



Union of Concerned Scientists

Catalyst

SUMMER 2009

Climate 2030

Our blueprint for cutting global warming emissions dramatically while boosting the economy



Also: Biotechnology's Failed Promise • Combined Heat and Power

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LETTERS

Please email your questions or comments to catalyst@ucsusa.org. Your submission implies permission to publish your letter and name in *Catalyst*. We reserve the right to edit letters for length.

An Even Greener Travel Option?

I enjoyed the article in the spring 2009 issue of *Catalyst* titled “Getting There Greener” [p. 7] and particularly the discussion of train travel to a ballpark. The table accompanying this article, however, has an error. Camden Yards in Baltimore is directly adjacent to Camden Station, with less than 500 feet between the ballpark and the train. Pennsylvania Station, the other train station in Baltimore, is about 2.5 miles from Camden Yards.

*Edward P. Caffarella
Cortland, NY*

The author responds:

You are correct about the proximity of light-rail access to the ballpark, but the distances cited in the article indicate proximity to stations with Amtrak service specifically (since we were comparing that transportation option with plane travel into a given city). As you suggest, however, public transit is often the best way to get to and from a ballpark—regardless of how you traveled to the city.

*Scott Nathanson, national field organizer
Clean Vehicles Program*

The High Cost of First Class

I am puzzled by the sidebar “A Tale of Two Vacations” in the spring 2009 issue [“Getting There Greener,” p. 7]. An explanation of the almost four-fold difference in carbon emissions between the two air travel options—first class with a layover being the “High-Carbon Vacation”—would have been helpful. Surely the difference is not, as one might conclude, between first class and coach. Is it from the hotel layover?

*Michael Furey
Blacksburg, VA*

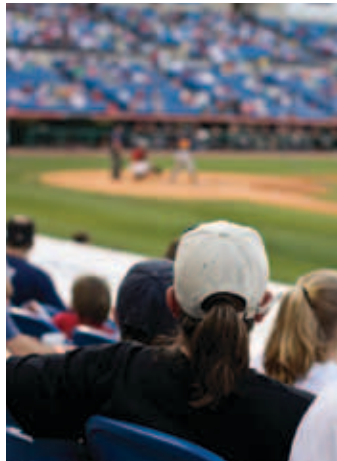
The author responds:

The emissions difference is a result of two factors: 1) the extra distance traveled due to multiple flight legs and 2) the first-class seating. The first factor is straightforward: a direct flight from Chicago to Orlando totals 1,005 miles (one way), but adding a layover in Houston increases the distance to 1,778 miles. As for the second factor, first-class seats take up twice as much room in the cabin as coach seats, so they are responsible for twice the amount of carbon dioxide (CO₂) emissions.

Using data from government and commercial sources, we calculated that the CO₂ associated with coach air travel on a typical narrow-body jet (assuming an industry average of 80 percent occupancy) is approximately 0.384 pound of CO₂ per mile traveled, plus 33 pounds per seat associated with the takeoff, landing, and ground operations of each leg. For first-class air travel, both numbers are doubled.

Thus, the “lower-carbon vacation” (direct flight, coach seating) generates almost 419 pounds of CO₂ per person each way, or 3,349 pounds round-trip for a family of four. The “high-carbon vacation” (layover, first-class seating) generates 1,497 pounds of CO₂ per person each way, or 11,972 pounds round-trip for a family of four—more than 3.5 times the emissions of the lower-carbon option.

Scott Nathanson



Back issues of *Catalyst* are available in PDF form on the UCS website at www.ucsusa.org/publications/catalyst.

Scientific Integrity Revitalized



As we look back on President Obama's first few months in office, UCS is heartened that his administration has planted the seeds for restoring scientific integrity to federal policy making—but recognizes that these seeds must be nurtured in order to grow.

We worked closely with the president's transition team to make scientific integrity one of his central themes. Beginning with his inaugural address promise to “restore science to its rightful place,” President Obama has made a series of remarkable commitments that closely mirrored our own recommendations. He pledged support for federal scientist whistle-blowers, stated that government agencies must better explain how they make science-based decisions, and tasked science advisor John Holdren with creating a strategy to restore scientific integrity to federal policy making.

But much remains to be done to repair the damage caused by previous administrations and insulate the scientific process from abuse by future administrations. The checks and balances that could prevent the executive branch from misusing scientific information are currently inadequate, and special-interest groups that subvert the public good are not going anywhere.

We were encouraged by the fact that Environmental Protection Agency (EPA) Administrator Lisa Jackson, on her first day in office, sent a memo to employees pledging to operate the agency “as openly as possible” and make science the “backbone for EPA programs.” Now the EPA needs to live up to those words, and a good first step is to improve access to its scientific resources. Scientific data essential to protecting the nation's health and safety remain secret, while the agency's current media policy limits the ability of scientists to communicate their findings to the press and public. UCS plans to meet with leaders of the EPA and other agencies to help strengthen their communications policies and practices.

Until new policies protecting science are put in place, it is up to groups like us to ensure that government officials follow through on their promises of reform. For example, the Obama administration failed to roll back the Bush administration's damaging changes to the Endangered Species Act until thousands of scientists spoke up (read more in “Newsroom,” p. 6).

To avoid similar disappointments, we should remember the following quote attributed to Franklin Delano Roosevelt: “I agree with you. I want to do it. Now make me do it.” In other words, UCS must help create the political space that allows the president and his administration to take the bold action we need to protect science, health, and the environment for years to come. To track the administration's progress, visit www.ucsusa.org/integrityprogressreport.

