

## Scientists back state's toughest-in-U.S. smog controls

By Chris Bowman -- Bee Staff Writer  
Sacramento Bee, Thurs. March 16, 2006

California won significant scientific backing today in its battle with automakers and engine manufacturers over adopting smog controls more protective - and often costlier - than federal standards.

In a study released this morning, the National Research Council concluded that California's tougher tailpipe exhaust standards are still needed to combat chronic pollution in the Sacramento region, San Joaquin Valley and Los Angeles basin.

A council committee of 11 experts in engineering, health and public policy said the economic and public health gains from having the cleanest-in-the-nation cars, trucks and power equipment outweigh the "additional costs and complexity" those stricter rules impose on industry and consumers.

"The California program has been beneficial overall," the committee concluded. At issue is California's unique authority under the federal Clean Air Act to adopt fuel and engine standards more stringent than those the U.S. Environmental Protection Agency sets nationwide. Other states can adopt the California standards but cannot set their own rules. The second set of standards has frustrated national manufacturers for decades, most recently with the state's pioneering rule to cut auto emissions linked to global warming.

Congress granted the exception solely to California when it enacted the clean-air law in 1967 because the state's smog was the worst in the nation and, unlike other states, already had smog controls on cars.

Congress required the research council study in 2003 under a legislative deal engineered by Sen. Kit Bond, R-Mo., who has tried for several years to block California's stricter rules on engines that power lawn mowers, chain saws and other equipment.

The leading small-engine manufacturer, Briggs & Stratton Corp., has two plants in Missouri, and Bond has complained that the costs of making the lower-polluting engines could force production to go overseas.

Bond saw today's report as an endorsement of his concerns over job layoffs, according to his spokesman, Rob Ostrander.

"Sen. Bond will continue to ensure that as California acts to clean up its own mess, that at a minimum their actions do not hurt Missouri workers and families," Ostrander said.

The California Air Resources Board, which regulates engine emissions, viewed the report differently.

"It vindicates our need for separate standards because of the magnitude of our air pollution problem," said Jerry Martin, board spokesman. "It shows that our standards are more effective and than federal standards in reducing air pollution."

Environmentalists, public health advocates and associations of state and local air pollution regulators said they were pleased the research council did not recommend changes that would restrict the ability of states to follow California's standards.

"State initiatives were the kick in the pants automakers needed to produce the cleanest cars on the market today," said Michelle Robinson, an advocate with the Union of Concerned Scientists in Washington state.

California asserted its special rights under the federal air pollution law beginning in the 1970s, becoming first in the nation to take toxic lead out of gasoline and require pollution-cutting catalytic converters on vehicles' exhaust systems.

The introduction of low-emitting vehicles, or LEVs, in the 1990s also stems from California, which has the nation's largest population of automobiles. And the air board maintains that its ultimate

smog standards - zero-emission vehicles - accelerated the industry's development of hybrid vehicles powered by batteries and gas and nonpolluting fuel cell technology under way.

California is required to obtain an EPA waiver for each new vehicle standard. The committee, citing the state's efforts to opt out of the federal rule on oxygenated gasoline, said the environmental agency should put a deadline on decisions for controversial requests.

For eight years the state sought a waiver from the requirement that gasoline used in areas with the worst smog, such as Sacramento, contain 2 percent oxygen by weight. The law did not say which oxygenate must be used, but most refiners use ethanol or methyl tertiary butyl ether, or MTBE. The air board argued that the state could require a cleaner-burning formulation for less cost at the pump.

The EPA eliminated the mandate last month.

The research council said the report did not address the California greenhouse gas regulations because the state adopted them after the study was launched and because there are no comparable federal standards.

Last year, New York, Massachusetts, Vermont and Rhode Island adopted California's rule that clamps down on auto emissions of carbon dioxide, a global warming gas. Seven other states, including Washington and Oregon, are on the verge of doing the same, air board officials said. The Alliance of Automobile Manufacturers is trying to win a court order to block the rule, which requires automakers to reduce the heat-trapping "greenhouse" gases from cars and light-duty trucks beginning with model year 2009. The group maintains the rule will raise the price of vehicle about \$3,000, triple the state's estimate.

