METHODOLOGY

REGIONAL INDICATORS INITIATIVE

FEBRUARY 2025

Prepared by:

Becky Alexander, LHB

Contributions by: J. Michael Orange, ORANGE Environmental

CONTENTS

ABBREVIATIONS

AR4 – IPCC's Fourth Assessment Report

AR5 – IPCC's Fifth Assessment Report

eGRID – Emissions & Generation Resource Integrated Database

EIA – Energy Information Agency

EPA – Environmental Protection Agency

FHWA – Federal Highway Administration

FLIGHT – Facility Level Information on Greenhouse Gases Tool

GHG – greenhouse gas

GPC – Global Protocol for Communities

GWP – global warming potential

IPCC - Intergovernmental Panel on Climate Change

MMSW – mixed municipal solid waste

MnDOT – Minnesota Department of Transportation

MPCA – Minnesota Pollution Control Agency

PUC – Public Utilities Commission

RDF – refuse-derived fuel

REC – renewable energy credit

RII – Regional Indicators Initiative

VMT – vehicle miles traveled

WARM – Waste Reduction Model

WTE – waste-to-energy

INTRODUCTION

The Regional Indicators Initiative tracks annual performance metrics for Minnesota cities, providing local government elected officials, staff, and community members with city-wide data and tools to inform their climate planning and action. It supports defining a baseline, tracking a business-as-usual trajectory, establishing targets, and measuring outcomes of strategy implementation at a city-wide scale.

The project collects the following data that reflect the activities of the people who live, work, learn, travel, visit, and play within each city's geographical boundaries:

- **Energy**: Electricity, fossil gas, and other heating fuels used within city boundaries - separated between residential and commercial/industrial use[1]
- **Water**: Municipal potable water consumption within city boundaries - separated between residential and commercial/industrial use
- **Travel**: On-road distance traveled by all vehicles within city boundaries
- **Waste**: Municipal solid waste generated within city boundaries (estimated from county-wide totals) - separated by management method (landfill, incineration, or recycling)

The greenhouse gas (GHG) emissions associated with each of these indicators are also calculated, providing a common metric to compare their climate impacts. GHG emissions are calculated in accordance with the *U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions* (U.S. Community Protocol), developed by ICLEI – Local Governments for Sustainability USA (ICLEI), which serves as a national standard to define which emissions sources and activities should be included in a community-wide inventory and provides methodologies to account for these emissions.[2] This protocol reflects the *Sources* and *Activities* that local governments are best able to influence, including emissions that occur within the community's geographic boundaries (also known as Scope 1 emissions) as well as emissions occurring outside the community (also known as Scope 2 and Scope 3 emissions).[3]

---

[1] The term "fossil gas" is used throughout this document rather than "natural gas" in acknowledgement that this gas is a fossil fuel comprised primarily of methane – which is a potent greenhouse gas.

[2] ICLEI, U.S. Community Protocol. While the October 2012 version of the protocol was used for RII's initial methodology development, it has since incorporated updates based on Version 1.1 (July 2013) and Version 1.2 (July 2019).

[3] The U.S. Community Protocol defines a *Source* as "Any physical process inside the jurisdictional boundary that releases GHG emissions into the atmosphere (e.g., combustion of gasoline in transportation; combustion of natural gas in electricity generation; methane emissions from a landfill)." An *Activity* is "The use of energy, materials, and/or services by members of the community that result in the creation of GHG emissions either directly (e.g., use of household furnaces and vehicles with internal combustion engines) or indirectly (e.g., use of electricity created

The U.S. Community Protocol identifies five Basic Emissions Generating Activities that must be included in community-wide inventories. The following is a direct excerpt from the U.S. Community Protocol v1.2 (July 2019):

1. **Use of Electricity by the Community** – Power plant emissions associated with generating electricity used within the jurisdictional boundary of the community, regardless of the location of the electricity generation facility.

   Rationale: Local governments can often influence electricity use in local buildings through local building codes, financial incentives, minimum regulatory requirements, technical assistance, and other programs.

2. **Use of Fuel in Residential and Commercial Stationary Combustion Equipment** – Combustion emissions associated with fuels used in residential and commercial stationary applications (e.g., natural gas used in boilers and furnaces) within the jurisdictional boundary of the community, excluding fuels used for production of electricity or district energy.

   Rationale: Local governments can often influence use of fuels in stationary combustion applications (e.g., furnaces) in local buildings through local building codes, financial incentives, minimum regulatory requirements, technical assistance, and other programs.

3. **On-Road Passenger and Freight Motor Vehicle Travel** – Emissions associated with transportation fuels used by on-road passenger and freight motor vehicles. Local governments may meet this requirement by reporting emissions associated with either: 1) Travel associated with origin and destination land uses in the community through a demand-based allocation of trips (preferred if available), or 2) Travel occurring within the jurisdictional boundary of the community.

   Rationale: Local governments can influence transportation emissions through land use and urban design regulations and through transportation infrastructure investments.

4. **Use of Energy in Potable Water and Wastewater Treatment and Distribution** – Emissions associated with energy used in the treatment and delivery of potable water used in the community and in the collection and

---

through combustion of fossil fuels at a power plant, consumption of goods and services whose production, transport and/or disposal resulted in creation of GHG emissions).” While *Sources* are bound by the geography (the community boundary), *Activities* are not.

treatment of wastewater used in the community, regardless of the location of the water and wastewater infrastructure.

Rationale: Local governments can influence community water use through local building codes, promoting and/or providing incentives to foster conservation and efficiency, and other programs and services.

5. **Generation of Solid Waste by the Community** – End-of-life emissions (i.e., projected future methane emissions) associated with disposal of waste generated by members of the community during the analysis year, regardless of disposal location or method.

   Rationale: Local governments can influence the amount of solid waste generated and sent to various disposal methods through their administration of municipal solid waste, recycling and composting services.

These Activities are required because 1) cities are the level of government that has the greatest authority and responsibility over the emissions-generating Activity; 2) the data needed to estimate emissions are reasonably available; 3) the emissions associated with the Activity tend to be significant in magnitude; and 4) the Activity is important and common across U.S. communities.

In addition to these required Activities, the U.S. Community Protocol defines the approach for other sources of emissions, including: industrial stationary combustion and process emissions; district heating and cooling; refrigerant leakage; rail, marine, and air transportation; off-road mobile equipment; agriculture, forests, and trees; upstream impacts of community-wide activities; and independent consumption-based accounting. Of these optional sources and activities, RII includes emissions from district energy systems and from the use of fuel in industrial stationary combustion equipment to the extent to which the data is available. Appendix A – GHG Inventory Scoping identifies how each possible emissions source and activity is accounted for – or not – within RII.

The U.S. Community Protocol sets a minimum size threshold – called *de minimis* – that allows for the exclusion of GHG sources and activities that collectively contribute less than 5% of a community's total emissions. It also describes methods to avoid double counting emissions for facilities that are shared among multiple communities.

The year-specific data points that are collected for RII communities are shown in Appendix B – Data Inputs, along with a description of the typical data availability timeline and where placeholder data may be used.

Greenhouse Gases

The U.S. Community Protocol accounts for the six internationally recognized GHGs that directly impact the climate (carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexaflouride).

Different gases have different levels of heat-trapping potential, also known as global warming potential (GWP). The Intergovernmental Panel on Climate Change (IPCC) has established carbon dioxide as the reference gas for measuring GWP and calculates GWPs for other greenhouse gases. For example, methane has the potential to trap 25 times as much heat as carbon dioxide over a 100-year timeframe, giving it a GWP of 25. GWP values have been most recently published in 2021 within the IPCC's Sixth Assessment Report (AR6). However, to be consistent with data reported by the U.S. EPA, the Regional Indicators Initiative uses values from a previous assessment (AR4), published in 2007 and shown in Table 1.[4]

Table 1. Global warming potential (GWP) values [5]

Gas	100-Year GWP
Carbon dioxide	1
Methane	25
Nitrous oxide	298

These GWP values are used to convert emissions of each gas into the common unit of carbon dioxide equivalents (CO2e). In this document, greenhouse gas emissions are referred to interchangeably as carbon dioxide equivalents (CO2e) or simply greenhouse gases (GHG).

GHG Inventory Comparisons

GHG inventories are impacted by many different variables, and their scope and granularity can vary depending on a community's needs, characteristics, and data availability. As such, results from different inventories may not be directly comparable – even when using the same protocol.

[4] RII uses emissions data from the U.S. EPA for large facilities (FLIGHT) as well as for calculating waste emissions (WARM). From The U.S. EPA's "Emission Factors for Greenhouse Gas Inventories" (March 2020): "While EPA recognizes that Fifth Assessment Report (AR5) GWPs have been published, in an effort to ensure consistency and comparability of GHG data between EPA's voluntary and non-voluntary GHG reporting programs (e.g. GHG Reporting Program and National Inventory), EPA recommends the use of AR4 GWPs. The United States and other developed countries to the UNFCCC have agreed to submit annual inventories in 2015 and future years to the UNFCCC using GWP values from AR4, which will replace the current use of SAR GWP values. Utilizing AR4 GWPs improves EPA's ability to analyze corporate, national, and sub-national GHG data consistently, enhances communication of GHG information between programs, and gives outside stakeholders a consistent, predictable set of GWPs to avoid confusion and additional burden."

[5] Intergovernmental Panel on Climate Change, Fourth Assessment Report (AR4), 2007.

RII prioritizes providing consistent inventories for each community from year to year to ensure they can track their progress over time. This often involves slight revisions to previous years as better data sources or calculation methods become available. Additionally, RII strives to use consistent data sources and methodologies across different communities, which allows for some comparisons between cities. However, in many instances, these types of comparisons are not possible due to the differences in data availability or city characteristics.

RII data should not be assumed to be directly comparable to GHG inventories conducted outside of the program. Appendix C – Inventory Comparison identifies how the RII methodology compares to several other sets of inventories.

ENERGY

The Regional Indicators Initiative's Energy category includes the energy consumed in the built environment (i.e. buildings and streetlights) within community boundaries. This includes electricity use, the stationary combustion of fossil gas and other fuels, and district heating and cooling.

ENERGY USE

Electricity and Fossil Gas

Primary energy consumption data for electricity and fossil gas is provided at the community scale by each energy utility, broken down between residential and commercial/industrial customers. In general, the residential classification is intended to include energy used, in Xcel Energy's words, "for domestic purposes in space occupied as living quarters." All other consumption – including energy used in commercial, institutional, and industrial buildings and processes, along with street lighting – is included in the Commercial/Industrial category. Since these two categories are typically defined by utilities based on their rate classes, there is often cross-over between the residential and the commercial classifications for multi-family buildings.[6]

Community-scale electricity and fossil gas data is obtained using one of several sources, listed in order of preference:

1. Public reports from energy utilities to the U.S. Energy Information Administration (U.S. EIA)

[6] Separating customers into different sectors is a reporting requirement for energy utilities for both the U.S. Energy Information Agency and the Minnesota Department of Commerce. Though the sector names and definitions used by these two agencies are slightly different, both can be divided into residential vs. non-residential. In practice, the easiest way for Minnesota utility companies to group customers into these different sectors is based on rate classes and tariffs, which are provided in utility documentation such as rate books. There are similar rate class categories across the state, such as residential, small/medium/large general, and large industrial. However, these categories do not have standardized definitions, and are more typically based on energy loads rather than the activities that take place in each premise. Most Minnesota energy utilities are able to use rate classes to separate residential from non-residential customers, though multi-family customers are often mixed between categories depending on how the energy is metered (at the unit or building scale).

Xcel Energy's Local Government Consumption Report notes, "Apartment buildings often have individual electric meters for each unit, which are served on a residential rate and are included in the electric Residential class of service. They usually have another electric meter for laundry rooms and for common area lighting and cooling, served on a commercial electric rate and included in the Commercial class. These same apartment buildings often have one gas meter connected to a boiler and a water heater providing heat and hot water to all of the individual units. These meters are served on a commercial gas rate and are included in the gas Commercial class. However, if each unit has an individual gas meter serving only that unit's individual furnace and/or water heater, then it is served on a residential gas rate and included in the gas Residential class." As it pertains to fossil gas, this distinction was confirmed by a CenterPoint representative.

The U.S. EIA requires electric and fossil gas utilities to report state-specific data regarding energy sold. [7] Fossil gas utilities as well as electric utilities providing over 200,000 MWh are required to subdivide this information into residential, commercial, industrial, and transportation/vehicle fuel sectors. These sectors are defined based on the activities that take place in each premise, unrelated to the amount of energy used.[8] Since EIA reporting is not disaggregated to the county or city scale, it is only used for utilities whose entire service territory is within the targeted community (such as municipal utilities).

2. Public reports from energy utilities to the Minnesota Department of Commerce

   Per MN Rules Chapter 7610, electric and fossil gas utilities serving Minnesota are required to file an annual report to the Department of Commerce that includes energy delivered, number of customers, and revenue.[9] Electricity sales are required to be separated into the following classifications: farm, non-farm residential, commercial, industrial, street and highway lighting, and other. Fossil gas sales are separated into slightly different classifications: residential firm, commercial firm, commercial interruptible, industrial firm, and industrial interruptible. While the definitions referenced in Minnesota's Administrative Rules are based on the activities that take place in each premise, in practice the commercial and industrial categories are distinguished by the account size. "Commercial" refers to "small commercial and industrial power accounts" and "Industrial" refers to "large commercial and industrial power accounts, including mining accounts".[10] Rule 7610 also requires electric and fossil gas utilities to report the total energy delivered to customers in each county, though no additional metrics or segregation by sector are required at this scale.[11] Since sector-specific data is not disaggregated to the county or city scale, this

---

[7] "Form EIA-861 Annual Electric Power Industry Report" is used for electric utilities. "Form EIA-176 Annual Report of Natural and Supplemental Gas Supply and Disposition" is used for fossil gas utilities. http://www.eia.gov/survey/

[8] U.S. Energy Information Agency, "Form EIA-861 Annual Electric Power Industry Report Instructions," http://www.eia.gov/survey/form/eia_861/instructions.pdf and "Form EIA-176 Annual Report of Natural and Supplemental Gas Supply and Disposition Instructions," page 3, http://www.eia.gov/survey/form/eia_176/instructions.pdf

[9] Minnesota Administrative Rules, part 7610.0310, https://www.revisor.mn.gov/rules/?id=7610.0310 and part 7610.0914, https://www.revisor.mn.gov/rules/?id=7610.0914

[10] For complete definitions of the electric customer classes, refer to page 9 of the "Forms & Instructions: Electric Utility Data Report", which can be found at the Minnesota Department of Commerce "Annual Reporting" webpage: http://mn.gov/commerce/industries/energy/utilities/annual-reporting/

[11] Minnesota Administrative Rules, part 7610.1130, https://www.revisor.mn.gov/rules/?id=7610.1130

source is only used for utilities whose entire service territory is within the targeted community (such as municipal utilities).

3. Other publicly-available reports from energy utilities

   Since 2016, Xcel Energy has provided Community Energy Reports for recent years on their website for Minnesota communities that are above a certain population or have had their data requested.[12] At this time, no comparable reports have been found for other utilities serving RII cities.

4. Data requests to energy utilities

   The majority of RII data is obtained via data requests to the energy utilities, asking for annual community-wide energy use (in MWh for electricity, therms for fossil gas) for the specified communities divided into two categories: 1) residential and 2) commercial and industrial.

Unit Conversions

RII uses the conversion factors shown in Table 2 to translate between different energy units. Some of these values are absolute (such as the relationship between kWh and MWh) while others involve rounding (such as therms to MMBTU). Converting cubic feet of fossil gas to therms requires the heat content of fossil gas, which may vary by location and over time.[13]

Table 2. Conversion factors

1,000	BTU	=	1	kBtu
1,000,000	BTU	=	1	MMBTU
1,000	kWh	=	1	MWh
3.412	MMBTU	=	1	MWh
96.7	cf (fossil gas)	=	1	therm
10	therms	=	1	MMBTU
2204.62	pounds	=	1	metric ton

[12] Xcel Energy, Community Energy Reports, https://www.xcelenergy.com/community_energy_reports

[13] The heat content of fossil gas used here roughly equates to the average heat content of fossil gas delivered to consumers in Minnesota from 2010-2020. U.S EIA, "Minnesota Heat Content of Natural Gas Deliveries to Consumers," https://www.eia.gov/dnav/ng/NG_CONS_HEAT_DCU_SMN_A.htm.

De Minimis Data

Many cities are served by multiple energy utilities.[14] Appendix D – Energy Utilities by City shows which utilities serve each RII city, along with a rough estimate of the percentage of electricity or fossil gas provided. Utilities that are estimated to provide less than 5% of the total electricity or fossil gas used within a city are excluded from the data as *de minimis.*

While grid-connected electricity generated from renewable sources within the community is accounted for within the electricity totals, non-grid-connected renewable electricity generation is not collected and is assumed to be *de minimis.*

Data Privacy

Utilities in Minnesota are required to protect the anonymity of customer energy use data.[15] In the absence of a statewide privacy protocol, each utility takes a unique approach to ensure customer privacy when reporting aggregated community-wide data.

Most of the privacy protocols currently in use involve excluding customer groups with fewer than a set number of customers (e.g., 4) and excluding customers that comprise a large percentage of the total aggregated energy use (e.g., 50%). This example is referred to as 4/50.

