



Sustainability Management:
Focus efforts and evaluate progress

February 2009
A Report by the Office of the Auditor

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MEMORANDUM

February 12, 2009

To: David Bragdon, Council President
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Carl Hosticka, Councilor, District 3
Kathryn Harrington, Councilor, District 4
Rex Burkholder, Councilor, District 5
Robert Liberty, Councilor, District 6

From: Suzanne Flynn, Metro Auditor

Subject: Audit of Sustainability Management

The attached report covers our audit of Metro's sustainability efforts. This audit was included in our FY07-08 Audit Schedule.

Recently, a growing consensus about global warming has caused businesses and governments to look at their effect on the environment. This audit examined Metro's efforts to increase the sustainability of its internal operations.

We found that Metro has not directed its efforts towards the largest sources of emissions or those facilities with the largest impact. This is due in part to the implementation design for sustainability management. To date, limited resources have affected Metro's efforts. ENACT and the Green Teams are volunteers who have many other job duties to perform. Because funds were allocated from Solid Waste revenues, efforts were also limited in scope by State statute. If Metro is to move forward, it must decide what price premium it is willing to pay.

We have discussed our findings and recommendations with Scott Robinson, Deputy COO, Jim Desmond, Director, Sustainability Center, and Teri Dresler, Director, Parks and Environmental Services. We have also reviewed the audit with ENACT. A formal follow-up to this audit will be scheduled within 1-2 years. We would like to acknowledge and thank the management and staff in the Departments who assisted us in completing this audit.

A handwritten signature in cursive script, appearing to read "Suzanne Flynn".

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Summary

In 2008, the Metro Council made sustainability the guiding principle for all Metro policies and programs and called for stronger sustainable business practices within Metro. The purpose of this audit was to evaluate whether Metro's sustainability efforts related to its internal operations were strategically managed to achieve intended results and ensure cost effectiveness. The audit looked at all Metro facilities, including the Metropolitan Exposition Recreation Commission (MERC).

To accomplish its objectives, Metro relied on two cross-department teams. These teams lacked centralized authority and accountability. Despite this barrier, the teams put into operation a diverse set of projects to increase Metro's sustainability. The Oregon Convention Center was the first convention center in the U.S. to receive the Leadership in Energy and Environmental Design certification for an existing building. Both Metro and MERC have hired sustainability coordinators.

The funding available to these teams also created a barrier. Derived from revenue generated by Metro's solid waste management system, the teams could only fund projects that reduced or prevented solid waste from Metro operations. As a result, Metro's efforts in the past five years have not targeted the largest sources of carbon emissions and water use.

Our inventory of Metro's emissions found that electricity and natural gas consumption and landfill gas flaring accounted for 91% of the agency's estimated emissions. From FY04 to FY08, 3% of expenditures focused on energy efficiency, even though 59% of Metro emissions were generated by electricity and natural gas consumption. Conversely, commuting accounted for 6% of Metro emissions, yet 59% of expenditures focused on commuting.

In addition to lacking a strong organizational structure, we found that Metro needed a system-wide sustainability plan. As part of the plan, the Metro Council should specify how much the agency should spend on sustainability related activities. Metro should conduct cost-benefit analyses prior to implementation.

Even with a system-wide plan in place, it would still be difficult for Metro to measure progress. For example, during our audit, we attempted to extract information from Metro's financial system about the use of electricity, natural gas, and fleet fuel, and the amount of air travel. We were unable to get complete, accurate, and reliable information from existing data management systems and had to request data directly from utility providers.

We acknowledge that sustainability management is a relatively new concept. To be most effective, Metro needs to have a clear understanding of two aspects of its operations. It needs to determine the availability of reliable data to estimate environmental impacts and its level of control over its resource use. Based upon these two aspects, Metro can move forward to reduce its impact.

Background

There is a general consensus that the Earth's climate is changing, and that the changes are the result of human activity. The burning of fossil fuels (coal, natural gas and oil) has increased the concentration of carbon dioxide, methane, nitrous oxide, and fluorinated gases in the atmosphere. These “greenhouse” gases prevent heat from escaping from the atmosphere. The average temperature of the Earth has increased 1.2 to 1.4° F in the last 100 years. This change is likely to produce changes in rainfall patterns, sea level and more frequent weather extremes.

International, national and local communities have responded to this problem, and some government agencies have taken steps to reduce the greenhouse gas emissions of the communities they serve and their own internal operations. Metro has committed itself to establish a sustainable business plan in response to global climate change. In 2003, the Metro Council passed a resolution that provided for the creation of a sustainable business model, and set goals for internal sustainability at Metro facilities. These goals included:

1. zero net increase in carbon emissions,
2. zero discharge of persistent bio-accumulative toxins,
3. zero waste disposed and incinerated,
4. fifty percent reduction in water consumption and
5. zero net loss of biodiversity and productive healthy habitat for forests and riparian areas.

In 2008, the Council made sustainability the guiding principle for all Metro policies and programs. It called for the development of a regional climate change action plan and the implementation of stronger sustainable business practices within Metro.

Several departments have initiated projects to make Metro’s operations more environmentally sustainable. Metro has made efforts to reduce paper use, increase recycling, make lighting and heating more efficient, manage energy used for computers, and reduce single occupancy vehicle commuting. The Oregon Convention Center was the first convention center in the United States to receive the Leadership in Energy and Environmental Design (LEED) certification for an existing building.

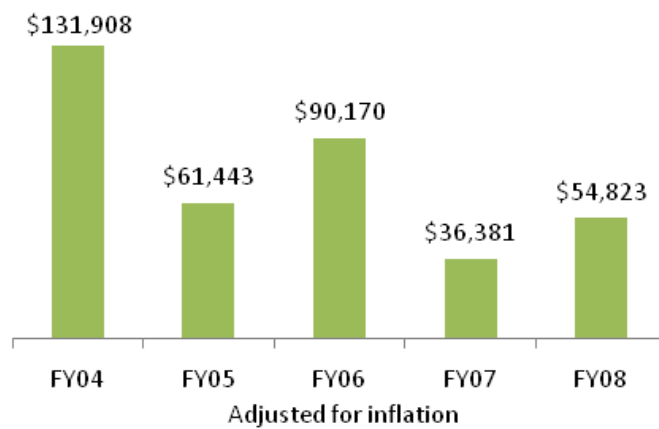
In 1999, the Environmental Action Team (ENACT) was convened to evaluate different sustainability models and to meet with local governments and businesses to review their sustainability programs. ENACT was made up of Metro employees from each department and Metropolitan Exposition Recreation Commission (MERC) facility. This volunteer group recommended funding for projects to reduce environmental impacts and to make facilities more resource-efficient. ENACT provided training in environmental sustainability and initiated projects for waste reduction, recycling, water use reduction and a “green

roof". ENACT also worked with Green Teams at three Metro facilities (Metro Regional Center, Oregon Zoo and Oregon Convention Center). These Green Teams identified opportunities to make Metro's operations more sustainable at individual facilities.

Metro has increased its recycling rate. Both Metro Regional Center (MRC) and the Oregon Convention Center now have Sustainability Coordinators and efforts have been made to increase the amount of "green" energy Metro purchases.

ENACT and Green Team expenditures have varied considerably over the last five years. Overall, ENACT and Green Team expenditures decreased by 58% between FY04 and FY08.

Exhibit 1
ENACT and Green Team
Expenditures



Source: Auditor's office analysis

In addition to ENACT, Metro had other programs that were designed to have a direct impact on environmental sustainability: a program to provide TriMet passes to employees and the Transportation Demand Management Program, which offered incentives for employees to walk, bicycle and use carpools for commuting to work.

Scope and Methodology

The objective of this audit was to evaluate whether Metro's internal environmental sustainability efforts were strategically managed to achieve its intended results and ensure cost-effectiveness. The scope of this audit encompasses all facilities operated by Metro, including the Metropolitan Exposition Recreation Commission (MERC) facilities. The purpose was to:

- Determine whether sustainability efforts were organized in a way that facilitated achievement of the agency's sustainability goals;
- Determine whether Metro monitored expected and actual results and used analysis in decision making;
- Analyze sustainability efforts and determine what was accomplished; and
- Determine which sustainability management strategies were most cost-effective and determine if Metro's was targeting those activities with the greatest impact.

Sustainability is typically defined as integrating three separate aspects: environmental, social, and economic. Metro's adopted definition says "Sustainability means using, developing and protecting resources in a manner that enables people to meet current needs and provides that future generations can also meet future needs, from the joint perspective of environmental, economic and community objectives of sustainability." For the purposes of this audit, we focused primarily on the environmental and economic impacts of Metro's internal operations.

To accomplish these objectives we reviewed Metro's goals, policies, strategies, organizational structure and funding for sustainability projects. We interviewed Metro staff members and reviewed expenditures related to environmental sustainability over the last five years in the agency's financial system. Since the financial data had been audited we believe this data is reasonable and accurate. We conducted research in best sustainability management practices. Finally, we collected electricity, natural gas, fleet fuel, landfill gas, recycling, air travel, water and commuting data for each Metro facility. Using this data we estimated the amount of greenhouse gases generated and water used at Metro's facilities.

To estimate greenhouse gas emissions and water use, we used data from:

- City of Portland Water Bureau
- City of Oregon City Utility Billing Department (water use)
- PacifiCorp (electricity)
- Portland General Electric (electricity)
- NW Natural (natural gas)
- Fleet fuel providers (gasoline, diesel, propane)

- State of Oregon (fleet fuel)
- Multnomah County (fleet fuel)
- Metro (St. Johns Landfill emissions, fuel)

We were able to compare water, fleet fuel and utility data with information collected from Metro's facilities and financial system. We concluded that the data from the utility providers was sufficiently reliable for the purposes of this audit. The methodology used to calculate greenhouse gas emissions is described in the appendix of this report.

