2007 Greenhouse Gas Emissions Inventory Falmouth, Maine

Prepared by

Emissions Subcommittee

of the

Falmouth Green Ribbon Commission

On Energy and Climate Protection

Fall 2008

Credits and Acknowledgements

The following individuals, organizations and departments are gratefully acknowledged for their contributions toward the preparation and production of this community wide emissions inventory for the Town of Falmouth:

Volunteers

Claudia King, Co-chair, Cool Falmouth & Emissions Subcommittee

Deirdre Conroy- Vella, Emissions Subcommittee

Bruce Henning, Emissions Subcommittee

Gary Glick, Teacher, Falmouth High School

Cathy Van der Kloot, Cool Falmouth

Ben Tweed, Student, Falmouth High School

Denise Dyck, Cool Falmouth

Simone Egidi, Student, Falmouth High School

Robert Welch, Cool Falmouth & Emissions Subcommittee

Lasse Skaarup Anderson, Student, Falmouth High School

Ellen Klain, Volunteer

Town of Falmouth

Nathan Poore, Town Manager

Chief Edward Tolan, Police Dept

Anne Gregory, Assessor

Doug Patey, Fire and EMS Dept

John McNaughton, Finance Dept

Pete Clark, Waste Water

Randy Davis, Finance Dept

Diane Moore, Wastewater

Ellen Planer, Finance Dept

Dan O'Shea, School Dept

Peter Lund, Finance Dept

Topper West, School Dept

Skip Varney, Public Works	Jennifer Phinney, Information Technologies Dept
Ryann Stevens, Public Works	Al Ferris, Code Enforcement Dept
Mike Susbury, Public Works	Barbara DiBiase, Energy & Sustainability Coordinator
Lucky D'Ascanio, Community Programs	Lyn Sudlow, Falmouth Memorial Library

Sierra Club

Joan Saxe, Partnership for Cool Communities	Glen Brand, National Director, Cool Cities Program
Stephanie Cutts, Policy Analyst, Cool Cities Program	

ICLEI - Local Governments for Sustainability

Missy Stultz, Senior Program Manager	Jonathan Knauer, Program Associate
Courtney Forrester, Program Associate	

And

Maine Dept of Transportation	METRO - Greater Portland Transit District
Greater Portland Council of Governments	Natural Resources Council of Maine
ECO Maine	Pine Tree Waste

INTRODUCTION

Climate change, caused by an increase in the concentration of greenhouse gases (GHG) in the atmosphere, may be one of the greatest challenges facing human society today. The Inter-Governmental Panel on Climate Change (IPCC) has concluded that climate disruption is real, and that human activities are primarily responsible for increasing concentrations of greenhouse gases.

What is a greenhouse gas? To quote the National Oceanic and Atmospheric Administration (NOAA):

> ***Many chemical compounds present in Earth's atmosphere behave as 'greenhouse gases'. These are gases which allow direct sunlight (relative shortwave energy) to reach the Earth's surface unimpeded. As the shortwave energy (that in the visible and ultraviolet portion of the spectra) heats the surface, longer-wave (infrared) energy (heat) is reradiated to the atmosphere. Greenhouse gases absorb this energy, thereby allowing less heat to escape back to space, and 'trapping' it in the lower atmosphere. Many greenhouse gases occur naturally in the atmosphere, such as carbon dioxide, methane, water vapor, and nitrous oxide, while others are synthetic. Those that are man-made include the chlorofluorocarbons (CFCs), hydrofluorocarbons (HFCs) and Perfluorocarbons (PFCs), as well as sulfur hexafluoride (SF6). Atmospheric concentrations of both the natural and man-made gases have been rising over the last few centuries due to the industrial revolution. As the global population has increased and our reliance on fossil fuels (such as coal, oil and natural gas) has been firmly solidified, so emissions of these gases have risen. While gases such as carbon dioxide occur naturally in the atmosphere, through our interference with the carbon cycle (through burning forest lands, or mining and burning coal), we artificially move carbon from solid storage to its gaseous state, thereby increasing atmospheric concentrations.***[1]

"What you can measure, you can manage." Ergo, the first milestone in creating a climate action plan is to create an emissions inventory. The main objectives of the Greenhouse Gas Emissions Inventory are:

1) to establish a baseline, against which to measure future progress;
2) to identify the largest sources of emissions and the greatest opportunities for emissions reductions; and

[1] http://www.ncdc.noaa.gov/oa/climate/gases.html

3) to serve as an educational tool that will help motivate change.