—Kevin Knobloch, president

It is up to groups like us to ensure that government officials follow through on their promises of reform.



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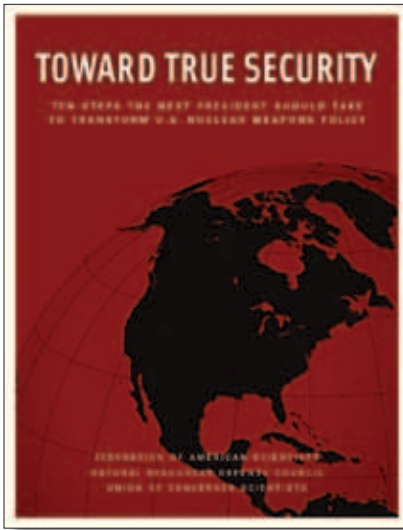
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Flawed Nuclear Programs Cut

Action reflects our recommendations

Two Bush-era programs opposed by UCS—the Reliable Replacement Warhead (RRW) and the Global Nuclear Energy Partnership (GNEP)—have been laid to rest.

The RRW program would have replaced nuclear weapons in the U.S. arsenal with new, untested warheads intended to be more reliable—despite the fact that existing U.S. warheads will remain reliable for another 50 years at least. Our 2008 report *Toward True Security* recommended that the next president stop RRW and continue existing stockpile stewardship efforts, and the Obama administration omitted RRW from its 2009 budget request.

The GNEP program would have initiated the “reprocessing” of spent fuel from commercial nuclear reactors, extracting plutonium for use in new fuel. As we stated in our 2007 report *Nuclear Power in a Warming World*, however, reprocessing also makes it easier for terrorists to obtain plutonium because the

process separates it from dangerously radioactive spent fuel assemblies. In early 2009, UCS provided an expert critique of the proposal, and 11,000 UCS activists submitted comments to the Department of Energy. Congress subsequently denied funds for GNEP, and the Obama administration discontinued its domestic component.

U.S. Autos to Get a Needed Tune-up

Our experts helped shape clean car standard

On May 19, the White House announced a new program aimed at significantly curbing America’s oil dependence and the global warming emissions from our cars and trucks. The new clean car standard sets a goal equivalent to raising the U.S. fleet average fuel economy to approximately 35 miles per gallon (mpg) in 2016. This accelerates the 35 mpg by 2020 goal that Congress set in 2007, and is roughly equivalent to the standards already adopted by 14 states.



Members of our Clean Vehicles Program were invited to the White House for the announcement in recognition of their contributions to the

The new clean car standard will reduce oil consumption, cut heat-trapping emissions, and help consumers save.

new standard. Our analysis indicates that this standard—compared with current fuel economy levels—would reduce U.S. oil consumption by about 1.4 million barrels per day in 2020, cut heat-trapping emissions by 230 million metric tons, and save consumers at least \$30 billion (based on a gas price of \$2.25 per gallon).

And as outlined in our September report *Setting the Standard*, we emphasized the fact that automakers can meet this standard using cost-effective, readily available technologies. We will work with the Obama administration to ensure the standard is properly implemented and that meaningful increases are planned for 2017 and beyond.

Clean Energy = Green Jobs

UCS sees economic boost in renewable energy

In March, UCS detailed the economic benefits that would be created by a national renewable electricity standard requiring utilities to increase their use of renewable electricity to 25 percent by 2025. We found that such a standard would support \$263 billion of new investments

in clean energy facilities, and create 297,000 U.S. jobs by 2025.

Increasing use of renewable energy also diversifies the U.S. electricity mix, reducing demand for fossil fuels. This not only protects against supply shortages and price spikes, but also lowers electricity and natural gas prices. Our research shows that homeowners, businesses, and industrial consumers in every state would save a total of \$64 billion by 2025 as a result of the standard.



A national renewable electricity standard would save \$64 billion and create 297,000 jobs by 2025.

In preparation for congressional debate on proposed national renewable electricity standards, UCS staff distributed our analysis to all members of Congress, and conducted an in-person Senate briefing on the results. To learn more about the economic and environmental benefits of a 25 percent standard, visit www.ucsusa.org/25by25.

A Victory for Public Health

UCS helps restore access to pollution data

UCS won a victory in March when the Obama administration rolled back Bush-era changes that significantly limited the information that companies are required to report about their release of toxic chemicals into the environment. We had been working on this problem since 2005, when the Environmental Protection Agency (EPA) first announced its changes to the Toxics Release Inventory, which alerts communities to the presence of deadly chemicals like mercury, lead, and dioxin.

During the public comment period that followed, 31,265 UCS activists—representing more than one of every



four comments received by the EPA—expressed their opposition to the changes. This campaign succeeded in undoing some of the Bush proposal's damaging provisions, but others remained intact. We continued to voice our concern in transition meetings with the incoming Obama administration, which not only followed our recommendation to return to the old reporting requirements, but also went a step further by requiring companies



Nearing Our Goal: 5,000 Partners for the Earth Members

Protecting the planet can feel like an overwhelming responsibility some days—believe us, we know. But doing a little each day can really add up, as our Partners for the Earth members know. UCS members who enroll in this program agree to have a small donation deducted from their bank account or charged to their credit card every month. This way of giving is simple, saves paper and postage, and provides UCS with a reliable stream of income that allows us to respond quickly to emerging opportunities.

