Environmental Commission

Bloomington Environmental Action Plan

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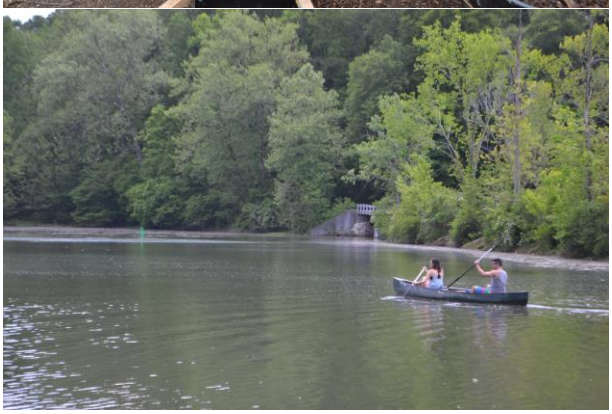

05/26/2013

BACKYARD WILDLIFE
HABITAT
NATIONAL WILDLIFE FEDERATION

Introduction

The Bloomington Environmental Action Plan (BEAP) was crafted because environmental degradation and climate change are two challenges that 21st century decision-makers must address. Current resource-consumption and waste-production activities are unsustainable and threaten life-supporting processes. Many of these activities also release greenhouse gases (GHGs) like carbon dioxide (CO_2), which trap heat in the atmosphere and alter climate cycles. Given that total atmospheric concentrations are at levels unprecedented in the last 800,000 years,[1] immediate mitigation efforts are necessary.[2]

With no climate action, scientists predict that average global temperatures will rise as much as 4.8°C (8.6°F) by the end of the century.[3] Temperature increases of this magnitude threaten human health and safety. Higher temperatures will raise heat-related mortalities; promote viral replication, making people more vulnerable to disease; lead to more frequent food crop failures; and decrease water availability. Due to these threats, the United Nations (UN) estimates that up to 50 million environmental refugees will migrate north as early as 2020.[4]

To prevent worst-case climate change scenarios, global GHG emissions must fall to 85 percent below 2000 levels by 2050.[5] Because cities are responsible for about 75 percent of global GHG emissions, municipalities around the world have a unique opportunity to affect change.[6] American cities, however, bear the most responsibility for action because we have the highest per capita emissions rates in the world. The City of Bloomington recognizes this opportunity and joins the ranks of other ambitious communities by creating this Environmental Action Plan.

As Bloomington mitigates climate change, it must also grow more resilient in the face of an already changing climate. This process requires community members to reevaluate infrastructure, agriculture, and land-use activities, especially. Current development practices

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[1] Intergovernmental Panel on Climate Change, "Summary for Policymakers," accessed June 21, 2016, http://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_SPM_FINAL.pdf.
[2] Ryan et al., "A Synthesis of the Science on Forests and Carbon for U.S. Forests." *Ecological Society of America* (2010): 2. Accessed February 18, 2016, http://www.esa.org/esa/wp-content/uploads/2013/03/issue13.pdf.
[3] IPCC, "Summary for Policymakers," accessed July 6, 2016, https://www.ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc_wg3_ar5_summary-for-policymakers.pdf.
[4] Karin Zeitvogel, "50 million 'environmental refugees' by 2020, experts say," *The Sydney Morning Herald*, accessed July 5, 2016, http://www.smh.com.au//breaking-news-world/50-million-environmental-refugees-by-2020-experts-say-20110222-1b314.html.
[5] Pew Center on Global Climate Change, "Greenhouse Gas Emissions Reduction Timetables," accessed June 21, 2016, http://www.c2es.org/docUploads/Timetables.pdf.
[6] United Nations Environment Programme, "Cities and Climate Change," accessed June 21, 2016, http://www.unep.org/resourceefficiency/Policy/ResourceEfficientCities/FocusAreas/CitiesandClimateChange/tabid/101665/Default.aspx.

often replace habitat with impermeable pavement and turf grasses, which weaken natural systems and reduce biodiversity. Climate change stresses these ecosystems further by making wildlife habitats inhospitable. Because restoring damaged ecosystems will be difficult, if not impossible, Bloomington must strengthen and protect its natural environment.

Since 1971, the City of Bloomington has maintained its commitment to environmental conservation through the Environmental Commission (EC). Established under the Bloomington Municipal Code 2.12.050 in 1971, the EC advises "the City of Bloomington on how its actions and policies may preserve and enhance the quality of Bloomington's environment, including the life-supporting processes that natural ecological systems provide to humans and other organisms." Holding true to this mission statement, the EC encourages environmentally conscientious development practices and monitors the community's environmental quality regularly. Because climate change falls under the purview of environmental quality, the EC committed itself to producing this plan.

The mission of the Environmental Commission is to advise the City of Bloomington on how its actions and policies may preserve and enhance the quality of Bloomington's environment, including the life-supporting processes that natural ecological systems provide to humans and other organisms.

Terminology

For the purposes of this document, "plan" refers to this Bloomington Environmental Action Plan. The "goal" is to identify policies and initiatives that will achieve a 17 percent GHG emission reduction from a 2014 baseline by 2020 while enhancing the natural environment. "Objectives" are the sector-based goals to help reach the overarching goal of this plan. Finally, "actions" are individual steps aimed at achieving the objectives.

Plan	This Bloomington Environmental Action Plan document
Goal	Identify policies and initiatives that will achieve a 17 percent GHG emission reduction from a 2014 baseline by 2020 while enhancing the natural environment
Objective	Sector-based goals to help reach the overarching goal of this plan
Action	Individual steps to achieve objectives

BEAP Background

In 2006, former Mayor Mark Kruzan signed the US Mayors' Climate Protection Agreement, which listed Bloomington among the ranks of over 1,000 other ambitious communities. Signing this agreement committed Bloomington to inclusive mobility targets, energy standards, and GHG emissions reductions to seven percent below 1990 levels by 2012. As part of this initiative, the EC made GHG inventorying an ongoing priority. A preliminary, 2006 document titled "A Framework for Developing a Greenhouse Gas Reduction Plan for Bloomington, Indiana" identified 120 action items to achieve the GHG reduction goal. Four years later, "2010 GGE-Reducing Action Items Summary Report and Recommendations for Future Steps," evaluated Bloomington's progress with these actions and found that 81 had been started, and two had been completed. Since 2010, six more of these actions are being done, and two actions are in the planning stages. Despite numerous community efforts, Bloomington did not reach the 2012 emissions reduction goal.

Harvesting produce at Banneker Green Thumbs Garden

This plan resulted from the collaborative efforts of community members and City staff, building on the suggestions of previous Bloomington GHG inventory reports; the Monroe County Energy Plan; the Peak Oil Task Force report, "Redefining Prosperity;" and extensive subcommittee efforts. The EC now releases the continuation and culmination of the earlier works. This plan follows the updated, 2014 US Mayors' Climate Protection Agreement goal: to reduce GHG emissions to 17 percent below a 2014 baseline by 2020. After identifying incomplete action items from previous reports, this plan articulates numerous 2020 objectives and actions to achieve the updated GHG goal. To ensure continued plan success, the EC will identify unfinished objectives and actions and inventory emissions at the end of each plan period. The EC will use this information to develop new objectives and actions to meet long-term GHG reduction goals. Because this plan focuses on tasks the City can accomplish by 2020, the objectives and action items articulated within this document are not exhaustive.

Scope of the Plan

Bloomington's GHG emissions must fall rapidly to meet the 2020 goal. Governments, industries, businesses, and community members alike must work together to ensure climate change mitigation and adaptation success. Because Bloomington cannot act alone in this pursuit, this plan encourages other localities to take action as well. For these reasons, this plan does the following:

- describes GHG emission trends in Bloomington to promote informed decision-making;
- promotes collaboration among the City government, local businesses, industry, and community members to take steps to reduce GHG emissions;
- identifies policy initiatives the City government can implement to achieve reduction goals; and
- presses the city government to lead by example by reducing emissions from its own operations.

Try to leave the Earth a better place than when you arrived.

-Sidney Sheldon

This plan's objectives and action items are arranged in the following seven categories:

1. Buildings and energy
2. Transportation
3. Air quality
4. Urban ecology
5. Water
6. Food and agriculture
7. Waste

Installing a bat box at the Goat Farm

Bloomington's 2050 Vision

In the face of long-term climate change, Bloomington must re-envision building standards, energy, transportation, land-use, food production, local economic development, water consumption, and waste. In the future, specific details about how to make these changes must be articulated. In the meantime, however, the EC presents a long-term vision to guide future plans:

Bloomington will have a strong and sustainable local economy.
Green jobs will create a thriving local economy.
Bloomington's residents will live in 20-minute neighborhoods, with businesses, schools, parks, and jobs within walking and biking distance.
All buildings will be energy efficient and comfortable, powered by renewable resources like solar, wind, and geothermal.
The urban forest will be lush, with green infrastructure limiting the heat island effect while also sequestering carbon, providing habitats, and cleaning air and water.
Community members will produce zero waste.
Bloomington will be prepared for climate change, using resilient water, food, energy, and transportation infrastructures.
Bloomington residents will consume significantly more locally grown food to promote community health, encourage the local economy, and decrease pollution.
Bloomington will protect and improve its natural habitats further to promote biodiversity and food security.

Student volunteers remove invasive species

Timeline of Bloomington's Environmental Progress	
1970	First Earth Day
1971	Environmental Commission (EC) formed
1975	Bloomington Farmers' Market began
1984	Bloomington recognized as Indiana's first Tree City USA by the National Arbor Day Foundation
1989	Bloomington Bicycle and Pedestrian Safety Commission formed
1991	First Growth Policies Plan published
1992	Rio Earth Summit
	Tree Commission formed
1997	Kyoto Protocol
2001	First Bloomington Environmental Quality Indicators (BEQI) report published
2003	EC published "Towards a Comprehensive Greenspace Plan"
	EC published "Greenspace Trends in Bloomington, Indiana 1993 – 2003"
2005	US Mayors Climate Protection Agreement published
	Bloomington Commission on Sustainability (BCOS) formed
2006	Former Mayor Kruzan signed the Climate Protection Agreement
	EC published "A Framework for Developing a Greenhouse Gas Reduction Plan for Bloomington, Indiana"
2007	EC published "Greenspace Trends in Bloomington, Indiana 1993 – 2007"
	EC published the Executive Summary to the 2006 BEQI report
2009	City Council passed the Green Building Ordinance
	The Peak Oil Task Force published "Redefining Prosperity: Energy Descent and Community Resilience"
	EC published "Baseline Greenspace Inventory & Assessment: Monroe County, Indiana 1998/1999"
	EC conducted its preliminary GHG inventory
2012	The first "Local Government Operations Energy Use and Inventory" is published by the Department of Economic and Sustainable Development
2014	EC published "Greenspace Trends Report 2007 – 2011"
	Bloomington named a Gold Bicycle Friendly Community by the League of American Bicyclists
	Civil Streets initiative began
2016	Bloomington named Bird Town Indiana by the Indiana Audubon Society
2017	Solarize Bloomington initiative began

CO_2-equivalent Emissions in Bloomington in 2014

In 2014, the Bloomington community released over 1.95 million metric tons of CO_2-equivalent (CO_2-e) emissions. The buildings and energy sector, comprised of City government, businesses, industry, and residents, contributed over two-thirds to the total emissions. Opportunities for the most significant GHG emission reductions are in this sector. The transportation sector was responsible for nearly 25 percent of GHG emissions, and waste contributed eight percent to total emissions. Reaching the 2020 goal requires Bloomington to reduce emissions by 337,403 metric tons of CO_2-e emissions to 1,621,053 metric tons. This plan suggests reducing energy use in the buildings and energy sector by 20 percent, vehicle miles traveled (VMT) by 10 percent, and landfilled waste by 15 percent.

Sector	Metric tons of CO_2-e emissions in 2014	Percentage of total emissions	2020 reduction target	2020 reduction target in metric tons of CO_2-e emissions
Buildings and energy	1,340,640	68%	20%	1,072,512
Transportation	467,940*	24%	10%	421,146
Waste	149,876	8%	15%	127,395
Total	1,958,456	100%	17%	1,621,053

Figure 1. CO_2-equivalent emissions estimates for Bloomington, IN (2014). Source: *City of Bloomington Environmental Commission.*
*represents total for Monroe County in 2013.

We need to remind ourselves that our ultimate goal is not to reduce greenhouse gases or global warming per se but to improve quality of life and the environment. We all want to leave the planet in decent shape for our kids…

-Thomas P.M. Barnett

2020 Objectives

Buildings and Energy

1. Reduce energy consumption in all of Bloomington's buildings by 20 percent.
2. Promote informed energy retrofit and consumption decision-making.
3. Build a renewable energy portfolio in Bloomington.

Transportation

4. Reduce vehicle-miles traveled in Bloomington by 10 percent.
5. Ensure that all Bloomington residents have safe access to transit and can walk or bicycle to meet all non-work needs.

Air Quality

6. Conduct air sampling tests in Bloomington.

Urban Ecology

7. Measure current tree canopy coverage in Bloomington, and work to reach 40 percent coverage.
8. Promote biodiversity by protecting, enhancing, and expanding natural wildlife habitat areas.
9. Reduce energy consumption and nonpoint source pollution by implementing green infrastructure best management practices.

Water

10. Provide Bloomington residents with educational resources about why they should conserve water.
11. Fix or replace 20 miles of clay drinking water transmission piping.
12. Reduce GHG emissions from Bloomington's WWTPs.

Food and Agriculture

13. Build a resilient system of local food production and consumption.

Waste

14. Reduce the amount of waste going to the landfill by 15 percent.

Buildings and Energy

The largest contributor to Bloomington's GHG emissions is the buildings and energy sector, which accounts for two-thirds of total emissions. In 2014, Bloomington's buildings emitted about 1.3 million metric tons of CO_2-equivalents, increasing by nearly six percent from 2008 levels (Figure 2). To help achieve this plan's 17 percent GHG emissions reduction goal, Bloomington must reduce energy consumption by 20 percent from 2014 levels by 2020. Meeting this target necessitates community-wide efficiency and conservation efforts in tandem with renewable energy infrastructure developments.

