

GREEN HOUSE GAS INVENTORY



City of Lawrence

KANSAS

PREPARED BY THE CITY OF LAWRENCE

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EXECUTIVE SUMMARY

This summarizes the City of Lawrence’s involvement with the International Council for Local Environmental Initiatives (ICLEI) and their City’s for Climate Protection (CCP) campaign. By subscribing to ICLEI in 2007, the city joined forces with over 715 cities, towns, counties, and their associations worldwide. In addition, ICLEI provides many resources and support for its members to reduce green house gases within their communities. The CCP program’s goals are to achieve significant reductions in domestic greenhouse gas emissions by assisting local governments in taking action to reduce emissions and realize multiple benefits for their communities – thinking globally, while acting locally.

Local governments play a vital role in climate change efforts because they directly influence and control decision making that can reduce emissions. Local policies and regulations regarding land use and development, energy efficient building codes, recycling programs, and public transit options all affect local air quality as well as the global climate.

ICLEI developed 5 milestones to help facilitate local governments efforts in reducing green house gas emissions. Through these five milestones, local agencies are able to quantify, implement, and track measures to reduce green house gas emissions within their communities. The outlined program includes:

1. Green House Gas Emissions Inventory
2. Adoption of an Emissions Reduction Target for the Forecast Year
3. Development of a Local Action Plan
4. Implementation of Policies & Measures
5. Monitoring & Verifying Results

Included in the report is the green house gas inventory for the City of Lawrence. ICLEI provides access to software designed to simplify the emissions analysis. The Clean Air and Climate Protection Software (CACPS) also allows users to forecast future annual emissions based on predicted growth rates for various sectors. Furthermore, CACPS is capable of tracking various measures implemented to reduce green house gas emissions over time.

The following table summarizes the annual green house gas emissions in the City of Lawrence for the given years:

Year	1990	1995	2000	2005
Equivalent CO ₂ Tonnes	2,241,690	2,400,703	2,431,863	1,661,047

Table 1.1 – Community Summary

The internationally accepted unit of measure for CO₂ is equivalent metric tons or tonnes of CO₂. Table 1.1 – Community Summary indicates a 30% decrease in green house gas emissions from the year 1995 to 2005.

METHODOLOGY

The green house gas inventory breaks down into two different sections, community and government. The CACPS software allows local governments to track emissions for the community as a whole and the city's operations separately. Each module is then broken down into specific segments:

- Community
 - Residential
 - Commercial
 - Industrial
 - Transportation
 - Waste
 - Other
- Government
 - Buildings
 - Vehicle Fleet
 - Employee Commute
 - Streetlights
 - Water/Sewage
 - Waste
 - Other

For the community green house gas inventory, citywide data was collected for local electricity and natural gas consumption, annual vehicle miles traveled (VMT) within the city limits of Lawrence, annual landfill contributions, and other green house gases otherwise not accounted for in the preceding fields.

The government module allows governing bodies to quantify the green house gas contributions associated with operating city owned buildings, city fleets, water and sewage facilities, streetlights, landfill contributions, and any other green house gases not otherwise accounted for. The government section makes up a portion of the overall community's green house gases; by tracking government operations specifically, officials are better able to implement and track green house gas reduction measures. Officials are also able to determine cost savings and payback periods using the software features.

Each category converts inputs into equivalent annual tonnes of CO₂. The CACPS software includes emissions and conversion factors to convert different utility measures into green house gas equivalents. For example, annual kilowatt-hours are converted into tonnes of CO₂ based on the average electricity generation methods in the area and their subsequent emissions. It should also be noted that the software analyzes point of use emissions, not life cycle emissions – that is, the software accounts for emissions created or as a result of actions taking place within the city limits. Even though a cubic foot of natural gas consumed a significant amount of energy to reach Lawrence, the only emissions accounted for in this survey are those associated with converting the cubic foot of natural gas into energy while in the city limits of Lawrence.

