Community Climate Action Plan

CITY OF BEND

BEND COMMUNITY WASTE AND MATERIALS MANAGEMENT SYSTEM

BACKGROUND REPORT

City Manager's Office

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Waste and Materials Management

The production, transport, use, and disposal of materials throughout the Bend community generates a substantial amount of greenhouse gas emissions. [1] Waste and materials management encompasses the entire life cycle of the materials in the goods and services we consume and use. In the 2016 Bend Community Greenhouse Gas (GHG) Emissions Inventory, two different analyses were completed with respect to materials. The sector based emissions analysis identified 37,378 MT CO2e, or 5% of the total, of our community greenhouse gas emissions as coming from waste. This portion of our sector-based greenhouse gas emissions includes disposal in landfills and wastewater treatment plants, which produces methane, a greenhouse gas that is 28 times stronger than carbon dioxide. Much of the methane is captured and flared but a fraction leaks out to the atmosphere and has a negative climate impact.

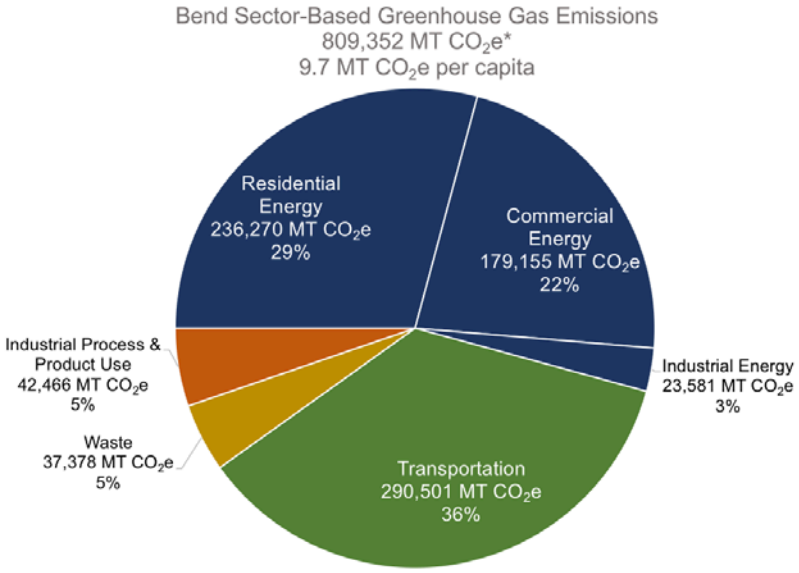


Figure 1. Summary of sector based greenhouse gas emissions from Bend's 2016 Community Greenhouse Gas Inventory

In addition to accounting for sector-based emissions, Bend's Community GHG Inventory shows a second analysis that considers emissions that are generated outside of the community during the production of goods, food, energy, and services that are consumed by residents of Bend. Within this category, emissions from the production of meat, clothing, vehicles, furniture, and home construction, and services consumed by Bend residents that are produced outside the city, such as health care and education are considered. These consumption based emissions total 871,543 MT CO2e. The scale of the emissions from household consumption is slightly more than the all of the sector-based emissions generated locally, which means that consumption emissions **more than doubles** our total greenhouse gas emissions portfolio**. The magnitude of these emissions supports the need to address these emissions in Bend's Community Climate Action Plan (C-CAP**). Figure 2 shows the scale of sector based emissions by materials category compared to the sector based emissions. Household consumption emissions are imported and therefore the community has less control over the efficiency of production and the source of energy to create these. However, the community does have control over the demand for various types of products, which presents mitigation opportunities.