The effects of Metro's purchases on the environment were considered during the survey phase of this audit. Metro Council resolutions and Executive Orders address sustainable procurement policies, and procurement has a direct effect on the agency's environmental sustainability. However, procurement and social aspects of sustainability management were excluded from this audit.

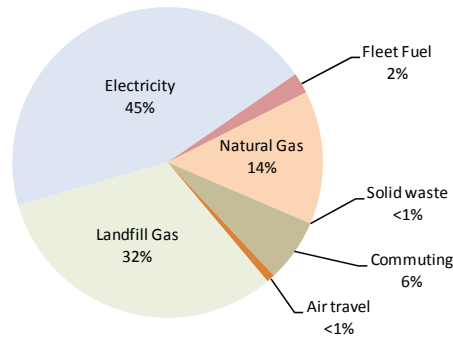
This audit was included in the FY08 audit schedule. We conducted this performance audit in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Results

Largest sources of carbon emissions not targeted

Metro's sustainability efforts over the last five years have not targeted the largest sources of carbon emissions and water use. Our inventory of Metro's emissions found that electricity and natural gas consumption and landfill gas flaring accounted for 91% of the agency's estimated emissions. Electricity was the single largest source accounting for 45% of total emissions. Flaring of landfill gas at St. Johns Landfill was the second largest source, accounting for 32% of agency emissions. Emissions from natural gas consumption account for 14% of emissions which was more than twice as much as the next largest emissions source.

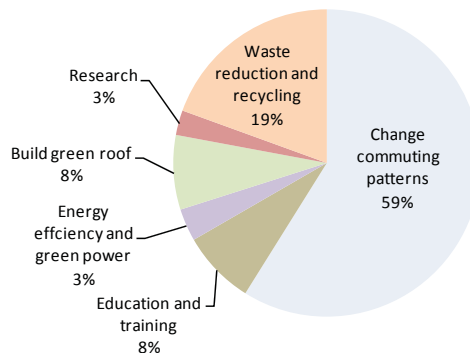
Exhibit 2
Sources of greenhouse gas emissions



Source: Auditor's Office Analysis

In comparison, sustainability related expenditures (including ENACT, Green Teams, bike coupons and Tri-Met transit passes) for the last five years did not focus on the largest sources of emissions. From FY04 to FY08, 3% of expenditures focused on energy efficiency and/or green power even though 59% of Metro emissions were generated by electricity and natural gas consumption. Conversely, commuting accounted for 6% of Metro emissions, yet 59% of expenditures focused on commuting. Similarly, solid waste from Metro facilities accounted for less than 1% of total emissions (not counting St. Johns Landfill) but 19% of expenditures were for waste reduction and recycling. However, these efforts did address Metro's goal for zero waste disposal.

Exhibit 3
Expenditure by objective FY04-FY08



Source: Auditor's Office Analysis

Metro has made some effort to reduce and mitigate emissions from electricity and landfill gas. Metro offset about 20% of its electricity emissions in 2007 by purchasing renewable power credits from PGE and PacifiCorp.

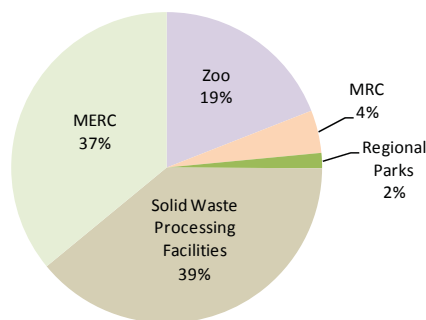
Metro has a lease agreement with Portland LFC Joint Venture which gives Portland LFC exclusive rights to sell the landfill gas from St. Johns Landfill until May 2012. Portland LFC currently sells landfill gas to Ash Grove Cement for use in its operations. In 2007, Ash Grove used about 48% of the gas generated at St. Johns Landfill. The other 52% was flared at the landfill accounting for 31% of Metro’s estimated greenhouse gas emissions.

During our audit, we were told about several lighting and heating projects at Metro facilities to reduce energy consumption. These efforts may increase energy efficiency at Metro facilities but we were unable to verify their impact on emissions due to a lack of baseline data from before and after the projects were completed. These efforts demonstrate some success in addressing the largest source of emissions, but more coordination will be needed to strategically align resources with the sources of the largest impact.

Focus efforts on facilities with the largest impact

Some Metro facilities have a greater impact on carbon emissions than others. During our greenhouse gas inventory we found that the Zoo, Solid Waste facilities, and Metropolitan Exposition Recreation Commission (MERC) facilities account for 94% of Metro’s estimated emissions. Metro’s sustainability efforts over the last five years have not targeted these facilities in a coordinated way. To meet its goal of carbon neutrality Metro will need to target efforts to the facilities with the largest greenhouse gas impact.

Exhibit 4
Sources of greenhouse gas emissions by facility



Source: Auditor’s Office Analysis (see page 36 of Appendix for a full description of included facilities)

Our analysis of water use shows that the Zoo has the highest water use of all Metro facilities (76%) followed by MERC (14%) and Solid Waste facilities (8%). Sustainability expenditures for FY04-FY08 by ENACT and the Green Teams did not include expenditures for water use reduction at sites with the highest levels of water use. Metro’s ability to reduce water use by 50% will depend largely on strategies that reduce water use at the Zoo.

Another area where Metro faces challenges in meeting its sustainability goals is recycling. Metro established two recycling goals. One was the long-term goal in the 2003 resolution of zero waste disposal or incineration. The other was a regional waste recovery goal of 62% in Oregon Statute that was included in the Metro Regional Solid Waste Management Plan (RSWMP). The recycling rate across all Metro facilities (46%) in 2007 was below the regional goal for 2005.

Exhibit 5
Recycling rates

Metro Facilities	2003 Recycling Rate	2007 Recycling Rate
Metro Regional Center	65%	58%
Regional Parks	0.2%	N/A *
Oxbow Park	0.6%	7%
Blue Lake Park	0.1%	N/A *
Oregon Zoo	69%	68%
MERC	18%	28%
Portland Center for Performing Arts	29%	38%
Oregon Convention Center	20%	31%
Expo Center	12%	20%
TOTAL	40%	46%

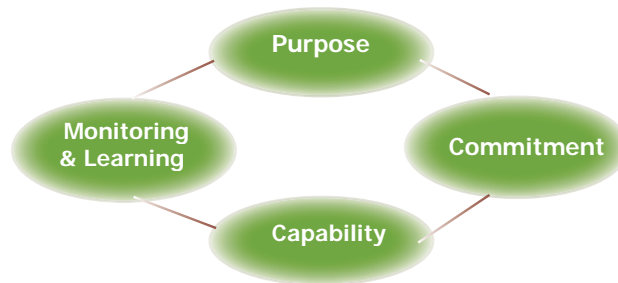
Source: Metro Sustainability Center
* Available beginning in 2008

In 2007, Metro Regional Center and the Zoo were the only two Metro facilities to meet or exceed the regional goal for 2005. Parks, MERC and Metro as a whole will need to increase their recycling rates considerably to meet the 2009 goals. Some progress has been made between 2003 and 2007 but Metro is still below its 2005 and 2009 goals, as well as the long-term goal of zero waste disposal (equivalent to a 100% recycling rate). Metro’s ability to demonstrate leadership in the region may be eroded if its facilities are unable to meet these goals.

Sustainability efforts need better organization

Best practices indicate that an organization needs to focus on four iterative and interconnected controls to effectively meet an objective. Controls comprise those elements of an organization that, taken together, support people in the achievement of the organization's objectives.

Exhibit 6
Control framework



Source: Canadian Institute of Chartered Accountants: *Guidance on Assessing Control*

Purpose provides a sense of the organization's direction including mission, vision and strategy; risks and opportunities; policies; planning; and performance targets and indicators.

Commitment focuses on the organization's identity and values including integrity; authority; responsibility and accountability.

Capability gives a sense of the organization's competence to ensure sufficient knowledge; skills and tools; communication process and information coordination.

Monitoring and learning provides a sense of the organization's evolution. This includes monitoring performance; challenging assumptions; reassessing information needs and systems; follow-up procedures and assessing the effectiveness of controls.

We used the above described control framework designed by the Canadian Institute of Chartered Accountants to assess Metro's sustainability management efforts and found areas for improvement at each stage of the control process.

Metro needs a plan in order to effectively manage its efforts

Controls related to purpose need to be strengthened. Metro's sustainability efforts over the last five years have consisted of a series of ad hoc projects with little agency wide coordination, policies, performance measures, or evaluation of costs and benefits. As a result, there does not appear to be a clear understanding of what price premium Metro is willing to pay to achieve greater sustainability.

The Metro Council has directed that Metro's definition of sustainability be the guiding principle for current and future policies and programs. To meet this requirement, Metro needs policies, plans and objectives that provide clear direction about the strategies the agency will use to meet its goals. Without a clear understanding of policy options and associated costs, there is a risk that Metro will not be able to target resources towards strategies that are most cost-effective.

Metro made limited progress toward meeting the sustainability goals in the 2003 and 2008 resolutions. While Metro has implemented many sustainability related projects, there has been little progress on the creation of an information management system, evaluation of accounting mechanisms, and annual reporting to Council as called for in the 2003 resolution.

Metro needs a system-wide sustainability plan. ENACT, Green Teams and individual departments have had success in providing leadership and implemented a diverse set of projects to increase Metro's internal sustainability. These projects have enhanced Metro's sustainability but have not been specific enough to identify and target activities that will be most cost-effective. Management states that the newly hired Sustainability Coordinator will create a sustainability management plan. This plan can help Metro create a coordinated strategy to reach its long-term sustainability goals. As part of the plan, Metro Council should clearly specify the price premium it is willing to pay for sustainability activities. The plan should include measurable short-term goals and objectives aligned with the long-term goals in the 2003 resolution.

