Lane County, Oregon

CLIMATE ACTION PLAN | PHASE 1:

Community Greenhouse Gas Inventory

FOR CALENDAR YEAR 2019

Prepared by Good Company

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ACKNOWLEDGEMENTS

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Good Company, a sustainability consulting firm based in Eugene, OR supported Lane County's work on this project. Aaron Toneys and Claudia Denton of Good Company provided data gathering assistance to Lane County staff and facilitated the use of Good Company's Carbon Calculator for Communities (G3C Community), a proprietary GHG inventory tool, to conduct analysis. They are the primary authors of this report.

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1. EXECUTIVE SUMMARY

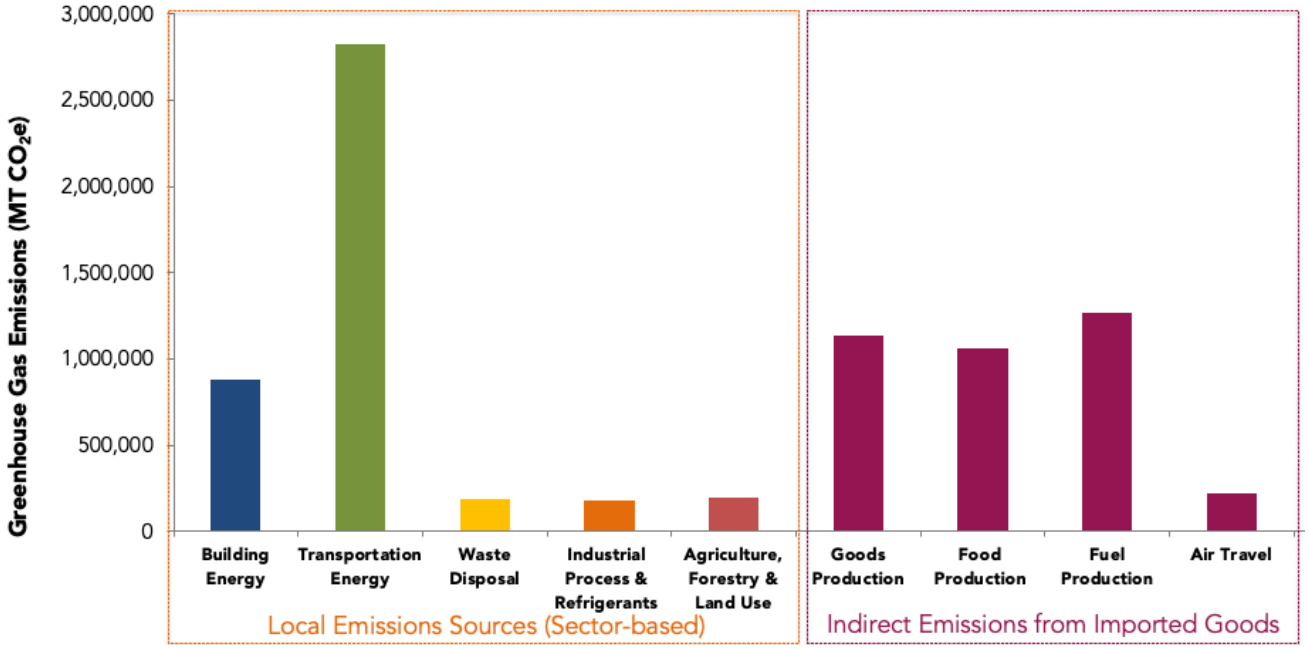
2019 COMMUNITY GREENHOUSE GAS (GHG) EMISSIONS

Lane County completed a Community Greenhouse Gas (GHG) Inventory to better understand sources of GHG emissions (i.e. climate pollution) to inform development of a community climate action plan (CAP). The inventory follows internationally recognized community GHG inventory protocols and accounts for all significant sources of GHG emissions driven by activities taking place within the County's geographic boundary. Beyond protocol requirements, the inventory also measures consumption-based emissions from imported goods and food, air travel, as well as negative emissions, including forest sequestration and the purchase of carbon offsets.

SUMMARY OF FINDINGS

- During 2019, Lane County's local emissions totaled **over 4.2 million Metric Tons of carbon dioxide equivalent (MT CO_2e).** The largest sectors were transportation (primarily diesel and gasoline combustion, 66% local emissions) and energy use by buildings (natural gas and electricity use, 21%). Smaller local sources of emissions included agricultural animal emissions (5%), refrigerant loss and industrial processes (4%), and waste disposal (4%).
- Imported emissions from household consumption in Lane County and production of fuel and energy sold in Lane County totaled **nearly 3.7 million MT CO_2e** and include emissions from upstream fuel production (34%), production of goods (31%), food (29%), and air travel (6%).
- All emissions combine for a total **7.9 million MT CO_2e**, or **21 MT CO_2e** per resident.
- Forest growth and purchased carbon offsets sequestered over **3.5 million MT CO_2e.**

Figure 1: Lane County community GHG emissions by sector



2. INTRODUCTION

Human activity in the form of fossil fuel combustion is the primary cause of planetary warming and changes in climate that have accelerated in recent years.[1] The best available scientific evidence indicates that human-caused greenhouse gas emissions (GHGs) must be reduced significantly by 2030 to avoid to avoid "severe, pervasive and irreversible impacts for people and ecosystems."[1]

We are already observing physical changes to Oregon's climate, including hotter temperatures, drought, wildfires and smoke intrusions, and reduced snowpack[2]. Understanding the areas of greatest risk gives us the opportunity to take action to mitigate, adapt, and become more resilient to changing conditions.

International goals to mitigate the worst climate impacts are commonly aligned with the Paris Climate Accord, which seeks to limit global average temperature increases to well below 2°C relative to pre-Industrial Revolution temperatures and strives to limit warming to 1.5°C. As of 2018, average temperatures have increased by more than 1°C and are on track to increase to 1.5°C by 2040. [1] It is with this sense of urgency that in February 2020, the Lane County Board of Commissioners passed an order and resolution to develop a climate action strategy.[3]

This community greenhouse gas (GHG) emissions inventory is part of a three-phased Climate Action Plan and broader climate action strategy. This inventory establishes a baseline for countywide GHG emissions against which we can measure trends, manage emissions from specific sources and activities, and track progress on our goals over time.

ABOUT LANE COUNTY

With a population of 378,000, Lane County is the fourth most populous county in Oregon, containing 12 incorporated cities and the third largest metropolitan area in the state, Eugene-Springfield. Spanning from the coast, across the Willamette Valley, to the Cascade Mountains, the county covers more than 4,700 square miles, more than 90% of which are forestland.[4] Lane County's largest employers are PeaceHealth Medical Group and the University of Oregon. In addition to healthcare and education, important sectors include retail, manufacturing, agriculture, and tourism.[5]

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[1] Intergovernmental Panel on Climate (2014). Assessment Report 5 Synthesis Report: Climate Change, 2014. http://www.ipcc.ch/report/ar5/syr/

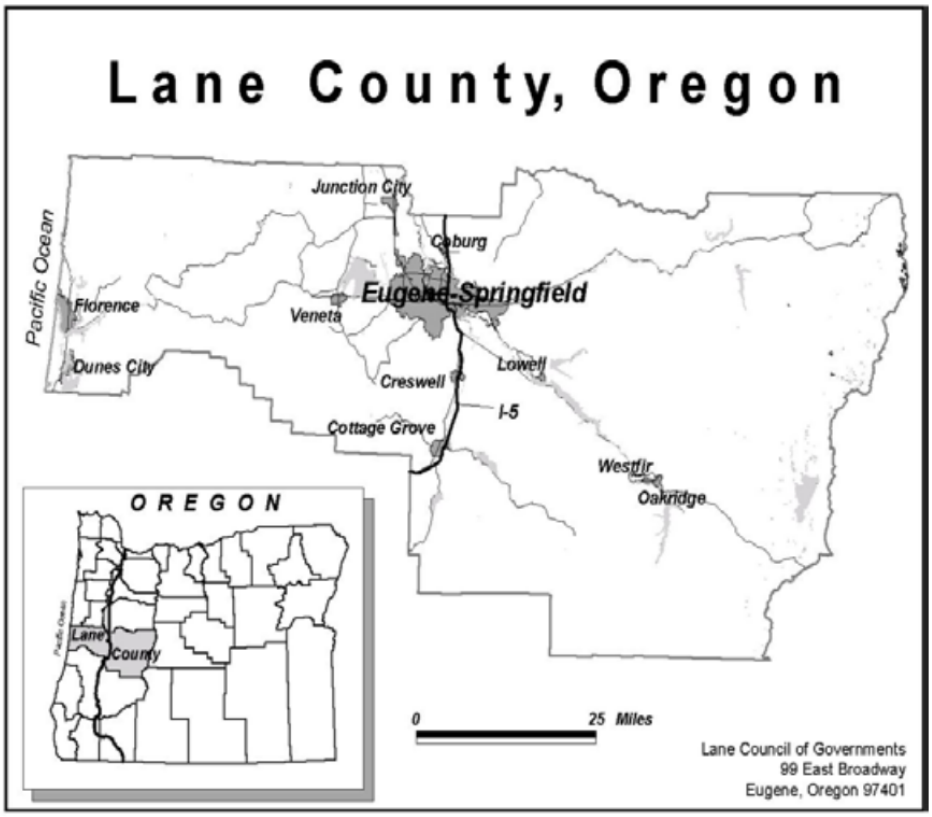
[2] Mote, P.W., J. Abatzoglou, K.D. Dello, K. Hegewisch, and D.E. Rupp, 2019: Fourth Oregon Climate Assessment Report. Oregon Climate Change Research Institute. occri.net/ocar4.