RESULTS

COMMUNITY:

The following data and graphs summarize the green house gas inventory for the City of Lawrence for selected years.

Year	1990	1995	2000	2005
Equivalent CO ₂ Tonnes	2,241,690	2,400,703	2,431,863	1,661,047
Equivalent CO ₂ Tonnes per capita	34.17	32.70	30.36	18.76

Table 1.2 – Equivalent Tonnes of CO₂ & Tonnes per capita

1995:

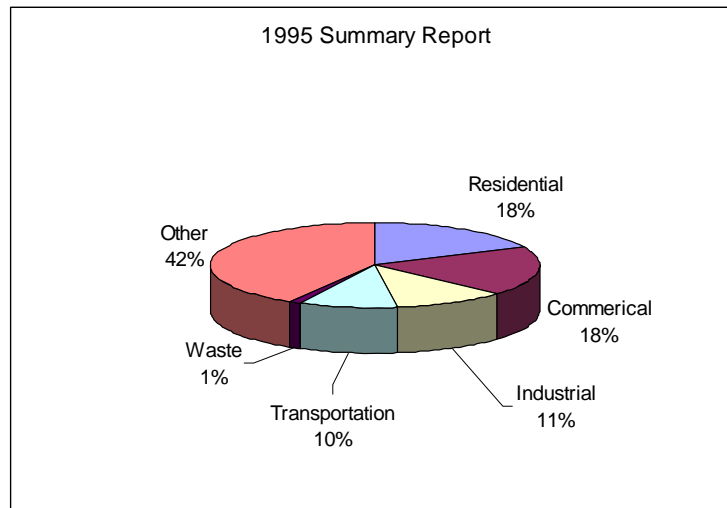


Figure 1.1 – 1995 Summary Report

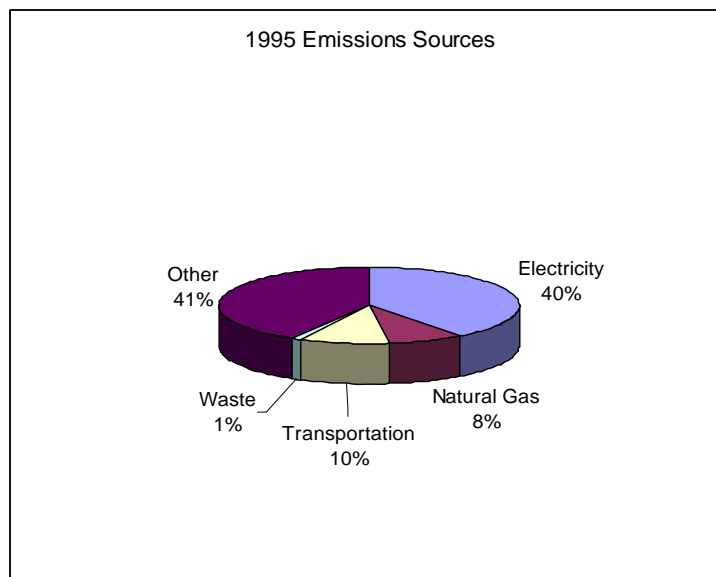


Figure 1.2 – 1995 Emissions Sources

2000:

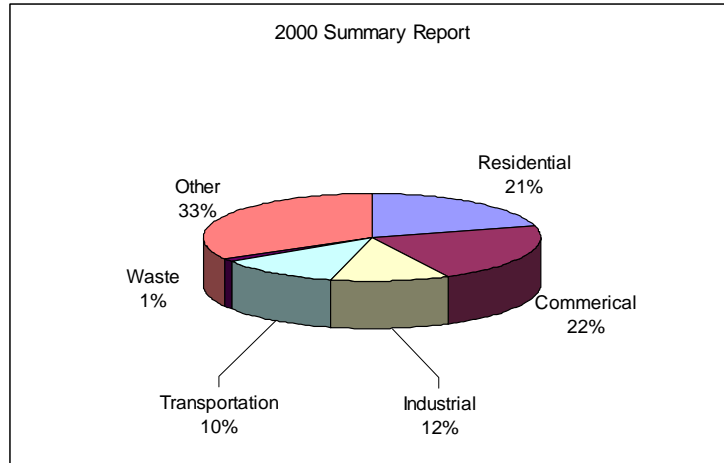


Figure 1.3 – 2000 Summary Report

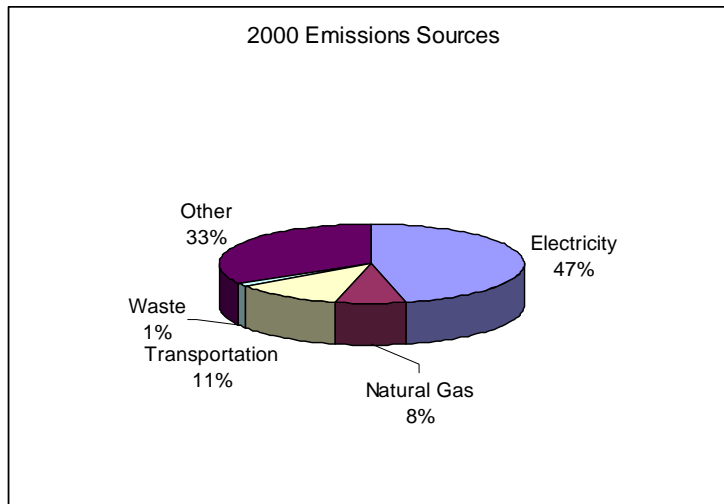


Figure 1.4 – 2000 Emissions Sources

2005:

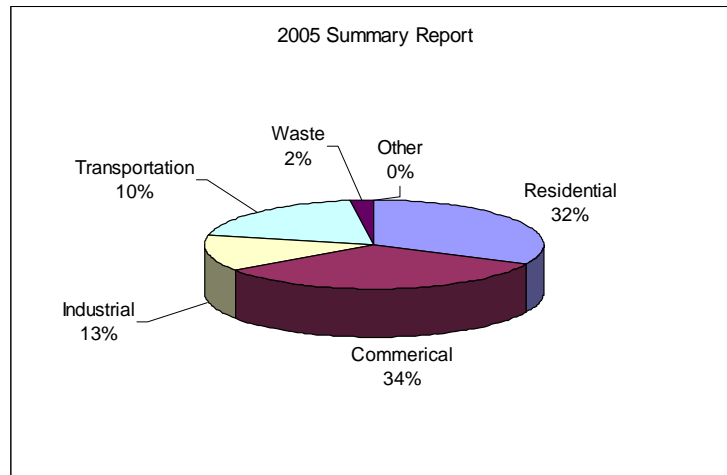


Figure 1.5 – 2005 Summary Report

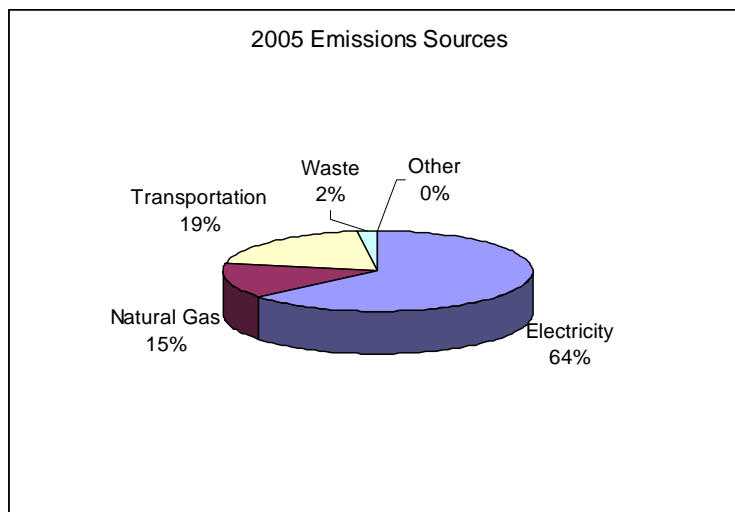


Figure 1.6 – 2005 Emissions Sources

Figure 1.1 – 1995 Summary Report through Figure 1.6 – 2005 Emissions Source summarizes the emissions inventories for each five year milestone from 1995 to 2005. A significant shift can be seen in the ‘other’ sector between the year 2000 and 2005; this data is provided by the Kansas Department of Health and Environment. It primarily encompasses emissions created by industrial processes that would not be included through gas consumption (i.e. methane or nitrous oxide production). The reduction can be attributed to the closing of the Farmland plant in east Lawrence. This and other measures already implemented by the City of Lawrence and its residents have contributed to a reduction in overall green house gas emissions in the city of Lawrence.

With a base year selected, ICLEI’s “business as usual” growth model can be analyzed. The “business as usual” model reflects how emissions would be expected to increase as a

community grows, without addressing any green house gas emission reductions. However, by adopting a 7% decrease from this trend, a community can decrease its emissions significantly. See Figure 1.7 – Emissions Trends, for a representation of this model.

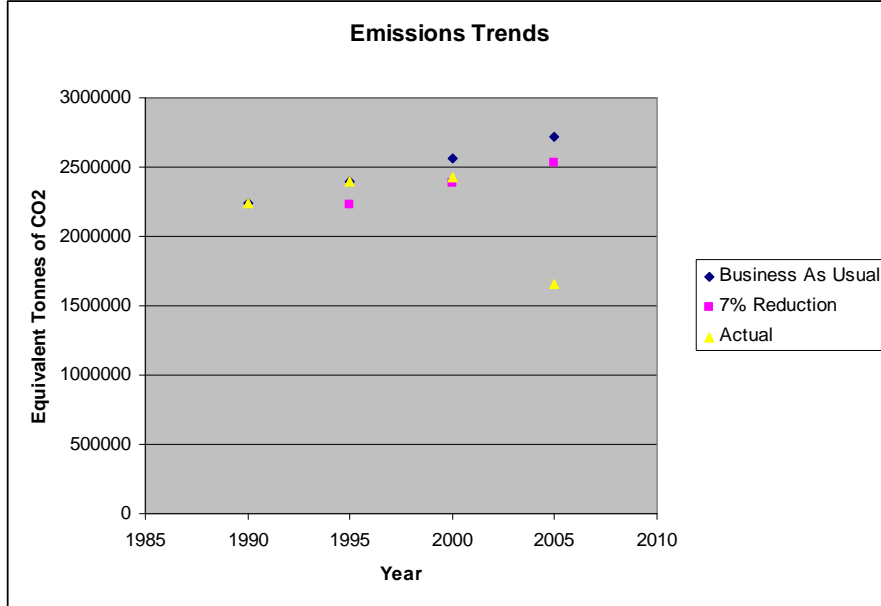


Figure 1.7 – Emissions Trends

Please see Appendix A for a more complete summary of yearly data.

GOVERNMENT:

An emissions inventory was also conducted for the City of Lawrence’s government operations. However, all of the data necessary to benchmark emissions was not available prior to 2001. Insufficiencies exist in the reporting of electricity consumption. The CACPS software requires utility breakdowns into three different categories: buildings, water and sewage, and streetlights. While total electricity consumption exists, future records should be broken down to reflect consumption amongst the three categories. This will also help officials to develop initiatives that will benefit the community the most by targeting less efficient facilities. Table 1.3 – Government Tonnes of CO₂ by Source and Figure 1.8 – Government Summary reflect a rough comparison of government created tonnes of CO₂ between 2001 and 2005. The data reflects a 20% increase in emissions from 2001 to 2005.