This year, in light of our fortieth anniversary, UCS has two special goals for Partners for the Earth: increase the total enrollment to 5,000 members and raise \$1 million. As *Catalyst* went to press, we were very close to reaching these goals; you can help us surpass them by joining Partners for the Earth today. Just fill out the form on the inside back cover of this magazine, call us at (800) 666-8276 x8000, or visit www.ucsusa.org/pfe. Thank you for your support.

to report chemical releases that occurred while the reporting requirements were relaxed.

Endangered Species Protected Again

But our work is not yet done

This past March, the secretaries of the Departments of the Interior and Commerce rescinded a Bush-era regulation that weakened the scientific foundation of the Endangered Species Act (ESA). President Obama had asked the secretaries to

More than 1,300 scientists asked the administration to restore endangered species protections.

review the regulation, which exempted federal projects such as roads and dams from review by government biologists, regardless of the project's potential impact on imperiled species. Another unfortunate Bush-era change to the ESA, which limits the types of information that scientists can consider in protecting polar bears (a species whose habitat is vulnerable to the effects of global warming), remains in place.

UCS had urged President Obama to rescind these rules during his first 100 days in office, and we met with administration representatives to make the scientific case. In partnership with other nonprofits and scientific societies, UCS also organized a letter-signing campaign involving more than 1,300 scientists, who asked the administration to roll back the ESA changes and look for other ways to strengthen the act.

Congress made it easier for the administration to act quickly by dispensing with the typically time-consuming rule-making process.

UCS will continue to push the administration to improve the way that science is used to protect all imperiled species.



The northern spotted owl is one of many endangered species whose habitats have been protected as a result of ESA project review.

UCS Recognized for Responsible Approach to Energy

UCS and other founding members of the American Wind Wildlife Institute, which promotes the development of wind power in a manner compatible with local wildlife, received a special achievement award in May from the American Wind Energy Association. Our Clean Energy Program Research Director Steve Clemmer (second from right) represented UCS at the award ceremony.





A Blueprint for a Clean Energy Economy

Our Climate 2030 Blueprint, which shows how the right mix of policies and technologies can curb global warming while strengthening the U.S. economy, has helped shape the climate legislation currently being debated in Congress.

Reducing oil dependence. Strengthening energy security. Creating jobs. Tackling global warming. Addressing air pollution. Improving our health.

By Eric Misbach

emissions) working in concert with complementary solutions that promote energy efficiency, renewable energy, lower-carbon transportation, and smart growth. No other study has taken this integrated approach, nor demonstrated the strong savings potential of this combined approach—more than \$1.7 trillion in cumulative savings by 2030.

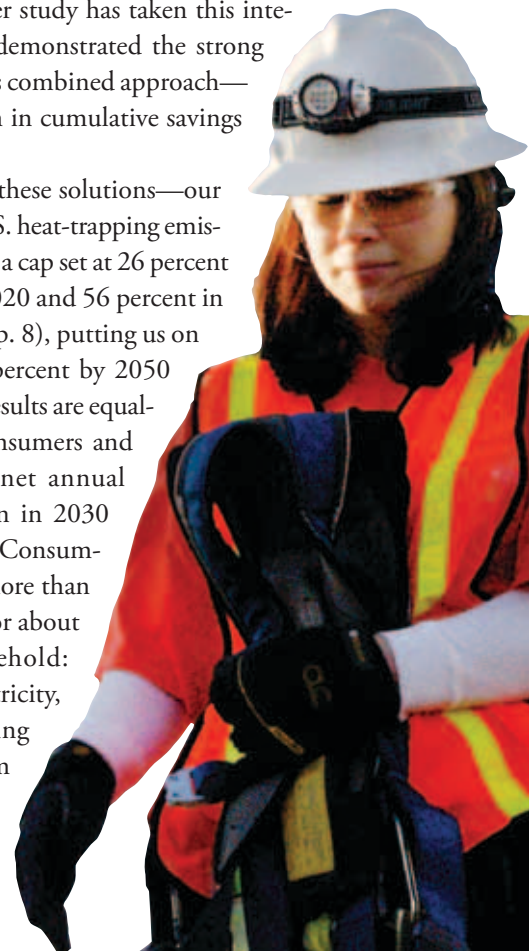
These are just a few of the many reasons for the United States to transition to a clean energy economy. And the rapid growth of the renewable energy industry and strong sales growth of hybrid vehicles show that this transition is under way. These changes, however, are still too gradual to address our urgent need to reduce heat-trapping emissions to levels that are necessary to protect the well-being of our citizens and the health of our environment.

We are already experiencing some effects of global warming (including hotter summers and melting glaciers), and recent observations show these changes are occurring more quickly, and often more intensely, than scientists previously projected. To help avoid the worst of these effects, the United States must reduce its emissions of carbon dioxide and other heat-trapping gases *at least* 80 percent below 2005 levels by 2050. UCS has outlined a comprehensive set of smart policies that would jump-start these efforts, as described in our report *Climate 2030: A National Blueprint for a Clean Energy Economy*.

The results of this groundbreaking, peer-reviewed analysis using sophisticated modeling techniques show that the United States can deeply reduce heat-trapping emissions while saving consumers and businesses money. Our analysts used a modified version of the U.S. Department of Energy's National Energy Modeling System to project the changes in energy use, emissions, and consumer and business energy costs resulting from a "cap-and-trade" program (which puts a price on carbon

emissions) working in concert with complementary solutions that promote energy efficiency, renewable energy, lower-carbon transportation, and smart growth. No other study has taken this integrated approach, nor demonstrated the strong savings potential of this combined approach—more than \$1.7 trillion in cumulative savings by 2030.

