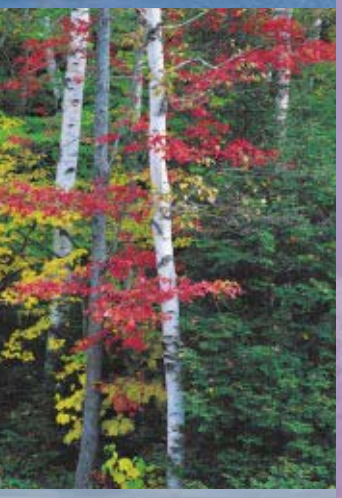

Climate Change Roadmap for Connecticut

Economic and Environmental Opportunities

Part II: Strategies

Environment Northeast
Hartford, CT • Rockport, ME

Funding provided by the Emily Hall Tremaine Foundation

ABOUT US

Environment Northeast (ENE) is a not-for-profit, membership supported environmental research and advocacy organization focusing on the northeastern United States and eastern Canada. Our mission is to address large-scale environmental problems through policy analysis, collaborative problem solving efforts, and an advocacy program that promotes environmental sustainability. Our staff has professional backgrounds in the areas of environmental law, energy policy, climate change, ecosystem planning and forestry.

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TABLE OF CONTENTS

STRATEGY GROUP I: CREATE NEW PRIVATE SECTOR AND GOVERNMENT INSTITUTIONS

Measure I-1: Greenhouse Gas (GHG) Credit Trading

GOAL

Initiate and/or participate in a GHG credit trading system.

DESCRIPTION

A system for GHG credit trading (also called "emission reduction trading" or "cap and trade") offers the potential for large reductions in GHGs. A credit represents an amount of emissions (e.g., one ton of CO_2) that has been successfully reduced. Every year, participants individually find the most cost-effective way to reduce emissions. For every ton of emissions reductions that exceeds their annual target, they can trade (sell) the credit to another participant who has fallen short of its target.

In this way participants are given flexibility to determine what reductions work best for them, and they receive (or pay) a market-based financial incentive depending on their success in meeting the targets. In the aggregate, gradual but significant reductions can be achieved among the participants.

A trading system could take various forms. Ideally, the system may eventually operate on a national or larger basis. In the long-term, a credit trading system may also comprise mandatory caps on GHG emissions and economy-wide participation.

In the short-term, a voluntary system could be joined or created. In a voluntary GHG credit trading system, interested parties agree to establish a baseline of GHG emission levels (typically their own emission level during a previous period of time), and then commit to reduce their emissions by a fixed amount over time (e.g., 1% per year).

Large energy users and industrial emitters of global warming emissions should develop a baseline inventory of the annual emissions associated with their operations.

One such system is the Chicago Climate Exchange (CCX). The Chicago Climate Exchange project is a voluntary, business-driven pilot project intended to help participants get familiar with accounting for their annual GHG emissions and trading GHG credits. The concept and mechanisms of this system are based on the programs established by the U.S. EPA for trading sulfur and NOx credits. The National Association of Securities Dealers (NASD) was recently chosen to provide regulatory oversight services to CCX.

Initial GHG emissions reduction targets for CCX participants are 1%/year for a four year period. Trading of reductions in all six "Kyoto" greenhouse gases will be supported. In addition to direct "in house" reductions in GHG emissions, qualifying reduction projects will include renewable energy, energy efficiency improvements, terrestrial carbon sink expansion or protection, landfill methane recovery and vehicle fleet fuel efficiency improvements.

Candidates for participation in Connecticut include:

- Companies
- State government
- Major cities
- Universities and independent secondary schools, and
- In-state terrestrial sink providers.

Two major forest products companies with connections to Connecticut, International Paper and MeadWestvaco, are among the companies already working with CCX.

Connecticut could work with other northeastern states and within existing regional entities such as New England Governors' Conference to develop a regional plan for forming or joining a trading system. A viable system would need to address a range of issues such as agricultural waste management and increased agricultural soil carbon resulting from changes in farming practices; increased storage of carbon in forest vegetation and soil resulting from improved forest management practices; industrial process changes that reduce or eliminate GHG; methane capture; and CO_2 capture from natural gas power plants.

REDUCED EMISSIONS

This measure could start immediately impacting all recognized types of GHGs, and could later be expanded to other global warming emissions as the necessary research to support their inclusion becomes available.

Initial reductions from any voluntary system would be small. For example, the initial CCX emissions reduction commitments are modest and early Connecticut participants would be associated with only a small fraction of current Connecticut GHG emissions.

However, if participation were scaled up over time (decades), both by continually expanding participation and by increasing reduction targets, reductions could be very large. Even the modest CCX reduction targets of 1% per year would produce significant reductions if maintained over a long period of time.

Efficient GHG credit trading systems appear essential to achieving our long-term emissions reduction goals. Introducing broad and effective GHG trading is a "critical path" task to meeting Connecticut's 2050 GHG emissions targets.

IMPLEMENTATION "NEXT STEPS"

A good starting place for large energy users and emitters is to develop a baseline inventory of their annual global warming emissions. Numerous private sector service companies can help with this task and are complemented by a range of non-profit programs and accounting tools aimed at helping develop such an inventory.

Promoting participation in a program such as the Chicago Climate Exchange can lead to real reductions and is a good learning and organizing opportunity. It also provides an immediate, reasonable "ask" for both emitters and energy users (government entities, college campuses, and "green" businesses) as well as GHG reduction providers (terrestrial sink providers).

This action would also provide a readily understandable opportunity for media coverage of greenhouse gas emissions reduction trading in Connecticut. Specific steps that would get this measure off the ground include:

1. Gather specific information on CCX, including the precise process for "joining" CCX and the date when new participants can "bid-in" emissions reduction projects;
2. Develop a list of Connecticut programs, associations and individual contacts that may have role to play in a GHG credit trading system;
3. Identify and work with likely initial prospects for CCX participation;
4. Start completing baseline emission inventories using the CCX methodology or similar accounting tools.

Additional research

- Explore the details and prospects for working with other potential voluntary GHG reduction systems already in operation or under development for potential expansion in Connecticut. Review such regimes as the Partnership for Climate Action established by Environmental Defense and a group of large companies with substantial GHG emissions;
- Outline potential regional trading system that could develop; and,
- Identify and review various GHG accounting tools, such as that developed by the World Resources Institute (WRI), for establishing GHG emission baseline inventories.

References

- Environment Northeast, "Protecting Our Biosphere" at 9 (May 2003) – www.env-ne.org.
- Chicago Climate Exchange – www.chicagoclimateexchange.com.
- UK Emissions Trading Scheme – www.defra.gov.uk/environment/climatechange/trading/index.htm
- Denmark's CO_2 Cap and Trade law – www.ens.dk/sw1084.asp.
- Environmental Resources Trust GHG registry project – www.ert.net/ghg.
- Registry project of the Northeast States for Coordinated Air Use Management (NESCAUM) – www.nescaum.org/Greenhouse/Registry.
- Greenhouse Gas Protocol Initiative is a registry and accounting tool offered by the World Resources Institute and the World Business Council for Sustainable Development – www.ghgprotocol.org.
- California Climate Action Registry where you can access the Climate Action Registry Reporting Online Tool (CARROT) – www.climateregistry.org.

STRATEGY GROUP I: CREATE NEW PRIVATE SECTOR AND GOVERNMENT INSTITUTIONS

Measure I-2: Public GHG Purchase Program

GOAL

Establish a public program to purchase greenhouse gas (GHG) reductions.

DESCRIPTION

A public greenhouse gas reduction purchase program would buy GHG credits through an auction. Eligible reductions could initially be limited to those occurring within Connecticut or some other appropriate geographic region like New England.

A useful program could probably be launched for as little as $1 million per year. An initial target might thus be to begin the program at $1 million per year and add an additional million dollars each year for a ten-year period. Funding could come from a set of fossil-fuel taxes reflecting fuel carbon content (these would be "mini" carbon taxes). Initial funding could also come from sources such as the Clean Energy Fund.

Connecticut's existing sales taxes on motor fuels (gasoline and diesel fuel) and natural gas produced about $458 million in FY 2000–2001 revenues. An initial GHG reduction purchase program starting at $1 million per year and rising to $10 million per year by 2013 would be an incremental tax burden initially of 0.2% of existing fuel tax revenues rising to about 2% in 2013. Connecticut does not appear to currently tax sales of coal or of residual oil used by stationary sources (power plants, industrial and commercial boilers, etc.).

An analogous program to the one we propose here is currently used by the State of Georgia in its effort to reduce water consumption during drought. Georgia pays farmers to forego rights to water that these farmers would normally use for irrigation. The funds are paid to those farmers who offer to reduce their water consumption for the least cost.

The initial phase of a public GHG purchase program in Connecticut should focus on establishing the necessary institutions, including the annual reduction purchase auction, supplemental taxes to fund reduction purchases and rules for qualifying reductions. Subsequent activity could focus on increasing the financial commitment to purchasing reductions and refining auction processes.

REDUCED EMISSIONS

At the outset, carbon dioxide and other GHGs could be reduced under this program. The program could be eventually expanded to include additional pollutants as the necessary research to support their inclusion is completed. The initial program could also include incentives for expanding terrestrial carbon sinks.

GHG reductions purchased would small at first, to facilitate getting this program in place. But the purchases could be significant with even a modest investment. For example, assuming mid-range prices (of $11 to $21 per metric ton of carbon) for reductions in this year's carbon emissions reduction programs in Denmark and the U.K. and a funding level of $10 million, this program would initially produce between 47,600 to 90,900 tons of carbon-equivalent reductions (or about 0.05 to 0.09 MMTC).

Annual GHG reductions resulting from a range of plausible future funding commitments, using current GHG reduction prices, are shown in the table below.

GHG Reduction Estimates at Different Funding Levels
(millions of metric tons of carbon equivalent)

Funding Level	Low Reductions	High Reductions
$1,000,000	0.05	0.09
$10,000,000	0.50	0.90
$50,000,000	2.40	4.50
$100,000,000	4.80	9.00

As shown above, reductions purchased through this mechanism could be progressively and substantially ramped up over time to very significant levels. In addition, the increase in fuels tax based on carbon content would begin to impact purchase and investment decisions if these taxes could be increased over time to serious levels.

These reduction figures may be optimistic, as GHG reduction prices may increase from current levels over time as global demand for purchasing such reductions increases.

A $100,000,000 per year program (representing less than one quarter of current fuels taxes) could conceivably produce 9 MMTC/year of net reductions (about 80% of current Connecticut carbon emissions). This would constitute a very large contribution to meeting Connecticut 2050 GHG emissions targets.