During the audit, we found sustainability related projects are not consistently supported by objective cost-benefit analysis of their potential return on investment. In some cases, sustainability activities are very well planned, with detailed analysis of costs and benefits. In other cases, there is limited cost-benefit analysis, or analysis by vendors is used. As a result, there is no way to determine whether many of the sustainability activities deliver financial or environmental benefits that exceed their costs. To help Metro effectively manage its sustainability activities, there should be an assessment of the fiscal and environmental costs and benefits of projects prior to implementation.

Organizational design hindered implementation

Metro needs to strengthen its controls related to commitment and capability. Organizational and funding barriers prevented effective sustainability management at Metro. Metro relied on ENACT and Green Teams to coordinate and implement internal sustainability efforts. This management structure began in 1999 with the creation of ENACT and was formalized in the 2003 resolution.

ENACT and the Green Teams were volunteer groups that have completed many projects but lacked centralized authority, accountability, or control to direct efforts across all Metro facilities. The result was a completely

voluntary organizational structure for sustainability without clear direction about what is expected and who is responsible for achieving results.

In addition to ENACT and Green Team projects, individual departments undertook sustainability efforts independently. The goals and strategies that guide individual department decisions varied widely across the agency which made coordination for sustainability efforts difficult. These efforts were largely driven by individual advocates rather than formalized as part of position descriptions and work plans.

Because Metro's efforts were dependent on a relatively small number of people, there is a risk that employee turnover could impact outcomes. These factors made Metro's efforts variable from year-to-year as funding and management priorities fluctuated. Some progress has been made to address these issues with the creation of two Sustainability Coordinator positions in the FY09 budget.

Finally, the variety of Metro's operations presents challenges for coordinated sustainability management. Metro operates the Zoo, event facilities (MERC), solid waste processing facilities, office buildings, regional parks, and a landfill. Each facility has unique challenges and opportunities in managing sustainability. Metro's sustainability management organizational structure and plan should recognize these differences by creating facility and source specific strategies.

Source of funding
limited effectiveness

Funding for ENACT was also a barrier to effective sustainability management and limited Metro's ability to strategically use funds. ENACT's funding came from solid waste revenue which by Oregon Statute can only be used for projects and programs "...related to solid waste and related planning, administrative and overhead costs of the district." As a result, the grants ENACT made each year for sustainability projects were limited to projects that reduced or prevented solid waste from Metro operations.

We found that this funding structure was one of the reasons why the agency focused its efforts on waste reduction and recycling. Moreover, it has limited ENACT's ability to fund projects that would have the greatest environmental impact. A 2007 consultant report recommended significant changes to ENACT'S business model including diversifying its sources of funding.

Limits on ENACT's funding may also contribute to the lack of coordination across the agency. Sustainability projects not focused on waste reduction and recycling were primarily funded from departmental budgets. This decreased the utility and authority of ENACT as a centralized planning and coordinating body. The result was uncoordinated efforts and disparities in the level of investment by departments.

Track important information

Even with a system-wide sustainability plan in place, it would be difficult for Metro to measure progress toward its sustainability goals. Metro lacked the fourth element of the control framework: monitoring and learning from its sustainability efforts. Metro did not collect data needed to track progress.

Metro's internal sustainability goals include zero net increase in carbon emissions and a fifty percent reduction in water consumption. Best practice research states that it is important to establish baseline data by facility and emission source in order to track progress towards sustainability goals.

We attempted to extract information about the amount of electricity, natural gas, and fleet fuel used and the amount of air travel from Metro's accounting system to estimate the amount of greenhouse gases generated. We also attempted to estimate greenhouse gases produced by employee commuting and to determine the amount of water used in Metro facilities. We were unable to get complete, accurate and reliable data on emissions sources and water use from Metro's data systems, and had to use data from the utility providers. We also found that the data was difficult to obtain and analyze.

Utilities

Metro staff provided a partial list of utility accounts. It was difficult to identify all the meters associated with Metro's facilities. To get complete electricity, gas and water consumption data required several contacts with two electric companies, two water utilities and a natural gas company.

To ensure that we obtained data for all Metro facilities, we compared account numbers and addresses the utilities provided to Metro facility addresses. The utility providers did not list all Metro accounts under the name "Metro," making it difficult to capture all Metro information from their databases as well. At one facility, the water meter was shared with another tenant, making it impossible to determine how much of the water was used by the Metro operation.

Fleet fuel

Metro does not track its vehicle fuel use. It was difficult to determine the amount of gasoline and other fuels Metro uses for several reasons:

- There was no single inventory for all Metro vehicles.
- No facilities were actively tracking their fuel consumption.
- The accounting systems used to pay for fuel varied by department and within departments. At some sites, fuel was purchased by individuals using procurement or fuel cards while at others fuel was delivered onsite.
- Some Metro facilities used more than one fuel vendor.

Eleven fuel vendors were contacted to get fuel consumption data for one year. Tracking fuel expenditures was further complicated by the fact that some MRC vehicles are billed through the State of Oregon while expenses for some Parks vehicles are billed through Multnomah County.

Air Travel It was also difficult to estimate the amount of greenhouse gases generated from Metro air travel. There is no accounting code to distinguish air travel from other travel expenditures, making it difficult to identify air travel in Metro's accounting system. Greenhouse gas estimates for air travel use the distance travelled, which can be determined using the destination of each trip. However, it was usually impossible to identify the travel destination from the electronic records in the accounting system without looking at scanned procurement card receipts.

Commuting Metro does not have information that can be easily used to estimate greenhouse gases generated by employee commuting. The Lloyd District Transportation Management Association conducted an annual survey of the travel modes used for commuting by staff for one facility (MRC). The survey estimated greenhouse gas reductions resulting from the use of transit and bicycles. This information was only collected for commutes during one week out of the year. Since the survey was conducted during the summer, it is likely that it does not represent typical commuting patterns.

Solid Waste The waste and recycling data Metro collects was more comprehensive than other sustainability management data we reviewed, but it was collected in a way that made it difficult to use to calculate greenhouse gas emissions. Metro facilities reported the amount of waste they dispose of and recycle, but this data was not collected consistently enough to allow analysis or comparability over time. Forms requesting the weight of the waste disposed or recycled were sometimes completed with other information (e.g. the number of dumpsters, fluid quantities or a list of items). Without the weight of these items, it was not possible to use this information to determine the amount of greenhouse gases they generate.

Greenhouse Gas Emissions Metro must select an appropriate model for estimating greenhouse gas emissions. Some models were developed for businesses, which have priorities that are different from government organizations. It is important to consider comparability, completeness, and suitability to the varied types of facilities Metro operates. As the science of greenhouse gas estimation is an evolving field, different models also use different assumptions to generate their greenhouse gas estimates, and yield different results. For example, estimates of the greenhouse gas emissions produced by the St. Johns Landfill vary widely. The State of Oregon Department of Environmental Quality estimates the fugitive emissions from the St. Johns Landfill for 2007 at 19,972 metric tons (CO₂ equivalent). Metro's Sustainability Center staff believes that fugitive emissions are "negligible."

Expenditures The 2003 Council resolution required Metro to "evaluate accounting mechanisms by which departments that make the capital investment in resource-efficient materials and services are able to receive operational savings even if those savings might accrue to another department." However, information about expenditures for sustainability was not tracked in Metro's accounting system. It was also difficult to know how much staff time is devoted to managing internal sustainability, since accounting codes for sustainability activities are not included in the agency's accounting system.

Considerations and strategies to move forward

Sustainability management is a relatively new concept. The tools used to estimate impacts and manage efforts are evolving at a rapid pace, making best practices for sustainability management very dynamic. There are a variety of tools for estimating greenhouse gas emissions, reporting results and developing mitigation strategies. These tools are valuable resources but their effectiveness is dependent on the clarity of purpose, availability of data, consistency of efforts, and overarching strategy of Metro's sustainable business model. The previous sections of this report have outlined the environmental impacts, and organizational and data availability challenges of Metro's operations. Using this information, we suggest possible strategies to help Metro better manage its efforts.

Best practice research, as well as our own experiences during the audit, indicates that it is critical for Metro to have a clear understanding of two aspects of its operations to manage its sustainability efforts effectively. One is the availability of reliable data which has a large impact on the quality of estimating environmental impacts. Availability of data determines what can be measured and is critical for establishing baselines and tracking results. The other aspect is control over resource use. Metro has greater control over some parts of its operations than others.

At Metro, availability of data and control over usage varied by facility. For the most part Metro had the ability to obtain reliable data for its facilities and emissions sources although the complexity of gathering data varied by facility.

Control over resource use depended on the type of facility. For example, the Zoo and MERC have large indoor public facilities requiring considerable heating and cooling throughout the year. Metro had less control over resource use at these facilities than at others where only Metro employees worked. Metro had two types of facilities that impact the level of agency control over resource use:

- **Assembly facilities:** Oregon Convention Center, Exposition Center, Portland Center for the Performing Arts, Zoo, Regional Parks, Pioneer Cemeteries; and
- **Non-assembly facilities:** Metro Regional Center, South Transfer Station, St. Johns Landfill, Central Transfer Station, South Hazardous Waste Facility, Metro Paint.

Acknowledging and accounting for availability and control challenges is important for developing effective sustainability management strategies.

Exhibit 7
Availability-control matrix

		Control over usage		
		High control	Moderate control	Low control (or long term horizon for change)
Availability of relevant information	High availability	<ul style="list-style-type: none"> Electricity (non-assembly facilities) Natural gas (non-assembly facilities) Water (non-assembly facilities) 	<ul style="list-style-type: none"> Waste reduction (non-assembly facilities) 	<ul style="list-style-type: none"> Electricity (assembly facilities) Natural gas (assembly facilities) Water (assembly facilities) Waste reduction (assembly facilities, regional parks) Landfill gas
	Moderate availability		<ul style="list-style-type: none"> Fleet Air travel 	<ul style="list-style-type: none"> Employee commuting
	Low availability	<ul style="list-style-type: none"> Refrigerants Procurement 		

Source: Auditor's Office Analysis

Source-specific strategies should be planned

Metro's sustainability management plan should prioritize efforts based on the largest sources of emissions. If Metro is to become carbon neutral, it will need to mitigate about 32,000 metric tons of carbon equivalent emissions. Based on our greenhouse gas inventory electricity, natural gas and landfill gas flaring accounted for 91% of Metro's emissions. These three sources should be the primary targets for Metro's sustainability efforts related to carbon neutrality.

