Greenhouse Gas Inventory for the Kansas City Region

2015 Baseline

Regional GHG Inventory: stationary energy, waste and transportation sectors.

This Greenhouse Gas (GHG) Inventory represents the best estimate of regional CO_2e emissions for the 10-county planning area. It includes emission estimates associated with stationary energy generation, solid waste and surface transportation. The purpose of the inventory is to assess a region's carbon footprint and identify the areas of largest impact. The results of the inventory inform the development of GHG strategies for the Climate Action Plan.

What is CO_2e?

Not all greenhouse gases have the same global warming potential. In fact, of all of the greenhouse gases (carbon dioxide, methane, nitrous oxide, and fluorinated gases), fluorinated gases trap substantially more heat than the other gases. However, carbon dioxide (CO_2) is the most prevalent greenhouse gas, so for the ease of measuring total greenhouse gases, CO_2 *equivalent* (CO_2e) is used. For any quantity and type of greenhouse gas, CO_2e signifies the amount of CO_2 which would have the equivalent global warming impact.

Stationary Energy. Through cooperation with regional energy providers, we have gained a good cross-sectional understanding of the sources contributing to the total emissions generated. Future work will entail acquiring more detailed annual data associated with closer alignment to our specific geographic area.

Solid Waste. Our understanding of solid waste emissions within the greater Kansas City region has been well documented for more than 10 years. Estimates for the GHG contributions related to this sector have been evaluated to account for solid waste produced locally and outside the region and disposed within the study area, and the solid waste exported from our region and disposed elsewhere.

Transportation. Emissions from the transportation sector are limited to on-road contributions. Railroads, off-road/construction and non-vehicular airport-based emissions have not been assessed for this inventory. Waterway port emissions are also typically included within a greenhouse gas inventory. However, the water port, being re-established in the Kansas City area, received its first barge traffic in August 2015. Therefore, while the emissions associated with the port do not contribute a prominent source of GHG for the baseline inventory, this element of the transportation sector will require monitoring as traffic is quickly expanding.

Greenhouse Gas Emissions and Data Sources by Sector

Stationary Energy Generation. Information about energy use, fuel mix and population served was provided by the two natural gas and the major electric utilities serving the region as well as several electric co-ops and municipal units contracting directly with larger, multi-state regional power pools. With this rich dataset, we were able to address minor issues with geographic data gaps and slight differences in reporting dates. Residential data was separated from institutional, commercial and industrial data, but the remaining data was combined and included energy associated with both building facilities and any manufacturing processes. Future efforts will be made to separate the non-residential cluster and isolate the energy used for manufacturing processes. As we clarify how this energy is used, more effective policies and modifications of existing processes can be identified and implemented.

Solid Waste. Regional landfills are required to regularly report information to the states on the volume of solid waste processed and the composition of the mixture of materials, as well as the location of its final disposition. Traditionally this detailed information has been used to monitor usage and determine estimated lifespan of facilities to plan for future regional needs. However, these data also provide a high- quality picture of the greenhouse gases generated by the sector. While greenhouse gas monitoring was not part of the reporting structure in 2005, beginning in 2010 there was increased focus on data collection and by 2012 facility reporting had become much more comprehensive.

Transportation. Baseline data were estimated using the EMME transportation model with associated land use and street grid patterns for the 2015 baseline year, and the EPA MOVES 2014b modeling program was then used to determine subsequent 2015 baseline emissions. MOVES defaults were used for fuel characteristics (regional), meteorological conditions (regional), vehicle age profile (national), number of vehicles by type (bi-state regional estimate), average speed distribution (national) and vehicle age (national). Outputs from EMME were used to define the road type distributions, ramp compared with the tri-annual 2014 EPA emissions inventory and EPA generated run specs for Kansas counties in the MARC region. The estimates we produced compared favorably with a variance of between -3.8% and 1.8%.
As an element of the 2050 long range transportation plan, future transportation demands were modeled based upon a range of expected land use patterns, investment policies and regional infrastructure priorities. We then ran the MOVES model using those future demand estimations and the supplied 2050 default estimates for transportation sector GHG emissions.