Economically efficient mechanisms like carbon taxes and GHG credit trading systems appear essential to achieving our long-term emissions reduction goals in an affordable fashion. This measure institutionalizes both concepts (along with the GHG credit trading measure), which are "critical path" tasks for achieving the 2050 emissions reduction targets.

IMPLEMENTATION "NEXT STEPS"

1. Outline complete tax package and associated revenues to raise funds for purchase;
2. Develop a model act, and research on precedent and function of analogous programs such as those in the UK, Denmark, Georgia and other reduction programs.
3. Develop a fact sheet and outreach program explaining this concept to solicit feedback on the concept from key policymakers and stakeholders; and,
4. Explore statutory changes needed to allow state agencies to implement the program.

This measure is an excellent organizing tool. It provides a vehicle for reaching out and engaging a wide range of interests (community groups, religious organizations, large emitters, etc.) and focusing attention on an action that is critical to achieving large, long-term reductions. It is designed to be initiated at funding levels that should be feasible to enact. Once enacted, it then becomes a focal point for such interests to advocate for "ratcheting up" Connecticut's commitment to climate action over time.

Additional research

- Identify current consumption levels of all fossil fuels in Connecticut;
- Convert these consumption levels to their carbon equivalent; and,
- Calculate a tax rate for each fuel that reflects sales volume, carbon content and target revenue (initially $1,000,000 per year).

References

- The rationale for government purchase of GHG reductions as a public good has been well developed by the Carbon Management Initiative program (www.princeton.edu/~cmi/) at Princeton's Center for Energy and Environmental Studies. Key documents describing this approach include:
  - David F. Bradford, "A No Cap But Trade Approach to Greenhouse Gas Control," October 13, 2001, and
  - David F. Bradford and Klaus Keller, "Carbon Dioxide Sequestration: How Much, When, and Who Should Pay?" January 15, 2002.
- A recent Pew Climate Center Report, "The Emerging International Greenhouse Gas Market," prepared by Richard Rosenzweig and Josef Janssen (available at www.pewclimatecenter.org) provides a survey of emerging GHG trading systems and documents about the emerging GHG credit price information used in estimating the amount of GHG reductions that might occur from this measure.
- Introduction to the United Kingdom's Climate Change Levy – www.defra.gov.uk/environment/ccl/intro.htm.
- Georgia's Department of Environmental Protection Division of the Department of Natural Resources, www.dnr.state.ga.us/environ/ and the Georgia Environmental Facilities Authority www.gefa.org.
- The Climate Trust in Oregon – www.climatetrust.org.

STRATEGY GROUP I: CREATE NEW PRIVATE SECTOR AND GOVERNMENT INSTITUTIONS

Measure I-3: Comprehensive Clean Air Initiative

GOAL

Establish a comprehensive Connecticut clean air initiative to address complex interactions among many air pollutants and integrate climate benefits into the process of setting pollution reduction targets.

DESCRIPTION

Clean air regulation today in Connecticut is largely driven by the structure of the federal Clean Air Act that tends to focus on a series of actions over time addressing individual pollutants.

Recently emerging science is finding that:

- Many air pollutants interact with each other in the atmosphere and these interactions can impact pollution levels. Attaining clean air goals will require planning reductions across many pollutants in a fashion that reflects their interactions, rather than focusing on "one at a time;" and
- Nearly all air pollution impacts regional and global climate.

Because of the complex interactions among pollutants, the climate benefits of reducing conventional air pollution could vary greatly depending on how reductions occur across methane and all of the reactive gases. To optimize climate "co-benefits" of a clean air strategy, pollutant interactions and net climate impacts of alternative approaches to reducing conventional pollution need to be considered.

The immediate public health and environmental benefits of reducing conventional pollutants that contribute to global warming are generally large enough to drive significant near-term reductions. The rationale for large, near-term reductions can be further enhanced by considering associated climate benefits.

The federal Clean Air Act allows climate benefits to be formally considered in setting secondary national air quality standards as well as many air regulations.

Thus, a comprehensive Connecticut clean air initiative should be established that addresses the complex interactions among many air pollutants and integrates climate benefits into the process of setting pollution reduction targets. Such a process would be instrumental to cleaning up Connecticut's unhealthy air, could produce significant climate benefits and could also serve as a model for other states and EPA.

Some potential climate co-benefits of conventional pollution reduction may not be realized unless an integrated planning process is established.

REDUCED EMISSIONS

All climate forcing air pollutants (in addition to CO_2) that contribute to global warming would be impacted by this measure. These include black carbon aerosols, methane (which is also a potent greenhouse gas) and several reactive gases—nitrogen oxides (NOx), volatile organic compounds (VOCs) and carbon monoxide (CO).

Near-term (10–20 year) reductions in positive climate forcing (warming) could be large. Estimated "100 year" CO_2 equivalent of proposed reductions in diesel black carbon emissions in Connecticut would alone be 0.9–1.5 MMTC/year. A comprehensive clean air program addressing ozone, methane and reactive gases could clearly deliver larger reductions.

The immediate cooling resulting from these near-term reductions could also be large relative to that achievable from plausible near-term CO_2 reductions, due to the relatively immediate climate response to reductions in black carbon, ozone and methane. This is explained further in measure M-1 Diesel Emissions where we estimate impacts of reducing black carbon emissions from mobile diesel engines in Connecticut. Atmospheric modeling is probably necessary to develop estimates of climate benefits associated with other air pollutants and to assess how such benefits might vary among alternative reduction strategies.

IMPLEMENTATION "NEXT STEPS"

1. Meet with state environmental regulators to discuss this concept.
2. Facilitate state support for the necessary research and analysis to design a comprehensive clean air strategy for CT.
3. Organize broad support for developing and implementing a comprehensive clean air strategy for CT, with emphasis on those who would benefit greatly from associated reductions in air-pollution driven death and disease.

Additional Research

- Review legal authority, under both the federal Clean Air Act and current state law, to require reductions in all non-CO_2 air pollutants that directly or indirectly (through atmospheric chemical and physical interactions) impact climate;
- Develop the capability to design comprehensive strategies to reduce emissions of all non-CO_2 air pollutants that directly or indirectly (through atmospheric chemical and physical interactions) impact climate in a manner that maximizes climate benefits; and,
- Develop analysis tools for applying such an "optimal" climate strategy to design a fully comprehensive clean air strategy for CT and to fully document all public health and environmental benefits that would flow from such a program.

References

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STRATEGY GROUP I: CREATE NEW PRIVATE SECTOR AND GOVERNMENT INSTITUTIONS

Measure I-4: Hydrogen Infrastructure Development

GOAL

Identify and implement near-term actions that would facilitate a transition to the use of hydrogen fuel for mobility, building energy and power production by 2050–60.

DESCRIPTION

The potential for the use of hydrogen as a fuel for transportation and stationary power sources to reduce greenhouse gas emissions is very large. To reduce Connecticut carbon dioxide emissions 75% by 2050–60, the mobility system in Connecticut must be fully transitioned to hydrogen fuel that is produced from sources with little or no carbon emissions. There appears today to be no other practical path for transportation systems—aside from possibly total electrification using low/no carbon electricity—that can reduce carbon emissions sufficiently, while providing our necessary transportation services. (Note that Arthur Weiss, MIT Energy Lab, has indicated that electric vehicles might provide an alternative to hydrogen fuel but would require significant breakthroughs in battery technology capability that cannot be assumed.)

To meet the 2050–60 emissions target, considerable use of hydrogen to provide building energy and to produce electric power may also be essential.

Hydrogen is already in large-scale industrial use and many elements of potential hydrogen use in vehicles are being demonstrated in Europe and the U.S. Production of hydrogen from fossil feed stocks is a mature commercial technology, although the means for storing and distributing the fuel are not.

While hydrogen can be used to fire internal combustion engines, fuel cells appear to be the most efficient potential hydrogen power conversion technology for mobility and other applications.

Hydrogen can be produced using zero-emissions renewable energy. At present, these methods are not economic and produce only limited quantities of the fuel. Advanced fossil energy systems—ultimately with carbon capture and geologic sequestration—are likely to be the most economic initial source of the large volumes of hydrogen necessary to support this transition.

Both industry and the U.S. Department of Energy (DOE) are beginning to outline how this transition could occur. DOE's preliminary views on what is necessary to facilitate this transition are presented in the National Hydrogen Energy Roadmap (see reference, below). There are important technical barriers facing the transition to hydrogen as a primary fuel—and to systems that would produce hydrogen in a climate friendly manner. Nonetheless, the potential benefit is so large that Connecticut should start now to implement a well thought through approach to hydrogen research and development.

As a preliminary step, Connecticut should identify the actions of a comprehensive Hydrogen Economy Research and Demonstration program. This program should start by outlining near term actions that we can take today to pave the way for a long term transition to use of hydrogen fuel. Such actions could include:

- Demonstrate the practicality and safety of key hydrogen mobility system components (for example, fuel cell vehicles using hydrogen fuel, vehicle fueling stations, local hydrogen production at fueling stations, etc.);
- Demonstrate co-production of hydrogen for local mobility use at an advanced fossil (or biomass) gasification power system in Connecticut, ideally in combination with carbon capture and sequestration;
- Facilitate development of the necessary safety codes;
- Conduct targeted public education on hydrogen safety, etc.;
- Facilitate commercialization of key technologies, for example, vehicle-scale fuel cells or improved on-vehicle hydrogen fuel storage systems;
- Identify potential funding sources for priority actions.

In addition to this R&D program, we think it is critical that Connecticut continue to support the commercialization of products that convert hydrogen to useful energy forms or services. Notable among immediate opportunities in the state is the further development of fuel cells, whether for stationary, portable or mobility applications. Statewide programs to develop markets for these emerging products will contribute to success of a timely transition to hydrogen-based energy systems. (See also our reference to the potential for combined heat and power systems in Measure E-2.)

REDUCED EMISSIONS

This measure would principally reduce carbon dioxide emissions. Where natural gas fuel use is displaced (such as where vehicles using CNG fuel are switched to hydrogen), the measure will also reduce methane emissions.

The long-term carbon emissions reduction potential of this measure is very large: ranging from 7.8 to 13.2 MMTC, or more than half of the required total reductions needed for the state to reach its climate stabilization target. This measure is the single largest and probably most important carbon emissions reduction opportunity that can be pursued in Connecticut.

Connecticut's 2050–60 carbon emissions targets probably cannot be met without nearly complete transition to use of hydrogen as a mobility fuel and considerable use of hydrogen to produce electric power and building energy.

IMPLEMENTATION "NEXT STEPS"

1. Organize an advisory committee of Connecticut businesses associated with hydrogen production and use;
2. Develop a Connecticut "game plan" for useful near-term actions working with the advisory committee and with input from recent DOE and other infrastructure needs analyses; and,
3. Identify or organize a facilitating/coordinating entity (possibly a Connecticut industrial council on hydrogen fuels that might evolve out of the advisory committee), to help implement the Connecticut "game plan."