To its credit, Metro made efforts to reduce emissions from electricity consumption by implementing energy efficiency projects and purchasing renewable power credits from PGE and PacifiCorp. Metro could increase its efforts, however, to implement this requires Council direction. Our analysis indicated Metro offsets about 20% of its carbon emissions from electricity. These credits cost about \$56,000 per year, which added 2.4% to Metro's annual electricity costs. Metro could purchase renewable power credits to offset 100% of its electricity consumption. Purchasing these credits would offset 44% of Metro's total emissions, at a cost of about \$293,000 per year. Offsetting 100% would require an additional \$237,000 per year over current electricity costs, which is about 10% of Metro's annual cost for electricity. Such a purchase would require prioritizing carbon neutrality over other agency goals.

Metro was successful in reducing emissions from the St. Johns Landfill. There is a landfill gas collection system and Metro leases the gas to Portland LFC. Ash Grove Cement in turn purchases the gas from Portland LFC for use in its operations. In 2007, Ash Grove used about 48% of the gas generated at the landfill. The other 52% was flared at the landfill. If Ash Grove increased its use of landfill gas it could reduce up to 9,800 metric tons of Metro's carbon emissions. Landfill gas flaring accounted for 31% of Metro's total carbon emissions in 2007.

Another option to reduce Metro's emissions is to purchase offsets for natural gas consumption. NW Natural offers an offset program called Smart

Energy. OCC recently signed up for the program and will be purchasing credits to offset 100% of its natural gas use beginning in January 2009. Our analysis indicated it would cost an additional \$85,000 annually to offset 100% of Metro’s natural gas emissions. This represents a price premium of about 9% over current natural gas costs. Such a purchase would require Council direction.

Moving forward, Metro appears to have two complimentary strategies to target emissions from electricity, natural gas and landfill gas. One strategy focuses on reducing electricity and natural gas use by implementing energy efficiency projects and increasing the productive use of landfill gas rather than flaring. Another strategy involves increasing participation in offset programs for natural gas and electricity. Offsetting emissions from natural gas will cost Metro a little under \$20 per ton. Currently, Metro is paying on average a little over \$20 per ton to offset electricity emissions.

It is important to note that there appears to be a significant price difference between PGE and PacifiCorp offset programs. The majority of Metro’s offsets have been purchased through PacifiCorp. Our analysis indicates offsets from PacifiCorp are about \$7 cheaper than offsets from PGE on a per ton basis. Part of this price disparity is because the cost to offset electricity emissions decreases with the level of participation. Nonetheless, our analysis indicates that if Metro offset 100% of its electricity from each provider the cost per ton for PacifiCorp offsets would be about \$9 less expensive. This is important for strategy development because it might influence the relative trade-off between purchasing offsets and reducing consumption for electricity and natural gas.

Exhibit 8
Offset program cost per ton

Program	Cost per metric ton	
	Current Levels	100% offset
PGE	\$26.20 (8.6% offset)	\$25.85
PacifiCorp	\$18.75 (30% offset)	\$16.67
NW Natural	\$19.71 (26% offset beginning in 2009)	\$19.71

Source: Auditor’s Office Analysis

Facility-specific strategies

In addition to prioritizing efforts based on the sources of emissions, Metro’s sustainability plan should include strategies to address the unique challenges at each facility. During the audit, we found sustainability efforts have not addressed facility specific approaches. Without a clear understanding of each facility’s resource use and management challenges, it will be difficult for Metro to meet its long-term goals.

The Zoo, Solid Waste facilities and MERC account for 94% of Metro’s carbon emissions. Reducing emissions from these facilities will be challenging. MERC and the Zoo include large indoor spaces for public use requiring heating and cooling throughout the year. As a result, electricity and natural gas consumption were significantly higher at these facilities than others.

OCC, which is part of MERC, offers an example of how the Zoo and other MERC facilities might address their sustainability challenges. OCC has completed energy efficiency projects and purchased offsets for 39% of its electricity and 100% of its natural gas consumption. They are considering options to let events pay to offset their emissions and working on putting solar panels on their roof to reduce emissions from electricity generation. PCPA is also considering purchasing offsets for natural gas consumption and has explored options to allow performers to offset the emissions from their events.

Based on the availability-control matrix and our analysis of Metro’s facilities and emission sources, the following priority areas and strategies for each facility may help focus efforts to reach the agency’s sustainability goals.

Exhibit 9
Priority areas and possible strategies by facility

Facility	Priority Areas (% of facility emissions)	Possible Strategies
MRC	Electricity (65%) Commuting	<ul style="list-style-type: none"> • Increase offsets (currently purchasing credits for 32%) • Energy efficiency projects • Continue incentives for transit options
Solid Waste	Landfill gas (81%) Electricity (16%)	<ul style="list-style-type: none"> • Increase use of landfill gas for industrial purpose • Energy efficiency projects • Increase offsets (currently purchasing credits for 30%)
Regional Parks	Fleet fuel (45%) Recycling rate (low impact but important for regional leadership)	<ul style="list-style-type: none"> • Continue efforts to reduce fleet fuel usage • Work with Sustainability Center and ENACT to increase recycling rates
Zoo	Water (76% of all Metro water use) Electricity (55%) and natural gas (30%)	<ul style="list-style-type: none"> • Explore water reduction/reuse options • Energy efficient projects • Purchase offsets
OCC	Electricity (76%) Natural gas (19%) Recycling rate (low impact but important for regional leadership)	<ul style="list-style-type: none"> • Increase offsets for electricity (currently purchasing credits for 39%) • Continue to purchase offsets for natural gas (starting Jan. 2009 will begin purchasing credits for 100%) • Work with Metro Sustainability Center to develop a plan to increase recycling rates
Expo	Electricity (68%) and Natural gas (29%) Recycling rate (low impact but important for regional leadership)	<ul style="list-style-type: none"> • Purchase offsets for electricity and natural gas • Energy efficiency projects • Work with Metro Sustainability Center to develop a plan to increase recycling rates
PCPA	Electricity (63%) and Natural gas (27%) Recycling rate (low impact but important for regional leadership)	<ul style="list-style-type: none"> • Increase purchase offsets (currently purchasing credits for 9%) • Purchase offsets for natural gas • Energy efficiency projects • Work with Metro Sustainability Center to develop a plan to increase recycling rates

Source: Auditor’s Office Analysis

Use efforts to demonstrate leadership

In the 2008 resolution, Metro Council instructed management to make sustainability the guiding principle for all its programs. As such, Metro has the opportunity to demonstrate successful sustainable business practices for the region. To provide this leadership, Metro will need to make sure it is meeting its goals and demonstrating cost-effective sustainability management.

During the audit, we found that there is a general belief that additional steps are needed to ensure that Metro is seen as a regional leader for sustainable operations. Metro's role in planning regional transportation, land use, and solid waste disposal provide ample opportunity to lead by example, yet there is a perception that the agency is not doing enough to "walk its talk." Without clear leadership, Metro risks losing credibility in the region which could undermine its ability to achieve its mission.

Reaching the long-term goals Metro has established for itself is one way to demonstrate leadership. Metro facilities, and the agency as a whole, are below the regional waste recovery goal. Even though emissions from solid waste are not a large component of Metro's carbon footprint, it is important for the agency to meet or exceed the regional goal.

Metro could also demonstrate leadership for sustainability management by publicizing the results of its pilot/demonstration projects on the web to help inform best practices for sustainability. Metro has implemented several innovative projects including the green roof at MRC, LEED certification at OCC, the landfill gas collection system at St. Johns Landfill, composting programs at MRC and OCC, and bonuses for reaching recycling goals in union contracts at OCC. Metro should make an effort to document the processes, challenges and successes, and results of these projects so that others can learn from Metro's innovative efforts.

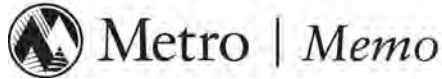
RECOMMENDATIONS

Recommendations

For Metro to provide regional leadership, demonstrate best management practices and meet its sustainability goals in a cost-effective way, the agency should address the following recommendations.

- 1. To develop clear policies and goals for agency sustainability;**
 - a. The Metro Council should specify the price premium it is willing to pay for sustainability activities related to its internal business operations.
 - b. Create an agency-wide sustainability plan that includes:
 1. Measurable short-term goals and objectives
 2. A strategy to prioritize, by facility and utility type, the highest impact areas
 3. Options to expand the use of landfill gas from St. Johns Landfill gas recovery system when the current lease agreement expires in 2012
 4. Strategies to ensure that Metro is meeting or exceeding regional recycling goals
- 2. To reduce organizational barriers, Metro should establish:**
 - a. Written roles and responsibilities for the various groups working on sustainability management at Metro (e.g. ENACT, Sustainability Coordinators, Green Teams and department managers).
 - b. A funding structure that enables effective sustainability management.
- 3. To ensure it has the tools needed to implement a sustainable business model, Metro should:**
 - a. Develop a data management system that can track the major sources of greenhouse gas emissions and water use.
 - b. Assess costs and potential economic and environmental benefits of sustainability activities.
 - c. Standardize the protocols used to estimate greenhouse gas emissions for internal operations and projects.
 - d. Utilize staff expertise and resources in the Sustainability Center to help managers develop strategies to increase recycling.
- 4. To measure progress towards meeting objectives and disseminate results of its efforts, Metro should:**
 - a. Issue regular sustainability reports.
 - b. Collect and analyze data to measure progress towards its sustainability goals.
 - c. Publish results of its innovative demonstration projects to help inform best practices for sustainability management and provide leadership in the region.