Stationary energy	Transportation	Waste
Natural gas and steam • Spire Energy • Kansas Gas Service (ONE Gas) • Atmos Energy • Veolia **Electricity** • Evergy • Independence Power & Light • Kansas City BPU • City of Gardner	**Passenger vehicles, freight trucks and public transit** modeled in the MARC Regional Transportation Model	**Waste disposal tons** sent to in- and out-of-region landfills

Emissions by Sector 2005-2015: Baseline Estimate and Benchmark

For clarity and confidence, we used 2015 as our benchmark year and backcasted to 2005 based on population change. This resulted in a very conservative estimate of our decrease in emissions since 2005 because the GHG emissions per capita in 2005 is undoubtedly higher than in 2015. Nonetheless, we took this approach because prior to 2010 the available data on greenhouse gas emissions is fragmented and imprecise.

Stationary energy. Producers and distributors of both electricity and gas have been consolidated, split and rearranged multiple times in the decade between 2005-2015. This has deeply fragmented available data. In addition, data collection specific to greenhouse gas was less rigorous in QA/QC and the data were not sufficiently granular to allow data to be filtered for our region. However, by 2015 the energy providers organizational structure had become more stable and data were being carefully reviewed and tracked.

Solid waste. Regional landfills were able to react fairly quickly to produce greenhouse gas estimates because facilities were smaller in size and scope, and they already collected data needed for calculation inputs. However, robust calculating and tracking of GHG emissions really began in earnest following the 2009 endangerment finding.

Transportation. Prior to 2010, EPA used the MOBILE6 emissions model. It did not calculate greenhouse gases directly but provided a fuel economy number which could then be used to estimate GHG by vehicle type (EPA 420-F-05-004). This rough estimate could then be used with travel model outputs to provide a value for GHG emissions. The first MOVES model came out of the EPA in 2010, and its update to 2010b in 2012 provided the first integrated GHG emissions modeling. Released in 2014, MOVES2014 provided an improved platform and updated default variables reflecting the latest engine standards. The estimates currently used in this plan were generated using MOVES2014. The latest EPA model, MOVES3, was released in November 2020 (this month) and will be used in future updates.

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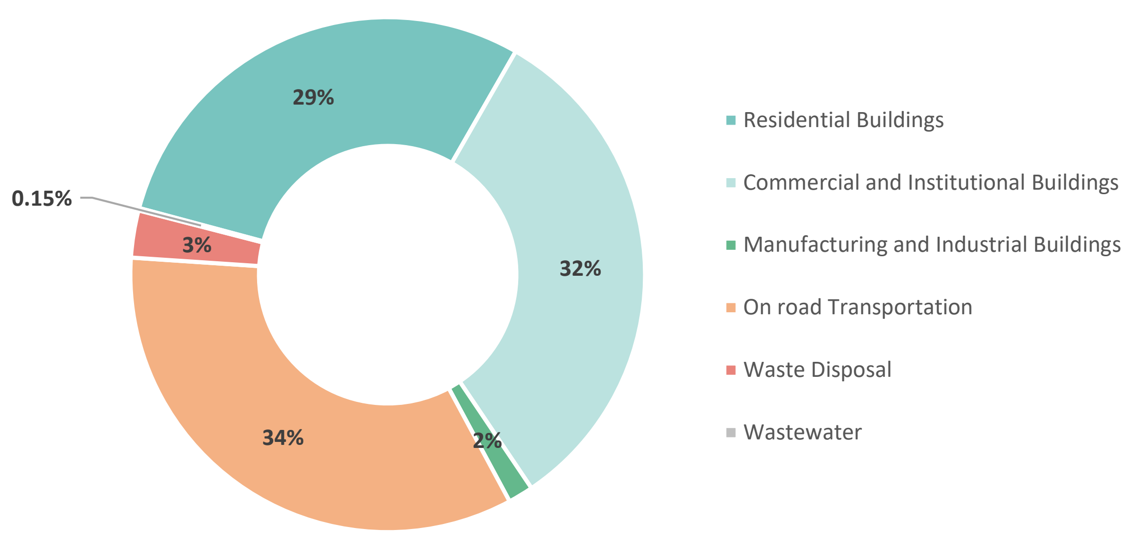
Greenhouse gas inventory results 2015

