Greenhouse Gas Tracking Framework for King County: 2010 Update

Peter Erickson and Chelsea Chandler, SEI
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Introduction and Methodology

The February 2012 *Greenhouse Gas Emissions in King County*[1] report defines a new tracking framework for King County to assess progress in efforts to reduce emissions. The tracking framework includes a "core" scope of emission sources that can be estimated annually using readily available data on local building energy, vehicle transportation, and waste. The report tracks this "core" set of emissions for 2003 and 2008.[2] This memo updates the tracking framework for 2010 and discusses trends that help explain the changes.

The "core" set of metrics relies on activity data from three primary sources: energy utilities (Puget Sound Energy and Seattle City Light) for electricity and natural gas consumption, the Puget Sound Regional Council for local vehicle travel, and solid waste utilities (King County Solid Waste Division and Seattle Public Utilities) for solid waste generation. These sources are supplemented with additional data on the emissions-intensity of these activities from national sources such as the U.S. DOT and the U.S. EPA. For more information on the method and data sources for the tracking framework, see *Appendix A* to the *Greenhouse Gas Emissions in King County* report.[3]

Results

Table 1 presents the tracking metrics for 2003, 2008, and 2010. The findings for 2010 reiterate and extend two important trends:

- **Core emissions continued to rise slightly,** increasing 1.3% to 16.6 million $MTCO_2e$ in 2010 from 16.4 million $MTCO_2e$ in 2008, maintaining approximately the same rate of growth as between 2003 and 2008.[4] However, these gains were less than the rate of population growth (2.9%), meaning that:
- **Core emissions *per person* continued to decline, and at a slightly faster rate.** Per-person emissions declined from 9.0 $MTCO_2e$ per resident in 2003 to 8.7 in 2008 (a 0.6% average decline per year) to 8.6 in 2010 (a 0.8% average decline per year).

Declines in per-person vehicle travel and building energy use help explain the drop in emission per person, as will be discussed further below. Note also that these trends evolved as the national recession continued. For example, average commercial employment in King County fell by about 4% between 2008 and 2010. This and other factors contributing to the changes in emissions are discussed below.

[1] The report is available at http://www.kingcounty.gov/environment/climate/climate-change-resources/emissions-inventories.aspx
[2] Note: the following data were not available for 2010 and have been estimated based on data from prior years: emissions intensity of passenger vehicle travel (held at 2008 levels due to lack of data from USDOT); emissions intensity of freight vehicles (held at 2009 levels due to lack of data from USDOT).
[3] We make one small methodological shift in this memo compared to the prior calculations. Previously, we used WSDOT data from the Highway Performance Management System (HPMS) program to scale PSRC's estimates of vehicle travel by mode from 2006 to other years. However, for the year 2010, WSDOT changed its method for tabulating VMT in HPMS such that it was no longer comparable. As a result, to scale from 2009 to 2010, we used WSDOT VMT data for a major subset of the HPMS data for which the method was known to be stable: WSDOT-owned roads (i.e., state highways), which carry about half of the VMT in King County. Future updates should use updates to PSRC's estimates (expected later in 2012, with a 2010 model base year) and use HPMS data for 2010 and beyond to scale across years, presuming the method remains stable.
[4] Emissions rose an average of 0.67% annually between 2003 and 2008 and 0.65% annually between 2008 and 2010.