[3] Lane County Board of Commissioners (2020). Order and Resolution No 20-02-04-04: In the matter of establishing a climate change strategy for Lane County. https://www.lanecounty.org/cms/one.aspx?pageId=16461487

[4] Lane County (2020). FY 20-21 Adopted Budget: Overview. https://www.lanecounty.org/UserFiles/Servers/Server_3585797/File/Budget/2020-2021%20Proposed/Proposed%20Budget%20Document/Overview.pdf

[5] Eugene Area Chamber of Commerce (2019). Lane County Principle Employers Report. https://www.eugenechamber.com/lane-county-principal-employers.html

Figure 2: Map of Lane County[4]



3. WHAT'S INCLUDED? (INVENTORY BOUNDARIES & METHODOLOGY)

Lane County's community inventory follows Greenhouse Gas Protocol's *Global Protocol for Community-Scale Greenhouse Gas Emissions (GPC)*.[6] The GPC accounts for sector-based emissions – those generated within county boundaries. For a more comprehensive look, the Lane County inventory also provides an estimate of emissions embodied in goods, services, and food produced elsewhere and consumed locally.

The greenhouse gas inventory presented in this report is based on calendar year 2019 data within the geographic boundaries of Lane County. The share of emissions is also estimated for each of the 12 incorporated cities in the county. The inventory considers all seven recognized greenhouse gases, four of which are relevant for Lane County – carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and hydrofluorocarbons (HFC). All gases are reported in terms of metric tons of carbon dioxide equivalent (MT CO_2e).

[6] GPC has become the recommended or required standard for international reporting to CDP's Cities Survey and the Global Covenant of Mayors for Climate & Energy. While Lane County does not currently participate in these endeavors, the Lane County inventory has been conducted to allow for adoption in the future. GPC protocol may be found at https://ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities.

The Lane County 2019 Community GHG Inventory includes the following emissions sources:

Building Energy use by residential, commercial, and industrial buildings and facilities represents a large source of community emissions. These emissions come from combustion of natural gas for hot water and building heat and from electricity generated from fossil fuels. Small quantities of combusted propane and other fuels are also included. Additionally, a fraction of natural gas is lost during local distribution, releasing methane, a potent greenhouse gas pollutant.

Transportation energy, particularly on-road vehicle transportation of passengers and freight, also represents a large fraction of community emissions. Like building energy, transportation emissions are generated at the tailpipe by combustion of gasoline, diesel, other liquid and gas fuels, or from electricity generation for electric vehicles.

Waste disposal in landfills and **wastewater** treatment produces methane, of which a fraction leaks out to the atmosphere, having a negative climate impact.

Industrial Process & Product Use (refrigerants) Emissions from refrigerants are lost from transportation and building cooling systems. Refrigerants are potent global warming gases. Therefore, relatively small losses have a large climate impact. Industrial process emissions are also included here.

Agriculture, Forestry, & Land Use generate emissions from agricultural activity (e.g. animal waste and agricultural inputs) and community land use change (e.g. development of forest or grasslands).

Consumption-based Emissions* are generated outside of the community during the production of goods, food, fuels and service products consumed by residents within Lane County.
*Note: *Consumption-based emissions presented in this inventory are **estimated** and therefore the results have a greater level of uncertainty compared to other sources of emissions.*

Table 2 (next page) includes protocol sectors and sub-sectors and notes which were included in this analysis. This inventory also considers the origin location, either within a community or outside – referred to as 'scopes.' Scope categories as outlined below distinguish between those emissions that occur within the geographic boundaries (Scope 1) from those that occur outside the boundaries, but that are driven by activity from within (Scope 2 and Scope 3). **Table 1** explains the three emissions scopes.

Table 1: Greenhouse gases accounting and reporting scopes

Scope 1	GHG emissions generated within the geographic boundary.
Scope 2	GHG emissions from power generation of grid-supplied electricity to users in the geographic boundary.
Scope 3	All other GHG emissions that are created outside the geographic boundary as a result of activities taking places within the boundary.

Table 2: Description of Community GHG Protocol emissions sources and scopes relevant for Lane County

Emissions Sector / Sub-Sector	Included in Inventory	Scope 1	Scope 2	Scope 3
Building Energy				
Residential Buildings	•	✓	✓	✓
Commercial Buildings and Facilities	•	✓	✓	✓
Industrial Facilities and Irrigation	•	✓	✓	✓
Potable Water and Wastewater Stationary Energy	•	✓	✓	✓
Energy Generation Supplied to the Grid	•	✓	✓	✓
Agriculture, Forestry, and Fishing	•	✓	✓	✓
Fugitive Emissions from Natural Gas Systems	•	✓		
Fugitive Emissions from Coal Production	NO			
Transportation				
On-Road Passenger and Commercial Vehicles	•	✓	✓	
On-Road Freight Vehicles	•	✓		
On-Road Transit Vehicles	•	✓		
Off-Road Vehicles and Equipment	•	✓		
Passenger & Freight Rail	•	✓		
Aviation	IE			
Waterborn Navigation	•	✓		
Waste & Wastewater				
Solid Waste	•	✓		
Wastewater Treatment	•	✓		
Biological Treatment of Waste	•	✓		
Incineration of Waste	NO			
Industrial Process and Product Use				
Product Use (refrigerants)	•	✓		
Industrial Processes	•	✓		
Agriculture, Forestry, and Land Use				
Livestock	•	✓		
Land Use	NE			
Other Agriculture	NE			
Consumption-based Emissions Sources				
Household Consumption	•			✓
Air Travel	•			✓
Upstream Energy Production	•			✓
Negative Emissions (Sequestration & Offsets)				
Purchased carbon offsets	•	✓		
Local carbon storage (annual growth)	•	✓		

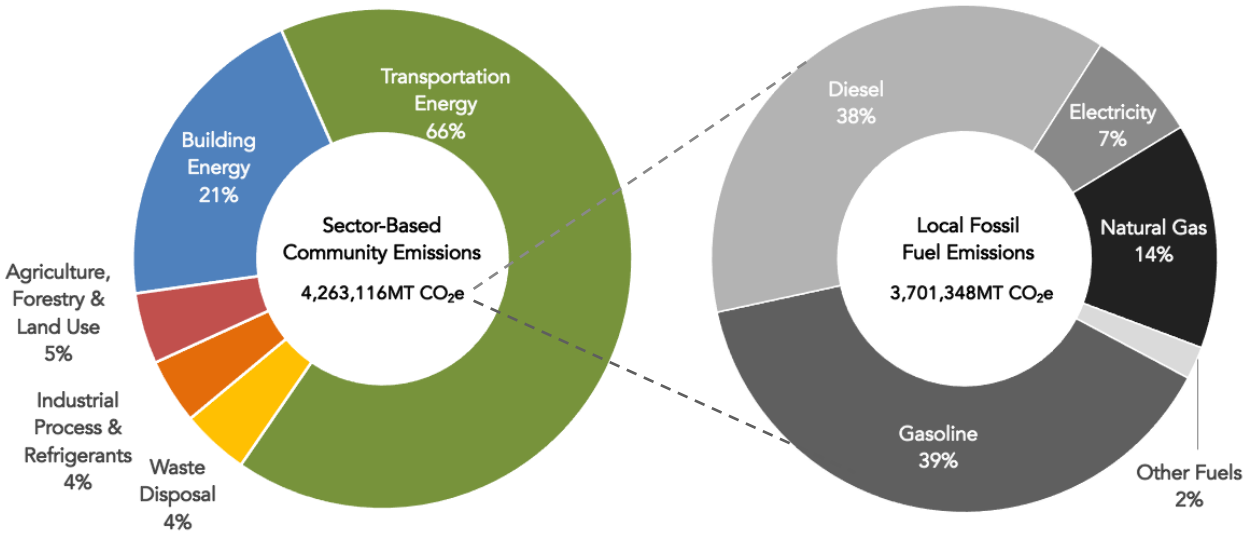
IE = Included Elsewhere
NE = Emissions occur but are not reported or estimated - see justification in exclusions
NO = Activity or process does not occur within boundary

