

# Des Moines, IA

## 2017 Inventory of Community Greenhouse Gas Emissions



**Produced by the University of Northern Iowa Center for Energy  
and Environmental Education**

With Assistance from ICLEI - Local Governments for Sustainability USA



# Credits and Acknowledgements

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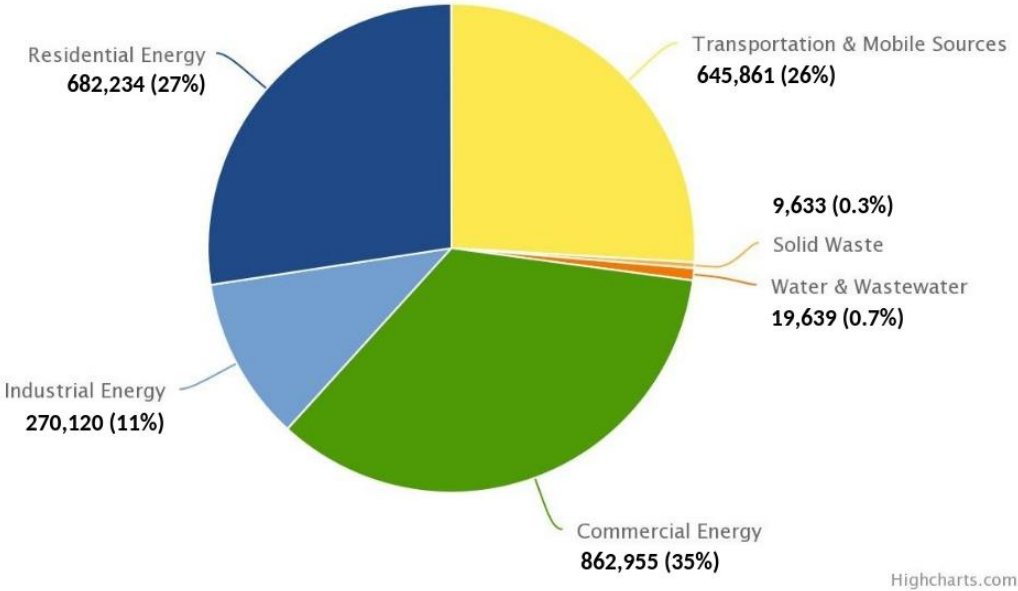
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# Executive Summary

The City of Des Moines recognizes that greenhouse gas (GHG) emissions from human activity are catalyzing profound climate change, the consequences of which pose substantial risks to the future health, wellbeing, and prosperity of our community. Furthermore, Des Moines has multiple opportunities to benefit by acting quickly to reduce community GHG emissions. With reducing GHG emissions, Des Moines has the opportunity to create green jobs, reduce energy and transportation costs for residents, improve health for residents, and make Des Moines a more attractive place to live and grow a business. Des Moines has begun the climate action planning process, starting with inventorying emissions. This report provides estimates of greenhouse gas emissions resulting from activities in Des Moines for the base year 2017.

## Key Findings

Figure ES 1: 2017 GHG Inventory for Community of Des Moines, IA  
(MT CO<sub>2</sub>e)



There are a variety of emissions sources and activities included in the community-wide inventory. Figure ES-1 shows Des Moines’ community-wide emissions for the baseline calendar year of 2017. The largest contributor in this set is commercial energy with 35% of emissions. The next largest contributor is residential energy with 27% of emissions followed closely behind by the transportation and mobile sources at 26%. Actions to reduce emissions in both of these sectors will be a key part of a climate

action plan. Industrial energy, water and wastewater, and solid waste were responsible for the remainder of the community's emissions.

The Inventory Results section of this report provides a detailed profile of emissions sources within Des Moines; information that is key to guiding local reduction efforts. This data will also provide a baseline against which the city will be able to compare future performance and demonstrate progress in reducing emissions.