Utilities take different approaches when a customer class fails the data privacy screen, such as combining multiple customer classes (e.g., "commercial" and "industrial" become "business"), extracting individual customer data until the privacy screen is passed, or not reporting any data for the impacted community. Some utilities note when provided data has been impacted by these privacy measures while others do not. Utility-specific privacy protocols are listed in Appendix E – Energy Data Privacy Impacts, along with the communities that are known to be impacted by these protocols.

Estimating data

In certain circumstances, RII uses energy use estimates when data has not been provided by the utility. Estimates are used when energy data is missing from:

---

[14] Minnesota's Public Utilities Commission provides a map of electric utility services territories: https://minnesota.maps.arcgis.com/apps/webappviewer/index.html?id=95ae13000e0b4d53a793423df1176514/ Gas providers for each community are determined using the Minnesota Blue Flame Gas Association's "Who's my utility?" functionality: https://blueflame.org/whos-my-utility/

[15] *In the Matter of Commission Inquiry into Privacy Policies of Rate-Regulated Energy Utilities,* Docket No. E,G999/CI-12-1344, "PUC Order Governing Disclosure of Customer Energy Use Data to Third Parties, Requiring Filing of Privacy Policies and Cost Data, and Soliciting Comment" (January 19, 2017)

- A utility that has provided city-specific data for at least one other year
- One or more utilities that are estimated to comprise less than 25% of the city's total energy use (for cities served by multiple utilities)

Cities that use estimated energy data are listed in Appendix F – Estimated Energy Use, which also describes the methodology used for estimating. In general, these calculations utilize the sector-specific energy data that is available for the city to estimate the missing year/utility, accounting for factors like city growth, weather, and utility service territories.

Non-Utility Fuels

Non-utility fuels – such as fuel oil, propane, coal, and wood – account for over 20% of the emissions from stationary combustion energy in Minnesota households, typically in areas not served by fossil gas.[16] Due to the dispersed distribution model for these fuels, it is not feasible to collect direct usage data for each community. Instead, residential non-utility fuel use is estimated for each community by applying the community's average household energy use (derived from fossil gas data) to the percentage of households with each non-utility fuel as their primary heating source, which is gathered from the U.S. Census American Community Survey.[17]

On the commercial and industrial side, permitted facilities are required to annually report fuel used for stationary combustion.[18] Non-utility fuels are included in the community's inventory when comprising more than 5% of the community's total energy consumption, which is the 'de minimis' threshold specified by the U.S. Community Protocol.

In some cases, non-utility fuels are presented separately from electricity and fossil gas, while in other instances they are combined with fossil gas.

District Energy

Some RII communities include district energy systems that provide heating and cooling for multiple buildings within a defined area, such as a downtown or campus. These systems use a variety of primary energy sources – such as fossil fuels, solar

---

[16] MPCA, Greenhouse gas emissions data. In 2018, the CH_4, CO_2, and N_2O emissions from coal, oil, and other fossil fuels were 23% of those plus fossil gas emissions.

[17] U.S. Census American Community Survey, "House Heating Fuel." The 5-year estimates are used, which are published every year and represent the average from the households surveyed over the previous five years. These estimates are available for all cities and have smaller margins of error than the 1-year estimates (only available for areas with a population above 65,000).

[18] Over 1,400 permitted facilities in the state report on-site combustion for Minnesota's air emissions inventory under Minnesota Statute 216H.021 Subd. 2. (b) (1); these data were obtained through a data request to the MPCA.

thermal, biomass, electricity, and municipal solid waste – to generate the steam, hot water, and/or chilled water that is distributed to each building.

There are two different ways that district energy could be accounted for:

1. System scale (source energy) – Track the primary energy (e.g., electricity, fossil gas, coal) used by the district energy system to generate and distribute steam, hot water, and/or chilled water and estimate the associated GHG emissions directly.
2. Building scale (site energy) – Track the energy (e.g., steam, hot water, chilled water) delivered to each building, and apply an emissions factor based on the generation energy mix.

RII uses the system scale approach, with the electricity and fossil gas generally accounted for within utility totals and non-utility fuels as reported to the MPCA if above the *de minimis* threshold. This differs from RII's approach to electricity, where the energy delivered to buildings (site energy) is reported rather than the energy used at the power plants (source energy). Unlike power plants, district energy plants typically only serve buildings within the community's boundary, and the difference between site and source energy is much lower for district systems than for electricity.[19]

Any grid-independent wind and solar used as source energy for district systems is not accounted for within the energy totals – similarly to other applications of distributed renewable energy generation that are not connected to the grid. This is estimated to have a very small impact on the community-wide totals.[20] Similarly, district energy derived from combusting waste is not accounted for in the energy totals, and the emissions associated with this are included in the "Waste" category sector rather than the "Energy" category. See the Waste versus Energy Emissions section for more detail.

Avoiding Double Counting

Several communities host major facilities such as power plants and waste processing facilities. The GHG emissions of these types of facilities are already accounted for through the activities of residents and organizations within the community and/or surrounding region. To avoid double counting the impacts of these facilities, their energy consumption is not included in the community-wide total. This is described

[19] On average in the U.S. – according to the U.S. EPA's Energy Star Portfolio Manager – electricity requires 2.80 units of source energy to generate a single unit of the site energy used in buildings. For steam and hot water, this ratio is 1.20, and for chilled water it is 0.91.

[20] District Energy St. Paul's large solar hot water installation represents less than 1% of the heating system's total fuel mix, according to Ever-Green Energy's 2021 ESG Reporting.

in the U.S. Community Protocol, which differentiates between Sources (e.g., power plants) and Activities (e.g., on-site electricity use).

- Power plants: Because the GHG emissions associated with electricity consumption already account for the energy required to generate that electricity, energy used at power plants is not included in the total energy for the community in which they are located.
- Waste-to-energy facilities: RII's "Waste" category accounts for each community's share of emissions associated with processing municipal solid waste in waste-to-energy facilities. Since this includes emissions from the energy used within these facilities, this energy use is not included in the total energy for the community in which the facility is located.

See Appendix G – Avoiding Double Counting for a list of the facilities in RII communities that are excluded from community-wide energy totals to avoid double-counting.

ENERGY EMISSIONS

Energy emissions are calculated based on the emissions factors associated with each energy source. Emissions factors refer to the emissions from each unit of energy consumed, in tonnes of carbon dioxide equivalents per million British thermal units (tonnes CO_2e/MMBtu). For fossil fuels, this includes emissions from carbon dioxide, methane, and nitrous oxide. Per the U.S. Community Protocol, carbon dioxide emissions from biogenic fuels – such as wood – are considered biogenic emissions and are excluded from the total energy emissions calculation. The methane and nitrous oxide emissions from biogenic fuels are not considered biogenic and are included in the total.

Electricity

The emission intensity of electricity varies based on the energy sources used for generation, such as coal, gas, wind, solar, and nuclear. This generation mix varies by utility and over time. When available, RII uses annual emissions factors that are specific to each electricity supplier. Emissions factors for carbon dioxide, methane, and nitrous oxide are collected separately, then combined into carbon dioxide equivalents using the global warming potential values used throughout RII (shown in Table 1).

The sources used for electricity emissions factors are listed below in order of preference:

1. Third-party verified emissions factors reported by the utility in accordance with a national standard

To enable comparisons across utilities, RII aims to use emissions factors that were calculated in accordance with the standards set in either The Climate Registry's Electric Power Sector Protocol or the World Resources Institute/World Business Council for Sustainable Development GHG Protocol Scope 2 Guidance. It also prefers data that has been verified by a third-party, such as through ISO 14001 or The Climate Registry's General Verification Protocol. The Climate Registry publishes these values through CRIS Public Reports.

2. Emissions factors reported by the utility, not third-party verified

   When third-party verified data is not available, RII uses emissions factors reported directly by utilities, such as within the company's sustainability reporting or through Edison Electric Institute's "Electric Company Carbon Emissions and Electricity Mix Reporting Database for Corporate Customers".[21]

3. Emissions factors calculated based on electricity generation mix

   Several electricity providers serving Minnesota customers do not publicly report emissions factors but do produce Environmental Disclosure Brochures each year.[22] These brochures contain both the utility-specific fuel type breakdown for the reporting year and the emissions factors for each fuel type, which can be used in combination to create an overall emissions factor that is weighted based on the generation mix.

4. Regional average emissions factors

   When utility-specific emissions factors are not available through any of the sources above, the regional average is used based on data from the EPA's Emissions & Generation Resource Integrated Database (eGRID) for the Midwest Regional Organization West. Since these values were only published in alternating years for a portion of the study period, any missing values are estimated as the average of the two adjacent years.

Appendix H – Electricity Emissions Factors shows the emissions factors used for each utility.

[21] This database is published every two years, providing utility-specific emissions factors and identifying which protocol was used and whether the values have been third-party verified.

[22] These brochures are required for regulated electric utilities and filed within Minnesota's eDocket system within Docket Nos. E,G999/CI-00-1343 & E999/CI-01-1127.

Green Power/RECs

In the calculation of overall electricity emissions factors, electricity generated using wind or solar is assigned an emissions factor of zero if the renewable energy credits (RECs) associated with that generation have been retired on behalf of the utility or its customers. In this way, local participation in green power purchase programs – where RECs are retired on behalf of the customer – helps reduce the emissions factors for the utility serving those customers. However, in accordance with the U.S. Community Protocol – which does not allow market-based solutions to offset community emissions – RII does not assign green power purchases to individual cities.[23] Similarly, RECs purchased by community members, institutions, or businesses outside of utility programs are not accounted for in the community's inventory. This means that the same electricity emissions factor is used for a city with 1% of its electricity offset by RECs and a city in the same utility territory with 15% of its electricity offset by RECs.[24]

[23] One reason to avoid including market-based solutions is the risk of double-counting carbon savings from renewable electricity generation – once in the utility's emissions factors and again within the community. To counter this, some utilities publish a "residual mix" emission intensity, which excludes the electricity associated with RECs that are sold to the market, purchased, or retired on behalf of customers participating in green power purchase programs. In the five years that residual mix intensities have been published by Xcel Energy, these values have ranged from 0.6% to 2.4% higher than the other reported factors – decreasing as the grid has gotten cleaner.

[24] At the rates communities are currently using RECs to offset electricity emissions (less than 1% for three-quarters of the communities), the exclusion of market-based solutions has a minimal impact on community totals. However, some communities have set green power purchase goals in order to achieve carbon-free electricity sooner than the grid, which may make this issue increasingly relevant.

Fossil Gas and Other Fuels

Unlike electricity – where emissions vary significantly depending on the energy source used for generation – the emissions factors for other energy types do not vary significantly between utilities or over time. Table 3 shows the emissions factors used for the stationary combustion of fossil gas and other fuels.

Table 3. Emissions factors from stationary combustion[25]

Energy type	Tonnes CO_2e per MMBTU
Coal and coke[26]	0.0978
Fuel oil[27]	0.0744
Fossil gas[28]	0.0532
LPG[29]	0.0633
Wood[30]	0.0056

[25] ICLEI, U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, Version 1.1, July 2013. Tables B.1 and B.3, using global warming potential values from Table 1.

[26] Values for subbituminous coal used. CH_4 and N_2O values are based on the industrial and commercial sectors (rather than residential, which has higher CH4 emissions).

[27] Fuel oil emissions use the average CO_2 rates of distillate fuel oils #1, #2, and #4 (including diesel). This is similar to the average for residual fuels #5 and #6. This uses CH_4 and N_2O rates for “Petroleum Products,” taking an average of the Industrial and Residential/Commercial sectors for CH_4.

[28] Fossil gas CO_2 emissions are based on the "Pipeline (US weighted average)" and CH_4 and N_2O is for Residential and Commercial End-Use Sectors (vs. Industrial or Energy Industry).

[29] LPG emissions use CH_4 and N_2O rates for “Petroleum Products,” taking an average of the Industrial and Residential/Commercial sectors for CH_4.

[30] Wood emissions exclude CO_2, which is considered biogenic, and uses CH_4 and N_2O rates for “Biomass Fuels Solid,” taking an average of the Industrial and Residential/Commercial sectors for CH_4.

WATER

The Regional Indicators Initiative's Water category includes potable water consumption within community boundaries, regardless of where the water is sourced from. Separated between residential and commercial/industrial uses, the dataset includes water sold by public suppliers (typically the municipality) to customers within community boundaries, as reported to the Minnesota Department of Natural Resources. It does not include water used by other permit holders within the city, such as residences with private wells or commercial, industrial, or agricultural uses with separate use permits. These values do not include water lost to distribution leakage – similarly to RII's approach to electricity, which does not account for transmission and distribution losses in the usage data.

The GHG emissions associated with the treatment and distribution of potable water within each community's boundaries are included within the "Energy" category and are not reported separately. The same is true for the GHG emissions from energy used within the community to manage wastewater. Process emissions from wastewater treatment are not included. Emissions from wastewater treatment were calculated for approximately 20 RII communities for early years of the study period and were generally found to comprise less than 1% of community-wide emissions.

TRAVEL

The Regional Indicators Initiative's Travel category includes metrics related to vehicle miles traveled (VMT) on roads within each city's geographic boundaries. The U.S. Community Protocol does not require emissions from other modes of transportation (e.g., by air, rail, or water) to be quantified. For most cities, all transportation activities except air travel are likely to be de minimis. Similarly, emissions from off-road transportation or mobile equipment (e.g., snowmobiles, construction equipment, lawnmowers) are not required to be quantified and are expected to be de minimis.

VEHICLE MILES TRAVELED

The Minnesota Department of Transportation (MnDOT) annually reports vehicle miles of travel (VMT) on Minnesota roads, broken down by County, City, and Route System.[31] The VMT data reflects travel within each city's geographic boundaries, regardless of trip origin or destination.[32] While this data is critical for estimating the relative impact of vehicle travel compared to other emissions sources and can indicate which cities have higher rates of VMT than others, cities should be cautious about directly comparing their year-over-year data due to methodological limitations.[33]

Estimating VMT involves[34,35]:

1. **Counting cars.** Sensors are used to count the number of cars traveling in both directions – either continuously or for a representative short-term

[31] Minnesota Department of Transportation (MNDOT), Roadway Data, "VMT by Route System in each City, within each County."

[32] In recognition of the ability of local governments to influence vehicle trips both inside and outside the community's geographic boundaries, the U.S. Community Protocol recommends using an origin-destination method to calculate emissions from passenger vehicles. For this method, demand-based models are used to estimate miles traveled from trips that start or end within the community. However, since travel demand models are not consistently available for communities throughout Minnesota, RII uses the alternative, in-boundary method. Compared to the origin-destination method, the in-boundary method will show higher VMT for communities with a disproportionately large amount of pass-through traffic and lower VMT for communities with high numbers of commuters to/from other cities. Due to these differences, RII inventories cannot be directly compared to inventories that use the origin-destination method.

[33] MnDOT's VMT Trend Report for 1992-2018 states that "Consecutive year VMT comparisons (using the current mileage) should only be used as an estimate of Statewide VMT changes. Cross year comparisons of VMT at the county level are valid only when "actual" data is used (from counted year to counted year) and the data is reported using the current mileage." MnDOT representatives have further noted several variables that can impact a city's reported VMT regardless of actual shifts in travel, including: changes in how road length (centerline miles) is calculated, changes in the functional class of roads, changes in the percent sampled, and the most recent measurement year for sampled locations.

[34] Minnesota Department of Transportation (MNDOT), Traffic Forecasting & Analysis, "Collection Methods."

[35] Minnesota Department of Transportation (MNDOT), "Vehicles Miles of Travel In Minnesota: 1992-2018."

period, typically 48 hours – at approximately 39,000 locations throughout the state.[36] These counting locations are distributed among each route system (e.g., Interstate, MN Highway, Municipal Street) in a manner that is roughly proportional to their average traffic, and counting typically occurs over a two- or four-year cycle, depending on the road type.[37] Due to counting requirements associated with state or federal funding, cities with more highways and state-aid streets will have more counting locations than cities without these road types.[38]

2. **Calculating annual average daily traffic (AADT).** The raw count of daily traffic is adjusted to account for variables such as day of the week and month and is converted into a yearly value. AADT for road segments that were not counted in the reporting year are estimated using annual adjustments to the traffic volumes from an earlier year, modeled AADT from probe data, location-specific AADT estimates, or non-sampled estimates.[39,40]

3. **Extrapolating to all roads.** AADT values for each road type are multiplied by the number of centerline miles of that road type within the jurisdiction to calculate the total miles traveled.

This dataset is not available for 2015 due to replacement data systems being implemented that year. Vehicle travel for 2015 is therefore estimated for each route system using the average of 2014 and 2016 data.[41]

---

[36] Approximately 10% of the counting locations use automated, continuous sensors. A majority of these continuous sensors are located on major roadways (e.g., trunk highways), which account for approximately 58% of Minnesota's yearly VMT despite only containing around 8% of Minnesota's centerline miles of road.

[37] All roads in Minnesota are scheduled for traffic counting based on categories defined by MnDOT. Major roadways, such as Interstates, US and MN State Highway are on a two-year cycle, while those defined as local road systems – County State Aid Highways, County Roads, and Municipal State Aid Streets – are on a four-year cycle. Approximately one half of major roadways and one quarter of local roadways in Minnesota are scheduled for counting during any given year. Counts for other sections of roads such as ramps take place on a six-year cycle, while particularly low-traffic county roads are counted on a twelve-year cycle. Counts are required to be timed to exclude the impacts of construction projects.

[38] Since cities with populations under 5,000 are not eligible for state-aid, they typically have lower sampling rates.

