Online Resource 2
Identifying and Quantifying OCRRA's Mobile Source Greenhouse Gas Reduction Opportunities

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(This is a full version of the report summarized in Section 4 of the report)

Introduction

The first step towards achieving OCRRA's targeted GHG emissions reduction was measuring OCRRA's 2007 baseline emissions. The 2007 GHG Emission Inventory Report estimated OCRRA's GHG emissions at 1,985 metric tons of carbon dioxide equivalents (CO_2eq). Therefore, to achieve OCRRA's goal of a 10% reduction, OCRRA will need to reduce GHG emissions by approximately 200 tons.

In the grand scheme of things, 200 metric tons of CO_2eq is not very much. For comparison, each year the average person in the United States generates 20 metric tons of CO_2eq (http://www.eia.doe.gov/oiaf/ieo/emissions.html) and a coal fired power plant emits approximately 4.6 million CO_2eq annually (http://www.epa.gov/solar/energy-resources/calculator.html). This report will evaluate options for directly reducing OCRRA's GHG emissions –specifically, mobile emissions (from on- and off-road trucks and equipment), which account for 86% of OCRRA's total emissions. The Board's intent is to reduce actual emissions, but for purposes of comparison, the cost of purchasing GHG "offsets" ranges from $3 to $30 per metric ton CO_2eq (http://www.carboncatalog.org/providers/usa/?currency=USD, June 19, 2009). More detail about offsetting emissions is included at the end of this section.

Objective

The objective of this report is to identify cost-effective and efficient opportunities for reducing OCRRA's GHG emissions. As previously mentioned, the cost for OCRRA to purchase 200 metric tons of CO_2eq ranges from $400 to $6,000 per year. Therefore, it does not make sense to spend tremendous amounts of money on GHG reduction projects. Instead, the primary focus should be on GHG emission reduction opportunities that save OCRRA money. It also makes logical sense to start with projects that offer significant emissions reduction potential, as opposed to those projects that reduce GHG emissions by only a small amount. In summary, evaluation of reduction opportunities will focus on estimating cost and reduction potential, as well as assessing feasibility. Any changes in OCRRA's operations will of course maintain the Agency's high standards of safety and environmental protection.

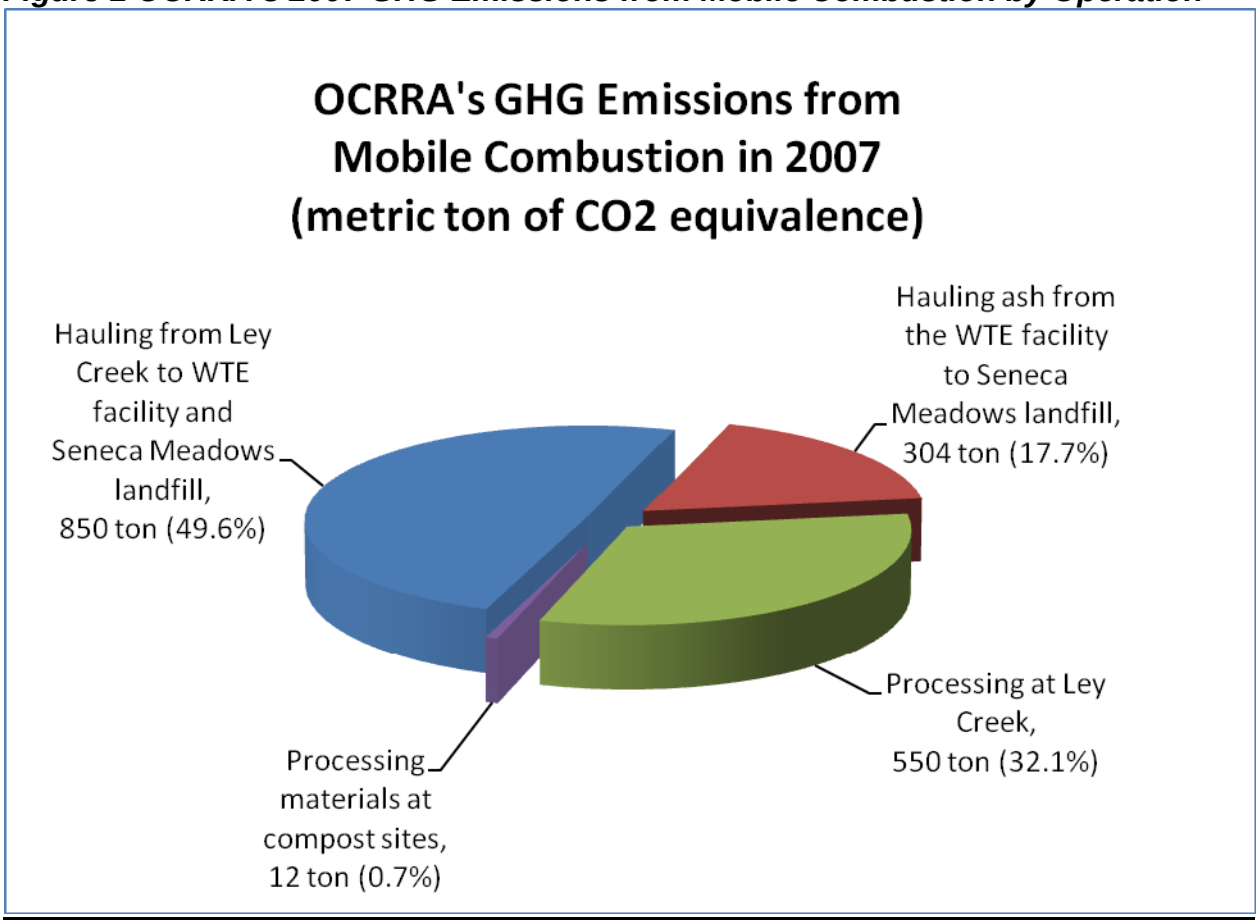
Identification, Feasibility Assessment, and Detailed Evaluation of Opportunities