# Climate Change Background

Naturally occurring gases dispersed in the atmosphere determine the Earth's climate by trapping solar radiation. This phenomenon is known as the greenhouse effect. Overwhelming evidence shows that human activities are increasing the concentration of greenhouse gases and changing the global climate. The most significant contributor is the burning of fossil fuels for transportation, electricity generation and other purposes, which introduces large amounts of carbon dioxide and other greenhouse gases into the atmosphere. Collectively, these gases intensify the natural greenhouse effect, causing global average surface and lower atmospheric temperatures to rise. Des Moines has the potential to be impacted by increased air pollution, more severe flooding, and other environmental concerns. Current and expected impacts to Des Moines related to climate change are explained below.

Many communities in the United States have taken responsibility for addressing climate change at the local level. Reducing fossil fuel use in the community can have many benefits in addition to reducing greenhouse gas emissions. More efficient use of energy decreases utility and transportation costs for residents and businesses. Retrofitting homes and businesses to be more efficient creates local jobs. In addition, money not spent on energy is more likely to be spent a local businesses and add to the local economy. Reducing fossil fuel use improves air quality, and increasing opportunities for walking and bicycling improves residents' health.

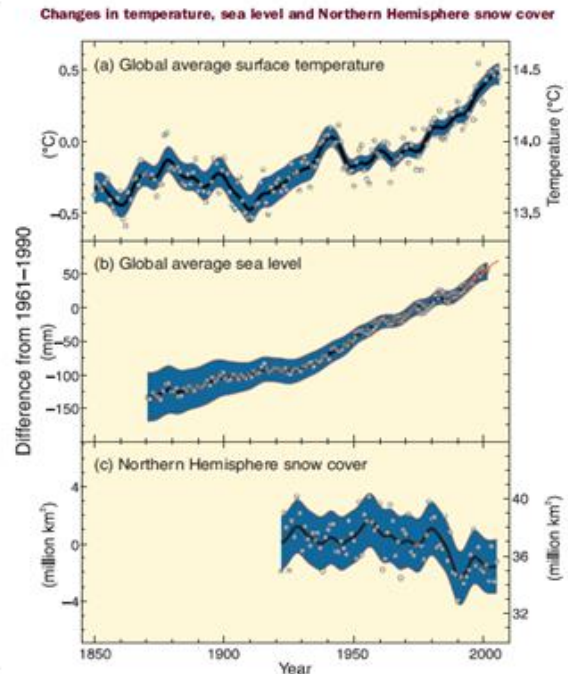
## Regional and Local Impacts

Regional impacts of climate change on the Midwest are expected to increase dramatically in the near future. These impacts include increases in extreme heat, heavy downpours, and extensive flooding that will have long-lasting impacts on the overall health of the population, infrastructure, agriculture, transportation, air and water quality throughout the Midwest. Although the growing season is expected to expand due to increased temperatures, extreme weather and heat have the potential to lead toward reduced yield or crop failure.

## Evidence of Human-Caused Climate Change

There is overwhelming scientific consensus that the global climate is changing, and that human actions, primarily the burning of fossil fuels, are the main cause of those changes. The Intergovernmental Panel on Climate Change (IPCC) is the scientific body charged with bringing together the work of thousands of climate scientists. The IPCC's Fourth Assessment Report states that "warming of the climate system is unequivocal."<sup>1</sup> Furthermore, the report finds that "most of the observed increase in global average temperatures since the mid-20th century is *very likely* due to the observed increase in anthropogenic GHG concentrations."

2014, 2015, and 2016 were the 3 hottest years on record globally, each warmer than the last. 11 of the 12 hottest years on record occur after 2003, with 1998 being the only year in the 20<sup>th</sup> century to make the list.<sup>2</sup> 1976 was the last year with a below average global temperature. The steady uptick in average temperatures is significant and expected to continue if action is not taken to greatly reduce greenhouse gas emissions.



