GREENHOUSE GASES: METHANE

Methane (CH_4) is the primary component of natural gas and an important energy source. Methane is also a greenhouse gas, meaning that its presence in the atmosphere affects the Earth's temperature and climate system. Due to its relatively short life time in the atmosphere (9-15 years) and its global warming potency — 20 times more effective than carbon dioxide (CO_2) in trapping heat in the atmosphere — reducing methane emissions should be an effective means to reduce climate warming on a relatively short timescale.

Human-influenced sources of methane include landfills, natural gas and petroleum production and distribution systems, agricultural activities, coal mining, stationary and mobile combustion, wastewater treatment, and certain industrial processes. About 60% of global methane emissions come from these sources and the rest are from natural sources.[1] Natural sources include wetlands, termites, oceans, and hydrates (which consist of methane molecules each surrounded by a cage of water molecules and are present in seafloor deposits around the world).

The historical record, based on analysis of air bubbles trapped in ice sheets, indicates that methane is more abundant in the Earth's atmosphere now than at any time during the past 400,000 years.[1] Over the last two centuries, methane concentrations in the atmosphere have more than doubled. However, in the past decade, while methane concentrations have continued to increase, the overall rate of methane growth has slowed.[2] Given our incomplete understanding of the global methane budget, it is not clear if this slow down is temporary or permanent.

Methane is one of several greenhouse gases that contribute to global climate change. Human influenced sources include landfills, natural gas and petroleum systems production and distribution, agriculture, coal mining, combustion, wastewater treatment, and certain industrial processes. Natural sources include wetlands, termites, oceans, and hydrates. Once emitted, methane is removed from the atmosphere by a variety of processes, frequently called "sinks." The balance between methane emissions and methane removal processes ultimately determines atmospheric methane concentrations, and how long methane emissions remain in the atmosphere. The dominant sink is oxidation by chemical reaction with hydroxyl radicals (OH).

Scientific Research on Methane

Scientific agencies within the Federal government are actively researching many aspects of methane, all of which have an impact on global climate change. This research utilizes observations, inventories, and computer models to help scientists determine how much methane is being put into the atmosphere, its effects on the global climate, and how the amount of methane in the atmosphere can be reduced.

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1 IPCC, 2001: Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change [Houghton, J.T., Y. Ding, D.J. Griggs, M. Noguer, P.J. van der Linden, X. Dai, K. Maskell, and C.A. Johnson (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 881pp.

2 Dlugokencky, E.J., S. Houweling, L. Bruhwiler, K.A. Masarie, P.M. Lang, J.B. Miller, and P.P.Tans, Atmospheric methane levels off: Temporary pause or new steady state?, Geophysical Research Letters, 30(19), 1992, doi:10.1029/2003GL018126, 2003.

Scientists take air measurements around the world in distant and remote places, as well as in populated areas to calculate average global concentrations. They also maintain running inventories of methane emission factors and activities. By doing this on an ongoing basis, they can track the changes in overall concentration from year to year and detect whether global methane concentrations are rising or falling. These trends are factored into calculations of how atmospheric composition has affected or "forced" our climate. These observations are also used to estimate how long methane persists in the atmosphere. Regardless of the source of methane — whether human-produced or natural — data on why, how much, and where methane is being emitted are being used to complete the assessment of the role of methane in the Earth system.

Over the last two centuries, methane concentrations in the atmosphere have more than doubled, although the rate of growth of methane in the atmosphere has slowed in the last decade.[2] Scientists are measuring the amount of methane in the atmosphere, where it is coming from and where it goes, and modeling its behavior to try to understand the effects of increased levels of methane in the atmosphere.

Reducing Atmospheric Methane Concentrations: Methane to Markets

U.S. government programs to reduce atmospheric methane concentrations have led to emissions reductions of about 10% below 1990 levels.[3] These voluntary programs have targeted methane reductions in coal mining, landfills, oil and natural gas systems, and agriculture by more effectively capturing methane during fossil-fuel extraction, capturing methane from landfills, and reducing biomass burning. A new partnership, called Methane to Markets and led by the U.S. EPA, was initiated in 2004 to engage developed countries, developing countries, and countries with economies in transition, and the private sector, in an international effort to reduce methane emissions. The Partnership will reduce global methane emissions by recovery and use to enhance economic growth, promote energy security, improve the environment, and reduce greenhouse gas emissions. Other benefits include improving mine safety, reducing waste, and improving local air quality. The Partnership has the potential to deliver by 2015 annual reductions in methane emissions of up to 50 million metric tons of carbon equivalent (MMTCE) or recovery of 500 billion cubic feet (Bcf) of natural gas. These measurable results, if achieved, could lead to stabilized or even declining levels of global atmospheric concentrations of methane. To give a sense of scale, this would be equivalent to:

- removing 33 million cars from the roadways for 1 year, planting 55 million acres of trees, or eliminating emissions from fifty 500 megawatt coal-fired power plants; and
- providing enough energy to heat approximately 7.2 million households for 1 year.

What You Can Do?

The largest source of human-produced methane in the U.S. results from the breakdown of garbage in landfills. Reducing the amount of trash thrown out will reduce methane emissions the most. Other sources of methane in the U.S. include direct production from ruminant animals and methane that is released as a byproduct of transporting fossil fuel and fossil-fuel combustion. Using energy more efficiently will also help reduce national methane emissions.

[3] U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2003*, EPA 430-R-05-003 (Washington, DC, April 2005).