MANAGEMENT RESPONSE



Date: Feb. 9, 2009

To: Suzanne Flynn, Metro Auditor

From: Michael Jordan, Chief Operating Officer
Scott Robinson, Deputy Chief Operating Officer
David Woolson, Chief Executive Officer, MERC
Kathy Taylor, Chief Operating Officer, MERC
Jim Desmond, Director, Sustainability Center
Teri Dresler, Director, Parks and Environmental Services

CC: Matt Korot, Program Director, Resource Conservation & Recycling
Molly Chidsey, Sustainability Coordinator

Re: Sustainability Management Audit

This memorandum is management's response to the final audit report transmitted by your office on Jan. 23, 2009. We appreciate this thoughtful insight and recommendations as Metro builds a sustainability program for its operations.

After reviewing available data on resource use and investigating the methods by which Metro has managed its sustainability program for internal operations, the report finds that the program has made some progress toward sustainable operations. However, the primary conclusion is that a more focused, organized, and strategic approach is needed if Metro is to meet or exceed its goals and be a model for sustainable business operations.

We agree with this finding and believe that Metro's actions over the past year demonstrate that this approach is being implemented. The Metro Council's sustainability resolution in spring 2008, the creation of new Metro and Oregon Convention Center sustainability coordinator positions, and a number of other actions have positioned us to take significant steps to enhance the sustainability of Metro's operations.

Response to Recommendations in the Auditor's Report

The following summarizes the Sustainability Center's response to the specific recommendations in the Auditor's report.

Recommendation 1:

To develop clear policies and goals for its sustainability:

- A. The Metro Council should specify the price premium it is willing to pay for sustainability activities related to its internal business operations.

Response:

This recommendation is directed to the Metro Council. The Chief Operating Officer could provide the Council with information on the relative benefits and costs of specific sustainability activities that could assist Council in its decision-making. Given the variety of Metro operations, these benefits and costs may vary significantly by facility. For example, costs could be high to implement certain changes at some MERC facilities due to the relative age and condition of those facilities.

B. Create an agency-wide sustainability plan that includes:

1. Measurable short-term goals and objectives.

Response:

Metro, now staffed by Molly Chidsey, Metro's Sustainability Coordinator, is developing an agency-wide sustainability plan. This plan will include interim goals and objectives by which Metro can measure progress toward the Council-adopted goals.

2. A strategy to prioritize, by facility and utility type, the highest impact areas.

Response:

We agree that that the plan should prioritize the areas in which Metro's operations have the most significant environmental and sustainability impacts.

3. Options to expand the use of landfill gas from St. John's landfill gas recovery system.

Response:

Parks and Environmental Services will explore potential options when Metro's contract with Ash Grove Cement for use of the landfill gas expires in 2012.

4. Strategies to ensure that Metro is meeting or exceeding regional recycling goals.

Response:

The audit report notes a range of recycling performance across Metro's different facilities and locations. Actions taken during 2008 included completion of waste composition studies at several Metro locations. Waste reduction and recycling efforts can now be targeted to areas of greatest need. Metro and MERC staff will continue to work to implement the most effective best management practices to increase recycling levels at these locations and integrate waste reduction into the sustainability plan.

Recommendation 2:

To reduce organizational barriers, Metro should establish:

- A. Written roles and responsibilities for the various groups working on sustainability management at Metro (e.g. ENACT, Sustainability Coordinators, Green Teams and department managers).

Response:

We agree that roles should be more clearly defined. We can report that this work began with the hiring of Metro's Sustainability Coordinator in fall 2008 and will also be integrated into the sustainability plan.

- B. A funding structure that enables effective sustainability management.

Response:

The Chief Operating Officer will make funding recommendations to Council through the annual budget process.

Recommendation 3:

To ensure it has the tools needed to implement a sustainable business model, Metro should:

- a. Develop a data management system that can track the major sources of greenhouse gas emissions and water use.

Response:

As part of Metro's climate initiative work, the Research Center is developing greenhouse gas emission models and data management systems that will also be applicable to Metro's internal operations. We will look into the feasibility of an analogous system for water use.

- b. Assess costs and potential economic and environmental benefits of sustainability activities.

Response:

The intent of the sustainability plan under development is to provide a framework in which to prioritize actions Metro can take to improve its operations. This prioritization will necessarily include an assessment of relative benefits and costs.

- c. Standardize the protocols used to estimate GHG emissions for internal operations and projects.

Response:

This will be achieved as a result of the work that the Research Center is doing on Metro's climate initiative.

- d. Utilize staff expertise and resources in the Sustainability Center to help managers develop strategies to increase recycling.

Response:

We agree that expertise of Metro staff should be tapped. To this end, Metro's new Sustainability Coordinator is placed in the Resource Conservation and Recycling section of the Sustainability Center. Participation on this team will ensure that internal operations mirror Metro's programs for influencing behavior change toward recycling and sustainable practices in the region.

Recommendation 4:

To measure progress towards meeting objectives and disseminate results of its efforts, Metro should:

- a. Issue regular sustainability reports.
- b. Collect and analyze data to measure progress towards its sustainability goals.

Response:

The Sustainability Center will coordinate the collection and analysis of data from all Metro departments and facilities, and provide a sustainability status report to Council on an annual basis.

- c. Publish results of its innovative demonstration projects on the web to help inform best practices for sustainability management and provide leadership in the region.

Response:

Agreed.

APPENDIX

APPENDIX

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I. Greenhouse Gas Inventory

A. Determining Metro’s Organizational Boundaries

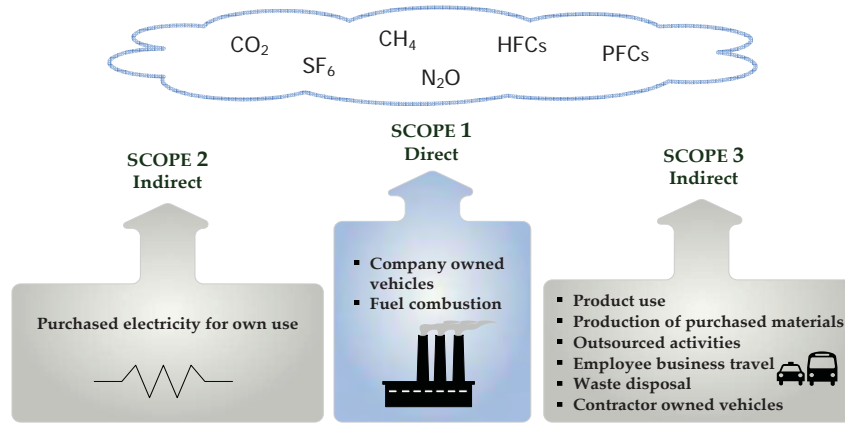
Metro owns and operates office buildings, a convention center, an exposition center, performing arts venues, a zoo, regional parks, cemeteries, solid waste transfer facilities, a paint recycling center, and a landfill. Each of these facilities generates carbon emissions. According to best practices¹, it is important to identify the sources of emissions and choose a scope for accounting and reporting emissions. Scopes are typically grouped into three categories.

- Scope 1:** All direct greenhouse gas (GHG) emissions (with the exception of direct CO₂ emissions from biogenic sources).
- Scope 2:** Indirect GHG emissions associated with the consumption of purchased or acquired electricity, steam, heating, or cooling.
- Scope 3:** All other indirect emissions not covered in Scope 2, such as emissions resulting from the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity (e.g. employee commuting and business travel), outsourced activities, waste disposal, etc.

Together, the three scopes provide a comprehensive accounting framework for managing and reducing direct and indirect emissions.

¹ ICLEI-Local Governments for Sustainability, “Local Government Operations Protocol” (September 2008, Version 1)
<http://www.icleiusa.org/programs/climate/ghg-protocol>

Exhibit 10
Overview of scopes
and emission sources



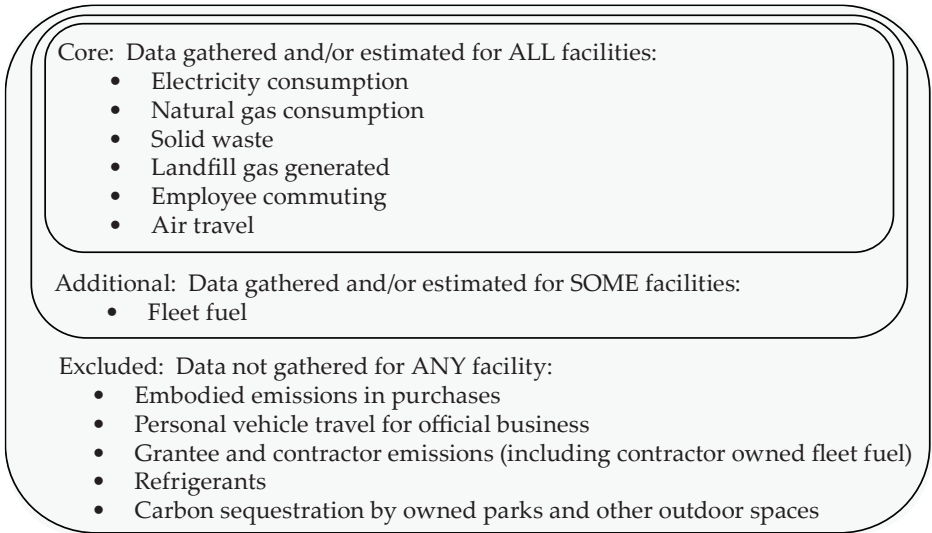
Source: Derived from the WRI/WECS D GHG Protocol Corporate Standard, Chapter 4 (2004)

Our analysis attempted to estimate all three scopes but due to data limitations, we were unable to estimate some emissions in scope three, like production of purchased materials and contractor owned vehicles. It is also important to note that inventory focused exclusively on CO₂, CH₄ and N₂O emissions. We were unable to get reliable data for other greenhouse gas emissions like SF₆, HFCs and PFCs. Below is a summary of the Metro facilities used to set the organizational boundary for our analysis.