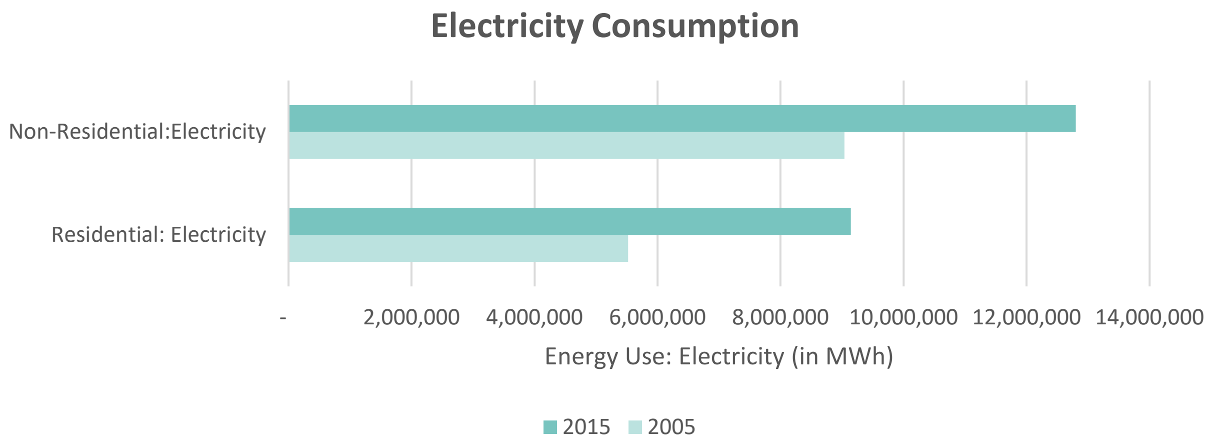


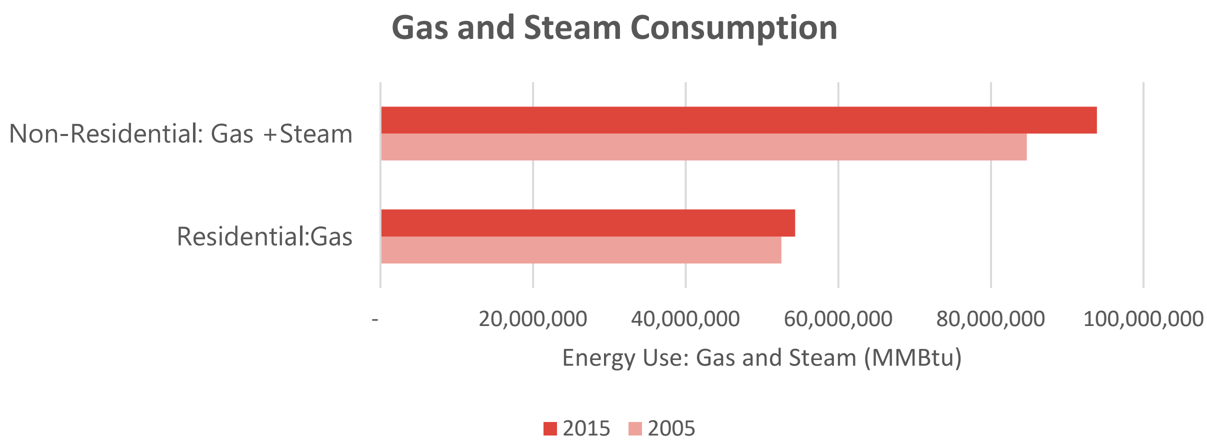
Stationary Energy. Greenhouse gas emissions associated with stationary energy use are estimated to be 18,862,000 tons of carbon dioxide equivalent (CO_2e) per year, representing nearly two-thirds of the regional GHG contribution. Driven by the fuel mix used to provide this power and regional energy demand, successful reduction in these emissions will require a combination of both ongoing investment in renewable/sustainable energy and improvements in building energy efficiency.