4. COMMUNITY RESULTS

LOCAL EMISSIONS (SECTOR-BASED EMISSIONS)

The Lane County community generated nearly **4.3 million MT CO_2e** of local emissions – about **11.3 MT CO_2e** per resident. **This is less than the U.S. average of 16.5 and considerably greater than global average of 5.0.**[7] Protocols refer to local emissions as sector-based emissions. Those emissions are generated close to home and are most often under the community's direct control. **This quantity of GHGs is equivalent to the carbon sequestered by about 5.6 million acres of average U.S. forest – a land area nearly twice the size of Lane County**.[8]

Figure 3: 2019 Community Local Emissions and Fossil Fuel Details. In Lane County, fossil fuel emissions come from Building Energy and Transportation Energy sources only. *Note – Figure 3 and all other figures present market-based accounting for electricity emissions unless otherwise noted.*



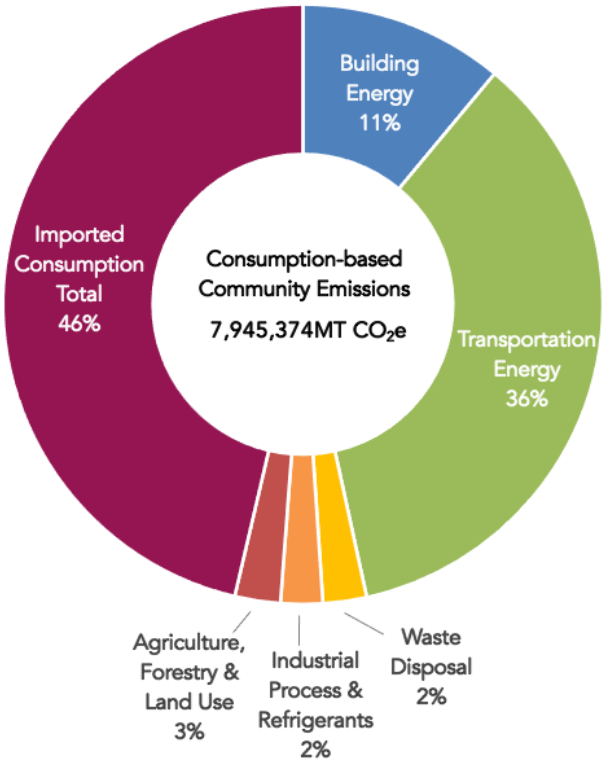
Lane County's local emissions are shown on the left side of **Figure 3** and come primarily from transportation, mainly gasoline and diesel combustion in vehicles (**green segment**) as well as electricity use and combustion of natural gas by buildings and other facilities (**blue segments**). Emissions from waste include landfill disposal of community solid waste and wastewater treatment (**yellow**). Emissions from industrial process & product use include refrigerant gas loss from buildings and vehicles and federally reported special industrial emissions (**orange**). Agriculture emissions include farm animal sources (**red**). The right side of **Figure 3** details fossil fuel use. Note that all emissions from **buildings** and **transportation** are from fossil fuels (86% of total); only **waste**, **refrigerants**, and **agriculture** are non-fossil fuel emissions.

[7] Data from World Bank. For details visit https://data.worldbank.org/indicator/EN.ATM.CO2E.PC.
[8] Using EPA's GHG equivalency tool https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

IMPORTED EMISSIONS FROM HOUSEHOLD CONSUMPTION AND FUEL AND ENERGY PRODUCTS SOLD IN LANE COUNTY

In addition to accounting for local emissions, the inventory also estimates imported **consumption-based emissions**, which are generated outside of Lane County to produce and provide the imported goods, food, services, air travel, and production and transport of fuels consumed by Lane County households. Consumption-based emissions total nearly **3.7 million MT CO_2e** in addition to sources of sector-based emissions. **This quantity of GHGs is equivalent to the carbon sequestered by over 4.8 million acres of average U.S. forest**. **Figure 4** compares the scale of local, sector-based emissions to imported emissions from household consumption.

Figure 4: 2019 Community Local + Imported Emissions.



Within goods, the largest purchasing categories include vehicles & parts, appliances, and construction materials. Within food, the largest emissions are from the production of meats, particularly beef and lamb products.

Upstream emissions from fuel production (gasoline, diesel, electricity and natural gas) and air travel from flights taken by county residents (regardless of airport location) are also significant sources of Lane County consumption-based emissions. For more details on these emissions see **Figure 9** and the related section on page 16.

ALL EMISSIONS

Local and imported emissions combine for a total **7.9 million MT CO_2e**, or **21 MT CO_2e** per resident. **This quantity of GHGs is equivalent to the carbon sequestered by over 10.3 million acres of average U.S. forest**. There are **negative emissions** sources as well, from purchased carbon offsets from Northwest Natural Gas customers (nearly **22,000 MT CO_2e**) as well as annual additional **sequestration** from growth in local forests – over **3.5 million MT CO_2e**. This shows the importance of keeping our forests healthy and intact. **Figure 5** and **Figure 6** on the following pages detail and compare local emissions, imported emissions, and negative emissions.

Figure 5: Lane County 2019 Community GHG Emissions by sector emissions, imported consumption-based emissions (magenta) and carbon storage (teal).