[1] City of Bend, 2016 Community Greenhouse Gas Inventory, Prepared by Good Company, August 2018. https://www.bendoregon.gov/Home/ShowDocument?id=38856

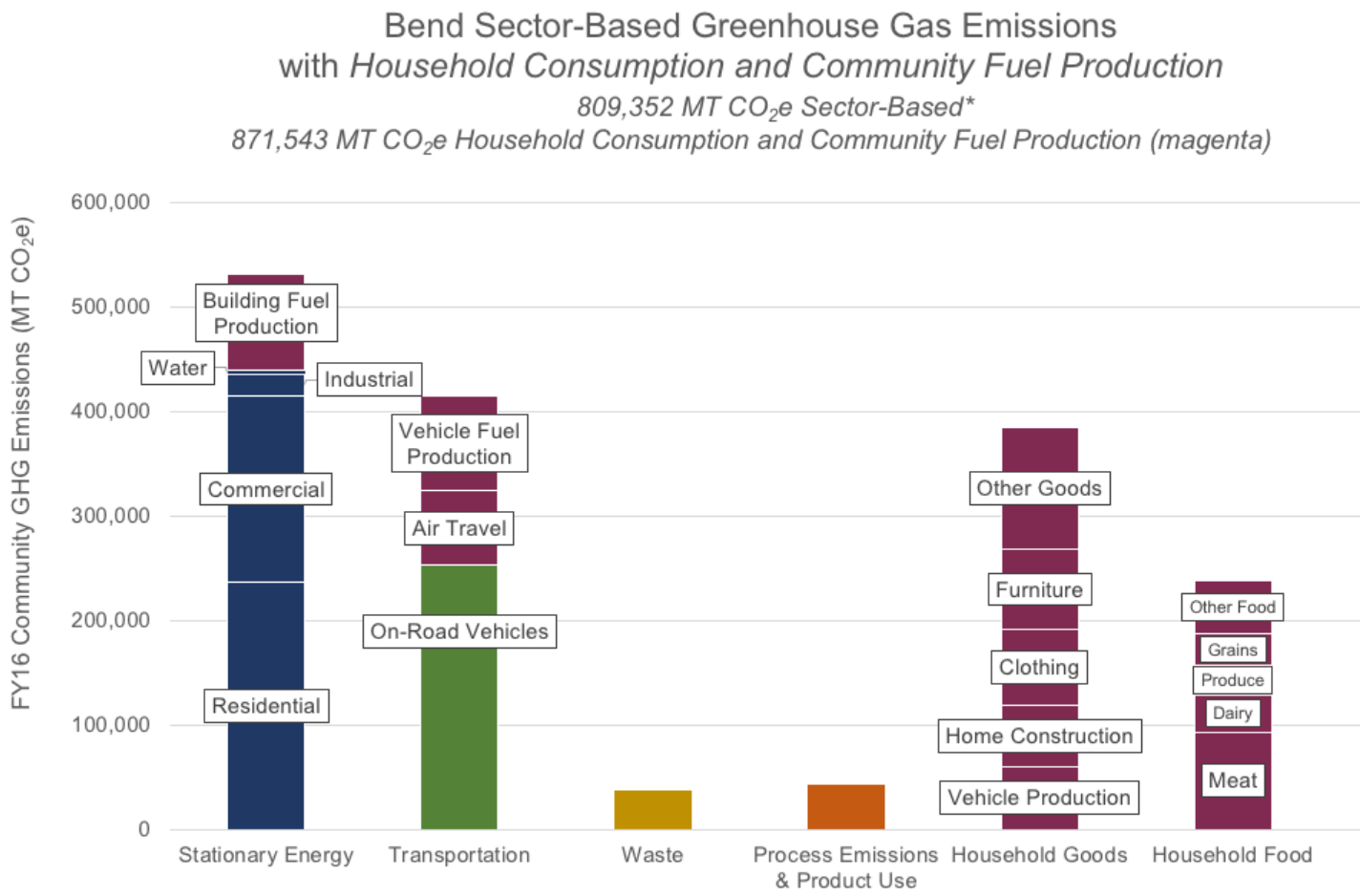


Figure 2. Sector based emissions with household consumption and community fuel production from Bend's 2016 Community GHG Inventory[2]