Year	2001	2005
Electricity	27,914	35,921
Diesel	1,782	2,156
Gasoline	1,908	2,131
Natural Gas	20,219	24,719
Total	51,823	64,927

Table 1.3 – Government Tonnes of CO₂ by Source

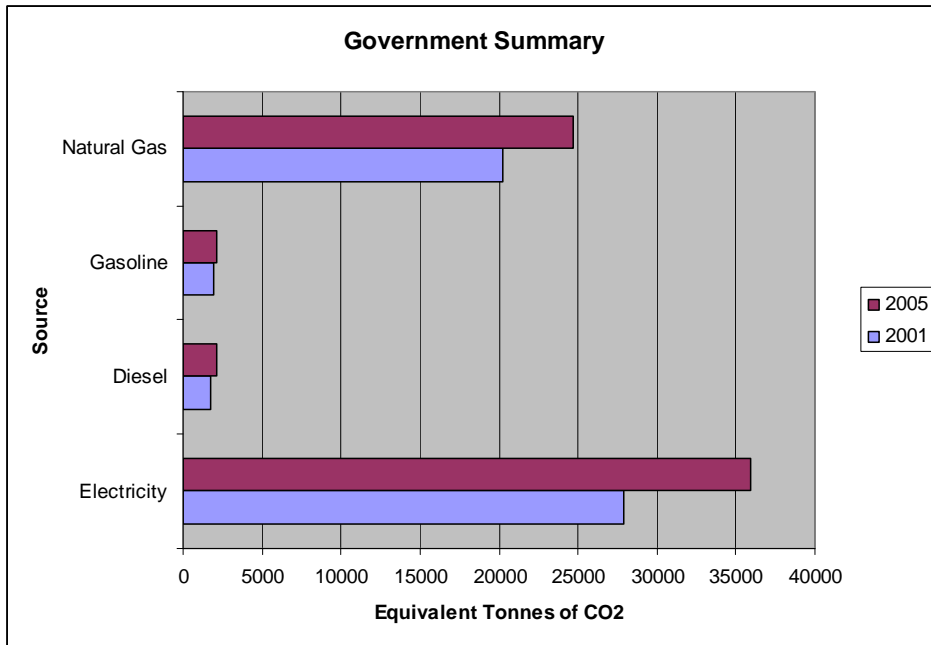


Figure 1.8 – Government Summary

While the government data makes up a portion of the community’s total emissions, it is important to benchmark and track government emissions. Through adopting specific measures to make all government facilities more efficient, the city can reduce its utility costs while improving the local environment. The City of Lawrence also has the ability to set an example for the community’s residents and surrounding cities.

Many initiatives have already begun at the government level, including but not limited to, (electric) hybrid and flex-fuel cars, replacing incandescent light bulbs with compact fluorescents, more efficient T8 fluorescent lighting strips, and light emitting diode (LED) traffic signals. Due to insufficient data, the exact realization of these benefits cannot be quantified.

Please see Appendix B for a more complete summary of yearly government data.