Direct combustion of coal for district heating only results in about 249,000 T-CO_2e/yr, and natural gas emits 4,638,000 T-CO2e/yr of GHG. In these dedicated utilities, fuel switching opportunities are limited. However, grid-based electrical power use accounts for most of the energy provided to the region with an equally large level of 13,348,000 tons CO_2e/yr in emissions. Between 2005 and 2015, Evergy, the largest electric utility serving our region, has heavily invested in renewable power. Successful reduction in regional GHG will rely heavily on implementation of their Sustainable Transformation Plan. In addition, during this ten-year period, all utilities have undertaken infrastructure maintenance and replacement programs to minimize leakage and transmission losses associated with distribution of power and natural gas.

When considering the demand for energy, it becomes more useful to review the stationary energy emissions by end user sectors. Review of the inventory shows that emissions related to commercial and institutional facilities are estimated to be 9,665,000 metric tons CO2e/yr, slightly higher than the 8,723,000 metric tons CO2e/yr for residential buildings. Emissions resulting from manufacturing and construction processes are difficult to currently ascertain with accuracy because reporting from electricity utilities combines this power use with the overall facilities and environmental controls. However, partial quantification of the emissions derived from natural gas supporting these activities indicates an initial level of about 464,000 metric tons CO2e/year.

Adoption of 2012 energy codes for new building construction, promotion of energy star appliances, use of more efficient lighting technology and weatherization programs supported between 2010 and 2015 all contributed to reduction in GHG emissions between 2005 and 2015, however significant opportunities continue to exist for energy efficiency particularly with improvement of the building envelope (insulation, windows and excess leaks/ventilation). Improvement of residential structures offers a higher greater benefit than commercial structures, but they are widely understood to be more difficult to achieve. Similarly, bringing existing out-of-date structures up to code provides a greater relative reduction than an incremental improvement associated with implementing a tighter energy standard on new construction. Updating or retrofitting existing building stock is often much more challenging due to policy constraints, community support, funding and enforcement.