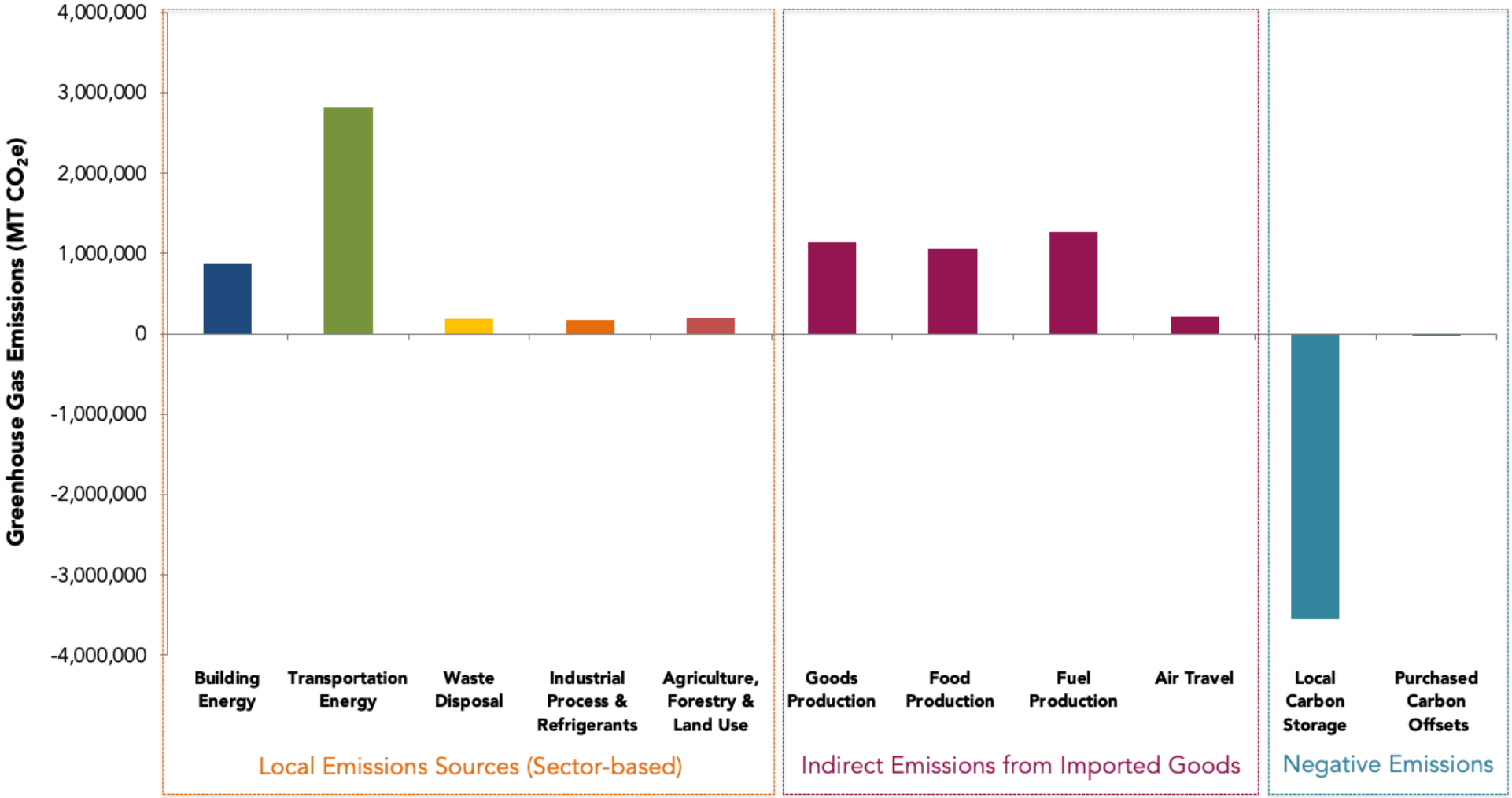


Table 3: Summary Table of Lane County 2019 Community GHG Emissions*

Emissions Sector / Sub-Sector	2019 Emissions		Per capita	
	Market-based	Location-based	Market-based	Location-based
Stationary Energy, 11%	**877,495**	**1,946,833**	**2.3**	**5.1**
Residential Buildings				
Electricity	128,389	605,857	0.3	1.6
Natural Gas	122,802		0.3	
Other Fuels	20,415		0.1	
Commercial Buildings and Institutions				
Electricity	82,971	355,707	0.2	0.9
Natural Gas	129,438		0.3	
Other Fuels	31,787		0.08	
Industrial Facilities & Water Treatment				
Electricity	55,313	374,447	0.1	1.0
Natural Gas	280,074		0.7	
Other Fuels	12,562		0.03	
Fugitive Natural Gas	13,743		0.04	
Transportation, 36%	**2,823,852**	**2,825,725**	**7.5**	**7.5**
On-Road Passenger Vehicles	1,436,274		3.8	
Freight & Commercial Vehicles	1,252,935		3.3	
On-Road Transit Vehicles	10,470		0.03	
Electric Vehicles	102	1,974	0.0003	0.005
Off-Road Vehicles and Equipment	103,212		0.3	
Passenger & Freight Rail (in-territory only)	20,049	20,049	0.1	0.1
Waterborne transportation	812		0.002	
Waste, 2%	**186,802**		**0.5**	
Solid Waste Landfill and Compost	174,089		0.5	
Wastewater Treatment & Septic Systems	12,713		0.03	
Industrial Process and Product Use, 2%	**179,643**		**0.5**	
Refrigerant Product Use	144,239		0.4	
Industrial Process	35,404		0.1	
Agriculture, Forestry, and Land Use, 2%	**195,324**		**0.5**	
Livestock	195,324		0.5	
Land	NE			
Other Agriculture	NE			
Consumption-based & Upstream Emissions, 46%	**3,682,257**	**3,821,021**	**9.7**	**10.1**
Household Consumption				
Goods	1,136,294		3.0	
Food	1,059,825		2.8	
Upstream Energy Production	1,264,073	1,402,837	3.3	3.7
Air Travel	222,065		0.6	
Negative Emissions (Sequestration & Offsets)	**-3,566,228**		**-9.4**	
Purchased Offsets	-21,513		-0.1	
Local Carbon Storage	-3,544,715		-9.4	
Local Emissions	4,263,117	5,334,327	11.3	14.1
Local + Consumption	7,945,374	9,155,348	21.0	24.2

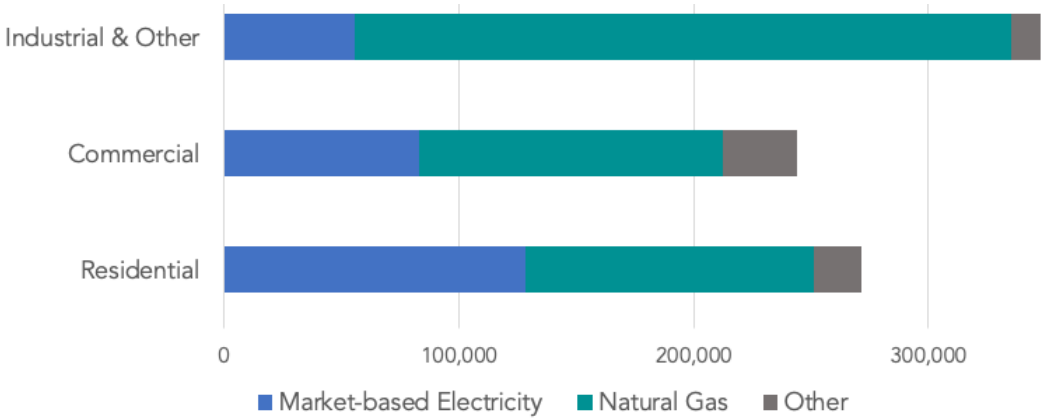
**Sector percentages are based on the market-based accounting Local + Consumption total.*
See **Appendix B: Methodology & Protocols** for a discussion of location-based and market-based electricity accounting emissions and a Summary of Exclusions for sub-sectors that are not included.

5. DETAILED RESULTS BY SECTOR

Buildings Energy

Electricity, natural gas use, and other fuels are large sources of local emissions – totaling nearly **900,000 MT CO_2e**. Lane County commercial and industrial uses have a slightly larger impact in Lane County than residential uses. By energy type, natural gas had the largest impact (61% of total building emissions + 1.7% from local fugitive gas); followed by electricity (30%); and other fuels (7%). **Figure 6** shows emissions broken down by sub-sector and energy type.

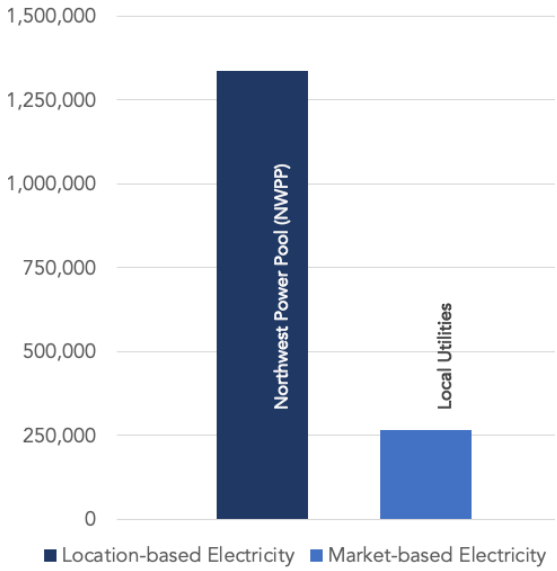
Figure 6: Comparison of Building Energy Emissions (MT CO_2e)



Lane County is served by seven electric utilities:

- Eugene Water & Electric Board (EWEB),
- Springfield Utility Board (SUB),
- Emerald People's Utility District (EPUD),
- Lane Electric Cooperative,
- Blachly-Lane Electric Cooperative,
- Central Lincoln People's Utility District, and
- Pacific Power.

Figure 7: Comparison of Location-based to Market-based Electricity Emissions.