The Falmouth Green Ribbon Commission (FGRC) Emissions Subcommittee prepared this Greenhouse Gas Emissions Inventory (the "Inventory") in 2008 using data for the year 2007. The total community emissions will sometimes be referred as the town's "carbon footprint." [2]

Inventory Methods

For the purpose of this Inventory, we have limited our scope to emissions directly attributable to activities within the boundaries of the town of Falmouth. Not included in this Inventory are many indirect emissions, which include such things as air travel by residents, consumption of goods by residents produced elsewhere, etc.

The Inventory employs data collected for the calendar year 2007. After consultation with ICLEI Northeast, the Commission selected 2007 as the baseline year, because this was the year with the most complete and reliable data.

The Subcommittee used software called Clean Air and Climate Protection Software (CACP) purchased from ICLEI Local Governments for Sustainability, a leading non-profit dedicated to assisting state and local government in addressing climate change.

The CACP software addresses the most commonly found gases and converts them to carbon dioxide equivalents (CO2e) as a common language for emissions. The version of CACP that was used tracks emissions and reductions of greenhouse gases associated with electricity, fuel use, and incineration of Falmouth's solid waste (trash).

The CACP software determines emissions using specific factors (or coefficients) according to the type of fuel used. CACP aggregates and reports the three main GHG emissions (CO_2, CH_4, and N_2O) in terms of equivalent carbon dioxide units (CO_2e). Converting all emissions to equivalent carbon dioxide units allows for consideration of different greenhouse gases in comparable terms. For example, on a per-weight basis, methane (CH_4) is 21 times more potent than carbon dioxide in its capacity to trap heat. Therefore, the CACP software converts one metric ton of methane emissions to 21 metric tons of carbon dioxide equivalents. The potency of a given gas in heating the atmosphere is defined as its Global

[2] "carbon footprint" is a measurement of the amount of carbon dioxide or carbon dioxide equivalents produced by a person or entity.

Warming Potential (GWP). Emissions coefficient factors used in the software are based on USEPA's (2007) Inventory of Greenhouse Gas Emissions and Sinks: 1990-2005. The emissions coefficients and quantification method employed by the CACP software are consistent with national and international inventory standards established by the Intergovernmental Panel on Climate Change and the U.S. Voluntary Greenhouse Gas Reporting Guidelines (EIA form1605). Coefficients are updated by ICLEI as new scientific research results become available.

The CACP software reports input and output data in several formats, including detailed, aggregate, source-based and time-series reports. Once a target reduction year has been agreed upon by the FGRC, the CACP software will be used to forecast future GHG emissions, based on growth rate indicator data inputs. This feature can be used in conjunction with the CACP measures selector and ICLEI's CAPPA tool to craft a pragmatic and achievable GHG reduction plan.

The emissions calculations for the analysis are based on complete data when available, and modeling calculations, assumptions and estimations when the data did not exist.

Emissions Results

The Inventory results presented in this section are segregated into two main sectors: Community and Government. The Community Sector refers to greenhouse gas emissions associated with all sectors of the town, including the municipality and schools, within the geopolitical boundary of Falmouth. However, we have called out Government as a specific section in this report because in the Government section we use a different methodology (Community data is based on best available estimations and Government data is based upon actual figures) and we have more detail. In both cases, results are limited by the quantity and quality of available data. However, it is important for the Falmouth community to recognize that emissions from municipal activities is a very small part of our total emissions.

Community Sector Emissions

The software separates emissions into Residential, Commercial, Transportation and Waste.

The results for the Community were startling (See Table 1). The Transportation Sector contributed 68% of our total emissions (198,000 CO_2e tons). In comparison with other towns' emissions inventory results, Falmouth's Transportation Sector was disproportionately high. Falmouth has many through-roads and highways which contribute to emissions which are not attributable to Falmouth-based travel.

As our Climate Plan is local in scope and is based on the Inventory results, we made the decision to break with the software methodology and to create a "local" picture by evaluating the data without the emissions from highway travel (we define this as the Maine Turnpike and Interstate 295). This adjustment changed the emissions from Transportation to 43% of total emissions.