## **Gov't Study Backs Calif. Emission Rules**

By Ken Thomas, Associated Press Writer  
In the S.F. Chronicle, Thursday, March 16, 2006

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WASHINGTON, (AP) -- A government report released Thursday does not recommend giving the Environmental Protection Agency the power to stop states from adopting tough vehicle-emission standards similar to those in California.

In a setback for automakers, the National Academies' National Research Council said California's role in setting emission standards has been scientifically valid and necessary because of persistent pollution in parts of the nation's most populous state.

The study, eagerly anticipated by the auto industry and environmentalists, examined emissions standards for mobile sources such as cars, light trucks and construction vehicles. The panel found that substantial progress has been made in reducing emissions but more needs to be done to meet federal air-quality standards in many parts of the country.

California, which began regulating pollution before the federal government, has the authority under the Clean Air Act to set its own vehicle pollution standards. States can adopt either the federal standards or California's rules, and some Northeastern and Western states have followed California's lead.

David Allen, a chemical engineering professor at the University of Texas at Austin and the panel's chairman, said Thursday that manufacturers told the committee about the costs associated with complying with both California and federal standards. But it was difficult for the committee to quantify those costs, he said.

Some environmental groups had feared the study might be used by Congress to put restrictions on states' abilities to choose the California regulations. But the committee said it disagreed over ways to improve the process by which states adopt California's standards.

"What role EPA is to have in the state adoption process is a policy decision that goes beyond scientific and technical considerations," the researchers said.

The report said the EPA needs to play a role in an improved process. The committee offered two recommendations: The EPA could help by providing formal but nonbinding guidance, or it could grant or (under limited circumstances) deny waivers allowing states to adopt the California rules. The panel disagreed over which would be most effective.

When the California Air Resources Board revises or sets an emission standard, it must seek a waiver from EPA. The study recommended that the EPA speed up waiver requests it considers noncontroversial and put a time limit on decisions that are more contentious.

Gary Marchant, a member of the panel and law professor at Arizona State University, said the committee recommended a time limit of two years for EPA review.

The report said California's standards, which are mostly stricter than those of the federal government, have helped push forward pollution-reducing technologies.

"California has used its authority as Congress envisioned: to implement more aggressive measures than the rest of the country and to serve as a laboratory for technological innovation," the report said.

Environmentalists said the study reaffirmed the role of states in reducing air pollution and global warming.

"We've learned the hard way that we can't always count on the federal government alone to protect our health and environment," said Frank O'Donnell, president of Clean Air Watch.

Bill Becker, the executive director of the State and Territorial Air Pollution Program Administrators and the Association of Local Air Pollution Control Officials, said the findings represented a "tremendous victory for the preservation of states' rights."

The Alliance of Automobile Manufacturers, in a statement, noted that the study recognized that vehicles are 99 percent cleaner than 1967 models because of reductions in smog-forming emissions.

"Automakers continue working hard to develop automobiles that are cleaner, safer and smarter than ever before," the industry group said.

The study was sought by Sen. Kit Bond, R-Mo., in 2003. While it was under way, California air regulators in September 2004 approved the world's most stringent rules to reduce greenhouse gas emissions.

The auto industry has challenged those standards in court.

## **California's strict air quality standards praised**

In USA Today, Thursday, March 16, 2006

WASHINGTON (Reuters) — The National Research Council on Thursday endorsed efforts by California and other states to set tailpipe emission standards higher than existing federal levels. "California should continue its pioneering role in setting mobile-source emissions standards," the NRC said. "The role will aid the state's effort to achieve air quality goals and will allow it to continue to be a proving ground for new emissions-control technologies that benefit California and the rest of the nation."