There are three main categories of GHG reduction opportunities: behavioral changes, equipment component alterations, and equipment purchases. Behavioral changes require a change in operating procedures, practices, and/or habits. Equipment component alterations involve switching out components of equipment, rather than entirely replacing a piece of equipment. Equipment purchases mean replacing entire pieces of equipment. A feasibility assessment of each GHG emission reduction opportunity for OCRRA's specific operations will be conducted in this report.

Mobile Source GHG Emissions

Since 86.4% of OCRRA's GHG emissions are from mobile fuel combustion, initial efforts to reduce GHG emissions should focus on improving fuel economy in OCRRA's trucks and off-road equipment. Figure 1 illustrates the breakdown of OCRRA's mobile combustion GHG emission by operation. The vehicles and/or equipment associated with each operation are listed in Appendix A. As depicted in the chart, 50% of the GHG are associated with transporting materials from Ley Creek to the Waste-to-Energy Facility and Seneca Meadows Landfill, 32% are associated with processing materials at Ley Creek, and 18% are associated with hauling ash from the Waste-to-Energy Facility to Seneca Meadows Landfill.

Figure 1 OCRRA's 2007 GHG Emissions from Mobile Combustion by Operation



Mobile Source GHG Emissions – Behavioral Changes

Reduce maximum vehicle speed

Bridgestone research has indicated that, for speeds over 55 miles per hour, fuel economy (miles per gallon) is increased by about 1.6% for each mile per hour reduction in speed. However, by reducing vehicle speed, total trip time and, potentially driver work hours, increase. Safety also has to be considered before implementing speed reduction initiatives. In April 2009, the OCRRA management team decided to reduce the maximum speed set by the tractor and dump truck governors from 72 mph to 68 mph. Since GHG emissions and fuel economy are directly proportional, a 4 mph decrease in peak speed could

potentially reduce highway emissions by approximately 6 percent. If a third of the mileage is on the NYS Thruway, this change would theoretically reduce OCRRA's GHG emissions by approximately 30 tons at no cost.

Check tire pressure daily
Proper tire pressure is important for achieving maximum fuel efficiency. Properly inflated tires are also safer and last longer. OCRRA's drivers are already supposed to be checking tire pressure at the start of every day, so it then just becomes a matter of making sure it gets done, which is the responsibility of OCRRA's management team as well as the drivers/operators.