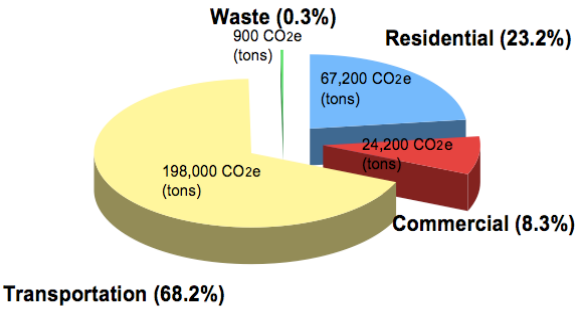

FIGURE 1 INCLUDING STATE HIGHWAY EMISSIONS

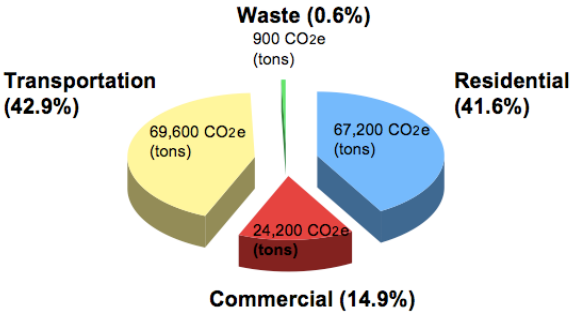

FIGURE 2 EXCLUDING STATE HIGHWAYS

	CO2e Tons W/Highways	CO2e % W/Highways	CO2e Tons W/o Highways	CO2e % W/o Highways
Residential	67,200	23.2 %	67,200	41.6%
Commercial	24,200	8.3%	24,200	14.9%
Transportation	198,000	68.2%	69,600	42.9%
Waste	900	.3%	900	.6%
Total	**290,300**	**100%**	**161,900**	**100%**

TABLE 1 GREENHOUSE GAS EMISSIONS BY SECTOR, WITH AND WITHOUT HIGHWAYS

The largest contributing Sectors in the Community Inventory remain **Transportation** (43 %, 69,600 CO2e tons) and **Residential** (42%, 67,200 CO2e tons). This data and its depiction allows us to see that our Plan should consider these two Sectors equally. Transportation no longer dwarfs the other Sectors.

From this point forward, the percentage of emissions will refer to emissions without the Maine Turnpike and I-295.

A. Residential Sector Emissions

Falmouth's housing stock is primarily single-family homes whose mean age of construction is 1958. There are approximately 4,200 homes in town, and average size single family home contains a 2,280 square feet of livable space.[3i] The average low temperature in January is 12.5degrees F; and the average high is 30.9 degrees F. The average low temperature in July is 58.6 degrees F; the average high in July is 78.8 degrees F.

The Residential Sector emissions include those which are created at a home and emissions from electricity which are generated elsewhere but which result from consumption within the home; these emissions data account for all energy use within the residence. The data was gathered in the form of energy use (gallons, kilowatts, etc.) from varied sources. The electrical data is actual kilowatts as measured by Central Maine Power. Consistent with the methodology used in other communities, propane, light fuel oil and wood consumption were calculated using energy data from the Energy Information Administration and Falmouth Town Assessor's records. The ICLEI software was used to calculate the emissions of those fuels.

The Residential Sector accounts for 42% (67,200 tons) of the total emissions, a significant portion of total emissions in our community. Of this 67,200 tons of residential emissions, the largest contributor is **heating oil: 50,000 tons, or 74% of all residential emissions.** The high contribution of emissions from heating oil is consistent with media reports that Maine is one of the most oil dependent states in the country.

Electricity accounts for 15,400 tons CO2e, or 23% of the total. Electricity use includes both heat and light. Wood fuel contributes 60 tons CO2e and represents just 0.1% of total residential emissions. Data for wood heat was calculated using residences' primary source heat as listed on the Town Assessor's records. Fireplaces and woodstoves which are not listed as primary heating sources are not taken into account. Propane produces 2,000 tons CO2e and represents 3% of the total residential emissions. Although there is a natural gas line which runs through the geographic boundary of Falmouth, natural gas is currently not available to resident of Falmouth.

	CO2e Tons	CO2e %
Electricity	15,400	23 %
Fuel Wood (Air Dry)	60	.1%
Light Fuel Oil	50,000	74%
Propane	2,000	3%
Total	**67,460**	**100%**

[3] Provided by Town Assessor's office, 2008.