[2] City of Bend, 2016 Community Greenhouse Gas Inventory, Prepared by Good Company, August 2018. https://www.bendoregon.gov/Home/ShowDocument?id=38856

State and Local Policy Framework for Waste & Materials Management

State Policy

The Oregon Regulatory Statutes (ORS) section 459 describes the rules and regulations that govern management of solid waste. Currently under Oregon law, all cities with a population of at least 4,000 must provide recycling services. In 2015, Senate Bill 263: Opportunity to Recycle: Goal and Recovery Rate Updates was passed, which raised statewide recovery rates, expanded the education, and increased the number or recycling program elements available to local governments.[3] Oregon recycling laws require 52% of the general solid waste stream to be recovered by 2020, rising to 55% by 2025. The law also requires material-specific recovery rates for food waste – 25%, plastic waste – 25%, and carpet waste – 25%, by 2020.

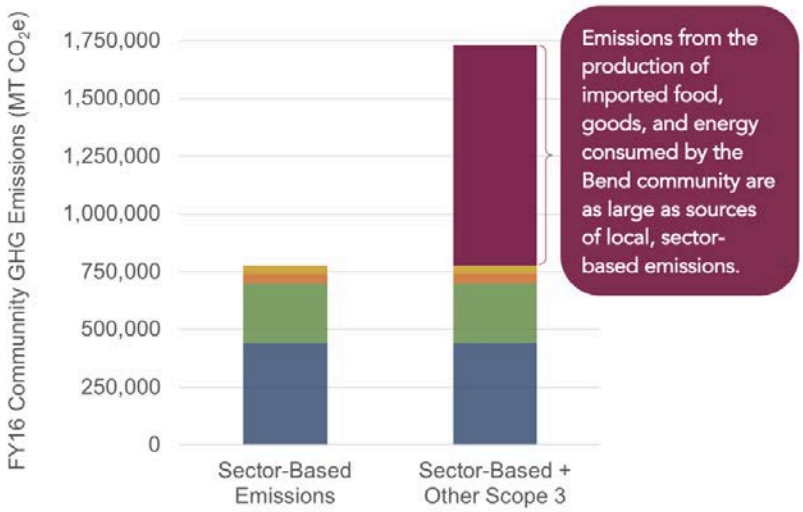


Figure 3. Comparison of Bend's emissions portfolio with and without household consumption.

ORS 459.A.010 established statewide recovery rate goals and establishes targets for each County. Deschutes County recovery rate established by this is 45% by 2025. This target will be measured on an annual basis and programs and facility assessments will be made on the County's progress towards reaching this state goal.

DEQ Materials Management

The State of Oregon Department of Environmental Quality (DEQ) has a Materials Management program with the goal of addressing upstream emissions from consumption throughout the state. The DEQ's 2050 Vision states a goal for Oregon to reduce its consumption and impact on the environment. According to the EPA, the production, transportation, and disposal of materials contributed 42% of all domestic emissions.[4] Emissions "upstream" of the consumer: resource extraction, production, and transportation are much greater than emissions from disposal. Preventing waste through reducing and reusing is the most effective way to limit greenhouse gas emissions. Outlined in the 2050 Vision, there are a number of programs the DEQ has planned to change how communities produce, consume, and prevent waste.

Local Waste Management System Structure

Deschutes County is the primary agency that manages solid waste disposal services for all entities in the County. The County owns and operates Knott Landfill, and the County's Solid Waste Department has the primary responsibility for planning and operating the County's solid waste system. Cities support Deschutes County's role by entering into agreements or memorandums of understanding. Each of the four cities in Deschutes County have franchise agreements with private companies to provide collection

[3] https://www.oregon.gov/deq/recycling/Pages/Oregon's-Recycling-Laws.aspx
[4] https://www.epa.gov/sites/production/files/documents/ghg-land-materials-management.pdf

and recycling services for their jurisdiction. The franchise agreements grant each company the sole right to collect solid waste and recyclables from a specified area, and the haulers are obligated to provide a regular schedule for collection of garbage in all areas of the County and recyclables in urbanized areas. More information about the components of the local waste system, including the facilities and the waste streams collected, are detailed in Chapter 2 of the Solid Waste Management Plan, which is available in draft form on the Deschutes County website.

