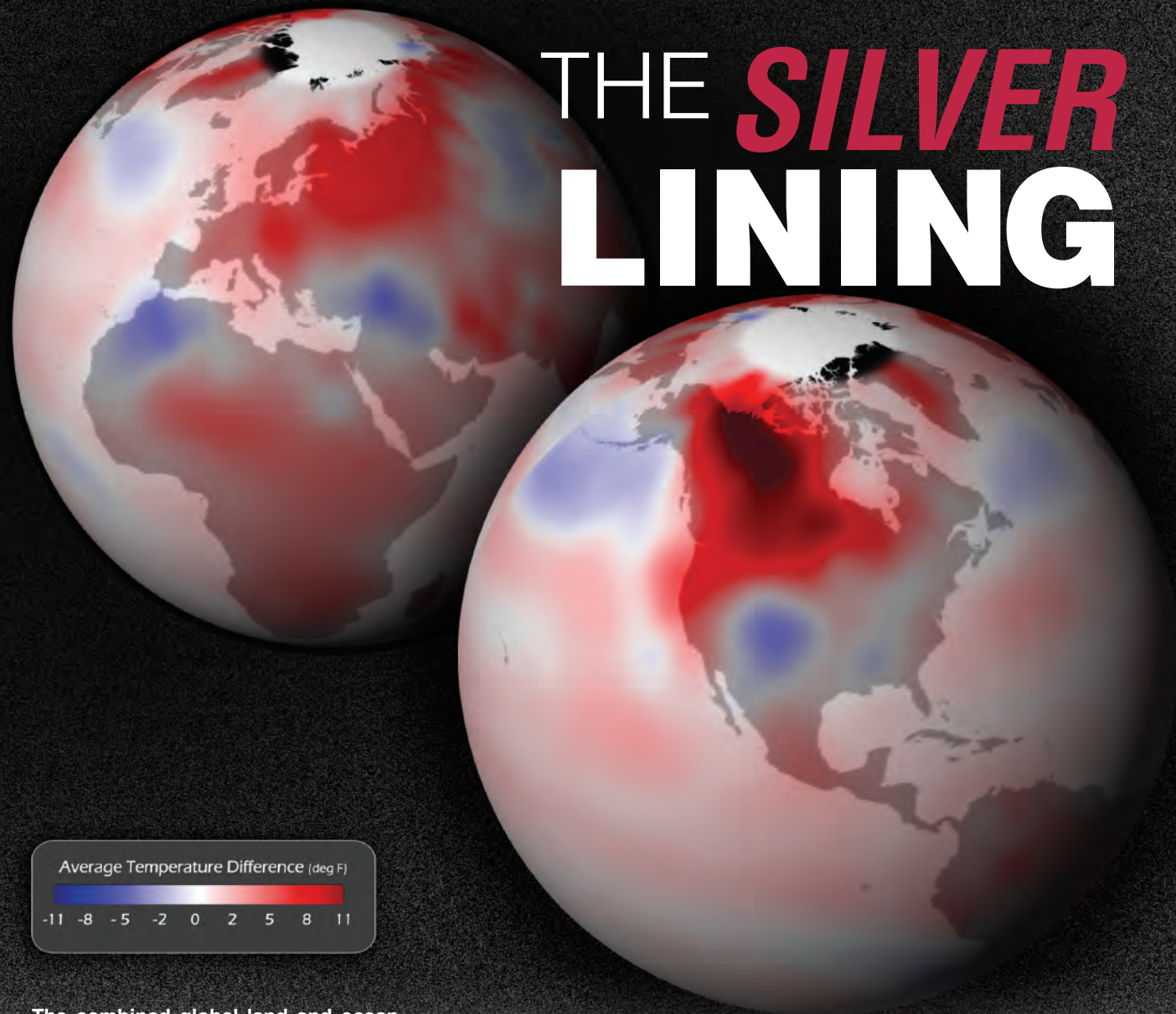


THE *SILVER* LINING



Average Temperature Difference (deg F)

-11 -8 -5 -2 0 2 5 8 11

The combined global land and ocean surface temperature in September was the second warmest on record, according to NOAA's National Climatic Data Center.