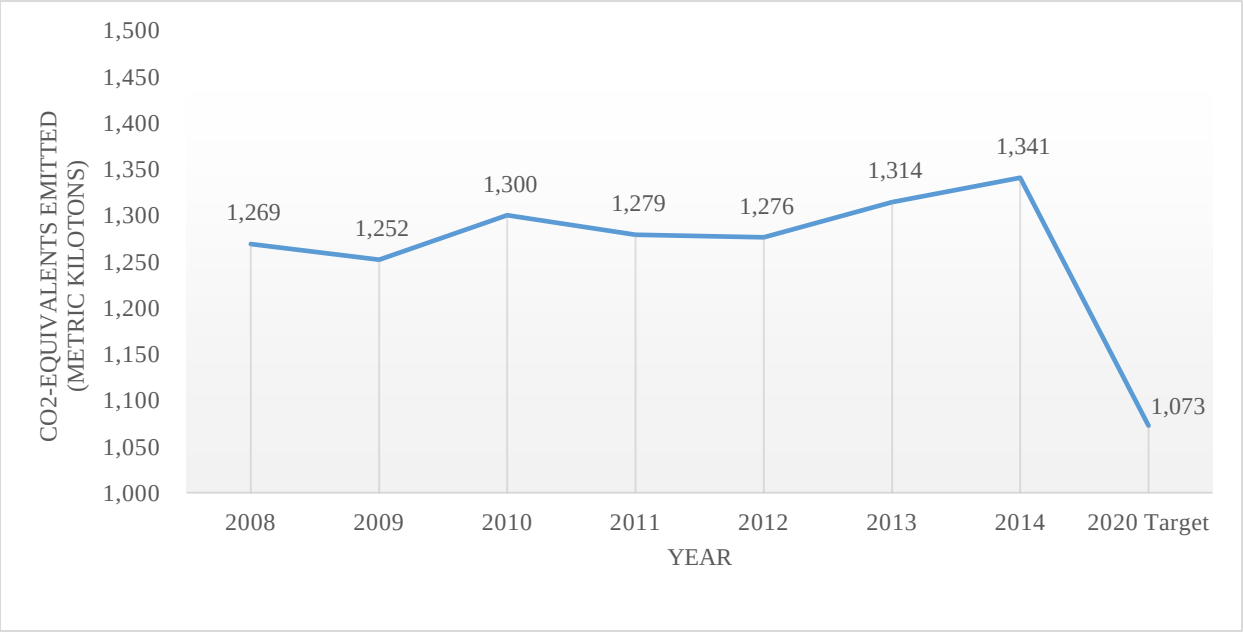

Figure 2. Bloomington energy consumption emissions in CO_2-equivalents. Source: *Bruce Calloway, Duke Energy, District Manager and Nathan Kunkler, Vectren, Senior Account Manager.*

Energy Efficiency and Conservation

Reducing Bloomington's GHG emissions requires community-wide energy efficiency and conservation efforts. Home retrofits like replacing incandescent with fluorescent or light-emitting diode (LED) bulbs, using programmable thermostats, and installing storm windows improve energy efficiency. Bloomington residents can conserve energy through simple actions like unplugging unused electronics, turning off lights when leaving rooms, and setting computer monitors to energy-saving modes. Because many of Bloomington's buildings will stand for several decades, this plan's energy efficiency and conservation objectives target both existing and future structures.

Buildings and Energy	
2020 Objective 1	**Reduce energy consumption in all of Bloomington's buildings by 20 percent.**

Bloomington's buildings must consume less energy than today to meet this plan's goal. Adopting more stringent energy standards provides one way to help limit GHG emissions. Buildings constructed prior to energy-standard changes, however, might need to be weatherized and retrofitted to meet this objective. These changes will lower GHG emissions and help save residents money in the long-run.

2020 Actions		**Responsible Party**	**Time Frame**
1.	Clarify the Green Building Ordinance to require existing City facilities to exceed commercial and residential energy efficiency standards by 10 percent.	Common Council	Medium-term
2.	Explore options to collaborate with county officials to enact more stringent building codes that require developers to design for greater energy efficiency.	Common Council and Monroe County Council	Medium term
3.	Encourage homeowners, rental property owners, and businesses to insulate or improve insulation in their attics.	Environmental Commission	Short-term
4.	Encourage landlords to offer green leases, splitting the costs and benefits of energy-saving retrofits between lessors and lessees.	Housing and Neighborhood Development	Short-term
5.	Provide residents with information about where to plant trees to maximize heating and cooling benefits.	Tree Commission and Environmental Commission	Short-term

6.	Create a "Lights Out Bloomington" education campaign to limit unnecessary energy waste from indoor lighting in commercial buildings.	Environmental Commission, Monroe County Energy Challenge	Short-term

Buildings and Energy	
2020 Objective 2	**Promote informed energy retrofit and consumption decision-making.**

Bloomington's older buildings were not constructed to meet current energy efficiency standards and might need to be retrofitted. Energy audits will determine if retrofits are necessary and identify ways to reduce energy consumption.

2020 Actions		Responsible Party	Time Frame
1.	Collaborate with County officials to create and implement an ordinance requiring energy performance ratings for all houses and multi-unit buildings upon sale and/or new lease periods.	Common Council and Monroe County Council	Long-term
2.	Collaborate with IU to create a publicly available database of utility information on rental units in Bloomington.	Economic and Sustainable Development Department, IU	Ongoing
3.	Pass an ordinance requiring sub-metering and individual unit billing of energy consumption for multi-unit buildings.	Common Council	Long-term
4.	Require the Environmental Commission Planning Committee to review City-owned construction and renovation projects, and recommend actions.	Plan Commission and Planning Dept.	Short-term

Invest in Renewable Energy

Indiana currently stands third in US coal consumption, with coal-fired power plants generating about 85 percent of the state's electricity in 2014.[7] As a result of these practices, Indiana ranks seventh in US GHG emissions.[8] Given that fossil fuel combustion causes most of this country's GHG emissions, the need for renewable energy is greater than ever.[9]

> *Here is your country. Cherish these natural wonders, cherish the natural resources, cherish the history and romance as a sacred heritage, for your children and your children's children. Do not let selfish men or greedy interests skin your country of its beauty, its riches, or its romance.*
>
> -Theodore Roosevelt

Indiana has potential for a renewable energy infrastructure comprised of wind, geothermal, and solar power. Indiana's first wind farm opened in 2008 and can generate enough energy to power 300,000 homes.[10] Ball State University installed the largest geothermal heating and cooling system in the country in 2012,[11] which will heat 47 campus buildings and save the university an estimated $2 million annually.[12] Solar power may be a viable option as well because the southern portion of the state receives upwards of four hours of direct sunlight each day.[13]

Buildings and Energy	
2020 Objective 3	**Build a renewable energy portfolio in Bloomington.**

If fossil fuels remain as Bloomington's primary energy sources, emissions will continue rising, especially as the population grows. One of the most effective ways to reduce these emissions is to rely on less carbon-intensive energy sources like wind, solar, and geothermal power. The community can begin building its renewable energy portfolio by installing solar panels on buildings. Transitioning away from fossil fuels, however, requires Bloomington to assess renewable energy generation feasibility and create an energy master plan.

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[7] U.S. Energy Information Association (EIA), "Profile," accessed June 21, 2016, http://www.eia.gov/state/?sid=IN#tabs-1.
[8] EIA, "Rankings, Total Carbon Dioxide Emissions, 2013 (million metric tons)," accessed June 21, 2016, http://www.eia.gov/state/rankings/?sid=IN#series/226.
[9] EIA, "Emissions of Greenhouse Gases in the U.S.," accessed June 21, 2016, http://www.eia.gov/environment/emissions/ghg_report/ghg_carbon.cfm.
[10] Natural Resources Defense Council (NRDC), "Indiana," accessed June 10, 2015, http://www.nrdc.org/energy/renewables/indiana.asp#footnote4.
[11] EIA, "Profile," accessed June 21, 2016, http://www.eia.gov/state/?sid=IN.
[12] Ball State University, "Nation's Largest Program of Its Kind Goes Live," accessed June 21, 2016, http://cms.bsu.edu/about/geothermal.
[13] NRDC, "Indiana," accessed June 10, 2015, http://www.nrdc.org/energy/renewables/indiana.asp#footnote13.

2020 Actions		Responsible Party	Time Frame
1.	Study the feasibility of all types of renewable energy generation in Bloomington.	Public Works	Medium-term
2.	Develop an energy master plan for the City of Bloomington.	Common Council, BCOS, EC	Long-term
3.	Install solar panels on City Hall.	Public Works	Short-term
4.	Explore funding options to purchase solar panels to sell to Bloomington residents at cost.	Public Works	Short-term

Rain gardens provide numerous benefits, including water conservation, pollution control, and pollinator habitat.

Transportation

The transportation sector accounts for approximately 24 percent of Bloomington's GHG emissions, making it the second leading emitter after the energy sector.[14] In 2013, Monroe County's vehicle miles traveled (VMT) reached an estimated 975 million miles and caused about 467,940 metric tons of CO_2 emissions.[15] Reducing emissions in this sector requires Bloomington residents to drive personal automobiles less frequently. Sprawling neighborhoods developed without nearby amenities (e.g., grocery stores, entertainment venues, schools, and workplaces) increase the need for single-occupancy vehicles, which contributes to GHG emissions. The City can ease the transition away from single-occupancy vehicles by developing alternative transportation infrastructure and urban form in tandem.

Inclusive Mobility Infrastructure

Bloomington already leads in transportation infrastructure development. The City government directs about $500,000 annually toward bicycle and pedestrian infrastructure.[16] As a result, Bloomington's bicycle lane mileage expanded by over 300 percent since 2000 and by over 80 percent since 2010 (Figure 3). Recognizing Bloomington's strides in this area, the League of American Bicyclists named Bloomington a Gold Bicycle Community in November 2014.

Bloomington has a strong public transportation system as well. Since IU started providing Bloomington Transit passes to all students in 2000,[17] annual bus ridership has increased by over 150 percent (Figure 4). These efforts promote Bloomington's long-term sustainability and resilience while also setting positive examples for the rest of the country. Despite these improvements, more work must be done in this area; IU bus ridership is declining (Figure 5) and transportation-related GHG emissions are rising.

> *Cyclists see considerably more of this beautiful world than any other class of citizens. A good bicycle, well applied, will cure most ills this flesh is heir to.*
>
> -Dr. K. K. Doty

[14] EPA, "U.S. Greenhouse Gas Inventory Report: 1990 – 2014," accessed June 21, 2016, https://www.epa.gov/ghgemissions/us-greenhouse-gas-inventory-report-1990-2014.
[15] Scott Robinson, Planning Services Manager, personal communication, October 27, 2015
[16] City of Bloomington Environmental Commission, "Commute to Work," accessed June 21, 2016, https://bloomington.in.gov/documents/viewDocument.php?document_id=2980.
[17] City of Bloomington Environmental Commission, "Public Bus Ridership in Bloomington," accessed June 21, 2016, https://bloomington.in.gov/documents/viewDocument.php?document_id=2981.

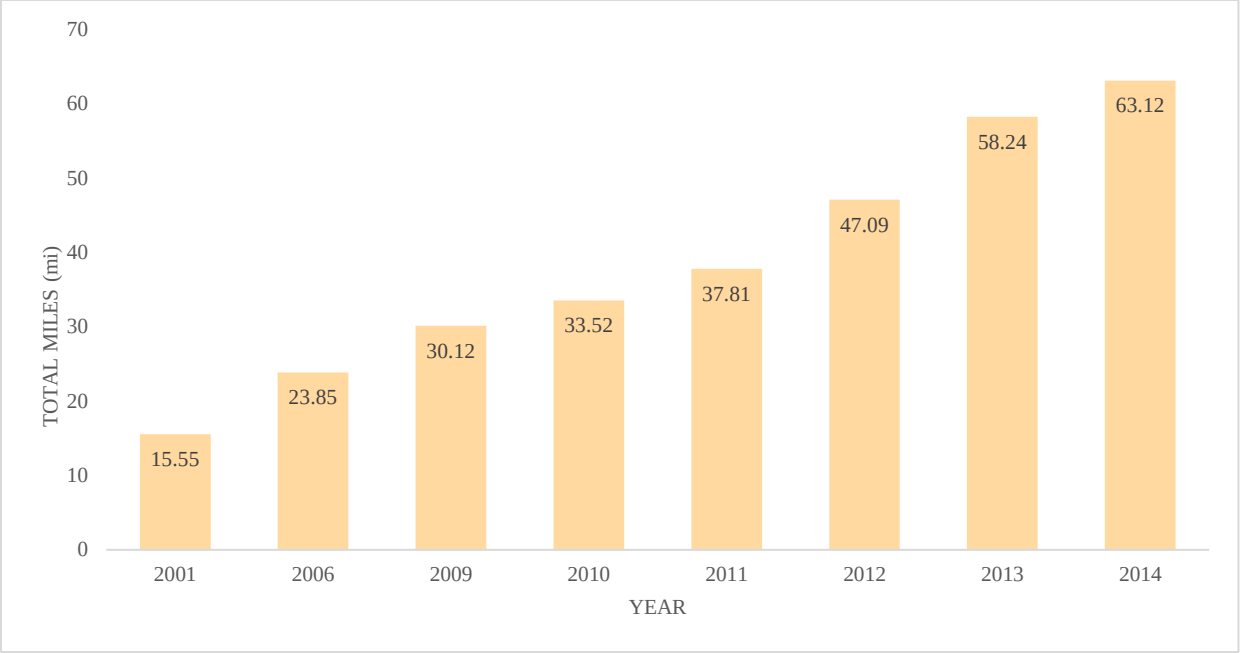

Figure 3. Bloomington bikeways, paths, and trails (2001-2014). Source*: Vince Caristo, City of Bloomington, Bicycle and Pedestrian Coordinator. Personal Communication. May 2015.*

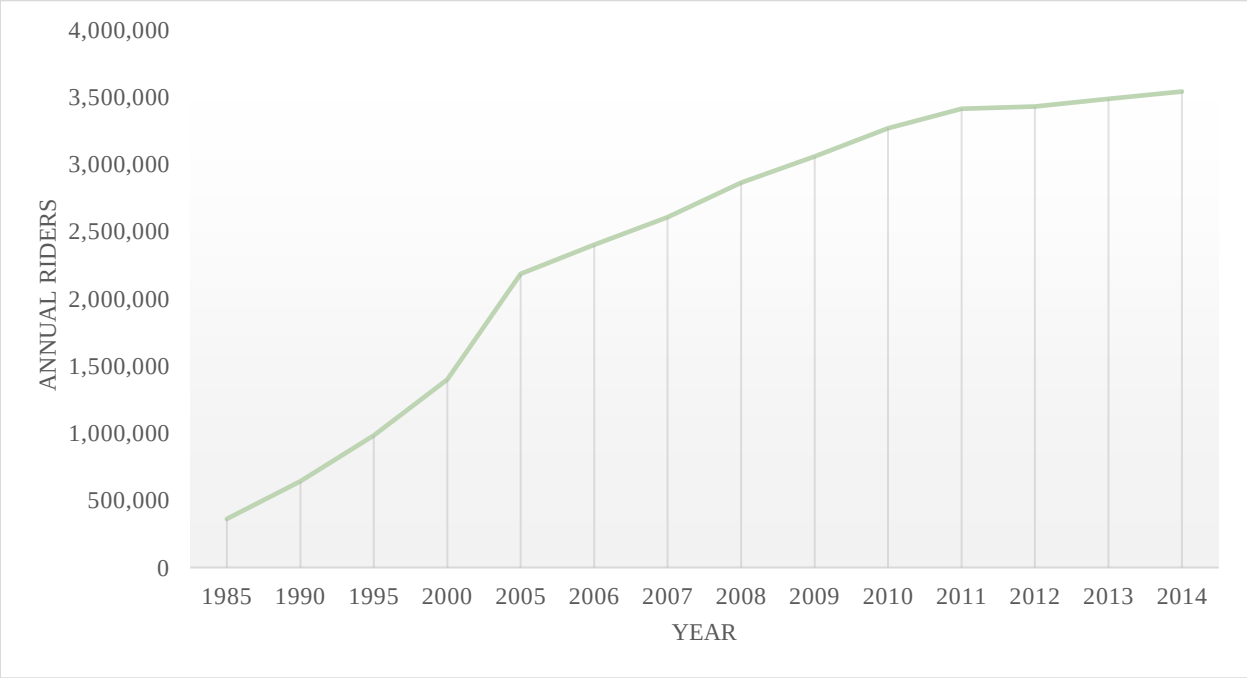

Figure 4. Total annual bus ridership for Bloomington Transit (1985-2014). Source*: Lew May (Bloomington Transit, Director). Personal Communication. June 2015.*