Working together, these solutions—our "Blueprint"—lower U.S. heat-trapping emissions to meet a cap set at 26 percent below 2005 levels in 2020 and 56 percent in 2030 (see the chart on p. 8), putting us on track to meet the 80 percent by 2050 target. The economic results are equally impressive, with consumers and businesses reaping a net annual savings of \$465 billion in 2030 (see the table on p. 9). Consumers alone would save more than \$126 billion in 2030, or about \$900 per U.S. household: \$320 from lower electricity, natural gas, and heating oil costs, and \$580 from lower transportation costs. What's more, savings would be realized in every region of the country.





Beyond 2030

Our analysis did not include the following advanced technologies, which could reduce emissions even further.

- **Thin-film solar photovoltaic cells** can be used to generate electricity on large surfaces such as an entire rooftop or building facade.
- **Wave and tidal power projects** can generate clean electricity by harnessing the energy stored in ocean currents.
- **Batteries or fuel cells** powered by renewable energy could replace all car and truck engines by 2050 if key technical hurdles are overcome and costs lowered.
- **High-speed electric rail** could replace airplanes for shorter trips and shift freight shipments from trucks to trains.

The Blueprint's Building Blocks

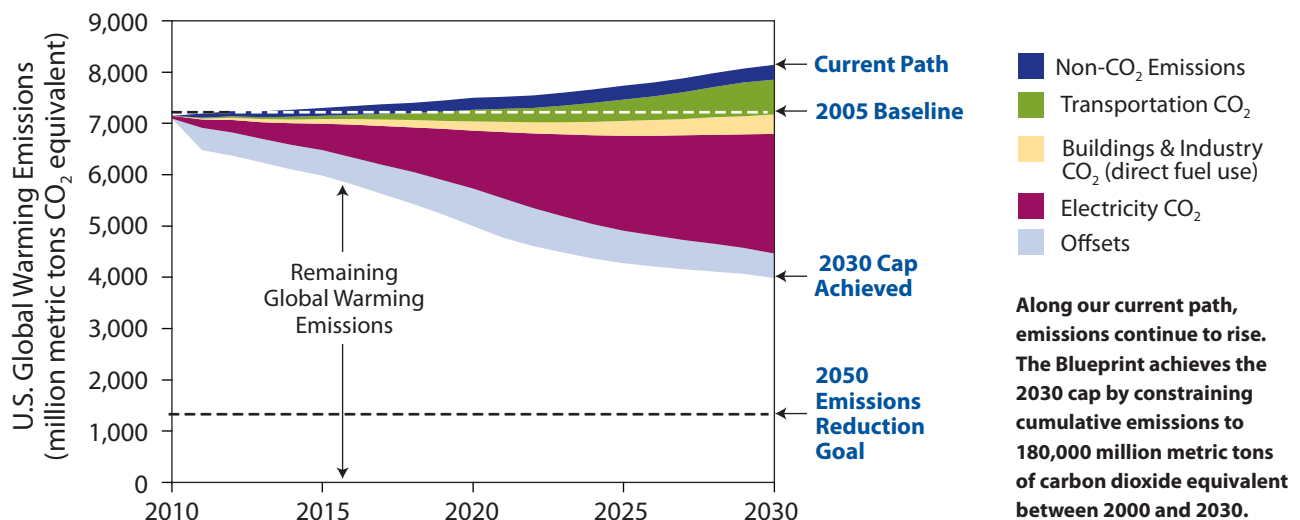
Cap and trade. The linchpin of the Blueprint is an economy-wide cap-and-trade program that draws on the power of the marketplace to reduce carbon emissions in a cost-effective and

flexible manner. First, a “cap” on emissions is established for all polluters, who must obtain permits for each ton of their emissions. Putting a price on emissions in this manner would encourage companies to find ways to cut back on their emissions and would reward innovations in clean technology. Polluters would also have the option to purchase a limited number of “offsets,” instead of purchasing carbon permits, for a small portion of their emissions (see “Less Is More” on p. 9).

Ideally, all carbon permits would be auctioned, and the proceeds used for the public benefit. The energy model used in our analysis could not calculate the benefits of investing auction revenues for specific purposes, so we assumed all of the revenue would be recycled back into the economy in a general way. In practice, we recommend that most of the revenue be invested in energy efficiency and renewable energy, assistance to low-income consumers, transition assistance to workers in industries disproportionately affected by the cap, prevention of tropical deforestation, transfer of clean technologies to developing nations, and assistance for communities in adapting to unavoidable climate changes.

Energy efficiency. Powering, heating, and cooling our homes and businesses is one of the largest sources of carbon emissions, so making these activities more efficient is a key part of the Blueprint. The Blueprint examined multiple efficiency approaches in the buildings and industry sectors, including an energy efficiency resource standard (which requires retail electricity

Net Cuts in Global Warming Emissions under the Climate 2030 Blueprint





and natural gas providers to help their customers reduce energy use), federal energy efficiency standards for buildings and equipment, more efficient industrial processes, greater reliance on efficient combined-heat-and-power (CHP) systems (see “How It Works,” p. 13) and increased research and development funding.

