

# Rogue Valley Regional 2011 Greenhouse Gas Inventory

## RVMPO Community GHG Inventory - Technical Appendix

This supporting documentation explains the methodology, assumptions and data sources used to generate Rogue Valley Regional 2011 Greenhouse Gas Inventory. This resource is best used in conjunction with the two other project deliverables: Rogue Valley Regional 2011 Greenhouse Gas Inventory report and the Inventory Calculator (an Excel spreadsheet used to perform all inventory calculations as well as track data sources).

The overall approach uses a September 2009 Environmental Protection Agency (EPA) analysis titled, *Opportunities to Reduce Greenhouse Gas Emissions through Materials and Land Management Practices* as a foundation, in terms of both data and method. This Technical Appendix (and indeed the overall results) can best be understood by using the “crosswalk” (or matrix) provided in the EPA analysis, as shown below in Figure 1. This matrix integrates two distinct methods for doing “greenhouse gas (or carbon) accounting,” i.e., providing categories for disaggregating greenhouse gas emissions: sectors and systems. The “sectors” accounting (a more familiar set of labels) are in rows, while the “systems” (as suggested by the EPA analysis and modified as described in this technical appendix) are in columns. Each intersection between one sector and one system, as can be seen in Figures 1 through 3, will from this point forward be referred to as a “cell”.

The method used to conduct the Rogue Valley inventory consists of modifying the U.S. per capita emissions in the crosswalk, cell by cell. The EPA analysis reports total U.S. emissions, which are divided by the 2006 U.S population to determine U.S. average per capita emissions for each cell in the crosswalk. See Figure 2 on the next page. With the starting point of national data, this Technical Appendix describes each modification, proceeding one “system” (or column) at a time, and moving through each “sector” (or row). Some cells have multiple modifications that require detailed discussion, while others are straightforward. A few cells were not modified at all. Modified cells are shown in yellow on Figure 3, while cells that were not modified (default U.S. average value) are shown in gray.

It is important to note that this approach is provisional and experimental. It does not represent a fully vetted “protocol” for carbon accounting at the regional level. However, it significantly expands the typical scope of community GHG inventories that focus only on transportation, energy and waste by including the consumption of goods and materials and in so doing, it provides a much more realistic picture of a community’s carbon footprint. It is the intent of the report team to advance the discussion of community inventories and potentially contribute to a rethinking of the conventional narrow approach.

**Figure 1:** Total greenhouse gas emissions for the United States by sector and system.

Sector / System	Materials (Production & Movement of Goods and Food)			Energy		Transportation		Sector Subtotals
	Provision of Goods & Services	Provision of Food	Infrastructure	Building HVAC and Lighting	Use of Appliances and Devices	Local Passenger Transport	Other Passenger Transport	
Electric Power Industry	572	112	8	1,244	416	16	9	2,377
Agriculture		533						533
Industry	912	106	55	73	24	122	78	1,370
Residential	14			235	96			345
Commercial	150	31	2	167	44			394
Transportation	392	112	6			882	578	1,970
System Subtotals	2,040	894	71	1,719	580	1,020	665	6,989
System Totals		3,005		2,299		1,685		

**Figure 2:** Per capita greenhouse gas emissions for the United States by sector and system.

Sector / System	Materials (Production & Movement of Goods and Food)					Energy		Transportation		Sector Subtotals
	Goods	Food	Infrastructure	Long-Haul Freight	Solid Waste	Building HVAC and Lighting	Use of Appliances and Devices	Local Passenger Transport	Other Passenger Transport	
Electric Power Industry	1.91	0.37	0.03			4.15	1.39	0.05	0.03	7.9
Agriculture		1.78								1.8
Industry	3.05	0.35	0.18			0.24	0.08	0.41	0.26	4.6
Residential	0.05					0.78	0.32			1.2
Commercial	0.09	0.10	0.01		0.41	0.56	0.15			1.3
Transportation			0.02	1.68				2.95	1.93	6.6
System Subtotals	5.09	2.61	0.24	1.68	0.41	5.74	1.94	3.41	2.22	23.3
System Totals			10.04			7.68		5.63		

**Figure 3:** Per capita greenhouse gas emissions for the Rogue Valley region by sector and system.

Sector / System	Materials (Production & Movement of Goods and Food)					Energy		Transportation			Sector Subtotals
	Goods	Food	Infrastructure	Long-Distance Freight	Solid Waste	Building HVAC and Lighting	Use of Appliances and Devices	Local Passenger Transport	Other Passenger Transport	Local Freight	
Electric Power Industry	1.53	0.35	0.03			2.88	0.96				5.8
Agriculture		1.65									1.7
Industry	2.61	0.33	0.18			0.06	0.02	0.50	0.22		3.9
Residential	0.05					0.36	0.15				0.6
Commercial	0.08	0.10	0.01		0.42	0.27	0.07				0.9
Transportation			0.02	1.23				3.66	1.65	0.22	6.8
System Subtotals	4.27	2.43	0.24	1.23	0.42	3.57	1.20	4.16	1.88	0.22	19.6
System Totals			8.59			4.77		6.26			

The following sections will describe the adjustments made to each cell of Figure 3. They are discussed column-by-column, beginning with the goods column. Under each column heading in the following sections the cells are discussed row-by-row beginning with the electric power industry. This structure is used to describe the adjustments to all columns and rows in Figure 3. If there is more than one adjustment made to a given cell in Figure 3 look to the final adjustment equation for the final value used in the analysis and in Figure 3.

## Acknowledgments

Dan Moore of Rogue Valley Council of Governments (RVCOG) supervised this analysis and the creation of the summary report and this technical appendix in collaboration with Alan Journet of the Geos Institute. Joshua Skov and Aaron Toney of Good Company ([www.goodcompany.com](http://www.goodcompany.com)) developed the method, conducted the inventory and authored this documentation.

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## Materials, Goods and Food (Production, Movement and Disposal)

### Provision of Goods

#### Electric Power Industry

1. The per capita emissions for this cell, taken from the EPA report, are based on the U.S. average greenhouse gas (GHG) intensity for electricity generation (pounds of CO<sub>2</sub>e / MWh). The U.S. average electricity generation GHG intensity is significantly larger than the northwest's regional electricity grid (Northwest Power Pool - NWPP), 1,336 pounds CO<sub>2</sub>e / MWh and 907 pounds CO<sub>2</sub>e / MWh respectively. The NWPP sub-regional emissions factor for 2005 is taken from the EPA's eGRID database.<sup>1</sup> It is assumed that 20% of the goods consumed in the Rogue Valley (RV) region are produced in the Northwest using Northwest Power Pool (NWPP) electricity.<sup>2</sup> This cell is adjusted to account for the quantity of goods produced in the northwest using the sub-regional grid's carbon intensity.

**Figure 4:** Modification to electricity emissions for goods provision for regionally produced goods.

$$\left( \frac{1.91 \text{ MT CO}_2\text{e}}{\text{U.S. Resident}} \times 80\% \right) + \left( \frac{1.91 \text{ MT CO}_2\text{e}}{\text{U.S. Resident}} \times 20\% \times \frac{907 \text{ pounds CO}_2\text{e}}{1,336 \text{ pounds CO}_2\text{e}} \times \frac{\text{MWh}}{\text{MWh}} \right) = \frac{1.79 \text{ MT CO}_2\text{e}}{\text{RV Citizen}}$$

2. This cell is also modified for the difference between U.S. and Rogue Valley (specifically Josephine and Jackson counties) median household (HH) income. This modification assumes that because the Rogue Valley's median HH income is less than the U.S. median, Rogue Valley households will purchase fewer goods thus reducing per capita emissions in this sector / system.

According to U.S. Census Bureau data<sup>3</sup> the U.S. median 2006 household income equals \$48,855 while in the Rogue Valley's median household income equals \$41,917.<sup>4</sup> The Rogue Valley median HH income value used in this analysis represents the weighted average of 2006 median HH incomes for Josephine and Jackson counties by 2006 county population<sup>5</sup>. The U.S. median HH income is reported in 2008 dollars, which are adjusted for inflation with the Consumer Price Index<sup>6</sup>. The following equation is applied to the value calculated in the electric power industry modification 1 (shown above).