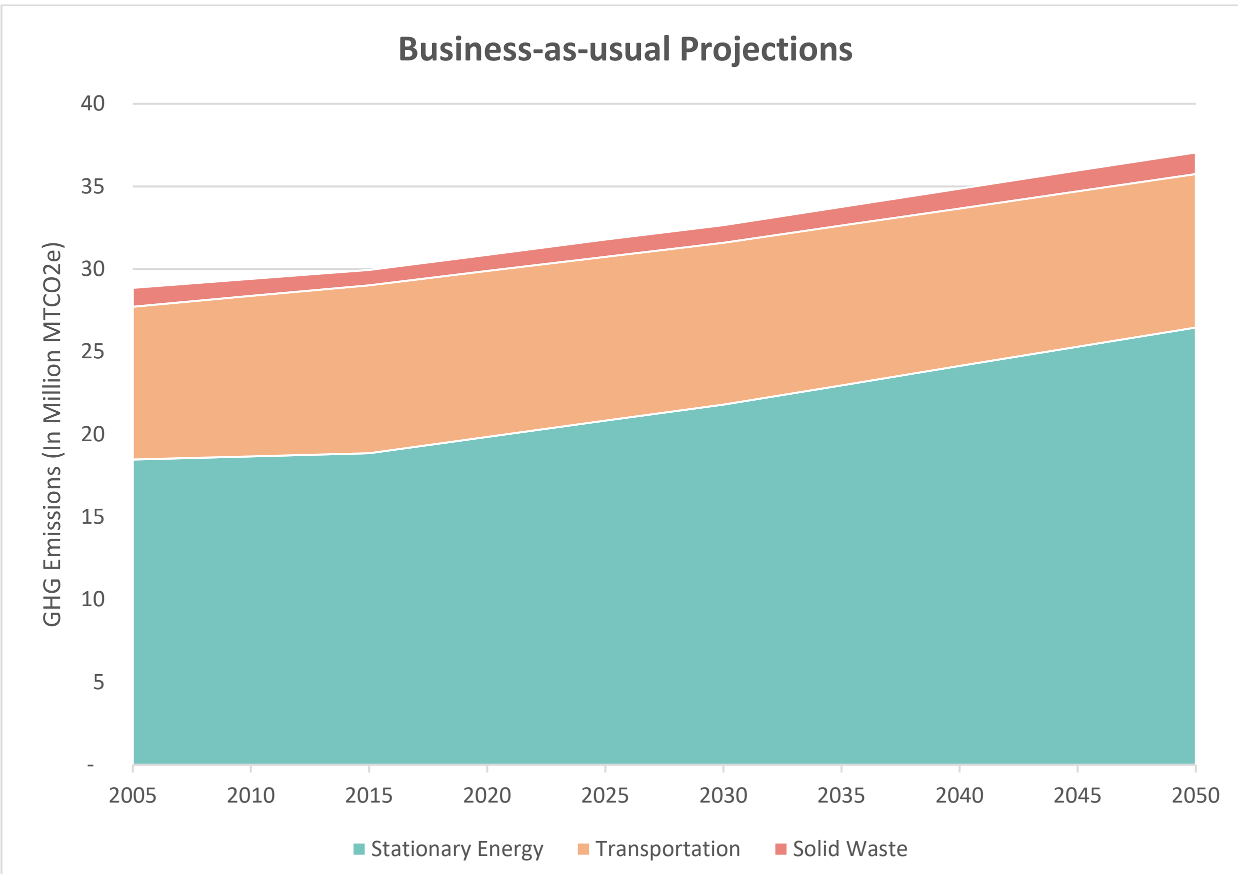
Solid Waste. Greenhouse gas emissions due to solid waste disposal in 2015 are estimated at 886,000 metric tons CO2e/yr. In 2008, the regional solid waste district embraced a goal to achieve 80 percent waste diversion by 2023 using stepwise goals of 40, 60, 80 percent with a stretch goal of zero-waste by 2028. While ambitious, the region has taken strong, positive strides in this direction between 2008 and 2015. Continued efforts to divert paper and plastic, and expansion of composting collection are being made in concert with development of innovative businesses which utilize recycled products and compost as feedstock.

Transportation. On-road transportation produced just over one-third of the region's GHG emissions at 10,159,000 metric tons CO2e/yr. National fuel efficiency standards for passenger vehicles and heavy-duty trucks improved dramatically between 2005 and 2015 with advancement improvements accelerating after 2007. Continued reduction in transportation emissions will require both improvement in vehicle technology, fuels switching, sustainable land use and behavior change.

In the near to mid-term, research and innovation into battery capacity, advanced engine design and other fuel efficiency refinements represent a critical part of reducing transportation emissions. However, fuel efficiency efforts will wane over time and switching to clean, renewable fuel will become much more important. Committing to low carbon urban design, public transit investment, carpooling and shifting away from motorized transportation represent a small but resilient strategy for decreasing emissions. By 2050, design and changing transportation behavior could account for over 25% of ongoing emissions reduction.

Business-as-Usual Projections

A Business-As-Usual (BAU) projection uses locally specific parameters like population growth or gross domestic product (GDP) growth projections to model future emissions in the planning area. A BAU projection allows us to see what will happen to GHG emissions in the region if we do not act. Based on this projection, greenhouse gas emissions are estimated to increase by 28% from 2005 base year to 37 Million MTCO2e by 2050, if no actions are taken. These projections are based on current population and transportation emissions forecasts for the MARC Region.



Target Emissions Reduction

Meeting a 'net zero by 2050' target means that the region will need to reduce this projected 37 million $MTCO_2e$ through reduced emissions and drawing down of greenhouse gases already in the atmosphere through sequestration.