Educate drivers
The way drivers handle the trucks has a major impact on fuel economy. Unnecessary rapid acceleration, hard braking, and improper shifting can all negatively impact fuel efficiency. Continuing driver education should be an important part of OCRRA's fuel management program. In April 2009, OCRRA's management team circulated a video, "What Drivers Can Do to Save Fuel" by Bridgestone to the driver team. It was narrated by a driver with the intended audience being the drivers themselves. The total video length was about 10-15 minutes, but it achieved the goal of getting drivers to consider vehicle handling techniques and the importance of fuel economy.

Perform proper vehicle maintenance
Proper vehicle maintenance is critical for optimal vehicle performance, but for safety and longevity reasons, OCRRA already follows a regimented vehicle maintenance program and has a computer program for tracking maintenance activities. Given OCRRA's rigorous vehicle maintenance program, it doesn't appear that vehicle maintenance is an area for fuel efficiency gains.

Monitor fuel economy
There's a great saying – "You can't manage what you don't measure." This is especially true for fuel economy. OCRRA currently has two systems in place for monitoring fuel economy – the fuel management system and the GPS system in the trucks, however, both require careful monitoring and analysis, and likely need additional attention and perhaps even updating. Based on the past couple months of data, the dump trucks are getting between 5-6 mpg and the tractors get about 4-5 mpg. The way the system currently works is that drivers manually enter mileage information when fueling the vehicles. As you can imagine, this results in occasional errors in mileage data. It may be prudent to investigate potential upgrades that automatically get mileage information from the vehicle computers, ultimately preventing user error.
Furthermore, it seems like the OCRRA management team needs to focus more resources on doing monthly fuel analyses to track fuel economy. With the current system, this is a time-intensive process. It likely makes sense to explore the best management tools, systems, and software for monitoring fuel economy. The OCRRA management team is currently evaluating the existing systems and is considering the costs and benefits of upgrades; however in any event, fuel monitoring should be minimally performed and reported on a monthly basis. Though monitoring does not directly reduce GHG emissions, it is imperative for tracking progress.

Reduce time idling

By cutting back on engine idling time, OCRRA will be able to make reductions in GHG emissions. However, it's important to note that there is already a system in place to prevent/reduce idling time – specifically, the vehicles are equipped with an automatic shut-off device that turns the engine off after 5 minutes of idling time. It's also important to note that, under certain conditions (*e.g.,* dust, cold, extreme heat) it is unreasonable to ask that drivers sit in the vehicle without the engine running while waiting at the landfill. Recent construction delays on Interstate 81 and the NYS Thruway also make some idling time unavoidable.

An analysis of idling time for the past few months brought several issues to light. First and foremost, there is doubt as to the accuracy of the idling time reported by the GPS system. What was learned during this process was that, under certain conditions, idling time was being recorded even when the vehicle engine was off – depending on which direction the key was turned. Driver education should be sufficient for remedying this problem, but it means that the data collected to date is unreliable. Preliminary analysis had showed that a relatively small percentage of fuel consumption is due to idling time – approximately 0.5%, which is equivalent to about 8 metric tons of carbon dioxide equivalents. However, given the problem with data reliability, it makes sense to perform further analysis once driver education has been conducted.

In addition to the inaccuracy of the idling time, the OCRRA management team is currently working to address other concerns with the GPS system on the on-road vehicles. Specifically, certain units do not reliably download information into the system. OCRRA is currently looking into repairing or replacing these problematic units. OCRRA is also investigating opportunities for linking the fuel and GPS systems to ultimately achieve better fuel management capabilities.

<u>Mobile Source GHG Emissions – Equipment Component Alterations</u>

Change to low rolling resistance tires

As you can imagine, low rolling resistance tires may not be optimal for our central NY winter conditions, but perhaps even more importantly, low rolling resistance tires would be detrimental for off-road conditions at the landfill. Vehicles with low rolling resistance tires often have to be dragged around the landfill because they do not have enough traction to move around without assistance. This results in additional idling time. Given current operations, low rolling resistance tires do not seem to be feasible for OCRRA vehicles.