**Figure 5:** Modification to goods provision emissions based on median household income ratio.

$$\frac{1.79 \text{ MT CO}_2\text{e}}{\text{U.S. Resident}} \times \frac{\$41,917}{\$48,855} = \frac{1.53 \text{ MT CO}_2\text{e}}{\text{RV Citizen}}$$

<sup>1</sup> The Emissions & Generation Resource Integrated Database (eGRID) is a comprehensive source of data on the environmental characteristics of almost all electric power generated in the United States. eGRID is unique in that it links air emissions data with electric generation data for United States power plants. The database and GHG emissions factors are found online at <http://cfpub.epa.gov/egridweb/>.

<sup>2</sup> This value is an inventory assumption.

<sup>3</sup> U.S. Census Bureau data may be accessed online at [http://factfinder.census.gov/servlet/ADPTable?\\_bm=y&-context=adp&-\\_gr\\_name=ACS\\_2008\\_3YR\\_G00\\_DP3YR3&-ds\\_name=ACS\\_2008\\_3YR\\_G00\\_&-tree\\_id=3308&-redoLog=false&-\\_caller=geoselect&-geo\\_id=01000US&-format=&-\\_lang=en](http://factfinder.census.gov/servlet/ADPTable?_bm=y&-context=adp&-_gr_name=ACS_2008_3YR_G00_DP3YR3&-ds_name=ACS_2008_3YR_G00_&-tree_id=3308&-redoLog=false&-_caller=geoselect&-geo_id=01000US&-format=&-_lang=en)

<sup>4</sup> U.S. Census Bureau data may be accessed online at [http://www.census.gov/cgi-bin/saige/saige.cgi?year=2006&type=county&table=county&submit=States%26Counties&areas=all&display\\_data=DisplayData&state=41-SA91](http://www.census.gov/cgi-bin/saige/saige.cgi?year=2006&type=county&table=county&submit=States%26Counties&areas=all&display_data=DisplayData&state=41-SA91)

<sup>5</sup> 2006 Oregon Population Report accessed online at <http://www.pdx.edu/prc/annual-oregon-population-report>.

<sup>6</sup> U.S. Department of Labor - Consumer Price Index accessed online at <http://data.bls.gov/cgi-bin/surveymost>

## Agriculture

1. No modifications.

## Industry

1. This cell is modified for the difference between U.S. and Rogue Valley median household (HH) income. This modification assumes that because median HH income is less in Rogue Valley than the U.S. that Rogue Valley households will purchase less, thus reducing per capita emissions in this sector / system. According to U.S. Census Bureau data the U.S. median 2006 household income equals \$48,855 while in Oregon median household income equals \$41,917.

**Figure 6:** Modification to goods provision emissions based on median household income ratio.

$$\frac{3.05 \text{ MT CO}_2\text{e}}{\text{U.S. Resident}} \times \frac{\frac{\$41917}{\text{RV median HH income}}}{\frac{\$48855}{\text{U.S. median HH income}}} = \frac{2.61 \text{ MT CO}_2\text{e}}{\text{RV Citizen}}$$

## Residential

1. No modifications.

## Commercial

1. This cell is modified for the difference between U.S. and Rogue Valley median per household income. This modification assumes that because household income is less in Rogue Valley than the U.S. Rogue Valley households will purchase less, thus reducing per capita emissions for this sector / system. According to U.S. Census Bureau data the U.S. median 2006 household income equals \$48,855 while in Rogue Valley median household income equals \$41,917.

**Figure 7:** Modification to goods provision emissions based on median household income ratio.

$$\frac{0.089 \text{ MT CO}_2\text{e}}{\text{U.S. Resident}} \times \frac{\frac{\$41917}{\text{RV median HH income}}}{\frac{\$48855}{\text{U.S. median HH income}}} = \frac{0.077 \text{ MT CO}_2\text{e}}{\text{RV Citizen}}$$

2. Per capita landfill methane emissions for the Rogue Valley were calculated using actual solid waste quantities<sup>7</sup>, EPA emissions factors<sup>8</sup> and the Rogue Valley 2006 population<sup>9</sup>. Its important to note that the emissions factor used for this calculation is based on the national average rate of fugitive landfill methane emissions and the known methane collection system<sup>10</sup> used at the Dry Creek landfill, which serves the waste disposal needs of the entire Rogue Valley region.

**Figure 8:** Modification to goods provision emissions based on median household income ratio.

$$\frac{248509 \text{ short tons}_{2006} \cdot \frac{0.4767 \text{ MT CO}_2\text{e}}{\text{short ton}}}{279740 \text{ RV Citizens}} = \frac{0.42 \text{ MT CO}_2\text{e}}{\text{RV Citizen}}$$

<sup>7</sup>Email from Wendel Smith, Rogue Disposal & Recycling.

<sup>8</sup>Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks downloaded online at <http://www.epa.gov/climatechange/wycd/waste/reports.html>.

<sup>9</sup>2006 population from Portland State University – Population Research Center's 2006 Oregon Population Report accessed online at <http://www.pdx.edu/prc/annual-oregon-population-report>.

<sup>10</sup>Information on the Dry Creek Landfill methane collection system accessed online at <http://roquedisposal.com/about-the-landfill/>.

## Transportation

1. The emissions in this cell were split into two parts for the purpose of this analysis: long-haul freight and local transportation. The long-haul freight is modified in this section while local freight will be discussed in the transportation sector methods. For this analysis it is assumed that 85% of the transportation associated with the Provision of Goods is long-haul freight, while the remaining 15% is local freight movement, but both are based on the emissions reported in the transportation sector / materials system. Local freight is separated from long-haul trucking in this analysis because these emissions will be directly addressed through Rogue Valley Council of Government transportation planning and policies.

The long-haul freight emissions are modified based on the difference between U.S. and Rogue Valley median household income. This modification assumes that because household income is less in Rogue Valley than the U.S., Rogue Valley households will purchase less, thus reducing per capita emissions for this sector / system. According to U.S. Census Bureau data the U.S. median 2006 household income equals \$48,855 while in Rogue Valley median household income equals \$41,917.

**Figure 9:** Modification to goods provision emissions based on median household income ratio.

$$\frac{1.68 \text{ MT CO}_2\text{e}}{\text{U.S. Resident}} \cdot 85\% \cdot \frac{\frac{\$41,917}{\$48,855}}{\frac{\text{RV median HH income}}{\text{U.S. median HH income}}} = \frac{1.23 \text{ MT CO}_2\text{e}}{\text{RV Citizen}}$$

## Provision of Foods

### Electric Power Industry

1. This cell is modified for the difference between U.S. and Rogue Valley region median per household income. This modification assumes that because household income is less in the Rogue Valley compared to the U.S., Rogue Valley households will purchase less, thus reducing per capita emissions. Unlike the modification for goods the median income ratio is not fully applied to food consumption. The consumption of food is not assumed to increase at the same rate as goods as income increases. A human being can only eat so much food, regardless of income. The difference between the Rogue Valley and U.S. incomes is split in half and applied to food. According to U.S. Census Bureau data the U.S. median 2006 household income equals \$48,855 while in Rogue Valley median household income equals \$41,917.

**Figure 10:** Modification to goods provision emissions based on median household income ratio.

$$\frac{0.37 \text{ MT CO}_2\text{e}}{\text{U.S. Resident}} \times \left( \left( 1 - \frac{\frac{\$41,917}{\$48,855}}{\frac{\text{RV median HH income}}{\text{U.S. median HH income}}} \right) \cdot 0.5 \right) + \frac{\frac{\$41,917}{\$48,855}}{\frac{\text{RV median HH income}}{\text{U.S. median HH income}}} = \frac{0.35 \text{ MT CO}_2\text{e}}{\text{RV Citizen}}$$

### Agriculture

1. No modifications.

### Industry

1. This cell is modified for the difference between U.S. and Rogue Valley region median per household income. This modification assumes that because household income is less in Rogue Valley than the U.S., Rogue Valley households will purchase less, thus reducing per capita emissions for this sector / system. According to U.S. Census Bureau data the U.S. median 2006

household income equals \$48,855 while in Rogue Valley median household income equals \$41,917.