Exhibit 11
Facilities included in
GHG inventory

Facility Name	Facility Description
Metro Regional Center	Office building
Solid Waste Processing Facilities	Transfer facilities (South and Central) Hazardous waste processing (South and Central) Paint Recycling (Metro Paint) St. Johns Landfill
Regional Parks	Oxbow Blue Lake Smith and Bybee Lakes Mt. Talbert Nature Park Howell Territorial Park Beggars-tick Wildlife Refuge Glendoveer Golf Course Boating facilities Pioneer Cemeteries Native Plant Center
Oregon Convention Center	Largest convention center in the Pacific Northwest
Portland Metropolitan Exposition Center	Seven multi-purpose event halls
Portland Center for the Performing Arts	Arlene Schnitzer Concert Hall Keller Auditorium Newmark Theatre Dolores Winningstad Theatre
Oregon Zoo	64 acre zoo

Exhibit 12
Metro greenhouse gas
inventory boundaries



B. Time frame for data sources

To make comparisons among sources of greenhouse gas generation, data on utility use was collected for use in this report. For emissions sources for air travel and solid waste, data from fiscal year 2007 was used. Water data used in this report is also from fiscal year 2007.

For the following sources, data was not available for fiscal year 2007, and calendar year 2007 data was used:

- Electricity
- Natural gas
- Fleet fuel
- St. Johns Landfill

The commute estimate was based on the employee list as of October 6, 2008.

C. Emissions from Natural Gas

The methodology used to estimate emissions from Metro’s natural gas consumption is based on ICLEI’s Local Government Operations Protocol (September 2008, Version 1) using data from NW Natural.

Data was collected from NW Natural for Metro’s accounts at the following facilities:

- MRC
- Zoo
- Metro Paint
- OCC
- Expo
- Howell Territorial Park
- PCPA
- Glendoveer Golf Course

² Diagram adapted from “Oregon University System Greenhouse Gas Inventory” (July 2007).
http://www.oregon.gov/ENERGY/GBLWRM/docs/OUS_GHG_Inventory.pdf

The following steps were completed using the data supplied by NW Natural. The steps are based on ICLEI Protocol 6.1.1 Recommended Approach.

Step 1: Determine annual consumption of each fuel combusted at your facilities. Note: NW Natural data was in therms. Converted therms to MMBtus using Equation 6.14 from ICLEI’s Protocol.

Equation 6.14	Converting steam consumption from therms to MMBtu
Energy Consumption (MMBtu)	= Energy Consumption (therms) x 0.1 (MMBtu/therm)

Step 2: Select the appropriate CO₂ emission factor for each fuel.

Factor for fossil fuel combustion (ICLEI Table G.1)

Fuel type	CO ₂ emission factor (per unit energy)
Natural gas (by heat content)	kgCO ₂ /MMBtu
Weighted U.S. Avg	53.06

Step 3: Determine the appropriate CH₄ and N₂O emission factors for each fuel.

Factors by fuel type and sector (ICLEI Table G.3)

Fuel type / End-use Sector	CH ₄ (g/MMBtu)	N ₂ O (g/MMBtu)
Natural gas		
Commercial/Institutional	5	0.1

Note: “For most local government operations, you will use the “commercial/institutional” sector emissions factors.”

Step 4: Calculate each fuel’s CO₂ emissions and convert to metric tons.

Equation 6.2	Calculating CO ₂ emissions from stationary combustion (fuel use in gallons)
Fuel A CO₂ Emissions (metric tons) = Fuel Consumed (gallons) x Emission Factor (kg CO ₂ /gallon) ÷ 1,000 (kg/metric ton)	
Fuel B CO₂ Emissions (metric tons) = Fuel Consumed (gallons) x Emission Factor (kg CO ₂ /gallon) ÷ 1,000 (kg/metric ton)	
Total Emissions (metric tons) = CO ₂ from Fuel A (metric tons) + CO ₂ from Fuel B (metric tons) + . . . (metric tons)	

³ Available online at <http://www.icleiusa.org/programs/climate/ghg-protocol>.

Step 5: Calculate each fuel's CH₄ and N₂O emissions and convert to metric tons.

Equation 6.3	Calculating CH ₄ emissions from stationary combustion
Fuel/Sector A	
CH ₄ Emissions = Fuel Use x Emission Factor ÷ 1,000,000 (metric tons) (MMBtu) (g CH ₄ /MMBtu) (g/metric ton)	
Fuel/Sector B	
CH ₄ Emissions = Fuel Use x Emission Factor ÷ 1,000,000 (metric tons) (MMBtu) (g CH ₄ /MMBtu) (g/metric ton)	
Total CH₄ Emissions (metric tons) = CH ₄ from Type A + CH ₄ from Type B + ... (metric tons) (metric tons) (metric tons)	

Equation 6.4	Calculating N ₂ O emissions from stationary combustion
Fuel/Sector A	
N ₂ O Emissions = Fuel Use x Emission Factor ÷ 1,000,000 (metric tons) (MMBtu) (g N ₂ O/MMBtu) (g/metric ton)	
Fuel/Sector B	
N ₂ O Emissions = Fuel Use x Emission Factor ÷ 1,000,000 (metric tons) (MMBtu) (g N ₂ O/MMBtu) (g/metric ton)	
Total N₂O Emissions (metric tons) = N ₂ O from Type A + N ₂ O from Type B + ... (metric tons) (metric tons) (metric tons)	

Step 6: Convert CH₄ and N₂O emissions to units of CO₂ equivalent and determine total emissions from stationary combustion.

Equation 6.5	Converting to CO ₂ e and determining total emissions
CO₂ Emissions (metric tons CO ₂ e)	= CO ₂ Emissions x 1 (metric tons) (GWP)
CH₄ Emissions (metric tons CO ₂ e)	= CH ₄ Emissions x 21 (metric tons) (GWP)
N₂O Emissions (metric tons CO ₂ e)	= N ₂ O Emissions x 310 (metric tons) (GWP)
Total Emissions (metric tons CO ₂ e)	= CO ₂ + CH ₄ + N ₂ O (metric tons CO ₂ e)

D. Emissions from Electricity

The methodology used to estimate emissions from Metro's electricity consumption is based ICLEI's Local Government Operations Protocol (September 2008, Version 1) using data from Portland General Electric (PGE) and PacifiCorp (the parent company of PacificPower). Data was collected for Metro's accounts at the following facilities:

PGE	PacifiCorp
<ul style="list-style-type: none"> Regional Parks Solid Waste Expo Center Zoo 	<ul style="list-style-type: none"> Metro Regional Center PCPA OCC

Step 4: Convert total annual emission to metric tons of carbon dioxide equivalent.

Equation 6.9	Converting to CO ₂ equivalent and determining total emissions	
CO ₂ Emissions (metric tons CO ₂ e)	=	CO ₂ Emissions (metric tons) x 1 (GWP)
CH ₄ Emissions (metric tons CO ₂ e)	=	CH ₄ Emissions (metric tons) x 21 (GWP)
N ₂ O Emissions (metric tons CO ₂ e)	=	N ₂ O Emissions (metric tons) x 310 (GWP)
Total Emissions (metric tons CO ₂ e)	=	CO ₂ + CH ₄ + N ₂ O (metric tons CO ₂ e)

E. Emissions from Fleet Fuel

The methodology used to estimate emissions from Metro’s fleet fuel consumption (i.e. mobile sources) is based on ICLEI’s Local Government Operations Protocol (September 2008, Version 1) using data from the following sources:

Exhibit 13
Fleet fuel types and sources by facility

Facility	Fuel Type	Data Sources
Metro Regional Center	<ul style="list-style-type: none"> • Diesel • Gasoline • Ethanol (E10) • Ethanol (E85) 	<ul style="list-style-type: none"> • Voyager card • State of Oregon, Dept of Administrative Services
Zoo	<ul style="list-style-type: none"> • Diesel • Gasoline • Propane 	<ul style="list-style-type: none"> • AmeriGas Propane • Don Thomas Petroleum
OCC	<ul style="list-style-type: none"> • Diesel • Gasoline • Propane 	<ul style="list-style-type: none"> • Transaction receipts
Expo	<ul style="list-style-type: none"> • Diesel • Ethanol (E10) • Ethanol (E8) • Biodiesel (B5) 	<ul style="list-style-type: none"> • Star Oil Company
Parks	<ul style="list-style-type: none"> • Diesel • Gasoline • Biodiesel (B20) • Motor oil 	<ul style="list-style-type: none"> • Don Thomas Petroleum • Multnomah County • Voyager card
Solid Waste	<ul style="list-style-type: none"> • Diesel • Gasoline • Ethanol (E10) • Ethanol (E8) • Biodiesel (B20) • Biodiesel (B5) • Propane 	<ul style="list-style-type: none"> • FerrellGas Propane • Don Thomas Petroleum • Star Oil Company • PetroCard • Legacy Propane

Note: Obtaining fuel consumption data was challenging. Each Metro facility has a slightly different method for purchasing fuel and no facilities appear to be actively tracking their fuel consumption. The accounting systems used to track and pay for fuel varies by department/facility and within departments. In some cases fuel is purchased by individuals using procurement cards or fuel cards (e.g. Voyager, PetroCard) while at others fuel is delivered on site (e.g. Solid Waste, Parks). The process is further complicated because some MRC vehicles are billed through the State of Oregon and some Parks vehicles are billed through Multnomah County. Another complication is that fuel vendors vary by facility so obtaining data for a given period of time requires contacting multiple providers for each facility.