Install aerodynamic features

The more aerodynamic a vehicle is the better fuel efficiency – as a general rule of thumb, each 10% reduction in air resistance increase mpg by 5%. OCRRA's tractors already have an air foil on the top of the cab of the tractor. The OCRRA management team has explored side fairings, however the distance between the tractor and the trailer (based on the size of the frame, which is based on load) would negate any gains of the fairings. One feature that the OCRRA management team plans on exploring in the future is smooth-sided trailers. By reading trade magazines and attending trade shows, the OCRRA management team is always searching for new ways to improve vehicle aerodynamics.

Increase biodiesel content in fuel

GHG emissions from the combustion of biofuels are considered biogenic, and do not contribute to OCRRA's GHG footprint, according to current GHG reporting protocols. Therefore, by increasing the biodiesel content of the fuel, one can reduce GHG emissions. OCRRA currently utilizes a blend of biodiesel and diesel (20/80 in the warm months and 5/95 in the winter months). In cold weather it's not currently feasible to use more than 5% biodiesel. The cost and availability of fuel with more than 20% biodiesel is unknown at this point; however, OCRRA may wish to explore a cost-benefit analysis in the future.

Mobile Source GHG Emissions – Equipment Purchases

Purchase hybrid vehicles

Class 8 hybrid vehicles are just starting to become commercially available – right now, several companies are piloting these vehicles in line haul applications; note this is a slightly different application than OCRRA's off-road landfill applications. The incremental capital cost of hybrid vehicles as compared to traditional vehicles is substantial – however, there are significant savings in fuel consumption over the life of the vehicle. Incentives and grants may also be available. OCRRA's management team is currently following the development of the Class 8 hybrid electric vehicles for off-road applications, as this would be a demonstration platform for the hybrid diesel technology in a new application.

According to OCRRA's 2009-2013 Five-Year Capital Plan, four dump trucks are scheduled for purchase in 2010 and another four in 2011, and two tractors are scheduled for purchase in 2011 and another two in 2012. Additionally, two service vehicles (light-duty pickup trucks) are scheduled for replacement in 2009. In accordance with Resolution #1655, the OCRRA management team plans on exploring hybrid options during these upcoming purchase in 2010, 2011, and 2012.

It may also be worthwhile exploring the purchase of a hybrid car for OCRRA's enforcement officers, as they spend a large portion of their workday driving around in their cars. It's important to note, however, that GHG emissions associated with their mileage is included under "business travel" rather than "mobile combustion" in the annual GHG emission inventory.

Purchase dump pups

Dump pups are basically a mini-dump attached to a dump truck. They generally have a maximum capacity of about half the capacity of the dump truck itself and are self-unloading. Though they would reduce the number of trips to the landfill by a maximum of one third, they may pose challenges in winter months and the equipment may get too much wear and tear. There are also ash handling concerns because the main dump of the truck dumps over the tongue of the pup when the truck is unloading at a 90 degree angle to the pup. Towing additional weight would decrease the fuel economy of the dump trucks, however the reduced number of trips would likely compensate for the reduced fuel economy. It's difficult to project the exact quantity of GHG emissions that would be saved because there are many unknowns. The exact costs of these set-ups are also unknown at this time.

New dump trucks with larger engines may be required to tow the additional weight, and permitted tonnage may also limit potential reductions in GHG emissions. As evident, the disadvantages of this setup likely outweigh the advantages, however if in the future a different landfill is used, consideration should be given to alternative hauling methods.

Purchase double trailers

Double trailers also provide an opportunity for reducing the number of trips to the landfill, thereby also reducing GHG emissions. However, the current engines in our tractors are not large enough to accommodate a tandem configuration. Generally, a double trailer configuration is used for long hauling, where costs can be significantly reduced by cutting the number of trips in half. OCRRA's trip distance to the landfill isn't too long – about 45-50 miles each way, so the disadvantages of double trailers likely offset the benefits. Even on the busiest days, OCRRA generally only makes about 6 trips to the landfill from Ley Creek. A tandem system would entail additional time at the landfill to unload each trailer individually. Winter driving conditions would also be concern, as well as additional driver safety issues. As with dump pups, at this time it appears that the disadvantages of a tandem setup likely outweigh the advantages. However, if in the future a different landfill is used, consideration should be given to tandem hauling methods.