The hearth industry has the potential to profit enormously from the response to climate change and the coming cap-and-trade programs.

Residential space heating in the United States consumes more than four quadrillion Btus of energy annually. In 2005, the last year complete Department of Energy data are available, more than 106 million households reported using space-heating fuel; expenditures for the fuel exceeded \$56 billion.

Major space-heating fuels are natural gas, fuel oil, kerosene, LPG, wood and electricity. Residential space heating represents a significant fraction of our nation's energy budget, and is a contributor to air pollutant emissions and global climate change.

As diverse as natural gas, fuel oil, kerosene, LPG, and wood seem – gas, liquid and solid – they all have one thing in common – **carbon**. Fundamentally the energy they provide is from breaking **carbon/carbon, carbon**/hydrogen and **carbon**/oxygen bonds in the fuel and forming **carbon** dioxide and water as products of combustion. Even 71 percent of electricity is from the combustion of **carbon**-based fuels.

The key pollutants and greenhouse emissions released by the fuels are **carbon** compounds. For example, **carbon** monoxide gas is emitted at

the highest concentration among all pollutants from most space heating equipment and the two principal greenhouse gases are **carbon** dioxide and methane. All three gases are composed of a single **carbon** atom with oxygen or hydrogen bounded to that **carbon** atom.

Recently black (elemental) **carbon** contained in particles, along with organic compounds, has been implicated in global climate change. Virtually all air pollutants (particles and gases alike) from residential heating, with the exception of **carbon** monoxide and elemental **carbon** which are technically inorganic, are organic compounds that have a **carbon** backbone.

Creosote is primarily made up of **carbon** containing organic compounds, elemental **carbon** and carbonates. Ash from solid-fuel combustion contains **carbon**ates and char. Char is composed of **carbon**-containing organic compounds and elemental **carbon**. Carbon is clearly the currency of the realm when it comes to residential space heating.

Okay, so what if particles (PM_{2.5} and PM₁₀) from residential space heating are primarily made up of **carbon**-containing compounds and, to a lesser extent, black **carbon**, and that common air toxics such **carbon** monoxide, formaldehyde, benzene, and polycyclic aromatic hydrocarbons (PAH) all contain **carbon**? So what if **carbon** dioxide and **carbon**-containing methane are the key greenhouse gases? Federal, state and local air quality regulations historically have dealt with them. So what's new? What's new is that, for the first time, the use of **carbon**-based fuels may offer a financial opportunity to the hearth industry, rather than a burden of air pollutant regulations, due to efforts to control climate change.

The Opportunity

The opportunity is carbon cap and trade. Cap-and-trade programs turn pollution reductions into marketable assets. Analysts estimate the potential size of the U.S. carbon cap-and-trade market to be anywhere from \$300 billion to \$2 trillion. There's already trading in pork bellies, propane, crude oil and cocoa; now there's trading in carbon emissions, although it is off to a slow and convoluted start, particularly in the U.S. because of the complexity of the politics involved.

Internationally, there are already car-

"For innovators who find safe and workable solutions to global warming, the rewards will be staggering."

— Fred Krupp
President Environmental
Defense Fund

bon brokers, carbon funds, carbon exchanges and carbon tip sheets. The tremendous potential growth in the carbon market is attracting a diverse group of players. These include development banks, venture capital firms, hedge funds and private equity firms, commercial banks and various industry players. The European Union is already in the game; the U.S. still is lagging behind.

Cap and trade works by setting mandatory enforceable limits on greenhouse gas emissions (the "cap") and then allowing the market to identify the most cost-effective way to achieve those limits. Tradable emissions "allowances," or permits, are distributed among industries, utilities, etc., that emit greenhouse gases. Allowance limits are not necessarily achieved by the traditional emission control equipment on a smoke stack, but credits against the limits can be achieved by non-traditional methods. For example, UPS has saved about 38 million drive miles corresponding to about 3 million gallons of gasoline or about 31,000 metric tons of carbon dioxide by eliminating left hand turns on many of its routes.

The hearth industry has two things to offer:

(1) The replacement of older, inefficient units with newer, efficient models. Higher efficiency means

less fuel is used and concomitantly less carbon dioxide and often less methane emitted.