Table 1. Baseline Core GHG Tracking Metrics for King County: 2003, 2008, and 2010
(Parentheses indicate emissions avoided, sequestered, or stored;
italics indicate data points based on 2008 data)

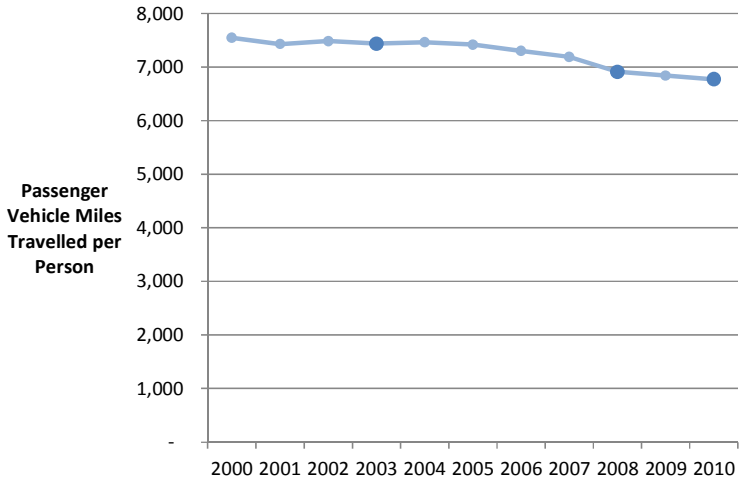
Emissions Source	2003	2008	2010
Core			
Transportation: Road			
Emissions (Million $MTCO_2e$)	9.2	8.9	9.0
Emissions per person ($MTCO_2e$ /resident)	5.2	4.7	4.6
Passenger emissions per person ($MTCO_2e$ /resident)	3.4	3.1	3.0
Freight emissions per person (tCO_2e/resident)	1.7	1.7	1.6
Passenger VMT per person (thousand miles/resident)	7.4	6.9	6.8
Freight VMT per person (thousand miles/resident)	1.1	1.1	1.0
Passenger emissions per mile ($kgCO_2e$/VMT)	0.46	0.44	*0.44*
Freight emissions per mile ($kgCO_2e$/VMT)	1.53	1.57	*1.58*
Buildings: Residential & Commercial			
Emissions (Million $MTCO_2e$)	7.0	7.8	7.8
Emissions per person ($MTCO_2e$ /resident)	3.9	4.1	4.0
Residential emissions per person ($MTCO_2e$ /resident)	2.1	2.2	2.1
Commercial emissions per person ($MTCO_2e$ /resident)	1.8	1.9	2.0
Residential energy per person (MBTU[5]/resident)	33.5	34.8	31.3
Commercial energy per person (MBTU/employee)	59.3	61.9	61.9
Heating Degree Days (HDD)	4,509	5,022	4,512
Cooling Degree Days (CDD)	277	195	163
Residential GHG intensity of energy (kg CO_2e/MBTU)	62.6	62.3	66.3
Commercial GHG intensity of energy (kg CO_2e/MBTU)	58.9	59.0	63.7
Waste: Landfills (CH_4 Commitment Basis)			
Emissions ($MTCO_2e$)	(0.25)	(0.22)	(0.20)
Emissions per person ($MTCO_2e$ /resident)	(0.14)	(0.12)	(0.10)
Residential waste disposed per person (tons / resident)	0.39	0.34	0.30
Nonresidential waste disposed per person (tons / employee)	0.80	0.68	0.59
Total Core Emissions			
Total Emissions (Million $MTCO_2e$)	**15.9**	**16.4**	**16.6**
Population (million residents)	**1.77**	**1.88**	**1.94**
Employment (million commercial employees)	**0.93**	**1.01**	**0.97**
Emissions per person ($MTCO_2e$ /resident)	**9.0**	**8.7**	**8.6**

Sector-specific findings include:

- **In road transportation, emissions increased slightly, though emissions per-person continued to decline.** Passenger and freight vehicle travel declined modestly per person. Figure 1 display trends in passenger VMT. Note that the decline in passenger VMT per person began well before the onset of the recession in 2008, though the recession (or perhaps more importantly, high fuel prices in 2008) may have intensified the effect. The continued decline in passenger VMT is particularly notable given that gasoline prices in the Seattle area were, on average, about 12% lower in 2010 than in 2008.[6] Other analysts have hypothesized that a decline in vehicle travel per-person could be due to demographic shifts (e.g., aging baby boomers driving less), land use changes (people living closer to work and other destinations), cultural shifts, and saturation of roads (where roads are so full during peak periods that they can't carry any more vehicles).[7]