<u>Offsetting Mobile Source GHG Emissions that cannot be eliminated</u>

As mentioned previously, the cost of purchasing GHG "offsets" ranges from $3 to $30 per metric ton CO_2eq. Prices for credits on the Chicago Climate Exchange (CCX) have varied greatly over time – from less than $1 to more than $7 per metric ton. Today, credits on the CCX are trading for just about $1 per metric ton. At the most recent Regional Greenhouse Gas Initiative auction, allowances traded for approximately $3.73 per metric ton. Therefore, for benchmarking purposes, the cost for OCRRA to "buy its way" to GHG reductions ranges from about $400 to $6,000 per year.

In addition to buying GHG "offsets," OCRRA could also explore carbon sequestration as an alternative to directly reducing GHG emissions. For example, according to CCX Reforestation Carbon Accumulation Tables, to achieve the target GHG reduction of 200 metric tons, OCRRA could densely plant (>250 stems per acre) approximately 150 acres with white or Norway spruce trees (http://www.cinram.umn.edu/publications/landowners_guide1.5-1.pdf).

Recommendations

Of all the steps OCRRA can take to reduce mobile source GHG emissions, it seems that the most important at this point is to improve fuel economy and idling management capabilities. Though this will not directly reduce GHG emissions, proper management will result in further identification of GHG reduction opportunities. As previously mentioned, OCRRA is currently evaluating the existing fuel management and GPS systems and identifying opportunities for upgrades. Additional investment in fuel management systems may be required. Vehicle fuel economy and idling time should be monitored on a monthly basis. Operators should be trained in accurate record-keeping methods, and OCRRA should explore appropriate software for recording engine utilization, mileage, and GPS data. It's also critical that OCRRA continue to annually train drivers in proper vehicle handling techniques for optimal fuel efficiency. At some point, it may be appropriate to implement a fuel economy incentive program for drivers. In summary, this report suggests that there does not appear to be a "silver bullet" solution, but that instead by focusing time and resources on proper fuel management, OCRRA will be able to gradually achieve its GHG emissions reduction goal and, over time, to seek even greater reductions in GHG emissions as the technology advances and market conditions change.

Appendix A: Vehicle/Equipment Inventory by Operation

Hauling ash from the WTE facility to Landfill	*Hauling C&D/MSW from Ley Creek to WTE facility or Landfill*	*Processing C&D/MSW at Ley Creek*	*Processing materials at Compost Sites*
• Dump Truck 21 • Dump Truck 22 • Dump Truck 23 • Dump Truck 24 • Dump Truck 25 • Dump Truck 26 • Dump Truck 27 • Dump Truck 194 (spare)	• Tractor 10 • Tractor 11 • Tractor 195 • Tractor 196 • Tractor 197 • Tractor 198 • Tractor 199 • Tractor 185 (spare) • Tractor 187 (spare)	• Al Jon Compactor 525 • Komatsu Excavator #1 • Komatsu Excavator #2 • Komatsu WA500 Loader • Komatsu WA450 Loader • Komatsu Front End Loader • Yard Tractor • Street Sweeper • Nissan Forklift • Cat Skid Steer Loader • 2008 Skid Steer Loader • 2006 Skid Steer Loader • 2005 Skid Steer Loader • Ford Service Truck S-6 • Dust Boss 1 • Dust Boss 2 • Al Jon Compactor (backup) • Kawasaki Loader (backup)	• Deere 4WD Loader 207 • Deere 4WD Loader 216 • Skid Steer Loader • Horizontal Grinder

Other miscellaneous equipment:

- Mitsu Forklift (Rock Cut Road Operations)
- Bobcat Loader (Rock Cut Road Operations)
- Cat 966 Loader (Rock Cut Road Operations)
- Chevy Stake Truck (Rock Cut Road Operations)
- Ford Service Truck S-5 (Rock Cut Road Operations)
- Roll-off Truck (Rock Cut Road Operations)
- Heil Forklift (Community Collection Center Operations)
- 2004 Box Van (Recycling Operations)