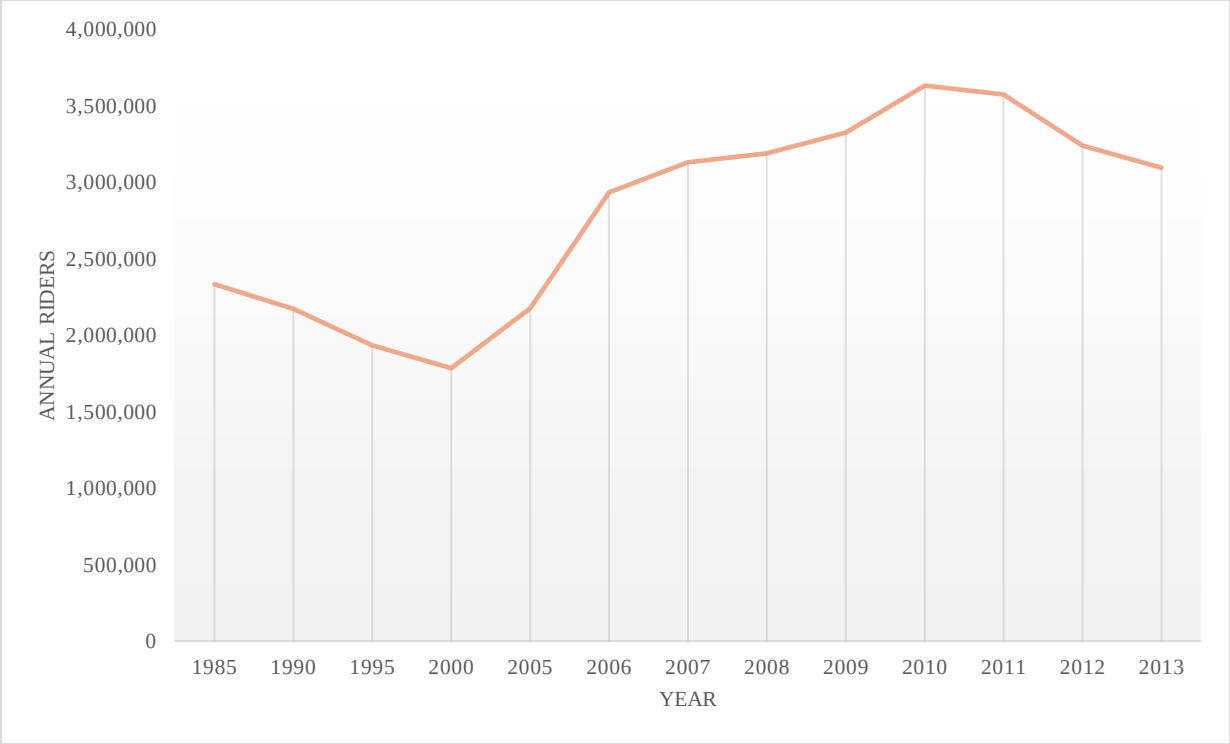

Figure 5. Total annual IU bus ridership (1985-2013). Source: *adapted to reflect calendar years from* http://iubus.indiana.edu/campus_bus/information/index.aspx

Transportation	
2020 Objective 4	**Reduce vehicle miles traveled (VMT) by 10 percent.**

In 2013, Monroe County residents drove an estimated 929 million miles, contributing 24 percent to Bloomington's total GHG emissions. Residents can help reduce these emissions significantly by driving less and relying on alternative transportation more.

2020 Actions		Responsible Party	Time Frame
1.	Promote City Hall telework and flexible hour policies to enable employees to work fewer, but longer days.	Mayor's Office	Short-term
2.	Lobby Indiana state legislators to allow Bloomington to implement a local option income tax to increase Bloomington Transit funding for bus service expansions.	Bloomington Transit, Environmental Commission	Short-term

Transportation	
2020 Objective 5	**Ensure that Bloomington residents have safe access to transit and can walk or bicycle to meet all non-work needs.**

More compact communities reduce the need for personal automobiles. Compact neighborhoods also require fewer materials because the infrastructure gets used more; more people share sidewalks, water pipes, cables, etc.

2020 Actions		Responsible Party	Time Frame
1.	Require high-destination City facilities to have covered bicycle structures.	Common Council, Plan Commission	Medium-term
2.	Make "20-Minute Neighborhoods" a core component of the updated Comprehensive Plan.	Plan Commission, Planning and Transportation	Long-term
3.	Double the amount of secure, covered bicycle storage at schools, shopping areas, and other heavy-use destinations.	Bicycle and Pedestrian Commission, Planning and Transportation	Medium- to long-term
4.	Identify pedestrian areas in the Bloomington community that lack crosswalks, crosswalk signs, sidewalks, or need repair work, and make the appropriate corrections.	Sidewalk Committee	Existing and ongoing

5.	Achieve the League of American Bicyclists Platinum Bicycle Community level.	Bicycle and Pedestrian Commission	Long-term
6.	Increase the frequency and variety of bicycle and pedestrian courses offered at City facilities.	Bicycle and Pedestrian Commission, Planning and Transportation Dept., Center for Sustainable Living	Short-term

Green roofs are more energy efficient than traditional roofs, reduce stormwater runoff, improve air quality, and promote biodiversity

Air Quality

Our lungs are our primary contact points with the environment. Each day, every human being breathes in between 50 and 60 pounds of air.[18] Clean air contains mostly oxygen and nitrogen in proportions of one to three. Air becomes polluted when human activities, especially activities linked to transportation and industry, release unwanted gases and particles into the atmosphere.[19] Many of these gases and particles threaten human and wildlife health and are federally regulated as a result. Since it is a key part of the environment, protecting air quality must necessarily be a part of the Bloomington Environmental Action Plan.

The Clean Air Act at a Glance

Environmental Commission tabling at Dunn Meadow on the IU campus

In 1970, Congress passed the Clean Air Act (CAA), which recognized air pollution as a threat to public health and welfare. This act established two federally regulated air pollutant categories: (1) criteria air pollutants and (2) hazardous air pollutants (i.e., toxics). Criteria air pollutants, regulated under the National Ambient Air Quality Standards (NAAQS), set levels for six air pollutants to provide an "adequate margin of safety" to US populations.[20] Hazardous air pollutants are "air pollutant[s]… which may reasonably be anticipated to result in an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness."[21] Regulated under the National Emission Standards for Hazardous Air Pollutants (NESHAPs), the EPA set toxics standards at levels that provide an "ample margin of safety" to protect public health and welfare.[22]

[18] Steven Ferrey, "Air Quality Regulation," in *Environmental Law*, ed. Vicki Been et al. (New York: Wolters Kluwer Law & Business, 2013), 180.
[19] Ibid.
[20] Ibid., 193.
[21] CAA §112(a)(2); 42 U.S.C. §7412(a)(1)(1977).
[22] Ibid., 129-33.

Air Quality Monitoring in Bloomington

During the 1970s and 1980s, the Indiana Department of Environmental Management (IDEM) sampled for pollutants to estimate Total Suspended Particulates (TSP) under the National Air Sampling Network (NASN).[23] Partly due to a shift in standards, IDEM discontinued TSP monitoring in the 1980s. IDEM did not resume sampling for criteria air until 2009, when they began testing for the criteria air pollutant, fine particulate matter ($PM_{2.5}$), at the Binford Elementary School. $PM_{2.5}$ results from a wide array of industrial processes and combustion activities, especially activities linked to transportation and electricity generation (EPA).

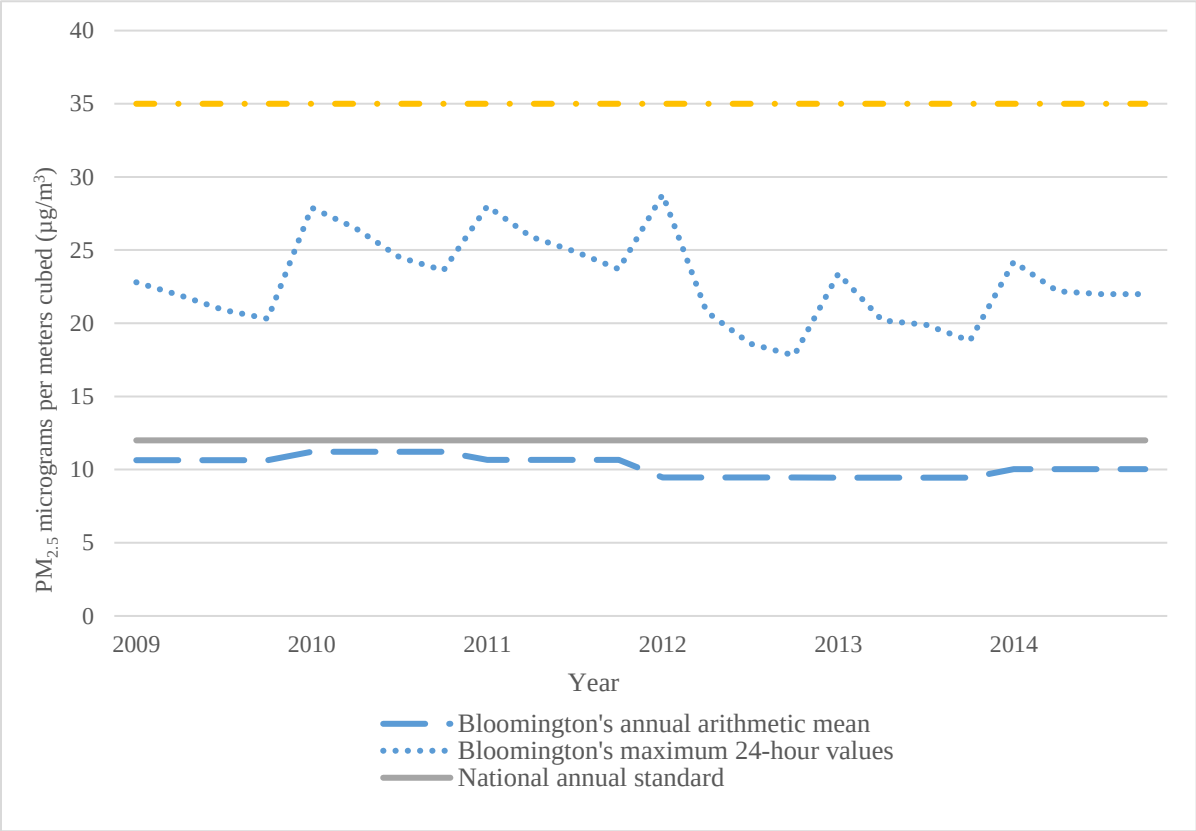

Figure 6. Bloomington's annual and 24-hour $PM_{2.5}$ measurements (2009-2014).
Source: *Lisa Wagner (IDEM, Office of Air Quality). Personal Communication. February 2015.*

[23] City of Bloomington Environmental Commission, "Air Pollution Basics," accessed June 22, 2016, https://bloomington.in.gov/documents/viewDocument.php?document_id=3004.

These fine particulates threaten human health because their small size, roughly 1/30th the width of a strand of human hair, allows them to travel deeply into the lungs and cause injury.[24] Newly tightened primary NAAQS require $PM_{2.5}$ levels not to exceed an annual arithmetic mean of 12.0 micrograms per cubic meter ($\mu g/m^3$) and 24-hour values of 35.0 $\mu g/m^3$. [25] States have until 2020 to comply, but Bloomington already meets these standards.

Air Quality	
2020 Objective 6	**Conduct air sampling and monitor air quality indicators in Bloomington.**

We cannot survive without breathing air. Breathing contaminated air can lead to negative health outcomes. To avoid this threat, we need to take steps to gauge our air quality and make the necessary improvements.

2020 Actions		Responsible Party	Time Frame
1.	Install air monitors.	IU, Citizen scientists	Long-term
2.	Develop fugitive dust containment guidelines for construction sites.	Common Council	Short-term
3.	Determine and monitor how many asthmatics are in the Bloomington community.	Monroe County Health Department	Ongoing

[24] EPA, "Frequent Questions," accessed June 22, 2016, https://www.epa.gov/pm-pollution/particulate-matter-pm-basics.
[25] EPA, "NAAQS Table," accessed July 6, 2016, https://www.epa.gov/criteria-air-pollutants/naaqs-table.

Urban Ecology

The City of Bloomington prioritizes the environment and is recognized nationally for its efforts. In 1984, the Arbor Day Foundation named Bloomington the First Tree City USA in Indiana for having the Tree Commission, a tree ordinance, an Arbor Day proclamation and observance, and an urban forestry program that budgets at least $2 per capita.[26] The tree fund goes toward new tree plantings and urban forest education, including the regularly updated Tree Care Manual. To monitor the health of the urban forest, the City inventories street trees and greenspace acreage regularly as well. This plan suggests objectives and actions that build on this progress to protect Bloomington's biodiversity and overall environmental health.

Urban Forestry

Urban forests provide numerous environmental benefits by promoting wildlife along with water and air quality. For instance, urban forests promote wildlife by providing critical habitat, contributing to biodiversity, and conserving soil. Urban forests reduce stormwater runoff and pollution that threaten waterways by filtering and absorbing rainwater.[27] Urban forests also improve air quality by limiting smog and GHG emissions. Because trees reduce summertime temperatures in cities, they can reduce smog pollution. Similarly, trees lower the need for heating and cooling by blocking winter winds and providing shade in the summertime, which limits CO_2 emissions resulting from energy consumption.[28] Trees also sequester CO_2 directly from the atmosphere as they grow and store carbon in the soil.[29]

A student volunteer conducting a tree survey by measuring DBH (diameter at breast height) of a tree at Leonard Springs Nature Park

Urban forests build community resilience and cohesion as well. For instance, healthy urban forests trees

[26] City of Bloomington, "Street Trees and Landscaping," accessed June 9, 2016, http://bloomington.in.gov/street-trees-and-landscaping.
[27] Dwyer et al., "Assessing the Benefits and Costs of the Urban Forest," *Journal of Arboriculture*, 18 (1992): 227-33.
[28] Michael Kuhns, "Planting Trees for Energy Conservation: The Right Tree in the Right Place," Utah State University, accessed June 9, 2016, http://forestry.usu.edu/htm/city-and-town/tree-selection/planting-trees-for-energy-conservation-the-right-tree-in-the-right-place.
[29] Tribal Energy and Environmental Information, "Terrestrial Sequestration of Carbon Dioxide," accessed June 9, 2016, http://teeic.indianaffairs.gov/er/carbon/apptech/terrapp/index.htm.

make neighborhoods more aesthetically pleasing and raise property values, which increases tax bases. This tax revenue can fund local infrastructure projects and schools. Stronger infrastructure makes communities more resilient in the face of severe weather, and better-funded schools set up more children for successful futures. Furthermore, tree-planting programs build community cohesion by encouraging people to work together and better their common environment.[30]

Urban Ecology	
2020 Objective 7	**Measure current tree canopy coverage in Bloomington and work to reach 40 percent coverage.**

In the Midwest, 40 percent tree canopy coverage is recommended to maximize benefits.[31] Getting to this percentage, however, first requires an analysis of current tree canopy coverage and potential tree planting efforts. Reaching this mark also means preventing tree losses in Bloomington. Developers often remove vegetation in lieu of concrete and asphalt-based infrastructure. To prevent further tree losses, especially with a growing population, Bloomington must implement and enforce more stringent standards for developers.