Deschutes County Solid Waste Management Plan Update

The County is currently leading a planning effort to update the region's Solid Waste Management Plan (SWMP), in coordination with the Cities and other local jurisdictions. The SWMP will examine each component of the Deschutes County solid waste system. It will provide guidance and a direction for developing policies and programs as well as the infrastructure needed to manage solid waste over a 15-year planning timeline. The overriding goal for the County is "to work cooperatively with cities and service providers to offer citizens and businesses an integrated solid waste management system that delivers quality and cost effective services while achieving the best use of our resources and reducing waste disposed in landfills." The SWMP also has five objectives that serve as guiding principles to consider when selecting the best approaches to meeting the goals for the region. Three of those five guiding principles have direct focus on waste reduction, including objectives to use the waste hierarchy as a guiding principle, promoting waste reduction practices through education, and ensuring materials are directed towards their highest and best use[5]. The objectives for the SWMP can be found in section 1.2 of the SWMP draft.

Deschutes County Waste Characterization

Over the last seven years, the County has experienced a continual increase in the amount of waste generated. Waste generated typically increases when the economy is growing. The current recovery rate in Deschutes County is 33%[6]. The Knott Landfill accepts both municipal solid waste and construction and demolition waste. Knott Landfill is currently the only waste disposal facility in Deschutes County that accepts MSW and is expected to close in 2029, due to reaching capacity.

[5] [5] Deschutes County Solid Waste Management Plan Draft, Chapter 2

[6] [6] Deschutes County Solid Waste Management Plan Draft, Chapter 2

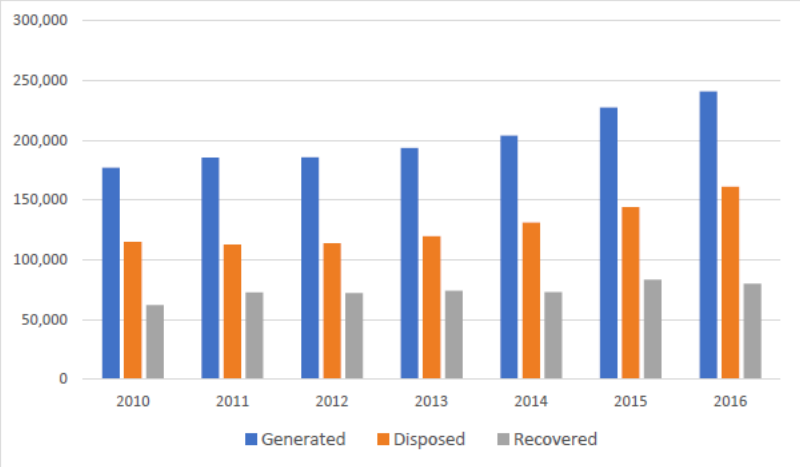


Figure 4. Graph of annual solid waste in Deschutes County[7]

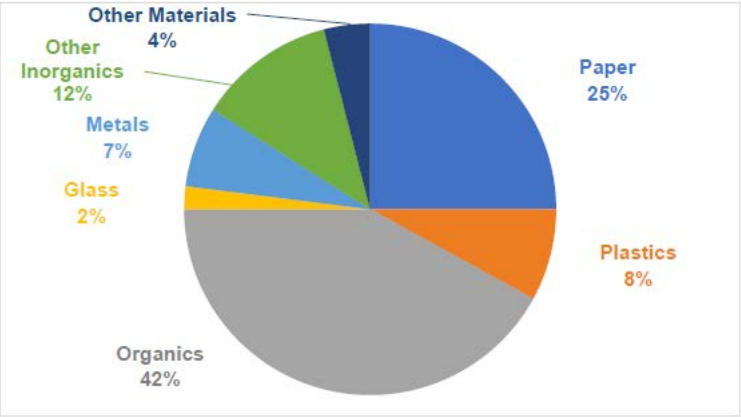
The historic waste characterization data for Deschutes County shows that the county has experienced about a 22% increase in waste generated and disposed over the last 3 years. The recovery rate (materials recycled or composted divided by the total waste generated) has decreased over the last several years[8]. Waste characterization data is useful information to identify the biggest opportunities for increasing the recovery rate. The 2016 waste characterization data is summarized in the graphs below.