Another challenge was determining how complete and accurate the records were for each facility. Without a detailed vehicle and equipment inventory, it is difficult to know the type of fuel that is used by each asset. To overcome this challenge, expenditure data from Metro’s PeopleSoft accounting system was used to determine the vendor names associated with fuel and lubricant purchases over the last two years. Depending on how the purchases are coded, it is possible that some vendors were not identified using this method. For example, fuel and lubricants are purchased for Parks vehicles, but they are billed through vendor Multnomah County. Conversely, Solid Waste purchases fuel and lubricants for its contracted haulers but these costs are passed on to the contractor. We did not use this method for MERC facilities (OCC, PCPA and Expo) because they use a different accounting system (EBMS) which was not readily accessible. The fleet at these facilities appears to be relatively small. No data was readily available for PCPA. As a result, it is possible that fleet fuel emissions are underestimated for MERC facilities.

The following steps were completed using the data detailed above. The steps are based on ICLEI Protocols: 7.1.1.1 Recommended Approach; 7.1.2 CO₂ Emissions from Vehicles Combusting Biofuels; and 7.1.3.1 Recommended Approach.

Step 1: Identify total annual fuel consumption by fuel type.

Step 2: Determine the appropriate CO₂ emission factor for each fuel.

Factors for Transport Fuels (ICLEI Table G.9)

Fuel Type	Carbon content (per unit energy)	Heat content	Fraction oxidized	CO ₂ emission factor (per unit volume)
Fuels measured in gallons	kg C/MMBtu	MMBtu / barrel		kg CO ₂ / gallon
Crude oil	20.33	5.8	1	10.29
Disel fuel No. 1 and 2	19.95	5.825	1	10.15
Propane	17.2	3.824	1	5.74
Motor gasoline	19.33	5.218	1	8.81
Non-fossil fuels	kg C/MMBtu	MMBtu / barrel		kgCO₂ / gallon
Biodiesel (B100) +	N/A	N/A	1	9.46
Ethanol (E100) +	17.99	3.539	1	5.56

Step 3: Calculate CO₂ emissions and convert to metric tons.

Equation 7.2	Calculating CO ₂ emissions from mobile combustion
Fuel A CO₂ Emissions (metric tons) =	
Fuel Consumed x Emission Factor ÷ 1,000	
(gallons) (kg CO ₂ /gallon) (kg/metric ton)	
Fuel B CO₂ Emissions (metric tons) =	
Fuel Consumed x Emission Factor ÷ 1,000	
(gallons) (kg CO ₂ /gallon) (kg/metric ton)	
Total CO₂ Emissions (metric tons) =	
CO ₂ from Fuel A + CO ₂ from Fuel B + . . .	
(metric tons) (metric tons) (metric tons)	

Step 4: Identify the vehicle type, fuel type, and technology type or model year of all the vehicles you own and operate.

Note: This was the final step completed for the majority of Metro’s emissions from fleet fuel consumption. As a result our emissions estimates for fleet fuel are in metric tons of CO₂, not CO₂e. Data for miles driven by vehicle type is required to calculate CO₂e resulting from N₂O and CH₄ emissions. We were only able to calculate N₂O and CH₄ emissions for Metro’s fleet that is leased through the State of Oregon due to insufficient data related to miles traveled and vehicle type. Our estimates for N₂O and CH₄ emissions indicate that these two emissions sources account for about 3% of CO₂e emissions for this subset of Metro’s fleet. As result, we may have underestimated fleet fuel emissions by up to 3%.

Step 5: Identify the annual mileage by vehicle type.

Step 6: Select the appropriate emission factor for each vehicle type.

Factors for Highway Vehicles by Model Year (ICLEI Table G.10)

Vehicle Type	Year	N ₂ O (g/mi)	CH ₄ (g/mi)
Gasoline passenger cars			
Model Years	1984-1993	0.0647	0.0704
Model Year	1994	0.056	0.0531
Model Year	1995	0.0473	0.0358
Model Year	1996	0.0426	0.0272
Model Year	1997	0.0422	0.0268
Model Year	1998	0.0393	0.0249
Model Year	1999	0.0337	0.0216
Model Year	2000	0.0273	0.0178
Model Year	2001	0.0158	0.011
Model Year	2002	0.0153	0.0107
Model Year	2003	0.0135	0.0114
Model Year	2004	0.0083	0.0145
Model Year	2005	0.0079	0.0147
Gasoline light trucks (vans, pickup trucks, SUV’s)			
Model Year	1987-1993	0.1035	0.0813
Model Year	1994	0.0982	0.0646
Model Year	1995	0.0908	0.0517
Model Year	1996	0.0871	0.0452
Model Year	1997	0.0871	0.0452
Model Year	1998	0.0728	0.0391
Model Year	1999	0.0564	0.0321
Model Year	2000	0.0621	0.0346
Model Year	2001	0.0164	0.0151
Model Year	2002	0.0228	0.0178
Model Year	2003	0.0114	0.0155
Model Year	2004	0.0132	0.0152
Model Year	2005	0.0101	0.0157
Diesel passenger cars			
Model Year	1960-1982	0.0012	0.0006
Model Year	1983-2004	0.001	0.0005
Diesel light trucks			
Model Year	1960-1982	0.0017	0.0011
Model Year	1983-1995	0.0014	0.0009
Model Year	1996-2004	0.0015	0.001

Step 7: Calculate CH₄ and N₂O emissions by vehicle type and sum to obtain total CH₄ and N₂O emissions.

Equation 7.6	Calculating CH ₄ emissions from mobile combustion
Vehicle Type A CH₄ Emissions (metric tons) = Annual Distance x Emission Factor ÷ 1,000,000 (miles) (g CH ₄ /mile) (g/metric ton)	
Vehicle Type B CH₄ Emissions (metric tons) = Annual Distance x Emission Factor ÷ 1,000,000 (miles) (g CH ₄ /mile) (g/metric ton)	
Total CH₄ Emissions = CH ₄ from Type A + CH ₄ from Type B + . . . (metric tons) (metric tons) (metric tons)	

Equation 7.7	Calculating N ₂ O emissions from mobile combustion
Vehicle Type A N₂O Emissions (metric tons) = Annual Distance x Emission Factor ÷ 1,000,000 (miles) (g N ₂ O/mile) (g/metric ton)	
Vehicle Type B N₂O Emissions (metric tons) = Annual Distance x Emission Factor ÷ 1,000,000 (miles) (g N ₂ O/mile) (g/metric ton)	
Total N₂O Emissions = N ₂ O from Type A + N ₂ O from Type B + . . . (metric tons) (metric tons) (metric tons)	

Step 8: Convert CH₄ and N₂O emissions to units of CO₂ equivalent and determine total emissions from mobile combustion.

Equation 7.8	Converting to CO ₂ equivalent and determining total emissions
CO₂ Emissions (metric tons CO ₂ e) =	CO ₂ Emissions x 1 (metric tons) (GWP)
CH₄ Emissions (metric tons CO ₂ e) =	CH ₄ Emissions x 21 (metric tons) (GWP)
N₂O Emissions (metric tons CO ₂ e) =	N ₂ O Emissions x 310 (metric tons) (GWP)
Total Emissions (metric tons CO ₂ e) =	CO ₂ + CH ₄ + N ₂ O (metric tons CO ₂ e)

F. Emissions from St. Johns Landfill

Two estimates of the greenhouse gases produced by the St. Johns Landfill were reviewed. One was prepared by Rob Smoot, a Senior Engineer in Metro's Parks and Environmental Services, and the other by David Allaway, Senior Policy Analyst at the Oregon State Department of Environmental Quality. The estimate prepared by Rob Smoot was used in the analysis because it was supported by a more comprehensive explanation of how it was calculated than the estimate from David Allaway. However, the estimate from David Allaway is also presented here in order to provide a complete representation of the available data.

Exhibit 14
Comparison of
emission estimates

	Smoot estimate (metric tons CO ₂ equivalent)	Allaway estimate (metric tons CO ₂ equivalent)
Flare emissions	9,807	9,807 (from Smoot estimate)
Fugitive emission	~ 0	19,192
Total emissions from St. Johns Landfill in calendar year 2007	9,807	28,999

The following description of the landfill gas collection system used at St. Johns Landfill is taken from Metro's brochure: *Fueling the Future: St. Johns gas pipeline*.

"The landfill gas is kept from escaping into the atmosphere by creating a vacuum beneath the landfill cover and drawing out the gas through a network of vertical and horizontal (trench) wells. Each of the wells is connected by a web of pipelines to the motor blower/flare facility, which creates the vacuum. Metro began collecting and flaring gas from the landfill in 1993.

The landfill cover includes a plastic cap, which prevents air from infiltrating the landfill as the gas is removed and creating a condition in which underground fires can start. The cap also prevents rainwater from leaching contaminants into groundwater.

Most of the wells are drilled to the bottom of the refuse, while horizontal wells are constructed in the top few feet of the waste. The spacing and location of the wells efficiently removes gas from all areas of the landfill.

Moisture is removed from the landfill gas by collecting "condensate" at low points throughout the landfill and at tanks at the motor blower/flare facility. If the moisture was not removed, it would block the flow of gas. The blowers move the gas to the compressor station, where the gas is compressed and chilled to remove any remaining moisture before entering the pipeline: A dedicated 9,400-foot pipeline delivers the gas to Ash Grove Cement Co., almost two miles away."

Metro estimate

Rob Smoot, the engineer with the Solid Waste department, estimated that the total amount of gas collected at St. Johns Landfill was 399,798,720 cubic feet. 193,232,922 cubic feet was sent to Ash Grove Cement, and the remainder, 206,565,798 was burned at the flare facility.

Exhibit 15
Gas allocation at
St. Johns Landfill

Metro 2007		Ash Grove 2007		Flared 2007	
gas (CF)	methane (CF)	gas (CF)	methane (CF)	gas (CF)	methane (CF)
399,798,720	201,936,257	193,232,922	110,143,517	206,656,798	91,792,1740

Based on those measurements, he estimates that the flare facility produced 9,807 metric tons (CO₂ equivalent) during calendar year 2007.