[39] For example, minimal short-term counts were conducted during the COVID-19 pandemic in 2020. Therefore 2020 data is primarily based on continuous count locations, with the reduced VMT at those locations applied to roads of that type that were not counted.

[40] Non-sampled estimates use statewide defaults based on road types. Representatives from MnDOT have noted that the defaults used for non-sampled roads have not changed over time and do not account for local conditions (e.g., streets ending in cul-de-sacs will use the same default as other neighborhood streets, despite having lower traffic). Therefore, for cities with large percentages of non-sampled data, these estimates will not reflect the impacts of local programs or projects.

[41] VMT data for most cities appears relatively consistent from 2014 to 2016. However, some cities did see a noticeable increase or decrease in VMT due to significant changes in their centerline miles. These changes can be

MnDOT representative noted several methodological changes that may contribute to jumps or dips in citywide VMT over the study period, including:

- **Centerline miles** – The methodology for calculating centerline miles was standardized in 2010, with major changes also occurring in the 2016 dataset due to the data system replacement in 2015. Since AADT is extrapolated to all roads based on the number of centerline miles of each road type, changes in how centerline miles are calculated can have a significant impact on VMT estimates.

- **Roadway classification** – A 2014 federal ruling led to adjustments in how roadways are categorized into functional classes. This occurred in the 2016 dataset for Greater Minnesota and the 2021 dataset for the Twin Cities metropolitan area. Changes in functional class impact extrapolations of vehicle counts since AADT is calculated by functional class and then applied to all roads in that functional class. Additionally, changes in functional class will change the percent sampled over time, since the sampling requirements vary by functional class. Moving from default to measured AADT values can be a significant shift.

- **Year measured** – Since VMT estimates are based on the most recent measured data, getting new measured data for a significant percentage of the counting locations in a city may cause a jump or dip that was actually a more gradual change over time.[42]

VEHICLE TRAVEL EMISSIONS

Vehicle travel emissions account for the GHGs emitted from the tailpipes of vehicles while in use. Some vehicle types – such as battery electric, hydrogen, and some alternative fuel vehicles – do not produce tailpipe emissions. In accordance with the U.S. Community Protocol, the emissions from the electricity or fossil gas (to produce hydrogen) used for these vehicles is included within the Energy sector in the jurisdiction where the vehicle refuels or recharges. Vehicle tailpipe emissions are dependent on miles driven, fuel type, and fuel efficiency (Equation 1).

---

attributed to the different calculation methodology for centerline miles used in the replacement data system rather than changes in citywide travel patterns.

[42] MnDOT's Traffic Mapping Application shows traffic count locations, count cycle (e.g., 4 year), and sensor type (e.g., continuous vs. short-term). It also shows which year the most recent traffic count occurred and the traffic volume from that year.

Equation 1. Carbon dioxide emissions from vehicle travel [43]

$$CO_2 = \sum_{b,f} \left(\frac{VMT \times \%b}{MPG_b} \times EF_f \right)$$

for each vehicle type, b, and fuel type, f, where VMT = annual vehicle miles, %b = % of vehicle miles by vehicle type b, MPG_b *= average miles per gallon of vehicle type b, and* EF_f *= emissions factor for fuel type f*

To determine the percentage of miles traveled by different vehicle types, RII uses statewide vehicle type breakdowns by road type (Table 4). Fuel use by vehicle type is based on statewide averages for trucks and national averages for passenger vehicles (Table 5), and vehicle fuel economy is gathered using national averages reported annually by the U.S. Department of Transportation.[44]

[43] ICLEI U.S. Community Protocol, Appendix D: Transportation and Other Mobile Emission Activities and Sources, Version 1.1, July 2013, "Equation TR.1.B.2 CO2 Emissions from Passenger Vehicles."

[44] U.S. Department of Transportation Federal Highway Administration, Highway Statistics Series, Table VM-1: Annual Vehicle Distance Traveled in Miles and Related Data By Highway Category and Vehicle Type. "Light duty vehicles short WB" is used for passenger cars, "light duty vehicles long WB" is used for light trucks, and "single-unit 2-axle 6-tire or more and combination trucks" is used for heavy-duty vehicles.

Table 4. VMT breakdown by vehicle type (2019) [45]

Vehicle Type	Interstates	Other Arterials	Other
Urban			
Heavy-duty vehicles	10.70%	5.34%	5.45%
Light trucks	23.41%	27.87%	23.64%
Passenger cars	65.89%	66.80%	70.91%
Rural			
Heavy-duty vehicles	16.89%	11.66%	7.58%
Light trucks	22.17%	30.88%	30.65%
Passenger cars	60.94%	57.46%	61.77%

Table 5. Fuel used by vehicle type [46]

Vehicle Type	Diesel	Gasoline
Heavy-duty vehicles	92.2%	7.8%
Light trucks	5.0%	95.0%
Passenger cars	0.5%	99.5%

[45] Distribution of VMT by vehicle type is based on statewide averages for urban areas from the U.S. Department of Transportation Federal Highway Administration (FHWA), Highway Statistics Series, "Table VM-4: Distribution of Annual Vehicle Distance Traveled," as reported by MnDOT. Per the FHWA's definitions, cities with a population of 5,000+ use the data for urban areas, while cities smaller than 5,000 people use the data for rural areas.

Although vehicle type data is published annually, methodical shifts over time prevent this dataset from accurately reflecting changes in vehicle type breakdowns over the study period. Representatives from MnDOT have recommended using 2019 data for all years. They have also noted that the vehicle type breakdown is unlikely to change significantly from year to year, except due to major disruptions like the COVID-19 pandemic in 2020, which caused a drop in passenger vehicle traffic in comparison with service and freight traffic. Since this impact cannot be accurately quantified, it is not accounted for in RII's calculations.

City-specific VMT data is reported by Route System (e.g., 10 – Municipal Street), based on roadway ownership. Vehicle type data is reported in three categories (Interstate, Other Arterials, and Other) that correspond with Functional Class (e.g., 4 – Minor Arterial), based on the roadway's service type. While Route Systems and Functional Classes cannot be directly mapped to each other, the RII team determined that using the following assumptions are relatively accurate (discrepancies cause less than a 1% impact on travel emissions): Interstate = 01 – Interstate Trunk Highway; Other Arterials = 02 - U.S. Trunk Highway, 04 - County State-Aid Highway, 05 - Municipal State-Aid Street, and 52 - Unsigned Temp. State Owned Road; Other = all other Route Systems.

RII includes motorcycles and passenger cars in the "passenger cars" category, buses and light trucks in the "light trucks" category, and single-unit trucks and combination trucks in the "heavy-duty vehicles" category.

[46] The distribution of fuel used by passenger cars is from Oak Ridge National Laboratory's Transportation Energy Data Book: Edition 40, "Table A.1 Car Fuel Use and Fuel Type Shares for Calculation of Energy Use," which references data from Polk's 2001 National Vehicle Population Profile (NVPP) for all years included in the study period. Since RII accounts for ethanol content separately, the gasoline and gasohol numbers are combined.

The assumed distribution of fuel used by vehicle type for light and heavy trucks is from the *Minnesota: 2002 Vehicle Inventory and Use Survey*, "Table 6. Truck Miles by Vehicle Size: 2002," issued December 2004, with Medium, Light-heavy, and Heavy-heavy vehicle sizes considered to be heavy-duty vehicles.

Carbon dioxide emissions factors by fuel type are provided in the U.S. Community Protocol (Table 6). Biofuel percentages are assumed to comply with Minnesota's biofuel mandates.[47] Since these fuels are classified as biogenic, their emissions are not included in community totals.

Table 6. Carbon dioxide emissions factors by fuel type [48]

	kgCO_2/gallon
Gasoline	8.78
Diesel	10.21

Methane and nitrous oxide emissions comprise a very small fraction of total vehicle travel emissions and are estimated using per-mile emissions factors rather than per-gallon (Equation 2). Methane and nitrous oxide emissions factors are provided in the U.S. Community Protocol (Table 7).

Equation 2. Methane and nitrous oxide emissions from vehicle travel [49]

$$CH_4, N_2O = VMT \times \%b \times EF_b$$

for each vehicle type, b, where VMT = annual vehicle miles, %b = % of vehicle miles by vehicle type b, and EF_b = per-mile CH_4 and N_2O emission factors by vehicle type

Alternative fuel vehicles (electric, CNG) comprise a very small percentage of the overall vehicle fleet and their impacts have not been calculated. Since electricity used to charge electric vehicles is included within the "Energy" category, this approach results in a small amount of over-counting.

[47] Per M.S. 239.791, all gasoline sold in Minnesota must contain 10% ethanol (starting in 2003). Per M.S. 239.77, all diesel was required to be 2% biodiesel starting in 2005 and 5% starting in May 2009. Starting on July 1, 2014, diesel was required to be 10% biodiesel from April-September and 5% biodiesel in the winter months. In 2018, diesel was required to be 20% biodiesel from May-September and 5% in other months. Starting in 2019, diesel is required to be 20% biodiesel from April-September.

[48] ICLEI U.S. Community Protocol, Appendix D: Transportation and Other Mobile Emission Activities and Sources, Version 1.1, July 2013, "Table TR.1.6 CO2 Emission Factors by Transportation Fuel."

[49] ICLEI U.S. Community Protocol, Appendix D: Transportation and Other Mobile Emission Activities and Sources, Version 1.1, July 2013, "Equation TR.1.B.3 CH_4 and N_2O Emissions from Passenger Vehicles."

Table 7. Methane and nitrous oxide emissions factors by vehicle/fuel type [50]

	CH_4 (g/mi)	N_2O (g/mi)
Gasoline Passenger Cars	0.0210	0.0158
Gasoline Light Trucks	0.0246	0.0262
Gasoline Heavy Duty Vehicles	0.1142	0.0723
Diesel Passenger Cars	0.0005	0.0010
Diesel Light Trucks	0.0010	0.0015
Diesel Heavy Duty Vehicles	0.0051	0.0048

[50] ICLEI U.S. Community Protocol, Appendix D: Transportation and Other Mobile Emission Activities and Sources, Version 1.1, July 2013, "Table TR.1.4 Passenger Vehicle N2O and CH4 Emission Factors by inventory year" and "Table TR.2.2 Heavy Duty Vehicle Emission Factors." While methane and nitrous oxide emissions factors are presented as constants for diesel vehicles, ICLEI calculates year-specific factors for gasoline vehicles that reflect changes in the vehicle stock. These annual factors are built into ICLEI's ClearPath Tool and are available upon request. Since methane and nitrous oxide comprise less than 0.003% of the GHGs associated with vehicle travel, RII uses a constant – the average of 2007-2020 data – in order to simplify ongoing data collection.

WASTE

The Regional Indicators Initiative's Waste category includes metrics related to the management of mixed municipal solid waste (MMSW) generated within each city's geographic boundaries, regardless of disposal location.[51] Although municipalities often track metrics for city-sponsored garbage, recycling, and/or composting programs, counties are the primary compilers for comprehensive MMSW management data, which they provide annually to the Minnesota Pollution Control Agency (PCA). To estimate waste management amounts at the municipal level, it is assumed that on a per-capita basis, city waste will be generated and managed at the same rates as those measured for the county.[52]

RII presents MMSW generated within community boundaries broken down between three management methods: recycled (including organics recycling), landfilled, and combusted. Waste managed through on-site disposal (such as burning or burying) is assumed to be *de minimis* and is excluded from the inventory.[53]

RECYCLED WASTE

Recycled waste includes materials that are separated from mixed municipal solid waste for the purpose of recycling or composting, including paper, glass, plastics, metals, automobile oil, batteries, source-separated compostable materials, yard waste, and sole source food waste streams that are managed through biodegradative processes.[54]

The amount of recycled waste (in tons) is collected from data reported annually by counties to the PCA and shared publicly through the SCORE Report. This report only includes documented tonnages – estimated tonnages have been removed from the data and credits for yard waste and source reduction are not included. The PCA implemented hauler reporting requirements in 2016 and recycling documentation

---

[51] To avoid double counting emissions associated with waste generated by other communities, emissions from waste management facilities within community boundaries are only accounted for to the extent they serve the community. For example, emissions from the Hennepin Energy Recovery Center are distributed to each of the communities it serves, rather than accounted for entirely within Minneapolis' inventory.

[52] This will result in some inaccuracies at the city scale. For example, a city like Red Wing sends nearly all of its non-recyclable waste to be made into refuse-derived fuel rather than sending it to a landfill. However, at the County scale a larger percentage of waste is landfilled.

[53] The MPCA estimates that on-site disposal comprises around 1% of Minnesota's total MMSW managed. As shown in the 2020 SCORE Report, rates of on-site disposal vary across the state; very little is estimated within Metro area counties, but some Greater Minnesota counties are estimated at over 10%.

[54] MPCA, SCORE Report. The SCORE Report provides much more detailed information on waste streams than the Regional Indicators Initiative, including information about organics recycling, source reduction estimates, and recycling capture rates by material.

has become more comprehensive since then. However, recycling is still likely underreported.

Per the ICLEI U.S. Community Protocol, GHG emissions from recycling are not accounted for within the waste sector. As with other commercial and industrial processes, emissions from energy used at recycling facilities are included in the energy sector for the communities where they are located. Emissions from organics recycling are also not required to be accounted for as the amount of non-biogenic GHGs emitted are assumed to be negligible.

LANDFILLED WASTE

Landfilled waste includes garbage, refuse, and other solid waste from residential, commercial, industrial, and community activities that the generator of the waste aggregates for collection and is disposed of in a landfill. It includes common materials found in household and commercial garbage such as packaging materials, containers, food discards, plastic, paper, etc.[55]

The amount of landfilled waste (in short tons) is collected from the same source as other waste quantities: the MPCA's annual SCORE Report.

Landfilled waste with bio-based ingredients – like food waste, yard trimmings, paper, and wood – release methane and carbon dioxide as they degrade. The U.S. Community Protocol requires accounting for methane emissions from landfilled waste as an anthropogenic source, since these emissions would not occur during degradation occurring outside of a landfill. The carbon dioxide generated by landfilled waste is excluded, since it is considered to be part of the natural carbon cycle of growth and decomposition. Landfilled materials that do not contain bio-based ingredients – such as metals, glass, and most plastics – do not generate emissions, as they do not biodegrade in landfills.

Since many materials do not fully decompose under anaerobic conditions, some carbon remains stored in the landfill. In accordance with the U.S. Community Protocol, this stored carbon is not accounted for in the landfilled waste emissions.[56] Similarly, avoided emissions from utilizing captured landfill gas for energy is not accounted for. Although the U.S. Community Protocol includes guidance on

[55] PCA 2020. This category does not include auto hulks, street sweepings, ash, construction debris, mining waste, sludges, tree and agricultural wastes, tires, lead acid batteries, motor and vehicle fluids and filters, and other materials collected, processed, and disposed of as separate waste streams (Minn. Stat. § 115A.03, subd. 21).

[56] The EPA's WARM model accounts for carbon stored in landfills within bio-based materials as an anthropogenic sink (framed as negative emissions) since this carbon would be released under natural conditions as these materials fully biodegrade. It does not account for the storage of fossil carbon such as petroleum within plastics and rubber since this is already considered to be "stored" in its natural state.

estimating process emissions associated with landfilling (e.g., fuels used by landfill equipment) as well as collection and transportation emissions, these sources are not required and are not included in the Regional Indicators Initiative's waste category, though miles traveled by waste haulers within community boundaries is accounted for within the travel category.

As described in the U.S. Community Protocol, "Landfill emissions are unique among sources of emissions in that the emissions are generated over long periods of time from the activity that caused them. Emissions from past generation of solid waste disposed in landfills are still occurring today, and solid waste deposited in a landfill today will continue to produce emissions for many years into the future."[57] To best reflect the impacts of recent local decision-making, the U.S. Community Protocol requires that communities account for the projected future emissions associated with waste landfilled in the inventory year.[58]

Emissions from landfilled waste are dependent on the waste composition as well as the characteristics of the landfill – most notably whether a system for methane capture is in place. Default values for methane emissions by material, average methane recovery rates by material, and typical oxidation rates are provided in the EPA's WARM model (Table 8). These are combined with a statewide waste composition study from 2013 (Table 9) to generate an equation for calculating GHG emissions per short ton of landfilled waste (Table 10).[59]

[57] U.S. Community Protocol

[58] This "end-of-life" approach is in contrast both to other emissions sources inventoried – where emissions occur during the inventory year – and to the approach used in Minnesota's GHG Inventory which looks instead at landfill emissions during the inventory year.

[59] Statewide waste composition studies were conducted in 2000 and 2013. With the Regional Indicators Initiative study years starting in 2007, the 2013 data was judged to be appropriate to use for all study years. Emissions rates decreased by about 10% from 2000 to 2013 due to a decrease in bio-based content being landfilled.

Table 8. Emissions rates for landfilled waste [60]

Material	Methane emissions rate [61]	Methane recovery rate [62]
Corrugated Containers	0.1048	56%
Magazines/ Third-Class Mail	0.0476	54%
Newspaper	0.0420	59%
Office Paper	0.1556	59%
Food Waste	0.0648	52%
Grass	0.0228	41%
Leaves	0.0260	49%
Branches	0.0580	54%
Dimensional Lumber	0.0068	58%

Table 9. Minnesota Waste Composition

Material [63]	2000 [64]	2013 [65]
Corrugated Containers	24.6%	21.2%
Magazines/ Third-Class Mail	2.5%	0.7%
Newspaper	4.1%	1.5%
Office Paper	3.1%	1.1%
Food Waste	14.5%	17.8%
Grass	1.1%	1.4%
Leaves	1.1%	1.4%
Branches	1.6%	4.7%
Dimensional Lumber	7.5%	5.7%
Total Bio-Based Content	**60.0%**	**55.5%**

[60] WARM U.S. Environmental Protection Agency Office of Resource Conservation and Recovery and ICF, Documentation for Greenhouse Gas Emission and Energy Factors Used in the Waste Reduction Model (WARM), Management Practices Chapters, WARM Version 15, November 2020.