Waste Composition	% of Total Waste[1]	Total Waste (Disposed + Recycalbes) (tons)	Waste Disposed (tons)	% Disposed	Recycled Materials (tons)[4]
TOTAL PAPER	**26%**	**62,198**	**40,272**	**25%**	**21,926**
Cardboard/Kraft	8%	18,185	5,638	4%	12,547
Clean Mixed Paper/ONP	7%	15,822	6,443	4%	9,379
Mixed Paper	5%	11,276	11,276	7%	
Compostable/Soiled	7%	16,109	16,109	10%	
TOTAL PLASTICS	**6%**	**14,327**	**12,887**	**8%**	**1,440**
		-	-		
ORGANICS	**43%**	**102,654**	**67,657**	**42%**	**34,997**
Yard Debris	14%	33,266	6,443	4%	26,823
Wood	9%	22,330	16,109	10%	6,221
Food	18%	42,701	41,883	26%	818
Other Organics	2%	4,357	3,222	2%	1135
		-	-		
GLASS	**4%**	**9,786**	**3,222**	**2%**	**6,564**
		-	-		
METALS	**8%**	**19,844**	**11,276**	**7%**	**8,568**
Aluminum	1%	2,230	1,611	1%	619
Tin Cans	1%	3,549	3,222	2%	327
Other (scrap metal)	6%	14,065	6,443	4%	7,622
		-	-		
OTHER INORGANICS	**9%**	**21,584**	**19,330**	**12%**	**2,254**
Rock / Concrete / Brick	3%	6,033	4,833	3%	1,200
Gypsum Wallboard	2%	4,833	4,833	3%	
Electronics	1%	2,663	1,611	1%	1052
Misc Organics	5%	11,278	11,276	7%	2
		-	-		
OTHER MATERIALS	**4%**	**10,055**	**6,443**	**4%**	**3,612**
Motor Oil	1%	2,245	322	0.20%	1,923
Other Materials	3%	6,522	4,833	3%	1,689
Other Recyclables	**0%**	**396**	-	**0%**	**396**
TOTAL WASTE	**100%**	**240,844**	**161,087**	**100%**	**79,757**

[9]

Figure 5. Deschutes County waste stream for 2016, retrieved from Table 2-13 in the SWMP draft

[7] Deschutes County Solid Waste Management Plan Draft, Chapter 2.
[8] Deschutes County Solid Waste Management Plan Draft, Chapter 2.
[9] Deschutes County Solid Waste Management Plan Draft, Chapter 2.



[10]

Figure 6. Waste composition graph, retrieved from Figure 2-6 in the SWMP draft

Current Programs

Bend Garbage and Recycling and Cascade Disposal have a number of options for customers to recycle yard debris and food waste. The Residential Yard Debris Service offers to pick up yard debris and raw vegetative food waste bi-weekly. Currently, this program services over 11,000 residential customers within the City of Bend. "The current program has the ability to divert 80% of the potential food waste that is estimated to be in a resident's waste system." A Commercial Food Waste service is also offered, which composts all food products and some paper products such as napkins from restaurants and other commercial accounts. Bend Garbage and Cascade Disposal are currently working with the City of Bend to offer expanded food collection and composting services to residential customers in the near future.