**Figure 11:** Modification to goods provision emissions based on median household income ratio.

$$\frac{0.354 \text{ MT CO}_2\text{e}}{\text{U.S. Resident}} \times \left( \left( 1 - \frac{\frac{\$41,917}{\text{RV median HH income}}}{\frac{\$48,855}{\text{U.S. median HH income}}} \right) * 0.5 \right) + \frac{\frac{\$41,917}{\text{RV median HH income}}}{\frac{\$48,855}{\text{U.S. median HH income}}} = \frac{0.329 \text{ MT CO}_2\text{e}}{\text{RV Citizen}}$$

## Residential

1. No modifications.

## Commercial

1. This cell is modified for the difference between U.S. and Rogue Valley region median per household income. This modification assumes that because household income is less in Rogue Valley than the U.S., Rogue Valley households will purchase less, thus reducing per capita emissions. According to U.S. Census Bureau data the U.S. median 2006 household income equals \$48,855 while in Rogue Valley median household income equals \$41,917.

**Figure 12:** Modification to goods provision emissions based on median household income ratio.

$$\frac{0.104 \text{ MT CO}_2\text{e}}{\text{U.S. Resident}} \times \left( \left( 1 - \frac{\frac{\$41,917}{\text{RV median HH income}}}{\frac{\$48,855}{\text{U.S. median HH income}}} \right) * 0.5 \right) + \frac{\frac{\$41,917}{\text{RV median HH income}}}{\frac{\$48,855}{\text{U.S. median HH income}}} = \frac{0.096 \text{ MT CO}_2\text{e}}{\text{Metro Resident}}$$

## Transportation

1. No modifications.

## Infrastructure

### Electric Power Industry

1. No modifications.

### Agriculture

1. No modifications.

### Industry

1. No modifications.

### Residential

1. No modifications.

### Commercial

1. No modifications.

### Transportation

1. No modifications.

## Energy

### Building HVAC and Lighting

#### Electric Power Industry

1. The per capita U.S. electricity emissions for this cell were modified using actual electricity consumption data to reflect the consumption trends of Rogue Valley region residents and businesses. Pacific Power provided 2006 retail sales data, by sector: industrial, commercial and residential. This consumption data was to calculate per capita emissions using the EPA's 2005 eGRID emissions factor for the NWPP sub region<sup>11</sup> and the 2006 population of the Rogue Valley<sup>12</sup>.

The EPA report splits electricity use between two systems, Building HVAC and Lighting and Use of Appliances and Devices. The emissions for this sector were split between the two systems using the U.S. average values to create a ratio for each system. These ratios were applied to the emissions calculated for the Rogue Valley in order to split the emissions into the two energy sector systems.

#### a. Residential Electricity Emissions – Building HVAC and Lighting

**Figure 13:** Residential per capita emissions based on regional data split for specific energy system.

$$\frac{666563 \text{ MT CO}_2\text{e} \cdot \frac{4.15 \text{ MT CO}_2\text{e}}{5.5 \text{ MT CO}_2\text{e}}}{279740 \text{ RV Citizens}} = \frac{1.79 \text{ MT CO}_2\text{e}}{\text{RV Citizens}}$$

#### b. Commercial Electricity Emissions – Building HVAC and Lighting

**Figure 14:** Commercial per capita emissions based on regional data split for specific energy system.

$$\frac{393875 \text{ MT CO}_2\text{e} \cdot \frac{4.15 \text{ MT CO}_2\text{e}}{5.5 \text{ MT CO}_2\text{e}}}{279,740 \text{ RV Citizens}} = \frac{1.06 \text{ MT CO}_2\text{e}}{\text{RV Citizens}}$$

#### c. Industrial Electricity Emissions – Building HVAC and Lighting

Unlike the ratios used for the Residential and Commercial sectors the denominator in this ratio includes not only the Energy system, but also the natural gas used in industry/materials. These values are included because the industrial natural gas use reported by Avista Energy includes all natural gas use, not only use in support buildings.

<sup>11</sup> The Emissions & Generation Resource Integrated Database (eGRID) is a comprehensive source of data on the environmental characteristics of almost all electric power generated in the United States. eGRID is unique in that it links air emissions data with electric generation data for United States power plants. The database and GHG emissions factors are found online at <http://cfpub.epa.gov/eGRIDweb/>.

<sup>12</sup> 2006 population from Portland State University – Population Research Center's 2006 Oregon Population Report accessed online at <http://www.pdx.edu/prc/annual-oregon-population-report>.



Consistent with the methodology for a consumption-based inventory the energy consumed in the production of goods is excluded.

**Figure 15:** Industrial per capita emissions based on regional data adjusted to exclude production energy consumption and split for specific energy system.

$$175898 \text{ MT CO}_2\text{e} \cdot \frac{\frac{0.24 \text{ MT CO}_2\text{e}}{\text{U.S. Resident}}}{\frac{3.05+0.35+0.18+0.24+0.08 \text{ MT CO}_2\text{e}}{\text{U.S. Resident}}} = \frac{0.039 \text{ MT CO}_2\text{e}}{279740 \text{ RV Citizens}} = \frac{0.039 \text{ MT CO}_2\text{e}}{\text{RV Citizens}}$$

d. *Total Per Capita Electricity Emissions – Building HVAC and Lighting*

The residential, commercial and industrial emissions are summed to determine the sector / system subtotal.

**Figure 16:** Sum of the three individual sectors for a total sector / system value.

$$\frac{1.79 \text{ MT CO}_2\text{e}}{\text{RV Citizen}} + \frac{1.06 \text{ MT CO}_2\text{e}}{\text{RV Citizen}} + \frac{0.039 \text{ MT CO}_2\text{e}}{\text{RV Citizen}} = \frac{2.88 \text{ MT CO}_2\text{e}}{\text{RV Citizen}}$$

## Agriculture

1. No modifications.

## Industry

1. The emissions in this cell represent all other fuel use, which is primarily natural gas, but also includes fuel oil and liquid propane gas. Average per capita U.S. natural gas consumption was modified using actual natural gas data to reflect the consumption trends of Rogue Valley residents and businesses. Avista Utilities provided industrial natural gas consumption for 2006.<sup>13</sup> These values were used to calculate per capita emissions with emissions factors from The Climate Registry's *General Reporting Protocol*<sup>14</sup> and the 2006 population of the Rogue Valley<sup>15</sup>.

The emissions for this sector were split between the two systems using the U.S. average values to create a ratio for each system. These ratios were applied to the emissions calculated for the Rogue Valley in order to split the emissions into the two systems.

Unlike the ratios used for the Residential and Commercial sectors the denominator in this ratio includes not only the Energy system, but also the natural gas used in industry/materials. These values are included because the industrial natural gas use reported includes all use, not only use in support buildings. Consistent with the methodology for a consumption-based inventory the energy consumed in the production of goods is excluded.

<sup>13</sup> Email from Steve Vincent, Avista Utilities.

<sup>14</sup> The Climate Registry – General Reporting Protocol downloaded online at <http://www.theclimateregistry.org/resources/protocols/general-reporting-protocol/>.

<sup>15</sup> 2006 population from Portland State University – Population Research Center's 2006 Oregon Population Report accessed online at <http://www.pdx.edu/prc/annual-oregon-population-report>.



**Figure 17:** Industrial per capita emissions based regional data adjusted to exclude production energy consumption and split for specific energy system.

$$\frac{188306 \text{ MT CQe} \cdot \frac{0.24 \text{ MT CQe}}{\text{U.S. Resident}}}{\frac{3.05+0.35+0.18+0.24+0.08 \text{ MT CQe}}{\text{U.S. Resident}}} = \frac{0.04 \text{ MT CQe}}{\text{RV Citizens}}$$

- Actual data on consumption of distillate fuel oil (DFO) in the Rogue Valley were not readily available for use in this analysis. An estimate of consumption and the associated emissions was made based on Oregon consumption and population in 2006. Oregon's total distillate fuel oil consumption for 2006 is available on the Energy Information Association (EIA) website<sup>16</sup> and Oregon's 2006 population is available from Portland State University – Population Research Center's *2006 Oregon Population Report*.<sup>17</sup> The EIA data are available by sector. These values were used to calculate per capita emissions with emissions factors from The Climate Registry's *General Reporting Protocol*.<sup>18</sup> The Oregon per capita value was applied to the Rogue Valley population to estimate regional use and the associated emissions. These emissions are then split for the energy system using the same method described in adjustment 1.