2020 Actions		Responsible Party	Time Frame
1.	Update codes and policies to maximize the preservation of the largest, longest-living trees, encouraging tree species age and diversity.	Common Council	Long-term
2.	Expand public and private outreach programs to provide educational resources about carbon sequestration, energy conservation, and other benefits of urban forests; and to encourage native tree planting and preservation by allocating larger budgets to the Bloomington Tree Fund, Tree Commission, and EC.	Parks and Recreation Dept., Tree Commission	Short-term
3.	Develop a policy outlining tree protection guidelines for contractors.	Tree Commission	Medium-term

[30] Dwyer et al., "Assessing the Benefits and Costs of the Urban Forest," *Journal of Arboriculture*, 18 (1992): 227-33.
[31] Davey Resource Group, "Assessing and Addressing Indiana Urban Tree Canopy: Madison, Indiana," accessed July 15, 2016, http://www.in.gov/dnr/forestry/files/fo-MadisonUTCFactSheet.pdf.

Promote Biodiversity

We are facing a crisis of declining biodiversity, which carries serious implications for our quality of life and the health of the natural world. Some of the most significant contributors to biodiversity declines are land-use changes, invasive species, and climate change.[32] Within the continental United States alone, 41.4 percent of land is used for agriculture, and between 53.6 and 55.6 percent is devoted to urban and suburban development.[33] Landscape ecologists estimate that between three and five percent of the remaining land comprises undisturbed habitat for plants and animals, existing in isolated pockets.[34] Because little habitat remains, the plants we grow affect wildlife populations directly. For instance, 90 percent of plant-eating insects are specialists, meaning their survival requires particular host plants. Furthermore, 96 percent of birds fledge their young exclusively on insects.[35]

> *It is that range of biodiversity that we must care for—the whole thing—rather than just one or two stars.*
>
> -David Attenborough

Bloomington's native wildlife populations are at risk due to current land development and management practices that destroy and remove habitats. Greenspace losses have been common over the last several decades. Since 1993, Bloomington lost over 2,000 acres, decreasing by 24 percent. Between 2007 and 2011, however, Bloomington regained nine acres of greenspace for the first time in over 20 years (Figure 7).

Pollinators are especially vulnerable to these land-use changes and are declining in population. Continued pollinator survival hinges on a few important strategies: preventing further greenspace loss and habitat fragmentation, restoring and protecting habitats, and limiting unnecessary pesticide use. Reducing habitat fragmentation requires the Bloomington community to connect habitat areas by creating wildlife corridors, which can promote the smallest species' survival.[36] The Bloomington community must also revitalize and protect habitat by planting more native species to provide food for pollinators and other wildlife. Furthermore, avoiding unnecessary pesticide use on these native plants can help prevent poisoning pollinators.

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[32] Sala et al., "Global Biodiversity Scenarios for the Year 2100," *Science* 287 (2000): 1770-1774, accessed July 5, 2016, doi: 10.1126/science.287.5459.1770
[33] Douglas W. Tallamy, *Bringing Nature Home*, (Portland: Timber Press, 2007), 27
[34] Douglas W. Tallamy, *Bringing Nature Home*, 30-31.
[35] Douglas W. Tallamy, *Bringing Nature Home*, 21.
[36] Shepherd et al, *Attracting Native Pollinators: Protecting North America's Bees and Butterflies*, (North Adams, MA: Storey Publishing, 2011), 195.

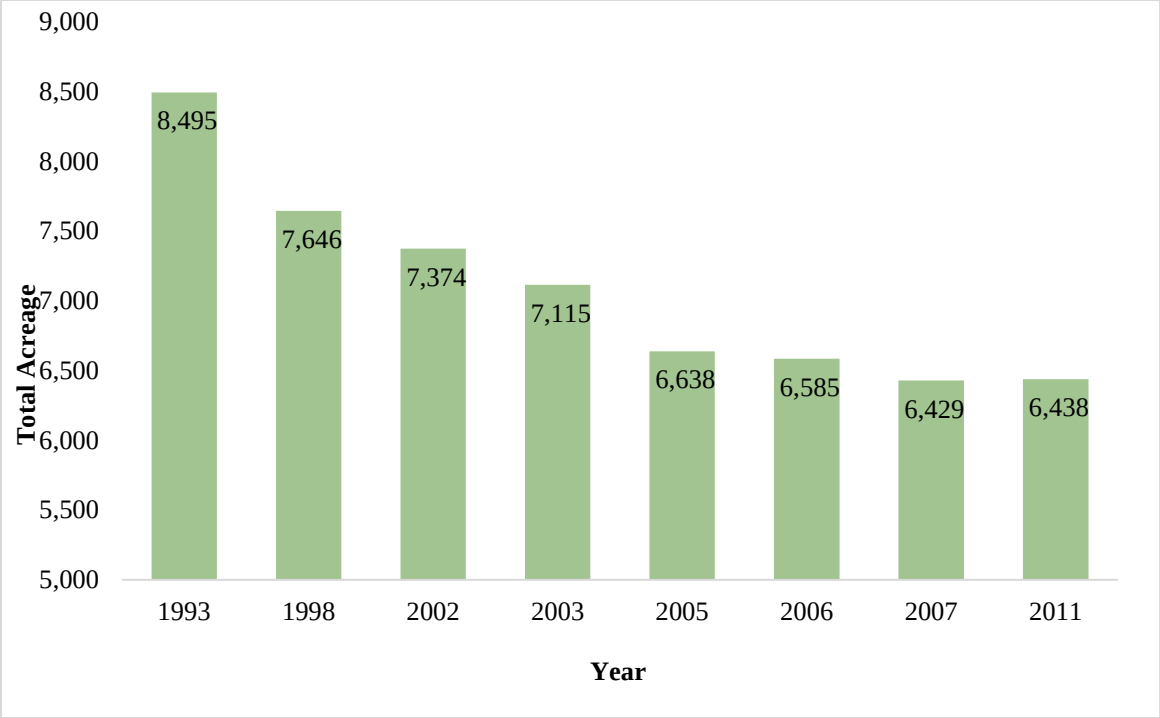

Figure 7: Total Greenspace in Bloomington (1993-2001) Source: *Adapted from Bloomington Greenspace Trends Report*

Protecting biodiversity also necessitates controlling invasive species. Invasive species are non-native organisms that outcompete, prey on, spread disease to, or prevent the reproduction of native species. [38] Invasive species can also alter food webs in ecosystems by replacing or killing native food sources and offering little to no nutritional value to wildlife. Some invasive plant species can even change ecosystem conditions by altering wildfire fuel loads and soil chemistry.[39] The City of Bloomington Parks and Recreation Department already makes efforts to control invasive plants and encourages volunteer action with its Adopt-an-Acre program. Furthermore, Chapter six in the City's Code of Ordinances makes it unlawful to have invasive species taller than eight inches on any lot or tract of ground.[40] However, more City staff, nonprofit organizations, and individuals should work to control these invasive plant species.

[38] National Wildlife Federation (NWF), "Invasive Species," accessed on June 9, 2016, https://www.nwf.org/Wildlife/Threats-to-Wildlife/Invasive-Species.aspx.
[39] Ibid.
[40] Ord. No. 12-23, § 1, 10-3-2012

Volunteers removing invasive species at Ferguson Dog Park

Waiting to take further action will lead to worse invasions, greater biodiversity losses, and higher management costs.[41]

Climate change is also a growing threat to biodiversity worldwide. Raised temperatures and precipitation changes will stress organisms, forcing them to adapt, relocate, or perish. Furthermore, climate change will likely change the frequency and intensity of disturbances like wildfires and floods, which could reduce biodiversity.[42] In response to these changes, species will likely shift their habitat ranges and growing seasons.[43] Taking all of these threats together, studies show that climate change could become the leading threat to biodiversity.[44]

Urban Ecology	
2020 Objective 8	**Promote biodiversity by protecting, enhancing, and expanding native wildlife habitat areas.**

Plant and wildlife populations are currently being threatened by land-use changes, habitat degradation, invasive species, and climate change. The Bloomington community must take steps to improve, expand, and protect its habitat areas to encourage wildlife success and environmental health in the years to come.

[41] Native American Invasive Species Network (NAISN), "General Invasive Species Information," accessed on June 9, 2016, http://www.naisn.org/information/.
[42] United Nations International Panel on Climate Change (IPCC), "Climate Change and Biodiversity," accessed June 9, 2016, https://www.ipcc.ch/pdf/technical-papers/climate-changes-biodiversity-en.pdf.
[43] Camille Parmesan & Gary Yohe, "A globally coherent fingerprint of climate change impacts across natural systems," *Nature* 421 (2003).
[44] Ibid.

2020 Actions		Responsible Party	Time Frame
1.	Pass a resolution recognizing native plant life and habitats as City assets.	EC and Common Council	Short-term
2.	Create pocket parks in Bloomington to promote wildlife mobility.	Parks and Recreation	Medium-term
3.	Become a signatory of the National Wildlife Federation's Mayors' Monarch Pledge, building upon our Certified Community Wildlife Habitat status.	EC and Mayor's Office	Short-term
4.	Identify and create policies for sensitive natural areas in need of protection.	EC, Planning and Transportation	Short-term
5.	Hire additional employees to the Parks and Recreation Department to help control invasive species in Bloomington.	Parks and Recreation, Common Council, Mayor's Office	Medium-term
6.	Provide educational resources to residents about invasive species management.	EC, Parks and Recreation, MC-IRIS	Short-term

Green Infrastructure

As Bloomington's built environment expands, the community loses greenspace to impermeable surfaces like asphalt and concrete. These surfaces create a heat island where local temperatures in the City are higher than in rural areas, which contributes to summertime smog and degraded air quality.[45] Green infrastructure, which incorporates plant life, soil, and natural processes, can help keep cities cooler by increasing shade and providing insulation.[46]

The built environment also contributes to stormwater pollution. Impermeable surfaces promote local flooding and carry chemicals from rooftops, lawns, industry, and roads to Bloomington's waterways, which diminishes water quality and threatens natural habitats. Permeable pavers and vegetation allow water to absorb into the ground and prevent this stormwater pollution. [47]

Urban Ecology	
2020 Objective 9	**Reduce energy consumption and nonpoint source pollution by implementing green infrastructure best management practices.**

Green infrastructure techniques such as rain gardens and green roofs prevent contaminated stormwater from entering Bloomington's waterways. Instead of diverting stormwater directly into streams, green infrastructural techniques allow water to be slowed down and absorbed into the earth prior to travelling away from the built environment. These techniques also promote Bloomington's community and natural ecosystems.

2020 Actions		Responsible Party	Time Frame
1.	Adopt at least one green infrastructure technique at each City facility.	Utilities and Parks and Recreation	Short-term
2.	Review and update erosion control ordinances.	Common Council	Long-term
3.	Adopt a City green infrastructure policy to manage stormwater.	Common Council, Planning and Transportation	Medium-term
4.	Promote permeable, high albedo pavement in new construction and in repair/replacement projects.	EC	Short-term
5.	Apply for grants to offer financial incentives for rain gardens in Bloomington.	CBU, EC	Long-term

[45] EPA, "Heat Island Impacts," accessed June 6, 2016, https://www.epa.gov/heat-islands/heat-island-impacts.
[46] Ibid.
[47] EPA, "What is Green Infrastructure?" accessed June 6, 2016, https://www.epa.gov/green-infrastructure/what-green-infrastructure.

Water

Water is a foundational building block of life on this planet, supporting all living creatures. In fact, water comprises about 60 percent of the typical human adult body.[48] Without water, we can only survive for a few days.[49] Although water is this planet's most abundant resource, covering nearly three-quarters of the earth's surface, only 1.2 percent of that amount is fresh and easily available for human consumption.[50] Climate change and global population growth will drain existing water supplies further, and the treatment required to support increased water consumption will raise GHG emissions and intensify pressure on infrastructure.

Climate Change and Population Growth

Climate change threatens hotter, drier warm-weather seasons and wetter cool-weather seasons in Indiana. More frequent and intense precipitation events will promote flooding and erosion in Bloomington as well. Bloomington's close proximity to its water source and Indiana's largest body of water, Lake Monroe, might encourage water complacency. Fortunately, Bloomington residents currently consume less water than the national average. According to the EPA, the average household uses about 12,000 gallons of water per month.[51] Eighty-two percent of City of Bloomington Utilities (CBU) customers use less than 5,000 gallons per household each month.[52] Regardless of Bloomington's strides in water conservation, summertime droughts might occasionally strain the water supply. For instance, the summer drought of 2012 caused increased water demand and prompted CBU to implement water restrictions due to a lack of treatment capacity.

Bloomington gained media attention recently due to elevated levels of disinfectant byproducts (DBPs) that might be carcinogenic with long-term exposure. DBPs are caused by the interaction of disinfectants like chlorine and naturally occurring organic matter.[53] This interaction is facilitated by temperature and time.[54] As temperatures rise and the longer the water sits in the pipes after the addition of disinfectants, DBP levels increase. From a treatment perspective, this potential threat can be remedied by changing disinfection point, thus reducing the amount needed and allowing the treated water to stay in the pipes for a shorter time.

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[48] United States Geological Survey (USGS), "The Water in You," last modified May 2, 2016, http://water.usgs.gov/edu/propertyyou.html.
[49] Corey Binns, "How Long can a Person Survive without Water?" last modified November 30, 2012, http://www.livescience.com/32320-how-long-can-a-person-survive-without-water.html.
[50] USGS, "How much water is there on, in, and above the earth," last modified May 2, 2016, http://water.usgs.gov/edu/earthhowmuch.html.
[51] EPA, "Indoor Water Use in the United States," last modified May 16, 2016, https://www3.epa.gov/watersense/pubs/indoor.html.
[52] Rachel Atz, City of Bloomington Utilities Water Quality Coordinator, personal communication, April 19, 2016.
[53] Rachel Atz, presentation to City of Bloomington Environmental Commission, June 1, 2016.
[54] Ibid.

Population growth will place a heavier burden on our drinking water infrastructure. Bloomington's population is expected to grow between 0.9883 and 1.6 percent each year until 2030.[55] The water needed to accommodate this growth might require our water treatment plants to increase their million gallons per day (mgd) production, worsen wear at pump, and cause water pipes to develop new leaks. Currently, a number of drinking water transmission pipes have leaks already, losing about 30 percent of the water treated by the CBU.[56]

Water consumption and loss contribute to a somewhat hidden environmental cost. Because both drinking water and wastewater treatments rely on the electrical grid, which is primarily coal-powered, they also cause GHG emissions. In 2013, water treatment and pumping accounted for 24 percent of energy use and 31 percent of total City government GHG emissions.[57] An inevitable increase in consumption will only raise these numbers. To prevent increases in emissions, Bloomington should continue conserving water during warm weather and install renewable energy infrastructure.

Water	
2020 Objective 10	**Provide Bloomington residents with educational resources about why they should conserve water.**

Limiting water consumption in Bloomington, especially during warm weather, can help reduce GHG emissions. Such reductions could also prepare residents for times when water is less available.

2020 Actions		**Responsible Party**	**Time Frame**
1.	Expand/support an education campaign in Bloomington, distributing information about the relationship between water and energy use and ways to conserve energy by conserving water.	CBU	Short-term
2.	Require all new multi-unit buildings to sub-meter their water use, so residents can better-understand their consumption habits and make informed decisions.	Common Council	Medium-term
3.	Implement conservation billing and conservation pricing for water use.	CBU	Short-term

[55] Black & Veatch, "City of Bloomington Utilities Department Water Supply Evaluation," last modified June 29, 2007, https://bloomington.in.gov/media/media/application/pdf/2400.pdf.
[56] Rachel Atz, personal communication, April 19, 2016.
[57] City of Bloomington Department of Economic & Sustainable Development, "Energy Use and Emissions Inventory for Local Government Operations: 2013 Addendum," last modified December 2014, https://bloomington.in.gov/media/media/application/pdf/23138.pdf.