APPENDIX A

Community module

Government module

Emissions by benchmark year

COMMUNITY MODULE

Year	Residential Electricity (kWh)	Commercial Electricity (kWh)	Industrial Electricity (kWh)	Residential Gas (DTH) ^a	Commercial Gas (DTH) ^a	Industrial Gas (DTH) ^a	Annual VMT	Waste (Tons)	MSW Recycled (Tons)	Other (Tons CO ₂) ^b	Population
1990	220960786	325438558	264908716	2282201 ^c	591900 ^c	70675 ^c	289692470	21470	--	1110656	65608
1991	--	--	--	--	--	--	313294100	34018	--	--	66738
1992	214688249	336724558	245872155	2282201	591900	70675	334124285	37213	--	--	68141
1993	247644348	352533993	239964231	2760113	715849	85474	337301245	48430	--	--	69642
1994	258520249	367152742	245219418	2509087	650744	77701	339105440	49894	--	--	71328
1995	272069349	384453033	252312895	2688220	697203	83248	349651020	51333	18852	1094754	73419
1996	281432020	399826063	260816460	3000814	778276	92928	382055355	55444	--	--	74780
1997	299687617	417945167	273906280	2559644	663856	79266	389605015	58440	--	--	78128
1998	328118268	444278547	271356485	2220696	575948	68770	400300245	59764	20000	--	79186
1999	320940916	453310247	244576646	2207970	572648	68376	408272210	62532	21000	--	80839
2000	355309871	476497849	267484198	2522363	654187	78112	447380500	64286	21500	887528	80098
2001	355261185	482759613	216066406	2284020	592372	70731	447380500	68664	23278	--	81457
2002	372199531	483971279	182418951	2466338	639657	76377	418609375	67784	25566	--	83495
2003	372008477	485815013	161444472	2668945	692204	82651	433780235	68731	28342	--	85282
2004	363789152	487134755	164388374	2497339	647697	77337	520690750	71589	29640	--	87184
2005	395799160	505050987	168063260	2523738	654544	78154	537687705	71221	27473	--	88541
2006	397580268	506138279	167689907	2237072	580196	69277	551959570	75361		--	89176
2007											
2008											
2009											
2010											
2011											
2012											
2013											
2014											
2015											
2016											
2017											
2018											
2019											
2020											

^a Total annual consumption breakdown into classes based on historical percentages - see notes for details

^b Other category consists of Farmland Industries Pollutants - Information provided by KDHE

^c 1990 numbers are not available -- conservatively used 1992 data for 1990

GOVERNMENT MODULE

Year	Total Electricity (kWh)	Building Electricity (kWh)	Green Energy (kWh)	Building Gas (DTH)	Vehicle Fleet- Unleaded (gallons)	Vehicle Fleet- Diesel (gallons)	Streetlights (kWh)	Water /Sewage (kWh)	Waste (Tons)	Other (Tons CO ₂)
1990	--	--	--	--			3817527			--
1991	--	--	--	--			--			--
1992	--	--	--	--	182118	121570	3848832			--
1993	--	--	--	--	180372	129142	3934975			--
1994	--	--	--	--	165768	129563	3960010			--
1995	--	--	--	--	168929	135090	3958185			--
1996	--	--	--	--	181753	144472	4331536			--
1997	--	--	--	--	186577	166035	4667326			--
1998	--	--	--	--	193792	175532	4798992			--
1999	--	--	--	--	196572	186778	4786970			--
2000	--	--	--	--	209474	210964	4744667			--
2001	22468032		674041	360745	216920	207397	4740653			--
2002	24476411		734292	371683	226476	215394	4746834			--
2003	26331029		789931	415893	222728	218989	4858580			--
2004	31356918		940708	429920	226418	229251	4811355			--
2005	31489640		944689	441038	227486	233382	4700109			--
2006	31124793		933744	426476	212685	235043	4667284			--
2007				441223						--
2008										--
2009										--
2010										--
2011										--
2012										--
2013										--
2014										--
2015										--
2016										--
2017										--
2018										--
2019										--
2020										--

INCLUDED IN COMMUNITY TOTAL

Year 1990Emissions by Sector

	Equiv CO ₂ tonnes	Equiv CO ₂ %	Energy (MMBtu)
Residential	361,966	16.1%	3,082,224
Commerical	374,775	16.7%	1,714,514
Industrial	281,562	12.6%	976,221
Transportation	204,501	9.1%	2,614,269
Waste	11,316	0.5%	-
Other	1,007,570	44.9%	-
Total	2,241,690	100%	8,387,228

Emissions by Source

	Equiv CO ₂ tonnes	Equiv CO ₂ %	Energy (MMBtu)
Carbon Dioxide	1,007,570	44.9%	-
Diesel	32,216	1.4%	409,329
Gasoline	172,285	7.7%	2,204,939
Electricity	849,936	37.9%	2,768,969
Natural Gas	168,367	7.5%	3,003,990
Waste	11,316	0.5%	-
Total	2,241,690	100%	8,387,227