**Figure 18:** Commercial per capita emissions from distillate fuel oil.

$$\left( \frac{78078000 \text{ gallons} \cdot \frac{10.21 \text{ kg CQe}}{\text{gallon}}}{3,690,505 \text{ Oregon citizens in 2006}} \right) \cdot \frac{0.24 \text{ MT CQe}}{\text{U.S. Resident}} = \frac{0.013 \text{ MT CQe}}{\text{Oregon (or RV) citizen}}$$

- Actual data on consumption of liquid propane gas (LPG) in the Rogue Valley were not readily available for use in this analysis. An estimate of consumption and the associated emissions was made based on Oregon consumption and population in 2006. Oregon's total LPG consumption for 2006 is available on the Energy Information Association (EIA) website<sup>19</sup> and Oregon's 2006 population is available from Portland State University – Population Research Center's *2006 Oregon Population Report*.<sup>20</sup> The EIA data are available by sector. These values were used to calculate per capita emissions with emissions factors from The Climate Registry's *General Reporting Protocol*.<sup>21</sup> The Oregon per capita value was applied to the Rogue Valley population to estimate regional use and the associated emissions.

**Figure 19:** Commercial per capita emissions from distillate fuel oil.

$$\left( \frac{46,536,000 \text{ gallons} \cdot \frac{5.79 \text{ kg CQe}}{\text{gallon}}}{3,690,505 \text{ Oregon citizens in 2006}} \right) \cdot \frac{0.24 \text{ MT CQe}}{\text{U.S. Resident}} = \frac{0.005 \text{ MT CQe}}{\text{Oregon (or RV) citizen}}$$

<sup>16</sup> EIA - Oregon Adjusted Distillate Fuel Oil and Kerosene Sales by End Use accessed online at [http://www.eia.gov/emeu/states/hf.jsp?incfile=sep\\_use/res/use\\_res\\_or.html&mstate=OREGON](http://www.eia.gov/emeu/states/hf.jsp?incfile=sep_use/res/use_res_or.html&mstate=OREGON).

<sup>17</sup> 2006 Oregon Population Report available online at <http://www.pdx.edu/prc/annual-oregon-population-report>.

<sup>18</sup> The Climate Registry – General Reporting Protocol downloaded online at <http://www.theclimateregistry.org/resources/protocols/general-reporting-protocol/>.

<sup>19</sup> EIA - Oregon Adjusted Distillate Fuel Oil and Kerosene Sales by End Use accessed online at [http://www.eia.gov/emeu/states/hf.jsp?incfile=sep\\_use/res/use\\_res\\_or.html&mstate=OREGON](http://www.eia.gov/emeu/states/hf.jsp?incfile=sep_use/res/use_res_or.html&mstate=OREGON).

<sup>20</sup> 2006 Oregon Population Report available online at <http://www.pdx.edu/prc/annual-oregon-population-report>.

<sup>21</sup> The Climate Registry – General Reporting Protocol downloaded online at <http://www.theclimateregistry.org/resources/protocols/general-reporting-protocol/>.

## Residential

1. The emissions in this sector/system represent all other fuel use, which is primarily natural gas, but also includes distillate fuel oil and liquid propane gas. Average per capita U.S. natural gas consumption was modified using actual natural gas data provided by Avista Unities. These values were used to calculate per capita emissions with emissions factors from The Climate Registry's *General Reporting Protocol*<sup>22</sup> and the 2006 population of the Rogue Valley<sup>23</sup>. Distillate fuel oil and liquid propane gas were calculated using state averages and were applied to the Rogue Valley populations. These emissions were added to natural gas emissions for total sector / system emissions. For more detail see the inventory calculator.

The EPA report splits electricity use between two systems, Building HVAC and Lighting and Use of Appliances and Devices. The emissions for this sector were split between the two systems using U.S. average values to create a ratio.

**Figure 20:** Residential per capita emissions based regional data split for specific energy system.

$$\frac{110271 \text{ MT CQe} \cdot \frac{0.78 \text{ MT CQe}}{1.1 \text{ MT CQe}}}{279740 \text{ RV Citizens}} = \frac{0.28 \text{ MT CQe}}{\text{RV Citizen}}$$

2. Actual data on consumption of distillate fuel oil (DFO) in the Rogue Valley were not readily available for use in this analysis. An estimate of consumption and the associated emissions was made based on Oregon consumption and population in 2006. Oregon's total distillate fuel oil consumption for 2006 is available on the Energy Information Association (EIA) website<sup>24</sup> and Oregon's 2006 population is available from Portland State University – Population Research Center's *2006 Oregon Population Report*.<sup>25</sup> The EIA data are available by sector. These values were used to calculate per capita emissions with emissions factors from The Climate Registry's *General Reporting Protocol*<sup>26</sup>. The Oregon per capita value was applied to the Rogue Valley population to estimate regional use and the associated emissions.

**Figure 21:** Commercial per capita emissions from distillate fuel oil.

$$\left( \frac{27258000 \text{ gallons} \cdot \frac{10.21 \text{ kg CQe}}{\text{gallon}}}{3,690,505 \text{ Oregon citizens in 2006}} \right) \cdot \left( \frac{0.78 \text{ MT CQe}}{1.11 \text{ MT CQe}} \right) = \frac{0.054 \text{ MT CQe}}{\text{Oregon (or RV) citizen}}$$

3. Actual data on consumption of liquid propane gas (LPG) in the Rogue Valley were not readily available for use in this analysis. An estimate of consumption and the associated emissions was made based on Oregon consumption and population in 2006. Oregon's total LPG consumption for 2006 is available on the Energy Information Association (EIA) website<sup>27</sup> and

<sup>22</sup> The Climate Registry – General Reporting Protocol downloaded online at <http://www.theclimateregistry.org/resources/protocols/general-reporting-protocol/>.

<sup>23</sup> 2006 population from Portland State University – Population Research Center's *2006 Oregon Population Report* accessed online at <http://www.pdx.edu/prc/annual-oregon-population-report>.

<sup>24</sup> EIA - Oregon Adjusted Distillate Fuel Oil and Kerosene Sales by End Use accessed online at [http://www.eia.gov/emeu/states/hf.jsp?incfile=sep\\_use/res/use\\_res\\_or.html&mstate=OREGON](http://www.eia.gov/emeu/states/hf.jsp?incfile=sep_use/res/use_res_or.html&mstate=OREGON).

<sup>25</sup> 2006 Oregon Population Report available online at <http://www.pdx.edu/prc/annual-oregon-population-report>.

<sup>26</sup> The Climate Registry – General Reporting Protocol downloaded online at <http://www.theclimateregistry.org/resources/protocols/general-reporting-protocol/>.

<sup>27</sup> EIA - Oregon Adjusted Distillate Fuel Oil and Kerosene Sales by End Use accessed online at [http://www.eia.gov/emeu/states/hf.jsp?incfile=sep\\_use/res/use\\_res\\_or.html&mstate=OREGON](http://www.eia.gov/emeu/states/hf.jsp?incfile=sep_use/res/use_res_or.html&mstate=OREGON).

Oregon's 2006 population is available from Portland State University – Population Research Center's *2006 Oregon Population Report*.<sup>28</sup> The EIA data are available by sector. These values were used to calculate per capita emissions with emissions factors from The Climate Registry's *General Reporting Protocol*.<sup>29</sup> The Oregon per capita value was applied to the Rogue Valley population to estimate regional use and the associated emissions.