(2) A shift from fossil fuels to biomass. The carbon dioxide emitted from biomass combustion is generally not counted in greenhouse gas inventories because photosynthesizing plants that replace those that were harvested for fuel remove equivalent carbon dioxide from the atmosphere. The hearth industry conceptually could offer carbon credits to those that could pay and are in need of them.

Notably, that could include utilities and independent power producers. A conceivable scenario would be an independent power producer obtaining credits to apply against its allowance by funding a wood stove change-out program or replacing old gas furnaces with new, high-efficiency condensing models.

The Status of Cap-and-Trade Programs

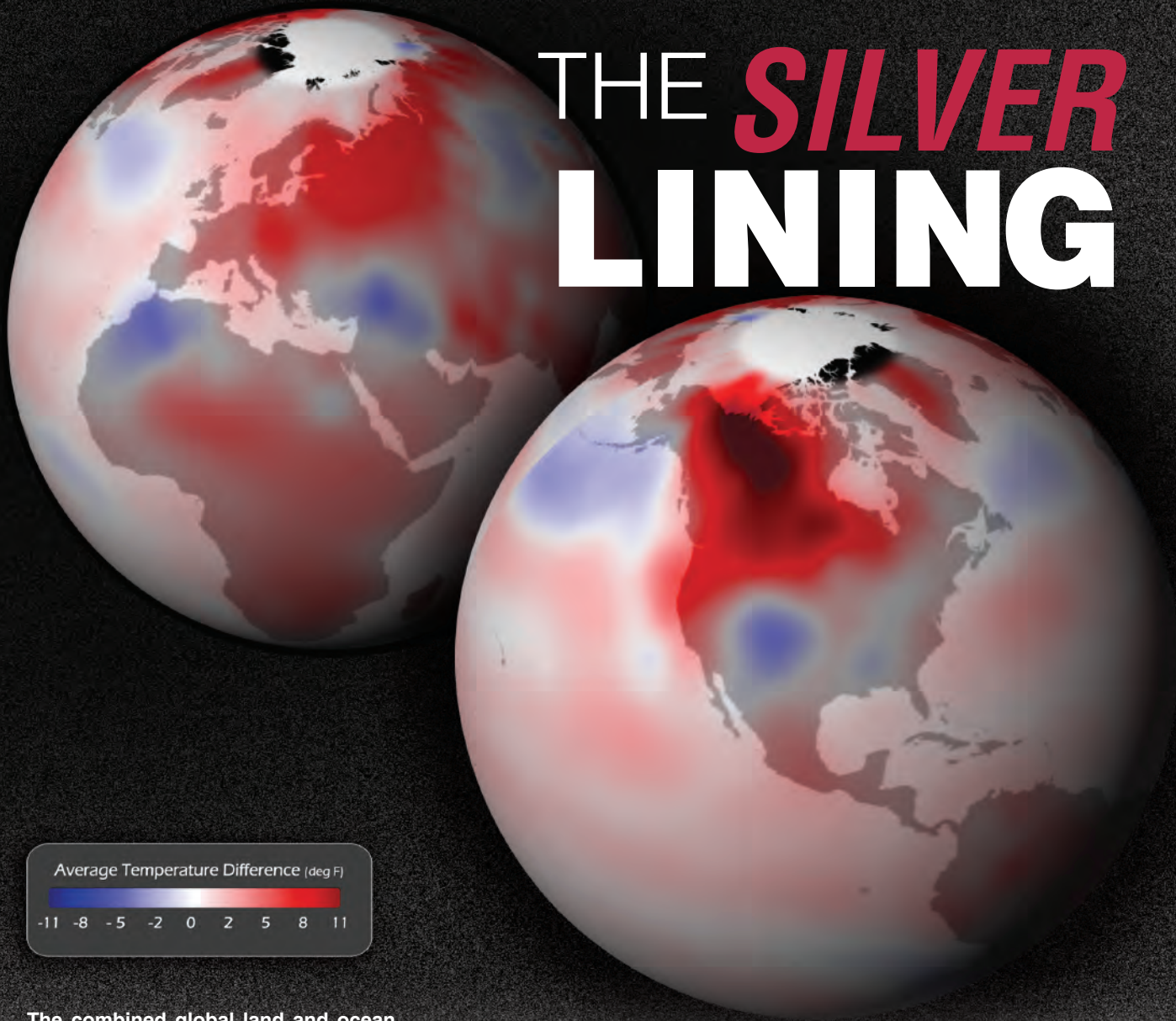
There are three already-active cap-and-trade programs under the Kyoto Protocol. They are the European Emission Trading Scheme (EU ETS), the Clean Development Mechanism (CDM), and the Joint Implementation (JI) mechanism.