TABLE 2 RESIDENTIAL EMISSIONS BY SOURCE

The above table shows what we all know: the heating season dominates our residential energy consumption, as opposed to warmer parts of the country, where air conditioning (and thus electricity) is much more important.

B. Commercial Sector Emissions

The Commercial Sector Inventory includes the emissions connected with the energy use of retail businesses and government buildings. Falmouth's commercial buildings are largely located in two service centers on Route 1 and Route 100. The buildings' mean age of construction is 1969 and they are, for the most part, one-story structures. Many of the government structures are also free-standing and single story. Falmouth has no significant quantity of industrial activity, and thus no Industrial Emissions to report.

It is important to note that a distinct government sector inventory follows the Community Inventory. The methodology for the Commercial Sector of the Community Inventory does not allow one to separate government emissions from commercial emissions.

Energy consumption calculations were carried out based on the Assessor's records of primary heat sources and building square footage, and CMP electrical records. Commercial buildings typically rely on more than one source of heat. Energy information was obtained through the Energy Information Administration. The emissions were calculated by the Town's ICLEI software.

Unlike the Residential Sector whose largest source of emissions, by far, comes from home heating oil, the **Commercial Sector's largest source of emission is electricity, which constitutes 63% of total emissions (15,200 tons CO2e).** Commercial buildings use electricity for lighting, air conditioning and heating, and office equipment. . Focusing on improving commercial electricity efficiency will likely yield substantial reductions in greenhouse gas emissions, as well as cost-savings for the commercial building owners. Although our Inventory does not address construction issues, it is reasonable to surmise that a lot of energy is lost from older HVAC units, inefficient lighting fixtures, lack of modern controls, inadequate insulation, traditional "black" (rather than white) roofs, and the large building envelope which accompanies spread out, single-story structures.

After electricity, light fuel accounts for the next largest percentage of total commercial sector emissions, representing 24%, (5,800 CO2e tons). Propane produces 13% of total commercial emissions, equivalent to 3,200 tons CO2e.

	CO2e Tons	CO2e %
Electricity	15,200	63%
Light Fuel Oil	5,800	24%

Propane	3,200	13%
Total	**23,200**	**100%**

TABLE 3 COMMERCIAL SECTOR EMISSIONS BY SOURCE

C. TRANSPORTATION SECTOR EMISSIONS

The Transportation Sector is a significant contributor to Falmouth's carbon footprint: 69,600 CO2e tons, or 43% of the community's total emissions. Thus the climate action plan recommendations need to address Transportation. (Remember, as noted above, that if we followed the strict ICLEI methodology, and included emissions from the sections of Maine Turnpike and I-295 that fall within Falmouth's geography, transportation emissions would be much higher, and thus an even more significant part of the emissions within town borders.)

It is helpful to provide some Transportation context. A coastal town of ~11,000, Falmouth is mostly suburban and travel is, for the most part, by private vehicle. METRO provides public service to/from Portland and there is a town-operated school bus system. Two freight train lines pass through Falmouth. The passenger rail line planned to connect Portland to Brunswick, with a stop in Freeport, passes through Falmouth, parallel to Route 1. The town also has one the largest anchorages north of Boston, which includes both sail and power vessels.

Falmouth, which is adjacent to the state's largest city, has a number of roads (Falmouth Road, Rte 1, Rte 100, Rte 88, Rte 9) that provide a transportation corridor for through traffic. Falmouth is now a "service center" community. Approximately the same number of people travel to work in Falmouth as commute from Falmouth to work in other communities.

The emissions calculation for Transportation was based on data provided by the Maine Department of Transportation. This date includes Vehicle Miles Travelled ("VMT")_on roads in Falmouth in 2007. Further calculations are done using ICLEI software. Local data was difficult or impossible to collect (e.g., types of vehicles registered in Falmouth and mileage travelled by Falmouth vehicles) as data collection systems were not completely accessible and/or were not designed to collect this increasingly important data. This situation has limited the Commission's potential recommendations. Data from off-road vehicles, lawnmowers, boats and planes was not available and not included. It would be helpful in terms of managing emissions to have better data available at the local level, particularly vehicle miles travelled by vehicles registered in town, and data that includes emissions from such activities as aviation, lawn maintenance vehicles, boats, etc. Hopefully, as citizens and governments recognize the utility and importance this of data, changes will be made in the data collection system.