**Figure 1: Observed changes in global temperature, sea level and snow cover**

## ICLEI Climate Mitigation Program

In response to the problem of climate change, many communities in the United States are taking responsibility for addressing emissions at the local level. Since many of the major sources of greenhouse gas emissions are directly or indirectly controlled through local policies, local governments have a strong role to play in reducing greenhouse gas emissions within their boundaries. Through proactive measures around land use patterns, transportation demand management, energy efficiency, green building, waste diversion, and more, local governments can dramatically reduce emissions in their communities. In addition, local governments are primarily responsible for the provision of emergency services and the mitigation of natural disaster impacts.



**Figure 2: ICLEI Climate Mitigation Milestones**

ICLEI provides a framework and methodology for local governments to identify and reduce greenhouse gas emissions, organized along Five Milestones, also shown in Figure 2:

1. Conduct an inventory and forecast of local greenhouse gas emissions;
2. Establish a greenhouse gas emissions reduction target;
3. Develop a climate action plan for achieving the emissions reduction target;
4. Implement the climate action plan; and,
5. Monitor and report on progress.

This report represents the completion of ICLEI's Climate Mitigation Milestone One for the community as a whole, and provides a foundation for future work to reduce greenhouse gas emissions in Des Moines.

## Sustainability & Climate Change Mitigation Activities in Des Moines

Des Moines has already implemented programs that have or will lead to ancillary benefits in the form of energy conservation and greenhouse gas mitigation. The initiatives that Des Moines currently has in place include:

- **LEED certification plan for businesses and city facilities**
  - The Council has a directive that all new city facilities must meet a minimum of Leadership in Energy and Environmental Design (LEED) Certified.
  - The city currently operates 7 LEED facilities including the three (3) Certified, three (3) Silver, and one (1) Platinum.
- **Strategic and comprehensive plan to reduce emissions for Des Moines**
  - Strategic Plan -- GuideDSM (2015-2017)
    - Reduce Greenhouse Gas Emissions 28% by 2025.
    - Establish a Citizen's Taskforce on Sustainability.
    - Identified a need for a sustainability plan.
    - Walkability Study (Connect Downtown).
    - Evaluation on our aging housing stock and a revitalization plan (underway).
    - Implement the City's complete streets policy (East Grant Avenue Pilot Project).
    - Be a 5 STAR Community.
  - Comprehensive Plan -- PlanDSM (2016)
    - Evaluate capacity for implementation and adaptation to green infrastructure.
    - Reduce the consumption of energy in City owned buildings.
    - Develop a complete multi-modal transportation network for pedestrians, bikes, transit, and automobiles.



- Promote sustainable housing development that utilizes existing resources and supports compact, walkable, and bikeable neighborhoods.
  - Foster a sustainable economy (locally produced materials, green building practices, energy efficiency, etc).
  - Design the City's trail system for all users, including commuters.
  - Strengthen the walkability and connectivity within and between neighborhoods.
- **City energy project**
  - Des Moines is one of 20 cities selected across the US to develop a plan around measuring and reducing energy through benchmarking, challenge programs, and policy. This cross-sector program is in partnership with the Downtown Community Alliance, Urban Land Institute of Iowa, and Capital Crossroads.
  - 30 City buildings have been benchmarked, will be partnering with the local utility to assess provide building tune-ups to reduce unnecessary energy consumption.
  - Energize Des Moines, a voluntary program to reduce energy use (electric, gas, and water) in Des Moines' largest buildings (above 25,000 square feet). The goal is to reduce usage by 10% by 2020. Currently 33 buildings are enrolled in the challenge, representing over 8M square feet.
  - Policy taskforce on water and energy efficiency will have its inaugural meeting on Thursday April 26th.
- **Establishment of the citizen task force on sustainability in 2016**
  - The Des Moines Citizens' Task Force on Sustainability engages the community and advises the City toward City-wide reductions in greenhouse gas emissions consistent with global agreements and scientific evidence, and ecologically and socially sustainable economic development
  - Held a city-wide sustainability tour for council and citizens to demonstrate the quality of environmentally focused design in Des Moines
  - Partnered with the City to organize the STAR Communities Sustainability Workshop, bringing more than 30 organizations and over 50 individuals together to discuss making Des Moines more sustainable.
  - Recent recipient of a Climate Ready Communities technical assistance grant from the Geos Institute to assist in establishing a multi-stakeholder approach to community-wide resiliency.
  - Planning a Climate & Equity Summit in September, 2018.
- **Certified as a 3-star community by STAR Communities project**
  - Recertification process is currently underway through a collaborative effort with the Citizen's Taskforce on Sustainability. The goal of this collaboration is to see progress in Climate & Energy and the other goal areas as our community comes together to combine our resources and measure our community-wide impact on creating a sustainable community.
- **Recycling program for downtown Des Moines**
  - Recycle DSM partner with the Downtown Community Alliance to incorporate recycling into our downtown to enhance our waste minimization goals.