The council is a private non-profit institution that Congress calls on frequently to advise policymakers on scientific and technical matters.

Automakers and energy companies are often at odds with California because of the state's longstanding efforts to pursue air pollution control measures that are typically much stricter than federal standards issued by the Environmental Protection Agency.

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Many of the industries affected by the state's rules want Congress to strip the state of its power because they say the rules are too expensive and unnecessary.

Under a 2003 EPA spending bill, Republican Sen. Kit Bond of Missouri called on NRC to study the issue. Some car companies and the diesel engine makers saw the legislation as a chance to dampen state authority to set tougher standards.

Several states besides California have adopted California emission standards over the years. In its report, the expert panel said it considered several changes to the status quo, but it could not reach a consensus. NRC did call on federal and state regulators, however, to do a better job of communicating with each other on testing and certification procedures.

Environmental groups and state air pollution administrators praised the report.

"This is a resounding victory for states' rights," said Frank O'Donnell, president of Clean Air Watch. "Every American is breathing cleaner air because states have the ability to set better standards."

"We are pleased that the NRC committee did not recommend any changes — legislative or regulatory — to restrict the ability of states to adopt California's motor vehicle standards. It is responsible public policy to maintain the rights of states without imposing additional hurdles," said S. William Becker, executive director of the State and Territorial Air Pollution Program Administrators and the Association of Local Air Pollution Control Officials.

*Contributing: The Associated Press*

## **Farm factor**

### **State's dairy businesses dispute smog blame**

By Jim Wasserman - Scripps-McClatchy News Service  
Lodi News Sentinel, Thurs., March 16, 2006

SACRAMENTO — One issue looms above all today in a \$4.6 billion California industry that has survived despite urbanization, complaining neighbors and even dwindling per-capita consumption of milk: the growing reputation of dairy businesses as air polluters.

As hundreds of the state's dairy owners gathered in Sacramento recently to assess their industry, no topic so dominated an agenda that included agricultural terrorism and disease as their cows' share of the responsibility for smog vs. that of cars. There were no firm answers for them, either.

"We don't know all the answers. We don't even know the questions yet," said Charles Krauter, soil and water science professor at California State University, Fresno.

Krauter and several other scientists are just scratching the surface of how the 1.7 million cows, feeding areas and manure lagoons actually affect smog formation. Yet, government regulators are about to clamp down, prompting farmers to question the science behind the regulations.

In developing its statistics, the San Joaquin Air Pollution Control District relied upon research done in Great Britain and a feedlot study from Texas. Krauter and fellow researcher Frank Mitloehner, air quality specialist at the University of California, Davis, are doing regional studies.

However, they've come under fire from environmentalists for tapping industry money for some of their research.

As the largest individual segment of California's \$31.8 billion agricultural economy, the 2,100 farms that produce milk, cheese and yogurt are finding themselves singled out as farming's leading contributor to organic gases that create smog, especially in the San Joaquin Valley. Tulare, Merced, Stanislaus and Kings counties are the state's leading dairy counties, producing almost 60 percent of the state's milk.

The industry would rather the public focus on how it leads the nation in milk production and trails only Wisconsin in making cheese. In 2004, its businesses produced 36.4 billion pounds of milk and almost 2 billion pounds of cheese, according to the California Dairy Research Foundation.

Until 2003, the state's dairy owners were exempt from state and regional air quality rules that govern vehicles, manufacturers and other businesses.

Now San Joaquin Valley air regulators are soon to crack down on a business sector that fled the urbanization of Southern California only to find itself targeted in Central California for producing smog, usually associated with the state's legendary traffic.

Air regulators between Lodi and Bakersfield say 1,500 dairies across their eight-county region generate more of the volatile organic gases that form smog than do passenger cars. (Vehicles, however, still create 60 percent of all ingredients that create Valley smog.)

For dairy owners, that's provoked defensiveness, which was on display Thursday during a panel discussion at the conference sponsored by the Western United Dairywomen.