[61] In tonnes of methane per short ton of landfilled waste. Methane emissions rates in CO2e are provided in "Exhibit 6-7: CH4 Yield for Solid Waste Components," assuming a global warming potential of 25.

[62] Average methane recovery rates for landfills with methane recovery systems are provided in "Exhibit 6-11: Waste Component-Specific Collection Efficiencies by Landfill Moisture Condition with Landfill Gas Recovery for Energy." The "Typical Landfill Scenario" is used for the landfill gas collection assumptions and the "National Average" is used for the moisture conditions of the landfill/decay rate.

[63] Since only bio-based materials generate emissions when landfilled, these are the only materials included here, which is why the categories don't add up to 100%.

The material categorizations in the statewide waste composition studies do not align directly with the categories available in the EPA's WARM model. The following assumptions were used to achieve alignment: the Corrugated Containers category includes all paper-based materials not explicitly covered in another category, since the Mixed Paper emissions factor in WARM v15 is closer to Corrugated Containers than any other paper category. Newspaper

Table 10. Methane emissions rates (tonnes CO_2e per short ton of landfilled waste) [66]

Year	Methane Recovery?	Emissions rate
2000	No	1.009
2000	Yes	0.400
2013	No	0.905
2013	Yes	0.364

Equation 3. Landfilled Waste Emissions Rate

GHG Emissions Rate (tonnes of CO2e per short ton of landfilled waste) = -0.905x + 0.905

*x = Methane Recovery Factor = 0.5974 * % of waste sent to landfills with methane recovery*

Of the 21 open landfills in Minnesota that accept MMSW, the MPCA reports that twelve do not have active gas capture (Table 11).

includes Newsprint and Phone Books. For 2000, Food Waste includes Diapers. The waste composition studies report a combined number for Grass and Leaves. This is split evenly between the two categories here. Other Organic Material is included in the Branches category, since the Mixed Organics emissions factor in WARM v15 is closer to this than any other organics category. For 2000, Dimensional Lumber includes Wood Pallets, Treated Wood, and Untreated Wood. For 2013, it includes Wood.

[64] Minnesota Pollution Control Agency Solid Waste Management Coordinating Board, Final Report: Statewide MSW Composition Study: A Study of Discards in the State of Minnesota, March 2000, "Detailed Table 1-7 Minnesota Statewide Aggregate Composition (By Weight)."

[65] Minnesota Pollution Control Agency and Burns & McDonnell, Final Report: 2013 Statewide Waste Characterization, December 2013, "Table 4-5: Minnesota Statewide Aggregate Composition (By Weight)."

[66] Emissions rates are calculated based on waste composition, material-specific methane emissions rates and methane recovery rates, and the oxidation rate – reflecting the amount of methane that is oxidized to carbon dioxide as it passes through the landfill cover. The WARM v15 documentation includes EPA's recommendations for methane oxidation rates at various stages of landfill gas collection; 10% is used for landfills without gas collection or final cover and 20% for landfills with gas collection before final cover.

Table 11. Open Minnesota landfills without active methane capture [67]

Facility	Permit Number
Brown	SW-89
Cottonwood	SW-143
Greater Morrison	SW-15
Kandiyohi	SW-79
MarKit	SW-92
Nobles	SW-11
Olmsted	SW-355
Polk	SW-124
Renville	SW-90
Rice	SW-123
St. Louis[68]	SW-405
Steele	SW-131

Additionally, some Minnesota waste is delivered to landfills in neighboring states that do not have methane recovery (see Appendix I – Waste Management Facilities). For metro area counties, the percentage of a county's waste sent to landfills with methane recovery is calculated based on information provided on their Metropolitan County Annual MSW Data Reports, obtained through an information request to the MPCA. These reports document the tonnage of the county's waste sent to each landfill. Counties in Greater Minnesota are not required to submit these reports. For these counties, information on the total waste landfilled at each landfill is combined with information on the percentage of each landfill's waste attributed to different counties. These data sources were also obtained through a data request to the MPCA.

COMBUSTED WASTE

Combusted waste includes garbage, refuse, and other solid waste from residential, commercial, industrial, and community activities that the generator of the waste aggregates for collection and is combusted at a waste-to-energy (WTE) facility. It includes common materials found in household and commercial garbage such as packaging materials, containers, food discards, plastic, paper, etc.[69]

[67] MPCA, provided July 2021 in response to a data request by LHB.

[68] St. Louis County Regional Landfill added an active methane capture system in 2018.

[69] PCA 2020. This category does not include auto hulks, street sweepings, ash, construction debris, mining waste, sludges, tree and agricultural wastes, tires, lead acid batteries, motor and vehicle fluids and filters, and other materials collected, processed, and disposed of as separate waste streams (Minn. Stat. § 115A.03, subd. 21).

There are two primary types of WTE facilities in Minnesota: (1) mass burn and (2) refuse-derived fuel (RDF). Mass burn facilities combust MMSW to generate steam that can be used by local businesses or to generate electricity. RDF facilities process MMSW into a more uniform fuel with a higher heating value. This RDF can then be combusted to generate electricity. In some cases, RDF is created and combusted in the same facility, while in others RDF is created in one location and then transported elsewhere to be used for electricity generation. See Appendix I – Waste Management Facilities for a list of facilities in Minnesota and their outputs.

The amount of combusted waste (in short tons) is collected from the same source as other waste quantities: the MPCA's annual SCORE Report. For metro area counties, the amount of waste sent to each WTE facility is calculated using the Metropolitan County Annual MSW Data Reports, obtained through an information request to the MPCA. These reports document the tonnage of the county's waste sent to each facility. Counties in Greater Minnesota are not required to submit these reports. For these counties, combusted waste destinations are based on facility waste sheds.[70]

Combusting waste generates carbon dioxide, nitrous oxide, and methane emissions. The carbon dioxide emissions from bio-based ingredients – like food waste, paper, and wood – are excluded from the inventory, since these emissions are intended to be accounted for within the agriculture/forestry/land use sector (which are typically only included in larger scale inventories). However, all other GHG emissions from combusted waste are anthropogenic and are included in the inventory, along with emissions from auxiliary fuels (e.g., fossil gas) used at the facility.

Most mass burn facilities report their GHG emissions to the EPA, based either on continuous emission monitors or an emissions factor.[71] Quarterly stack sampling and radiocarbon analysis is used to determine the percentage of carbon dioxide that is biologic. This information is combined with the total waste processed – provided by the MPCA – to calculate emissions per ton of waste.[72] Upon ICLEI's recommendation, emissions factors from the mass burn facilities are used as a proxy for RDF facilities as well.[73]

---

[70] Minnesota Resource Recovery Association, "Counties and Minnesota Waste Combustion Facilities," (2016).

[71] EPA FLIGHT.

[72] Total waste processed is from MPCA's incinerator data, accessed by downloading the SCORE Report Tableau Workbook. Includes all waste "Combusted" or "Processed on Site," but excludes "Bypassed" (e.g., non-processible items, residuals from processing line).

[73] Eli Yewdall & Mike Steinhoff, ICLEI-USA, "Minnesota Regional Indicators Initiative Peer Review," (June 2017).

Although electricity generating facilities that combust RDF do typically report their GHG emissions to the EPA, these emissions are more difficult to associate with the correct tonnage of waste disposed. The composition of waste is more impactful to GHG emissions than its energy density; a ton of plastic emits the same amount of carbon dioxide

WASTE VERSUS ENERGY EMISSIONS

Unlike other inventory protocols – such as the Global Protocol for Communities – the U.S. Community Protocol requires accounting for WTE emissions within the waste sector rather than in the energy sector.

Combusted Waste-to-Energy

Combusted MMSW is used to generate two forms of energy: steam and electricity. Steam generated at mass burn facilities is typically distributed to local businesses through district energy systems. This energy use is not reported within the energy sector, and associated emissions are fully included within the waste sector.

Excess steam from mass burn facilities may also be used to generate electricity that is either used on site or sold to an electric utility provider. Electricity that is both generated and used on site is not reported within the energy sector, and associated emissions are fully included within the waste sector. Electricity sold to utility providers becomes indistinguishable from other sources; this energy use gets reported in the energy sector and the emissions are incorporated into utility emissions factors. Similarly, both emissions and energy use from RDF-generated electricity are accounted for in the energy sector. This approach is summarized in Table 12.

Table 12. Accounting protocol for energy generated from combusting MMSW

Facility Type	Energy Type	GHG Accounting
Mass Burn	Steam	Waste
	Electricity (used on-site)	Waste
	Electricity (supplied to grid)	Waste and Energy
RDF	Electricity (supplied to grid)	Waste and Energy

As acknowledged in the U.S. Community Protocol, this approach may result in a small amount of emissions being double-counted. For context, approximately 1% of Xcel Energy's emissions from electricity generation for Midwest customers are estimated to be from combusting RDF.[74]

Emissions from WTE facilities include the impacts of auxiliary fuels such as fossil gas. To avoid double-counting, this fuel use and associated emissions is not included in

whether it is burned with mixed MSW or as part of a refined fuel. ICLEI notes that "while some differences may occur for N2O and CH4 due to higher temperature combustion in an RDF facility, these may be minor considerations" given other uncertainties in the data.

[74] Calculated by LHB from information provided in Xcel Energy's Environmental Disclosure Brochures for 2008-2020, filed through Docket Nos. E,G999/CI-00-1343 & E999/CI-01-1127.

the energy sector for the community the facility is in (Appendix G – Avoiding Double Counting).

Landfill Gas

Several of Minnesota's landfills use captured methane as an energy source: combusting it for heating or process loads, using it to generate electricity that is used on-site or sold to local electric utilities, or compressing it to be used in place of fossil gas in buildings or vehicles. The use of landfill gas is assumed to have a relatively small impact and is not directly tracked within RII. Table 13 includes additional detail.

Table 13. Accounting for energy captured from landfill gas

Use Type	User	GHG Accounting
Direct use	On-site	None
	Off-site	None
Electricity generation	On-site	None
	Off-site (supplied to grid)	Energy
Renewable gas	On-site	None
	Off-site (vehicle fuel)	Travel emissions not adjusted based on landfill gas content.
	Off-site (supplied to power generator)	Energy – may not be accounted for separately than fossil gas in emissions factor calculations
	Off-site (supplied to pipeline)	Fossil gas emissions not adjusted based on landfill gas content

APPENDIX A – GHG INVENTORY SCOPING

Adapted from ICLEI's U.S. Community Protocol Scoping and Reporting Tool

Table A-1. GHG inventory scoping for RII

Emissions Type		Source or Activity?	Included ● = required	Excluded	Notes
Built Environment					
Use of fuel in residential and commercial stationary combustion equipment		Source AND Activity	●		Community-wide natural gas data is provided by utilities, broken out between residential and non-residential uses. Other stationary combustion fuels (e.g., LPG, fuel oil, coal, wood) used in homes is estimated based on U.S. Census data, even when only a small percentage of a community's total. Non-utility fuels used in businesses is only known for permitted facilities, through annual reporting to the MPCA. These are included when they comprise 5% or more of the community's total energy consumption.
Industrial stationary combustion sources		Source			For most communities, non-residential natural gas data includes industrial uses. However, for some communities, data for one or more industrial users is excluded by the utility to protect customer privacy. Non-utility fuels used in industrial settings for permitted facilities is included when they comprise 5% or more of the community's total energy consumption.
Electricity	Power generation in the community	Source		Not Occurring/ Included Elsewhere	Several RII communities host power plants. The emissions from these facilities are accounted for within electricity emissions factors, meaning they get assigned to each of the communities that are served by the power plant based on their electricity use. To avoid double-counting, the energy used to generate electricity is excluded from the stationary combustion totals for its host community.
	Use of electricity by the community	Activity	●		Community-wide electricity data is provided by utilities, broken out between residential and non-residential uses. Emissions are assigned based on utility-specific emissions factors (when available) or regional averages.
District Heating/ Cooling	District heating/cooling facilities in the community	Source		Not Occurring/ Included Elsewhere	Several RII communities have district energy systems - typically operated by either the municipality or a commercial or institutional campus - that provide heating and cooling for buildings within the community. Emissions from these systems are included within the stationary combustion and electricity categories since they typically use utility natural gas and electricity and/or non-utility fuels

Emissions Type		Source or Activity?	Included ● = required	Excluded	Notes
					(which get reported as a permitted facility) to generate and distribute thermal energy.
	Use of district heating/cooling by the community	Activity		Not Occurring/ Included Elsewhere	See above.
Industrial process emissions in the community		Source		Not Occurring/Not Estimated	Some RII communities host industries that generate process emissions. Many facilities emitting more than 25,000 tonnes of CO2e are required to report their emissions to EPA under its Mandatory Reporting Rule (MRR), which can be viewed via EPA's FLIGHT dashboard. These emissions sources have not been quantified for RII communities.
Refrigerant leakage in the community		Source		Not Estimated	All RII communities generate emissions due to the leakage of refrigerants and fire suppressants from thousands of individual applications. These emissions have not been quantified.
Transportation and Other Mobile Sources					
On-road Passenger Vehicles	On-road passenger vehicles operating within the community boundary	Source	●		On-road vehicle miles traveled within community boundaries are reported through MnDOT, and their associated emissions are calculated for RII communities. This is not separated out between passenger, freight, and transit vehicles. Using this methodology causes disproportionately high travel emissions for small communities with heavy arterial traffic and unrealistically low travel emissions for communities that are the origin or destination of long commutes. As such, it does not fully reflect the impact of community-specific travel and land use planning and decisions.
	On-road passenger vehicle travel associated with community land uses	Activity		Not Estimated	Travel emissions are estimated using an in-boundary method rather than an origin-destination model. See above.
On-road Freight Vehicles	On-road freight and service vehicles operating within the community boundary	Source	●		See On-road Passenger Vehicles above.
	On-road freight and service vehicle travel associated with community land uses	Activity		Not Estimated	See On-road Passenger Vehicles above.

Emissions Type		Source or Activity?	Included ● = required	Excluded	Notes
On-road transit vehicles operating within the community boundary		Source		Not Occurring/ Included Elsewhere	On-road transit vehicles operating within the community boundary are included in the on-road vehicle totals.
Transit Rail	Transit rail vehicles operating within the community boundary	Source		Not Occurring/Not Estimated/ Included Elsewhere	Emissions from the Northstar Commuter Rail Line operating in downtown Minneapolis and the northwest suburbs are excluded from these communities as *de minimis*. The electricity emissions associated with light rail transit (LRT) operations within the Twin Cities metropolitan region are included within the commercial/industrial electricity values.
	Use of transit rail travel by the community	Activity		Not Occurring/Not Estimated	Emissions from Northstar passengers is excluded as *de minimis*. Emissions from LRT passengers are included in the commercial/industrial electricity values for the community in which they occur and are not assigned based on passenger origin or destination.
Inter-city passenger rail vehicles operating within the community boundary		Source		Not Occurring/Not Estimated	Passenger rail vehicles pass through several RII communities twice daily. This source has been excluded as *de minimis*.
Freight rail vehicles operating within the community boundary		Source		Not Occurring/Not Estimated	While freight rail operations occur in some RII communities, this source has been excluded as *de minimis*. Rail operations is estimated to comprise 1% of the community total for Duluth - the RII community with the most freight rail operations - according to the City's 2008 GHG Inventory.
Marine	Marine vessels operating within the community boundary	Source		Not Occurring/Not Estimated	Marine freight occurs within several RII communities located on the Mississippi River or Lake Superior. Duluth's 2008 GHG Inventory estimated the GHG emissions for marine operations as 0.3% of the community total. Additionally, recreational boats are used within many RII communities. These sources have been excluded as *de minimis*.
	Use of ferries by the community	Activity		Not Occurring/Not Estimated	There is a small amount a ferry/cruise operations serving communities located on the Mississippi River or Lake Superior. These sources have been excluded as *de minimis*.
Off-road surface vehicles and other mobile equipment operating within the community boundary		Source		Not Estimated	Every RII community includes emissions from off-road vehicles and/or mobile equipment used for agriculture, construction, industrial processes, property maintenance, and recreation. These sources are excluded as *de minimis*.

