cost to the environment of the resulting CO_2 emissions.[20]

The Watergy project (www.watergy.org) estimates that 2-3% of the world's energy consumption is used to pump and treat water for urban residents and industry. Worldwide, according to Watergy, energy consumption in most water systems could be reduced by at least 25% through cost-effective conservation measures.

Recommendation 7A. Ramp up the use of well-understood water conservation technologies in building projects.

Low-flow toilets and shower heads, stormwater collection systems using rain barrels and cisterns, native landscaping and slow-drip irrigation systems that reduce the use of fresh water—such technologies are becoming increasingly well known and relatively easy to implement, and they should be considered for every project.[21] Note: Waterless urinals have run into opposition from some plumbing locals and city councils, but they have been proven to be very effective when properly installed and maintained.

More technically elaborate systems, such as gray or black water recovery and pervious pavement (which reduces flooding and restores stormwater to the aquifer), are still somewhat experimental, but Building Teams should be monitoring their progress. Every gallon saved is one less gallon that has to be pumped, thus saving on electricity and resulting emissions.

Recommendation 7B. Cities and counties need to plug the leaks in their water systems.

The U.S. has an estimated 72,000 miles of water pipes and sewer mains that are 80 years of age or older, and they are leaking like crazy. This not only wastes precious supplies of fresh water, which are already threatened by climate change, but also adds to the cost and energy use of treating and pumping municipal water.

Chicago provides an example to other older cities in this regard. Over the last decade, the city has engaged in an aggressive program to plug the leaks in its century-old water system. Miles of old pipes have been replaced; others have simply been relined with a form of plastic pipe. As a result of these efforts, millions of gallons of fresh water have been saved, and the city's electric bill has gone down dramatically. And that has translated into reduced GHG emissions, as well.

We recommend that AEC professionals who serve on local and regional planning boards, water and sewer commissions, and similar public bodies use their influence and expertise to bring the problem of water leakage to the attention of their communities and to provide leadership in determining what steps can be taken. Local chapters of professional associations such as the American Institute of Architects, the Associated General Contractors of America, and the American Society of Civil Engineers should put this "hidden" problem on their national and chapter agendas.

Recommendation 7C. Building owners should conduct water use audits of their buildings, particularly in building types with intensive water use.

As energy prices have gone up, so, too, have building owners become more active in embracing the idea of energy audits. Now it is time for owners to think about their buildings' water use. It's time for water audits. Not only will water audits prevent waste and lower water bills, they will also reduce the GHG emissions that result from the energy used to pump the water.

Buildings with intensive water use, such as hospitals, multifamily developments, wet laboratories (biological, chemical, etc.), and hotels, should be at the top of the list.

8. Start now. The sooner, the better.

We have saved the most important recommendation for last. It is simple: The time to act is now. The longer we wait to take action, the greater the effort (and expense) needed to bring greenhouse gas emissions down to 450 ppm. Conversely, if we start early, with relatively small and easy steps, every ton of carbon we keep from coughing into the atmosphere will bring the long-term cost down to a much more feasible level. That's why it's so important to stop talking and get moving.

Though there will be first costs for any action, many of the initiatives in the building sector are among the

19. See "Living in a Green Laboratory," Dave Barista, Building Design+Construction, September 2008, at: www.BDCnetwork.com/article/ca6593092.html

20. We do not begin to discuss the effects of climate change on water supplies in the poorest regions of the world. Even under the most conservative scenario (a 2ºC rise in global temperature by 2030), the IPCC foresees as many as 1.7 billion people in the Third World suffering from water shortages. Cited in The Hot Topic, p. 82.
However, even the richest nations, including the U.S., would not be immune from the "water stress" caused by climate change. Building owners, real estate developers, and Building Teams have to start doing a better job of conserving water, which the U.S. Green Building Council CEO Rick Fedrizzi has called "the next oil." See "Water wars, slums coming soon to a planet near you," Robert Cassidy, Building Design+Construction, June 2007. At: www.BDCnetwork.com/article/ca6450424.html