The Blueprint is a comprehensive set of policies that will jump-start the United States’ transition to a clean energy future.

renewable energy resources that are commercially available and ready to be deployed today, such as wind, solar, geothermal, and bioenergy.

The Blueprint includes a national renewable electricity standard (which requires utilities to obtain a percentage of their electricity from renewable resources), increased research and development funding for renewable energy technologies, and carbon capture and storage (CCS) demonstration projects at coal power plants.

Cleaner transportation. Transportation—commuting, traveling, and the shipping of goods—accounts for the second largest share of U.S. global warming emissions, increases air pollution, and makes our nation dependent on a highly volatile oil market. The Blueprint calls for a broad suite of transportation policies to help break this dependence, including standards that would improve engine efficiency for cars and trucks and require the use of low-carbon fuels such as cellulosic ethanol. We also recommend “smart growth”

Lower-carbon electricity. Almost half of America’s electricity comes from burning coal. The resulting carbon emissions account for more than 40 percent of the U.S. total—making power plants the country’s greatest contributor to global warming. We can greatly reduce our reliance on fossil-fuel-based electricity by shifting to clean,

BLUEPRINT SAVINGS

(in billions of dollars)

Consumer and Business Savings:

National Energy Bill Savings	\$414B
Energy Investment Costs	– \$160B

Net Savings	\$255B
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Allowance Revenue Generated	+ \$219B
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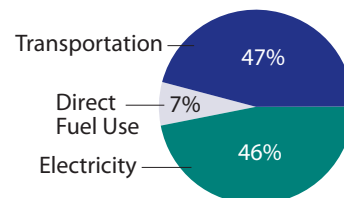
Policy Implementation Costs	– \$8B
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Total Savings	\$465B
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Cumulative net savings for consumers and businesses from 2010–2030 = \$1.7 trillion

Values may not sum properly because of rounding.

SAVINGS SOURCES



Less Is More

A limited investment in “offsets” can help lower costs while still encouraging a clean energy transition.

A cap-and-trade program can allow companies to comply with the emissions cap by “offsetting” a portion of their emissions—i.e., investing in carbon reduction or carbon storage projects elsewhere—rather than reducing their emissions directly. This helps polluters lower their cost of compliance, and allows companies and countries not officially participating in the program to contribute to emissions reduction efforts. However, offsets can also delay much-needed technological innovation and a rapid transition to these technologies (within sectors governed by the cap), potentially jeopardizing the program’s long-term emissions reduction goals.

An effective cap-and-trade program should therefore allow only a limited amount of offsets, and any offsets allowed should be of high quality (i.e., they provide real emissions reductions above what would have happened under a business-as-usual scenario). The Blueprint assumed that a maximum of 15 percent of the emissions cap could be met with offsets: 10 percent from domestic forestry and farming initiatives that promote carbon storage in trees and soils, and 5 percent from reduced tropical deforestation.



policies that reduce travel by encouraging mixed residential and commercial development with more public transit; “pay-as-you-drive” insurance, which could reduce annual premiums and provide an incentive for driving less; and the use of plug-in hybrids powered by renewable electricity.

Through energy efficiency and renewable energy measures, the Blueprint lowers power plant emissions 84 percent below 2005 levels by 2030.

Smart Policies Bring Big Results

Together, the Blueprint policies help meet our needed emissions reductions target in a cost-effective manner. Our results show that, by 2030, we can reduce overall energy demand by one-third; carbon-free electricity and low-carbon fuels help make up more than one-third of our remaining energy use. In addition, renewable electricity use is increased 25 percent. (Our analysis shows that hydropower and nuclear power will also contribute to carbon-free electricity at about the same levels they do today. But advanced nuclear and CCS play only a minor role through 2030 because they will not be economically competitive with other low-carbon electricity options.)

These policies translate to significant emissions cuts: power plant emissions are reduced 84 percent below 2005 levels by 2030, and transportation-related emissions are reduced 19 percent below 2005 levels. In addition, U.S. oil and petroleum consumption is reduced by 6 million barrels per day compared with 2005—as much oil as we currently import from OPEC (the Organization of Petroleum Exporting Countries). These reductions will cut projected expenditures on imports by more than \$85 billion in 2030—or more than \$160,000 per minute.

Because the Blueprint includes only those technologies that are commercially available today or likely to be available within the next two decades (see “Beyond 2030” on p. 8 for examples of excluded technologies), our emissions reduction estimates are conservative. Deeper reductions may be possible with more aggressive policies, more advanced technologies, or greater investments in both. Additionally, studies indicate that significant reductions could also be achieved via carbon storage

in U.S. agricultural soils and forests, but we were unable to analyze the full potential of this strategy.

We Must Get Started Today

The Blueprint’s projected benefits cannot be fully realized unless some of the critical policies are put into place quickly—as soon as next year. Fortunately, we have an opportunity to start down the path to a clean energy future this year, as comprehensive climate and energy legislation moves through the U.S. House of Representatives this summer. UCS worked closely with the bill’s sponsors to craft some of its most effective aspects, such as the framework for a comprehensive policy approach, strong science review of the bill’s emissions targets, and adequate funding for reducing tropical deforestation, and we presented the Blueprint findings to Congress in April. We will continue to work with legislators to pass the strongest bill possible.