"They're coming out with rules and regulations, but they're totally not based on science," argued Hanford-area dairy owner Mary Carnero.

Three air-quality scientists told dairy owners that their operations may have been assigned a higher degree of blame for smog than air regulators are claiming.

While the San Joaquin Valley's air district says dairies are releasing up to 19 pounds of volatile organic gases per cow per year, Krauter said early research shows it may be more like 2 pounds to 7 pounds.

Lower figures could significantly lighten regulations to curb dairies' share of smog. The first are due to roll out in July following workshops on the draft versions this month in Modesto, Fresno and Bakersfield.

Some environmentalists have defended the Valley air district's figure of 19 pounds, saying the actual number may be even higher.

Brent Newell, attorney for the San Francisco-based Center on Race, Poverty and the Environment, questioned Krauter's findings of lower numbers, calling it the equivalent of "reading tea leaves to tell a favorable crowd what they want to hear."

Newell, part of a group that originally sued to force regulation of the Valley's growing dairy industry, said he considers Krauter and Mitloehner to be "too close to the industry to be considered objective."

They are tapping research grants from the federal and state government and the dairy industry to develop more precise estimates for air regulators to cite in making regulations.

A similar study has begun nationally, Mitloehner told dairy owners.

## **Regulators discuss new air rules**

from the Associated Press  
in the Lodi News Sentinel, Thurs., March 16, 2006

San Joaquin Valley air regulators discussed new regulations aimed at curbing pollution from barnyard animals in a workshop on Monday.

The San Joaquin Valley Air Pollution Control District's rule would require frequent corral flushing, covering feed stockpiles, and other measures to minimize gases that lead to smog.

The valley's 2.5 million cows are a major source of smog in the region, which has some of the dirtiest air in the nation, air regulators said.

Leaders in the \$4 billion dairy industry said they want more research on dairy emissions before the rule takes effect July 1. Scientists still are confirming recent research on smog-forming gases from cows and manure.

Environmentalists said the rule doesn't go far enough because it does not regulate ammonia from cow waste.

## **IN BRIEF / ENERGY**

### **State OKs Shutdown of PG&E Power Plant**

From Bloomberg News

Los Angeles Times, Tues., March 16, 2006

Pacific Gas & Electric won approval from the state Public Utilities Commission to shut down its 77-year-old Hunters Point Power Plant in San Francisco by the end of June.

Environmentalists have called the 200-megawatt plant the leading stationary source of air pollution the Northern California city. PG&E is a unit of PG&E Corp.

### **Local Cities Look to Roundabouts to Move Traffic**

Valley Voice Newspaper, Tues., March 16, 2006

Tulare County - Three Tulare County cities are looking to traffic circles or roundabouts to help ease congestion, reduce automobile pollution and cut accidents. Seen in Europe, roundabouts allow traffic to enter an intersection and exit without stopping - instead slowing to travel in a circle until the exit they want is available. Cars don't spend time idling at red lights helping to speed circulation while reducing the emissions that come from idling motors.

Last week the City of Visalia took a hard look at construction of two roundabouts at their Lovers Lane freeway interchange - one large one to the south of the freeway plus a smaller circle further to the north. The plan was devised by Visalia engineers Omni Means.

The Visalia city council appeared impressed by the presentation by the engineering firm since it was the only option offered that showed it could accommodate growth in vehicle traffic in coming years while keeping the so-called level of service high - considered a level B rating.

As it is, Gary Mills of Omni Means says the Lovers Lane interchange at peak time reaches a level F as drivers must navigate a series of lights and turning movements to get where they want resulting in long waits that can back up onto the freeway. "CalTrans doesn't like that," Mills told the city council. "They don't like it, how about us who have to live here," quipped council member Don Landers.

Members Collins and Kirkpatrick said "roundabouts are the way to go once you get used to them," a short learning curve.