**Figure 22:** Commercial per capita emissions from distillate fuel oil.

$$\left( \frac{22,050,000 \text{ gallons} \cdot \frac{5.79 \text{ kg CO}_2\text{e}}{\text{gallon}}}{3,690,505 \text{ Oregon citizens in 2006}} \right) \cdot \left( \frac{0.78 \text{ MT CO}_2\text{e}}{1.11 \text{ MT CO}_2\text{e}} \right) = \frac{0.025 \text{ MT CO}_2\text{e}}{\text{Oregon (or RV) citizen}} \cdot \frac{\text{U.S. Resident}}{\text{U.S. Resident}}$$

## Commercial

1. The emissions in this sector/system represent all other fuel use, which is primarily natural gas, but also includes distillate fuel oil and liquid propane gas. Average per capita U.S. natural gas consumption was modified using actual natural gas data provided by Avista Utilities. These values were used to calculate per capita emissions with emissions factors from The Climate Registry's *General Reporting Protocol*<sup>30</sup> and the 2006 population of the Rogue Valley<sup>31</sup>. Distillate fuel oil and liquid propane gas were calculated using state averages and were applied to the Rogue Valley populations. These emissions were added to natural gas emissions for total sector / system emissions. For more detail see the inventory calculator.

The EPA report splits electricity use between two systems, Building HVAC and Lighting and Use of Appliances and Devices. The emissions for this sector were split between the two systems using U.S. average values to create a ratio.

**Figure 23:** Commercial per capita emissions from distillate fuel oil.

$$\frac{74,805 \text{ MT CO}_2\text{e} \cdot \frac{0.78 \text{ MT CO}_2\text{e}}{1.1 \text{ MT CO}_2\text{e}}}{279,740 \text{ RV Citizens}} \cdot \frac{\text{U.S. Resident}}{\text{U.S. Resident}} = \frac{0.21 \text{ MT CO}_2\text{e}}{\text{RV Citizen}}$$

2. Actual data on consumption of distillate fuel oil (DFO) in the Rogue Valley were not readily available for use in this analysis. An estimate of consumption and the associated emissions was made based on Oregon consumption and population in 2006. Oregon's total distillate fuel oil consumption for 2006 is available on the Energy Information Association (EIA) website<sup>32</sup> and Oregon's 2006 population is available from Portland State University – Population Research Center's *2006 Oregon Population Report*.<sup>33</sup> The EIA data are available by sector. These values were used to calculate per capita emissions with emissions factors

<sup>28</sup> 2006 Oregon Population Report available online at <http://www.pdx.edu/prc/annual-oregon-population-report>.

<sup>29</sup> The Climate Registry – General Reporting Protocol downloaded online at <http://www.theclimateregistry.org/resources/protocols/general-reporting-protocol/>.

<sup>30</sup> The Climate Registry – General Reporting Protocol downloaded online at <http://www.theclimateregistry.org/resources/protocols/general-reporting-protocol/>.

<sup>31</sup> 2006 population from Portland State University – Population Research Center's *2006 Oregon Population Report* accessed online at <http://www.pdx.edu/prc/annual-oregon-population-report>.

<sup>32</sup> EIA - Oregon Adjusted Distillate Fuel Oil and Kerosene Sales by End Use accessed online at [http://www.eia.gov/emeu/states/hf.jsp?incfile=sep\\_use/res/use\\_res\\_or.html&mstate=OREGON](http://www.eia.gov/emeu/states/hf.jsp?incfile=sep_use/res/use_res_or.html&mstate=OREGON).

<sup>33</sup> 2006 Oregon Population Report available online at <http://www.pdx.edu/prc/annual-oregon-population-report>.

from The Climate Registry's *General Reporting Protocol*<sup>34</sup>. The Oregon per capita value was applied to the Rogue Valley population to estimate regional use and the associated emissions. These emissions are then split for the energy system using the same method described in adjustment 1.

**Figure 24:** Commercial per capita emissions from distillate fuel oil.

$$\left( \frac{20,034,000 \text{ gallons} \cdot \frac{10.21 \text{ kg CO}_2}{\text{gallon}}}{3,690,505 \text{ Oregon citizens in 2006}} \right) \cdot \left( \frac{0.56 \text{ MT CO}_2}{0.70 \text{ MT CO}_2} \right) = \frac{0.044 \text{ MT CO}_2}{\text{Oregon (or RV) citizen}} \cdot \frac{\text{U.S. Resident}}{\text{U.S. Resident}}$$

- Actual data on consumption of liquid propane gas (LPG) in the Rogue Valley were not readily available for use in this analysis. An estimate of consumption and the associated emissions was made based on Oregon consumption and population in 2006. Oregon's total LPG consumption for 2006 is available on the Energy Information Association (EIA) website<sup>35</sup> and Oregon's 2006 population is available from Portland State University – Population Research Center's *2006 Oregon Population Report*.<sup>36</sup> The EIA data are available by sector. These values were used to calculate per capita emissions with emissions factors from The Climate Registry's *General Reporting Protocol*<sup>37</sup>. The Oregon per capita value was applied to the Rogue Valley population to estimate regional use and the associated emissions.

**Figure 25:** Commercial per capita emissions from distillate fuel oil.

$$\left( \frac{10,500,000 \text{ gallons} \cdot \frac{5.79 \text{ kg CO}_2}{\text{gallon}}}{3,690,505 \text{ Oregon citizens in 2006}} \right) \cdot \left( \frac{0.56 \text{ MT CO}_2}{0.70 \text{ MT CO}_2} \right) = \frac{0.013 \text{ MT CO}_2}{\text{Oregon (or RV) citizen}} \cdot \frac{\text{U.S. Resident}}{\text{U.S. Resident}}$$

## Transportation

- No modifications.

## Use of Appliances and Devices

### Electric Power Industry

- The per capita U.S. electricity emissions for this cell were modified using actual electricity consumption data to reflect the consumption trends of Rogue Valley region residents and businesses. Pacific Power provided 2006 retail sales data for by sector: industrial, commercial and residential. This consumption data was to calculate per capita emissions using the EPA's 2005 eGRID emissions factor for the NWPP sub region and the 2006 Rogue Valley population.

The EPA report splits electricity use between two systems, Building HVAC and Lighting and Use of Appliances and Devices. The emissions for this sector were split between the two systems using the U.S. average values to create a ratio for each system. These ratios were

<sup>34</sup> The Climate Registry – General Reporting Protocol downloaded online at <http://www.theclimateregistry.org/resources/protocols/general-reporting-protocol/>.

<sup>35</sup> EIA - Oregon Adjusted Distillate Fuel Oil and Kerosene Sales by End Use accessed online at [http://www.eia.gov/emeu/states/hf.jsp?incfile=sep\\_use/res/use\\_res\\_or.html&mstate=OREGON](http://www.eia.gov/emeu/states/hf.jsp?incfile=sep_use/res/use_res_or.html&mstate=OREGON).

<sup>36</sup> 2006 Oregon Population Report available online at <http://www.pdx.edu/prc/annual-oregon-population-report>.

<sup>37</sup> The Climate Registry – General Reporting Protocol downloaded online at <http://www.theclimateregistry.org/resources/protocols/general-reporting-protocol/>.

applied to the emissions calculated for the Rogue Valley in order to split the emissions into the two energy sector systems.

a. *Residential Electricity Emissions – Use of Appliances and Devices*

**Figure 26:** Residential per capita emissions based regional data split for specific energy system.

$$\frac{666563 \text{ MT CO}_2\text{e} \cdot \frac{1.39 \text{ MT CO}_2\text{e}}{5.5 \text{ MT CO}_2\text{e}} \cdot \frac{\text{U.S. Resident}}{\text{U.S. Resident}}}{279740 \text{ RV Citizens}} = \frac{0.597 \text{ MT CO}_2\text{e}}{\text{RV Citizen}}$$

b. *Commercial Electricity Emissions – Use of Appliances and Devices*

**Figure 27:** Commercial per capita emissions based regional data split for specific energy system.

$$\frac{393875 \text{ MT CO}_2\text{e} \cdot \frac{1.39 \text{ MT CO}_2\text{e}}{5.5 \text{ MT CO}_2\text{e}} \cdot \frac{\text{U.S. Resident}}{\text{U.S. Resident}}}{279740 \text{ RV Citizens}} = \frac{0.35 \text{ MT CO}_2\text{e}}{\text{RV Citizen}}$$

c. *Industrial Electricity Emissions – Use of Appliances and Devices*

Unlike the ratios used for the Residential and Commercial sectors the denominator in this ratio includes not only the Energy system, but also the natural gas used in industry/materials. These values are included because the industrial natural gas use reported by Avista Utilities includes all natural gas use, not only use in support buildings. Consistent with the methodology for a consumption-based inventory the energy consumed in the production of goods is excluded.