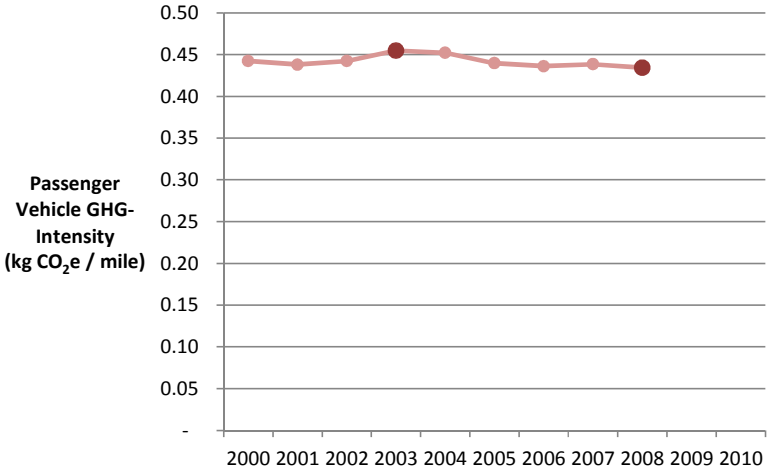
[5] MBTU = million BTU, also sometimes referred to as mmBTU. This metric includes all fuels and electricity in terms of final energy content. In other words, electricity is converted to BTUs based on the energy content of electricity delivered (3414 BTU/kWh) rather than the energy content of fuels and resources used to produce electricity ("primary energy").
[6] Per the U.S. EIA (http://www.eia.gov/petroleum/gasdiesel/), the average weekly retail gasoline price in the Seattle area was $3.00 in 2010 and $3.39 in 2008.
[7] For a description of these possible factors, see *Peak Gas?* by Clark Williams-Derry: http://www.sightline.org/research/energy/gasoline-use/peak-gas-report.pdf.

Figure 1. King County Passenger VMT per Person, 2000-2010



Between 2003 and 2008, the GHG intensity of passenger travel also declined, as displayed in Figure 2. However, comparable data for 2009 or 2010 are not yet available, and so we assume (given lack of better information) that the intensity has held constant.[8]

Figure 2. National Passenger (Light-duty) GHG-intensity, 2000-2010
(2009 and 2010 not yet available; assumed same as 2008)



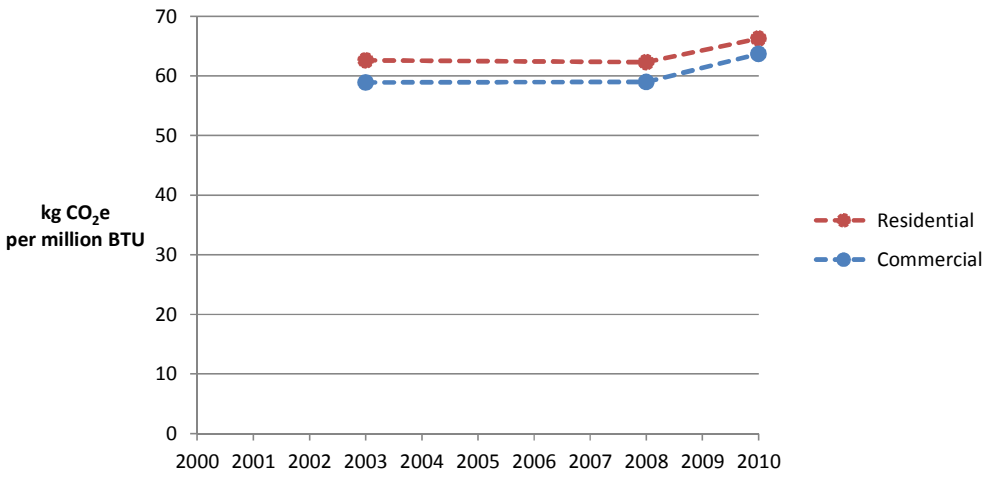
- **Emissions from buildings have continued to hold relatively constant, but declined slightly per person.** In 2008, this outcome could be explained relative to 2003 by modest gains in energy performance and residential GHG-intensity that slightly more than offset colder weather and associated higher heating needs. However, 2010 was warmer than 2008 and revealed a different story: reduced energy