Bigger Threat to Global Warming – Cars or Cows?[4]

"Now should be environmental vegetarianism's big moment," writes Ben Adler in the article "Are Cows Worse Than Cars," found in *The American Prospect*. "Global Warming is the single biggest threat to the health of the planet, and meat consumption plays a bigger role in greenhouse gas emissions than even many environmentalists realize."

Generally speaking, the environmentalist movement has largely downplayed, if not ignored, the impact that dietary choices have on global warming. On the one hand, we can support cleaner energy, buy more efficient cars, and reduce our consumption of products derived from petroleum, and yet with our other hand, eat a burger that has a carbon footprint bigger than most SUVs. Mike Tidwell, director Chesapeake Climate Action Network similarly has a negative view of environmentalists' awareness of dietary impact. "I think it's amazing that even the greenest of green liberal environment activists, the vast majority of them tend to consume meat at the same rate as people who think global warming is a hoax," he says. "Meat consumption seems to be the last thing that progressive people address in their lifestyle. If I had a nickel for every global warming conference that had roast beef on the menu, I'd be rich."

The beef industry is driven largely by corn subsidies (over 5 billion dollars last year alone). If feedlots had to pay the true cost of feeding the cows all of that corn, or if they had to offset all of the fuel and emissions produced from calf to slaughter, most of them would probably have been out of business long ago. We've been bailing out the meat industry with subsidies and price supports for years, and for what? For greenhouse gas emissions that out-pace the levels from cars and other transportation. Considering the large carbon footprint for animal agriculture, why is it that we're so stubborn to give up meat?

Cutting meat out of the diet is not a very catchy campaign. Owning a hybrid vehicle with Sierra Club stickers on the back is way more sexy than cutting the flesh out of our diets. "I don't know of anyone in the environmental community that has taken a stance of 'we support no meat consumption because of global warming,'" says Tim Greef of League of Conservation Voters. Until the connection between CO2 emissions, global warming, and our diet is accepted, you can be sure that people will be rolling through the drive-thru for a Big Mac, in the biodiesel or hybrid, feeling like they're really making a difference.

Conscious Choice of Food Can Substantially Mitigate Climate Change[5]

Reducing the consumption of meat and dairy products and improving agricultural practices could decrease global greenhouse gas emissions substantially. By 2055 the emissions of methane and nitrous oxide from agriculture could be cut by more than 80%, researchers of the Potsdam Institute for Climate Impact Research find. The results of the modeling study have recently been published in the journal *Global Environmental Change*.

Specifically, the two gases are methane and nitrous oxide, which contribute to global warming more than does carbon dioxide. This source states methane is twenty times more effective in trapping heat in the atmosphere than carbon dioxide. Nitrous oxide, traps even more heat in the atmosphere. According to the EPA, "Nitrous oxide is about 310 times more effective in trapping heat in the atmosphere than CO2 over a 100-year period." Methane and nitrous oxides

[4] Written by Derek Markham, Green Options
[5] ScienceDaily (June 29, 2010)

are generated by current agricultural practices. One source says, “According to the U.N., the meat, egg, and dairy industries account for a staggering 65% of worldwide nitrous oxide emissions.”

"Meat and milk really matter," says Alexander Popp of PIK. "Reduced consumption could decrease the future emissions of nitrous oxide and methane from agriculture to levels below those of 1995," explains the first author of the study. In the past, agricultural emissions of greenhouse gases, mainly methane and nitrous oxide, have increased steadily. In 2005 they accounted for 14% of total anthropogenic greenhouse gas emissions. "Besides the conscious choice of food on the consumers' side there are technical mitigation options on the producers' side to reduce emissions significantly," says Popp.

The researchers used a global land-use model to assess the impact of future changes in food consumption and diet shifts, but also of technological mitigation options on agricultural greenhouse gas emissions up to 2055. The global model combines information on population, income, food demand, and production costs with spatially explicit environmental data on potential crop yields.

The calculations show that global agricultural non-carbon dioxide (non-CO_2) emissions increase significantly until 2055 if food energy consumption and diet preferences remain constant at the level of 1995. Taking into account changing dietary preferences towards higher value foods, such as meat and milk, associated with higher income, emissions will rise even more. In contrast, reducing the demand for livestock products by 25% each decade from 2015 to 2055, leads to lower non-CO_2 emissions, even compared to 1995.

Furthermore, there are technological mitigation options to decrease emissions significantly. However, these technological mitigation options are not as effective as changes in food consumption. The highest reduction potential could be achieved by a combination of both approaches, the researchers report. Compared to a scenario that takes population growth and an increase in the demand for livestock products into account, emissions of methane and nitrous oxide could be cut by 84% in 2055.

However, livestock products are very valuable for nutrition as they contributed globally an average of one-third of protein to dietary intakes in 2003. For many poor and undernourished people in the developing world who frequently suffer from protein deficiencies livestock products are important parts of food consumption. In contrast, less meat-oriented diets in the developed regions would have positive health effects, the authors note.

Agricultural, non-carbon dioxide non-CO_2 greenhouse gas emissions consist mainly of methane and nitrous oxide. Nitrous oxide is about 300 and methane about 20 times more effective in trapping heat in the atmosphere than carbon dioxide. Agricultural emissions originate from the use of synthetic fertilizers on croplands and from flooded rice fields. Because animal products require large amounts of fodder crops, livestock production is connected to higher emissions from fertilizer application. Additional livestock emissions occur due to manure excretion, management and application and methane producing microbes in ruminants' digestive systems.

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