- The EU ETS was established by the EU member states to involve the private sector in achieving their obligation under the Kyoto Protocol.
- The CDM mechanism is one of the flexible mechanisms of the Kyoto Protocol that allows for project-based emission reduction (carbon credits) in countries that are parties to the Protocol but do not face emissions reduction caps of their own.
- The JI mechanism also allows for project-based emission reduction (carbon credits) but in countries that do face caps.

"CO₂ emissions from fuel combustion in households (mainly for heating purposes) accounted for eight percent of total greenhouse gas emissions in the EU-27...During the period 1990-2007...the shift from coal to oil or gas and the final energy efficiency per household resulted in significant lowering of emissions. Smaller improvements resulted from increased use of biomass wood for heating."

— European Environment Agency
EEA Report No. 9/2009

THE *SILVER* LINING



The combined global land and ocean surface temperature in September was the second warmest on record, according to NOAA's National Climatic Data Center.

The hearth industry has the potential to profit enormously from the response to climate change and the coming cap-and-trade programs.

Residential space heating in the United States consumes more than four quadrillion Btus of energy annually. In 2005, the last year complete Department of Energy data are available, more than 106 million households reported using space-heating fuel; expenditures for the fuel exceeded \$56 billion.

Major space-heating fuels are natural gas, fuel oil, kerosene, LPG, wood and electricity. Residential space heating represents a significant fraction of our nation's energy budget, and is a contributor to air pollutant emissions and global climate change.

As diverse as natural gas, fuel oil, kerosene, LPG, and wood seem – gas, liquid and solid – they all have one thing in common – **carbon**. Fundamentally the energy they provide is from breaking **carbon/carbon**, **carbon**/hydrogen and **carbon**/oxygen bonds in the fuel and forming **carbon** dioxide and water as products of combustion. Even 71 percent of electricity is from the combustion of **carbon**-based fuels.

The key pollutants and greenhouse emissions released by the fuels are **carbon** compounds. For example, **carbon** monoxide gas is emitted at

the highest concentration among all pollutants from most space heating equipment and the two principal greenhouse gases are **carbon** dioxide and methane. All three gases are composed of a single **carbon** atom with oxygen or hydrogen bonded to that **carbon** atom.

Recently black (elemental) **carbon** contained in particles, along with organic compounds, has been implicated in global climate change. Virtually all air pollutants (particles and gases alike) from residential heating, with the exception of **carbon** monoxide and elemental **carbon** which are technically inorganic, are organic compounds that have a **carbon** backbone.

Creosote is primarily made up of **carbon** containing organic compounds, elemental **carbon** and carbonates. Ash from solid-fuel combustion contains **carbon**ates and char. Char is composed of **carbon**-containing organic compounds and elemental **carbon**. Carbon is clearly the currency of the realm when it comes to residential space heating.

Okay, so what if particles (PM_{2.5} and PM₁₀) from residential space heating are primarily made up of **carbon**-containing compounds and, to a lesser extent, black **carbon**, and that common air toxics such **carbon** monoxide, formaldehyde, benzene, and polycyclic aromatic hydro**carbon**s (PAH) all contain **carbon**? So what if **carbon** dioxide and **carbon**-containing methane are the key greenhouse gases? Federal, state and local air quality regulations historically have dealt with them. So what's new? What's new is that, for the first time, the use of **carbon**-based fuels may offer a financial opportunity to the hearth industry, rather than a burden of air pollutant regulations, due to efforts to control climate change.