Emissions Type		Source or Activity?	Included ● = required	Excluded	Notes
Use of air travel by the community		Activity		Not Estimated	Emissions from air travel are not included. Past estimates of air travel emissions for RII cities range from 1-10% of community totals.
Solid Waste					
Solid Waste	Operation of solid waste disposal facilities in the community	Source		Not Occurring/ Included Elsewhere	Several RII communities host a waste-to-energy facility and/or landfill. The emissions from these sources are assigned to the waste's origin communities based on their percentage of the total waste managed.
	Generation and disposal of solid waste by the community	Activity	●		Emissions from municipal solid waste managed via landfills and waste-to-energy facilities (regardless of location) are included for RII communities based on per capita county-wide data.
Water and Wastewater					
Potable Water - Energy Use	Operation of water delivery facilities in the community	Source		Included Elsewhere	The energy used to operate potable water facilities within the community is accounted for within the electricity and stationary combustion categories.
	Use of energy associated with use of potable water by the community	Activity	●	Not Estimated	The energy used to treat and distribute potable water is accounted for within the energy sector for the community in which it occurs, which may not precisely align with the communities in which the potable water is used.
Use of energy associated with generation of wastewater by the community		Activity	●	Included Elsewhere/Not Estimated	The energy used to operate wastewater facilities within the community is accounted for within the electricity and stationary combustion categories. In some communities, this represents community-wide wastewater energy, while for others it does not (e.g., for wastewater plants serving multiple communities and those located outside of community boundaries).
Centralized Wastewater Systems - Process Emissions	Process emissions from operation of wastewater treatment facilities located in the community	Source		Not Estimated	Process emissions from wastewater treatment are not accounted for.
	Process emissions associated with generation of wastewater by the community	Activity		Not Estimated	Process emissions from wastewater treatment are not accounted for.
Use of septic systems in the community		Source AND activity		Not Estimated	Emissions from septic systems are not accounted for.

Emissions Type	Source or Activity?	Included ● = required	Excluded	Notes
Agriculture				
Domesticated animal production	Source		Not Estimated	RII does not account for agricultural emissions. Though agriculture is a significant source of emissions statewide, there are relatively few agricultural activities occurring within RII community boundaries.
Manure decomposition and treatment	Source		Not Estimated	RII does not account for agricultural emissions. Though agriculture is a significant source of emissions statewide, there are relatively few agricultural activities occurring within RII community boundaries.
Upstream Impacts of Community-Wide Activities				
Upstream impacts of fuels used in stationary applications by the community	Activity		Not Estimated	RII does not estimate upstream impacts.
Upstream and transmission and distribution (T&D) impacts of purchased electricity used by the community	Activity		Not Estimated	RII does not estimate upstream impacts.
Upstream impacts of fuels used for transportation in trips associated with the community	Activity		Not Estimated	RII does not estimate upstream impacts.
Upstream impacts of fuels used by water and wastewater facilities for water used and wastewater generated within the community boundary	Activity		Not Estimated	RII does not estimate upstream impacts.
Upstream impacts of select materials (concrete, food, paper, carpets, etc.) used by the whole community	Activity		Not Estimated	RII does not estimate upstream impacts.
Independent Consumption-Based Accounting				
Household Consumption (e.g., gas & electricity, transportation, and the purchase of all other food, goods and services by all households in the community)	Activity		Not Estimated	RII does not include consumption-based accounting.
Government Consumption (e.g., gas & electricity, transportation, and the purchase of all other food, goods and services by all governments in the community)	Activity		Not Estimated	RII does not include consumption-based accounting.
Life cycle emissions of community businesses (e.g., gas & electricity, transportation, and the purchase of all other	Activity		Not Estimated	RII does not include consumption-based accounting.

Emissions Type	Source or Activity?	Included ● = required	Excluded	Notes
food, goods and services by all businesses in the community)				
Forests and Trees Outside of Forests				
Emissions and Removals from Forest Land	Source		Not Estimated	RII does not include land-based accounting.
Emissions and Removals from Trees Outside of Forests	Source		Not Estimated	RII does not include land-based accounting.
Other (not covered in U.S. Community Protocol)				
Land Use and Land Use Change	Source		Not Estimated	RII does not include land-based accounting.
Other Land-Based Sources	Source		Not Estimated	RII does not include land-based accounting.

APPENDIX B – DATA INPUTS

Table B-1. Annual data inputs

Data	Source	Availability Timeline[i]
Demographics		
Population	MN Demographic Center	7 months
Households	MN Demographic Center	7 months
Jobs	MN DEED - QCEW	3 months
Primary household heating fuel breakdown*	U.S. Census (ACS)	13 months
Energy		
Electricity use	Form EIA-861 MN Rule 7610 Utilities	10 months 7 months 1-6 months[ii]
Gas use	Form EIA-176 MN Rule 7610 Utilities	9 months 7 months 1-6 months[iii]
Non-utility fuel use: Commercial/Industrial	MPCA	4 months
Electricity emissions factors: Utility-specific*	Utilities	Varies – often released as preliminary before 3rd party review
Electricity emissions factors: Regional average*	EPA eGRID	13-15 months
Water		
Water use	MN DNR	unknown
Travel		
Vehicle miles traveled	MNDOT	6 months
Vehicle fuel economy*	USDOT FHWA	12-15 months
Waste		
Municipal solid waste	MPCA	15 months
Waste-to-energy facility emissions factors	EPA FLIGHT WTE facilities	8 months Varies

* to provide timely data to Minnesota communities, RII uses the previous year's values as a placeholder for several of the datapoints until the study year's data becomes available.

Placeholder Data

To provide timely information to Minnesota communities, placeholder data is used for certain datapoints (specified in Table B-1) when year-specific data is not yet available. In these situations, the previous year's data is used as a placeholder, and is updated when year-specific data becomes available. While this document will not be updated to list the placeholder data currently in use, it is safe to assume that placeholders are used for RII values published before the timelines shown in the table.

The use of these placeholders has historically had less than a 5% impact on community-wide emissions, though it is possible for larger impacts – especially if electricity emissions factors change significantly from one year to the next.

Data Updates

Several of the data sources update previous years of data as their methodologies evolve and/or to correct errors. To ensure consistency over time, RII incorporates these updates when they are discovered. Similarly, as RII's methodology evolves, updates are applied consistently to all cities and years. This approach results in periodic changes to the RII metrics from previously published values. Updates are tracked by the RII team, along with their estimated impact on the published values.

---

[i] The availability timeline shows how long it typically takes for each data point to become available after the end of the calendar year being studied.

[ii] Xcel publishes their Community Energy Reports on June 1 each year.

[iii] Xcel publishes their Community Energy Reports on June 1 each year.

APPENDIX C – INVENTORY COMPARISON

Minnesota communities have access to several other sources of GHG inventories in addition to the Regional Indicators Initiative, such as:

- Community-specific inventories created by individual communities, with or without the assistance of a consultant,
- Community inventories developed by the Metropolitan Council for cities and townships in the Twin Cities metropolitan region (Metro Climate Stats),
- The statewide inventories developed by the Minnesota Pollution Control Agency.

The RII team compared the methodologies and data from RII, Metro Climate Stats, and Minnesota's statewide inventory to help local governments understand the similarities and differences between these three programs. This comparison was conducted between March 2022 and June 2023, reflecting the data and methodological descriptions available from each program during that time period. In addition to utilizing publicly-available information from program websites, this process included discussions with technical experts from each program as well as access to some of the unpublished data used to generate the final results.

METRO CLIMATE STATS

The Metropolitan Council has calculated sector-based community greenhouse gas emissions for the cities and townships within the Twin Cities metropolitan region and reports these metrics through an online platform.[i] While there are several similarities between the Metropolitan Council's inventories and RII's, there are also several key differences in how they approach allocating emissions to specific communities. These differences enable the two programs to provide complementary insights for communities that are served by both, but prevent results from being directly comparable or interchangeable. In general:

- **Energy use and emissions data is relatively consistent** between the two programs, though currently only available for the residential sector for Metro Climate Stats.
- **Vehicle emissions are not comparable** between the two programs due to methodological differences in how trips are allocated to communities and how emissions factors are calculated.
- **Waste emissions are not comparable** between the two programs due to methodological differences in how emissions are allocated to a specific inventory year (since landfilled waste generates emissions over time as materials decay), how waste-to-energy emissions are accounted for, and how waste is allocated to communities.

These differences do not result in one program being more accurate than the other, but rather represent slightly different approaches to community-scale GHG inventories. Metro Climate Stats is more closely aligned with the Global Protocol for Community-Scale Greenhouse Gas Inventories (GPC), which is intended to help cities around the world develop comprehensive and robust GHG inventories that can be aggregated at subnational and national levels.[ii] In contrast, RII uses ICLEI's U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, which is specific to the needs and data availability of U.S. local governments and prioritizes inventory relevance for local decision making.[iii]

Each of these approaches provides valuable insights into community emissions. But due to their differences, it is important to be consistent when making comparisons between different communities or inventory years. For example, it would not be appropriate to use one program to establish reduction goals from a baseline year and then use the other program to track progress toward these goals. Similarly, a community included in just one of the programs should not compare its emissions to communities tracked in the other program.

The following sections provide more detail on the similarities and differences between RII and Metro Climate Stats for each sector.

Energy

In general, Metro Climate Stats and RII use consistent data sources and methodologies for determining community-wide energy use and emissions. The primary differences between the two programs include:

- The sectors included – residential for MCS vs. residential and commercial/industrial for RII.
- The use of utility-specific emissions factors vs. regional averages – MCS uses utility-specific factors for Xcel Energy; RII uses them for Xcel Energy, Minnesota Power, and Great River Energy.
- The methodology and/or data sources for estimating residential other fuel use, though this has a minor impact on community totals.

Travel

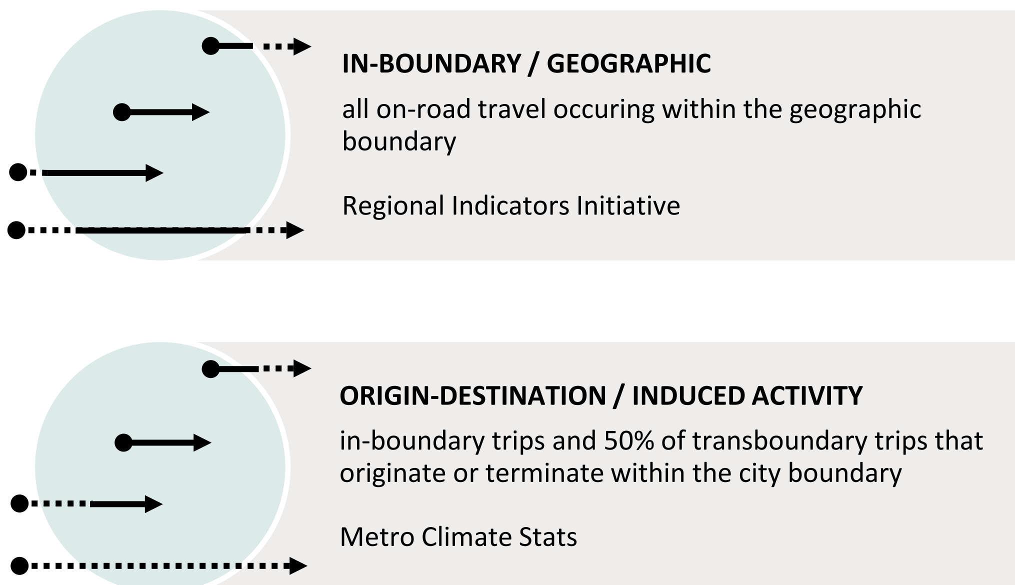
Both Metro Climate Stats and RII use ICLEI's U.S. Community Protocol for estimating emissions from vehicle travel. However, Metro Climate Stats uses the Recommended (origin-destination) method, while RII uses the Alternative (in-boundary) method.

- Metro Climate Stats uses data from location-based services to estimate vehicle miles traveled (VMT) from trips starting or ending in each community. This accounts for the travel of people living in, working in, or visiting the community – regardless of which communities these trips pass through.

- RII uses VMT estimates reported by the Minnesota Department of Transportation to account for vehicle travel occurring within community boundaries – regardless of where each trip starts or ends.

The method used by RII results in higher emissions than the method used by Metro Climate Stats for communities with a high proportion of pass-through traffic and lower emissions for communities with long commutes for employees and/or residents.

Figure C-1. Vehicle miles traveled methodology comparison



Additionally, RII and Metro Climate Stats use inputs from different sources to estimate emissions from vehicle travel, which requires assumptions related to vehicle type, fuel use, and fuel emissions factors. For 2018, this results in the average emissions factor for RII cities in the metro region to be 434 gCO_2e per vehicle mile traveled for RII and 399 gCO_2e per vehicle mile traveled for Metro Climate Stats.

Each of these methodological approaches provides insight into community-wide emissions, with RII’s in-boundary method more accurately reflecting the emissions occurring within the community’s geographic boundaries and Metro Climate Stats’ origin-destination method more accurately reflecting the emissions that can be impacted by community-scale action. However, due to the methodological differences, the travel emissions inventories done through these two programs are not directly comparable or interchangeable.

Waste

To calculate waste emissions the Regional Indicators Initiative follows the U.S. Community Protocol while Metro Climate Stats follows the Global Protocol for Communities. This causes two key differences:

1. Emissions from landfilled waste occur over many years as the materials break down. Using what is known as the methane commitment method, RII accounts for future emissions from waste landfilled during the inventory year. Metro Climate Stats uses the first order of decay method to account for emissions during the inventory year – which is primarily caused by waste landfilled in previous years.
2. RII accounts for waste-to-energy emissions in the waste sector while Metro Climate Stats accounts for it in the energy sector.

In addition, RII estimates city waste data based on countywide rates while Metro Climate Stats calculates community-specific waste data based on waste hauler reports.

Each of these methodological approaches is useful, with RII's method more accurately reflecting the long-term impacts of community actions during the inventory year and Metro Climate Stats' method more accurately reflecting the emissions that occur during the inventory year. However, due to the methodological differences, the waste emissions inventories done through these two programs are not directly comparable or interchangeable.

MINNESOTA GHG INVENTORY[iv]

In order to track progress toward Minnesota's GHG reduction goals the State of Minnesota calculates annual, statewide GHG emissions and shares the results through an interactive dashboard and biennial reports.[v] This effort is led by the Minnesota Pollution Control Agency (MPCA) with support from the Minnesota Department of Commerce and is referred to here as the MPCA statewide inventory.

While the MPCA statewide inventory does have similarities to RII's inventories in terms of scope, methodology, and data sources, there are also key differences between the two programs that reflect their unique purpose and scale. The MPCA statewide inventory is intended to both "provide timely reports on progress toward goals" and "support analysis and answer policy questions with confidence, credibility, and transparency."[vi] To this end, it includes as many emissions sources as feasible within the limitations of scientific knowledge, protocol development, and data availability.

While RII also enables communities to track progress toward goals and inform the development of policies and programs, it focuses on the five Basic Emissions

Generating Activities defined by the U.S. Community Protocol.[vii] These Activities are prioritized because they are the main contributors to emissions within communities and they can be influenced by community action. However, there are other sources of emissions – both within communities and in other areas of the state – that are not included in the RII inventories.

In addition to the difference in scope, the MPCA and RII inventories use different data sources based on availability at the state scale versus the community scale. In some cases – such as when the MPCA uses top-down data and RII uses bottom-up data – it may be useful to cross-reference these data sources to validate the results and identify potential gaps. In other cases – such as calculating emissions from vehicle travel – it may be possible to more closely align the data used in the future.

Due to the methodological differences, it is not valid to directly compare total emissions – such as claiming that an RII community represents X% of the state's total emissions. However, these types of comparisons may be possible for individual sectors after additional analysis confirms the consistency of the different data sources being used. For example, it may be acceptable to note that an RII community uses X% more residential energy per household than the statewide average. A detailed comparison by category is provided below; in summary:

- **Energy emissions use a similar approach** between the two inventories, but additional analysis is needed to determine data consistency.
- **Transportation emissions are not comparable** between the two inventories due to major differences in data sources, but have the potential to be more closely aligned in the future.
- **Waste emissions are not comparable** between the two inventories due to major methodological differences rooted in the guiding protocols.
- **Other emissions sources** that are accounted for within the MPCA statewide inventory (but not RII) can inform local goals, action, and the ongoing evolution of the RII methodology, but may not be directly translatable to the community scale.

Energy

RII uses the same approach to energy emissions as the MPCA statewide inventory – including both stationary fuel combustion within the jurisdiction and emissions from electricity consumed within the jurisdiction – regardless of where the generation occurs. However, there are some key differences between the two inventories:

1. *Sector breakdown*

   While RII reports a combined number for emissions from energy used in the built environment, the MPCA statewide inventory divides these emissions between the electricity generation, industrial, commercial, and residential sectors.[viii] This distinction reflects the meaningful spheres of influence at the local versus state scale and has the effect of emphasizing the importance of building energy efficiency for RII communities versus emphasizing clean electricity generation – along with other sectors like transportation and agriculture – for the state.

2. *Data sources*

For electricity, the MPCA statewide inventory calculates direct emissions – also known as Scope 1 – from in-state generation based on fuel use data from electricity generation facilities.[ix] Since most communities do not generate their own electricity, RII collects community-scale electricity use data and calculates indirect emissions – also known as Scope 2 – using 1) emissions factors reported by electric utilities, 2) calculated emissions factors based on each utility's unique mix of energy sources, or 3) regional average emissions factors (when utility-specific data is unavailable). While the approach used by RII should achieve similar results as MPCA's, additional analysis is needed to confirm this.

For fossil gas, the MPCA statewide inventory uses aggregated statewide data reported through the U.S. EIA while RII uses aggregated community-scale data provided by gas utilities. These two approaches should achieve similar results, but additional analysis is needed to confirm this.

Data privacy considerations for both electricity and fossil gas impact the RII dataset but not the MPCA dataset. Due to the risk of revealing the approximate energy use of large users, these users are sometimes excluded from the community-scale data provided by utilities to RII but are not excluded from the statewide data used for the MPCA inventory.[x]

3. *Non-utility fuels*

The MPCA statewide inventory uses a top-down approach for non-utility fuels (such as fuel oil and propane), using statewide total fuel sales reported to the U.S. EIA by companies that sell these fuels. RII uses a bottom-up approach, estimating residential fuel use based on the percentage of households in each community using these fuels, and including facility-level commercial/industrial fuel use reported to the MPCA by permitted facilities.