**Figure 28:** Industrial per capita emissions based regional data adjusted to exclude production energy consumption and split for specific energy system.

$$\frac{175898 \text{ MT CO}_2\text{e} \cdot \frac{0.080 \text{ MT CO}_2\text{e}}{3.05+0.35+0.18+0.24+0.08 \text{ MT CO}_2\text{e}} \cdot \frac{\text{U.S. Resident}}{\text{U.S. Resident}}}{279740 \text{ RV Citizens}} = \frac{0.013 \text{ MT CO}_2\text{e}}{\text{RV Citizen}}$$

d. *Metro Per Capita Electricity Emissions*

The residential, commercial and industrial are summed to the sector subtotal.

**Figure 29:** Sum of the three individual sectors for a total sector / system value.

$$\frac{0.597 \text{ MT CO}_2\text{e}}{\text{RV Citizen}} + \frac{0.35 \text{ MT CO}_2\text{e}}{\text{RV Citizen}} + \frac{0.013 \text{ MT CO}_2\text{e}}{\text{RV Citizen}} = \frac{0.96 \text{ MT CO}_2\text{e}}{\text{Metro Resident}}$$

## Agriculture

1. No modifications.

## Industry

1. The emissions in this sector/system represent all other fuel use, which is primarily natural gas, but also includes fuel oil and liquid propane gas. Average per capita U.S. natural gas consumption was modified using actual natural gas data to reflect the consumption trends of

Rogue Valley region residents and businesses. Avista Utilities provided industrial natural gas consumption for 2006. These values were used to calculate per capita emissions. Distillate fuel oil and liquid propane gas were calculated using 2006 Oregon values for consumption and were applied to the Rogue Valley populations. These emissions were added to natural gas emissions for total sector / system emissions. For more detail see the inventory calculator.

The EPA report splits electricity use between two categories, Building HVAC and Lighting and Use of Appliances and Devices. The emissions for this sector were split between the two systems using U.S. average values to create a ratio. Unlike the ratios used for the Residential and Commercial sectors the denominator in this ratio includes not only the Energy system, but also the natural gas used in industry/materials. These values are included because the industrial natural gas use reported by Avista Utilities includes all natural gas use, not only use in support buildings. Consistent with the methodology for a consumption-based inventory the energy consumed in the production of goods is excluded.

**Figure 30:** Industrial per capita emissions based regional data adjusted to exclude production energy consumption and split for specific energy system.

$$\frac{188306 \text{ MT CQe} \cdot \frac{0.08 \text{ MT CQe}}{\frac{3.05+0.35+0.18+0.24+0.08 \text{ MT CQe}}{\text{U.S. Resident}}}}{279740 \text{ RV Citizens}} = \frac{0.014 \text{ MT CQe}}{\text{RV Citizen}}$$

- Actual data on consumption of distillate fuel oil (DFO) in the Rogue Valley were not readily available for use in this analysis. An estimate of consumption and the associated emissions was made based on Oregon consumption and population in 2006. Oregon's total distillate fuel oil consumption for 2006 is available on the Energy Information Association (EIA) website<sup>38</sup> and Oregon's 2006 population is available from Portland State University – Population Research Center's *2006 Oregon Population Report*.<sup>39</sup> The EIA data are available by sector. These values were used to calculate per capita emissions with emissions factors from The Climate Registry's *General Reporting Protocol*.<sup>40</sup> The Oregon per capita value was applied to the Rogue Valley population to estimate regional use and the associated emissions. These emissions are then split for the energy system using the same method described in adjustment 1.

**Figure 31:** Commercial per capita emissions from distillate fuel oil.

$$\frac{78,078,000 \text{ gallons} \cdot \frac{10.21 \text{ kg CQe}}{\text{gallon}}}{3,690,505 \text{ Oregon citizens in 2006}} \cdot \frac{\frac{0.08 \text{ MT CQe}}{\text{U.S. Resident}}}{\frac{3.05+0.35+0.18+0.24+0.08 \text{ MT CQe}}{\text{U.S. Resident}}} = \frac{0.004 \text{ MT CQe}}{\text{Oregon (or RV) citizen}}$$

- Actual data on consumption of liquid propane gas (LPG) in the Rogue Valley were not readily available for use in this analysis. An estimate of consumption and the associated emissions was made based on Oregon consumption and population in 2006. Oregon's total LPG consumption for 2006 is available on the Energy Information Association (EIA) website<sup>41</sup> and

<sup>38</sup> EIA - Oregon Adjusted Distillate Fuel Oil and Kerosene Sales by End Use accessed online at [http://www.eia.gov/emeu/states/hf.jsp?incfile=sep\\_use/res/use\\_res\\_or.html&mstate=OREGON](http://www.eia.gov/emeu/states/hf.jsp?incfile=sep_use/res/use_res_or.html&mstate=OREGON).

<sup>39</sup> 2006 Oregon Population Report available online at <http://www.pdx.edu/prc/annual-oregon-population-report>.

<sup>40</sup> The Climate Registry – General Reporting Protocol downloaded online at <http://www.theclimateregistry.org/resources/protocols/general-reporting-protocol/>.

<sup>41</sup> EIA - Oregon Adjusted Distillate Fuel Oil and Kerosene Sales by End Use accessed online at [http://www.eia.gov/emeu/states/hf.jsp?incfile=sep\\_use/res/use\\_res\\_or.html&mstate=OREGON](http://www.eia.gov/emeu/states/hf.jsp?incfile=sep_use/res/use_res_or.html&mstate=OREGON).



Oregon's 2006 population is available from Portland State University – Population Research Center's *2006 Oregon Population Report*.<sup>42</sup> The EIA data are available by sector. These values were used to calculate per capita emissions with emissions factors from The Climate Registry's *General Reporting Protocol*.<sup>43</sup> The Oregon per capita value was applied to the Rogue Valley population to estimate regional use and the associated emissions.

**Figure 32:** Commercial per capita emissions from distillate fuel oil.

$$\frac{41,536,000 \text{ gallons} \cdot \frac{5.79 \text{ kg CO}_2\text{e}}{\text{gallon}}}{3,690,505 \text{ Oregon citizens in 2006}} \cdot \frac{0.08 \text{ MT CO}_2\text{e}}{\frac{3.05 + 0.35 + 0.18 + 0.24 + 0.08 \text{ MT CO}_2\text{e}}{\text{U.S. Resident}}} = \frac{0.001 \text{ MT CO}_2\text{e}}{\text{Oregon (or RV) citizen}}$$

4. The values in Figures 30-32 are summed.

## Residential

1. The emissions in this sector/system represent all other fuel use, which is primarily natural gas, but also includes distillate fuel oil and liquid propane gas. Average per capita U.S. natural gas consumption was modified using actual natural gas data provided by Avista Energy. These values and the Rogue Valley population were used to calculate per capita emissions. Distillate fuel oil and liquid propane gas were calculated using state averages and were applied to the Rogue Valley populations. These emissions were added to natural gas emissions for total sector / system emissions. For more detail see the inventory calculator.

The EPA report splits electricity use between two systems, Building HVAC and Lighting and Use of Appliances and Devices. The emissions for this sector were split between the two systems using U.S. average values to create a ratio. See the following equation for more detail on the natural gas portion of the "Use of Appliances and Devices" category formula.