The Opportunity

The opportunity is carbon cap and trade. Cap-and-trade programs turn pollution reductions into marketable assets. Analysts estimate the potential size of the U.S. carbon cap-and-trade market to be anywhere from \$300 billion to \$2 trillion. There's already trading in pork bellies, propane, crude oil and cocoa; now there's trading in carbon emissions, although it is off to a slow and convoluted start, particularly in the U.S. because of the complexity of the politics involved.

Internationally, there are already car-

"For innovators who find safe and workable solutions to global warming, the rewards will be staggering."

— Fred Krupp
President Environmental
Defense Fund

bon brokers, carbon funds, carbon exchanges and carbon tip sheets. The tremendous potential growth in the carbon market is attracting a diverse group of players. These include development banks, venture capital firms, hedge funds and private equity firms, commercial banks and various industry players. The European Union is already in the game; the U.S. still is lagging behind.

Cap and trade works by setting mandatory enforceable limits on greenhouse gas emissions (the "cap") and then allowing the market to identify the most cost-effective way to achieve those limits. Tradable emissions "allowances," or permits, are distributed among industries, utilities, etc., that emit greenhouse gases. Allowance limits are not necessarily achieved by the traditional emission control equipment on a smoke stack, but credits against the limits can be achieved by non-traditional methods. For example, UPS has saved about 38 million drive miles corresponding to about 3 million gallons of gasoline or about 31,000 metric tons of carbon dioxide by eliminating left hand turns on many of its routes.

The hearth industry has two things to offer:

(1) The replacement of older, inefficient units with newer, efficient models. Higher efficiency means

less fuel is used and concomitantly less carbon dioxide and often less methane emitted.

(2) A shift from fossil fuels to biomass. The carbon dioxide emitted from biomass combustion is generally not counted in greenhouse gas inventories because photosynthesizing plants that replace those that were harvested for fuel remove equivalent carbon dioxide from the atmosphere. The hearth industry conceptually could offer carbon credits to those that could pay and are in need of them.

Notably, that could include utilities and independent power producers. A conceivable scenario would be an independent power producer obtaining credits to apply against its allowance by funding a wood stove change-out program or replacing old gas furnaces with new, high-efficiency condensing models.

The Status of Cap-and-Trade Programs

There are three already-active cap-and-trade programs under the Kyoto Protocol. They are the European Emission Trading Scheme (EU ETS), the Clean Development Mechanism (CDM), and the Joint Implementation (JI) mechanism.

- The EU ETS was established by the EU member states to involve the private sector in achieving their obligation under the Kyoto Protocol.
- The CDM mechanism is one of the flexible mechanisms of the Kyoto Protocol that allows for project-based emission reduction (carbon credits) in countries that are parties to the Protocol but do not face emissions reduction caps of their own.
- The JI mechanism also allows for project-based emission reduction (carbon credits) but in countries that do face caps.

"CO₂ emissions from fuel combustion in households (mainly for heating purposes) accounted for eight percent of total greenhouse gas emissions in the EU-27...During the period 1990-2007... the shift from coal to oil or gas and the final energy efficiency per household resulted in significant lowering of emissions. Smaller improvements resulted from increased use of biomass wood for heating."

— European Environment Agency
EEA Report No. 9/2009

None of these apply to the United States since it is not a party to the Kyoto Protocol, but they could offer a model and precedence for future U.S. programs.

The Copenhagen Climate Summit held in December of 2009 produced only a nonbinding accord that is a skeletal outline for global action, not the detailed legally-binding accord that was originally expected. According to United Nations secretary-general Ban Ki-moon,

from large facilities such as coal-fired power plants. Additionally, in April of 2007, the Supreme Court found that greenhouse gases are air pollutants covered by the federal Clean Air Act.

Greenhouse gas programs in the U.S. on the state and regional levels are in their early stages but appear dynamic. There is the Regional Greenhouse Gas Initiative (RGGI) which is made up of 10 Northeastern and Mid-Atlantic states.

A final note on U.S. cap-and-trade programs: There have been two successful cap-and-trade programs to date that may provide insights and set precedence for future greenhouse cap-and-trade programs. One is for sulfur dioxide (SO₂), known as the Acid Rain Program, which started in 1995 and one is for nitrous oxides (NO_x) in the Northeast, known as the NO_x Budget Trading Program, which started in 2003.