Several Connecticut companies are technology leaders in key areas related to hydrogen mobility fuel use. These include HydrogenSource, United Technologies, Proton Energy Systems, and Fuel Cell Energy.

Additional research

- Identify potential demonstration project funding sources; and,
- Review existing relevant safety codes, the status of codes under development, and assess potential barriers to development of a hydrogen infrastructure.

References

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STRATEGY GROUP I: CREATE NEW PRIVATE SECTOR AND GOVERNMENT INSTITUTIONS

Measure I-5: Climate Friendly Procurement

GOAL

Maximize the impact of consumer "willingness to pay" strategies for procurement of lower-emissions products.

DESCRIPTION

Several Roadmap measures (see list below) advocate that consumers (individuals, institutions, government entities, private businesses) purchase specific services or products like green power and high fuel-efficiency vehicles that are typically more expensive than the purchases that would otherwise be made.

Such purchases can have:

- Direct emissions reduction effects, resulting from specific purchases; and
- Indirect effects by expanding and advancing the commercial market for such products and services (market transformation). For example, the "Golden Carrot" high-efficiency refrigerator project conducted in the early 1990s used a small fraction of state energy efficiency funding to "pull" a previously unavailable, very high efficiency refrigerator into the market. This program had much broader and longer term efficiency benefits than providing consumer incentives to purchase the most efficient refrigerators then available.

These purchases rely upon willingness to pay extra for products and services that benefit climate by any of these consumer groups. This willingness to pay is limited, however, and the fact is that some purchases would produce larger climate benefits than others. It would be useful to develop a strategic plan to optimize the ability to use this "willingness to pay" to benefit climate. Such a plan could also help make the climate friendly procurement advocacy process more effective by developing standard purchase "asks."

Preparing such a plan would require the following:

- Identify all potentially beneficial purchase categories and estimate their benefits;
- Identify purchases that can change market offerings by bringing otherwise unavailable products or services into the market (market transformation), as opposed to those that increase the purchase volume of already available products;
- Estimate the potential willingness to pay of different consumer groups;
- Identify opportunities to streamline the process of advocating for climate friendly purchases (for example, do opportunities exist to market to central purchasing organizations for certain classes of government entities?);
- Identify the full range of NGOs who might participate in a long-term, strategic "climate friendly" purchasing campaign and the specific advantages each might have in marketing to certain consumer groups; and,
- Rank purchasing options so that those with the greatest long-term benefits can become a marketing priority.

While developing such a plan would be a considerable challenge, the ability to optimize the process of climate friendly purchasing could significantly increase resulting benefits and create marketing and other efficiencies.

This action contemplates and would be the basis for a coordinated campaign to identify the full range of products and services that would help meet long-term Connecticut climate-related emissions reduction targets and explore an efficient, coordinated process for advocating such purchases.

REDUCED EMISSIONS

This measure would impact all global warming emissions. The magnitude of the impact could be large if consumer "willingness to pay" could be maximized and focused on those products and services with the best prospects of expanding markets and delivering long term reductions.

Broad, coordinated procurement of products and services that reduce greenhouse gas emissions could help expand markets for such products and services. If such market expansion occurs, resulting long-term emissions reductions could be significant.

IMPLEMENTATION "NEXT STEPS"

1. Develop detailed scope for strategic plan with marketing assistance;
2. Secure resources to support the planning process;
3. Develop a strategic plan; and,
4. Design and implement an advocacy campaign for climate friendly procurement.

Developing a coordinated, ongoing strategic campaign for consumer purchasing of climate friendly products and services could be the focal point for organizing a wide range of NGOs and other potential interests.

Additional research

See referenced strategies.

References

Referenced strategies include: reducing light vehicle emissions; energy efficiency standards and energy building codes; green power purchases; use of distributed generation.

STRATEGY GROUP II: MODERNIZE OUR ELECTRICITY AND ENERGY SYSTEMS

Measure E-1: Retire Coal and Oil Power Plants by 2020

GOAL

Eliminate the emissions from oil and coal power plants by 2020.

DESCRIPTION

Oil and coal-fired power plants in Connecticut emitted about 9.4 million tons of CO_2 (2.34 million metric tons of carbon) in 2001. These plants also emit heavy metals and other detrimental air pollutants. Many of these plants are located in urban areas with a high incidence of childhood health problems such as asthma.

These plants include two coal plants—Bridgeport Harbor 3 and AES Thames—and six oil plants at Devon, Montville, Norwalk Harbor, Middletown, and New Haven Harbor. The two coal plants emitted about 1 MMTC, or 43% of the total carbon emissions from oil and coal units combined.

The six older oil units will likely be retired within the coming decade given their economics. Energy from these plants would likely be replaced by power from new, efficient, combined cycle natural gas plants (CCNG). The two coal plants might operate for much longer, however. AES Thames is a relatively new power plant. The current owners of Bridgeport Harbor are planning to install flue gas de-sulfurization controls ("SO_2 scrubbers"), at considerable cost, to meet the recently enacted Connecticut sulfur dioxide emissions limits.

None of these eight plants use technology that is economically compatible with capturing carbon in their flue gases for geologic sequestration. Together their carbon emissions represent 83% of the 2050 carbon emissions targets from all sources in Connecticut. Connecticut cannot meet long term emissions levels if these plants operate over a 50-year life. These plants must be eventually retired and their electricity replaced from generation producing much less carbon to meet the 2050 emissions target.

Actions to facilitate the replacement of these plants could include:

- Ensuring that these plants are subjected to market competition and that any unfair obstacles or subsidies they currently enjoy be removed. In this regard, a review of current ratemaking policies should be conducted to determine if there are obsolete subsidies or incentives that support uneconomic operation of the plants. Environmental standards can also act to subsidize power plants unfairly. For example, it is unclear if the combustion wastes from these units are being managed in an environmentally sound fashion. Massachusetts is considering a bill to eliminate the loophole that allows coal plant waste to be treated as unregulated fill and to instead classify it as a "solid waste." The financial impacts on plant operation and competitiveness if such updated practices were required could be substantial. As another example, consider establishing more refined and geographically desegregated transmission congestion pricing within Connecticut.
- Exploring financial incentives for replacing the two coal plants that could be provided in the 2010–2020 time frame if market forces alone appear unlikely to retire these units.
- Exploring regulatory or statutory options to facilitate timely replacement of the coal plants, including the potential for a public grassroots campaign to raise awareness around legislation.

REDUCED EMISSIONS

Oil and coal-fired power plants in Connecticut emitted about 2.34 million metric tons of carbon in 2001.

Replacing the electricity produced by these plants with electricity from new, efficient natural gas plants (the most carbon-intensive option) would still reduce Connecticut's carbon emissions about 60%, or 1.35 MMTC/year. If the energy from these plants were to be replaced entirely with "no-carbon" renewables, Connecticut carbon emissions would be reduced by about 2.34 MMTC/year.

Connecticut's long-term CO_2 emissions target cannot be met if these plants are not phased out well before 2050 and their energy replaced with sources producing much less carbon.

IMPLEMENTATION "NEXT STEPS"

1. Identify any obstacles to cleaner generation that impairs fair competition with these dirtier oil and coal plants;
2. Where such obstacles are found to exist, identify appropriate remedies; and,
3. Organize stakeholder advocacy campaigns.

This measure would benefit from significant stakeholder involvement, including especially representatives of the health, environmental justice and community organizations as well as the impacted municipal governments and the workers employed at these plants. Organizing steps that should be considered include:

- Undertake economic assessment of the useful life of these plants;
- Approach power plant owners to discuss the plants' retirement target date. Issues such as the appropriate phase-out period and the counting of marketable credits for reductions achieved ahead of schedule should be addressed. Retirement before 2020 could be negotiated;
- Present elected officials representing the affected towns with estimates of the economic impacts of shutting down the plants, opportunities for redeveloping the plant sites, and the air quality benefits of reduced nitrogen oxides and sulfur dioxide emissions that will accompany reduced CO_2 emissions; and,
- Contact health-based and community organizations operating in proximity to the affected plants so they are empowered to communicate the relevant information to their elected officials and the media.

Additional research

- Determine if any of these units are unfairly benefiting from current transmission congestion pricing.
- Identify existing tax structure for coal and oil in Connecticut;
- Determine current procedures for managing combustion wastes from these plants, with particular attention to coal plant combustion wastes. Research potential environmental contamination problems associated with current combustion waste management practices and disposal sites;
- Determine current water use and wastewater discharge practices at the two coal plants and identify any environmental, health or water use conflicts associated with such current practices, to include the use of toxic substances in power plant cooling systems and resulting environmental or health impacts;
- Determine the useful economic life of existing coal and oil power plants;
- Estimate the economic costs from retiring these plants by 2020 in terms of lost tax revenue, jobs, local power supply; and,
- Estimate the economic benefits from retiring these plants by 2020 in terms of new development opportunities for the plant sites, avoided health costs associated with NOx and PM emissions, other avoided environmental impacts (e.g., from coal waste, water pollution), additional development afforded by new headroom in regional NOx and PM emission budgets, marketable CO_2 reduction credits.

References

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- Clean Air Task Force and the Land and Water Fund of the Rockies, "The Last Straw, Water Use by Power Plants in the Arid West," at www.catf.us.

STRATEGY GROUP II: MODERNIZE OUR ELECTRICITY AND ENERGY SYSTEMS

Measure E-2: Maintain and Expand Energy Efficiency

GOAL

Increase energy efficiency in the use of electricity, natural gas and oil.

DESCRIPTION

Improving the efficiency of energy use in Connecticut will reduce electricity, natural gas and oil consumption and the GHG emissions that would have been associated with the amount of avoided energy.

Energy Efficiency

Electrical efficiency can be improved in Connecticut through a wide range of actions. Key opportunities include the following:

- Maintain funding for the conservation and load management (C&LM) programs;
- Explore opportunities to focus C&LM investment in programs and measures that maximize long-term reduction of carbon emissions (for example in long-lived measures like shell efficiency and day-lighting for buildings;
- Explore opportunities to facilitate commercialization of energy efficiency investments with emphasis on opportunities that could be facilitated by the Energy Conservation Management Board (ECMB);
- Enact state electrical appliance and equipment efficiency standards;
- Facilitate state support for aggressive federal appliance and equipment standards;
- Periodically update Connecticut building energy efficiency codes; and,
- Explore opportunities to facilitate development of economic, clean combined heat and power (CHP) projects.

In particular, state standards for products should be updated to reflect new commercially viable technologies that consume less energy. By 2020, new appliance standards would avoid upwards of 800 MW of new plant capacity needs and avoid 350,000 metric tons of GHG.