[8] Table VM-1 from the USDOT's *Highway Statistics* publication suggests the fuel-intensity of passenger vehicles may actually have *increased* slightly in 2009, though comparable statistics are not available. The emissions intensity of freight travel again experienced a small increase in 2009 (2010 data not yet available). As for 2008, this increase in the GHG-intensity of freight – based on national statistics, is not well understood but has been thought to be due to a trend towards more powerful engines as well as due to implementation of energy-consuming devices to control other air pollutants (NO_x and particulates). For discussion of these trends, see http://www.fra.dot.gov/Downloads/Comparative_Evaluation_Rail_Truck_Fuel_Efficiency.pdf.

consumption was offset by an *increase* in the GHG-intensity of energy, while energy performance improved very slightly. We discuss each of these factors below.

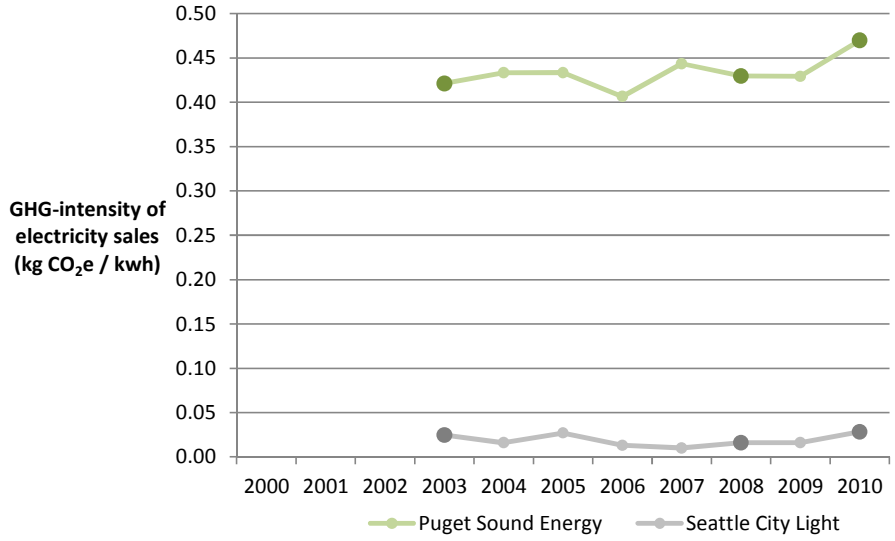
- Reduced energy consumption (both absolute and per capita) in 2010 was the result, in part, of warmer weather (and reduced heating needs) relative to 2008. Heating degree days decreased 10% from 5,022 in 2008 to 4,512 in 2010.[9] Since approximately 40% of building energy consumption is for heating[10], and heating demands decreased 10%, then building energy consumption could be expected to fall by about 4% between 2008 and 2010. This is the level observed in the commercial sector, though employment also dropped 4%, so per-capita commercial energy use remained constant. Residential energy use declined by a bit more (6% absolute, 10% per resident), perhaps due to a combination of factors: ongoing efforts to increase energy performance of the existing building stock, continued fuel switching from less-efficient oil to more-efficient natural gas, the growing fraction of residents that live in less energy-intensive multifamily housing, and the economic recession.[11]
- The jump in GHG-intensity of building energy (Figure 3) was due largely to an increase in the GHG-intensity of electricity from Puget Sound Energy (Figure 4), due in turn to a decrease in the utility's use of low-GHG hydropower and an increase in use of natural gas for electricity generation. Hydroelectricity comprised 42% of the Puget Sound Energy's electricity sales in 2003, 41% in 2008, and 33% in 2010, while electricity from natural gas comprised 4%, 13%, and 22%, respectively.[12]