**Figure 33:** Residential per capita emissions based regional data split for specific energy system.

$$\frac{110,271 \text{ MT CO}_2\text{e} \cdot \frac{0.32 \text{ MT CO}_2\text{e}}{\frac{1.1 \text{ MT CO}_2\text{e}}{\text{U.S. Resident}}}}{279,740 \text{ RV Citizens}} = \frac{0.11 \text{ MT CO}_2\text{e}}{\text{RV Citizen}}$$

2. Actual data on consumption of distillate fuel oil (DFO) in the Rogue Valley were not readily available for use in this analysis. An estimate of consumption and the associated emissions was made based on Oregon consumption and population in 2006. Oregon's total distillate fuel oil consumption for 2006 is available on the Energy Information Association (EIA) website<sup>44</sup> and Oregon's 2006 population is available from Portland State University – Population Research Center's *2006 Oregon Population Report*.<sup>45</sup> The EIA data are available by sector. These values were used to calculate per capita emissions with emissions factors from The Climate Registry's *General Reporting Protocol*.<sup>46</sup> The Oregon per capita value was applied to the Rogue Valley population to estimate regional use and the associated

<sup>42</sup> 2006 Oregon Population Report available online at <http://www.pdx.edu/prc/annual-oregon-population-report>.

<sup>43</sup> The Climate Registry – General Reporting Protocol downloaded online at <http://www.theclimateregistry.org/resources/protocols/general-reporting-protocol/>.

<sup>44</sup> EIA - Oregon Adjusted Distillate Fuel Oil and Kerosene Sales by End Use accessed online at [http://www.eia.gov/emeu/states/hf.jsp?incfile=sep\\_use/res/use\\_res\\_or.html&mstate=OREGON](http://www.eia.gov/emeu/states/hf.jsp?incfile=sep_use/res/use_res_or.html&mstate=OREGON).

<sup>45</sup> 2006 Oregon Population Report available online at <http://www.pdx.edu/prc/annual-oregon-population-report>.

<sup>46</sup> The Climate Registry – General Reporting Protocol downloaded online at <http://www.theclimateregistry.org/resources/protocols/general-reporting-protocol/>.



emissions. These emissions are then split for the energy system using the same method described in adjustment 1.

**Figure 34:** Commercial per capita emissions from distillate fuel oil.

$$\left( \frac{27,258,000 \text{ gallons} \cdot \frac{10.21 \text{ kg CO}_2\text{e}}{\text{gallon}}}{3,690,505 \text{ Oregon citizens in 2006}} \right) \cdot \left( \frac{0.32 \text{ MT CO}_2\text{e}}{1.11 \text{ MT CO}_2\text{e}} \right) = \frac{0.22 \text{ MT CO}_2\text{e}}{\text{Oregon (or RV) citizen}} \cdot \left( \frac{\text{U.S. Resident}}{\text{U.S. Resident}} \right)$$

- Actual data on consumption of liquid propane gas (LPG) in the Rogue Valley were not readily available for use in this analysis. An estimate of consumption and the associated emissions was made based on Oregon consumption and population in 2006. Oregon's total LPG consumption for 2006 is available on the Energy Information Association (EIA) website<sup>47</sup> and Oregon's 2006 population is available from Portland State University – Population Research Center's *2006 Oregon Population Report*.<sup>48</sup> The EIA data are available by sector. These values were used to calculate per capita emissions with emissions factors from The Climate Registry's *General Reporting Protocol*.<sup>49</sup> The Oregon per capita value was applied to the Rogue Valley population to estimate regional use and the associated emissions.

**Figure 35:** Commercial per capita emissions from distillate fuel oil.

$$\left( \frac{22,050,000 \text{ gallons} \cdot \frac{5.79 \text{ kg CO}_2\text{e}}{\text{gallon}}}{3,690,505 \text{ Oregon citizens in 2006}} \right) \cdot \left( \frac{0.32 \text{ MT CO}_2\text{e}}{1.11 \text{ MT CO}_2\text{e}} \right) = \frac{0.01 \text{ MT CO}_2\text{e}}{\text{Oregon (or RV) citizen}} \cdot \left( \frac{\text{U.S. Resident}}{\text{U.S. Resident}} \right)$$

- The values in Figures 24-26 are summed. Values in these equations and those that appear in Figure 3 may be slightly different due to rounding.

## Commercial

- The emissions in this cell represent all other fuel use, which is primarily natural gas, but also includes distillate fuel oil and liquid propane gas. Average per capita U.S. natural gas consumption was modified using actual natural gas data provided by Avista Energy. These values and the Rogue Valley population were used to calculate per capita emissions. Distillate fuel oil and liquid propane gas were calculated using state averages and were applied to the Rogue Valley populations. These emissions were added to natural gas emissions for total sector / system emissions. For more detail see the inventory calculator.

The EPA report splits electricity use between two systems, Building HVAC and Lighting and Use of Appliances and Devices. The emissions for this sector were split between the two systems using U.S. average values to create a ratio. See the following equation for more detail on the natural gas portion of the "Use of Appliances and Devices" category formula.

**Figure 36:** Commercial per capita emissions based regional data split for specific energy system.

<sup>47</sup> EIA - Oregon Adjusted Distillate Fuel Oil and Kerosene Sales by End Use accessed online at [http://www.eia.gov/emeu/states/hf.jsp?incfile=sep\\_use/res/use\\_res\\_or.html&mstate=OREGON](http://www.eia.gov/emeu/states/hf.jsp?incfile=sep_use/res/use_res_or.html&mstate=OREGON).

<sup>48</sup> 2006 Oregon Population Report available online at <http://www.pdx.edu/prc/annual-oregon-population-report>.

<sup>49</sup> The Climate Registry – General Reporting Protocol downloaded online at <http://www.theclimateregistry.org/resources/protocols/general-reporting-protocol/>.

$$\frac{74,805 \text{ MT CQe} \cdot \frac{0.14 \text{ MT CQe}}{\frac{\text{U.S. Resident}}{0.70 \text{ MT CQe}}}}{279,740 \text{ RV Citizens}} = \frac{0.06 \text{ MT CQe}}{\text{RV Citizen}}$$

2. Actual data on consumption of distillate fuel oil (DFO) in the Rogue Valley were not readily available for use in this analysis. An estimate of consumption and the associated emissions was made based on Oregon consumption and population in 2006. Oregon's total distillate fuel oil consumption for 2006 is available on the Energy Information Association (EIA) website<sup>50</sup> and Oregon's 2006 population is available from Portland State University – Population Research Center's *2006 Oregon Population Report*.<sup>51</sup> The EIA data are available by sector. These values were used to calculate per capita emissions with emissions factors from The Climate Registry's *General Reporting Protocol*.<sup>52</sup> The Oregon per capita value was applied to the Rogue Valley population to estimate regional use and the associated emissions. These emissions are then split for the energy system using the same method described in adjustment 1.

**Figure 37:** Commercial per capita emissions from distillate fuel oil.

$$\left( \frac{20,034,000 \text{ gallons} \cdot \frac{10.21 \text{ kg CQe}}{\text{gallon}}}{3,690,505 \text{ Oregon citizens in 2006}} \right) \cdot \left( \frac{\frac{0.14 \text{ MT CQe}}{\text{U.S. Resident}}}{\frac{0.70 \text{ MT CQe}}{\text{U.S. Resident}}} \right) = \frac{0.012 \text{ MT CQe}}{\text{Oregon (or RV) citizen}}$$

3. Actual data on consumption of liquid propane gas (LPG) in the Rogue Valley were not readily available for use in this analysis. An estimate of consumption and the associated emissions was made based on Oregon consumption and population in 2006. Oregon's total LPG consumption for 2006 is available on the Energy Information Association (EIA) website<sup>53</sup> and Oregon's 2006 population is available from Portland State University – Population Research Center's *2006 Oregon Population Report*.<sup>54</sup> The EIA data are available by sector. These values were used to calculate per capita emissions with emissions factors from The Climate Registry's *General Reporting Protocol*.<sup>55</sup> The Oregon per capita value was applied to the Rogue Valley population to estimate regional use and the associated emissions.

**Figure 38:** Commercial per capita emissions from distillate fuel oil.

$$\left( \frac{10,500,000 \text{ gallons} \cdot \frac{5.79 \text{ kg CQe}}{\text{gallon}}}{3,690,505 \text{ Oregon citizens in 2006}} \right) \cdot \left( \frac{\frac{0.14 \text{ MT CQe}}{\text{U.S. Resident}}}{\frac{0.70 \text{ MT CQe}}{\text{U.S. Resident}}} \right) = \frac{0.003 \text{ MT CQe}}{\text{Oregon (or RV) citizen}}$$

4. The values in Figures 25-27 are summed. Values in these equations and those that appear in Figure 3 may be slightly different due to rounding.