It Doesn't Matter What You Think

Everyone seems to have an opinion on global warming; it's like politics or religion. Whether you are a proponent of Al Gore's "An Inconvenient Truth" or are from a Red State, quite frankly, it doesn't matter what you think about global warming. What matters is that the general consensus is that atmospheric CO₂ is increasing due to fossil-fuel combustion, and the increased CO₂ will cause a warmer world. The only debate is how warm it will get and how big a role natural swings in climate are playing.

A plethora of august bodies have weighed in on the inevitability of global climate change and the impact that it may have. These include national and international scientific academies and societies. To name a few: Intergovernmental Panel on Climate Change, U.S. Global Change Research Program, Intergovernmental Arctic Council, International Arctic Science Committee, European Academy of Sciences and Arts, InterAcademy Council, International Council of Academies of Engineering and Technological Sciences, Network of African Science Academies, Royal Society of New Zealand, Polish Academy of Sciences, National Research Council, American Association for the Advancement of Science, European Science Foundation, Federation of Australian Scientific and Technological Societies, American Geophysical Union, European Federation of Geologists, European Geosciences Union, Geological Society of America, Geological Society of Australia, International Union of Geodesy and Geophysics, National Association of Geosciences Teachers, American Meteorological Society, Australian Meteorological and Oceanographic Society, Canadian Foundation for Climate and Atmospheric Sciences, Canadian Meteorological and Oceanographic Society, Royal Meteorological Society, World

"The consumption of biomass fuels – such as wood, charcoal, and wood waste – and biomass-based fuels, such as ethanol from corn and woody crops, generates CO₂. However, in the long run the CO₂ emitted from biomass consumption does not increase atmospheric CO₂ concentrations, assuming that the biogenic Carbon emitted is offset by the uptake of CO₂ that results from the growth of new biomass. As a result, CO₂ emissions from biomass combustion have been estimated separately from fossil fuel-based emissions and are not included in the U.S. totals."

— U.S. EPA

*Inventory of U.S. Greenhouse Gases Emissions and Sinks:
1990-2009*

"We sealed the deal. And it is a real deal. And we will try to have legally-binding (language) as soon as possible – in 2010." In the parlance of international politics, clearly the "jury is still out" on whether there will be viable cap-and-trade and carbon credit mechanisms that evolve from the Copenhagen Climate Summit.

In the United States the national cap-and-trade legislation is stalled in the Senate. This legislation did pass in the House of Representatives by the narrowest of margins, 219 to 212 in June of 2009. Some pundits feel that the legislation will pass the Senate in 2010; others believe it will take longer or never be passed.

It is also generally believed if Congress does not act on a cap-and-trade program it will be agency-initiated, i.e., the U.S. EPA will act. This is not unreasonable in light of the fact that, in September of 2009, the U.S. EPA did announce a proposed rule, referred to as "Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule," that limits and requires permits for greenhouse gas emissions

There is the Midwestern Greenhouse Gas Reduction Accord that has seven midwestern member states, and there is the Western Climate Initiative (WCI) that has seven U.S. states and four Canadian provinces as members. In general, each state or province that is a member of these regional organizations has some type of greenhouse gas program or initiative underway.

Of particular relevance is the greenhouse gas cap-and-trade plan released in draft form by California in November of 2009. State law requires California to cut its carbon dioxide and other greenhouse gas emissions to 1990 levels by 2020. Measures will range from clean vehicle and building rules to the cap-and-trade system that lets factories and power companies trade credits.

It has been noted that residential heating fuel suppliers could be included in the first cap-and-trade phase, which had been originally expected to focus on big pollution sources such as power plants and refineries. The proposed California plan has received considerable attention as California's environmental programs are often considered trend setters.