Statewide, MPCA reports that over 20% of residential stationary combustion emissions are from non-utility fuels, while this number is about 4% for RII cities. This difference may be partially due to the methodological differences, but also likely reflects that RII cities – which are typically more densely developed areas – are more likely to be connected to fossil gas than other areas of the state.

There is a larger discrepancy for commercial/industrial non-utility fuel use, which comprises 50% of stationary combustion emissions statewide (per the MPCA statewide inventory), but less than 1% for RII cities. This is likely due to a combination of large fuel oil users being located outside of RII cities as well as the bottom-up approach missing data from organizations not covered by the permitted facilities dataset.

The approaches used by RII and the MPCA to calculate electricity and fossil gas emissions are likely similar enough to enable cross-references between the datasets. For example, analyzing the electricity emissions factors from each inventory could help validate the data and improve each methodology. Similarly, RII communities may be able to compare their average household energy use data to a statewide average from the MPCA. However, additional data validation is needed before cross-referencing data for non-utility fuels or making claims such as "Community A represents X% of the state's total energy emissions."

Travel

RII uses the same in-boundary/geographic approach to vehicle transportation emissions as the MPCA statewide inventory – accounting for emissions that occur on roads within the jurisdiction regardless of where trips start and end or where fuel is purchased. It also uses the same data source for vehicle miles traveled. However, there are several differences between the two inventories:

1. *Vehicle emissions factors*

   RII and MPCA use different approaches and data sources to estimate emissions from on-road vehicle travel, which requires assumptions related to vehicle type, fuel use, and fuel emissions factors. While RII uses a combination of statewide and national averages for these inputs, MPCA uses the U.S. EPA's MOVES model, which accounts for Minnesota-specific vehicle characteristics, vehicle speeds, operating parameters, fuel parameters, and weather. In 2020, the on-road, tailpipe emissions per vehicle mile traveled calculated from RII data was 13% lower than the emissions per mile calculated from the MPCA data – which likely reflects both the differing data sources and the additional heavy truck transportation that occurs outside of RII city boundaries.

2. *Non-road transportation emissions*

   While RII's travel emissions are limited to the tailpipe emissions from on-road vehicles (per the U.S. Community Protocol), MPCA's transportation emissions also includes aviation (based on jet fuel loaded onto aircraft at Minnesota airports), fossil gas transmission leaks, mobile air conditioning, off-highway vehicles and equipment, railroad, and marine emissions. These sources accounted for 24% of the state's overall transportation emissions in 2020. Much – but not all – of these emissions occur outside of city boundaries.

While RII's and MPCA's approaches to calculating transportation emissions each meet the needs of the communities served, the results are not directly comparable between the two inventories.

Waste

In accordance with the guiding protocols, there are key differences in how waste emissions are calculated for RII versus the MPCA statewide inventory:

1. *Waste scope*

   RII only accounts for emissions from mixed municipal solid waste (MMSW) management while the MPCA accounts for emissions from MMSW landfills, industrial landfills, landfill flares, MMSW and yard waste composting, rural open burning, waste incineration, and wastewater treatment. Statewide, MMSW landfills represented about 75% of total waste emissions in 2020.

   The MPCA statewide inventory also accounts for biogenic carbon stored permanently within demolition and construction landfills, which represents significant carbon removals.

2. *Geographic scope*

   RII accounts for all municipal solid waste generated within the community (Scope 3) – regardless of where it is managed – while the MPCA statewide inventory accounts for all municipal solid waste managed within the state (Scope 1) regardless of its origin and does not account for Minnesota waste treated outside the state.

3. *Landfilled waste emissions*

   Emissions from landfilled waste occur over many years as the materials break down. Using what is known as the methane commitment method, RII accounts for future emissions from waste landfilled during the inventory year. The MPCA statewide inventory uses the first order of decay method to account for emissions during the inventory year – which is primarily caused by waste landfilled in previous years.

4. *Waste-to-energy approach*

   RII accounts for waste-to-energy emissions in the waste sector while the MPCA accounts for it in the energy sector.

Due to these major methodological differences, the results of RII's waste inventories are not directly comparable to the MPCA statewide estimates.

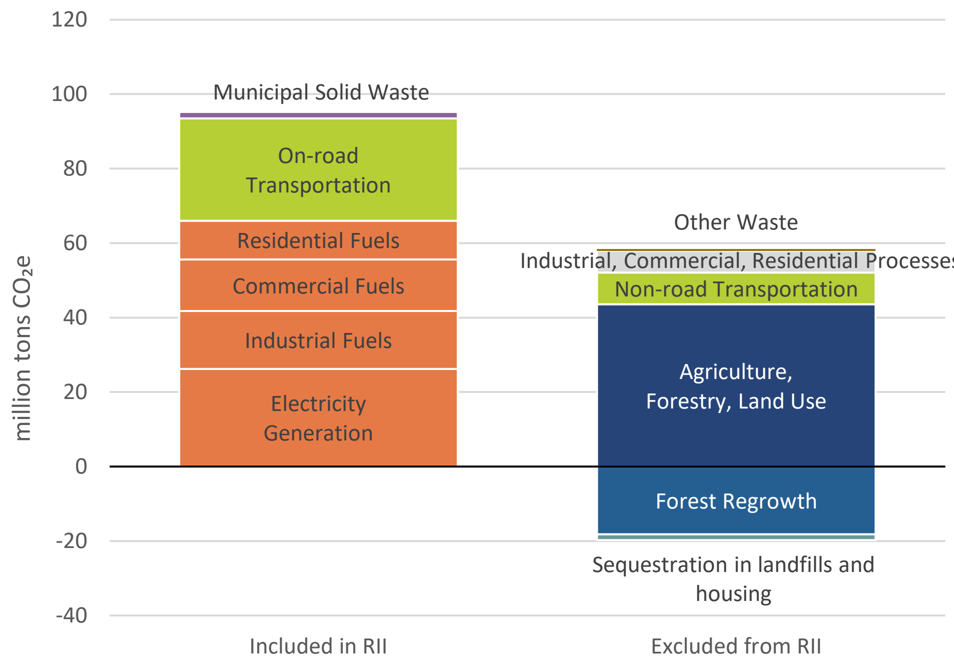
Other emissions sources

The MPCA statewide inventory includes additional GHG emissions sources that are not included in the RII inventories. In addition to the non-road transportation and waste sources described above, MPCA's inventory includes:

- emissions and removals from agriculture, forestry, and land use
- process emissions from industrial, commercial, and residential sectors (e.g., refrigerant leakage from air conditioning, chemical reactions from manufacturing processes, etc.)
- carbon dioxide stored in wood used to build new homes

As shown in Figure C-2, the emissions from sources not included in the RII inventories make up 38% of the state's total gross emissions, and the removals from sources not included in the RII inventories represent 13% of the state's total gross emissions. While the major sources of emission and removals – agriculture and forestry – occur primarily outside of city boundaries, some cities likely do include significant sources of emissions and/or removals that are not required to be tracked by the U.S. Community Protocol. In particular, the carbon sequestered in urban trees can be significant for some communities, and many are interested in quantifying these benefits.

Figure C-2. Minnesota statewide emissions in 2020 - as reported in the MPCA statewide inventory - broken down between the sources included in RII and those excluded from RII.



---

[i] Metropolitan Council, Greenhouse Gas Inventory, https://metrotransitmn.shinyapps.io/ghg_tool/

[ii] World Resources Institute, C40 Cities Climate Leadership Group, ICLEI, Global Protocol for Community-Scale Greenhouse Gas Inventories v1.1, page 20.

[iii] ICLEI U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions v1.2 (July 2019), pg 22.

[iv] This comparison was conducted by Becky Alexander of LHB (the primary researcher for the Regional Indicators Initiative) during June 2023 using publicly available information about the MPCA Statewide Greenhouse Gas Inventory as well as a draft version of the "Technical support document to the MPCA Statewide Greenhouse Gas Inventory" and feedback from Anne Claflin of the MPCA.

[v] MPCA, "Climate change trends and data," https://www.pca.state.mn.us/air-water-land-climate/climate-change-trends-and-data

[vi] MPCA, "Technical support document to the MPCA Statewide Greenhouse Gas Inventory," June 2023 DRAFT.

[vii] The five Basic Emissions Generating Activities defined by the U.S. Community Protocol include: use of electricity by the community, use of fuel in residential and commercial stationary combustion equipment, on-road passenger and freight motor vehicle travel, use of energy in potable water and wastewater treatment and distribution, generation of solid waste by the community

[viii] Each program also provides additional breakdowns within these categories. For example, RII's energy emissions can be broken down by sector (residential vs. commercial/industrial) and fuel type (electricity vs. heating fuels). MPCA emissions are reported by greenhouse gas (e.g., CO2, CH4, N2O), activity (agriculture, commercial process, energy, forestry, industrial process, land use, residential process, waste), and source (e.g., coal, natural gas, etc.).

[ix] For electricity imports, the MPCA statewide inventory uses the average emissions factor from eight neighboring states (and one Canadian province).

[x] See Appendix E – Energy Data Privacy Impacts within the Regional Indicators Initiative Methodology document for more information about how data privacy impacts the RII dataset.

APPENDIX D – ENERGY UTILITIES BY CITY

The following tables show which energy utilities serve each RII city, along with an estimated percentage of the community's energy they provide and whether data from each secondary utility is included in RII's accounting. In general, only utilities that provide 5% or more of the community's total energy are included. Most of the percentages were calculated based on actual data provided for one or more years between 2007 and 2020. These may change over time – for example, as a municipal utility extends service to customers previously served by an energy cooperative. To ensure consistency over time, utilities included for one study year are included for all study years. For utilities listed as providing "<5%", complete utility data was not obtained; these are assumed to be *de minimis* based on the amount of land area or building footprint area within their service territory.

Table D-1. Electric utilities by city

City	Utility 1	%	Utility 2	%	inc?	Utility 3	%	inc?
Andover	Connexus Energy	100%						
Apple Valley	Dakota Electric Association	98%	Xcel Energy	2%	N			
Arlington	Arlington	100%	Minnesota Valley Elec. Coop.	0%	N			
Austin	Austin	100%						
Belle Plaine	Xcel Energy	91%	Minnesota Valley Elec. Coop.	9%	Y			
Bemidji	Otter Tail Power	>95%	Beltrami Electric Coop. Inc.	<5%	N			
Big Lake	Connexus Energy	74%	Xcel Energy	26%	Y			
Blaine	Connexus Energy	78%	Xcel Energy	22%	Y			
Bloomington	Xcel Energy	100%						
Brainerd	Minnesota Power - Allete	52%	Brainerd	48%	Y			
Brooklyn Center	Xcel Energy	100%						
Brooklyn Park	Xcel Energy	100%						
Burnsville	Dakota Electric Association	69%	Xcel Energy	27%	Y	Minnesota Valley Elec. Coop. [1]	4%	Y
Columbia Heights	Xcel Energy	100%						
Coon Rapids	Connexus Energy	60%	Xcel Energy	39%	Y	Anoka Municipal	1%	N
Crystal	Xcel Energy	100%						
Duluth	Minnesota Power - Allete	100%						
Eagan	Dakota Electric Association	59%	Xcel Energy	41%	Y			
Eden Prairie	Xcel Energy	96%	Minnesota Valley Elec. Coop.	4%	N			
Edina	Xcel Energy	100%						

Elk River	Elk River	91%	Connexus Energy	9%	Y			
Falcon Heights	Xcel Energy	100%						
Fridley	Xcel Energy	100%						
Golden Valley	Xcel Energy	100%						
Grand Marais	Grand Marais	100%						
Hastings	Xcel Energy	84%	Dakota Electric Association	16%	Y			
Hopkins	Xcel Energy	100%						
Hutchinson	Hutchinson	100%						
Inver Grove Heights	Xcel Energy	89%	Dakota Electric Association	11%	Y			
Isanti	Connexus Energy	98%	East Central Energy	2%	N			
Jordan	Xcel Energy	74%	Minnesota Valley Elec. Coop.	26%	Y			
Kasson	Kasson	>95%	Xcel Energy	<5%	N	Peoples Energy Cooperative	<5%	N
Lake Elmo	Xcel Energy	100%						
Lauderdale	Xcel Energy	100%						
Lexington	Xcel Energy	71%	Connexus Energy	29%	Y			
Mahtomedi	Xcel Energy	100%						
Mankato	Xcel Energy	94%	BENCO Elec. Coop.	6%	Y			
Maplewood	Xcel Energy	99%	North St. Paul	1%	N			
Marine on Saint Croix	Xcel Energy	100%						
Minneapolis	Xcel Energy	100%						
Minnetonka	Xcel Energy	100%						
Moorhead	Moorhead Public Service	100%						
Morris	Otter Tail Power	100%						
New Brighton	Xcel Energy	100%						
New Germany	Xcel Energy	100%						
Newport	Xcel Energy	100%						
Nisswa	Crow Wing Power	86%	Minnesota Power - Allete	14%	Y			
North Mankato	Xcel Energy	42%	BENCO Elec. Coop.	58%	Y			
North Saint Paul	North St. Paul	100%						
Northfield	Xcel Energy	100%						
Oak Park Heights	Xcel Energy	100%						

Oakdale	Xcel Energy	96%	North St. Paul	4%	N	
Orono	Xcel Energy	>95%	Wright-Hennepin Elec. Coop.	<5%	N	
Red Wing	Xcel Energy	98%	Dakota Electric Association	2%	N	
Richfield	Xcel Energy	100%				
Robbinsdale	Xcel Energy	100%				
Rochester	Rochester	100%	Peoples Energy Cooperative	0%	N	
Rosemount	Xcel Energy	78%	Dakota Electric Association	22%	Y	
Roseville	Xcel Energy	100%				
Royalton	Minnesota Power - Allete	>95%	East Central Energy	<5%	N	
Saint Anthony Village	Xcel Energy	100%				
Saint Louis Park	Xcel Energy	100%				
Saint Paul	Xcel Energy	100%				
Saint Paul Park	Xcel Energy	100%				
Shoreview	Xcel Energy	100%				
South Saint Paul	Xcel Energy	100%				
Stillwater	Xcel Energy	100%				
Sunfish Lake	Xcel Energy	100%				
Victoria	Xcel Energy	51%	Minnesota Valley Elec. Coop.	49%	Y	
Warren	Warren	>95%	PKM Elec. Coop.	<5%	N	
Wayzata	Xcel Energy	100%				
West Saint Paul	Xcel Energy	100%				
White Bear Lake	Xcel Energy	96%	Connexus Energy	4%	N	
Willmar	Willmar	100%				
Winona	Xcel Energy	>95%	Tri-County Elec. Coop./MiEnergy	<5%	N	
Woodbury	Xcel Energy	100%				

[1] Minnesota Valley Electric Cooperative data is included in Burnsville's inventory - despite being below the 5% de minimis threshold - in order to be consistent with annual metrics tracked by the City.