<sup>50</sup> EIA - Oregon Adjusted Distillate Fuel Oil and Kerosene Sales by End Use accessed online at [http://www.eia.gov/emeu/states/hf.jsp?incfile=sep\\_use/res/use\\_res\\_or.html&mstate=OREGON](http://www.eia.gov/emeu/states/hf.jsp?incfile=sep_use/res/use_res_or.html&mstate=OREGON).

<sup>51</sup> 2006 Oregon Population Report available online at <http://www.pdx.edu/prc/annual-oregon-population-report>.

<sup>52</sup> The Climate Registry – General Reporting Protocol downloaded online at <http://www.theclimateregistry.org/resources/protocols/general-reporting-protocol/>.

<sup>53</sup> EIA - Oregon Adjusted Distillate Fuel Oil and Kerosene Sales by End Use accessed online at [http://www.eia.gov/emeu/states/hf.jsp?incfile=sep\\_use/res/use\\_res\\_or.html&mstate=OREGON](http://www.eia.gov/emeu/states/hf.jsp?incfile=sep_use/res/use_res_or.html&mstate=OREGON).

<sup>54</sup> 2006 Oregon Population Report available online at <http://www.pdx.edu/prc/annual-oregon-population-report>.

<sup>55</sup> The Climate Registry – General Reporting Protocol downloaded online at <http://www.theclimateregistry.org/resources/protocols/general-reporting-protocol/>.

## Transportation

1. No modifications.

## Transportation

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### *Local Passenger Transport*

#### Electric Power Industry

1. There is no electricity powered transportation infrastructure located in the Rogue Valley, so this value was excluded from the analysis.

#### Agriculture

1. No modifications.

#### Industry

1. This value represents upstream, fuel-cycle emissions. For example, the energy and process emissions associated with extracting crude oil and refining to gasoline as well as the associated transportation, etc.

To determine the upstream emissions associated with industry transportation in the Rogue Valley, the sum of the industry transportation emissions is multiplied by the ratio of U.S. industrial and total transportation emissions. The results of the GreenSTEP model (see Transportation sector description below) include upstream emissions. This adjustment an accounting construct based on the actual regional values (from GreenSTEP and local transit agencies).

**Figure 39:** Residential per capita emissions based regional data split for specific energy system.

$$(4.15 \text{ MT CO}_2\text{e} + 0.008 \text{ MT CO}_2\text{e}) \cdot \left( \frac{0.4 \text{ MT CO}_2\text{e}}{3.4 \text{ MT CO}_2\text{e}} \right) = 0.498 \text{ MT CO}_2\text{e}$$

#### Residential

1. No modifications.

#### Commercial

1. No modifications.

#### Transportation

1. The U.S. average per capita emissions for this sector/system were partially substituted with a value provided by Oregon Department of Transportation's (ODOT) GreenSTEP model. Based on ODOT's model the per capita intensity for Local Passenger Transport is 4.15 MT CO<sub>2</sub>e / person. The greenhouse gas (GHG) emissions were estimated for on-road transportation sources that weight less than 10,000 pounds in support of Oregon's Sustainable Transportation Strategy and Senate Bill 1059.
2. In addition to the value described in adjustment 1 are the emissions from the local transit agencies. These emissions were calculated based on data provided by Rogue Valley Transit District and Josephine County on quantities of fuel consumed for transit operations in 2006.

3. The previous emissions modification made in the industry sector (i.e. the fuel cycle emissions) of this system is subtracted from this cell.

**Figure 40:** Local passenger transportation emissions minus fuel cycle emissions.

$$\left( \frac{4.15 \text{ MT CO}_2\text{e}}{\text{RV Citizen}} + \frac{0.008 \text{ MT CO}_2\text{e}}{\text{RV Citizen}} \right) - \frac{0.498 \text{ MT CO}_2\text{e}}{\text{RV Citizen}} = \frac{3.66 \text{ MT CO}_2\text{e}}{\text{RV Citizen}}$$

## ***Other Passenger Transport***

### **Electric Power Industry**

1. There is no electric powered transportation infrastructure located in the Rogue Valley, so this value was excluded from the analysis.

### **Agriculture**

1. No modifications.

### **Industry**

1. This value represents upstream, fuel-cycle emissions. For example the energy and process emissions associated with extracting crude oil and refining to gasoline as well as the associated transportation of the raw materials and refined product, etc.

To determine the upstream emissions associated with Other Passenger Transportation in the Rogue Valley, the per capita emissions value for Rogue Valley citizens after the adjustment made in the Transportation sector of this system is multiplied by the ratio of U.S. industrial and transportation emissions to determine the upstream fuel-cycle emissions associated with the Transportation sector / system emissions.

**Figure 41:** Residential per capita emissions based regional data split for specific energy system.

$$\frac{1.7 \text{ MT CO}_2\text{e}}{\text{RV Citizen}} \cdot \left( \frac{\frac{0.4 \text{ MT CO}_2\text{e}}{\text{US Resident}}}{\frac{3.4 \text{ MT CO}_2\text{e}}{\text{US Resident}}} \right) = \frac{0.22 \text{ MT CO}_2\text{e}}{\text{RV Citizen}}$$

### **Residential**

1. No modifications.

### **Commercial**

1. No modifications.

### **Transportation**

1. This sector/system is also modified for the difference between U.S. and Rogue Valley, Oregon (Josephine and Jackson counties) per household (HH) median income. This modification assumes that because the Rogue Valley's median household income is less in than the U.S. median, Oregon households will purchase less thus reducing per capita emissions. According to U.S. Census Bureau data<sup>56</sup> the U.S. median 2006 household income equals \$48,855 while in the Rogue Valley's median household income equals \$41,917.

<sup>56</sup> U.S. Census Bureau data may be access online at <http://quickfacts.census.gov/qfd/index.html>.

**Figure 42:** Residential per capita emissions based regional data split for specific energy system.

$$\frac{1.93 \text{ MT CO}_2\text{e}}{\text{U.S. Resident}} \times \frac{\frac{\$41917}{\text{RV median household income}}}{\frac{\$48855}{\text{US median household income}}} = \frac{1.7 \text{ MT CO}_2\text{e}}{\text{RV Citizen}}$$

### **Local Freight**

The emissions presented as “Local Freight” are based on the Transportation sector emissions for the Materials system. It is assumed that 15% of these materials transportation emissions result from local freight transportation. This change is only an accounting construct to signify that a certain portion of these emissions happens within the boundaries of the Rogue Valley region. See the Transportation sector of this system below for more detail.

#### **Electric Power Industry**

1. No modifications.

#### **Agriculture**

1. No modifications.

#### **Industry**

1. No modifications.

#### **Residential**

1. No modifications.

#### **Commercial**

1. No modifications.

#### **Transportation**

1. The EPA reported emissions for the sector/system, Transportation/ Procurement of Goods was split into two parts for the purpose of this analysis (as was described in the Materials and Infrastructure methods): long-haul freight and local freight. The local freight is addressed here. For this analysis it is assumed that 15% of the transportation associated with the Provision of Goods is local freight, while the remaining 85% is long-haul freight. Local freight is included in this section because these emissions will be directly addressed through Rogue Valley Council of Government transportation planning and policies.

The local freight emissions are modified for the difference between U.S. and Rogue Valley median per household income. This modification assumes that because household income is less in the Rogue Valley than the U.S. average; therefore Rogue Valley households will purchase less, thus reducing per capita emissions. According to U.S. Census Bureau data the U.S. median 2006 household income equals \$48,855 while in the Rogue Valley’s median household income equals \$41,917.

**Figure 43:** Residential per capita emissions based regional data split for specific energy system.

$$\frac{1.7 \text{ MT CO}_2\text{e}}{\text{U.S. Resident}} \cdot 15\% \cdot \frac{\frac{\$41917}{\text{RV median household income}}}{\frac{\$48855}{\text{US median household income}}} = \frac{0.25 \text{ MT CO}_2\text{e}}{\text{RV Citizen}}$$