D. WASTE SECTOR EMISSIONS

Waste sector means solid waste what might be referred to as "trash", whether that trash is incinerated or trash that is recycled. "Waste" is not human solid waste (sewage), or wastewater at the Sewage Treatment plant.

Falmouth's waste stream consists of residential solid waste collected by several methods:

- weekly pickup of trash to be incinerated, and bi-weekly pickup of trash to be recycled;
- drop off of recyclable trash at the "silver bullets" - at Hannaford and the Central Fire Station on Bucknam Rd (24/7);
- drop off of trash (trash both for incineration and recycling) at the Transfer Station) (limited hours); and
- drop off of brush, metals, petroleum and other products c at the Transfer Station.

Commercial waste is handled privately by commercial waste handlers.

The Waste Sector Emissions Inventory accounts ONLY for residential waste which was incinerated after curb-side collection or drop off at the transfer station. It does not include waste from businesses as that data is not currently available (although we estimate based on conversations with commercial haulers that this figure might be approximately 1,500 tons of waste annually), nor does it include other wastes handled at the Transfer Station. The emissions from the trucks used for curbside pickup and from the Transfer Station is accounted for under Transportation.

Total waste-related emissions are ~ 600 CO2e tons, which represents less than 1% of total community emissions. Because this is an incomplete picture of emissions from waste in the community, and because recycling represents to some extent avoided emissions, we caution the reader from concluding that managing emissions from waste is not important. Better data would be very helpful relative to emissions from the waste sector.

Data concerning "waste characterization," can be helpful in identifying categories of trash to target for reduction. The Subcommittee characterized the town's waste stream according to an EPA tool which characterizes "typical" American residential trash. Whether Falmouth's waste stream is typical due to our waste reduction efforts such as recycling and brush collection is difficult to say. Although much of the waste in the table is uncharacterized, areas for potential further waste reduction might be plant debris, brush and paper products. Given the magnitude of the "all other waste" category (73% of total), refined characterization of waste composition may yield more accurate estimates of emissions.

	CO2e Tons	CO2e %
Collected brush	27	4.5%
Paper products	79	13.2%
Food waste	27	4.5%
Plant debris	21	3.5%
Wood / textiles	8	1.3%
All other waste	437	73%
Total	**599**	**100%**

TABLE 4 RESIDENTIAL WASTE BY CATEGORY – "WASTE CHARACTERIZATION"

The role of recycling in this Inventory deserves comments. Although the emissions from the total Waste Sector are small relative to the total Community emissions number, it should be made plain that through recycling Falmouth has avoided a significant percentage of the emissions that would have been created in the Waste Sector (43%) had the recycled materials been incinerated. Additionally as this Inventory only tracks waste which is incinerated, the indirect emissions (emissions created in the producing of materials for manufacture and in the manufacturing of products) avoided by collecting materials for recycling is not included. These are important considerations in a town whose recycling rate has passed 50% of residential waste. It is important to note that reduced emissions is just one of many environmental benefits of recycling.

	Weight (tons)	CO2e (tons)	CO2e (tons) as a %
Incinerated waste	2,908	599	60.3%
Recycled waste (avoided)	1,781	395	39.7%
Total	**4,689**	**994**	**100%**

TABLE 5 COMPARISON OF RESIDENTIAL WASTE AND RECYCLING

According to this Inventory emissions from the Waste Sector are small relative to Transportation and Residential sectors. However, the Waste Sector is one in which reduction efforts have been instituted and have changed the "business as usual" emissions. In summary, inventorying Waste in our town provides an incomplete picture of emissions or avoided emissions from this Sector.

GOVERNMENT SECTOR EMISSIONS

The Government Sector Emissions Inventory includes the energy consumed through all operations and facilities of the Town of Falmouth. This Inventory is distinctive from the Community Inventory in that the

data is from actual utility invoices and data gathered from Town departments. This inventory will allow the government sector to track its individual facilities and vehicles and to evaluate the effectiveness of its emissions reduction efforts at a more detailed level. The results of both sectors are limited by the quantity and quality of available data.