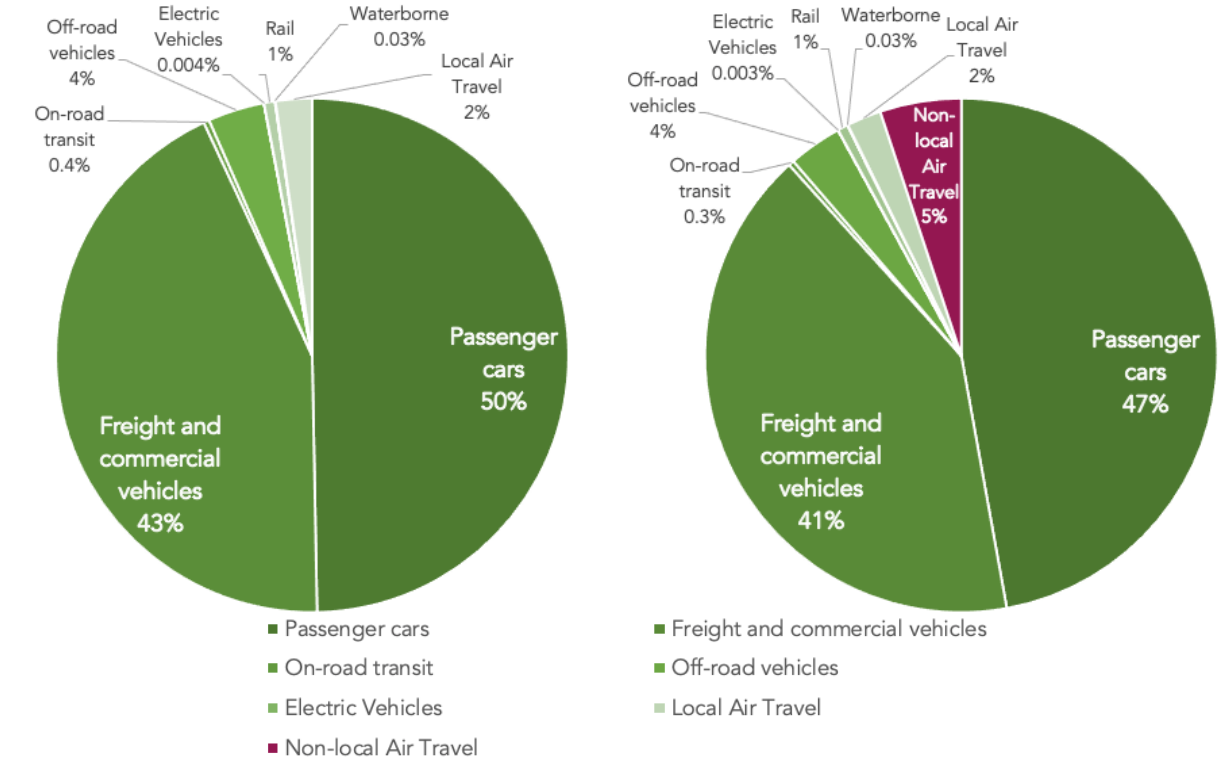
Each utility has its own specific emissions factor (MT CO_2e emitted per kWh of electricity) which is dependent on the utility's power generation supply contracts. The market-based electricity accounting method also accounts for community participation in utility green power programs. In 2019, Lane County customers purchased renewable energy in the form of Renewable Energy Credits (RECs) equal to about .5% of demand, which decreased market-based electricity accounting emissions. In addition, about .5% of community demand is generated within the county through landfill gas combustion at Short Mountain Landfill, as well as a small amount of residential and commercial PV solar installations.

Transportation

Transportation emissions are the largest sector for Lane County, totaling over **2.8 million MT CO_2e.** On-road passenger vehicles were Lane County's leading source of local transportation emissions and represented 51% of transportation emissions. These emissions originate from gasoline sales, primarily used by private use cars and trucks. The next largest category is diesel sales, primarily used by freight & commercial vehicles at 44%; the majority of these emissions are expected to be on-road vehicles but may include rail and other non-road uses. The next category is known off-road (e.g. construction, agriculture and forestry) sources at 4% of emissions. In-boundary passenger and pass-through freight rail, transit, and marine transportation all represent around 1% or less of transportation emissions. See **Figure 8.**

Based on GHG Protocol guidance, Eugene airport is not included as a local transportation source. Instead, air travel services used by Lane County residents are included as part of Lane County **consumption-based emissions**. For comparison, Eugene airport reported jet fuel and aviation gasoline use totaled just over **66,000 MT CO_2e** while additional non-local air travel is estimated at an **additional 156,000 MT CO_2e** (local air travel in **green** and non-local in **magenta** in **Figure 8**). *Note that local Eugene airport emissions account only for trips out of Eugene for customers regardless of place of residence, but consumption-based air travel account for all trips regardless of airport (e.g. all connecting flights) for Lane County residents specifically.*

Figure 8: Transportation Emissions by Vehicle Category, Comparing Local Emissions (all green, left) and Local Emissions with Non-local Air Travel (with magenta, right).



Waste

Waste emissions in Lane County includes process methane and nitrous oxide emissions from landfill disposal of mixed solid waste (MSW) and compost, wastewater emissions at wastewater treatment plants, and emissions from residential septic systems. Disposal of solid waste, specifically the landfilling of MSW, is the largest source of waste emissions (93%) with the remainder from wastewater (7%), totaling approximately **187,000 MT CO_2e**.

Lane County Government owns and operates Short Mountain Landfill, the primary source of these emissions. While these emissions are caused by waste produced by the community, Lane County acknowledges the ability and responsibility to mitigate these emissions on behalf of all residents, and have put forward several mitigation strategies in the Climate Action Plan Phase 1: Climate Action Plan for Operations (see Reports, Plans, & Relevant Documents).

Industrial Process & Product Use (IPPU)

Large industrial process emissions sources were identified within Lane County using the U.S. Environmental Protection Agency's Facility-Level Information on Greenhouse Gases Tool (FLIGHT). These emissions total about **35,000 MT CO_2e** for 2019.

Emissions from product use in Lane County includes fugitive loss of refrigerants from buildings and vehicle sources. These sources are estimated for Lane County using State per capita data, downscaling from emissions reported in the State of Oregon's 2015 GHG Inventory, and are estimated at about **145,000 MT CO_2e**. In Oregon, sources of refrigerant emissions have grown significantly over the past 10 years.

Agriculture, Forestry, & Land Use (AFLU)

Agricultural emissions, and specifically, methane emissions from livestock are the only AFLU source included in the Lane County inventory and totals approximately **195,000 MT CO_2e**. A wide variety of livestock are raised within the County and these emissions come from enteric fermentation by ruminant animals and manure management.

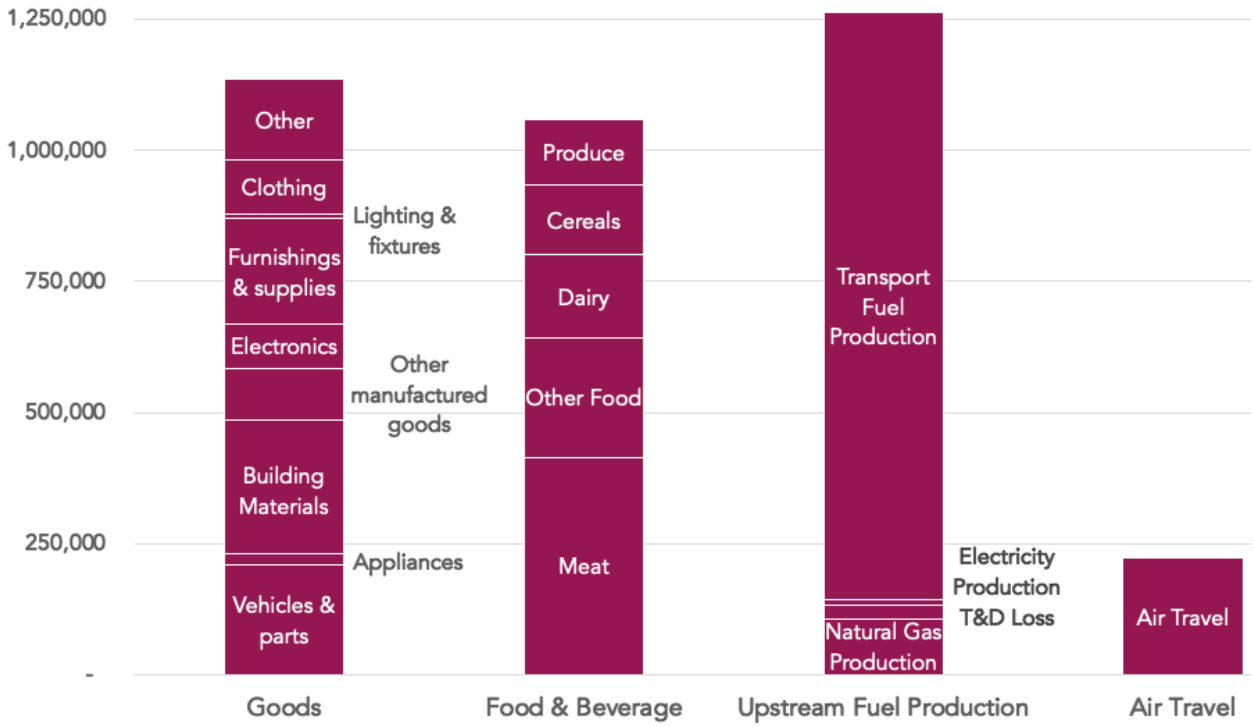
Two other sources of emissions are expected to be significant within the County, but data was not available to support emissions calculations; these include application of soil inputs (e.g. nitrogen fertilizers) and the conversion of greenspace to developed land. See Appendix B for additional details for excluded emissions sources.