Greenhouse Gas Inventory Detail

I.2 Commercial and Institutional Buildings and Facilities

GPC Ref No.	Scope	GHG Emissions Source	Activity Data		Converted Activity Data			Emission Factor		GHG Emissions
		Activity	Activity/year	Unit	Factor	Activity/year	Unit	Value	Unit	t CO2e/year
I.2.1	1									**1,542,229**
I.2.1	1	Natural gas	1,817,778	Mcf	1.0260	1,865,040	MMBtu			100,412
I.2.1	1	Natural gas	2,971,950	Mcf	1.0260	3,049,221	MMBtu			164,168
I.2.1	1	Natural gas	18,335,734	Mcf	1.0260	18,812,463	MMBtu			1,008,954
I.2.1	1	Natural gas	369,533	MMBtu	1.0000	369,533	MMBtu			19,628
I.2.1	1	Coal (Bituminous or Black coal)	2,649,323	MMBtu	1.0000	2,649,323	MMBtu			249,068
I.2.2	2									**7,758,067**
I.2.2	2	Electricity	43,441,280	kWh	0.0010	43,441	MWh			33,456
I.2.2	2	Electricity	4,481,148,043	kWh	0.0010	4,481,148	MWh			2,746,151
I.2.2	2	Electricity	225,322,985	kWh	0.0010	225,323	MWh			165,756
I.2.2	2	Electricity	7,460,963,686	kWh	0.0010	7,460,964	MWh			4,812,704
I.2.3	3									**364,713**
I.2.3	3	Electricity	2,042,209	kWh	0.0010	2,042	MWh			1,573
I.2.3	3	Electricity	210,662,284	kWh	0.0010	210,662	MWh			129,099
I.2.3	3	Electricity	10,592,610	kWh	0.0010	10,593	MWh			7,792
I.2.3	3	Electricity	350,745,754	kWh	0.0010	350,746	MWh			226,249
I.2	**Commercial and Institutional Building and Facility Energy Use**									**9,665,009**

I.3 Manufacturing Industries and Construction

GPC Ref No.	Scope	GHG Emissions Source	Activity Data		Converted Activity Data			Emission Factor		GHG Emissions
		Activity	Activity/year	Unit	Factor	Activity/year	Unit	Value	Unit	t CO2e/year
I.3.1	1									**464,190**
I.3.1	1	Natural gas	19,237	Mcf	1.0260	19,737	MMBtu			1,063
I.3.1	1	Natural gas	8,416,424	Mcf	1.0260	8,635,251	MMBtu			463,127
I.3.2	2									**9,409**
I.3.2	2	Electricity	12,217,860	kWh	0.0010	12,218	MWh			9,409
I.3.3	3									**442**
I.3.3	3	Electricity	574,371	kWh	0.0010	574	MWh			442
I.3	**Manufacturing Industries and Construction Energy Use**									**474,042**

III.1 Solid Waste (landfills and open dumps)

GPC Ref No.	Scope	GHG Emissions Source	Activity Data		Converted Activity Data			Emission Factor		GHG Emissions
		Activity	Activity/year	Unit	Factor	Activity/year	Unit	Value	Unit	t CO2e/year
III.1.1	1									**886,275**
III.1.1	1	Municipal solid waste	1,974,435	tonne	NA	NA	NA			886,275
III.1.2	3									**0**
III.1.3	1									**0**
III.1	**Landfill Disposal and Open Dumping**									**886,275**

III.4 Wastewater

GPC Ref No.	Scope	GHG Emissions Source	Activity Data		Converted Activity Data			Emission Factor		GHG Emissions
		Activity	Activity/year	Unit	Factor	Activity/year	Unit	Value	Unit	t CO2e/year
III.4.1	1									**44,321**
III.4.1	1	All wastewater			NA	NA	NA			44,321
III.4.2	3									**0**
III.4.3	1									**0**
III.4	**Wastewater Treatment and Discharge**									**44,321**