- **Tree Inventory to assess health of tree canopy**
  - Maintain over 40,000 trees.
  - In one year, these trees:
    - Prevent 53 million gal. of water from entering storm sewers, enough to fill 80 Olympic size pools.
    - Eliminate 18.7 million lbs of CO2 from the air, the equivalent of removing 1,792 cars from our roads.
    - Save 6.3 million Kilowatt-hours of energy by providing shade, the same amount of energy used to power 468 homes.
    - Absorb 60,000 lbs of pollutants from the air.
    - This equals \$4.5 million+ in annual environmental benefits.
- **Tiny Trees program to increase tree canopy in Des Moines**
  - Annual program designed to increase the city's tree canopy by 3% in alignment with the Iowa DNR's challenge to Iowa cities. IN 2017, 5,200 trees were distributed to 1,100 residents at a cost of \$6,800. The program is currently accepting requests for 2018 distribution.

# Inventory Methodology

## Understanding a Greenhouse Gas Emissions Inventory

The first step toward achieving tangible greenhouse gas emission reductions requires identifying baseline emissions levels and sources and activities generating emissions in the community. This report presents emissions from the Des Moines community as a whole. The government operations inventory is mostly a subset of the community inventory, as shown in Figure 3. For example, data on commercial energy use by the community includes energy consumed by municipal buildings, and community vehicle-miles-traveled estimates include miles driven by municipal fleet vehicles.



**Figure 3: Relationship of Community and Government Operations Inventories**

As local governments have continued to join the climate protection movement, the need for a standardized approach to quantify GHG emissions has proven essential. This inventory uses the

approach and methods provided by the Community Greenhouse Gas Emissions Protocol (Community Protocol)<sup>3</sup>.

### Community Emissions Protocol

The Community Protocol was released by ICLEI in October 2012, and represents a national standard in guidance to help U.S. local governments develop effective community GHG emissions inventories. It establishes reporting requirements for all community GHG emissions inventories, provides detailed accounting guidance for quantifying GHG emissions associated with a range of emission sources and community activities, and provides a number of optional reporting frameworks to help local governments customize their community GHG emissions inventory reports based on their local goals and capacities.

## Quantifying Greenhouse Gas Emissions

### Sources and Activities

Communities contribute to greenhouse gas emissions in many ways. Two central categorizations of emissions are used in the community inventory: 1) GHG emissions that are produced by “sources” located within the community boundary, and 2) GHG emissions produced as a consequence of community “activities”.

| Source   | Activity   |
|--|--|
| <b>Any physical process inside the jurisdictional boundary that releases GHG emissions into the atmosphere</b> | <b>The use of energy, materials, and/or services by members of the community that result in the creation of GHG emissions.</b> |

By reporting on both GHG emissions sources and activities, local governments can develop and promote a deeper understanding of GHG emissions associated with their communities. A purely source-based emissions inventory could be summed to estimate total emissions released within the community’s

jurisdictional boundary. In contrast, a purely activity-based emissions inventory could provide perspective on the efficiency of the community, even when the associated emissions occur outside the jurisdictional boundary. The division of emissions into sources and activities replaces the scopes framework that is used in government operations inventories, but that does not have a clear definition for application to community inventories.

## Base Year

The inventory process requires the selection of a base year with which to compare current emissions. Des Moines community greenhouse gas emissions inventory utilizes 2017 as its base year.