Strong, comprehensive climate legislation faces significant barriers in the form of entrenched special interests. Champions of the status quo including the National Association of Manufacturers and U.S. Chamber of Commerce, as well as the coal and oil industries, are attempting to weaken the bill. However, the Blueprint provides solid evidence for legislators, business leaders, and advocates that smart climate, energy, and transportation solutions are the right choice for our climate and our economy.

Addressing global warming will require a concerted effort to show policy makers and civic and business leaders that our climate and economy are intricately connected—that the path toward a clean energy future will not only help ensure a healthy climate for future generations but also encourage long-term economic prosperity. Implementing the approaches outlined in the Blueprint is an important step down this path, but it is only a first step. Smart climate policies must be extended beyond 2030 to ensure our long-term emissions reduction goals are met. And as recent climate observations have shown, we cannot afford to wait.

Eric Misbach is the administrative coordinator for the UCS Climate Program.



To see the projected savings your region of the country would receive as a result of the **Climate 2030 Blueprint**, or to learn more about its other benefits, visit the UCS website at www.ucsusa.org/blueprint.

FAILURE TO YIELD

Genetically engineered crops were supposed to help meet the world's growing food needs. New UCS research shows that these crops have yet to deliver on that promise.

When food prices soared to record highs in 2007 and 2008, localized food shortages sparked rioting in Bangladesh, Egypt, Haiti, and other countries. These price spikes and shortages, combined with increasing global population and food consumption, have prompted calls to boost agricultural productivity, or yield—the amount of a crop produced per unit of land over a specified amount of time.

For two decades, biotechnology companies have maintained that genetic engineering (GE)—inserting genes with desirable traits into organisms such as food crops—is the technology needed to meet this goal. Monsanto recently claimed that its engineered seeds “significantly increase crop yields.” UCS set out to test such claims with a comprehensive and up-to-date study of the overall effect GE has had on crop yields relative to other technologies in the United States. Our report, *Failure to Yield: Evaluating the Performance of Genetically Engineered Crops*, found that the industry’s promises have largely proven to be empty, and are likely to remain so for the foreseeable future.

Hitting the Productivity Ceiling

When evaluating a crop’s potential productivity, it is important to understand the critical distinction between intrinsic and operational yield—concepts that are often conflated by

**By Doug Gurian-Sherman
and Emily Robinson**

the biotechnology industry and misunderstood by policy makers. *Intrinsic* (or *potential*) yield refers to a crop’s maximum production under the best possible conditions. *Operational* yield refers to actual production levels after accounting for losses due to pests, drought, and other environmental factors. While operational yield is important, intrinsic yield must be improved in order to increase the maximum amount of food a crop can produce.

In *Failure to Yield*, UCS reviewed more than two dozen academic studies of corn and soybeans, the two primary GE food and feed crops grown in the United States. GE soybeans comprise more than 90 percent of the domestic crop, while GE corn comprises more than 60 percent of the domestic crop. The three most common types of these GE crops are: herbicide-tolerant soybeans, herbicide-tolerant corn, and insect-resistant corn (known as *Bt* corn because it is engineered with a gene from the bacterium *Bacillus thuringiensis*, which kills several kinds of insects).

Our analysis found that these crops have failed to increase intrinsic yields. Herbicide-tolerant soybeans and herbicide-tolerant corn have also failed to increase operational yields compared with conventional methods; *Bt* corn has provided a marginal operational yield increase of 3 to 4 percent. Since *Bt* corn became commercially available in 1996, its yield advantage averages out to an increase of 0.2 to 0.3 percent per year.

Field Trials of Crops Genetically Engineered to Increase Yield

GE Trait	Number of Approved Field Trials	
	1987–1999	1987–2008
Herbicide Tolerance	1,729	4,623
Insect Resistance	1,487	3,630
Disease Resistance	1,012	1,787
Yield	55	652
Tolerance to Stress (e.g., heat, drought, poor soil)	41	583
Total	4,324	11,275

Approximately 75 percent of all field trials conducted in the last 20 years have focused on herbicide tolerance and insect resistance, only to yield two types of commercially viable genes. The remaining trials have yielded no widespread commercialized genes.

Source: Animal and Plant Health Inspection Service.

What Price Productivity?

As genetic engineering becomes more high-tech, could growing food crops become more high-risk?

There are many genetic interactions that take place in a plant as it grows, each of which can influence the function of other genes and potentially change the plant's properties. Many newer engineered genes have been selected for agriculture because they influence crop genes responsible for intrinsic yield or drought tolerance (which affects operational yield). But because genetic interactions are so complex, altering the function of crop genes can lead to side effects far removed from the desired effect. For example, a promising engineered gene for drought tolerance was recently found to increase susceptibility to several plant diseases. Commercialization of this gene may therefore help increase yield, but increase the use of pesticides in order to avoid disease outbreaks.

Similar side effects could make it difficult to successfully increase yields without some degree of harm. Even genes that work as expected could sometimes cause significant unintended consequences for food safety and the environment. Because these potentially harmful effects could go undetected under current U.S. biotechnology regulations, improved oversight is needed to ensure such effects are discovered and prevented.

To put that figure in context, overall U.S. corn yields over the last several decades have increased approximately 1 percent each year—considerably more than what the *Bt* trait has provided.

A Better Path Forward

So GE has made a paltry contribution to crop productivity, but not for lack of trying. Over the past 20 years the industry has spent billions of dollars on research and carried out more than 3,000 field trials that have not resulted in any widely grown commercialized genes; thousands of additional trials on herbicide tolerance and insect resistance have come up with only two types of engineered genes in widespread use—and neither of those has raised potential yields. Though GE could conceivably increase crop yields in the future, it makes little sense to support this technology at the expense of other technologies and practices already proven to increase yields, such as marker-assisted breeding (using specific markers in plant DNA to breed for desirable traits).