Connecticut can adopt standards for products that are not regulated by federal law. These include products such as traffic signals, exit signs, ceiling fans, commercial refrigerators and torchiere lights.

Oil and Natural Gas Conservation

Energy efficiency investment programs for natural gas equipment and buildings heated with natural gas or heating oil should be established.

Current Connecticut "public benefits" energy efficiency investment programs are funded through electricity distribution charges and do not fund programs that improve the energy efficiency of natural gas or heating oil consumption.

This action would establish new programs that would improve the efficiency of natural gas and heating oil use in Connecticut. These programs would:

- Focus on buildings with natural gas service or that use heating oil for space and water heating; and,
- Focus on new construction and building renovation, as well as long-lived equipment (furnaces, for example) that operate on natural gas.

Building Energy Codes

State building energy codes have significant impact on long-term energy consumption (both thermal and electrical) as they address many aspects of building construction that can potentially save energy over long periods of time (for example, building shell thermal efficiency and day-lighting). Standard new building construction practice can be "raised" over time as new technology enters the market and—in Connecticut—as public energy efficiency investment programs provide financial incentives for capturing efficiency beyond "standard practice."

The Connecticut building energy codes should be periodically upgraded to capture the advances in "standard practice" resulting from ECMB and other public energy efficiency programs, which in turn allows ECMB new building efficiency programs to continuously raise their efficiency targets.

The savings from this measure are large over the long term.

Combined Heat and Power (CHP)

Cogeneration or "combined heat and power" (CHP) is power generation where waste heat from the power production process is captured to provide useful work and displace the fuel-use that would otherwise be required to provide such work. A range of existing policies and practices may be constraining optimal development of highly-efficient CHP projects, many of which are likely to involve distributed generation. Such constraints, the most important of which are regulatory and rate-making barriers addressed in *Roadmap* Measure E-3, should be removed wherever possible.

REDUCED EMISSIONS

This suite of measures will impact emissions of CO_2.

The potential for electrical energy efficiency improvements to reduce carbon emissions in 2050 will depend on the carbon emissions rate (if any) of the forms of electricity generation used to meet increases in uses of electricity that could be avoided by improved efficiency. The highest carbon emissions rate likely to be avoidable would be that of a relatively new, natural gas power plant that emits about 832 pounds of carbon dioxide per MWh of electricity produced. If fossil fuel power systems with carbon capture and geologic sequestration are deployed and become the "marginal" (or avoidable) power generation, energy efficiency savings might produce considerably smaller carbon emissions reductions. For example, adding carbon capture and geologic sequestration to a new natural gas power plant could reduce the carbon emissions rate from 832 lbs./Mwh to about 208 lbs./MWh (or less). This would reduce carbon emissions savings per unit of electricity production avoided by 75%. If carbon capture and geologic sequestration is implemented on a large scale in Connecticut by 2050, energy efficiency improvements would largely shift from a measure that reduces carbon emissions to a key factor in the economics of low/no carbon power production.

Very rough estimates of potential 2050 electrical energy efficiency carbon emissions savings are as follows:

Potential Electrical Energy Efficiency Carbon Emission Savings
(millions of metric tons of carbon equivalent)

Actions	2050 Savings	% of Target Reductions
Maintain ECMB Programs	2.0	12–16%
CHP	0.6	4–5%
Comprehensive Programs	2.6–4.6	15–36%

"Comprehensive programs" would include all of the actions listed in this measure. These estimates assume that natural gas power production is avoided, that the ECMB programs reduce the future rate of annual electricity consumption increases by about 0.25% and that a full set of programs could reduce this rate by about 0.5%. These figures may be conservative, as an annual electricity consumption growth rate reduction of 0.6% has been reliably measured for at least one set of comprehensive electrical energy efficiency investment programs over an extended period of time.

The reduction target estimates assume—as is likely—that Connecticut power generation emissions revert to national averages before 2050 as the current Connecticut nuclear power plant fleet retires.

Appliance standards would save an additional 350,000 metric tons (0.35 MMTC) by 2020. Updating building energy codes and appliance standards would save as much as 900MW of electrical capacity by 2020 in Connecticut.

A conservation investment fund for natural gas and home heating oil uses would supplement electrical energy saving programs and increase the amount of avoided GHG. Fuel blind and joint fuel programs would cost-effectively leverage savings across fuel types.

Moderate to large savings are possible by 2050, and will be highly dependent on future power system carbon emissions rates. Savings will be lower to the extent that Connecticut power and building energy systems transition to low/no carbon hydrogen fuel.

IMPLEMENTATION "NEXT STEPS"

1. Develop legislative proposals for establishing and periodically updating state electrical energy efficiency equipment standards;
2. Develop detailed proposals in each action area; and,
3. Develop an appropriate action plan to implement each action area.

This measure presents a good opportunity for advocates to work with vendors, state agencies, and utility programs to focus on increased energy conservation.

Additional research

- Identify an initial list of areas where it may be feasible to "commercialize" certain energy investments that are now only (or largely) occurring as a result of ECMB programs;
- Develop a preliminary outline of research that could be conducted by the ECMB to identify potential programs and measures that optimize long-term electrical energy savings; and,
- Develop legislative proposals for implementing oil and natural gas energy efficiency programs.

References

- "Energy Efficiency Standards: A Low-Cost, High Leverage Policy for Northeast States," Raynolds and deLaski, (Summer 2002).
- Energy efficiency savings produced by Massachusetts Electric Company's comprehensive energy efficiency investment programs were measured from 1990–1999 and the results of these measurements were litigated before the Massachusetts Public Utility Commission. Estimated annual energy demand reduction for this ten-year period averaged 0.6%.

STRATEGY GROUP II: MODERNIZE OUR ELECTRICITY AND ENERGY SYSTEMS

Measure E-3: Reform Ratemaking and Regulation

GOAL

Increase market penetration of energy efficiency and clean distributed generation by removing regulatory and ratemaking barriers.

DESCRIPTION

The current system for regulating the distribution of electricity and natural gas systems in Connecticut presents several constraints to the cost-effectiveness of clean, on-site generation (such as fuel cells, other clean CHP projects, solar and wind) and the incorporation of energy efficiency into broad consumer practices. By "distributed" or "on-site" generation, we mean sources of electric (and thermal) energy that are located on the end-user's premises and are not delivered through the power grid. Constraints on distributed generation include:

- Ratemaking policies that encourage sales of grid power rather than on-site generation;
- Efficiency policies that are biased against on-site generation;
- Interconnection standards—the engineering standards that connect small generators to the electricity grid—currently make siting small, on-site generation difficult; and,
- Ratemaking policies that "hide" real prices, and thus constrain economic market development.

Transmission and Distribution (T&D) Rates

Current electricity and natural gas distribution rates (tariffs) in Connecticut do not reflect the actual economic costs of providing these services. Transmission and distribution (T&D) charges are the costs passed on to customers associated with the delivery of electricity or gas. These charges are separate from the "energy" costs of generating electricity or producing the gas delivered to the customer.

The actual costs of delivery vary dramatically by time period and location and are driven primarily by maximum (or "peak") demand (rather than energy consumption/gas volume). Areas in which the amount of electricity or gas that can be delivered is constrained by the capacity of the wires or pipelines are said to be "congested." Relieving congestion adds costs in the form of purchasing more expensive energy either locally or delivered through an alternate route, or of constructing additional facilities.

For most commercial and industrials customers, the delivery charges are based on the average statewide delivery costs and the customer's highest (peak) monthly demand for energy. Residential and small commercial customers generally do not pay demand charges. Although congestion costs are substantially higher in certain areas of the state, mainly Southwestern Connecticut, customer charges do not reflect this variation. The electric transmission system operator (ISO-NE) plans to calculate and assess congestion costs that vary by zones throughout New England beginning in the summer of 2003. However, there are no plans to pass these price signals through to Connecticut customers in the congested zones.

Cost-Based Rates

Cost-based delivery rates would generally be based on the maximum demand for power or gas delivery at specific times, rather than on total volume of energy delivered over the course of a month.

Cost-based rates would reflect specific time period and location costs and thus present real price signals for the use of the T&D system to customers. Portions of both electric and gas systems have substantially higher costs of serving incremental delivery demand than other areas. Shifting closer to cost-based tariffs would likely create zones (overlap of high electricity and gas distribution costs) where the benefits of energy-efficiency and clean on-site generation investments would become far more attractive than they are to customers under the current system. An alternative approach could be to provide credits for customer investments that reduce congestion.

It is very difficult to move "low carbon" distributed generation technology or market-driven energy efficiency investments into a market that today does not reflect the real economic impacts of investing in such resources.

Time of Use Rates for Electrical Energy

Time of use (TOU) electrical energy rates reflect the principles of "supply and demand," which means that costs of providing electricity vary by time of day, by day of the week and by season. During peak periods, the cost of electricity is substantially higher than off-peak periods. Most medium to small electricity customers are currently served by average energy price rates, which mask the real costs of producing energy at different times and thus do not allow customers to alter their demand in response to varying electrical energy prices. Larger customers have TOU pricing, which may vary on a seasonal basis.

The efficiency of the electric system could be significantly improved if customers were aware of and could react to the actual costs on a daily and hourly basis. However, this "real time pricing" is only likely to be successful, in most cases, if the price signals can be automatically read and reacted to by computers or similar devices. In high cost periods, these signals could cause air conditioners to raise their target temperatures or lights to dim, thereby reducing demand. The movement to more accurate pricing will take time, but is an important component of the transition to a manageable and sustainable supply system.

Unbiased Rates

Current electric and gas rates collect a substantial portion of fixed costs such as plant, equipment, salary and overhead through charges based on the total volume of energy delivered in the course of a month. This provides an incentive to the utility to maximize sales in order to increase revenues and profits. Correspondingly, there is a disincentive to the promotion of energy efficiency and on-site generation that would reduce sales. Ratemaking policies that avoid this bias through an adjustment clause or similar mechanism would better align the utility's incentives with sound public policy to reduce consumption.

Distribution Wheeling and Back-up Power Tariffs

In many situations, it may be cost-effective to develop on-site generation that produces more power than needed at the customer site. Currently, there are no tariffs for wheeling power within an electric distribution system. As a general matter, this is appropriate because generation at the distribution level avoids electrical losses (and costs) that would result from stepping down transmission levels to those required by customers. Moreover, delivery costs within the state are assessed to retail customers rather than generators.

In Connecticut, both electric utilities have rates in place for supplemental, backup and maintenance power which allow self-generators the option to choose one or more of these services. In the past, utilities have sometimes attempted to revise these rates to discourage distributed generation. Any efforts in this direction must be rejected to preserve the opportunity to develop these resources.

Interconnect Standards and Costs

By adopting a uniform interconnect standard, Connecticut can remove barriers to the installation of on-site generation.