## Quantification Methods

Greenhouse gas emissions can be quantified in two ways:

- Measurement-based methodologies refer to the direct measurement of greenhouse gas emissions (from a monitoring system) emitted from a flue of a power plant, wastewater treatment plant, landfill, or industrial facility.
- Calculation-based methodologies calculate emissions using activity data and emission factors. To calculate emissions accordingly, the basic equation below is used: *Activity Data x Emission Factor = Emissions*

Most emissions sources in this inventory are quantified using calculation based methodologies. Activity data refer to the relevant measurement of energy use or other greenhouse gas-generating processes such as fuel consumption by fuel type, metered annual electricity consumption, and annual vehicle miles traveled. Please contact the UNI Center for Energy and Environmental Education for a detailed listing of the activity data used in composing this inventory.<sup>4</sup>

Known emission factors are used to convert energy usage or other activity data into associated quantities of emissions. Emissions factors are usually expressed in terms of emissions per unit of activity data (e.g. lbs CO<sub>2</sub>/kWh of electricity).

For this inventory, calculations were made using the ICLEI Clearpath tool, the leading online software platform for completing GHG inventories.

# Community Emissions Inventory Results

Following the U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, this report looks at Des Moines' emissions through the Community-Wide Activities frame.

## Community Profile

To put emissions inventory data in context, basic information about the community such as population, number of households, number of business establishments, and commercial workforce size is needed. This information is provided in Table 1.

**Table 1: Des Moines Community Indicators (United States Census)**

|   |                |
|---|----------------|
| <b>Population</b>                         | <b>217,521</b> |
| <b>Households</b>                         | <b>83,141</b>  |
| <b>Number of Business Establishments*</b> | <b>16,543</b>  |
| <b>Commercial Workforce Size*</b>         | <b>115,109</b> |

\*2012 Survey of Business Owners

[https://factfinder.census.gov/faces/nav/jsf/pages/community\\_facts.xhtml](https://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml)

## Community-Wide Activities Frame

The community-wide activities frame includes emissions that result from use of energy, materials, and services by all members of the community. The City of Des Moines may have significant influence over some of these emissions, but it may also have little influence over others. Note that these emissions may be occurring within or outside of the community boundary. This frame includes the following five Basic Emissions Generating Activities:

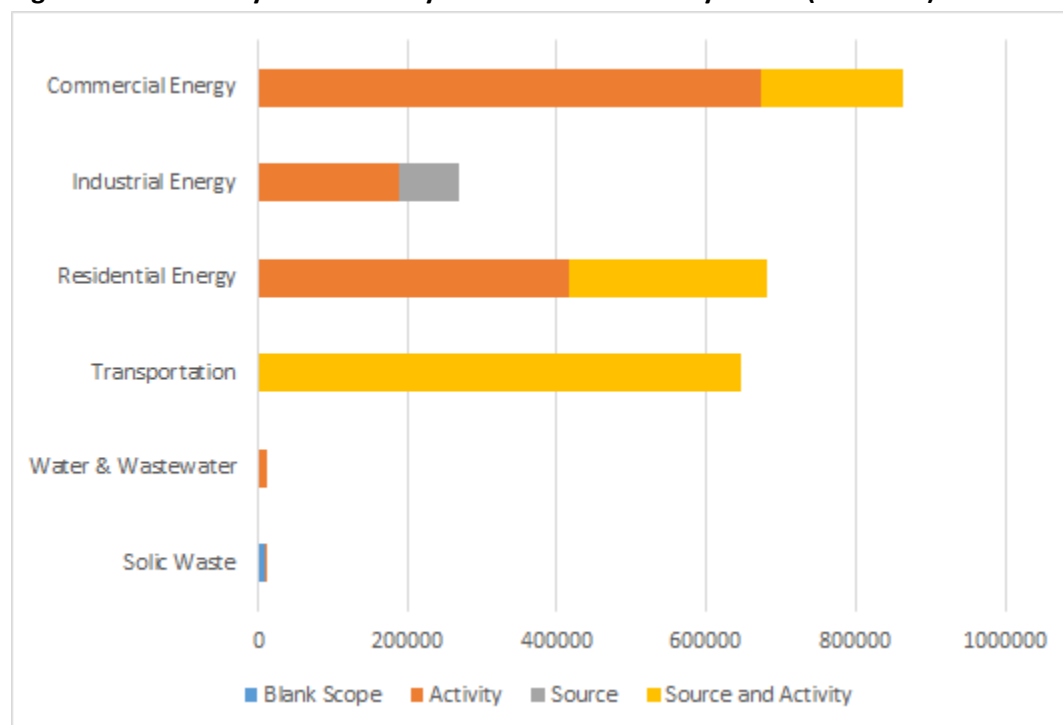
- Use of electricity by the community
- Use of fuel in residential, commercial, and industrial stationary combustion equipment
- On-road passenger and freight motor vehicle travel
- Use of energy in potable water and wastewater treatment and distribution
- Generation of solid waste by the community