Facilities included in government sector include town hall, three active fire stations, a recently completed (2008) LEED certified police and public safety building, public works building, recently renovated water sewage treatment plant and building, two elementary schools, one middle school, one high school and one school superintendent's buildings. Town vehicles include police vehicles, public works vehicles and machinery and school busses (over 100 vehicles). Of course Falmouth is in a four season environment (snow plowing in the winter, mowing in the summer; heating and air conditioning).

The town's buildings account for the greatest portion of the total emissions, 49%, equivalent to 3,000 tons CO2e emitted. The vehicle fleet accounts 21% of the total, equal to 1,300 tons CO2e. Employees' commutes account for 17%, or 1,000 tons CO2e, while water/sewage (treatment, pump stations and wastewater treatment) accounts for 11%, or 700 tons CO2e. **Buildings are emitting nearly half of the government sector emissions**.

	CO2e (tons)	CO2e (%)	Energy (MMBtu)
Buildings	3,000	49	33,000
Vehicle fleet	1,300	21	17,000
Employee commute	1,000	17	12,000
Streetlights	100	2	1,200
Water/sewer	700	11	6,600
Total	**6,100**	**100%**	**69,800**

TABLE 6 GOVERNMENT EMISSION SUMMARY BY SECTOR

When looked at by fuel type, electricity, fuel oil (heat) and vehicle consumption are nearly equivalent in their impact and importance for reduction strategies.

	CO2e (tons)	CO2e (%)
Electricity	1,889	30.8%
Light Fuel Oil	1,937	31.5%
Propane	11	.2%
Biodiesel (B-20)	840	13.6%
Diesel	4	.1%
Gasoline	1,462	23.8%
Total	**6,143**	**100%**

TABLE 7 GOVERNMENT EMISSIONS BY FUEL TYPE

Comparison of Community and Government Emissions

Although comparing the Community CO2e Emissions and the Government CO2e is not an "apples to apples" comparison (please read how the data is gathered for each Sector), looking at them together allows us to make a couple of statements. First, we can see that it is non-governmental entities make the vast majority of measured emissions. It can be deduced that, although businesses and through-traffic contribute substantially to the overall emissions, Falmouth residents and their residences contribute the largest percentage.

	CO2e (tons)	CO2e (%)
Entire Community	161,900	
Less Government	(6,143)	
Community w/o Govt	155,757	96.2%
Government	6,143	3.8%
Total	**161,900**	**100%**

TABLE 8 COMPARISON OF TOTAL EMISSIONS FROM COMMUNITY AND GOVERNMENT

Second, although the government's emissions as a percentage of the emissions by the total community may be relatively small (~4%), the government has a special role in town. The government can take a leadership role in implementing reductions and in demonstrating their efficacy. Developing programs at the government level may help define which reduction measures make the most environmental, economic and social sense for application in the commercial and residential sectors. And finally, the Government Sector may yield CO2e reductions more readily than the rest of the town. Such success may encourage others to make the necessary changes.

Summary of Inventory and Implications for Strategies

1. The Inventory understates the direct emissions taking place within town borders. Except for electricity consumption, the Inventory does not include indirect emissions.
2. Emissions from Residential activities and Transportation are nearly equal and constitute over 80% of inventoried emissions.

3. Heating oil is overwhelmingly the largest source of residential emissions. This implies reducing consumption of heating oil (think weatherization, passive solar designs, on-demand water heaters, etc.) and switching to cleaner fuels for heating (natural gas, propane, photo voltaics).

4. Commercial activity should focus on reducing electricity consumption (day lighting in large retail stores; light colored roofs; energy star HVAC equipment; insulating exterior walls and roofs) and specifying renewables for the source of their electricity.

5. Transportation represents 43% of the town's measured emissions. Strategy implications for reducing the total tonnage of emissions from Transportation include reducing idling (traffic lights, drive-throughs, vehicle waiting); reducing vehicles miles travelled; increasing gasoline efficiency in vehicles; and reducing reliance on single occupancy vehicles (car pooling, biking, walking, METRO) etc.

6. While the Government sector is a tiny portion of total measured emissions, its decisions affect other sectors (support for public transportation, building codes, land use planning, transportation infrastructure, provision of curbside recycling, etc). Government can lead by example, and it can facilitate actions by others. Thus the government sector is important well beyond the measured emission figure for this sector.

The Commission's Climate Action Plan includes recommendations which address the findings and implications of this Inventory.