A roundabout to solve the Lovers Lane freeway interchange problems has another benefit over two other options the city council considered last week. It requires no right-of-way acquisition. In other options the city would have to buy someone's going business to make room for onramps with signals.

Interchanges in the county are a big problem, says city engineers, because TCAG doesn't fund interchanges and the state is concentrating on Highway 99. "198 is way down the list," says Mills.

Roundabouts may qualify for extra funding because they cut emissions.

Visalia is already installing a smaller roundabout at the intersection of Santa Fe and Houston as Houston is to be widened later this year.

Besides Visalia, the City of Lindsay is planning 4 roundabouts says city manager Scot Townsend. Two of the sites are located at the most important intersections in Lindsay's Downtown including Mirage and Honolulu. Two smaller ones are in new home subdivisions. The city manager expects

the traffic circles will be going in next year. Townsend says the city got funds to put in the street features with federal and state funds allotted to the county's cities.

Roundabouts can dress up a community, provide a place to display art or a water feature like a fountain in the middle even as they guide car traffic through Downtown, says Townsend. "We think it will help people come into our Downtown."

Besides Visalia and Lindsay, Porterville is also considering a roundabout.

Some cities have gone big time for roundabouts including Colorado Springs where there are 40 roundabouts and plans for 20 more. "They are safer, more efficient and prettier" than a normal intersection, says a Colorado Springs city official. Many fatal accidents occur when someone runs a red light which just doesn't happen in traffic circles. You can get rid of the millions spent on signals as well as the high cost of maintenance. Maintaining a roundabout costs one-third the cost of maintaining a signal.

Visalia mayor Jesus Gamboa reminded everyone that Visalia already has a roundabout at the Oval. Part of the secret to a roundabout compared to a traditional intersection is that everyone slows down to get in the flow of traffic.

Besides cities here, Long Beach, Santa Maria, Goleta and Palo Alto have traffic circles that seem to work well. A recent study by the Insurance Institute for Highway Safety found a 38% drop in accidents at 24 intersections that had been converted to a roundabout and an 89% decline in serious accidents.

## **What's New**

Valley Voice Newspaper, Tues., March 16, 2006

California's largest biodiesel plant burned down near Bakersfield last month. The company, Green Star Products, produced about 7 million gallons of the renewable fuel in 2005 perhaps 10% of US production. CEO of the company, Joseph LeStella says plans are underway to build a new plant and components are being assembled. He says he is searching for locations to put the plant, perhaps out of state where permits are easier to get. The plant burned down as a result of the mixing of sulfur with ethanol in a forklift accident. The plant site was also a fertilizer manufacturing facility.

While Valley Air offices discuss requiring dairies and hog farms to reduce their emissions one entrepreneur says he may have a way to use all those gases to power a new biofuel plant. "We could substitute the methane gas that comes off a covered lagoon instead of natural gas to fire our boilers, says Matt Schmitt of Calgren Renewable Fuels - the company that is about to build a ethanol plant on Ave. 120 at 99 in Pixley. Schmitt's idea is to enlist nearby dairymen and even Corc Pork hog farm to sell their waste gas coming off lagoons and pipe the gas down Ave. 120 to the plant site. In essence a waste product and pollutant - manure - would power the manufacture of biofuels and dairymen would get compensated for their supply. Schmitt says he is still studying the feasibility of his idea that depends on large animal confinement facilities to be near a large user of the gas like an ethanol plant - typically built in a rural area.

## **Ag News**

Valley Voice Newspaper, Tues., March 16, 2006

Hot issue - will dairymen need to capture gas from lagoons by installing a methane digester at cost the industry of \$1.9 billion. The valley air district is making its final recommendations on what new and expanding dairies will need to spend to meet requirements of Best Available Technology (BACT).

A Valley Air Board will hear draft rules on Best Available Technology as it applies to dairies in the valley with at least 1000 cows march 13/14 in Fresno. SB 700 requires rules be in place by July 1.