Exhibit 16
CO₂ equivalence
calculation

Volume	Description
399,798,720	cubic feet(cf) landfill gas generated in 2007
193,232,922	cf gas to Ash Grove in 2007
206,565,798	cf gas to flare in 2007
50%	approximate methane in landfill gas
103,282,899	cf methane flared in 2007
1.7	CO ₂ factor
175,580,929	cf CO ₂ from flared landfill gas in 2007
0.116	lbs. CO ₂ per cubic foot
20,367,388	lbs. CO ₂ from flared landfill gas in 2007
0.00002	lbs. NOx per cf landfill gas flared
4.214	lbs. NOx from flared landfill gas in 2007
296.0	CO ₂ equivalence per NOx
1,247,327	lbs. CO ₂ equivalence from NOx
9,807	metric tons of CO ₂ equivalence from landfill flare in 2007

Rob Smoot supplied the following additional notes to support his calculations:

One mole of methane, CH₄, burns in air to form one mole of carbon dioxide, CO₂, plus two moles of water, 2H₂O, plus 7.53 moles of nitrogen, N₂.

If all the methane in the landfill gas is burned an equal volume of carbon dioxide will be created.

Landfill gas is about 50% methane and 35% carbon dioxide. If this ratio stays the same, then carbon dioxide is about 70% of the value of the methane in landfill gas. Therefore the volume of carbon dioxide created by burning landfill gas is about 1.7 times its methane content.

Nitrogen oxides also contribute to greenhouse gas at about 296 CO₂ equivalence per NOx (from EPA website). The emission factor for NOx creation in burning landfill gas is 2.04 x 10⁻⁵ pounds per cf of landfill gas burned (from source testing).

Allaway estimate

David Allaway is a Senior Policy Analyst of the Oregon Department of Environmental Quality Solid Waste Policy & Program Development division. The main difference between his estimate and the one provided by Robert Smoot is how fugitive emissions are treated. Mr. Smoot believes that the gas capture system gets most of the gas generated by the landfill and that gas that escapes into the atmosphere (beyond the gas burned in the flare facility) is negligible. Mr. Allaway believes that about 30% of the greenhouse gases generated from landfills escape into the atmosphere as fugitive emissions. This assumption was developed by DEQ based on a combination of gas collection reports, modeled generation rates, and the professional judgment by DEQ staff. He stated that this assumption is used in and is consistent with the State's Greenhouse Gas Emissions Inventory. Mr. Allaway estimated that in 2007, an additional 1,048 short tons of methane were emitted from the St. Johns Landfill. This converts to 22,015.54 short tons carbon equivalent, using the conversion factor of 21. The conversion factor of 0.90718474 was used to convert this number to 19,192 metric tons (CO₂ equivalent).

G. Emissions from employee commuting

Greenhouse gases generated by employee commuting during one year were estimated using the following method:

1. Audit staff requested and received a list of employee addresses from Metro Human Resources. This file was a one-day snapshot of all Metro employees as of October 6, 2008. Measures were taken to maintain employee confidentiality.
2. Addresses for work sites were determined. Geographically central locations were used in place of a work site address in cases where the employees typically report to more than one work site (Pioneer Cemeteries, PCPA, and Demonstration Garden).
3. Audit staff requested assistance from the Data Resource Center to determine the distances between work facilities and home addresses. Planning Department staff generated a file of commute distances using the home and work addresses with Metro's travel model. This model currently uses 1998 transportation analysis zones (TAZs) to represent the four metro area counties (Clackamas, Multnomah, Washington, Clark). Distances were extracted from Metro's 2005 model by associating employee residences and worksites with the TAZs in which they are located. Trip distances were calculated from the shortest path, in miles, between employee residence TAZs and worksite TAZs.
4. There were several addresses for which trip distances could not be calculated using the above method. Audit staff used Google Maps to obtain travel distance for these addresses. In cases where only post office boxes or out-of-state addresses were available, the average commute distance for all other employees at that site was used, since that is likely to be closer to the actual commute distance than zero.
5. Adjustments for seasonal Zoo workers were made based on information provided by Zoo staff (377 out of the 745 Zoo employees in the file were seasonal employees who work an average of 68.32 days per year, and 49% of them use mass transit to get to work). Zoo staff also provided estimates of employee bicycle commuting to the Zoo.
6. An adjustment to trip distances was made for the estimated percentage of employees who commute by bicycle. This was based on commute percentages from 2005 American Community Survey, US Census Bureau. Other estimates of bicycle commuting (for example, the Lloyd District TMA estimate) were not judged to be sufficiently accurate to use, except in the case of the Zoo, who had year-round estimates of commute mode.
7. Audit staff used survey results and raw data from the MRC transportation surveys from the Lloyd District Transportation Management Association along with census information to estimate the proportion of people using 2 and 3 person carpools. This information was not used to estimate overall proportions of bike and carpool commuters, since it estimated percentages of employees at MRC only, and only for one week during the month of June. The census estimate was judged to be more accurate and reliable. Adjustments were made to the total commute distance for carpool users as follows:
 - a. The percentage of Portland commuters using carpools from the 2005 American Community Survey (US Census Bureau) was 10.4%.
 - b. The percentage of Metro Regional Center commuters from the 2007 Lloyd District TMA survey was 8.9% for 2-person carpools and 2.4% for 3-person carpools.

- c. The Lloyd TMA proportions of 2- and 3-person carpools was used to apportion the census estimate for general carpooling into those two groups was used to get a more accurate estimate of carpool commute distances as follows.

Taken together, the 2- and 3-person carpool users added up to 11.3% (from Lloyd TMA survey)

$$8.9\% + 2.4\% = 11.3\%$$

Out of the 10.4% that use carpools (from Census data), the proportion of them that used 2-person carpools is:

$$\frac{(8.9\% \times 10.4\%)}{11.3\%} = 8.19\%$$

The balance of the 10.4% of carpoolers (3-car carpools) is:

$$10.4\% - 8.19\% = 2.21\%$$

This results in an estimate of 8.9% of employees using 2-person carpools and 2.21% of employees using 3-person carpools.

- 8. An estimate of the daily round trip distance for all employees at each site was made by doubling the calculated distance between the home address and the work site.
- 9. Based on the estimated number of miles travelled, daily fuel consumption was estimated using a fuel efficiency of 22.4 mpg based on information from the Bureau of Transportation Statistics.
- 10. Based on that estimate of fuel consumption, daily greenhouse gas generation was estimated using the ICLEI Model for Local Governments. This included:
 - a) an estimate of CO₂ emissions (kg) at 8.81 kg per gallon of gasoline used
 - b) an estimate of CH₄ (methane) emissions at 0.041901 grams per mile travelled
 - c) an estimate of N₂O emissions at 0.037975 grams per mile travelled.
- 11. Daily CH₄ and N₂O emissions were converted to CO₂ equivalents.
- 12. Total daily CO₂ equivalents for CO₂, N₂O and CH₄ added together.
- 13. Daily greenhouse gas generation estimates were converted to an annual estimate using a conversion factor of 261 working days per year.

H. Emissions from air travel

Greenhouse gas generation from Metro employee air travel was estimated for this report. Due to the difficulty of identifying air travel expenditures in the accounting system, the estimate was limited to FY07.

1. MRC and Zoo air travel

- A. A PeopleSoft query was used to extract information about all procurement card travel purchases for FY07.
- B. These results were filtered to include only payments to air carriers and travel services.
- C. Destinations for these trips were found by examination of scanned PDF (Portable Document Format) files of procurement card receipts.
- D. Based on this data, starting and end points of most trips were determined.
- E. Three methods were considered to estimate greenhouse gas generation from air travel. The online International Civil Aviation Organization Emissions calculator was judged to be more accurate than other methods

of estimating greenhouse gas generation from air travel. It uses more factors to make this estimate than other methods (type of planes used on specific air routes).

- F. GHG emissions were derived from the International Civil Aviation Organization Carbon Emissions Calculator.
- G. Using these emission estimates, round trip emission estimates were made where applicable.
- H. The emissions calculator gave results in kilograms. These results were converted to both short tons and metric tons.

2. MERC air travel

- A. A spreadsheet of travel expenditures was requested and received from the MERC accounting department.
- B. Entries were filtered for air carriers and travel services.
- C. In cases where the destination could not be identified from the description field of the spreadsheet, staff members were contacted via email for the destinations.
- D. Greenhouse gas emissions were derived from the International Civil Aviation Organization Carbon Emissions Calculator as in Step 1F above.
- E. These results were converted to both short tons and metric tons as in Step 1H above.

Note: It was challenging to get a complete depiction of greenhouse gases generated from Metro employee air travel. Air travel expenditures do not have unique coding that would allow them to be extracted from the financial database, and current records often omit the destination of air travel.

I. Emissions from waste and recycling

- 1. Data from Metro waste and recycling reports for FY07 was summarized.
- 2. This data was sorted into the categories used in the Environmental Protection Agency's Excel Version of the Waste Reduction Model (WaRM), and a report summary of greenhouse gases emitted was generated.

Note: Estimating greenhouse gas generation from solid waste was hampered by a lack of standardization in recycling reports. While the report forms call for measurement of waste and recycled materials in terms of weight, the forms are sometimes completed with other information (lists of items disposed, fluid quantities) that cannot be used to determine approximate greenhouse gas generation potential.

II. Estimating Water Consumption

- 1. Metro Finance and Administrative Services provided a spreadsheet with account numbers for several utility accounts.
- 2. OCC staff provided water consumption records for the Convention Center.
- 3. Audit staff requested water use information from City of Portland's Water Bureau and Oregon City.
- 4. City of Portland's Water Bureau provided spreadsheets of water account information.
- 5. Audit staff researched the addresses associated with each account, associated each account with a Metro facility, sorted the information by fiscal year, converted it into gallons and summarized it by facility and department.



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