Table D-2. Fossil gas utilities by city

City	Utility 1	%	Utility 2	%	inc?	Utility 3	%	inc?
Andover	CenterPoint Energy	100%						
Apple Valley	CenterPoint Energy	100%						
Arlington	CenterPoint Energy	100%						
Austin	Austin	100%						
Belle Plaine	CenterPoint Energy	100%						
Bemidji	Minnesota Energy Resources	100%						
Big Lake	CenterPoint Energy	85%	Xcel Energy	15%	Y			
Blaine	CenterPoint Energy	92%	Xcel Energy	8%	Y			
Bloomington	CenterPoint Energy	100%						
Brainerd	CenterPoint Energy	98%	Xcel Energy	2%	N			
Brooklyn Center	CenterPoint Energy	100%						
Brooklyn Park	CenterPoint Energy	100%						
Burnsville	CenterPoint Energy	100%						
Columbia Heights	CenterPoint Energy	100%						
Coon Rapids	CenterPoint Energy	100%						
Crystal	CenterPoint Energy	100%						
Duluth	ComfortSystems	100%	Minnesota Energy Resources	0%	N			
Eagan	Minnesota Energy Resources	98%	Xcel Energy	2%	N	CenterPoint Energy	0%	N
Eden Prairie	CenterPoint Energy	100%						
Edina	CenterPoint Energy	100%						
Elk River	CenterPoint Energy	100%						
Falcon Heights	Xcel Energy	100%						
Fridley	CenterPoint Energy	100%						
Golden Valley	CenterPoint Energy	100%						
Grand Marais	n/a	n/a						
Hastings	CenterPoint Energy	100%						
Hopkins	CenterPoint Energy	100%						
Hutchinson	Hutchinson	100%						

Inver Grove Heights	Xcel Energy	100%						
Isanti	CenterPoint Energy	100%						
Jordan	CenterPoint Energy	100%						
Kasson	Minnesota Energy Resources	100%						
Lake Elmo	Xcel Energy	100%						
Lauderdale	Xcel Energy	100%						
Lexington	CenterPoint Energy	100%						
Mahtomedi	Xcel Energy	100%						
Mankato	CenterPoint Energy	>95%	Greater Minnesota Gas	<5%	N			
Maplewood	Xcel Energy	100%						
Marine on Saint Croix	Xcel Energy	100%						
Minneapolis	CenterPoint Energy	100%						
Minnetonka	CenterPoint Energy	100%						
Moorhead	Xcel Energy	100%						
Morris	CenterPoint Energy	100%						
New Brighton	Xcel Energy	100%						
New Germany	CenterPoint Energy	100%						
Newport	Xcel Energy	100%						
Nisswa	Xcel Energy	100%						
North Mankato	CenterPoint Energy	100%						
North Saint Paul	Xcel Energy	100%						
Northfield	Xcel Energy	100%						
Oak Park Heights	Xcel Energy	100%						
Oakdale	Xcel Energy	98%	CenterPoint Energy	2%	N			
Orono	CenterPoint Energy	100%						
Red Wing	Xcel Energy	100%						
Richfield	CenterPoint Energy	100%						
Robbinsdale	CenterPoint Energy	100%						
Rochester	Minnesota Energy Resources	100%						
Rosemount	Minnesota Energy Resources	94%	Xcel Energy	5%	Y	CenterPoint Energy	0%	N
Roseville	Xcel Energy	100%						
Royalton	Xcel Energy	100%						

Saint Anthony Village	CenterPoint Energy	100%			
Saint Louis Park	CenterPoint Energy	100%			
Saint Paul	Xcel Energy	100%			
Saint Paul Park	Xcel Energy	100%			
Shoreview	Xcel Energy	100%			
South Saint Paul	Xcel Energy	100%			
Stillwater	Xcel Energy	100%			
Sunfish Lake	Xcel Energy	100%			
Victoria	CenterPoint Energy	100%			
Warren	Warren	100%			
Wayzata	CenterPoint Energy	100%			
West Saint Paul	Xcel Energy	100%			
White Bear Lake	Xcel Energy	100%			
Willmar	CenterPoint Energy	100%			
Winona	Xcel Energy	100%			
Woodbury	Xcel Energy	98%	CenterPoint Energy	2%	N

APPENDIX E – ENERGY DATA PRIVACY IMPACTS

Regulated utilities in Minnesota are required to protect the anonymity of customer energy use data.[vi] In 2023, Minnesota's Public Utilities Commission (PUC) implemented a standard for protecting customer privacy for aggregated, community-scale datasets.[vii] This standard begins with a privacy screen – known as 4/50 – to check whether there are any customer groups with fewer than 4 customers or any individual customers that comprise more than 50% of their group's total aggregated energy use. For data requests that fail this privacy screen, utilities are directed to use an approved order of operations to include customer data that is publicly reported elsewhere, procure permission to include the customer(s) that triggered the privacy screen failure, combine different customer groups, or exclude the data for each customer that triggered the privacy screen failure. Utilities do have the discretion to modify their approach or deny requests deemed to be a risk to customer privacy or security.

Prior to this Order, each utility used a unique approach to ensure customer privacy when reporting aggregated community-wide data. The known data privacy protocols for community-scale data prior to the 2023 PUC Order are listed in Table E-1.

Table E-2 shows for which years energy data is known to have been excluded for one or more commercial/industrial customers, and the number of customers excluded (if known). Data collected before the 2023 PUC Order (through 2020 for most cities) aligns with the protocols shown in Table E-1, while data collected after the Order uses the new, standardized approach. Residential energy data is typically only excluded for utilities serving very few customers within a city. These exclusions are considered to be *de minimis* and are not shown here.

Since data privacy for smaller utilities is not regulated in this way, their data is assumed to include all customers unless otherwise stated during the data request process.

Table E-1. Community-scale energy use data privacy protocols prior to the 2023 PUC Order

Utility	Privacy Protocol
CenterPoint Energy[i]	Case-by-case
Minnesota Energy Resources[ii]	Case-by-case
Minnesota Power[iii]	4/50
Otter Tail Power[iv]	15/15
Xcel Energy[v]	15/15

[i] *In the Matter of Commission Inquiry into Privacy Policies of Rate-Regulated Energy Utilities*, Docket No. E,G999/CI-12-1344, “CenterPoint Energy Aggregation and Data Release Policies” (February 17, 2017)

[ii] *Minnesota Energy Resources Corporation 2021 Annual Report on Aggregation and Data Release Policies,* Docket Nos. E, G-999/M-19-505 and E, G-999/CI-12-1344, “Minnesota Energy Resources Corporation Compliance Filing – MERC CEUD Filing 2021” (March 1, 2022)

[iii] *In the Matter of a Commission Inquiry into Privacy Policies of Rate-Regulated Energy Utilities,* Docket No. E,G999/CI-12-1344, and *In the Matter of a Petition by Citizens Utility Board of Minnesota to Adopt Open Data Access Standards*, Docket No. E,G-999/M-19-505, “Minnesota Power Compliance Filing – Data Access Standards Report” (February, 25 2022)

[iv] *In the Matter of a Petition by Citizens Utility Board of Minnesota to Adopt Open Data Access Standards,* Docket No. E,G-999/M-19-505 and *In the Matter of a Commissions Inquiry into Privacy Policies of Rate-Regulated Energy Utilities*, Docket no. E,G-999/CI-12-1344. “Otter Tail Power Company Compliance Filing – Annual Report” (February 28, 2022)

[v] *Compliance Filing – Annual Report*, Docket Nos. E,G-999/CI-12-1344 and E,G999/M-19-505, “Xcel Energy Compliance Filing – Annual Report” (March 1, 2022)

[vi] *In the Matter of Commission Inquiry into Privacy Policies of Rate-Regulated Energy Utilities,* Docket No. E,G999/CI-12-1344, “PUC Order Governing Disclosure of Customer Energy Use Data to Third Parties, Requiring Filing of Privacy Policies and Cost Data, and Soliciting Comment” (January 19, 2017)

[vii] In the Matter of a Petition by Citizens Utility Board of Minnesota to Adopt Open Data Access Standards, Docket No. E,G-999/M-19-505 and In the Matter of a Commissions Inquiry into Privacy Policies of Rate-Regulated Energy Utilities, Docket no. E,G-999/CI-12-1344. “PUC Order Refining Open Data Access Standards” (March 13, 2023).

Table E-2. Commercial/industrial customers with energy data excluded from RII totals

	n/a, data not reported
	data estimated based on surrounding years
	no known exclusions
?	exclusions likely, but unverified
#	customers excluded, including number if known

City	Energy Type	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Andover	Electricity																	
	Gas																	
Apple Valley	Electricity																	
	Gas																	
Arlington	Electricity																	
	Gas																	
Austin	Electricity																	
	Gas																	
Belle Plaine	Electricity										1							
	Gas																	
Bemidji	Electricity																	
	Gas																	
Big Lake	Electricity									1	1							
	Gas									22	23							
Blaine	Electricity										1							
	Gas																	
Bloomington	Electricity																	
	Gas																	
Brainerd [1]	Electricity									?	?	?						
	Gas																	
Brooklyn Center	Electricity																	
	Gas																	
Brooklyn Park	Electricity																	
	Gas																	
Burnsville	Electricity																	
	Gas	1	1	1	1	1	1	1	1	1	1	1	1					
Columbia Heights	Electricity																	
	Gas																	

City	Energy Type	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Coon Rapids	Electricity																	
	Gas																	
Crystal	Electricity																	
	Gas																	
Duluth	Electricity																	
	Gas																	
Eagan [2]	Electricity																	
	Gas									4	3	4	3					
Eden Prairie	Electricity								E									
	Gas																	
Edina	Electricity																	
	Gas																	
Elk River	Electricity																	
	Gas	1	1															
Falcon Heights	Electricity									5	5	5	5	4	4	4	1	1
	Gas	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1
Fridley	Electricity																	
	Gas																	
Golden Valley	Electricity																	
	Gas																	
Grand Marais	Electricity																	
	Gas																	
Hastings	Electricity									1	1							
	Gas																	
Hopkins	Electricity																	
	Gas																	
Hutchinson	Electricity																	
	Gas																	
Inver Grove Heights	Electricity									1	1	1	1	1	1			
	Gas																	
Isanti	Electricity																	
	Gas																	
Jordan	Electricity																	
	Gas																	
Kasson	Electricity																	
	Gas																	

City	Energy Type	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Lake Elmo	Electricity																	
	Gas																	
Lauderdale	Electricity									3	3	3						
	Gas																	
Lexington	Electricity										1							
	Gas																	
Mahtomedi	Electricity									2	3	2	2	3	3	3		
	Gas									1	1	2	2	2	2	2		
Mankato	Electricity									1		1				1		
	Gas																	
Maplewood	Electricity									1	1	1	1	1	1			
	Gas									1	1	1	1	1	1			
Marine on Saint Croix	Electricity									3	3	3						
	Gas									7	6	4						
Minneapolis	Electricity																	
	Gas																	
Minnetonka	Electricity																	
	Gas																	
Moorhead	Electricity																	
	Gas																	
Morris	Electricity																	
	Gas																	
New Brighton	Electricity																	
	Gas																	
New Germany	Electricity										4	3						
	Gas																	
Newport	Electricity																	
	Gas																	
Nisswa	Electricity													?	?			
	Gas													1	1			
North Mankato	Electricity																	
	Gas																	
North Saint Paul	Electricity																	
	Gas									1	1							
Northfield	Electricity																	
	Gas																	

City	Energy Type	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Oak Park Heights	Electricity																	
	Gas																	
Oakdale	Electricity																	
	Gas									1	1	1		1	1			
Orono	Electricity																	
	Gas																	
Red Wing	Electricity																	
	Gas									2	2	2	1	2	1			
Richfield	Electricity																	
	Gas																	
Robbinsdale	Electricity									2	2	2						
	Gas																	
Rochester	Electricity																	
	Gas																	
Rosemount	Electricity	1	1	1	1	1	1	1										
	Gas																	
Roseville	Electricity																	
	Gas																	
Royalton [3]	Electricity									?	?	?						
	Gas									1	1	1						
Saint Anthony Village	Electricity																	
	Gas	1	1	1	1	1	1	1	1	1	1	1	1					
Saint Louis Park	Electricity																	
	Gas																	
Saint Paul [4]	Electricity																	
	Gas																	
Saint Paul Park	Electricity											2						
	Gas											2						
Shoreview	Electricity																	
	Gas																	
South Saint Paul	Electricity																	
	Gas											1	1	1	1			
Stillwater	Electricity																	
	Gas																	
Sunfish Lake	Electricity											15						
	Gas											4						

City	Energy Type	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Victoria	Electricity																	
	Gas																	
Warren	Electricity																	
	Gas																	
Wayzata	Electricity																	
	Gas																	
West Saint Paul	Electricity																	
	Gas																	
White Bear Lake	Electricity																	
	Gas									1	1	1	1	1	1			
Willmar	Electricity																	
	Gas			1	1	1	1	1		2	2							
Winona	Electricity																	
	Gas									1	1	1	1	1				
Woodbury	Electricity																	
	Gas																	

1 Brainerd: Electricity data is assumed to be complete for Brainerd Public Utilities, but may exclude customers from Minnesota Power, which noted in an email providing data for seven cities that "a total of 22 billed services were removed from the results."

2 Eagan: 2015 gas data was provided for Xcel Energy (with 4 excluded customers) and estimated for Minnesota Energy Resources Corp.

3 Royalton: Electricity data may exclude customers from Minnesota Power, which noted in an email providing data for seven cities that "a total of 22 billed services were removed from the results."

4 Saint Paul: Gas data provided by the utility excludes one large customer prior to 2022. However, as a permitted facility this customer annually reports their gas use to the Minnesota Pollution Control Agency. This data was added to the utility gas data to provide a complete dataset for Saint Paul, though it was estimated for 2007-2010 since the MPCA dataset was only provided back to 2011.

APPENDIX F – ESTIMATED ENERGY USE

In certain circumstances, RII uses energy use estimates when data has not been provided by the utility. Estimates are used when energy data is missing from:

- a utility that has provided city-specific data for at least one other year
- one or more utilities that are estimated to comprise less than 25% of the city's total energy use (for cities served by multiple utilities)

While a utility comprising less than 25% of the city's total energy use is eligible to be estimated for any year that the data is unavailable, estimating data for the primary utility serving a community typically only occurs when there is a gap in the data, with energy usage provided both before and after the missing year. For example, 2014 data is estimated when 2007-2013 and 2015-2020 data is available, but not when only 2007-2013 data is available.

Method 1 – For utilities that have provided at least one year of data for the city [i]

- For residential electricity: assume residential electricity per household is linear over time.[ii]
- For commercial/industrial electricity: assume commercial/industrial electricity per job is linear over time.[iii]
- For residential fossil gas: determine which has a stronger linear correlation based on the available years of data: residential fossil gas per heating degree day (HDD) or residential fossil gas per household by HDD.[iv] Use the resulting linear equation in combination with city- and year-specific household and HDD data to estimate the missing year of fossil gas.
- For commercial/industrial fossil gas: determine which has a stronger linear correlation based on the available years of data: commercial/industrial fossil gas per HDD or commercial/industrial fossil gas per HDD over time.[v] Use the resulting linear equation in combination with city- and year-specific HDD data to estimate the missing year of fossil gas.

Method 2 – When year-specific data is available from other utilities serving the city

When cities served by multiple utilities are missing data for one or more utilities that are estimated to comprise less than 25% of the total, energy data is estimated based on the assumption that each utility's percentage of the community's total commercial energy use matches their percentage of total commercial building area, and each utility's percentage of the community's total residential energy use matches their percentage of total households.[vi]

Table F-1. RII Estimated Energy Use Data

City	Estimated Data	Method
Bloomington	2014 Electricity Xcel	Residential – assumes linear electricity use per household from 2013 to 2015 Commercial/Industrial – assumes linear electricity per job from 2013 to 2015
Bemidji	2014-2015 Gas Minnesota Energy Resources	Residential – assumes linear trendline for residential fossil gas per heating degree day from 2007-2023 Commercial/Industrial – assumes linear trendline for commercial fossil gas per heating degree day from 2007-2023
Burnsville	2014 Electricity Xcel	Residential – assumes linear electricity use per household from 2013 to 2015 Commercial/Industrial – assumes linear electricity per job from 2013 to 2015
Eagan	2014 Electricity Xcel	Residential – assumes linear electricity use per household from 2013 to 2015 Commercial/Industrial – assumes linear electricity per job from 2013 to 2015
	2014-2015 Gas Minnesota Energy Resources	Residential – based on relationship between gas use and HDD from 2007-2020 Commercial/Industrial – based on relationship between gas use and HDD from 2011-2020[vii]
Eden Prairie	2014 Electricity Xcel	Residential – assumes linear electricity use per household from 2013 to 2015 Commercial/Industrial – assumes linear electricity per job from 2013 to 2015.
Edina	2014 Electricity Xcel	Residential – assumes linear electricity use per household from 2013 to 2015 Commercial/Industrial – assumes linear electricity per job from 2013 to 2015.
Elk River	2014-2015 Electricity Connexus	Residential – assumes the city's total residential electricity use per household is linear from 2013-2016. Commercial/Industrial – assumes Connexus' commercial/industrial electricity per job stayed constant from 2013 to 2014 and then dropped in 2015 (corresponding to Elk River Municipal Utilities' 2015 increase).[viii]
Falcon Heights	2014 Electricity Xcel	Residential – assumes linear electricity use per household from 2013 to 2015 Commercial/Industrial – assumes linear electricity per job from 2013 to 2015.

City	Estimated Data	Method
	2014 Gas Xcel	Residential – assumes linear trendline for residential fossil gas per heating degree day from 2007-2020. Commercial/Industrial – assumes linear trendline for commercial/industrial fossil gas per heating degree day over time from 2007-2020.
Hopkins	2014 Electricity Xcel	Residential – assumes linear electricity use per household from 2013 to 2015 Commercial/Industrial – assumes linear electricity per job from 2013 to 2015.
Maplewood	2014 Electricity Xcel	Residential – assumes linear electricity use per household from 2013 to 2015 Commercial/Industrial – assumes linear electricity per job from 2013 to 2015.
	2014 Gas Xcel	Residential – assumes linear trendline for residential fossil gas per household by heating degree day from 2007-2020. Commercial/Industrial – assumes linear trendline for commercial/industrial fossil gas per heating degree day from 2007-2020.
Minnetonka	2014 Electricity Xcel	Residential – assumes linear electricity use per household from 2013 to 2015 Commercial/Industrial – assumes linear electricity per job from 2013 to 2015.
Oakdale	2014 Electricity Xcel	Residential – assumes linear electricity use per household from 2013 to 2015 Commercial/Industrial – assumes linear electricity per job from 2013 to 2015.
	2014 Gas Xcel	Residential – assumes linear trendline for residential fossil gas per household by heating degree day from 2007-2020. Commercial/Industrial – assumes linear trendline for commercial/industrial fossil gas per heating degree day over time from 2007-2020.
Richfield	2014 Electricity Xcel	Residential – assumes linear electricity use per household from 2013 to 2015 Commercial/Industrial – assumes linear electricity per job from 2013 to 2015.
Saint Anthony Village	2014 Electricity Xcel	Residential – assumes linear electricity use per household from 2013 to 2015 Commercial/Industrial – assumes linear electricity per job from 2013 to 2015.