Consumption-based Emissions (Imported Emissions)

From Imported Goods, Food, Fuel, and Air Travel (Also known as Other Scope 3)

Lane County's inventory goes beyond GPC protocol requirements to highlight known large sources of consumption-based emissions. These emissions are considered Scope 3 in GHG inventory accounting. This means the community has less ownership and control over management of these emissions as compared to sources of local emissions. These consumption-based emissions will be in another community's local accounting. That said – these emissions are included in the inventory because they are large, they are caused by local demand, it follows State of Oregon inventory practices, and because opportunities exist to reduce these emissions locally. These emissions were estimated at nearly **3.7 million MT CO_2e.**

Figure 9: Detailed results of Consumption-based Emissions (MT CO_2e)



Category Descriptions:

- **Goods:** Emissions from extraction, manufacture, and transportation of raw materials into final products such as building materials, automobile, furniture, clothing, and other goods.
- **Food & Beverage:** Emissions from agriculture (energy for irrigation, production of fertilizers, methane emissions from livestock, etc.), transportation of raw materials, and finished products emissions. Categories included are produce, cereals, dairy, meat, and other foods.

- **Upstream Fuel Production:** Process and energy emissions from the extraction and production into usable fuel products (e.g. electricity from household outlets, gasoline pumped into cars, natural gas combusted by furnaces, etc.). These upstream emissions are considered at the community-scale for electricity, natural gas, gasoline, and diesel (not available for propane and fuel oil).
- **Air Travel:** Emissions associated with air travel by the community from all airports regardless of location.

Upstream fuel production, specifically transport fuel, is by far the largest source, which goes hand-in-hand with transportation being the largest sector-based emissions source. Other large purchasing categories include meat and other food, building materials, furniture, and vehicles & parts. Within food, the largest emissions are from meats, specifically beef and lamb products. Air travel is also a significant source of Lane County consumption-based emissions. Note that these air travel emissions are from air travel trips taken by residents regardless of airport location and are not based on Eugene airport fuel use alone.

Negative Emissions

From Carbon Sequestration and Purchased Carbon Offsets

When considering what to do with information about greenhouse gases the community is emitting or causing to be emitted, there are different categories of action. The primary and essential action is to reduce emissions from fossil fuels. The combustion of fossil fuels release carbon into the atmosphere that has been stored for millions of years in the earth (as coal, petroleum and natural gas) and without human intervention would continue to be locked away. Greenhouse gas inventories and climate action plans are focused on understanding and implementing actions to reduce sources of these emissions. *Lane County's sector-based emissions consist of 86% fossil fuel combustion sources.*

But there are complementary actions that may be taken, particularly when we consider opportunities within a County's geographic boundary, through either local carbon storage in community land use (i.e. forests and soils) or by community purchase of carbon offset credits. These actions can be thought of as "negative emissions" or sequestration actions, and are needed to reduce carbon dioxide that is already in the atmosphere. Negative emissions may be pursued by communities by managing local natural resources for greater carbon storage (e.g. forests and soil) or participating in community-wide purchased carbon offset programs using land-based project types (e.g. Northwest Natural Gas' Smart Energy program). These types of actions are a complement to reducing fossil fuel and other man-made greenhouse gas

emissions. But these actions cannot act as a substitute as the current rate of fossil fuel combustion far outpaces the availability of natural resources to sequester fossil fuel carbon.

Negative emissions accounting methodology is not currently included in community GHG inventory protocol. Further, the protocol explicitly states that local sequestration and purchased offsets may not be used calculate a net reduction in community emissions. That said – this category is included as current best practice given the recent emergence of net-zero climate goals and the potential scale of land use opportunities within Lane County's forest and agricultural resources.

Lane County land area is approximately three million acres with roughly 2.7 million acres of forestland. Lane County's forested land gained significant additional carbon storage during 2019. It is estimated that additional carbon storage by Lane County in 2019 totals over **3.5 million MT CO_2e**, or about **1.3 MT CO_2e** per acre per year. This value is the net gain in carbon storage for the inventory year, not the total carbon storage for forest lands. Storage will fluctuate from year to year depending on a variety of factors including the impact of wildfires. This scale illustrates that future management towards maximizing vegetative and soil carbon storage may offer a significant climate action opportunity for the Lane Community. This not only demonstrates the opportunity for additional carbon sequestration, but the importance of keeping this large carbon storage source healthy and intact.

In addition to local carbon storage, about 4% of the natural gas used in Lane County is compensated for by community members who participate in Northwest Natural's innovative Smart Energy program (**21,513 MT CO_2e**). This program allows customers to purchase carbon offsets from The Climate Trust on their bill to offset emissions from their natural gas use.

Appendix A: Glossary of Terms

GHG

Short for greenhouse gases. Emission of greenhouse gases are the cause of current climate change. An inventory of GHGs measures gases in units of CO_2e. A GHG inventory is also known as a carbon footprint.

GHGP/GPC/Protocol

This type of inventory follows a set protocol, the GHG Protocol (GHGP) standard for cities and communities known as Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC). This protocol determines what is included within a set boundary and categorizes emissions by sector. See Sector-based inventory for more information.

GWP

Short for global warming potential. This refers to the potency of emissions to trap heat in the atmosphere. Carbon dioxide has a GWP of 1, and other GHG gases are more potent and expressed as a multiple of carbon dioxide. For example, methane has a GWP of 34, meaning one molecule has 34 times the effect of one molecule of carbon dioxide.

Imported, Consumption-based Emissions (Other Scope 3)

Emissions from consumption of imported goods and services, also known as Other Scope 3 Emissions per GPC protocol, include emissions from upstream fuel production and household consumption, such as food, household goods, and air travel.

IPCC AR5

The United Nations Intergovernmental Panel on Climate Change (IPCC) releases Assessment Reports providing an overview of the state of knowledge concerning climate change science. The fifth report, AR5, is the most recent version released in 2014.

KWh

Short for kilowatt hour. Kilowatt hours are a standard unit for electricity consumption, and a measure of electrical energy equivalent to a power consumption of 1,000 watts for 1 hour.

Sector-based Greenhouse Gas Inventory (Local Emissions)

This refers to preparing an inventory that is broken down by various sectors of the community that have common GHG characteristics. In this report, sector-based emissions are also known as **local emissions**. This type of inventory follows a set protocol (GPC) determining what is included in each sector. Mainly, sector-based emissions include emissions from building energy and vehicles along with local sources of GHGs from waste, uncontrolled loss of industrial and refrigerant gases, and agriculture. Note that emissions from household consumption of goods

and services are not included in sector-based inventories. The sectors applicable to this inventory include:

- **Building Energy:** emissions from energy used or produced in a fixed location, e.g. electricity, natural gas, propane, and fuel oil. The GPC term is stationary energy.
- **Transportation:** emissions from vehicles and mobile equipment.
- **Waste:** landfilled waste emissions and wastewater treatment emissions.
- **Process Emissions & Product Use:** refrigerants and other fugitive gases from industrial processes.
- **Agriculture, Forestry & Land Use:** emissions from agriculture (e.g. animal waste and agricultural inputs) and community land use change (e.g. development of forest or grasslands).

Location-based Electricity Emissions Accounting
Refers to GHG intensity of the regional electricity grid, representing the average impacts of electricity use and efficiency efforts across the region. Contrast with Market-based Electricity Emissions Accounting.