21. Water conservation may not be enough. A U.S. Environmental Protection Agency "WaterSense" survey of 18,000 homes, half of them built before 2001 and half built in 2001 or later, shows that new homes in seven of nine cities under study used 40% more water than older homes. Why? More bathrooms. See "Can water efficient technology save us from ourselves?" Doug Bennett, Landscape Management, 9 September 2008. At: www.landscapemanagement.net/landscape/Green%20Industry%20News/Can-water-efficient-technology-save-us-from-oursel/ArticleStandard/Article/detail/548578?contextCategoryId=465

22. The Hot Topic, p. 98.

23. Based on the work of Arthur C. Nelson, FAICP, and Robert E. Lang, co-directors of the Metropolitan Institute at Virginia Tech University, Washington, D.C., in Planning Magazine, January 2007. See "Building 'Second America' for the Next 100 Million," Building Design+Construction, February 2007, p. 7, at: www.BDCnetwork.com/article/ca6417667.html

most cost-effective actions that can be taken and would, over time, pay for themselves or even save money, thanks to the savings in energy costs. As Gabrielle Walker and Sir David King note, "Even in the short term, over the next 15 years we could cut at least 30% from the projected rise in emissions from buildings without paying a penny"—more, if we could change people's behavior (turning off lights, easing up on the A/C, and so on) and stopped wasting so much energy.[22]

IN CONCLUSION, we find that there is a growing recognition among AEC Building Team stakeholders that climate change is an unprecedented threat to humanity and the planet, and many AEC professionals and firms are already taking steps to address it. Yet even among those who say they do not support a climate change agenda, there is a strong belief that energy conservation makes sense from a business—and environmental—perspective. And looming in the background is the very real prospect of stricter government regulation of greenhouse gas emissions and greater client demand for more energy-efficient properties.

This scenario provides a platform for everyone in the AEC industry to pursue emissions abatement measures—especially low-risk ones like lighting upgrades, energy-efficient building envelope design, appropriate building siting, high-efficiency HVAC systems, and optimal insulation—through proven design and construction methodologies. For these reasons, we are confident that high-quality professional practice in sustainable design and construction will meld with the goal of combating climate change.

In the next 30 years, the U.S. will add 100 million to its population. This will require the construction of 70 million housing units—30 million new, 40 million replacement units—and 100 billion square feet of commercial, industrial, and institutional construction.[23]

How will the AEC industry meet the dual challenge of building the next America and addressing global warming? With business-as-usual practices that fail to address the ever-darker threat of climate change? Or by tackling global warming head-on? Our children and grandchildren will judge how well we responded to the call to action. BD+C

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RECOMMENDED READING

Of the many publications on climate change, the editors have benefited the most from these three:

- *Climate Change 2007,* Fourth Assessment Report of the Intergovernmental Panel on Climate Change (3 vol.), Cambridge U Press, 2007.
- *Global Warming: A Very Short Introduction*, Mark Maslin, Oxford U Press, 2004.
- *The Hot Topic: What We Can Do About Global Warming*, Gabrielle Walker and Sir David King, Harcourt, 2008.

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'Green Buildings + Climate Change' Discussion and Q&A at Greenbuild

Robert Cassidy, Editor-in-Chief of *Building Design+Construction*, will discuss the major findings of BD+C's White Paper, "Green Buildings + Climate Change," Wed., Nov. 19 (11:20 a.m. – 12:05 p.m.), Thurs., Nov. 20 (2:00 – 2:45 p.m.), and Fri., Nov. 21 (1:15 – 2:00 p.m.) at BD+C's 'School of the Future, Today,' located at the front entrance of the Boston Convention Center, as part of the U.S. Green Building Council's Greenbuild Expo and Conference.

All Greenbuild attendees are invited to attend.

Download all six BD+C White Papers

The entire contents of "Green Buildings + Climate Change" and five previous White Papers can be downloaded in .pdf form at: http://www.bdcnetwork.com/university/community/934/White+Papers/47492.html

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