Installing clean, on-site generation requires straightforward and fair engineering standards for connections to the electricity grid. The Federal Energy Regulatory Commission (FERC) is currently developing standards, which will be applicable at least to interconnections at the transmission level. Connecticut needs to review these rules and current practices in order to remove any barriers to the connection of small on-site clean generation.

Utilities contend that there are severe limits to the amount of generation that can be connected to distribution circuits because they have not been designed for this purpose. There has been significant recent interest in "adaptive grids" which can facilitate the use of distributed generation, thus promoting both environmental and energy security goals. Directing the utilities to determine the kinds of modifications needed to increase the ability of distribution circuits to accommodate distributed generation and to make such modifications in appropriate circuits would facilitate the use of distributed generation.

The Institute of Electrical and Electronics Engineers, Inc., (IEEE) has developed an interconnect standard P1547 that establishes a uniform protocol governing the interconnections between a utility grid and a distributed generator. The standards include requirements relevant to the performance, operation, testing, safety, and maintenance of interconnections.

REDUCED EMISSIONS

This measure would reduce carbon dioxide and methane (from some natural gas combustion systems) in concert with reduced electrical energy consumption. While the amount of such reductions depends entirely on how rates and regulations are revised, the potential is large.

On the policy side the potential impacts are also important. Delivery service regulatory reform is probably essential to large-scale commercialization of key distributed generation technologies (for example, small, high-efficiency fuel cell-gas turbine hybrid power systems) that could significantly reduce fuel consumption and electricity delivery losses.

IMPLEMENTATION NEXT STEPS

1. Establish a collaborative project to explore rate design with one or more Connecticut gas and electricity distribution companies; and,
2. Establish Department of Public Utility Control proceedings to adopt
   - a delivery rate structure that more transparently reflects real costs and therefore real benefits,
   - revenue neutral tariffs, and
   - sound distributed generation interconnection standards.

Cost-based delivery rates, along with revenue neutral tariffs and sound distributed generation interconnection standards are probably essential to commercializing clean on-site electricity and thermal energy technologies. Potentially broad coalitions could be formed to move such rates and standards with

manufacturers and distributors of on-site generation technology, energy services providers and possibly some customer associations. To temper resistance, efforts should be made to demonstrate that current rates with no relationship to actual cost structure are probably not financially sustainable. A phased-in approach, one customer class at a time, could form the basis for a demonstration program.

Additional research

- Review current Connecticut statutes and administrative rules; and,
- Develop case studies illustrating alternate customer costs of current versus reformed systems.

References

- "Helping Distributed Resources Happen: A Blueprint for Regulators, Advocates, and Distribution Companies," prepared for The Energy Foundation by Fred Gordon, Joe Chaisson and Dave Andrus, December 21, 1998.
- "Distributed Resources Investment, Pursuing Short & Long Term Opportunities," presentation by Joe Chaisson to Rick Sergel, New England Power, May 1999.

STRATEGY GROUP II: MODERNIZE OUR ELECTRICITY AND ENERGY SYSTEMS

Measure E-4: Increase Renewable Power

GOAL

Increase the supply and use of renewable energy.

DESCRIPTION

Current Supply

Connecticut currently consumes 31,816,000 megawatt hours (MWh) of electricity annually and has an installed capacity of approximately 6,200 megawatts (MW). Of that amount, about half of one percent comes from renewable energy sources that are both climate-friendly and have the potential to grow in future years. In recent years, 1 MWh of electricity from the current mix of power plants serving the New England "grid" has produced 1,500 pounds of CO_2. (In the near term, we expect cleaner natural gas plants will drive the marginal average emissions rate down closer to 1,000 pounds of CO_2/MWh). By increasing the supply of climate-friendly renewable energy, Connecticut can displace the dirtier power generation and reduce GHG from the electricity sector.

Clean renewable energy levels can be increased as a percent of state consumption through a variety of mechanisms including:

- Public Sector Power Procurement;
- Improved Renewable Portfolio Standard; and,
- Green Markets, Green Pricing and Related Options.

The most significant immediate impact of these policies would be to get the fledgling marketplace of green power generators and marketers established. As a large, credit worthy customer with a long term demand for clean power, the State can enhance the profitability (and ensure continued operation) of new renewable generators and suppliers. Additionally, a meaningful RPS mandate would complement a state commitment by spreading the financial support for green supply across all consumers. Once established, green generators and marketers will be able to grow the supply of clean energy as they slowly build a green market over time. In the later years, the reductions from zero-emission renewables could be substantial.

Public Sector Power Procurement

The State of Connecticut contracts for approximately 50MW of electricity capacity. This includes state office buildings, labs, and correction centers, the Connecticut State University System and other state owned and operated facilities. In addition, the University of Connecticut requires another 40MW of capacity. While these numbers are not large (the entire load in Connecticut is over 6,000 MW), the state should act to lead by example.

Under state law, the Office of Policy and Management (OPM) has authority to aggregate the state load. While OPM has asserted that it is trying to purchase green energy, it has not done so to date. By contrast, New York, New Jersey, Maryland, Illinois and other states have each made specific commitments to purchase green power. State government in New Jersey has purchased 12% of its energy requirements from a renewable energy product.

Connecticut state government should agree to purchase at least 20% of its electrical needs by 2012 from renewable power sources:

- The criteria for energy sources that qualify as "green power" should be restricted to energy that is produced in a manner that benefits climate action. At least half of the qualifying power should be from sources that are "new" (built since 1997);
- Initially, the most likely sources of qualifying new power would be wind energy and landfill methane; and,
- State universities should provide leadership as they have in other states.

The state could secure this commitment through a Request for Proposal (RFP), bilateral negotiations with green power suppliers and generators, and/or through increases in on-site generation.

As with state agencies and schools, municipal governments are also in a position to be early adopters of green power.

Improve the Renewable Portfolio Standard

The Renewable Portfolio Standard (RPS) mandates that all suppliers demonstrate a minimum renewable energy content of total energy used to serve Connecticut customers. The state RPS needs to be strengthened by:

- Applying to all power suppliers, including utility or "default" services;
- Considering future amendments to the definition of eligible resources to ensure that only those renewables that produce a demonstrable net GHG reduction can be used to satisfy the RPS; and,

- Further refining eligibility rules to facilitate the eligibility of climate-friendly renewable sources from outside NEPOOL (where many of the best such opportunities are found).

Green Markets, Green Pricing and Related Options

Approximately two-thirds of Connecticut's electricity is consumed by commercial and industrial users and one-third by residential customers. If even a small percent of these customers chose a green electricity product, it would have a major impact on increasing demand for the development of new renewable energy projects.

As Connecticut faces a decision point on utility restructuring and the expiration of its standard offer on Dec. 31, 2003, different mechanisms should be included in state laws and programs to ensure the growth in demand for green power:

- Build incentives to promote customer choice and the development of green power markets;
- In deregulated markets where competition has been slow to develop, provide a temporary "green power option" to default service customers and marketed by one or more competitive suppliers;
- In markets or territories where there is no retail competition (e.g., municipal utilities), consider including a green pricing option that would allow customers to support the development of new renewable energy;
- For future supplies of default service, consider mandating a minimum percent of renewables that is greater than the RPS requirements; and,
- Support programs to promote private sector purchases of renewables. Consider significantly enhancing State incentives (e.g., Clean Energy Fund programs, tax provisions) to reward customers that displace grid power (or antiquated self-generation) with clean, climate-friendly renewable energy.

Public sector programs to promote green power could include:

- Develop "C-Free," a rebate for electricity made with zero carbon emissions, and establish additional rebates for each ton of carbon avoided from demonstrated baselines; and,
- Focus investments from the Connecticut Clean Energy Fund (CCEF) on commercializing "break through" businesses or products with potential for large-scale, climate-beneficial generation in the northeast. Examples of such businesses or products are off-shore tidal hydropower, which could make a major contribution to meeting long-term electricity production needs in New England and the Maritimes, true commercialization of PV in niche markets where this technology is currently economically competitive; and high efficiency fuel cell applications such as combined heat and power.

REDUCED EMISSIONS:

The reductions of CO_2, methane, and ozone from displacing conventional power supplies with renewable energy will be small initially, but increasing over time to significant levels. Sometime between 2025 and 2050, we estimate that between 25–30% of the region's electricity could, hypothetically, be generated from zero-emission renewables such as wind and ocean power. Assuming this power displaced the emissions from new natural gas power plants, these renewables could reduce Connecticut's annual CO_2 emissions by about 5.4 million tons, or 1.36 MMTC.

Additional research:

- Assess the projected future availability of certificates from the NEPOOL Generation Information System to satisfy public and private sector "green" purchases and the RPS in Connecticut;
- Assess the relative climate impact of renewable energy resources currently eligible to satisfy RPS requirements;
- Calculate the potential costs and reductions in GHGs and other air pollutants from creating a state-funded rebate system that rewards customers who reduce the carbon content of their electricity use; and,
- Conduct new commercialization studies on the potential for region-specific climate friendly energy technologies, including fuel cells, tidal electric, wave, and gasified biomass.

References

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- NY Executive Order 111 – "Green and Clean State Buildings and Vehicles," 10 June 2001.
- Green Mountain Energy – "Proposal for A Firm Supply of Electricity for Various NJ State Agencies and Institutions," T-1866, 13 March 2002; NJ Department of Treasury, "Request for Proposal" 01-X-32079
- U.S. EPA, Landfill Gas-to-Energy Project Opportunities: Landfill Profiles for the State of Connecticut, EPA 430-K-99-006, January, 1999
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STRATEGY GROUP III: TRANSITION TO NEW TRAVEL AND FREIGHT SYSTEMS

Measure M-1: Reduce Diesel Emissions by 90%

GOAL

Reduce diesel engine emissions of particulate matter (PM) and nitogen oxides (NOx) by 80–90% by 2015.

DESCRIPTION

In 1995, Connecticut's DEP estimated that 30% of the state's global warming gases were emitted from mobile sources. This was before anyone realized that the black carbon particulates and NOx emissions from mobile sources have a major additional warming effect on global temperatures.

- Diesel engines, especially those used for heavy duty trucks, buses, construction equipment, trains and marine applications, are the number one source of black carbon in Connecticut.
- U.S. EPA's official inventory of ozone forming nitrogen oxides (NOx) emissions shows that over one-third of Connecticut's NOx comes from mobile diesel engines.

At the national level, heavy duty diesel engines have been targeted for major reductions through a combination of federal regulation and government programs. Over the next decade, states have an opportunity to aggressively participate in and complement these national initiatives and to pick the low-hanging fruit of emissions reductions, especially with regard to existing engines and off-road engines.