When used for comparison across communities, this framework is helpful in illustrating relative urban efficiencies. Table 2 summarizes emissions from community-wide sources and activities. Figure 4 shows emissions in each sector that come from sources, activities, or both.

**Table 2: Community-Wide Activity GHG Emissions by Activity**

| Source or Activity   | Activity Data<br>Quantity and Unit | Emissions Factor                    | Emissions<br>(metric tons CO <sub>2</sub> e) |
|--|------------------------------------|-------------------------------------|--|
| Residential Use of Electricity                               | 734,437,096 kWh                    | 0.701 kg<br>CO <sub>2</sub> e/kWh   | 415,558 MT                                   |
| Commercial Use of Electricity                                | 1,187,789,391 kWh                  | 0.701 kg<br>CO <sub>2</sub> e/kWh   | 672,072 MT                                   |
| Industrial Use of Electricity                                | 332,059,687 kWh                    | 0.701 kg<br>CO <sub>2</sub> e/kWh   | 187,885 MT                                   |
| Residential Stationary<br>Combustion                         | 50,168,560 therms                  | 53.02 kg<br>CO <sub>2</sub> /MMBtu  | 266,676 MT                                   |
| Commercial Stationary<br>Combustion                          | 35,909,892 therms                  | 53.02 kg<br>CO <sub>2</sub> /MMBtu  | 190,883 MT                                   |
| Industrial Stationary<br>Combustion                          | 15,494,919 therms                  | 53.02 kg<br>CO <sub>2</sub> e/MMBtu | 82,235 MT                                    |
| On-road Vehicle Travel                                       | 1,451,890,000<br>vehicle miles     | 0.484 kg<br>CO <sub>2</sub> e/mile  | 645,861 MT                                   |
| Water and Wastewater<br>Treatment                            | 11,083 million<br>gallons          | 0.537 g CO <sub>2</sub> e/gal       | 19,639 MT                                    |
| Generation, Collection, and<br>Transportation of Solid Waste | 70,131 tons                        | 1581.59 kg<br>CO <sub>2</sub> e/ton | 9,633 MT                                     |
| <b>Total Significantly Influenced Emissions</b>              |                                    |                                     | <b>2,490,442 MT</b>                          |

**Figure 4: Community-Wide Activity & Source Emissions by Sector (MT CO2e)**



Des Moines will focus on these emissions sources and activities in developing a climate action plan. The total emissions of 2,490,442 metric tons CO2e will be the baseline for setting an emissions reduction target and measuring future emissions reductions against.

## Household Consumption Frame

The other frame through which Des Moines has chosen to look at emissions is that of household consumption. The household consumption frame helps to illustrate the full, life cycle impacts of residents' activities. Household consumption includes lifecycle emissions associated with household electricity use, household natural gas use, household personal vehicle transportation, household use of public transportation, household use of water and wastewater services, household production of garbage, and household use of materials and services. Many of these emissions overlap with those looked at through the community-wide activities frames. But the household consumption frame also includes emissions that are not included in the other frames, in particular emissions from goods and services that are produced outside the community.