## **Easy access to 'Hydrogen Highway'**

**City opens cleaner-fuel pump**

Kerry Cavanaugh, Staff writer

L.A. Daily News, Thurs., March 16, 2006

BURBANK - At first glance, the fuel of the future doesn't look so different from gas of the present: There's a pump, a hose, a nozzle.

But at this corner of the city of Burbank maintenance yard is the San Fernando Valley's first hydrogen fueling station and another link in Gov. Arnold Schwarzenegger's "hydrogen highway," a network of stations slated to serve thousands of high-tech vehicles by 2010.

Air-quality agencies and automakers have embraced hydrogen as the next big thing in fuel, capable of powering zero-emission cars and reducing the nation's dependence on foreign oil.

While mass-marketed hydrogen fuel cell cars are perhaps a decade away, local governments are already investing in hydrogen infrastructure.

"I don't want to be a laggard, I want to be a leader," Burbank City Councilman Todd Campbell said. "If this is where we're going to go, let's do it."

A longtime clean-air advocate, Campbell pushed Burbank to take advantage of grants and become one of the first cities to install a hydrogen fueling station for city vehicles - one that eventually will be open to the public.

Burbank teamed with the South Coast Air Quality Management District, which has spent \$7 million to develop five hydrogen stations and convert 30 hybrid vehicles to use hydrogen instead of gasoline. The hope is that someday soon Southern Californians can pump their cars full of hydrogen and drive away with virtually no tailpipe emissions.

"We're proving the technology can be applied in a large fleet situation and proving to drivers that this fuel is not some far-off, space-age fuel. It's something they can use today," said Matt Miyasto, the AQMD's technology demonstrations manager.

So far, roughly 60 hydrogen cars are based in Southern California.

About half are hydrogen hybrids and the others are demonstration vehicles leased to government agencies.

However, hydrogen still presents big challenges.

Fueling stations can make hydrogen from water, breaking down the components of H<sub>2</sub>O. But some energy-industry experts warn that hydrogen costs about \$10 a gallon to produce, primarily because it takes a lot of electricity to separate hydrogen from oxygen in water molecules.

Also, automakers have struggled to develop a hydrogen car that can get mileage comparable to a gas-fueled vehicle.

Some environmental groups also accuse government agencies of investing too much money in technology that consumers won't be able to use for a decade, rather than funding zero-pollution, electric cars that could be cruising L.A.'s freeways today.

"With the amount of money the government is putting into hydrogen, if we put that into photovoltaic electric (electric-car drivers can plug into chargers powered by solar panels) and plug-in hybrids, we could end our dependence on foreign oil today," said Stephanie Barger, executive director with Earth Resource Foundation in Costa Mesa.

Just a few years ago, electric vehicles were seen as the wave of the future.

The Los Angeles Department of Water and Power developed the nation's most aggressive electric vehicle infrastructure program in the late 1990s and installed more than 500 charging stations before California air regulators and automakers pulled the plug on electric-vehicle requirements.

Now the DWP has a small hydrogen station for the city's five hydrogen cars. But the utility is also making a push for the plug-in hybrid, which has a larger battery that can be charged overnight and doesn't have to rely on the gas engine.

"You can basically use all electric and none of the gasoline engine, but you can still use the gasoline engine if, on the weekend, you go up to the mountains," said Bill Glauz, DWP manager of renewable and emerging technology.

AQMD and state officials said they are also funding demonstration vehicles using natural gas, biodiesel and hybrid engines.

However, they said, hydrogen appears to be the eventual replacement of petroleum. And, perhaps more important, automakers are putting their research dollars into hydrogen fuel cells.



"Carmakers are very optimistic about fuel cells, which is important because they were pessimistic about batteries. They're willing to spend the money (on research)," said California Air Resources Board spokesman Jerry Martin.

With hydrogen on the horizon, the AQMD is testing hybrids converted to hydrogen that can hit the road immediately.