New commercially available technologies, used with low sulfur fuels, make it possible to reduce diesel particulate matter emissions by 80–90% for certain diesel engines and duty cycles. These technologies can be implemented either in new engines (replacing or repowering old engines) or by retrofitting existing engines (where appropriate). Certain diesel engines, duty cycles and model years cannot use the most advanced retrofit technologies. In these situations, there is an alternative catalytic technology that can reduce PM by at least 30–40%. Projections are that by the end of the decade, 80–90% reductions in NOx will be possible as well.

A wide range of actions should be taken in Connecticut so that by 2015, every diesel engine operating in the state will use best available control technology for PM and NOx. The state should further set the goal of making this standard achieve 80–90% less particulate matter emissions and 80–90% less NOx emissions (compared to 2001 model year engines).

Diesel Fuel Rule

Connecticut should adopt a suite of rules and programs to phase in comprehensive upgrading of regular and residual diesel fuels to lower sulfur content fuels, such as Ultra Low Sulfur Fuel (ULSD). ULSD has a sulfur content of less than 30 parts per million (ppm) and is a prerequisite for proper operation of most clean, modern highway diesel engines and also for retrofit emission control technology. This action would help meet both climate change and human health objectives.

In-Use Engine Emissions Standard

Connecticut should adopt PM and NOx standards phased in over time for existing ("in use") diesel engines, requiring best available control technology for transit buses, school buses, garbage trucks (recycling, sanitation, etc.), dump trucks and snow plows, tanker trucks, street sweepers, delivery and utility trucks, construction equipment, and tractor trailer trucks.

Policymakers should consider the California precedent for these rules governing emissions from in use diesel engines.

Adopt a comprehensive anti-idling program.

Expand anti-idling legislation to apply to all diesel engines (not just school buses), including:

- all on-road and off-road heavy duty diesel engines; and,
- marine vessels while in port.

Establish programs to enhance use of auxiliary clean engines and electrification of areas where diesels tend to idle (e.g., bus depots, shipping depots, commercial marine ports, rail yards, and truck stops).

REDUCED EMISSIONS

This measure would reduce emissions of black carbon and ozone (by reducing ozone precursor emissions of NOx and carbon monoxide).

Reductions in black carbon emissions from diesel engines in Connecticut of at least 90% are practically achievable by 2015. Reductions of diesel engine NOx emissions of at least 70% (and perhaps as much as 90%) are also achievable by 2015.

Current (2000) diesel black carbon emissions in Connecticut are estimated to be about 1,495 to 2010 tons per year. A 90% reduction would represent reductions of 1,345 to 1,810 tons. By 2050, we estimate the total savings from cleaning up heavy duty diesel engines would range from 0.9–1.5 MMTC (see below).

Climate benefits from these reductions will be immediate as the full effects of reducing diesel emissions on climate are realized within about three to five years.

The black carbon emissions reductions alone would likely be significant. While uncertainty remains in our understanding of precisely how black carbon impacts climate, a recent paper in the Journal of Geophysical Research by Mark Z. Jacobson, a leading black carbon climate researcher suggests that reducing black carbon would have very large and immediate cooling effects on global climate.

Application of Jacobson's analysis suggests that a 90% reduction in current diesel black carbon emissions within Connecticut would have the same immediate impact (in the next three to five years) as eliminating all Connecticut CO_2 emissions for the next 1.25 to 6.75 years. To produce an equivalent amount of cooling in the year 2100 as would result from the 90% reduction in diesel black carbon emissions, current Connecticut CO_2 emissions would need to be cut by 0.9 to 1.5 MMTC (8% to 13% of 2000 Connecticut CO_2 emissions) and this reduction would have to be maintained through 2100.

IMPLEMENTATION "NEXT STEPS"

1. Raise public awareness about new standards, available technologies, and programs and about the associated health and climate benefits that will result;
2. Establish state procurement rules requiring best available control technology for all diesel engines owned by or operated principally for the benefit of the state;
3. Continue large-scale demonstrations (as have been started at the CTTransit fleet in Stamford and the Norwich School District) to build local experience with best available technologies (costs, emissions reductions, practicality, etc.);
4. Establish financial instruments (e.g., bonds, differentiated tax rates, dedicated registration fees, etc.) for funding or incentivizing purchase of ULSD and retrofit emissions controls and new (compliant) engines by the public and private sectors. Among other things, these funds will be needed to help pay for the In-Use Engine Emission Standard recommended above);
5. Advocate inclusion of ULSD and comprehensive diesel emissions control retrofit programs as elements in state 8-hour ozone and PM2.5 attainment state implementation plans (SIPs); and,
6. Develop broad support for an EPA emissions control rule for off-road vehicles with requirements similar to the recently enacted EPA rule for on-road diesel vehicles.

Additional Research

- Develop better inventories of the black carbon and NOx emissions from diesel engines operating in Connecticut;
- Build a comprehensive inventory of diesel engines registered or operating principally in the state, and gather data on diesel vehicles that pass through the state;
- Study health and environmental exposures to diesel emissions in the state; and,
- Consult with university experts regarding the relative impacts on black carbon and NOx emissions using competing fuel types and emission controls.

References

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- Section 22a-174-18 of the Regulations of Connecticut State Agencies.

STRATEGY GROUP III: TRANSITION TO NEW TRAVEL AND FREIGHT SYSTEMS

Measure M-2: Regulate GHG Emissions

GOAL

Reduce light vehicle GHG emissions through tailpipe emission controls.

DESCRIPTION:

California has enacted legislation, AB 1493, that directs the California Air Resources Board (CARB) to establish rules for reducing emissions of greenhouse gases from light vehicles for implementation in the 2009 model year. While the legislation leaves to CARB the standards and reductions, the possibility of reductions from this major emitter is significant. However, there are likely to be legal challenges to California's authority to adopt such rules. The ultimate substance, form, and impact of the resulting rules, assuming the legislation survives potential legal challenges, are currently uncertain.

As California proceeds to develop rules and they are ultimately approved by the California legislature, then Connecticut should consider adopting such rules.

Given expected legal challenges and the extended implementation schedule contained in the CA legislation, it is likely to be several years before the legality of this opportunity is determined conclusively in the courts. Under current Clean Air Act law, which allows states to implement standards developed in California, the California rule might flow automatically to states that have adopted the CA-LEV program.

REDUCED EMISSIONS

This measure will impact CO_2 emissions. The magnitude of any future reductions will depend entirely on the stringency of the final rule and the effective date of that rule. If states like Connecticut and California were to implement stringent rules, this would likely impact design decisions by manufacturers and would have the potential to drive national reductions.

IMPLEMENTATION "NEXT STEPS":

1. Monitor the California rulemaking process and any litigation;
2. Assess the potential for Connecticut based tailpipe effort modeled on California; and
3. Assess the potential for a similar region-wide effort.

A potential downside of this measure is the extreme political and environmental group-industry polarization that has occurred over proposed increases in national light vehicle fleet efficiency standards. The recent California GHG "tail pipe" emissions law appears to only increased this polarization to higher levels.

Additional research

Assess Connecticut adoption of CA-LEV standards as a foundation for automatic adoption of the California GHG tail pipe rule.

References

- The Pavley Bill, AB 1493, signed by Governor Davis July 22, 2002.
- "Greenhouse Gas Emissions and Transportation in Connecticut, A Hard Look at the Problem and its Solutions," Connecticut Fund for the Environment, Tri-State Transportation Campaign.

The greatest increase in CO_2 emissions will be driven by mobility demand and by electric power production.

STRATEGY GROUP III: TRANSITION TO NEW TRAVEL AND FREIGHT SYSTEMS

Measure M-3: Improve Light Vehicle Efficiency

GOAL

Improve light duty vehicle efficiency through bulk purchases and other jump-start measures.

DESCRIPTION

There are approximately 2.6 million cars and light trucks registered in the state of Connecticut. Together with heavy duty vehicles (discussed in the Diesel section, above) these mobile sources contributed about 30% of Connecticut's greenhouse gases emissions in 1995.

Connecticut should consider a comprehensive strategy for improving light vehicle efficiency through a range of activities, including:

Promote Procurement Standards for Increased Fleet Vehicle Efficiency

The State should establish a procurement policy that would upgrade the efficiency of its fleet of cars and light trucks (owned or leased) and develop programs to do the same for private vehicle fleets.

Currently, the State runs a fleet of 3,000 cars and 1,200 vans and light trucks. It replaces over one-sixth of the fleet each year, achieving complete fleet turnover every six years. The State also currently has obligations under EPAct to buy an increasing fraction of the fleet from "alternative fueled vehicles" (AFVs). These AFVs typically run on natural gas and to a lesser extent ethanol, propane, and electricity. Natural gas vehicles deliver improvements in NOx and hydrocarbon emissions but not CO_2 or methane.

Regardless of whether a vehicle is an AFV or not, the State could lead by example by ensuring that every vehicle it purchases gets the best achievable mileage per pound of CO_2 emitted in its class.

- For example, a new 4-door gas-electric hybrid car now gets 52 mpg city, 45 mpg highway and emits roughly 4 tons of CO_2/year. By comparison, the Pontiac Sunfire (in the same Small Car Class as the 4-door hybrid), gets 24 mpg city and 33 mpg highway and emits 6.9 tons CO_2/year. Not only would the hybrid save the State more than $450/year in fuel costs compared to the Sunfire, it also would avoid 2.9 tons CO_2/year, or 17.4 tons over six years.
- Within every class of vehicles (e.g., small car, sedan, station wagon, pickup, van, etc.) there is at least a 25% difference in the amount of CO_2 emitted annually between the most efficient and least efficient car in the class.

Various program incentives, such as leasing, as well as statewide efforts to build up the necessary fueling and maintenance infrastructure should be considered to facilitate implementation of this policy.

Finally, the State should build on its leadership in this area by establishing a program to encourage municipal fleets and private sector fleets (e.g., urban delivery vans, car rental agencies) to adopt the best achievable mileage in its class. This program could include a public awareness campaign and public recognition awards.

Because of the parallel reductions in greenhouse gases and other air pollutants that accrue from many of the more efficient vehicles, this program might also consider ways of tying into the motivation of businesses located along the I-95 corridor, where the ozone and PM problems are most pronounced and budgets for these emissions are tightest.

An example of one company that has taken the initiative to buy more efficient vehicles is Ohio Savings Bank/AmTrust Bank, one of the top ten mortgage lenders in the U.S. Recently this bank committed to replacing company vehicles with environmentally friendly hybrid electric vehicles wherever feasible.

Another example is found in Maine. On January 7, 2003, Maine Governor Angus S. King, Jr. issued an executive order that encourages state agencies to purchase gasoline-electric hybrid subcompact and compact vehicles and recommends that all other passenger vehicles meet a 30 mpg or greater highway fuel efficiency level.