Drinking Water Infrastructure

The age of many of the pipes transporting Bloomington's water supply is also a concern for CBU. Older neighborhoods in Bloomington are more likely to have lead components in their plumbing, solder, or service lines, which poses serious health risks to humans, especially children.[58] To help mitigate this issue, CBU offers free lead and copper pipe screening and replaces City-owned lead service lines. To prevent exposure to lead, CBU recommends running water for between 30 seconds and one minute to flush out water sitting in pipes.[59] Water sitting in lead pipes is more likely to have lead leachate in the water than in fresh water from the transmission lines.[60] CBU also recommends consuming tap water cold because hot water might contain metal components from water heaters.[61]

As mentioned above, old drinking water transmission pipes have leaks and lose about 30 percent of the treated water. To prevent water loss, a deterioration map will need to be created to know where infrastructure repairs should begin. With a fix-before-expand plan of action, a number of positive externalities could occur, as lowering the millions of gallons per day (mgd) average from a decrease in water loss along each transmission to the end user. This decrease in water loss will also reduce GHG emissions due to decreased water treatment needs.

Water	
2020 Objective 11	**Fix or replace 20 miles of drinking water transmission piping.**

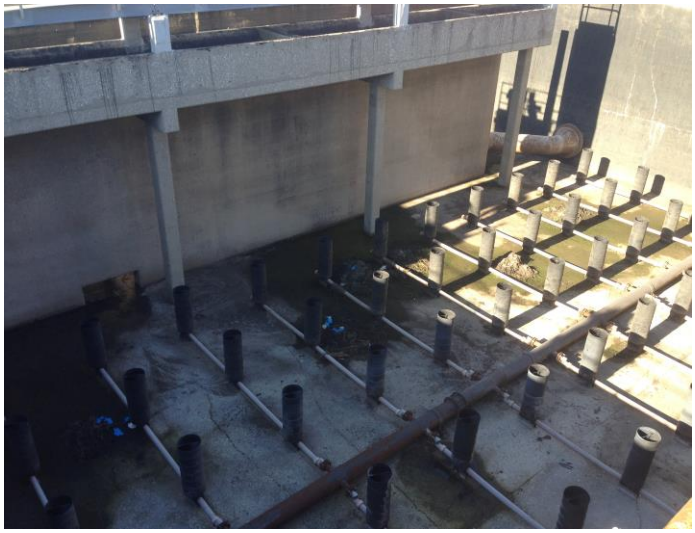
To fix or replace the oldest, leakiest pipes will help alleviate the pressures that CBU has been placing on our current system to keep the drinking water contaminates under EPA limit levels. It will also create an efficiency by reducing the amount of treated water the water treatment plant has to push out to the municipal area for use, thus lowering GHG emissions.

2020 Actions		Responsible Party	Time Frame
1.	Perform an American Water Works Association (AWWA) audit of non-revenue water.	CBU	Short-term
2.	Create and implement a leakage management plan.	CBU	Medium- to long-term

[58] Center for Diseases Control and Prevention (CDC), "Lead," last modified February 18, 2016, http://www.cdc.gov/nceh/lead/tips/water.htm.
[59] Rachel Atz, personal communication, April 19, 2016.
[60] CDC, "Lead," page last modified February 18, 2016, http://www.cdc.gov/nceh/lead/tips/water.htm.
[61] Rachel Atz, personal communication, April 19, 2016.

Wastewater Treatment

The City of Bloomington Utilities department currently operates two wastewater treatment plants (WWTPs): Blucher Poole and Dillman Road. The Blucher Poole WWTP, which began operating in 1970, has a design capacity of 6 million gallons per day and a peak capacity of 12 million gallons per day.[62] The Dillman Road WWTP began operating in 1982 and has a design capacity of 15 million gallons per day along with a peak capacity of over 30 million gallons per day.[63] Both of these WWTPs are significant contributors to Bloomington's energy use and GHG emissions. In 2013, Bloomington's WWTPs were responsible for about 24 percent of the energy consumed by and about 30 percent of the GHG emissions produced by the City government.[64]



The Dillman Road aerobic digestion basin when not in use

WWTP energy consumption depends on the type of process used. Typically, wastewater treatment follows one of two processes: aerobic or anaerobic. The more common aerobic digestion process, which is used by the City of Bloomington, uses oxygen to promote microorganism digestion of solids, pathogens, and bacteria.[65] This process produces carbon dioxide and biosolids. Anaerobic digestion, however, facilitates digestion without oxygen and produces methane-containing biogases and biosolids.[66] Anaerobic treatment, when feasible, tends to be less costly than the alternative because energy-intensive air blowers are not required. Furthermore, the methane produced during this process can be used to fuel WWTP electricity generation or digester heating.[67]

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[62] City of Bloomington, "Blucher Poole Wastewater Treatment Plant," accessed May 24, 2016, https://bloomington.in.gov/documents/viewDocument.php?document_id=3694.
[63] City of Bloomington, "Dillman Road Wastewater Treatment Plant," accessed May 24, 2016, https://bloomington.in.gov/documents/viewDocument.php?document_id=3695.
[64] City of Bloomington Department of Economic & Sustainable Development, "Energy Use and Emissions Inventory for Local Government Operations: 2013 Addendum," last modified December 2014, https://bloomington.in.gov/media/media/application/pdf/23138.pdf.
[65] Stillwell et al., "Energy Recovery from Wastewater Treatment Plants in the United States: A Case Study of the Energy-Water Nexus," *Sustainability*, accessed May 27, 2016, http://www.mdpi.com/2071-1050/2/4/945.
[66] Ibid.
[67] Food and Agriculture Organization of the United Nations (FAO), "Chapter six: Aerobic versus anaerobic wastewater treatment," accessed May 24, 2016, http://www.fao.org/docrep/t0541e/T0541E08.htm.

Of the roughly 16,000 municipal WWTPs in the US, only 544 use anaerobic digestion.[68] Anaerobic treatment represents a lost opportunity for much of the United States to save energy and limit GHG emissions. The City of Bloomington should investigate strategies to limit its WWTP energy consumption and emissions and study the feasibility of using anaerobic treatment processes.

Water	
2020 Objective 12	**Reduce GHG emissions from Bloomington's WWTPs.**

Bloomington's WWTPs are energy-intensive and significant contributors to the City's GHG emissions. To reduce energy consumption and GHG emissions, CBU should study ways to increase efficiency, including the possibility of using anaerobic wastewater treatment.

2020 Actions		Responsible Party	Time Frame
1.	Study the feasibility of anaerobic wastewater treatment in Bloomington.	CBU	Short-term

At the Dillman Road WWTP, sodium hypochlorite is used to disinfect water. Ultra-violet (UV) light is used to disinfect water at Blucher Poole WWTP.

[68] Bae et al., "Domestic Wastewater Treatment as a Net Energy Producer – Can This be Achieved?" Environmental Science and Technology, accessed May 27, 2016, https://www.researchgate.net/publication/51485659_Domestic_Wastewater_Treatment_as_a_Net_Energy_Producer-Can_This_be_Achieved.

Food and Agriculture

Large-scale agricultural machinery and agrochemical developments have transformed this country's food system over the last century. One hundred years ago, prior to this industrialization, nearly half of the US population made their livings as farmers.[69] Today, agricultural jobs make up less than two percent of the workforce. As a result of this shift, farming is separated from our communities. For instance, our food travels an average of 1,500 miles from the farm to the plate. Furthermore, less than five percent of the food consumed in Bloomington comes from Indiana, and less than two percent comes from within city limits or the surrounding counties.[70] Transporting food across these vast distances depends on fossil-fuel-based transportation, which contributes to GHG emissions. Reducing these emissions and improving community resilience requires Bloomington to increase both local food production and consumption.

Purchasing food directly from farmers at the Bloomington Community Farmers' Market

Not only does food transportation contribute to GHG emissions, but industrial agriculture relies on fossil fuels in nearly every stage of food production. For instance, most nitrogen fertilizers are derived using natural gas, and many pesticides are derived from natural gas and oil. Beyond these chemical treatments, most industrial farming machinery is energy-intensive. The machinery used for tilling, planting, fertilizing, irrigating, spraying pesticides, and harvesting runs on fossil fuels. Due to these practices, an estimated 17 percent of American energy use is taken up by our food system.[71]

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[69] Dimitri et al., "The 20th Century Transformation of U.S. Agriculture and Farm Policy," USDA, accessed on July 6, 2016, 2.
[70] Bloomington Peak Oil Task Force, "Redefining Prosperity: Energy Descent and Community Resilience," accessed June 22, 2016, 173, https://bloomington.in.gov/media/media/application/pdf/6239.pdf.
[71] Ibid., 174.

Eating In and For the Community

Food production remains an abstract idea for many Americans. Many people do not consider where and how their food was produced, where it was processed, whether chemicals were used during production, etc. At best, many people only count the number of miles their food travels from the grocery store to their plate. To protect our environment and improve community resilience, we must enlarge our perspective on the true cost of food.

Producing more food locally promotes community resilience by being more self-sufficient and less environmentally damaging, especially regarding processing, packaging, and shipping practices that produce waste. Furthermore, local food consumption has the added benefit of improving community health by providing essential nutrients, combatting obesity, and preventing diseases related to poor diets.

Bloomington has already made strides promoting local food. The summer and winter farmers' markets ensure year-round access to local food. In addition, the Bloomington Food Policy Council (BFPC) created a food charter that supports local food production, food security, and sustainability in all aspects of food production and consumption. The Bloomington Common Council adopted this charter in April 2015, and the Monroe County Commissioners adopted it in August 2015.

Buying local food is about community just as much as it's about food.
Photo credit: Merrill Hatlin

Food and Agriculture	
2020 Objective 13	**Build a resilient system of local food production and consumption.**

Encouraging Bloomington residents to consume less long-distance food will help decrease GHG emissions and waste while also promoting the local economy. Consuming fresh, local food also helps improve community health by providing essential nutrients, combating obesity, and preventing diseases related to poor diets.

2020 Actions		Responsible Party	Time Frame
1.	Support the creation of a local food hub.	BFPC, City Council	Medium-term
2.	Add additional community gardens to encourage Bloomington residents to grow and consume more local food.	Parks and Recreation	Medium-term
3.	Begin an education campaign informing Bloomington residents of the environmental impacts of food production, transportation, and waste to promote subsistence farming, local food consumption, and pollinator protection.	BFPC, EC	Short-term
4.	Work alongside the BFPC on a food action plan.	EC and BFPC	Short-term
5.	Revise the City's urban agriculture regulations to make urban farming easier.	Common Council and Planning and Transportation	Short-term
6.	Enhance education about the ways pollinators are a necessity to growing food.	Planning and Transportation, Parks and Recreation, EC	Short-term

The concept of being a locavore, or one who chooses whenever possible to incorporate local grown or locally produced food into one's nutrition plan, is of great importance.

-Tyler Florence

Waste

Landfilled waste accounts for approximately eight percent of Bloomington's GHG emissions, releasing about 150,000 metric tons of carbon dioxide equivalents in 2014 (Figure 8). Not only do household discards contribute to the release of GHGs like methane, but the transportation of the waste also makes a substantial contribution. Since the Monroe County Landfill's closure in 2004, the majority of Bloomington's solid waste travels 55 miles to Sycamore Ridge Landfill in Vigo County.[72] To reduce these emissions, this plan encourages Bloomington residents to reduce the volume of solid waste they produce.

Aluminum cans being processed for recycling at Ray's Recycling in Indianapolis

Each year, Monroe County residents produce just over 150,000 metric tons of trash (Figure 9).[73] Three strategies to reduce this tonnage and the resulting GHG emissions include reducing, reusing, and recycling. Bloomington already has a successful recycling program with rates higher than the national average. In 2014, Bloomington's recycling rate amounted to 36 percent, compared to a national average of about 34 percent (Figure 10).[74] However, this statistic does not include most apartment complexes or businesses, or IU. Reducing landfilling rates and the resulting GHG emissions requires recycling participation expansions to areas not included in the current curbside recycling program.

Another waste-reducing strategy is composting. According to the EPA, about 96 percent of the food waste we throw away could be composted.[75] Composting involves organic material like non-meat food scraps and yard wastes, which are broken down into nutrient-rich soils.[76] Not only does composting improve soil quality, thus promoting Bloomington's natural environment, but it also prevents unnecessary waste from going to the landfill. For these reasons, this plan promotes curbside composting programs and education efforts in tandem.

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[72] City of Bloomington Environmental Commission, "Waste Management Basics," accessed June 22, 2016, https://bloomington.in.gov/documents/viewDocument.php?document_id=2998.
[73] Shelby Walker, City of Bloomington Sanitation Director, personal communication, May 2015.
[74] EPA, "Advancing Sustainable Materials Management: Facts and Figures," accessed June 22, 2016, http://www.epa.gov/wastes/nonhaz/municipal/index.htm.
[75] EPA, "Together, We Can Make a Difference," accessed June 22, 2016, https://www.epa.gov/sites/production/files/2015-09/documents/advncng_smm_infogrphc.pdf.
[76] City of Bloomington Environmental Commission, "Waste Management Basics," accessed June 22, 2016, https://bloomington.in.gov/documents/viewDocument.php?document_id=2998.

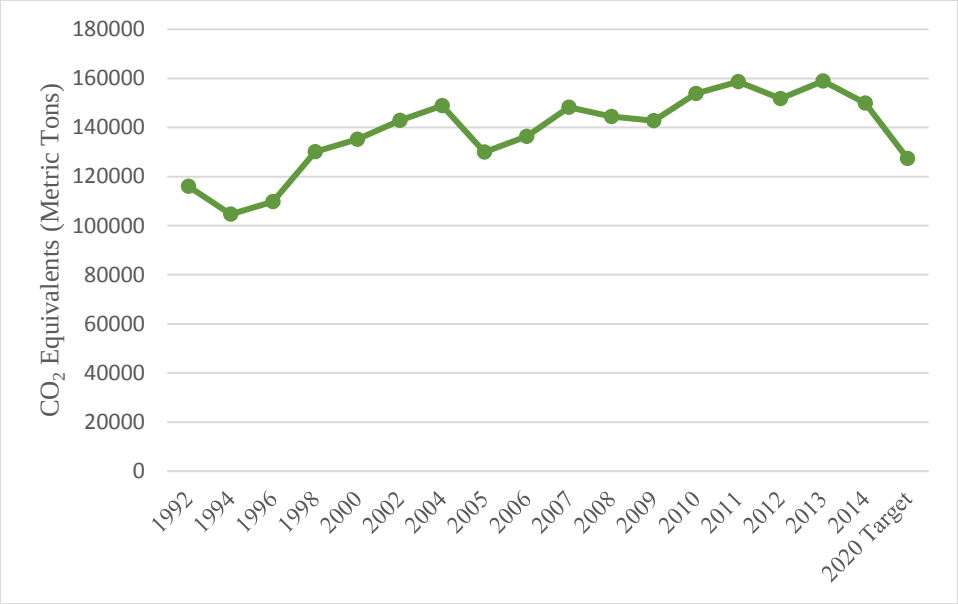

Figure 8. Bloomington greenhouse gas emissions from landfill methane production, 1992-2014. Source: *City of Bloomington Environmental Commission*.