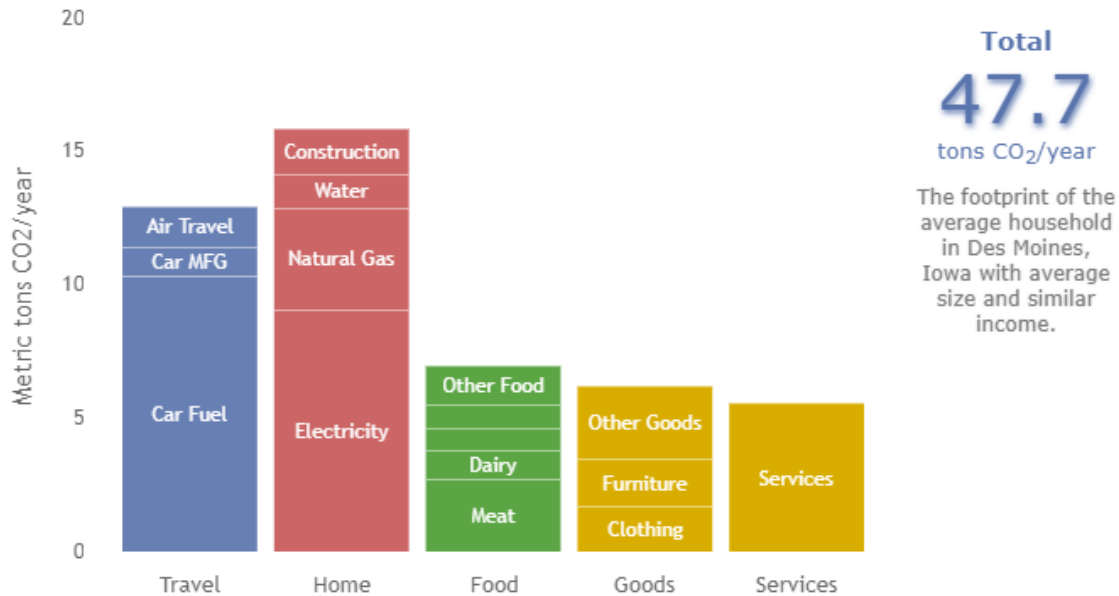
Consumption-based emissions for communities in the U.S. are often – but not always – higher than in-boundary emissions. Consumption based emissions are also larger than geographic emissions for the nation as a whole, although communities with small residential populations, limited government

presence, and large industrial or tourism activities (businesses serving non-resident customers) would find their consumption-based emissions to be relatively small. But regardless of whether consumption based emissions are larger or smaller, some of the emissions are *different*, and they represent additional ways in which the community contributes to climate change and by extension, additional opportunities for the community to reduce its contribution to climate change. Table 4 shows total household consumption emissions for Des Moines, while Figure 8 shows household consumption emissions for an average household in Des Moines.

**Table 3: Total Household Consumption Emissions for Des Moines**

|                           | Average Household Emissions (MT CO <sub>2</sub> e) | Number of Households | Total Household Consumption Emissions (MT CO <sub>2</sub> e) |
|---------------------------|--|----------------------|--|
| Grid Electricity          | 9.09   | 83,141               | 755,752  |
| Natural gas               | 3.81   | 83,141               | 316,767  |
| Total Household Emissions |  |                      | 1,072,519  |

**Figure 5: Household Consumption Emissions for an Average Household in Des Moines**



Graph generated by CoolClimate calculator.

Looking at the household emissions frame shows that household energy use and travel are large contributors to emissions, accounting for over 60% of total household emissions. A range of actions can



help to reduce these emissions, including materials management, reduction of wasted food, and sustainable purchasing practices by governments, businesses, and households. Des Moines may want to look at educational efforts in some of these areas as part of its climate action plan.

Consumption emissions for an average household were obtained from the calculator at <http://coolclimate.berkeley.edu>. Residents who want to learn more about consumption-based emissions from their own household can use the calculator to obtain emissions based on their personal energy use, transportation and purchasing.