This argument is further bolstered by evidence from recent studies that suggests developing countries—which have the most urgent need for higher crop yields—may be better served by low-cost farming methods and conventional seeds than GE seeds. Organic and similar sustainable farming methods can double crop yields in many developing countries while saving money (since they require less pesticide and synthetic fertilizer).

It should also be noted that most of the genes being considered for future GE crops cause more complex interactions with plants' genes than genes in current GE crops. These interactions often cause genetic "side effects" that could produce undesirable—or even harmful—properties (see the sidebar).

The United States should therefore fund solutions that have a track record of boosting crop yields in an efficient and sustainable manner. UCS recommends that the U.S. Department of Agriculture, state agricultural agencies, and universities increase research and development for modern conventional plant breeding methods, sustainable and organic farming, and other sophisticated farming practices. We also recommend that U.S. food-aid organizations make these more promising and affordable alternatives available to farmers in developing countries. Together, these actions can help farmers worldwide meet the goal of higher yields while preserving natural resources for future generations.

Doug Gurian-Sherman is a senior scientist in the Food and Environment Program. **Emily Robinson** is a press secretary.



To learn more about genetic engineering alternatives, or to download the full text of **Failure to Yield**, visit www.ucsusa.org/failuretoyield.

Combined Heat and Power

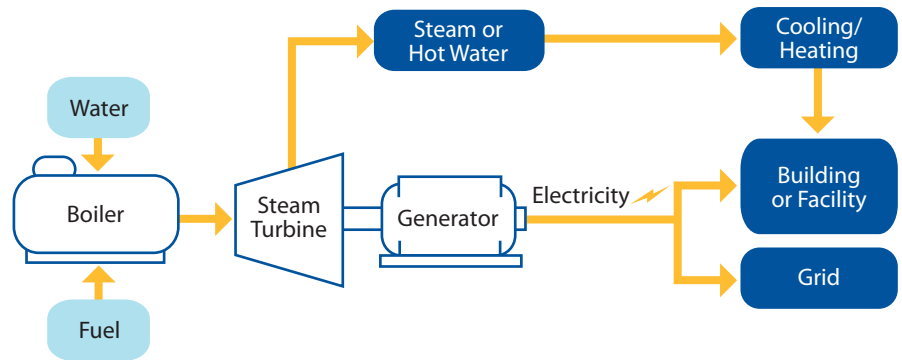
Most U.S. power plants operate by burning fossil fuels to create thermal energy (such as steam from a boiler or hot air from a turbine), which in turn drives generators to produce electricity. Much of this thermal energy does not get converted into electricity; a typical coal-fired power plant, for example, converts only about one-third of the energy contained in the coal into electricity, with the rest lost as “waste” heat. An additional 3 percent is lost in transmitting the electricity to homes and businesses.

Combined heat and power (CHP) systems, also known as cogeneration, offer a much more efficient option for energy consumers. CHP is not a new technology; it predates the national electricity “grid” and has been implemented in an increasing number of manufacturing plants, hospitals, colleges, and other facilities since the late 1970s. By generating electricity on-site and capturing much of the otherwise wasted thermal energy for space heating and other purposes, CHP systems have allowed industrial facilities and building owners to save money on energy costs and reduce the environmental impacts of their fossil fuel use.

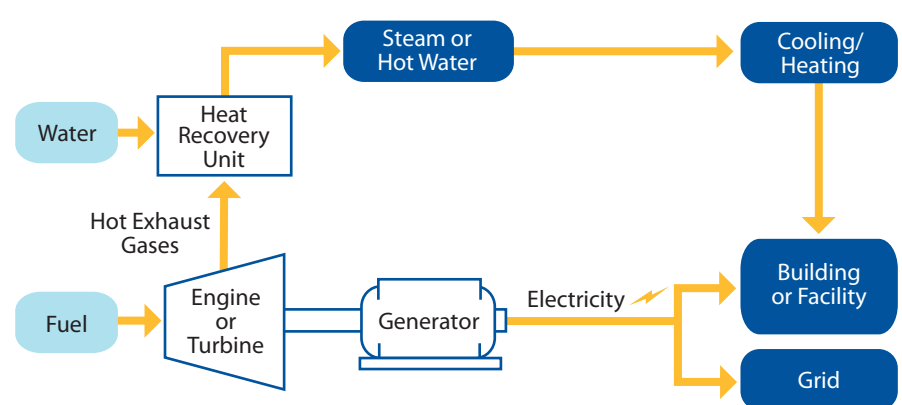
A Custom-Built Solution

CHP is actually not a single technology but rather an integrated system for producing electrical and thermal energy—in the form of heating or cooling—from one fuel. CHP systems are usually custom-engineered to meet the specific thermal needs, or “load profile,” of a particular user. While these systems vary in the fuel they use (e.g., coal, natural gas, diesel, plant-based “biomass” such as wood chips), there are just two common system configurations:

Boiler-based CHP system



Turbine-based CHP system



Combined heat and power (CHP) systems are typically based on one of the two configurations above, but vary in their generating capacity and fuel source, allowing them to be customized to the specific needs of a particular user.