ReThink Waste is a project of The Environmental Center that helps provide waste prevention and reduction education for Deschutes County residents through a partnership with Deschutes County. Rethink's services include: providing free presentations for community groups, businesses, and organizations, help events reduce waste, and organize repair cafes where volunteers fix broken items.[11]

Best Practices For Climate Action Planning

Community-wide climate action plans very often identify waste and materials management as one of the lowest hanging fruit towards curbing carbon emissions. The three divisions of waste and materials management are upstream design and production, consumption, and end-of-life management. Strategies to address end of life management are generally the easiest for cities to develop and implement effective programs and policies. More and more, cities are also recognizing the need to address the production, transport and consumption of materials as well, and newer programs and policies are being developed to meet this need.

[10] Deschutes County Solid Waste Management Plan Draft, Chapter 2.

[11] Rethink Waste, About Us Webpage, 2018.

Waste Hierarchy

Best practice and industry standard is to utilize a waste hierarchy-centric approach towards materials management The Waste Hierarchy was developed by the Environmental Protection Agency and is widely used by cities, counties and states to develop their local waste system. The Oregon DEQ 2050 Vision and the objectives in the Deschutes County both reflect alignment with the waste hierarchy, but more work can be done to develop and implement programs that ensure a waste hierarchy focused approach is implemented in Bend and throughout Deschutes County. The EPA waste hierarchy defines the highest and best ways to utilize materials, in order of most preferred to least preferred:

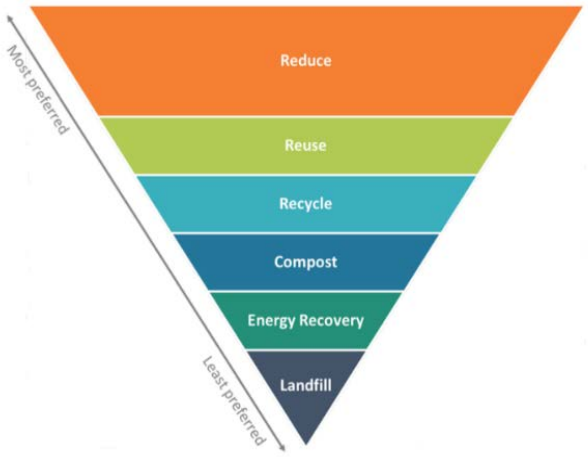


Figure 7. EPA Waste Hierarchy

1. **Source Reduction and Reuse:** Waste prevention, and making market decisions to reduce waste by purchasing in bulk, donating and reusing items, and redesigning products are all methods of source reduction.
2. **Recycling and Composting:** Continuing to recycle, and educate what items can and cannot be recycled can make an enormous impact on the environment.
3. **Energy Recovery:** Some waste can be used as full to power waste power plants. These plants are an effective way to diversify a city's energy supply and efficiently manage waste. Methane gas can also be collected and used as a fuel to generate electricity.
4. **Treatment and Disposal:** Garbage can be treated prior to disposal to reduce volume and toxicity. The lifespan of landfills can be extended if proper treatment methods are taken.

Low Impact Sourcing

To prioritize source reduction as a way of addressing a communities materials, many cities and community organizations have developed policies and programs designed to promote sourcing low impact materials. Low impact sourcing initiatives can take a wide variety of formats. Many states and communities have nonprofit organizations whose mission is to encourage investing in the local economy, which can provide a double benefit of boosting the local economy while reducing the climate impact of transporting goods and services. In Central Oregon, there are several organizations that promote local sourcing of food by connecting local businesses and residents with local farms.

Another way communities can promote low impact sourcing initiatives is through sustainable procurement initiatives, both in the public and private sectors. Local governments spend billions of dollars through their procurement of goods and services, and can therefore make a relatively large impact and also set a leading example in their communities by adopting sustainable procurement initiatives. The Urban Sustainability Directors Network published a Sustainable Procurement Playbook for Cities in 2016 to assist cities in developing programs in their own communities.