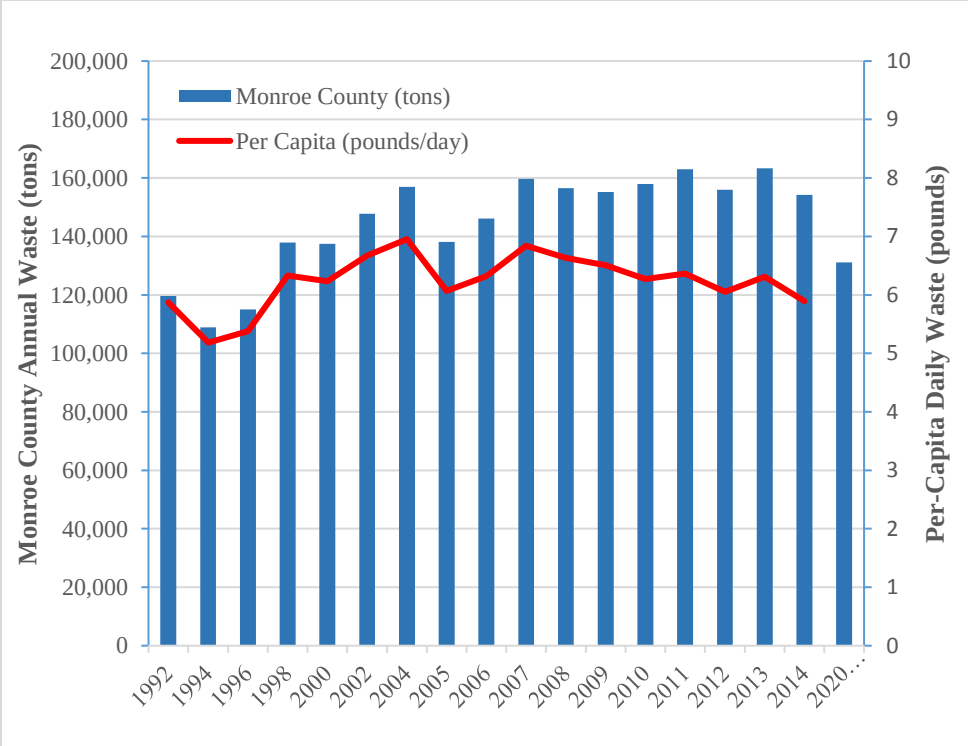

Figure 9. Monroe County estimated solid waste generation, 1992-2014. Source: *Nicholas Staller, Indiana Department of Environmental Management (IDEM), Nov. 17, 2015.*

Waste	
2020 Objective 14	**Reduce the amount of waste going to the landfill by 15 percent.**

Limiting residential and commercial waste can help reduce GHG emissions and even promote the natural environment. Curbside organic pickups can keep compostable materials out of the regular waste stream, allowing that organic waste to be transformed into healthy soil that promotes new plant growth. Furthermore, limiting or even banning some non-biodegradable wastes can help promote the natural environment.

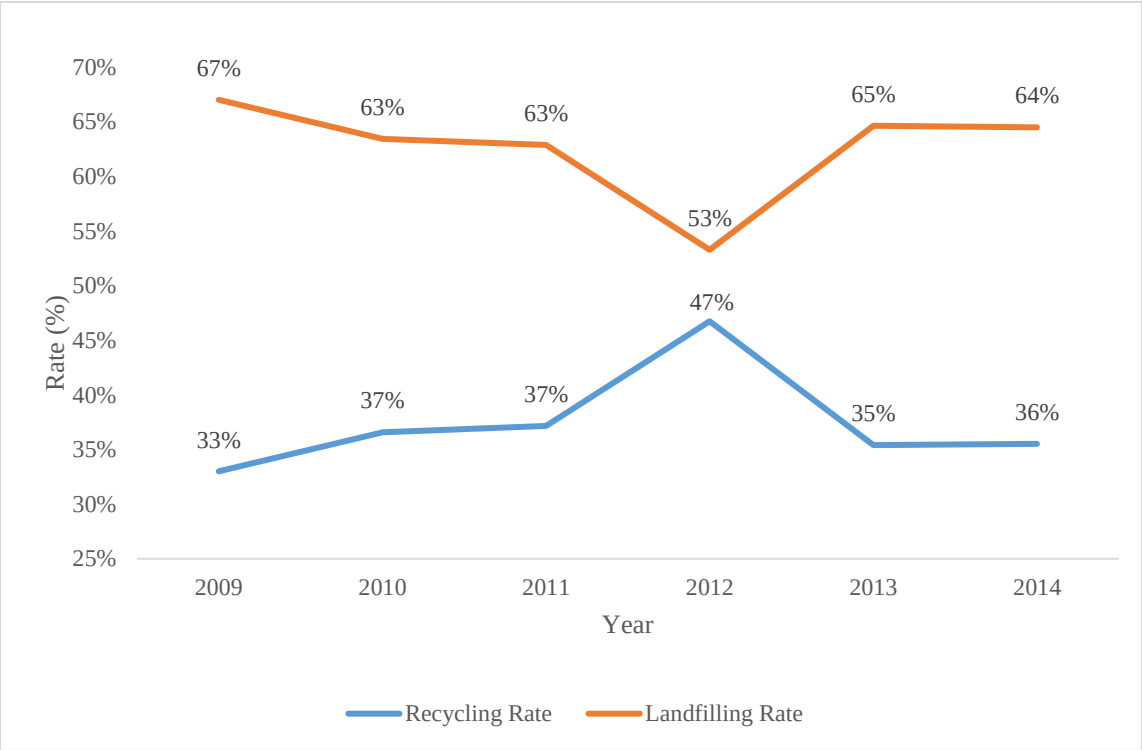

Figure 10. Bloomington's annual landfilled and recycled waste rates (2009-2014). Source: *Shelby Walker (City of Bloomington Sanitation, Director), personal communication, May 2015.*

2020 Actions		Responsible Party	Time Frame
1.	Support the creation of a compost facility.	MCSWD, EC	Long-term
2.	Educate the public about indoor and outdoor food composting, demonstrating the environmental benefits of a potential organic waste pickup program.	HAND, EC, BCOS, MCSWMD	Short-term
3.	Expand recycling curbside pick-up in Bloomington.	EC, Sanitation	Medium-term
4.	Require all multi-unit buildings to have adequate recycling facilities.	Common Council	Short-term
5.	Pass an ordinance requiring recycling for City permits for events.	Common Council	Short-term
6.	Create a master recycler program.	Sanitation and MCSWD	Long-term
7.	Promote using deconstruction services for developer and residents' demolition and reconstruction projects.	Sanitation and MCSWD	Short-term

The case for recycling is strong. The bottom line is clear. Recycling requires a trivial amount of our time. Recycling saves money and reduces pollution. Recycling creates more jobs than landfilling or incineration. And a largely ignored but very important consideration, recycling reduces our need to dump our garbage in someone else's backyard.

-David Morris of the Institute for Local Self-Reliance

HOLT 310SG

Appendix I: Glossary

- Aerobic: occurring in the presence of oxygen
- Anaerobic: occurring without the presence of oxygen
- Biodiversity: biological diversity – a variety of life.
- Carcinogenic: a substance that could potentially cause cancer.
- CO_2-equivalents: a measure to compare greenhouse gases by their global warming potential.
- Climate change: a significant change in the climate (e.g., changes in temperature, precipitation, wind patterns, etc.) that lasts for an extended period of time.
- Disinfectant byproducts: DBPs are caused by the interaction of disinfectants like chlorine and naturally occurring organic matter.
- Energy conservation: using less energy.
- Energy efficiency: delivering the same amount of services for less energy or delivering more services for the same amount of energy.
- Environmental refugees: a person who is displaced due to environmental causes like natural disaster and land loss.
- Fossil fuels: fuels like gas, coal, and oil that were formed from plant and animal matter.
- Green infrastructure: Green infrastructure incorporates plant life, soil, and natural processes to manage stormwater. Some examples include permeable pavers that allow water to absorb into the ground, green (i.e., vegetated) roofs, rain gardens, and trees/foliage.
- Greenhouse gases: gases that trap heat in the atmosphere and contribute to climate change. These include carbon dioxide, methane, nitrous oxide, and fluorinated gases.
- Greenspace: an area that is more than ten feet from any manmade development, is greater than one contiguous acre, and comprises permeable surfaces like grass, trees, and shrubbery.[77]
- Invasive species: non-native organisms that outcompete, prey on, spread disease to, or prevent the reproduction of native species.
- Renewable energy: an energy source that can be replenished, including wind, solar, and geothermal energy.
- Urban sprawl: low-density housing development expansions from city centers.
- Urban heat island effect: local temperatures in cities are higher than in surrounding rural counterparts.
- Wildlife corridors: linking two or more areas of habitat with vegetation.

[77] City of Bloomington Environmental Commission, "Greenspace Trends Report 2007-2011," accessed July 15, 2016, https://bloomington.in.gov/media/media/application/pdf/19821.pdf.

Appendix II: GHG Inventory Methodology

Electricity Consumption

Duke Energy distributes electricity to customers in Monroe County. Duke Energy representatives provided the EC with total kilowatt-hours (kWh) sold to their customers in the following sectors: commercial, government, industrial, residential, and unknown. These kWh totals appear in the chart below. To calculate carbon emissions from this electricity generation, this inventory uses the EPA Greenhouse Gas Equivalencies calculator available at https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator. The calculated CO_2-equivalents generated from this electricity generation follow the raw, kWh data chart.

Energy usage from Duke Energy--for the Bloomington District (which includes Ellettsville)

2014 billing activity

Customer Type	Number of Accounts	Total kWhs	Change in usage from previous year	% of Total Use	Total Cost	% of Total Cost	Cost per kWh
Commercial	5,939	421,254,282	0.97%	27.78%	$41,237,567	26.88%	$0.10
Government	730	341,460,258	1.25%	22.51%	$28,542,639	18.60%	$0.08
Industrial	88	194,519,782	3.79%	12.83%	$16,834,250	10.97%	$0.09
Residential	49,374	545,028,425	2.90%	35.94%	$65,593,901	42.75%	$0.12
Unknown	68	14,332,522	-9.84%	0.95%	$1,214,597	0.79%	$0.08
Totals	**56,199**	**1,516,595,269**	**1.96%**	**100.00%**	**$153,422,954**	**100.00%**	**$0.10**

2013 billing activity

Customer Type	Number of Accounts	Total kWhs	Change in usage from previous year	% of Total Use	Total Cost	% of Total Cost	Cost per kWh
Commercial	6,030	417,209,171	-1.49%	28.05%	$38,341,569	27.11%	$0.09
Government	696	337,260,371	-3.54%	22.67%	$26,483,498	18.72%	$0.08
Industrial	88	187,425,166	-4.55%	12.60%	$15,374,603	10.87%	$0.08
Residential	48,799	529,684,604	2.49%	35.61%	$59,950,275	42.39%	$0.11
Unknown	26	15,896,097	6.44%	1.07%	$1,288,501	0.91%	$0.08
Totals	**55,639**	**1,487,475,409**	**-0.92%**	**100.00%**	**$141,438,446**	**100.00%**	**$0.10**

2012 billing activity

Customer Type	Number of Accounts	Total kWhs	Change in usage from previous year	% of Total Use	Total Cost	% of Total Cost	Cost per kWh
Commercial	6,083	423,539,852	-0.83%	28.21%	$35,995,771	27.20%	$0.08
Government	706	349,619,532	-2.37%	23.29%	$25,195,560	19.04%	$0.07
Industrial	90	196,361,165	1.92%	13.08%	$14,674,781	11.09%	$0.07
Residential	48,629	516,791,532	-4.64%	34.42%	$55,381,043	41.85%	$0.11
Unknown	24	14,934,629	-6.77%	0.99%	$1,100,453	0.83%	$0.07
Totals	**55,532**	**1,501,246,710**	**-2.25%**	**100.00%**	**$132,347,608**	**100.00%**	**$0.09**

2011 billing activity

Customer Type	Number of Accounts	Total kWhs	Change in usage from previous year	% of Total Use	Total Cost	% of Total Cost	Cost per kWh
Commercial	6,047	427,068,987	0.77%	27.81%	$34,701,986	26.83%	$0.08
Government	695	358,091,166	-2.52%	23.32%	$24,240,342	18.74%	$0.07
Industrial	91	192,664,588	-0.46%	12.55%	$13,848,821	10.71%	$0.07
Residential	48,411	541,914,288	-4.81%	35.29%	$55,441,158	42.86%	$0.10
Unknown	53	16,018,804	-40.11%	1.04%	$1,131,699	0.87%	$0.07
Totals	**55,297**	**1,535,757,833**	**-2.84%**	**100.00%**	**$129,364,007**	**100.00%**	**$0.08**

2010 billing activity

Customer Type	Number of Accounts	Total kWhs	Change in usage from previous year	% of Total Use	Total Cost	% of Total Cost	Cost per kWh
Commercial	5723	423,789,718	5.21%	26.81%	$32,292,631	25.95%	$0.08
Government	705	367,350,121	-1.87%	23.24%	$23,446,319	18.84%	$0.06
Industrial	86	193,545,454	13.06%	12.24%	$13,053,479	10.49%	$0.07
Residential	48,184	569,282,047	10.28%	36.01%	$53,680,605	43.13%	$0.09
Unknown	385	26,746,692	35.86%	1.69%	$1,976,141	1.59%	$0.07
Totals	**55,083**	**1,580,714,032**	**6.50%**	**100.00%**	**$124,449,175**	**100.00%**	**$0.08**

2009 billing activity

Customer Type	Number of Accounts	Total kWhs	Change in usage from previous year	% of Total Use	Total Cost	% of Total Cost	Cost per kWh
Commercial	5,986	402,799,860	-6.85%	27.14%	$31,032,201	26.29%	$0.08
Government	705	374,353,554	1.56%	25.22%	$24,074,688	20.40%	$0.06
Industrial	95	171,191,560	-5.65%	11.53%	$11,517,811	9.76%	$0.07
Residential	47,903	516,200,450	-3.12%	34.78%	$49,989,564	42.36%	$0.10
Unknown	307	19,686,887	702.54%	1.33%	$1,406,141	1.19%	$0.07
Totals	**54,996**	**1,484,232,311**	**-2.21%**	**100.00%**	**$118,020,405.00**	**100.00%**	**$0.08**

2008 Billing Activity

Customer Type	Number of Accounts	Total kWhs	Change in usage from previous year	Percent of total use	Total Cost	Percent of total cost	Cost per kWh
Commercial	6,076	432,406,085	NA	28.49%	$31,260,686	27.48%	$0.07
Government	686	368,590,375	NA	24.29%	$22,202,447	19.52%	$0.06
Industrial	97	181,442,287	NA	11.95%	$11,501,294	10.11%	$0.06
Residential	47,378	532,842,259	NA	35.11%	$48,590,358.79	42.72%	$0.09
Unknown	98	2,453,072	NA	0.16%	$193,631	0.17%	$0.08
Totals	**54,335**	**1,517,734,078**	**NA**	**100.00%**	**$113,748,416.79**	**100.00%**	**$0.07**

Bloomington community electricity consumption (kwh) per account								
		2008	2009	2010	2011	2012	2013	2014
Commercial		71,166	67,290	74,050	70,625	69,627	69188.91725	70930.1704
Government		537,304	530,998	521,064	515,239	495,212	484569.4986	467753.7781
Industrial		1,870,539	1,802,016	2,250,529	2,117,193	2,181,791	2129831.432	2210452.068
Residential		11,247	10,776	11,815	11,194	10,627	10854.41513	11038.77395
Unknown		25,031	64,127	69,472	302,242	622,276	611388.3462	210772.3824

Bloomington community electricity consumption (kwh) by sector								
		2008	2009	2010	2011	2012	2013	2014
Commercial		432,406,085	402,799,860	423,789,718	427,068,987	423,539,852	417,209,171	421,254,282
Government		368,590,375	374,353,554	367,350,121	358,091,166	349,619,532	337,260,371	341,460,258
Industrial		181,442,287	171,191,560	193,545,454	192,664,588	196,361,165	187,425,166	194,519,782
Residential		532,842,259	516,200,450	569,282,047	541,914,288	516,791,532	529,684,604	545,028,425
Unknown		2,453,072	19,686,887	26,746,692	16,018,804	14,934,629	15,896,097	14,332,522
Totals		1,517,734,078	1,484,232,311	1,580,714,032	1,535,757,833	1,501,246,710	1,487,475,409	1,516,595,269
% Change from previous year			-2.21%	6.50%	-2.84%	-2.25%	-0.92%	1.96%

	% Change from 2008 to 2014
Commercial	-2.58%
Government	-7.36%
Industrial	7.21%
Residential	2.29%
Unknown	484.27%
Totals	-0.08%

Electricity Generation CO2-equivalent Emissions

Sector	2006	2007	2008	2009	2010	2011	2012	2013	2014
Commerical			298,166	277,751	292,225	294,486	292,052	287,687	290,476
Government			254,162	258,136	253,307	246,922	241,080	232,558	235,454
Industrial			125,114	118,045	133,459	132,852	135,401	129,239	134,131
Residential			367,422	355,947	392,549	373,678	356,354	365,245	375,825
Unknown			1,692	13,575	18,443	11,046	10,298	10,961	9,883
Totals			1,046,556	1,023,454	1089983	1,058,984	1,035,185	1,025,690	1,045,769
%Δ				-2.207430849	6.50043871	-2.84398931	-2.247342736	-0.917227355	1.957609024

Natural Gas Consumption

The Vectren Corporation distributes natural gas to the Bloomington area. Representatives from the Vectren Corporation provided the EC with therm (thm) data for customers in Bloomington in the following sectors: commercial, industrial, residential, transportation, and company use. To calculate carbon emissions from sold thms, this inventory uses the EPA Greenhouse Gas Equivalencies Calculator. Raw thm and calculated carbon emissions appear in the following tables.