Meteorological Organization, American Quaternary Association, International Union for Quaternary Research, American Association of Wildlife Veterinarians, American Society for Microbiology, Australian Coral Reef Society, Institute of Biology, Society of American Foresters, The Wildlife Society, American Academy of Pediatrics, American College of Preventive Medicine, American Medical Association, American Public Health Association, Australian Medical Association, American College of Preventive Medicine,

American Medical Association, Australian Medical Association, World Federation of Public Health Associations, World Health Organization, Engineers Australia, International Association of Great Lakes Research.

The Hearth, Patio & Barbecue Association is not on the list. Greenhouse gas initiatives that could affect the hearth industry will go forward anyway.

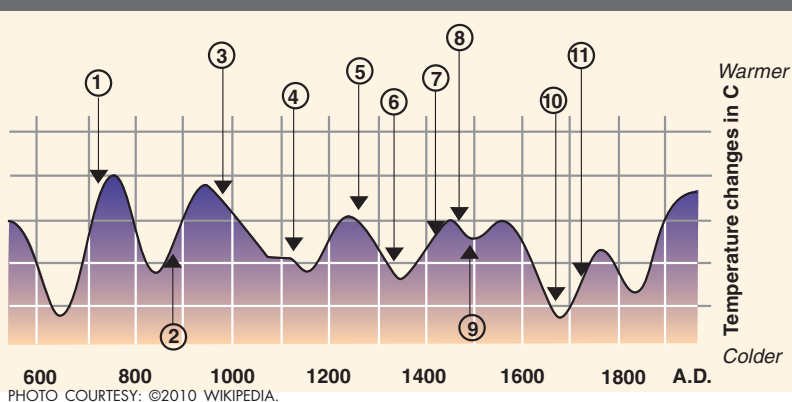
There is nothing wrong with being a skeptic. Norsemen settled Greenland in the late 10th century during the “Medieval Climate Optimum” and cut down forests



Norse ruins at Igaliku, Greenland.

PHOTO COURTESY: ©2010 GREENLAND.COM.

Changes in Temperature in Greenland from 500-1990 A.D.



A graphical description of changes in temperature in Greenland from 500 – 1990 A.D. based on analysis of the deep ice core from Greenland and some historical events. The annual temperature changes are shown vertical in °C. The numbers are to be read horizontally:

1. From 700 to 750 A.D. people belonging to the Late Dorset Culture move into the area around Smith Sound, Ellesmere Island and Greenland north of Thule.
2. Norse settlement of Iceland starts in the second half of the 9th century.
3. Norse settlement of Greenland starts just before the year 1000.
4. Thule Inuits move into northern Greenland in the 12th century.
5. Late Dorset culture disappears from Greenland in the second half of the 13th century.
6. The Western Settlement disappears in mid 14th century.
7. In 1408 the Marriage in Hvalsey is the last known written document on the Norse in Greenland.
8. The Eastern Settlement disappears in mid 15th century.
9. John Cabot is the first European in the post-Norse era to visit Labrador - Newfoundland in 1497.
10. “Little Ice Age” from ca 1600 to mid 18th century.
11. The Danish-Norwegian priest, Hans Egede, arrives in Greenland in 1721.

for fuel and lumber. The Norsemen and the birch forests are gone due to the “Little Ice Age.” No man-made, coal-fired power plants were involved in the creation of the Climate Optimum.

Precedents Have Been Set

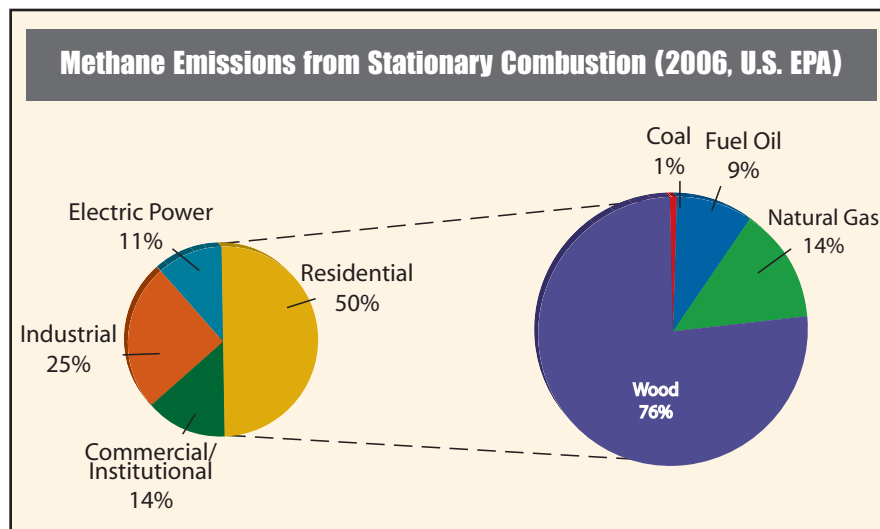
The hearth industry has successfully conducted many wood stove change-out programs across the country for the purpose of improving local air quality. Replacement of old, inefficient units with newer, cleaner and more efficient units has been the name of the game.