Year 1995Emissions by Sector

	Equiv CO ₂ tonnes	Equiv CO ₂ %	Energy (MMBtu)
Residential	435,692	18.1%	3,616,784
Commerical	441,834	18.4%	2,009,329
Industrial	268,992	11.2%	944,384
Transportation	233,986	9.7%	2,991,999
Waste	27,055	1.1%	-
Other	993,144	41.4%	-
Total	2,400,703	100%	9,562,496

Emissions by Source

	Equiv CO ₂ tonnes	Equiv CO ₂ %	Energy (MMBtu)
Carbon Dioxide	993,144	41.4%	-
Diesel	37,127	1.5%	471,568
Gasoline	196,859	8.2%	2,520,431
Electricity	952,107	39.7%	3,101,827
Natural Gas	194,412	8.1%	3,468,671
Waste	27,054	1.1%	-
Total	2,400,703	100%	9,562,497

Year 2000Emissions by Sector

	Equiv CO ₂ tonnes	Equiv CO ₂ %	Energy (MMBtu)
Residential	507,075	20.9%	3,735,025
Commerical	527,100	21.7%	2,280,460
Industrial	279,685	11.5%	991,027
Transportation	278,970	11.5%	3,569,203
Waste	33,881	1.4%	-
Other	805,152	33.1%	-
Total	2,431,863	100%	10,575,715

Emissions by Source

	Equiv CO ₂ tonnes	Equiv CO ₂ %	Energy (MMBtu)
Carbon Dioxide	805,152	33.1%	-
Diesel	46,307	1.9%	588,085
Gasoline	232,664	9.6%	2,981,118
Electricity	1,131,442	46.5%	3,751,850
Natural Gas	182,417	7.5%	3,254,662
Waste	33,881	1.4%	-
Total	2,431,863	100%	10,575,715

Year 2005Emissions by Sector

	Equiv CO ₂ tonnes	Equiv CO ₂ %	Energy (MMBtu)
Residential	534,315	32.2%	3,874,588
Commerical	547,816	33.0%	2,553,547
Industrial	220,702	13.3%	1,535,008
Transportation	320,678	19.3%	4,120,382
Waste	37,536	2.3%	-
Other	-	0.0%	-
Total	1,661,047	100%	12,083,525

Emissions by Source

	Equiv CO ₂ tonnes	Equiv CO ₂ %	Energy (MMBtu)
Carbon Dioxide	-	0.0%	-
Diesel	55,474	3.3%	704,521
Gasoline	265,204	16.0%	3,415,861
Electricity	1,060,988	63.9%	3,648,169
Natural Gas	241,845	14.6%	4,314,974
Waste	37,535	2.3%	-
Total	1,661,046	100%	12,083,525

APPENDIX B

Appendix B lists contact information for various data collection to aid the green house gas emission survey.

Company	Contact	Number	Email
Westar Energy	Chad Luce	785-575-8134	
Aquila Gas - External Affairs Director	Larissa Long	785-832-3918	larissa.long@aquila.com
(Green Energy Tags)-Zephyrenergy	Sarah Hill-Nelson	785-766-0884	shillnelson@zephyrenergy.org
Kansas Department of Health - Other	Pat Simpson	785-842-4600	
Kansas Department of Health - Other	Will Stone	785-296-6427	wstone@kdhe.state.ks.us
Hamm Landfill - Solid Waste	Charlie Sedlock	785-597-5111 ext. 238	
City of Lawrence - Solid Waste	Bob Yoos	785-832-3032	byoos@ci.lawrence.ks.us
City of Lawrence - Transportation Planner	Anson Gock	785-832-3155	agock@ci.lawrence.ks.us
City of Lawrence - Fleet Manager	Steve Stewart	785-832-3020	sstewart@ci.lawrence.ks.us
KDOT - Traffic & Field Operations (VMT)	Leif Holiday	785-296-2906	leifh@ksdot.org