Market-based Electricity Emissions Accounting
Refers to the GHG intensity of electricity contracts with local utilities. Contrast with Location-based Electricity Emissions Accounting.

MT
Short for Metric Ton (~2,200 lbs.). This is a common unit by international standards.

MT CO_2e
Metric Tons of carbon dioxide equivalent – a unit of measure. Most greenhouse gases are more potent in warming the atmosphere than carbon dioxide. In order to calculate and compare emissions easily, all gases are calculated and combined into a carbon dioxide equivalent, typically measured in metric tons.

Scope (as in Scope 1, Scope 2, Scope 3)
Scopes are one method to define the source of emissions. Scope categories distinguish between emissions that occur within a geographic boundary (scope 1), from electricity generation serving the community (scope 2), and emissions that occur outside the boundary, but that are driven by activity within the boundary (scope 3).

Therm
Common reporting unit of natural gas that represents 100,000 British thermal units. A therm is roughly equivalent to 100 cubic feet of natural gas.

APPENDIX B: METHODOLOGY & PROTOCOLS

Protocols and Tools

This inventory follows Global Protocol for Community-Scale Greenhouse Gas Emissions Inventories by Greenhouse Gas Protocol (GHGP). This inventory also follows GHGP's Scope 2 Guidance for location-based and market-based electricity accounting emissions and ICLEI's US Community Protocol for guidance on calculation of consumption-based emissions (i.e., other Scope 3 as defined by GPC protocol).

Good Company's carbon calculator tool *G3C – Community* was used for emissions calculations. Emissions are documented in the CY 2019 GHG Inventory Audit Trail. G3C – Community is an Excel-based calculator that documents all activity data; emissions factors; and emissions calculations used in the inventory. The audit trail catalogs all data, calculation, and resource files used to complete the inventory. These resources are highly detailed and will allow for those conducting future inventories to fully understand and replicate the methods used in the 2019 inventory.

GHG emissions presented in this report are represented in metric tons of carbon dioxide equivalent (MT CO_2e). The gases considered in the analysis are consistent with protocol and include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), Chlorofluorocarbons (CFCs), and perfluorocarbons (PFCs) per the Kyoto Protocol (Sulfur Hexafluoride, SF_6, was not applicable). All GHG calculations use 100-year global warming potentials (GWP) as defined in the International Panel on Climate Change's 5th Assessment Report (IPCC AR5).

Data Collection

Good Company worked with Lane County staff to collect the data required to calculate emissions. County staff along with other local and regional government staff as well as private entities that serve the Lane County community graciously provided time, data and expertise. Data and emissions factors are described in Appendix C.

Suggestion for Future Inventories

Transportation emissions from fuel sales may be separated into Scope 1 versus Scope 3 emissions in future inventories. Scope 1 emissions being those allocated to activities happening within Lane County's geographic boundaries and Scope 3 being emissions from local fuel sales for miles happening outside the County's geographic boundary. In this inventory all emissions from fuel sales in Lane County reported by Oregon Department of Transportation are accounted for as Scope 1 per GPC guidance. For future inventories, the

County should continue working with ODOT to determine if additional data details become available for a fuel's end-use and location of combustion.

Summary of Inventory Exclusions

Emissions Sector / Sub-Sector	Justification for Exclusion
Stationary energy: Agriculture, Forestry, and Fishing	Data splits are not available for these sub-sectors, but are included in the natural gas and electricity data reported for the County geographic boundary. In other words, emissions from these sources are included in the inventory, but data details are not available to report splits for these sub-sectors.
Stationary energy: Emissions from Coal Production	No activity identified within Lane County's geographic boundary.
Transportation: aviation	Aviation emissions within the GPC are specific to air travel that is confined to the Community's geographic boundary (local small agricultural aircraft or helicopter). This data is not readily available and therefore these emissions are excluded. That said – the community's air travel emissions for flights that extend beyond the community's boundaries are estimated and included as an Other Scope 3 emissions source. These emissions represent an estimate of air travel emissions by Lane County residents for transboundary trips where the final destination is outside of the community's geographic boundary.
Waste	It is possible that a small fraction of the community's waste (i.e. hazardous waste) is process or incinerated by facilities outside the County. Data is not readily available for this fraction of the waste stream and is anticipated to be a relatively small source of emissions.
Agriculture, Forestry, and Land Use: Land use	Lane County includes significant unincorporated land area that is undisturbed and currently storing carbon in the trees and soil. As land is cleared for development there is the potential to lose significant quantities of stored carbon and therefore should be included in a community GHG inventory. Data related to the development of this unincorporated land was not readily available for this inventory but should be re-considered in future years' inventories given the scale of forest carbon storage in Lane County and projected population growth. The data required would be land area converted (reported in acres) from either forest or grassland to developed.
Agriculture, Forestry, and Land Use: Other agriculture	Application of Soil Amendments – Data was not identified to estimate emissions from the application of soil amendments in Lane County agriculture (e.g. conventional nitrogen fertilizers). Given that agriculture is a significant economic sector in Lane County this emissions source should be reconsidered in future inventories. The data required would include the weight and type of soil amendments applied. This data may also be estimated using information about dominant crop types and average annual soil amendments required for these crop types.

Electricity

Activity data was collected from seven electric utilities: Eugene Water & Electric Board, Springfield Utility Board, Emerald People's Utility District, Blachly-Lane Electric Cooperative, Lane Electric Cooperative, Central Lincoln PUD, and Pacific Power. Data was collected directly from the utilities, including percentage of RECs purchased.

The Community Inventory Protocol (GPC) requires that communities report electricity emissions using two accounting methods: location-based and market-based.[9] ***Market-based accounting*** is based on the GHG intensity of electricity contracts with local utilities and is used in most of the figures presented in this report as the GPC protocols recommended methodology to track progress towards goals over time. ***Location-based electricity accounting emissions*** are calculated using the regional electricity grid's (Northwest Power Pool, NWPP) GHG intensity and represent the average impacts of electricity use and efficiency efforts.

- **Location-based method** (or regional grid) multiplies an organization's electricity use by the average emissions intensity of a specific regional electricity grid that is published by the Environmental Protection Agency (eGRID 2018). Note that over time there may be differences in emissions results for inventory years due to the use of an updated eGRID emissions factor (typically released every two years). Location-based electricity accounting offers a means of assessing the average impacts of electricity use on the regional electricity grid.

- **Market-based method** (or utility-specific) represents emissions specific to the utility and takes into account community purchase of renewable energy certificates. Market-based electricity accounting is commonly used for target and goal tracking and is useful to assess and manage GHGs associated with electricity generation and supply. It also highlights benefits for energy efficiency actions, particularly in communities served by utilities with very low GHG electricity. That is, the less electricity used in the community, the more low-GHG electricity there is available for export to communities with more GHG intensive electricity sources.

[9] For details visit http://www.ghgprotocol.org/scope_2_guidance.

APPENDIX C: SUMMARY OF DATA AND EMISSIONS FACTORS

Emissions Category	Category Description
Stationary Energy (Buildings)	
Residential Energy	*These categories include direct emissions from natural gas, fuel oil, and propane combustion by the residential, commercial, and industrial sub-sectors within the county's geographic boundaries. Also includes the emissions from grid electricity used by the same sub-sectors for the same geographic boundaries.*
Commercial Energy	
Industrial Energy	
Electricity and natural gas data provided by seven local electric utilities and natural gas utility, Northwest Natural. Electricity and gas data included information on retail sales; participation in renewable electricity and carbon offset programs; and local electricity generation from privately owned residential and commercial PV solar installations. This utility data is considered highly accurate. Residential and commercial fuel oil and propane use was estimated using state-level per capita fuel usage data downscaled by Lane County's 2019 population. Emissions factors for natural gas, fuel oil, and propane are from U.S. EPA's emissions factors hub and The Climate Registry's 2018 Default Emissions Factors and are considered highly accurate. Electricity location-based emissions factors are taken from EPA eGRID 2018 data for the Northwest Power Pool (NWPP) sub-region. Market-based electricity accounting emissions factors for electric utilities are taken from Oregon Department of Environmental Quality's report titled, *2010 – 2018 Greenhouse Gas Emissions from Electricity Use*. Online at https://www.oregon.gov/deq/aq/programs/Pages/GHG-Emissions.aspx.	
Fugitive Natural Gas System Emissions	*Fugitive loss of natural gas from the local product distribution system.*
Northwest Natural Gas reported a 0.14% system leakage rate for Lane County. Note that the NWN reported rate is less than half of the protocol default proxy value of 0.3%.	
Transportation	
On-Road Energy	*Direct emissions from gasoline and diesel for passenger & freight transportation.*
Fuel sales data for gasoline, diesel, propane, and CNG for Lane County was provided by the ODOT Fuels Tax Group.	
Transit	*Direct emissions from gasoline and diesel for passenger transit transportation.*
Data was collected from Lane Transit District, which provided fuel volume data by fuel type. Transit types included bus and paratransit. Data received is considered highly accurate.	
Water Transportation	*Direct emissions from gasoline and diesel used by marine vehicles.*
Gasoline and diesel use data was collected for several small marinas as well as Lane County operations. Data is considered highly accurate.	
Rail – Passenger & Freight	*Direct emissions from gasoline and diesel for passenger and freight transportation within the geographic boundary.*