Circular Economy

The circular economy is an approach towards materials management that emphasizes creating products and goods that can be continually reused. Circular economy shifts resource consumption from linear flows (raw materials to consumption to disposal) to circular flows, where materials at their end of life

are re-used as raw materials for new products or energy, rather than being disposed of. Circular economy integrates waste management with manufacturing processes and consumer life, ensuring that products and services are designed for reuse from the beginning and providing connections to collect and redistribute materials. Cities such as London, Amsterdam, and Phoenix have embraced a circular economy approach towards their materials by creating roadmaps for circular economies within their region that identify the partnerships, policies, and infrastructure needed[12].

References

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[12] Carbon Neutral Cities Alliance, Urban Sustainability Directors Network, C40 Cities, and the Kresge Foundation, 2016. Framework Deep Carbon Reduction Planning.

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TRANSFORMING SOLID WASTE SYSTEMS

A city's solid waste system directly produces carbon emissions in several ways. When compostable materials like food scraps and yard trimming that are sent to landfills produce methane, a greenhouse gas that has a much greater global warming effect than carbon dioxide. Fossil fuel vehicles hauling waste produce carbon emissions. Waste-to-energy facilities also produce these emissions. In some cities, large-scale wastewater treatment facilities and processes also produce large amounts of carbon emissions. In addition, there is the "opportunity cost" of materials that, instead of being reused or recycled, are sent to the landfill for disposal. Reuse and recycling reduces the amount of new material needed to make new products and the resulting emissions from new products production processes. An analysis by **NEW YORK CITY** found that landfill methane was responsible for 89 percent of the city's solid waste emissions, with emissions from waste-to-energy processing accounting for 6 percent, and the remainder from transporting waste.

Solid waste systems typically make up a small fraction of a city's carbon emissions profile. **NEW YORK CITY** estimated that methane emissions released from its landfilled waste added up to 4 percent of the city's total. But waste systems shouldn't be ignored because, given the difficulties of carbon reduction, "every bit counts" and because a great deal is understood about how to reduce emissions from solid waste systems. In **BERLIN**, for instance, planned reduction of solid waste system emissions amounted to about 25 percent of all reductions targeted for the decade from 2010 to 2020.77

In many leading edge cities the approach to solid waste system transformation starts with the goal of getting to "zero waste." Zero waste means that no material goes to landfill or high-temperature destruction. Instead, cities design their solid waste systems to prevent waste, reduce and reuse materials, recycle and compost, and recover energy in ways that do not release carbon emissions. In many ways, zero waste is part of a broader "sustainable consumption" approach. It is not just a matter of what is done with materials, but also of the design and packaging of products to minimize waste. It also involves affecting "upstream" purchasing decisions — consuming less, consuming smartly and influencing producers to produce less non-recyclable, non-compostable goods and packaging — because this can make a difference to downstream emissions. As **PORTLAND** reported from its analysis of how consumption generates carbon emissions: "The things we buy matter. Over one-third of local consumption-based carbon emissions come from the food and goods that we purchase."

In general, a city's solid waste system collects waste and then sends it to one of four types of destinations to be processed: recycling facility, organic waste processing facility, waste-to-energy facility, or landfill. **OSLO'S** Waste to Energy Agency describes its system as a cycle-based waste management cycle: "This first entails minimizing the amount of waste, then maximizing the amount of re-used waste, and at last recycle waste types such as food, plastic packaging,

"Zero waste" systems prevent waste, reduce consumption, reuse materials, recycle and compost, and recover energy in non-GHG emitting ways.

77 Berlin Senate Department for Urban Development and the Environment, "Municipal waste management in Berlin," 2013, p. 22.

and paper. The combustible residual waste is recycled to energy in form of district heating and electricity. The ash from this process is transported for metal recycling before what is left is used for landfill cover."

Progressing toward and achieving zero waste has additional benefits for cities. For example, composting food waste creates natural fertilizer to help grow fruits and vegetables at local farms. Biogas, an alternative fuel, is also produced from waste (and in OSLO is used as fuel for buses). Recycling saves city residents and businesses money and creates local green jobs.