City	Estimated Data	Method
Saint Paul	2014 Electricity Xcel	Residential – assumes linear electricity use per household from 2013 to 2015 Commercial/Industrial – assumes linear electricity per job from 2013 to 2015.
	2014 Gas Xcel	Residential – assumes linear trendline for residential fossil gas per heating degree day from 2007-2020. Commercial/Industrial – assumes linear trendline for commercial/industrial fossil gas per heating degree day from 2007-2020.
	2007-2010 Gas Large User	One large commercial/industrial customer was excluded from the utility dataset for 2007-2021. This customer was identified and manually added in for 2011-2021 using data from the Minnesota Pollution Control Agency's Permitted Facilities reporting. Since previous years of this dataset were not provided, 2007-2010 were estimated using the linear trend from 2011-2021.
Shoreview	2014 Electricity Xcel	Residential – assumes linear electricity use per household from 2013 to 2015 Commercial/Industrial – assumes linear electricity per job from 2013 to 2015.
	2014 Gas Xcel	Residential – assumes linear trendline for residential fossil gas per household by heating degree day from 2007-2020. Commercial/Industrial – assumes linear trendline for commercial/industrial fossil gas per heating degree day from 2007-2020.
White Bear Lake	2014 Electricity Xcel	Residential – assumes linear electricity use per household from 2013 to 2015 Commercial/Industrial – assumes linear electricity per job from 2013 to 2015.
	2014 Gas Xcel	Residential – assumes linear trendline for residential fossil gas per heating degree day from 2007-2020. Commercial/Industrial – assumes linear trendline for commercial/industrial fossil gas per heating degree day from 2007-2020.
Woodbury	2014 Electricity Xcel	Residential – assumes linear electricity use per household from 2013 to 2015 Commercial/Industrial – assumes linear electricity per job from 2013 to 2015.
	2014 Gas Xcel	Residential – assumes linear trendline for residential fossil gas per household by heating degree day from 2007-2020.

City	Estimated Data	Method
		Commercial/Industrial – assumes linear trendline for commercial/industrial fossil gas per heating degree day over time from 2007-2020.

[i] For example, Xcel Energy provided 2007-2013 electricity and fossil gas data for RII cities during the early years of this program. They began publishing Community Energy Reports with city-wide energy use data, with the earliest year of 2015. Since 2014 data was never obtained for most cities, RII uses the described approach to estimate the missing year.

[ii] Testing all years for several sample cities shows that there is a strong correlation between residential electricity per household and time.

[iii] Testing all years for several sample cities shows that there is a strong correlation between commercial/industrial electricity per job and time.

[iv] Fast-growing cities (like Woodbury) have a strong correlation between residential gas per household and HDD. For many other cities, the stronger correlation is between gas use and HDD, without considering number of households. Between these two methods, each of the eight cities tested achieved an r2 value between 0.79-0.96, with most above 0.90.

[v] Commercial/industrial gas trends are not as strong as residential, but there are correlations between gas use and HDD as well as between gas use per HDD and time (r2 values between 0.63-0.89). There is not a strong correlation with jobs.

[vi] Testing this methodology on 18 cities with one year of complete energy data that are served by multiple utilities found it to be very effective for residential electricity (r2 value of 0.99) and fairly effective for commercial/industrial electricity (r2 value of 0.87). This scenario is less common for fossil gas and has not been tested or used for fossil gas data.

[vii] Gas per HDD was relatively consistent from 2007-2010, jumped in 2011, and was relatively consistent from 2011-2020. There is not a strong relationship between gas use and number of jobs.

[viii] Connexus' electricity sales in Elk River decreased significantly from 2013 to 2016 for both residential and non-residential customers, while Elk River Municipal Utilities' increased, likely due to customers shifting from Connexus to Elk River Municipal. Since the Elk River Municipal Utilities residential data is relative consistent from 2007-2015 and then jumps in 2016, it is assumed that Connexus' residential sales are relatively consistent from 2013-2015 before dropping in 2016. Elk River Municipal Utilities' commercial/industrial electricity sales jumps from 2014 to 2015, and more significantly in 2016, suggesting the shift from Connexus happened over these two years.

APPENDIX G – AVOIDING DOUBLE COUNTING

Several communities host major facilities such as power plants and waste processing facilities. The GHG emissions of these types of facilities are already accounted for through the activities of residents and organizations within the community and/or surrounding region. To avoid double counting the impacts of these facilities, their energy consumption is not included in the community-wide total. This is described in the U.S. Community Protocol, which differentiates between Sources (e.g., power plants) and Activities (e.g., on-site electricity use).

Power Plants

Because the GHG emissions associated with electricity consumption already account for the energy required to generate that electricity, energy used at power plants is not included in the total energy for the community in which they are located.

Table G-1. Power plants in RII communities

City	Owner	Power Plant
Burnsville	Xcel Energy	Black Dog Plant
Duluth	Minnesota Power	Hibbard Renewable Energy Center
Hutchinson	Hutchinson Utility Commission	Hutchinson Plant
Inver Grove Heights	Xcel Energy	Inver Hills Plant
Mankato	Xcel Energy	Mankato Energy Center
Minneapolis	Xcel Energy	Riverside Generating Station
Red Wing	Xcel Energy	Prairie Island Nuclear Power Plant
Rochester	Rochester Public Utility	Cascade Creek and Silver Lake
Saint Paul	Xcel Energy	High Bridge Generating Station[i]
	District Energy St. Paul	District Energy St. Paul Cogeneration[ii]

Waste-to-Energy Facilities

RII's "Waste" category accounts for each community's share of emissions associated with processing municipal solid waste in waste-to-energy facilities. Since this includes emissions from the energy used within these facilities, this energy use is not included in the total energy for the community in which the facility is located.

Table G-2. Waste-to-energy facilities in RII communities

City	Waste-to-Energy Facility
Mankato	Wilmarth Generating Station
Minneapolis	Hennepin Energy Recovery Center (HERC)
Red Wing	Red Wing Solid Waste Campus
Rochester	Olmsted Waste-to-Energy Facility (OWEF)

---

[i] Although Xcel Energy's High Bridge Generating Station is located within the City of St. Paul, Xcel staff stated that the citywide fossil gas consumption data the utility provided for the city does not include gas consumption at the High Bridge plant. Therefore, there is no double counting.

[ii] The wood burned at the District Energy – St. Paul Cogeneration Plant is burned in a combined heat and power (CHP) plant, where the electricity generated is sold to Xcel. Since the emissions from this electricity generation are accounted for within Xcel's emissions rates, this wood use is excluded from Saint Paul's energy totals.

APPENDIX H – ELECTRICITY EMISSIONS FACTORS

Table H-1. Electric utility GHG emissions factors used in RII (lb/MWh)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Xcel Energy (CO_2e) [1]	**1,244**	**1,228**	**1,114**	**1,043**	**1,080**	**938**	**959**	**972**	**905**	**826**	**831**	**816**	**753**	**605**	**634**	**579**	**550**
CO2 [2]	1,235	1,219	1,105	1,034	1,072	930	950	961	895	817	822	807	745	598	627	572	543
CH4 [3]	0.0290	0.0289	0.0288	0.0285	0.0281	0.0276	0.0945	0.1614	0.1382	0.1150	0.1265	0.1380	0.1190	0.1040	0.1070	0.1020	0.1020
N2O [3]	0.0292	0.0285	0.0278	0.0263	0.0253	0.0243	0.0238	0.0233	0.0217	0.0200	0.0200	0.0200	0.0170	0.0150	0.0150	0.0150	0.0150
Minnesota Power (CO_2e) [1]	**2,195**	**2,186**	**2,102**	**2,008**	**2,069**	**2,130**	**1,980**	**1,831**	**1,651**	**1,506**	**1,371**	**1,462**	**1,400**	**1,116**	**1,013**	**843**	**939**
CO2 [4]	2,186	2,177	2,093	1,999	2,061	2,122	1,971	1,820	1,641	1,497	1,362	1,453	1,392	1,109	1,006	836	932
CH4 [3]	0.0290	0.0289	0.0288	0.0285	0.0281	0.0276	0.0945	0.1614	0.1382	0.1150	0.1265	0.1380	0.1190	0.1040	0.1070	0.1020	0.1020
N2O [3]	0.0292	0.0285	0.0278	0.0263	0.0253	0.0243	0.0238	0.0233	0.0217	0.0200	0.0200	0.0200	0.0170	0.0150	0.0150	0.0150	0.0150
Great River Energy (CO_2e) [1]	**1,991**	**1,921**	**2,000**	**1,852**	**1,733**	**1,761**	**1,725**	**1,789**	**1,878**	**1,675**	**1,475**	**1,724**	**1,510**	**1,497**	**1,517**	**1,535**	**1,272**
CO2 [5]	1,977	1,906	1,985	1,838	1,720	1,747	1,712	1,775	1,865	1,662	1,462	1,711	1,501	1,487	1,507	1,525	1,268
CH4 [5]	0.2300	0,2200	0.2300	0.2100	0.2000	0.2000	0,1700	0,2100	0.1900	0.1700	0.1500	0.1700	0.1300	0.1500	0.1600	0.1600	0.0400
N2O [5]	0.0300	0.0300	0.0300	0.0300	0.0300	0.0300	0.0300	0.0300	0.0300	0.0300	0.0300	0.0300	0.0200	0.0200	0.0200	0.0200	0.0100
Otter Tail Power (CO_2e) [1]				**1,961**	**1,914**	**1,835**	**1,867**	**1,753**	**1,532**	**1,587**	**1,552**	**1,687**	**1,574**	**1,368**	**1,239**	**1,201**	**1,183**
CO2 [6]				1,953	1,906	1,827	1,857	1,742	1,522	1,578	1,543	1,677	1,566	1,361	1,232	1,194	1,176
CH4 [3]				0.0285	0.0281	0.0276	0.0945	0.1614	0.1382	0.1150	0.1265	0.1380	0.1190	0.1040	0.1070	0.1020	0.1020
N2O [3]				0.0263	0.0253	0.0243	0.0238	0.0233	0.0217	0.0200	0.0200	0.0200	0.0170	0.0150	0.0150	0.0150	0.0150
Regional Average (CO_2e) [1]	**1,732**	**1,685**	**1,638**	**1,545**	**1,489**	**1,433**	**1,405**	**1,376**	**1,312**	**1,248**	**1,248**	**1,249**	**1,106**	**987**	**1,003**	**944**	**943**
CO2 [3]	1,723	1,676	1,629	1,536	1,481	1,425	1,395	1,365	1,302	1,239	1,239	1,240	1,098	980	996	936	936
CH4 [3]	0.0290	0.0289	0.0288	0.0285	0.0281	0.0276	0.0945	0.1614	0.1382	0.1150	0.1265	0.1380	0.1190	0.1040	0.1070	0.1020	0.1020
N2O [3]	0.0292	0.0285	0.0278	0.0263	0.0253	0.0243	0.0238	0.0233	0.0217	0.0200	0.0200	0.0200	0.0170	0.0150	0.0150	0.0150	0.0150
SMMPA (CO_2e) [1]	**2,337**	**2,380**	**2,029**	**1,886**	**1,848**	**1,848**	**1,849**	**1,785**	**1,811**	**1,812**	**1,735**	**1,889**	**1,829**	**1,291**	**1,468**	**1,443**	**1,453**
CO2 [7]	2,328	2,371	2,020	1,877	1,840	1,840	1,840	1,774	1,801	1,803	1,726	1,880	1,821	1,284	1,461	1,436	1,446
CH4 [3]	0.0290	0.0289	0.0288	0.0285	0.0281	0.0276	0.0945	0.1614	0.1382	0.1150	0.1265	0.1380	0.1190	0.1040	0.1070	0.1020	0.1020
N2O [3]	0.0292	0.0285	0.0278	0.0263	0.0253	0.0243	0.0238	0.0233	0.0217	0.0200	0.0200	0.0200	0.0170	0.0150	0.0150	0.0150	0.0150

1 Carbon dioxide equivalents (CO_2e) are calculated using the 100-year global warming potential values published in the IPCC's Fourth Assessment Report, consistent with data reported by the U.S. EPA.

2 Xcel Energy, "Carbon Dioxide (CO_2) Emissions Intensities Information Sheet," CO_2 intensity for the Upper Midwest, excluding CO_2 from biomass generation and adjusted for the sale or purchase of renewable energy credits. This is one of multiple emissions factor sets that has been provided for customers reporting emissions under The Climate Registry, World Resources Institute or ISO protocols. 2019-2021 emissions factors are preliminary (as submitted to The Climate Registry) until third-party verification is complete. https://www.xcelenergy.com/staticfiles/xe-responsive/Environment/Carbon/Carbon-Emission-Intensities-Info-Sheet.pdf. Emissions factors since 2018 can also be found in Edison Electric Institute, "Electricity Company Carbon Emissions and Electricity Mix Reporting Database for Corporate Customers".

3 U.S. EPA eGRID for Midwest Regional Organization West, "Output emissions rates." Factors do not include emissions from transmission and distribution losses. Data available for 2007, 2009, 2010, 2012, 2014, 2016, and 2018-2020; other historic years are estimated using the average of the surrounding years. The most recent year's data is used as a placeholder until updated data is available. Source: https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid (or https://www.epa.gov/egrid/power-profiler#/MROW and https://www.epa.gov/egrid/data-explorer)

4 Source for 2007-2018: Calculated from Minnesota Power, Environmental Disclosure Brochures filed through Docket Nos. E,G999/CI-00-1343 & E999/CI-01-1127. Emissions factors by fuel type are combined with the overall fuel type breakdown to estimate an overall emissions factor. Filings are not available for reporting years 2011 and 2013, so an average is used of the surrounding years. Source for 2019-2021: Edison Electric Institute, "Electricity Company Carbon Emissions and Electricity Mix Reporting Database for Corporate Customers". The estimating methodology used for earlier years results in values for 2019-2021 that are 9-22% lower than the values reported to EEI.

5 Great River Energy provided their emissions factors for CO_2, N_2O, and CH_4 in response to a data request. From Great River Energy: "These represent our calculated sales/delivery intensities, inclusive of all sources, market interactions, and REC retirements." Contact: Jake Geis (previously Deb Nelson and Mark Strofus).

6 Source for 2010-2020: Calculated from Otter Tail Power, Environmental Disclosure Brochures filed through Docket Nos. E,G999/CI-00-1343 & E999/CI-01-1127. Emissions factors by fuel type are combined with the overall fuel type breakdown to estimate an overall emissions factor. Filings are not available for reporting years 2007-2009. Source for 2021: Edison Electric Institute, "Electricity Company Carbon Emissions and Electricity Mix Reporting Database for Corporate Customers". The estimating methodology used for earlier years results in a value for 2021 within 1% of the value reported to EEI.

7 Southern Minnesota Municipal Power Agency (SMMPA) provided their annual emissions factors for CO_2 in response to a data request from Kayla Betzold (Sustainability Coordinator, City of Rochester).

APPENDIX I – WASTE MANAGEMENT FACILITIES

Table I-1. Waste-to-energy facilities serving Minnesota [i]

Facility	Location	Type	Output
Elk River Resource Processing Plant [ii]	Elk River	RDF	Electricity for GRE
French Island Generating Plant	La Crosse	RDF	Electricity for Xcel
Hennepin Energy Recovery Center	Minneapolis	Mass Burn	Electricity for Xcel Steam for district energy
Olmsted Waste-to-Energy Facility	Rochester	Mass Burn	Steam for district energy Electricity for RPU
Perham Resource Recovery Facility	Perham	Mass Burn	Steam for district energy
Polk County Resource Recovery Facility	Fosston	Mass Burn	Steam for district energy Electricity used on-site
Pope/Douglas Waste to Energy Facility	Alexandria	Mass Burn	Steam for district energy Electricity used on site
Ramsey/Washington Recycling & Energy Center	Newport	RDF	RDF for Xcel (Red Wing and Wilmarth plants)
Red Wing Solid Waste Campus	Red Wing	RDF	RDF for Xcel (Red Wing plant)
Wilmarth Generating Station	Mankato	RDF	Electricity for Xcel

Table I-2. Out-of-state landfills serving Minnesota

Landfill [iii]	Location	Methane Recovery? [iv]
Central Disposal Landfill	Lake Mills, IA	Y
Dakota Landfill	Gwinner, ND	N
Dickinson Landfill	Spirit Lake, IA	N
Grand Forks Landfill	Grand Forks, ND	N
La Crosse County Landfill	La Crosse, WI	Y
Lake Area Landfill	Sarona, WI	Y
Rice Lake Landfill	Rice Lake, WI	N
Roberts County Landfill	Sisseton, SD	N
Seven Mile Creek Landfill	Eau Claire, WI	Y
Superior/Moccasin Mike Landfill	Superior, WI	Y
Watertown Landfill	Watertown, SD	N

[i] Minnesota Resource Recovery Association, "Counties and Minnesota Waste Combustion Facilities," (2016).

[ii] The Elk River Resource Recovery Project closed in March 2019 and has been decommissioned.

[iii] The list of out-of-state landfills was gathered from the Metropolitan County Annual MSW Data Reports for 2007-2021 along with an MPCA spreadsheet showing waste tonnage and destination by waste hauler for the entire state for 2016-2020. All documents were obtained through a data request to the MPCA.

[iv] Evidence of methane recovery for landfills in Wisconsin was found from the Wisconsin DNR, "Landfill Gas Generation," (2020). Landfill gas recovery data was gathered by the EPA for the Central Disposal Landfill, "GHG Facility Details" (2020). The Watertown Landfill underwent a Landfill Gas Utilization Study in 2014 through Houston Engineering but no other evidence of gas recovery was found. No evidence of monitoring was found for the Rice Lake, Dakota, Dickinson, Grand Forks and Roberts County Landfills as of July 2023.