## Community Emissions Forecast

To illustrate the potential emissions growth based on projected trends in population growth and carbon intensity in the electricity grid from the baseline year of 2017 going forward, Des Moines conducted an emissions forecast for the year 2025. The forecast is applied to community-wide activity emissions.

**Table 4: Community-wide Emissions Forecast Results**

| Sector  | 2017 Emissions                      | 2025 Emissions                      | Percent Change from 2017 to 2025 |
|---|-------------------------------------|-------------------------------------|----------------------------------|
| Residential Energy                            | 682,234 MT CO <sub>2</sub> e        | 625, 089 MT CO <sub>2</sub> e       | -8.4%                            |
| Commercial Energy                             | 862,955 MT CO <sub>2</sub> e        | 759,553 MT CO <sub>2</sub> e        | -12.0%                           |
| Industrial Energy                             | 270,120 MT CO <sub>2</sub> e        | 242,532 MT CO <sub>2</sub> e        | -10.2%                           |
| Transportation & Mobile Sources               | 645,861 MT CO <sub>2</sub> e        | 675,369 MT CO <sub>2</sub> e        | 4.6%                             |
| Use of Energy in Water & Wastewater Treatment | 19,639 MT CO <sub>2</sub> e         | 16,391 MT CO <sub>2</sub> e         | -16.5%                           |
| Solid Waste                                   | 9,633 MT CO <sub>2</sub> e          | 10,074 MT CO <sub>2</sub> e         | 4.6%                             |
| <b>Total</b>                                  | <b>2,490,442 MT CO<sub>2</sub>e</b> | <b>2,329,008 MT CO<sub>2</sub>e</b> | <b>-6.5%</b>                     |

Under a business-as-usual scenario, the City of Des Moines’ emissions will shrink by approximately 6.5% percent by the year 2025, from 2,490,442 to 2,329,009 metric tons CO<sub>2</sub>e. Table 4 shows the results of the forecast. The decrease in emissions from residential, commercial, and industrial energy use and use

of energy in water and wastewater treatment can be attributed to the decarbonizing trend in grid electricity emissions. These emissions are projected to decrease because the amount of electricity generated by renewable resources is increasing and the amount generated by fossil fuels is decreasing. Rate of change of carbon intensity factors (lb CO<sub>2</sub>e/MWh) was estimated from recent historical rates of change in carbon intensity factors for the Midwest Reliability Organization (West) territory that were obtained from the EPA's Emissions and Generating Resource Integrated Database (eGRID).

## Conclusion

This inventory marks completion of Milestone One of the Five Milestones for Climate Mitigation. The next steps are to set an emissions reduction target, and to develop a climate action plan that identifies specific quantified strategies that can cumulatively meet that target. In addition, Des Moines should continue to track key energy use and emissions indicators on an on-going basis. ICLEI recommends completing a re-inventory at least every five years to measure emissions reduction progress.

Emissions reduction strategies to consider for the climate action plan include energy efficiency, renewable energy, vehicle fuel efficiency, alternative transportation, vehicle trip reduction, land use and transit planning, and waste reduction among others. This inventory shows that residential and commercial energy are currently the largest contributors to emissions in Des Moines, but transportation and solid waste are forecast to grow the most in the coming years. All of these sectors will therefore be important to focus on in Des Moines' Climate Action Planning process. Through these efforts and others the city of Des Moines can achieve additional benefits beyond reducing emissions, including saving money and improving Des Moines economic vitality and its quality of life.

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<sup>1</sup> IPCC, 2007: Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.)]. IPCC, Geneva, Switzerland, 104 pp.

<sup>2</sup> NOAA: State of the Climate 2012 Summary. <http://www.ncdc.noaa.gov/sotc/>

<sup>3</sup> <http://www.icleiusa.org/tools/ghg-protocol/community-protocol>

<sup>4</sup> Des Moines' community inventory includes emissions generating activity data provided by the City of Des Moines.