Irvine-based Quantum Fuel Systems Technologies WorldWide Inc. converted Toyota Priuses that run on gasoline and electric batteries to use hydrogen instead of gas. The cars can travel 80 miles per fill. They emit low levels of smog-forming pollutants but no carbon monoxide, carbon dioxide or hydrocarbons.

Burbank paid \$350,000 to buy five hybrids and to cover operation costs of the station. The AQMD paid \$1.4 million to convert the Priuses to hydrogen and pay for the fueling station, which converts water to hydrogen on site.

Burbank Assistant Public Works Director Bob Van Hazelen occasionally drives one of the hydrogen hybrids and, so far, he said, the car is smooth and quiet and fueling is fast and easy.

"Everyone has accepted them quite well," he said. "I can see this being mainstreamed very easily."

## **Carbon Dioxide Hit Record in 2005**

By RANDOLPH E. SCHMID - The Associated Press  
in the Washington Post, Tues., March 14, 2006

WASHINGTON -- The concentration of carbon dioxide in the atmosphere climbed to a record 381 parts per million last year, an increase sure to spark further debate on global warming.

The reading was up 2.6 parts per million, according to preliminary calculations, David J. Hofmann of the Office of Atmospheric Research at the National Oceanic and Atmospheric Administration said Tuesday.

Final calculations from reporting stations around the world won't be available until later in the spring, Hofmann said, but the preliminary numbers are usually quite close.

Carbon dioxide is a major greenhouse gas. Those are chemicals that have been increasing in the atmosphere since the Industrial Revolution, raising fears of altering the planet's climate by trapping heat from the sun.

In Geneva, Switzerland, meanwhile, the World Meteorological Organization issued its own report for 2004, in which Secretary-General Michel Jarraud said, "Global observations coordinated by WMO show that levels of carbon dioxide, the most abundant greenhouse gas in the atmosphere, continue to increase steadily and show no signs of leveling off."

While the total of carbon dioxide in the atmosphere goes up every year the amount of increase varies from year to year, Hofmann said.

The ocean absorbs carbon dioxide at a fairly steady rate, he explained, but some years plants are more active in taking it up as they grow while other years they use less. And years when there are large forest fires can release increased amounts of the gas into the air, he said.

"The real question is how long will the earth continue to adjust itself to take up the additional carbon dioxide," he said. "That's one of the major questions."

In addition to carbon dioxide, the 2004 data from WMO calculated that nitrous oxide, which has been rising steadily since 1988, totaled 318.6 parts per billion. Methane has risen the most dramatically over the past two centuries, with the total amount in 2004 at 1,783 parts per billion, but its growth has been slowing, WMO said.

Hans Verolme, director of climate change for the World Wildlife Fund in the United States, welcomed the report as providing an authoritative measurement of the change.

"Unfortunately it confirms the other data that we've seen from NOAA and NASA and also it confirms with the trends we've seen in emissions from countries like the United States that still have not taken any real action to reduce carbon pollution," Verolme said.

Leonard Barrie, chief of atmospheric research at WMO, said: "If you have that much more energy being trapped, where does it go? That's the question everybody wants to know. Is it increasing the average surface temperature? Is it increasing storm frequency?"

In September researchers at the Georgia Institute of Technology reported that the number of more powerful hurricanes, category 4 and 5, has increased over the last 20 years, a period when average sea-surface temperature has risen. It's the warm water vapor from the oceans that provides energy for these massive storms.

According to NASA, 2005 had the highest annual average surface temperature worldwide since instrument recordings began in the late 1800s.

Nevertheless, the question of dealing with global climate change has proven a political stumbling block in recent years with the Bush administration rejecting the Kyoto protocol, which seeks to reduce emissions of greenhouse gases.

Scientists worry that overall warming will melt glaciers and the polar ice caps, raising sea levels enough to damage many low-lying islands and cities around the world. In addition, a warmer climate could lead to changes in weather patterns, agriculture and even allow some diseases to expand into new areas.