For passenger and freight rail calculations, rail distance data was acquired from the U.S. Bureau of Transportation Statistics. Activity data estimates from ODOT and Amtrak were used to identify activity in Lane County. For Amtrak passenger rail, Amtrak's route-specific published data for ridership along Amtrak routes through Lane County was used to calculate passenger-miles which was then multiplied by EPA's rail emissions factor. Amtrak publishes annual reports, allowing for more accurate and convenient reporting. Amtrak data is considered high to medium accuracy. For freight rail, annual gross ton miles were multiplied by EPA's rail product transport emissions factor. Unlike Amtrak, ODOT does not publish annual reports, relying on older reports from 2010 including the Oregon State Rail Plan Technical Appendix. This sub-sector has limited data available and therefore is considered as having mid-to-low accuracy.	
Off Road	*Direct emissions from gasoline and diesel for off-road vehicles such as construction equipment, etc.*
The *Oregon Nonroad Diesel Equipment Survey and Emissions Inventory* is used to report emissions for Lane County. The report provides a 2017 total emissions value for Lane County. This value is used as a proxy for 2019 emissions and therefore is considered moderately accurate.	
Waste	
Landfill Solid Waste	*Fugitive methane emissions from mixed solid waste generated in the community regardless of disposal location.*
Activity data for Short Mountain Landfill was taken from EPA's FLIGHT database reporting from 2018 (most recent available) and adjusted for updated AR5 GWP values. Bethel-Danebo closed landfill data was received from Lane County staff. Emissions calculation methodology follows IPCC's first order decay model and is designated by EPA as EE-6 calculations. This activity data is considered highly accurate.	
Composting Organic Waste	*Fugitive methane and nitrous oxide emissions from composting of organic wastes (wood, yard debris, and food). It should be noted that while composting does produce emissions, they are significantly less than if the same material were landfilled. Also, land-application of compost increases soil carbon sequestration. That benefit is not currently accounted for in GPC methodology.*
Compost facility data was available from Oregon DEQ using 2018 reporting; 2019 data was not available. This activity data is considered highly accurate.	
Wastewater Treatment Process Emissions	*Fugitive nitrous oxide emissions from discharge of treated effluent (wastewater).*
Wastewater treatment plant process emissions for biogas combustion and effluent discharge are calculated using data provided by the Metropolitan Wastewater Management Commission and eight cities providing municipal wastewater services, including Veneta, Junction City, Coburg, Oakridge, Creswell, Cottage Grove, Lowell, and Florence. For biogas combustion data included square cubic feet per day of biogas and the percent methane in the biogas; this data was available for MWMC but not City of Florence and was estimated using MWMC data. No other treatment plants use anaerobic digestion systems. For effluent	

discharge the data included kilograms of nitrogen discharged per day; this data was only available from MWMC and was estimated for all other treatment plants using MWMC data. Emissions calculations for nitrification / denitrification are based on community population data either based on service population or residential population. This activity data is considered medium-to-highly accurate.	
Septic Systems	*Direct emissions from the combustion of biosolids (wastewater).*
Septic fugitive emissions are estimated using number of residents in the county not served by centralized sewer service. Average emissions factors for residential septic systems are provided by the U.S. Community GHG Protocol. This activity is considered highly accurate.	
Industrial Process and Product Use	
Refrigerant Loss	*Fugitive loss of refrigerants from building and vehicle air conditioning systems.*
County-specific data for fugitive refrigerant loss is not readily available and would be very time consuming to collect. Therefore, activity data for fugitive refrigerant loss is estimated using Oregon state-level data attributed to our community on a per capita basis. Activity data for state-level fugitive emissions from refrigerants, aerosols, and fire suppression systems is reported in the Oregon Department of Environmental Quality's (ODEQ's) Oregon Greenhouse Gas Inventory. Oregon's GHG inventory includes refrigerant loss for the residential & commercial, transportation, and industrial sub-sectors. Refrigerant loss is aggregated for a variety of refrigerant types and reported by ODEQ in units of CO_2e. The industrial sub-sector was not included because there are no significant industrial sources of fugitive refrigerant emissions in Lane County, per the EPA's Facility-Level Information on Greenhouse Gas Tool (FLIGHT). Refrigerant activity data is estimated from State of Oregon totals and therefore is considered as having mid-level accuracy.	
Agriculture, Forestry, and Land Use	
Livestock Methane	*Fugitive methane emissions from livestock enteric fermentation and manure management.*
Activity data for livestock taken from USDA's 2017 census of agriculture for Lane County. Emissions factors (per head of livestock for various breeds) are taken from ICLEI's U.S. Community Protocol, Appendix G. Activity data is considered highly accurate.	
Consumption-based emissions	
Goods	*Upstream energy and process emissions raw material extraction, manufacturing, and out-of-state transportation of goods.*
Food	*Upstream energy and process emissions from the growing, processing and transportation of foods.*
Services	*Upstream energy emissions from air travel by community members from all airports regardless of location.*
Accurate data on quantities and suppliers for the goods and food consumed by Lane County community households is not readily available. Therefore, the State of Oregon's 2015 consumption-based inventory was used to estimate these sources of emissions. State of Oregon CBEI results were downscaled for Lane County using US Census Bureau data on households' income and number of households within various income brackets. Note that	

ODEQ conducts the Oregon CBEI every 5 years and therefore this methodology may not be used to estimate emissions on an annual basis. Air travel is based on U.S. Census Data and Oregon's version of the UC Berkeley Household Cool Climate Calculator. Given inventory year and that Lane County data is estimated from a large and complicated economic model, this activity data is considered as having mid-to-low accuracy.	
Upstream Fuel Production	*Upstream energy and process emission from the production and distribution of natural gas, gasoline, diesel and electricity consumed either directly or indirectly by the Community.*
Data for gasoline, diesel, natural gas and electricity use is same as previously described. Lifecycle emissions factors for the various fuel types are provided by Oregon Department of Environmental Quality's Clean Fuels program carbon intensity scores. Upstream fuel and energy emissions are calculated as the difference between direct tailpipe emissions (reported under Transportation) and total lifecycle emissions. Activity data for electricity and natural gas is considered highly accurate while transportation fuel use is considered moderately accurate because the precise volume and feedstocks for biofuels sold within the County is not readily available. Upstream emissions can vary significantly for biofuels depending on feedstocks and therefore calculated emissions are considered moderately accurate. Upstream emissions factors are for regulatory purposes and therefore a considered highly accurate.	
Negative Emissions	
Local Carbon Storage	*Additional carbon storage in the inventory year by local forest and soil resources.*
Total acres of forestland and annual net growth in Lane County is reported in Oregon's 2018 *Oregon's Forest Resources, 2006–2015: Ten-Year Forest Inventory and Analysis Report Supplement*, which accounts for acres of forest and annual net growth (growth subtracting annual loss due to logging and forest death). Methodology and Emissions Factors: Acres of forest land are multiplied by the net-sequestration per acre as reported in the Supplement for Lane County to estimate the additional annual sequestration value for forested land. Activity data is an average of a 10-year period and not specific to the inventory year and therefore is considered moderately accurate.	
Purchased Carbon Offsets	*Community purchase of verified carbon offsets (e.g. offsets purchased by the community-at-large from participation in NWN's Clear Energy program).*
Carbon offsets purchased by account holders were provided by the natural gas utility as therm-equivalents and MT CO_2e. This activity data is considered highly accurate.	