Figure 3. GHG-intensity of Building Energy: 2003, 2008, and 2010



[9] A heating degree day is a measure of deviation of outside air temperatures from a base temperature above which a building needs no heating. Here we consider building heating energy demands to be directly proportional to heating degree days, which is a common assumption.
[10] Based on review of Seattle City Light and Puget Sound Energy planning documents.
[11] According to the U.S. Census Bureau's American Community Survey, 33% of the housing units added between 2000 and 2005 were in multi-unit (2+) buildings. Between 2005 and 2010, the fraction was 58%, and between 2008 and 2010 the fraction was greater than 90%.
[12] Per the Washington State Department of Commerce, http://www.commerce.wa.gov/site/539/default.aspx.

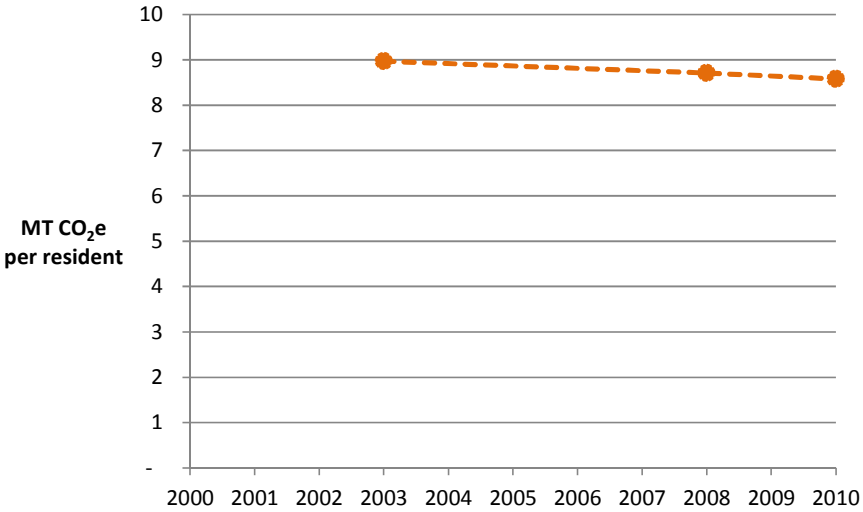
Figure 4. GHG-intensity of Electricity Sales, 2003-2010[13]



Summary

The updated tracking framework for 2010 indicates that GHG emissions from a core set of highly policy-relevant sources continued to rise slightly in King County. This trend suggests that significant action will be needed for King County to meet its long-term goal of an 80% reduction in greenhouse gases by 2050. However, this growth in emissions is proceeding slower than population growth, leading to a decline in emissions *per person* (Figure 5). This trend is the result of per-person decreases in vehicle travel and residential energy, suggesting that regional efforts to create pedestrian and transit-oriented communities and more energy-efficient buildings may be beginning to yield results.

Figure 5. King County's "Core" GHG Emissions per Person: 2003, 2008, and 2010



[13] Source: Utility reports to the Washington Department of Commerce. Does not account for GHG offsets purchased by Seattle City Light.

Other sources of GHG emissions are also associated with production and consumption of goods and services in King County. These other sources are not included in this "core" set of emissions, but are considered in two additional, expanded sets of tracking metrics. For example, an estimated 13 MT CO_2e per resident were associated with consumption of goods, food, and services in 2008. For details about these additional tracking metrics, as well as for complete GHG inventories that address all the sources described here for the year 2008, see *Greenhouse Gas Emissions in King County,* published in February 2012.[14]

[14] Available at http://www.kingcounty.gov/environment/climate/climate-change-resources/emissions-inventories.aspx