Recently, and notably, was the change-out program conducted in Libby, Montana, where PM_{2.5} levels were clearly documented to have been reduced. It does not take too much imagination to envision similar programs where greenhouse emissions are reduced with more efficient units or where fossil fuels are replaced by biogenic fuels (wood, corn, agricultural residues) producing greenhouse gas benefits.

Important lessons in logistics, management and cooperation between the hearth industry, the community and the government that would be applicable to carbon trading have been learned and will not have to be reinvented; they offer credibility to this strategy.

A specific small but relevant case study is the Three Mountain Power Project located in the Burney Valley of northern California. The particulate (PM₁₀) emissions from a 500 MW gas turbine power plant were in part offset by the replacement of older wood stoves with new, low-emission, EPA-certified wood stoves. Again it does not take too much imagination to envision how similar programs could fit into future carbon-trading schemes.

Among stationary combustion sources, residential combustion represents half of



the total methane emissions. Of that 50 percent, wood combustion represents 76 percent. Methane is a greenhouse gas considered 25 times more potent than carbon dioxide. New-technology heating units and fuels that reduce methane emissions could offer a considerable carbon credit.

Testing

There are no protocols currently in place specifically designed to show the carbon benefits of hearth products for capitalizing on possible future carbon trading opportunities. With what may be looming in the future, the documentation of efficiency (i.e., less fuel use with concomitantly less greenhouse gas emissions) and the direct measurement of relevant greenhouse air emissions seemingly would be prudent for any new hearth product. There have been a number of standard methods developed under other agenda that provide credible documentation to support carbon credit claims.

- Efficiency of Residential Central Furnaces and Boilers – DOE 10 CFR Pt. 430, Subpt. B App. N
- Efficiency of Vented Home Heating Equipment – DOE 10 CFR Pt. 430, Subpt. B App. O
- Efficiency of Vented Gas Fireplace Heaters – CSA P.4.1-09
- Efficiency of Residential Wood-Fired Appliances – CAN/CSA B415
- Efficiency of Cook Stoves – WBT version 1.5, Shell Foundation/VITA 1985
- Partitioning of Biogenic and Fossil CO₂ Emissions – ASTM D7459-08/ASTM D6866

- Black Carbon Emissions – ASTM D 6877-03/NIOSH 5040
- Methane Emissions – EPA TO-15
- Carbon Content of Solid Fuels – ASTM D-5373

Green Now, Proactively Green for the Future

Documentation of greenhouse gas emission reductions of new technologies serves to support green marketing claims now and creates awareness for their application for future carbon credits. To paraphrase Merrill Lynch, “(Green documentation and credits may be valuable to) companies in the Americas, Asia and Europe that are looking for financial opportunities and to enhance their brand in light of growing concerns about climate change. This includes companies that are in precompliance mode before a cap-and-trade system begins in consumer-facing sectors. (Many of these sectors) will likely not be directly affected by carbon constraints but are affected by consumer pressures in regions that may not face a carbon cap for several years. (In addition they may) wish to offset emissions as part of a broader corporate social responsibility strategy.”

About the authors: James E. Houck, Ph.D., is president of OMNI Environmental Services. Paul Tiegs, P.E., is president of OMNI-Test Laboratories. They can be reached at (503) 643-3788, houck@omnittest.com and paultiegs@omni-test.com. Visit OMNI's Web sites at www.omni-environmental.com and www.omni-test.com for technical publications and services. 🏠