Bloomington Data Request

*This includes billed data for the Bloomington zip codes: 47401, 47402, 47403, 47404, 47405, 47406, 47407, 47408

In Therms

Year	Commercial	Industrial Sales	Residential	Transportation	Company Use	Total (Therms)
2006	9,413,253	96,743	17,709,347	7,589,660	948,566	35,757,569
2007	9,643,324	100,982	18,349,369	7,760,630	740,502	36,594,808
2008	10,436,463	103,352	19,958,673	10,902,720	571,837	41,973,045
2009	10,226,887	85,487	19,049,368	13,171,800	577,234	43,110,776
2010	9,956,783	305,940	18,778,711	10,145,150	440,927	39,627,512
2011	10,007,362	76,637	18,591,976	12,295,880	547,626	41,519,481
2012	8,444,924	64,933	15,454,449	20,953,820	531,520	45,449,645
2013	10,180,592	74,749	19,184,576	24,484,710	536,473	54,461,100
2014	11,746,503	75,174	21,679,820	21,415,110	699,083	55,615,690

*2012 Company Use contains estimated data

Natural Gas Consumption CO2-equivalent Emissions

Sector	2006	2007	2008	2009	2010	2011	2012	2013	2014
Commerical	49,909	51,129	55,334	54,223	52,791	53,059	44,775	53,977	62,280
Industrial	513	535	548	453	1,622	406	344	396	399
Residential	93,895	97,288	105,821	101,000	99,565	98,575	81,939	101,717	114,946
Transportation	40,240	41,147	57,806	69,837	53,790	65,193	111,097	129,818	113,543
Company Use	5,029	3,926	3,032	3,060	2,338	2,904	2,818	2,844	3,703
Totals	189,586	194,025	222,541	228,573	210,106	220,137	240,973	288,752	294,871
%Δ		2.34141762	14.69707512	2.710511771	-8.079257	4.774256804	9.465014968	19.82753255	2.119119521

Landfilled Waste

The Indiana Department of Environmental Management (IDEM) maintains quarterly solid waste reports across the state. Monroe County municipal solid waste (MSW) yearly totals for 1992 to 1998 came from the "1998 Summary of Indiana Solid Waste Facility Data" report. Totals from 1998 to 2006 came from the "2006 Indiana Solid Waste Facility" report. Data from 2007 to 2008 came from "2008 Annual Report: Solid Waste Facilities." After 2008, IDEM stopped producing these reports but still kept track of MSW data. A representative from the IDEM Office of Land Quality provided the EC with these data, ranging from 2009 to 2014. These data include waste tonnages from municipal solid waste (MSW) facilities and transfer stations. To gather solid waste totals for only Monroe County, data for other counties and transfer stations (i.e., to avoid double-counting waste) were eliminated.

Gathering estimated waste totals for Bloomington required comparing U.S. Census population data between Monroe County and Bloomington from 1992 to 2014. Monroe County population estimates were divided by Bloomington population estimates to determine what percentage of the Monroe County population Bloomington comprised. These percentages for each year were multiplied by the Monroe County solid waste totals for each relative year to provide estimates for Bloomington's solid waste production.

To calculate GHGs emitted from the waste sector, this analysis followed the methodology used in the "Preliminary Assessment of Greenhouse Gas Emissions Associated with Activities in Bloomington, Indiana: Inventory and Trends" report prepared for the EC in 2006. The first step was to determine the degradable organic compound (DOC) value associated with each type of waste. A table summarizing DOC values appears below.

Default DOC Values for Major Waste Streams

Waste Stream		Per cent DOC (by weight)
A.	Paper and textiles	40
B.	Garden and park waste and other (non-food) organic putrescibles	17
C.	Food waste	15
D.	Wood and straw waste[1]	30

[1] excluding lignin C

Source: Bingemer and Crutzen, 1987.

In the previous report, the following equation was used to determine overall percent DOC:

Equation 1

Percent DOC =

(0.4)*(% paper) + (0.17)*(% yard waste) + (0.15)*(% food waste) + (0.3)*(% wood)

Average waste stream values were gathered from the EPA's "Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2012" report. This report outlined that paper and paper board typically make up 14.9 percent, food waste

comprises 21.1 percent, yard trimmings contribute 8.7 percent, and wood is responsible for 8.2 percent of the waste stream.[79] After putting these values into Equation 1, the percent DOC equaled 0.13204.

To calculate methane emissions, this analysis used the following equation:

Equation 2

Methane emissions (tons) =
$MSWtons*DOC*DOC_F*F*(16/12)$

MSWtons = total municipal solid waste for Bloomington in (year),
DOC = percent degradable organic carbon calculated in the equation above
DOC_F = the dissimilated fraction of the organic carbon, default value is 0.77. This is the percentage of available carbon that is converted into landfill gas (the remainder goes into microbial biomass or other byproducts)
F = the fraction of landfill gas that is methane, and has a default value of 0.5 (the remainder being mostly CO_2 with other amounts of other gases)

After calculating the methane emissions totals, they had to be converted to CO_2-equivalents to ensure that this sectors' emissions were comparable to other sectors. In comparison to CO_2, methane's impact on climate change is 25 times greater over a 100-year time period.[80] To make these methane emissions comparable to emissions from other sectors, they were multiplied by 25 to convert them to CO_2 equivalents. The results of these calculations appear in the following table:

Year	Bloomington Waste (tons)	DOC	DOCf	F	Weight conversion of carbon to methane (16/12)	Methane emission tons	Methane to CO2-e (methane is 25x more powerful than co2)
1992	69417.80906	0.13024	0.77	0.5	1.333333333	4641.034065	116025.8516
1994	62610.31615	0.13024	0.77	0.5	1.333333333	4185.908689	104647.7172
1996	65668.66388	0.13024	0.77	0.5	1.333333333	4390.379215	109759.4804
1998	77862.97121	0.13024	0.77	0.5	1.333333333	5205.64833	130141.2083
2000	80867.96025	0.13024	0.77	0.5	1.333333333	5406.55148	135163.787
2002	85522.42569	0.13024	0.77	0.5	1.333333333	5717.732904	142943.3226
2004	89093.71686	0.13024	0.77	0.5	1.333333333	5956.497051	148912.4263
2005	77756.15621	0.13024	0.77	0.5	1.333333333	5198.50705	129962.6762
2006	81592.13199	0.13024	0.77	0.5	1.333333333	5454.967092	136374.1773
2007	88704.60202	0.13024	0.77	0.5	1.333333333	5930.482182	148262.0545
2008	86453.53786	0.13024	0.77	0.5	1.333333333	5779.983836	144499.5959
2009	85409.25283	0.13024	0.77	0.5	1.333333333	5710.166559	142754.164
2010	92042.43174	0.13024	0.77	0.5	1.333333333	6153.637906	153840.9476
2011	94911.55342	0.13024	0.77	0.5	1.333333333	6345.457435	158636.4359
2012	90787.89013	0.13024	0.77	0.5	1.333333333	6069.763603	151744.0901
2013	95091.48124	0.13024	0.77	0.5	1.333333333	6357.486785	158937.1696
2014	89670.19452	0.13024	0.77	0.5	1.333333333	5995.038349	149875.9587
2020 goal	76219.66534	0.13024	0.77	0.5	1.333333333	5095.782596	127394.5649

[79] EPA, "Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2012," accessed July 8, 2016, https://www.epa.gov/sites/production/files/2015-09/documents/2012_msw_fs.pdf.
[80] EPA, "Overview of Greenhouse Gases," last modified June 10, 2016, https://www3.epa.gov/climatechange/ghgemissions/gases/ch4.html.

Appendix III: Previous Action Items

This list of action items came from "A Framework for Developing a Greenhouse Gas Reduction Plan for Bloomington, Indiana." The "Implementation 2010" column came from "2010 GGE-Reducing Action Items Summary Report Recommendations and Future Steps." This report outlines definitions for the following words: done, doing, defending, thinking, and not started. "Done" means that the action is finished. "Doing" means that work is underway, but the action is not finished. "Defending" means that work has been or is being done, but needs ongoing monitoring to maintain GHG reductions. "Thinking" signifies that the action item is being considered or is in initial development. "Not started" means that the action item has not begun.

Action item	Type of action	Government/ commercial	Macro sector	ICLEI sector	Implementation 2010	Implementation 2015
Implement a program to educate community groups and the general public about GHG effects and how to reduce GGEs.	Education campaigns	Comm	Energy-general	All	Doing	Doing
Promote vehicle sharing to individuals, businesses, and community groups.	Education campaigns	Comm	Energy-transport	Transportation	Thinking	Thinking — IU has a car-sharing program.
Replace incandescent light bulbs with CFLs in all City facilities.	Operations & infrastructure	Govt	Energy-stationary	Buildings & facilities	Defending	Doing
Use lighting automation options such as photosensors, motion sensors, and timers for all City facilities.	Operations & infrastructure	Govt	Energy-stationary	Buildings & facilities	Defending	Doing
Purchase only printers and copiers with duplexing capability for City use; evaluate making duplexing the default setting.	Operations & infrastructure	Govt	Energy-fugitive emissions	Other	Thinking	Thinking
Promote Bloomington's material salvage businesses.	Policy decisions	Comm	Waste-solid	Waste	Thinking	Thinking
Work with Bloomington Transit to improve access to bus service (e.g. park and ride, improved bus shelters).	Programs & services	Comm	Energy-transport	Transportation	Defending	Doing
Work with Bloomington Transit to expand bus routes and frequency of service.	Programs & services	Comm	Energy-transport	Transportation	Defending	Doing
Increase the number of locations that sell Bloomington Transit passes and tickets.	Programs & services	Comm	Energy-transport	Transportation	Thinking	Thinking

Facilitate the installation of energy conservation measures in single- and multi-family residential units.	Programs & services	Comm	Energy-stationary	Residential	Doing	Doing
Develop and adopt energy and resource-efficient building standards for all new construction and major renovation projects funded by the City.	Ordinance changes	Govt	Energy-stationary	Buildings & facilities	Done	Done, but more can be done
Meet LEED Gold standards in all new City buildings and major renovations.	Policy decisions	Govt	Energy-stationary	Buildings & facilities	Thinking	Not doing
Provide information and resources for local businesses and nonprofit organizations to estimate and reduce their GGEs.	Education campaigns	Comm	Energy-general	Commercial	Doing	Doing
Track solid waste disposal and recycling practices and quantities at all City facilities to obtain a baseline rate for future consumption.	Policy decisions	Govt	Energy-transport	Govt Transport/ Employee Commute	Doing	Doing
Require secure, covered bicycle parking at schools, shopping areas, and other destinations.	Ordinance changes	Comm	Energy-transport	Transportation	Thinking	Not doing
Prepare a progress report on the GGE reduction plan and update at least every two years.	Operations & infrastructure	Info	Info items	Info items	Defending	Doing
Research technologies and programs that reduce GGEs.	Operations & infrastructure	Info	Info items	Info items	Doing	Doing
Design and distribute maps showing suggested routes for alternative (non-fossil fuel-based) modes of transportation.	Education campaigns	Comm	Energy-transport	Transportation	Defending	Doing
Inform community leaders and local media about the causes and impacts of climate change.	Education campaigns	Info	Info items	Info items	Defending	Doing
Establish and advertise a website that residents can visit to obtain information about reducing GGEs and saving money through energy	Education campaigns	Comm	Energy-general	All	Doing	Doing

efficiency at home and work.						
Form neighborhood action teams to promote residential energy efficiency, water conservation, waste reduction, and alternative transportation.	Programs & services	Comm	Energy-general	All	Thinking	Doing
Publicize and support campaigns promoting alternatives to single-occupancy vehicle travel (e.g. internet-based ride share programs, increased information about pleasant walking and biking routs, etc.).	Education campaigns	Comm	Energy-transport	Transportation	Doing	Doing
Publicize public and private projects which seek to reduce GGEs or increase energy efficiency.	Education campaigns	Comm	Energy-general	All	Doing	Doing
Review all current and planned City policies and programs to identify ways to reduce City GGEs.	Policy decisions	Govt	Energy-general	Govt-all	Defending	Doing
Reduce the need for indoor air-conditioning by promoting green roofs and light-colored roofs and paving materials; strategic planting of trees; and increasing vegetative cover.	Policy decisions	Comm	Energy-stationary	Res/comm/ind	Doing	Doing
Establish an energy-efficiency program for local small businesses.	Programs & services	Comm	Energy-stationary	Commercial	Doing	Doing
Continue to improve Bloomington's pedestrian and bicycle infrastructure to meet the needs of pedestrians and bicyclists.	Operations & infrastructure	Comm	Energy-transport	Transportation	Doing	Doing
Increase energy efficiency in City buildings by 10%.	Operations & infrastructure	Govt	Energy-stationary	Buildings & facilities	Doing	Doing
Continue using biodiesel (B20 or higher) in City diesel vehicles.	Operations & infrastructure	Govt	Energy-transport	Govt transport	Defending	Doing