Boiler-based CHP systems burn fuel in a boiler to create high-pressure steam, which powers a turbine that, in turn, drives a generator to produce electricity (see the diagram). The remaining steam can be used to provide heat for an industrial process or to heat buildings in the vicinity. Steam turbines are well-suited to medium- and large-scale industrial sites that would already use boilers.

Gas turbine- or engine-based CHP systems burn fuel—typically natural gas—directly in a turbine or engine that drives the electricity generator. Hot exhaust

gas from the engine enters a heat exchanger that creates steam or hot water for space heating. This configuration is ideally suited to sites requiring ample amounts of both electricity and heat; it has also become less expensive to install compared with boiler-based systems due to recent advances in technologies.

The Benefits of Efficiency

While coal-fired power plants are only about 30 percent efficient (after transmission losses), CHP systems are 65 to more than 80 percent efficient depending on

the system design, the equipment and fuel being used, and the site's thermal energy demand. By substantially reducing the amount of fuel needed to produce heat and electricity, CHP systems can deliver significant cost savings and pollution reductions (see the sidebar). And because they generate electricity on-site, they not only eliminate transmission and distribution losses but also help protect against

power outages and other grid-related problems—an important benefit for hospitals, manufacturing plants, government facilities, and other sites that must be fully operational during emergencies.

Businesses, government, and consumers have much to gain if CHP is adopted on a larger scale. In 2006 CHP produced 506 billion kilowatt-hours (kWh) of electricity—more than 12 percent of total U.S.

power generation that year. Researchers at the Department of Energy estimate that if CHP accounted for 20 percent of the country's electricity capacity (a target already achieved by several European countries), we would reduce global warming emissions by more than 800 million metric tons per year, the equivalent of taking more than half of the United States' current passenger vehicles off the road. And because technology improvements and cost reductions promise to make CHP systems viable for homes and small businesses, all energy consumers will be able to use CHP to substantially reduce their heat-trapping emissions.

CHP Success Stories

A few examples of how CHP systems large and small can make a difference.

Large-scale

A CHP plant at the University of New Hampshire (UNH) provides heating, cooling, and electricity to the majority of buildings on the main campus. By reducing the amount of electricity it purchases from the grid by nearly two-thirds, UNH has shrunk its electricity-related carbon emissions from 28,500 to 11,000 metric tons per year.

In 2004, Harbec Plastics, an injection molding manufacturer near Rochester, NY, installed 25 natural gas "microturbines" capable of producing 750 MW of power. By generating its own electricity and space heating and cooling, the CHP system reduced Harbec's carbon emissions by 90 percent while paying for itself in two years.

Small-scale

In fall 2007, the small town of Epping, NH, installed a "micro-CHP" system in its 125-year-old town hall. Together with a one-kilowatt solar array on the roof, the system has reduced the building's electric costs by 50 percent, its heating costs by 50 to 60 percent, and its carbon emissions by 60 tons per year.



The CHP system installed in a Melrose, MA, home last year (shown here) runs on natural gas and is 83 to 90 percent efficient. This model circulates hot water for heating, but forced-air systems are also available. In northern climates, these units can generate about half of the electricity—and all of the space heating—needed by a home each year.

Ensuring a Strong Future for CHP

Despite the clear economic advantages and growing popularity of CHP, there are still significant regulatory and market barriers that are preventing these systems from achieving their full potential. For example, many project owners seeking to connect their systems to the electricity grid can face discriminatory pricing practices, as well as technical hurdles created by uncooperative utilities.

UCS recommends that the federal government and state utility regulators lower these barriers by establishing consistent national standards for CHP permits and interconnections; establishing an equitable financial structure for CHP owners wishing to purchase power from, or sell power to, their local utilities; and funding federal and state programs that support CHP development. We estimate that these policies and investments could create 4,000 megawatts (MW) of additional CHP capacity each year through 2030—a critical step forward in our transition to a clean energy future.

Ned Reynolds is the Northeast climate policy coordinator at UCS.

With Us from the Start

English professor. Single mother. Writer. Organic farmer. Grandmother. Drummer. Activist. Philanthropist. Elsie van Buren has played many roles, but one she has played the longest is Union of Concerned Scientists member. Elsie has supported UCS virtually since the beginning—for almost 40 years.

She was living in Cambridge, MA, during the late 1960s and recalls hearing about the founding of UCS across town at the Massachusetts Institute of Technology. At the time she thought, “That sounds like a good outfit—one that will have clout in Washington.”

A Lifetime Commitment

Elsie had been opposed to nuclear weapons from an early age; her horrified reaction to the bombings of Hiroshima and Nagasaki later found expression in her

“UCS has been right about everything over the years—often way ahead of its time.”

concerns about nuclear energy. When optimism about nuclear energy’s potential was at its highest, Elsie wrote a letter of protest in 1955 to her congressional representative focusing on the problem of nuclear waste. By the time UCS came into being, she was eager to support a group that could speak to legislators about the dangers of nuclear weapons and energy with a more authoritative voice than her own.

Our expansion into food, energy, and climate issues has also mirrored Elsie’s passions. She has been ahead of the curve,



for example, in embracing organic farming methods on her Hancock, NH, farm, installing solar panels for hot water and electricity, and supporting aggressive action to curb global warming.

Elsie observes that UCS has built tremendous credibility with the media and policy makers by being “right about everything over the years—often way ahead of its time. With the backing of top-ranked scientists and the tenacity to keep hammering away at the issues, UCS is so effective in Washington.”

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