Bulk purchase proposal for high fuel efficiency vehicles (not yet available in the market)

In the Northeast states, there are more than a million light duty vehicles owned and operated by private sector and government fleets of 10 or more vehicles. This number constitutes more than 10% of all vehicles sold into fleets in the U.S., and is estimated to generate purchases of about 100,000 new vehicles each year.

State	Total # Fleets 10+ Vehicles	Fleet Autos (% total autos)	Fleet Light Trucks (% total lt. trucks)
CT	2,252	62,000	82,000
ME	937	19,000	32,000
MA	3,366	81,000	123,000
NH	864	18,000	29,000
RI	557	14,000	18,000
VT	454	8,500	17,000
NY	6,824	229,000	271,000
TOTAL	15,254	432,000 (2.7%)	573,000 (11%)

The purpose of the action proposed here is to investigate the possibility of aggregating demand from fleets in the state (or the broader Northeast region) to cause manufacturers to introduce a new, significantly more efficient vehicle (or vehicles).

This "golden carrot" approach has been successfully used in the past. In the 1990s, several states used their combined demand to "pull" very high-energy efficiency refrigerators into the commercial marketplace.

Several light vehicle manufacturing companies are currently exploring introduction of more advanced and much larger hybrid vehicles than are currently offered. These vehicles would be more fuel-efficient than similar non-hybrids. Industry experts report that a manufacturer requires a minimum annual market size of about 25,000 vehicles before it will introduce a new model vehicle to the marketplace. A limiting factor is that market studies indicate that an immediate market exists for only about 12,000 vehicles per year in the U.S.

Thus an initial campaign target would be aggregating an annual purchase of about 12,000+ vehicles to "match" current market potential. A purchase of this magnitude might well draw such high-efficiency vehicles (e.g., new hybrids) into the market.

Because the State of Connecticut by itself does not purchase enough new vehicles each year to meet this threshold, it should explore partnering with other levels of local government and/or private fleets in the state to increase the size of the purchasing aggregation. Another approach is to expand the geographic area of the aggregation, folding the public and private fleets of other states (or Canadian Provinces) into the project. Connecticut could potentially serve as the focus for setting the minimum procurement criteria and aggregating such a purchase.

In addition, states like Connecticut should continue to advocate federal action on vehicle efficiency, such as setting efficiency standards (e.g., CAFÉ or an alternative approach) or establishing a cooperative voluntary agreement with light vehicle manufacturers, as has been done by the European Union.

REDUCED EMISSIONS

Net reductions in light vehicle CO_2 emissions of about 17% could be achievable by 2020, assuming aggressive action and currently available technology. This would provide reductions of about 0.68 MMTC in 2020 and 0.9 MMTC in 2050. These potential 2050 savings are probably low, as they do not include post-2020 technology improvements. These estimated savings assume "business as usual" mobility fuels and will be lower if the mobility system transitions to use of low/no carbon hydrogen by 2050.

The state initiatives proposed above could capture some portion of this carbon emissions reduction potential and would contribute to the probability of federal or other broad action by many states that could capture the full potential reductions.

The effect of the two fleet procurement policies would be to contribute to "market pull" for high-fuel efficiency vehicles. Pushing average vehicle fleet fuel efficiencies upward within available market offerings could reward vendors of the most efficient vehicles and ease the market entry threshold for more fuel efficient vehicles than are currently available.

IMPLEMENTATION "NEXT STEPS"

Additional Research:

- Identify the largest public and private fleets within Connecticut;
- Identify sources of information on "best fuel-efficiency in vehicle class/application;"
- Assess the feasibility of aggregating a 12,000+ annual high-efficiency vehicle purchase package in the State and the region.

References

- Northeast Association of State Transportation Officials
- Alternative Fuels Data Center and EPAct implementation – www.afdc.doe.gov
- U.S. DOE fuel economy website – www.fueleconomy.gov
- New York Executive Order 111 (January 10, 2001) – Requires 50% of all new state light-duty vehicle acquisitions to be clean fuel vehicles by 2005, increasing to 100% by 2010. Hybrid electric vehicles are eligible under this program.
- Arizona SB1429 (effective June 1, 2001) – Provides hybrid electric vehicles access to high-occupancy vehicle (HOV) lanes at any time, regardless of occupancy. Virginia and Utah have similar laws.
- Personal conversation with Arthur Weiss, MIT Energy Lab, author of "On the Road in 2020." Electric vehicles might provide an alternative to hydrogen fuel but they would require significant breakthroughs in battery technology capability that cannot be assumed.
- State of Maine Executive Order 05-FY 02/03, Gov. Angus S. King, Jr., "Procurement of Fuel Efficient, Less Polluting Vehicles" (Jan. 7, 2003)

STRATEGY GROUP III: TRANSITION TO NEW TRAVEL AND FREIGHT SYSTEMS

Measure M-4: Reduce VMT (Vehicle Miles)

GOAL

Reduce vehicle miles traveled (VMT) for passenger vehicles and freight.

DESCRIPTION

Reducing vehicle miles traveled (VMT) to meet potential mobility demand is one tool for reducing carbon and other global warming emissions from transportation systems. In the last decade, Connecticut VMT rose 16%. Projections suggest it will rise about 12% more in this decade. ("Greenhouse Gas Emissions and Transportation in Connecticut," Connecticut Fund for the Environment, Dec. 2002 at 2; see also, 2000 ConnDot, Clean Air Act Transportation/Clean Air Conformity Analysis.)

Several mechanisms for reducing VMT have been developed for transportation planning. Examples of potentially effective measures include:

- Expanded and more convenient public transportation services;
- Expanded ridesharing, high-occupancy vehicle (HOV) incentives and telecommuting;
- Encouraging high-density housing development around public transit stations;
- Introducing road user fees to fund public transit, encourage car pooling, etc.; and,
- Exploring options for long-term implementation of high-efficiency transport for goods and people traveling through Connecticut (which could reduce the number of trucks passing through the State).

The Connecticut Fund for the Environment (CFE) is developing a comprehensive VMT reduction advocacy program for the state. The CFE program could provide a good mechanism for studying and implementing activities related to this measure.

In addition to intrastate commuter traffic and personal travel, a substantial fraction of Connecticut mobility GHG emissions result from Northeast corridor traffic passing through the state to or from Massachusetts, Rhode Island and New York and points beyond.

In light of the 50-year perspective of this *Roadmap*, options may exist to transition a significant portion of this traffic to high-efficiency alternative transportation systems. Designing and deploying such systems may require innovative technology as well as innovative financing and/or operating institutions.

Notwithstanding the recent studies on potential increased use of barges for moving freight and for increased ferry systems to move commuters, these types of alternatives must be (re)considered so as to fully examine the relative efficiency (and reduced emissions) between modalities, and the potential for future engineering and technology solutions (such as tunnels, advanced rail systems, and water routes) to significantly reduce VMT.

REDUCED EMISSIONS

Carbon dioxide and, to a less significant extent, Carbon Monoxide, VOCs, black carbon and ozone.

CFE projects carbon emissions reductions of about 0.4 MMTC per year in 2020 from the proposed passenger vehicle VMT reduction actions in their "High Case." Similar VMT reductions would reduce carbon emissions in 2050 by about 0.52 MMTC per year. The potential reductions from establishing a long-term bi-pass system for freight is unclear at this time, but could be similar in size. These estimated savings assume "business as usual" mobility fuels and will be lower if the mobility system transitions to use of low/no carbon hydrogen by 2050.

IMPLEMENTATION "NEXT STEPS"

Additional research

- Analyze other states programs to incentivize reductions in passenger VMT;
- Conduct study of "outside the box" options for long term solutions to reduce through-traffic, especially of freight; and,
- Roughly estimate potential carbon reduction benefits from implementing various VMT reduction options.

References

- "Greenhouse Gas Emissions and Transportation in Connecticut, A Hard Look at the Problem and its Solutions," Connecticut Fund for the Environment, Tri-State Transportation Campaign (especially pages 12–14).
- "Transportation Choice for Connecticut," Transportation Choices Coalition, March 2001, available at www.cfenv.org
- "Greening Freight: Preliminary Research on heavy duty trucks in Southwestern Connecticut," Hall and Gordon, Oct. 2001, at www.cfenv.org/Greening_Freight.pdf
- The Tri-State Transportation Campaign is an alliance of public interest, transit advocacy, planning and environmental organizations working to reverse deepening automobile dependence and sprawl development in the New York/New Jersey/Connecticut metropolitan region, and looking at ways to move freight more efficiently through the region, at www.tstc.org.

STRATEGY GROUP IV: REDUCE METHANE EMISSIONS

Measure ME-1: Facilitate Methane Reduction Purchase & Trading

GOAL

Facilitate a broad methane (CH_4) emissions reduction purchase and/or trading program to reduce ozone levels.

DESCRIPTION

Connecticut should explore taking state actions that would facilitate a broad CH_4 emissions reduction purchase and/or trading program to reduce ozone levels.

Atmospheric chemistry and both climate and clean air policy researchers are increasingly convinced that a global approach to reducing methane emissions will be necessary to meet long-term clean air goals, as well as to reduce global warming.

Methane has a powerful, direct greenhouse effect and also plays a role in elevating ozone levels—which further contribute significantly to global warming. Methane is well mixed in the atmosphere due to its relatively long lifetime (about eight years), and therefore reductions of methane anywhere in the world will contribute to lowering ozone levels in Connecticut.

Conversely, ozone is increasingly being found to be a pollutant that cannot be reduced to levels posing acceptable human health and environmental damage (such levels are considerably lower than the new federal 8.0 hour standard of 800 parts per billion (ppb)) without a concerted global effort to significantly reduce methane emissions.

Connecticut could play a formative role in catalyzing broader action to design and implement a global methane emissions reduction system. This system would likely rely on a joint climate/clean air trading system that could be initiated by "least cost" purchase investments by a wide range of public entities responsible for reducing air pollution.

REDUCED EMISSIONS

Methane (CH_4) and ozone are the emissions implicated in this measure. The amount of reductions we can expect from this measure are not clear, but actions within Connecticut would likely produce only small reductions. Successful Connecticut programs to catalyze a broader methane reduction trading system could, however, produce large long-term reductions.

Methane has a warming effect that is 21 times stronger than CO_2. Large long-term reductions in methane emissions and associated ozone levels could significantly reduce global warming.

IMPLEMENTATION "NEXT STEPS"

1. Develop a "straw" proposal for a regional clean air methane emissions reduction trading system (possibly in cooperation with Environmental Defense or World Resources Institute).
2. Meet with relevant state officials to discuss this concept and potential for Connecticut to exert a leadership role in moving this action nationally and perhaps internationally.

This action could directly link clean air and climate impacts, which could accelerate public action to reduce methane emissions as this link is not yet widely recognized.

Additional research

- Research relevant international clean air protocols to determine if they present any opportunities for moving this action at the state or regional level.