Ensure that the City's vehicle fleet maintenance practices optimize fuel efficiency.	Operations & infrastructure	Govt	Energy-transport	Govt transport	Doing	Doing
Educate residents and businesses on how to lower their energy bills by weatherizing their homes and better maintaining their heating, ventilation, and air-conditioning systems.	Education campaigns	Comm	Energy-stationary	Residential	Doing	Doing
Inform local residents, businesses, and institutions of their opportunity to invest in carbon offset projects to meet personal or corporate GGE-reductions goals.	Education campaigns	Info	Info items	Info items	Not started	Doing
Work with the state and other partners to offer financial incentives for residents and businesses to weatherize buildings and homes and to purchase high-efficiency appliances and heating and cooling systems.	Advocacy	Info	Info items	Info items	Thinking	Thinking
Work with financial institutions and interested citizens to explore the potential for location-efficient mortgages (LEMs) in the Bloomington area.	Programs & services	Info	Info items	Info items	Thinking	Not doing
Promote City telework and flexible hours policies, and encourage department managers to consistently apply them. Enable 25% of City employees to telework 9-hr days to avoid commuting at least twice a month.	Policy decisions	Govt	Energy-transport	Employee commute	Thinking	Not doing
Publicly recognize that City policies and decisions have an impact upon Bloomington's contribution to climate change	Policy decisions	Info	Info items	Info items	Done	Done
Adopt policies to restrict the purchase and use of non-sustainably harvested timber by City agencies.	Ordinance changes	Govt	Energy-fugitive emissions	Other	Not started	Not started

Include a green building requirement for developers who receive tax-increment financing from the City.	Ordinance changes	Comm	Energy-stationary	Res/comm/ind	Not started	Not started
Invest in carbon offset projects to help the City meet its overall GGE-reduction goal.	Policy decisions	Info	Info items	Info items	Thinking	Thinking
Institute a "bike to work week" for City employees to take place each summer.	Policy decisions	Govt	Energy-transport	Employee commute	Defending	Doing
Stay informed of emerging waste-to energy (WTE) technologies and less-polluting methods of combusting organic waste for fuel.	Policy decisions	Comm	Waste-incineration	Waste	Thinking	Thinking
Institute recycling of all types of plastics, not just #1; tap into regional market for recycled plastics.	Programs & services	Comm	Waste-solid	Waste	Defending	Done
Reverse Monroe County Solid Waste Management District's e-waste recycling incentives (i.e. instead of requiring residents to pay for these items to be recycled, offer incentives for properly recycling of electronics).	Programs & services	Comm	Waste-solid	Waste	Thinking	Thinking
Launch a public education on food composting (indoor and outdoor) and explore the possibilities for a residential food-waste collection program.	Education campaigns	Comm	Waste-biological treatment	Waste	Thinking	Thinking
Assist local businesses in improving their waste management practices; expand commercial recycling programs and services.	Programs & services	Comm	Waste-solid	Waste	Doing	Doing
Advocate for the establishment of a state-wide Public Benefits Fund (AKA Systems Benefit Charge or Clean Energy Fund) to pay for energy efficiency programs by levying a small charge on each customer's electricity bill.	Advocacy	Info	Info items	Info items	Not started	Not started

Develop a consortium of local and state support for more stringent federal efficiency standards for furnaces, refrigerators, water heaters, air conditioners, other appliances and lighting products.	Advocacy	Info	Info items	Info items	Not started	Not started
Lobby for renewable energy incentives in utility agreements.	Advocacy	Info	Info items	Info items	Not started	Not started
Support lobbying and proposals that raise the federal CAFÉ standards for new vehicles.	Advocacy	Info	Info items	Info items	Not started	Not started
Lobby to increase driver's license test emphasis on pedestrian/bicyclist rights.	Advocacy	Info	Info items	Info items	Not started	Done
Explore the likely impact of an Energy Efficiency Portfolio standard (EEPS) for Indiana and/or Bloomington and consider advocating for legislation to establish a progressive, achievable EEPS target.	Advocacy	Info	Info items	Info items	Not started	Not started
Work with IDEM and other state agencies to develop policies promoting extended product responsibility (EPR; e.g. take-back programs).	Advocacy	Info	Info items	Info items	Not started	Not started
Lobby for an Indiana state bottle/can deposit law.	Advocacy	Info	Info items	Info items	Not started	Not started
Support nonprofit, private, and government efforts to reforest Indiana timberland.	Advocacy	Info	Info items	Info items	Not started	Not started
Encourage residents and businesses to purchase at least 10% of their electricity from renewable sources as they become available.	Education campaigns	Comm	Energy-stationary	Commercial	Not started	Not started
Work with auto repair shops to educate customers on the fuel savings (and financial savings) that result from properly maintaining vehicles and using	Education campaigns	Comm	Energy-transport	Transportation	Not started	Not started

fuel-efficient driving techniques.						
Educate City employees about sustainability, with a focus on specific operational changes that will result in GGE reductions.	Education campaigns	Govt	Energy-general	Buildings & facilities	Not started	Doing
Inform residents and businesses of their opportunity to purchase Renewable Energy Certificates to offset personal or corporate GGEs.	Education campaigns	Info	Info items	Info items	Not started	Not started
Install solar, geothermal and other renewable energy technologies at appropriate City facilities.	Operations & infrastructure	Govt	Energy-stationary	Buildings & facilities	Not started	Thinking
Promote improved operations and maintenance practices in buildings, including the creation of resource conservation management positions.	Operations & infrastructure	Comm	Energy-stationary	Comm/ind	Not started	Doing
Achieve a solid waste recovery rate (proportion of solid waste diverted to recycling, compost or for electricity generation) of 60% at City facilities.	Operations & infrastructure	Govt	Waste-solid	Waste	Not started	Not started
Maintain a GGE inventory for City government operations only.	Operations & infrastructure	Info	Info items	Info items	Not started	Doing
Adopt sliding-scale building permit fees, with lower fees for buildings that meet energy-efficiency criteria and higher fees for conventional construction.	Ordinance changes	Comm	Energy-stationary	Res/comm/ind	Not started	Not started
Develop local green building criteria; explore modeling these criteria on LEED green building standards.	Ordinance changes	Comm	Energy-stationary	Res/comm/ind	Not started	Not started
Strengthen Bloomington's building code and advocate for Indiana's building code to require all cost-effective energy-efficiency measures.	Ordinance changes	Comm	Energy-stationary	Res/comm/ind	Not started	Not started

Purchase 10% of City government electricity from renewable sources; take advantage of tax incentives and smart financing strategies to do so.	Policy decisions	Govt	Energy-stationary	Buildings & facilities	Not started	Not started
Implement a sliding-scale fee for vehicle registration or parking permits based on a vehicle's GGEs.	Policy decisions	Comm	Energy-transport	Transportation	Not started	Not started
Offer incentives for citizens to drive fuel-efficient vehicles.	Policy decisions	Comm	Energy-transport	Transportation	Not started	Not started
Hold City department managers responsible for resource-conservation practices in their departments.	Policy decisions	Govt	Energy-general/ waste-solid	Buildings & facilities/waste	Not started	Not started
Require City departments to pay public transportation fares for guests in any circumstance in which private car parking would normally be validated.	Policy decisions	Govt	Energy-transport	Govt transport	Not started	Not started
Require all City construction projects to exceed the energy code by 20% of new construction and by 10% on retrofits.	Policy decisions	Govt	Energy-stationary	Buildings & facilities	Not started	Not started
Establish the position of a City energy plans examiner and a required field inspection of energy systems, with technical consultation available at the planning stage.	Policy decisions	Comm	Energy-stationary	Comm/ind	Not started	Not started
Strategically finance energy-saving projects.	Policy decisions	Govt	Energy-general	Buildings & facilities	Not started	Thinking
Purchase Renewable Energy Certificates to offset City GGEs and support development of the US renewable energy infrastructure.	Policy decisions	Info	Info items	Info items	Not started	Not started — not currently possible
Purchase only EnergyStar® appliances for low-income housing supported with City funds.	Programs & services	Comm	Energy-stationary	Residential	Not started	Doing
Work with businesses to encourage all employers who offer their employees	Programs & services	Comm	Energy-transport	Transportation	Not started	Not started

subsidized parking also to offer a parking "cash out" — an equivalent payment to employees who do not require vehicle parking.						
Work with local industry to implement waste-heat recovery and other methods to improve energy efficiency.	Programs & services	Comm	Energy-stationary	Industrial	Not started	Not started
Work with appropriate local industries to explore possibilities for distributed electricity generation (DG) as a means to increase renewable energy production and energy-efficiency (e.g. combined heat and power (CHP), or cogeneration).	Programs & services	Comm	Energy-stationary	Industrial	Not started	Not started
Provide educational opportunities to develop local expertise in solar electric (PV) and solar hot water system installation.	Programs & services	Comm	Energy-stationary	Res/comm/ind	Not started	Not started
Implement a commercial food-waste collection and composting program.	Programs & services	Comm	Waste-biological treatment	Waste	Not started	Thinking
Research and install photovoltaic panels on the roof of City Hall.	Operations & infrastructure	Govt	Energy-stationary	Buildings & facilities	Thinking	Thinking
Maintain a GGE inventory for the City of Bloomington (using ICLEI-sponsored CACP tracking software).	Operations & infrastructure	Info	Info items	Info items	Defending	Doing
Ensure that Bloomington's teachers have access to effective resources for educating students about climate change and things they can do to reduce their carbon footprint.	Education campaigns	Info	Info items	Info items	Thinking	Thinking
Implement best management practices (BMPs) for City urban landscaped areas.	Policy decisions	Govt	Energy-fugitive emissions	Other	Doing	Doing
Ensure that the City's UDO promotes bicycle and pedestrian-friendly	Ordinance changes	Comm	Energy-transport	Transportation	Defending	Doing

urban and suburban neighborhoods.						
Develop a city-wide transportation plan to reduce the number of vehicle miles traveled, increase use of alternative modes of transportation, and support Smart Growth planning to limit urban sprawl.	Policy decisions	Comm	Energy-transport	Transportation	Defending	Doing
Promote mixed-use development that places residential units near commercial development and employment opportunities, to reduce the need for automobile transportation.	Policy decisions	Comm	Energy-transport	Transportation	Defending	Doing
Develop a green roofing program or set of incentives.	Ordinance changes	Comm	Energy-stationary	Res/comm/ind	Thinking	Doing — green building incentives
Promote planting native trees to offset GGEs, improve air quality, mitigate stormwater runoff, provide animal habitat, and reduce summer energy use through shading and mitigating urban heat island effect.	Policy decisions	Info	Info items	Info items	Defending	Doing
Work with local businesses (particularly the largest), industrial, and institutional energy customers in Bloomington to establish and meet energy-efficiency and GHG reduction targets.	Programs & services	Comm	Energy-general	Comm/ind	Thinking	Thinking
Protect existing trees from development impacts, and encourage planting new native trees as a component of future development projects.	Policy decisions	Comm	Land use change	Other	Defending	Doing
Ensure that the City's Unified Development Ordinance promotes infill and brownfield development.	Ordinance changes	Comm	Energy-transport	Transportation	Defending	Doing
Promote energy-efficient construction, renovation, and green building practices in all buildings — residential,	Policy decisions	Comm	Energy-stationary	Res/comm/ind	Doing	Doing

commercial, and industrial.						
Establish a green building incentives program for developers.	Ordinance changes	Comm	Energy-stationary	Res/comm/ind	Doing	Doing
Learn from the innovative parking solutions of other cities to implement smart parking policies for Bloomington.	Policy decisions	Comm	Energy-transport	Transportation	Doing	Doing
Require residential properties to be weatherized and brought up to a minimum code level at the time of sale.	Ordinance changes	Comm	Energy-stationary	Residential	Thinking	Thinking
Encourage the downtown mall to extend parking pricing to all appropriate commercial area.	Education campaigns	Comm	Energy-transport	Transportation	Not started	Doing
Increase the costs of parking on public lots and streets to make it reflect the costs of the infrastructure as well as the long-term effects driving has on the environment.	Ordinance changes	Comm	Energy-transport	Transportation	Doing	Doing
Implement life-cycle costing for the purchase of energy-using equipment — vehicles and otherwise.	Policy decisions	Govt	Energy-fugitive emissions	Other	Doing	Doing
Improve and expand curbside recycling and other residential recycling services; extend recycling to apartment complexes within city limits.	Programs & services	Comm	Waste-solid	Waste	Doing	Doing
Inform residents of federal, state, and local tax incentives to use renewable energy and low-emissions vehicles.	Education campaigns	Comm	Energy-transport	Transportation	Doing	Doing
Require a fuel efficiency of at least 35 mpg for all new City car purchases.	Policy decisions	Govt	Energy-transport	Govt transport	Thinking	Thinking
Encourage the use of lower-CO_2 emission technologies in off-road vehicles and equipment.	Education campaigns	Comm	Energy-transport	Transportation	Thinking	Thinking

Establish City policies to use recycled antifreeze, recycled latex paint, and paper with at least 30 % post-consumer recycled content. Establish recycled purchasing policy.	Policy decisions	Govt	Energy-fugitive emissions	Other	Thinking	Thinking
Require City contractors and vendors to use recycled materials in their products whenever possible and to handle their waste in an environmentally friendly manner.	Policy decisions	Govt	Waste-solid	Waste	Thinking	Thinking
Purchase only EnergyStar® appliances and energy-efficient machinery for city use.	Operations & infrastructure	Govt	Energy-stationary	Buildings & facilities	Doing	Doing
Institute City recycling of asphalt and other street material and encourage private contractors to do the same.	Operations & infrastructure	Govt	Waste-solid	Waste	Doing	Doing
Implement City policies to encourage bus travel whenever appropriate and to provide employees with bus tickets for business travel.	Policy decisions	Govt	Energy-transport	Govt transport/ employee commute	Doing	Doing
Reduce per-employee vehicle miles traveled in City administrative vehicles by 15% by 2013 by promoting teleconferencing and the availability of pedestrian, bicycle, bus and ridesharing options for employees on business travel.	Operations & infrastructure	Govt	Energy-transport	Govt transport	Doing	Doing
Convert traffic signals, street lights and outdoor lighting to the most energy efficient technology (LED or other).	Operations & infrastructure	Govt	Energy-stationary	Street lighting	Doing	Doing
Update the Parks & Rec Urban Forestry Division's inventory of the urban forest canopy to determine its current health and identify needs and priorities for future urban forest management.	Operations & infrastructure	Comm	Land use change	Other	Defending	Doing

Improve and sustain the health of Bloomington's urban forest through proper planning and maintenance.	Operations & infrastructure	Govt	Land use change	Other	Defending	Doing
Increase the acreage of Bloomington's urban forest by planting more trees each year than are lost through development or disease.	Operations & infrastructure	Comm	Land use change	Other	Doing	Doing
Assess the financial value of the city's urban forest by quantifying its benefits; use this assessment to guide policy decisions and include it in public education programs.	Operations & infrastructure	Govt	Land use change	Other	Doing	Doing
Work with local residents, businesses, and organizations to organize tree planting and maintenance events.	Programs & services	Comm	Land use change	Other	Doing	Doing
Increase public awareness of the importance of the urban forest, and solicit funding for the Bloomington Tree Fund from local businesses, residents, and organizations.	Education campaigns	Comm	Land use change	Other	Doing	Doing
Develop a contingency plan for fuel emergencies, so that essential public services can operate in the event of an energy crisis.	Policy decisions	Info	Info items	Info items	Defending	Doing
Track waste disposal and recycling practices and quantities at all City facilities to obtain a baseline rate for future consumption.	Operations & infrastructure	Govt	Waste-general	Waste	Doing	Doing
Hire a City resource conservation manager to reduce solid waste, energy use, and water use at City facilities; pay for this person's salary with the savings that result from lower utility bills.	Operations & infrastructure	Govt	Energy-general/ waste-solid	Buildings & facilities/waste	Thinking	Thinking
Expand City transit pass subsidy program.	Programs & services	Comm	Energy-transport	Transportation	Defending	Thinking

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