References

- EMEP: The Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe – www.unece.org/env/emep/welcome
- Convention on Long-range Transboundary Air Pollution – www.unece.org/env/lrtap

STRATEGY GROUP IV: REDUCE METHANE EMISSIONS

Measure ME-2: Reduce Landfill Methane Emissions

GOAL

Maximize the capture and conversion of methane from Connecticut and New England landfills.

DESCRIPTION:

Most known emissions of methane in Connecticut are from conversion of biomass materials in landfills. Connecticut landfill methane emissions were the carbon equivalent of 0.36 MMTC in 1995 (or 1,490,000 tons of carbon dioxide equivalent). Landfill methane emissions (or land-fill gas) can be reduced by collecting the methane generated within the landfill and disposing of the collected methane by:

- Flaring the methane gas (which converts methane to CO_2); or
- Using the methane to produce energy.

Measures can be taken to improve the amount of methane captured by collection systems. Conventional collection systems capture only about one-half of the methane generated in a landfill.

While some Connecticut landfills have installed methane collection systems, none of them appear to be taking measures to improve their capture efficacy. Additionally, most of these landfills are not converting the methane to generate heat or power that could displace the consumption of other fuels and their associated emissions.

Action to reduce methane emissions from landfills include the following:

- Explore opportunities for further state regulation of landfill methane emissions;
- Explore opportunities to facilitate installation of methane collection systems in landfills that do not yet have such systems; and,
- Explore opportunities to facilitate implementation of measures to improve landfill gas capture at sites with collection systems.

This strategy could be implemented in a number of ways, including through a joint project with an appropriate industrial partner to develop technical guidelines for improving landfill gas capture.

Estimated reduction amount

Significant reductions in current landfill methane emissions (which are a relatively small portion of Connecticut greenhouse gas emissions) are possible. Costs of doing so are not yet clear, but could be mitigated by clear air and/or climate emissions credit trading systems that include methane reductions as an eligible activity.

As an example of potential climate impact, reducing Connecticut landfill methane emissions by 50% from reported 1995 levels would reduce greenhouse gas emissions by 0.18 MMTC, as well as reducing global ozone levels and associated climate warming.

REDUCED EMISSIONS

The methane emissions reductions that would accrue from this measure are disproportionately important because they have relatively immediate (within about eight years) direct and indirect impacts (through ozone and water vapor formation) on climate. They are also necessary to reduce ozone pollution levels to acceptable levels.

Improving the efficacy of landfill gas emissions collection systems is a straightforward goal that could be implemented with known technology and provide immediate GHG reduction benefits.

IMPLEMENTATION "NEXT STEPS"

Develop a concept plan and identify near-term (2003–05) actions steps including:

1. Locating appropriate landfill sites;
2. Identifying potential partners including developers, suppliers, and customers; and,
3. Facilitating financing for projects.

Additional research

- Review the status of EPA landfill gas collection and flaring rules;
- Review the status of any Connecticut regulations regarding landfill gas collection and flaring;
- Create an inventory of Connecticut landfills that have collection and either flare or produce energy from the collected methane;
- Determine if a good inventory exists of all landfills in Connecticut, including small, closed small municipal landfills and industrial landfills (active or closed); and,
- Identify any relevant EPA programs activities in New England.

References

- EPA Landfill Methane Outreach Program, www.epa.gov/lmop

STRATEGY GROUP IV:
REDUCE METHANE EMISSIONS

Measure ME-3: Reduce Natural Gas Pipe Leakage

GOAL

Reduce methane leakage from natural gas pipelines and distribution systems.

DESCRIPTION

Small amounts of methane are known to leak from properly managed natural gas transmission and distribution systems. Leakage can be highest at points where natural gas transmission systems connect with distribution systems (city gates) or other large point users of natural gas (like power plants). Such leakage can be reduced through investment in appropriate engineering measures.

In 1995, Connecticut DEP reports estimated methane leakage from pipelines and distribution systems to be 0.00006 MMTC. While this figure is quite small, it may be substantially lower than actual leakage in light of recently reported leakage reduction efforts by TransCanada on their pipeline system. Given the growing use of natural gas to fuel power plants and for other uses, it is likely that leakage will increase in coming years.

EPA has established the Natural Gas Star program to helps natural gas transmissions and distribution companies reduce methane leakage from their systems.

Initial action will facilitate participation by all Connecticut natural gas distribution and transmission system companies in EPA's Natural Gas Star (NGS) Program.

The need for and value of additional steps can be evaluated after this initial step is taken and results evaluated.

REDUCED EMISSIONS

This measure will directly reduce methane emissions. The amount of reductions we can achieve in Connecticut is estimated to be relatively small, but it does have the advantage of being relatively simple and quick. Methane leakage should be reduced to the maximum possible extent.

IMPLEMENTATION "NEXT STEPS"

This action presents a straightforward opportunity to use existing programs for meaningful reductions at pipelines. Interest groups, communities and regulators could join with pipeline owners and operators to implement these reduction efforts. Perhaps a good place to start on this measure is to set up meetings with appropriate companies to ensure that all are participating in the NGS Program.

Additional research

- Contact NGS Program and find out the process for enrolling companies as well as which Connecticut companies have participated.

References

- EPA's Natural Gas Star Program, see www.epa.gov/gasstar
- "Estimate of Methane Emissions from the U.S. Natural Gas Industry," Kirchgessner, D.A., Lott, Cowgill, R. M., Harrison, M. R. and Shires, T. M., US EPA.
- Venugopal, S., "The Effective Mangement of Methane Emissions From Natural Gas Pipelines," IEA GHG-6 Conference, Kyoto, Japan, October 2002.

STRATEGY GROUP V: RECONSIDER FOREST CUTTING AND LAND CLEARING PRACTICES

Measure S-1: Expand Terrestrial Carbon Sinks

GOAL

Expand terrestrial storage of carbon through targeted timber cutting practices, new approaches to land clearing and open space protection.

DESCRIPTION

Carbon is removed from the atmosphere by the growth of plants and a portion of this carbon is stored within vegetation and soils. On undisturbed lands, the total amount of stored carbon will increase over time until the resulting forest naturally releases about the same amount of carbon through mortality that is captured each year.

Today, the US Forest Service estimates that about 36 million metric tons of carbon (MMTC) are currently stored above ground in vegetation, which is equivalent to more than three years of carbon emissions in Connecticut.

The Connecticut landscape is removing about 0.9 MMTC/year (equivalent to about 8% of current carbon emissions) from the atmosphere, while land conversion is releasing about 0.44 MMTC/year and timber harvesting is releasing about 0.27 MMTC/year.

A wide range of changes in land and forest management practices could potentially reduce or avoid carbon releases, increase the annual volume of carbon removed from the atmosphere by Connecticut's landscape and thus expand the amount of carbon storage, or "sinks." Expanding such carbon sinks beyond "business as usual" levels presents an important "bridge" opportunity to remove carbon from the atmosphere at a relatively low cost, while technology evolution lowers the costs of reducing carbon emissions.

Carbon sinks could be expanded by:

- Reforesting land not currently forested;
- Minimizing removal of site carbon when converting forested land to other uses and maximizing future tree growth on such sites;
- Modifying forest management practices to:
  - Increase the growth rates of forest stands, and
  - Expand harvesting of trees that would otherwise die and decay; and,
- Modifying agricultural practices to expand soil carbon content.

The process of taking action to expand terrestrial carbon storage would include:

1. Development of "prototype" carbon sink projects, with associated measurement, documentation and price "bid" information;
2. Identification or creation of carbon or broad greenhouse gas credit trading systems (or bilateral market opportunities) that include terrestrial carbon sink expansion as an eligible activity;
3. Evolution of sinks trading "market infrastructure," to include:
   - Efficient risk management services (for example, "carbon credit" insurance against natural risks like forest fire);
   - "Third-party" (possibly certified) carbon sink expansion measurement, documentation and verification services;
   - Development of trading protocols to address measurement and verification issues like the potential "leakage" of displaced forest harvests to non-project lands and demonstrating that proposed project sink expansion would not have occurred anyway under "business as usual" conditions even without the project; and,
   - Project development services; and
4. Facilitating broad awareness—by land owners, land preservation groups and other potentially interested parties—of opportunities to create and market carbon sink expansion.

REDUCED EMISSIONS

Rough estimates of potential sink expansion in two areas—by modifying land conversion and forest management practices—can be made by assuming that annual land conversion releases of about 0.44 MTTC/year and timber harvesting releases of about 0.277 MMTC year are eliminated. This would expand annual carbon storage in the Connecticut landscape by about 0.7 MMTC per year—equivalent to about 6.3% of current carbon emissions.

While the full potential for reducing carbon releases from these two areas may be not be biologically or economically

achievable, expansion of carbon storage is possible in several other areas like re-forestation and agriculture.

Potential to reduce net annual carbon emissions in Connecticut by expanding the volume of carbon removed from the atmosphere and subsequently stored on the Connecticut landscape is significant – possibly exceeding 0.7 MMTC/year.

As such potential could not be pursued indefinitely, achievable terrestrial sink expansion is probably limited to a "bridge" strategy to help reduce net carbon emission over at least the next several decades.

IMPLEMENTATION "NEXT STEPS"

1. Establish collaborative projects with land owners, managers or developers to evaluate the economics of expanding carbon storage on specific types of sites. For example, state forest managers have already indicated an interest in collaboratively exploring such opportunities on state forest lands. These evaluations would initially focus on land conversion and forest management opportunities;
2. Identify research needed to identify and quantify further sink expansion opportunities. Facilitate funding and implementation of this research;
3. Facilitate development of sink expansion projects that could be bid into carbon trading systems on site types identified as having economic potential; and,
4. Conduct outreach to ensure that potential terrestrial carbon sink expansion project opportunities are well understood by relevant land owners, managers, developers and preservation interests.

We believe this measure offers significant opportunity to organize land owners (including the State of Connecticut), land managers and potentially land protection organizations to support relevant *Roadmap* actions.

Additional research

- Contact "sinks program" staff at The Nature Conservancy for information and advice.
- Identify and contact organizations that might be interested in collaboratively evaluating modifications to land management or development practices for carbon sink expansion potential on specific site types.
- Identify and obtain any evaluations of the economics of terrestrial sink expansion on site conditions relevant to Connecticut.

References

- Robert Bonney, "Draft White Paper on Terrestrial Sink Expansion," Environmental Defense, October, 2002.
- Land & Water Associates, "Opportunities for Carbon Storage in Connecticut," November 13, 2002 (prepared for Environment Northeast).
- Environmental Research Institute and the Department of Natural Resources Management and Engineering, Connecticut's greenhouse gas emissions inventory, 1990 and 1995 calendar years, March 1999; also detailed inventory files used to estimate net carbon capture in Connecticut.

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