Variations that Affect Cities' Solid Waste Transformation

Levels of Consumption and Waste Production	• Existence of a culture of "reuse/recycle" versus a culture of "throw it away" • In its "Pathways to Deep Carbon Reductions" document New York City noted "The wealthier a city, the more its residents tend to consume, and the less they tend to reuse."
Waste Disposal Legacies	• Degree of landfilling, incineration, and other disposal • Exporting and importing of solid waste
Recycling Markets	• Existence of strong markets for recyclables • Degree to which market process cover cost of collecting and transporting recyclables
Regulatory Framework	• Mandates by other levels of government for waste prevention and recovery

Solid Waste System Conditions

- **A Blend of Regulation and Technologies** — Waste management is a blend of public regulation, mix of technologies, assets, services, and fees along with commercial, market-driven services. This "infrastructure" has many elements: local transport — from trucks to transfer stations and disposal sites for different waste streams (e.g., commodities, C&D, organics).
- **Prevailing Solid Waste Management Model** — As landfilling starts to become an unacceptable option, cities are turning to a management hierarchy that starts with waste reduction, emphasizing recycling and energy recovery. Recycling typically costs less than landfilling, and, as in the case of paper and other waste streams in many markets, may generate revenue.
- **Enormous Waste Management Operations** — Waste management in NEW YORK CITY costs about $1 billion annually — $700 million to collect waste and $300 million to export it to landfills.
- BERLIN'S management operation, Berliner Stadtreinigungsbetriebe (BSR), "is one of the largest waste management companies in Europe. It has around 5,300 employees and a fleet of some 1,600 vehicles... In 2012, BSR collected and disposed of more than 1 million tonnes of waste... The waste collection and disposal in Berlin is organised from four BSR depots. Operating some 194 trips every day for residual waste collection and 42 'BIOGUT' trips (collection of organic waste), BSR collects some 820,000 tonnes of residual waste annually and more than 62,000 tonnes of biodegradable waste from households and businesses... In addition, BSR operates 15 recycling yards in the city with 6 collection points for harmful substances, collecting 20 recyclable substances and 30 harmful substances. Here members of the public can hand in domestic recyclable substances, e.g. bulky waste items, wood, scrap paper, electric and electronic waste, as well as problem waste. The recycling yards are visited by about 2.2 million customers annually. Every year, the recycling yards collect some 140,000 tonnes of recyclable materials and 3,000 tonnes or harmful waste."[78] In Berlin there are some 20,000 public litter bins.

78 Berlin Senate Department for Urban Development and the Environment, "Municipal waste management in Berlin," 2013, p. 26-27.

Source: Berlin Senate Department for Urban Development and the Environment, "Municipal waste management in Berlin," 2013, p. 26

- **Organic Waste.** In many cities, organic waste—food scraps and yard trimmings, mainly—is one of the least managed sources of waste. Even in cities with high rates of waste recovery through recycling, composting, or anaerobic digestion, there is likely to be a much lower rate of recovery of food waste.
- PORTLAND diverts 70 percent of waste from landfill, among the highest in U.S. cities, but "food scraps now make up the biggest slice of landfill-bound waste."
- A study in BERLIN found that "the district parks and gardens departments alone collected some 41,000 tonnes of grass clippings and dead leaves every year, and that this could be treated in ways which promised to offer higher quality than simple composting. The implementation of these measures can reduce annual greenhouse gas emissions in Berlin by some 12,000 tonnes CO2 equivalent. The further refinement of the separate collection of green waste—in particular dead leaves—could further increase this reduction to 20,000 tonnes CO2 equivalent. Large quantities of dead leaves and grass cuttings are also collected by the BSR utility and private companies. In total, some 150,000 tonnes of green waste are generated every year in Berlin which could in future be available for high-quality handling with corresponding reductions in climate impacts."[79]
- **Major Producers of Waste.** Although solid waste is generated by everyone, there are general categories of large producers of waste. In some cities the majority of waste is generated in the commercial sector, including rental residential buildings.
- In PORTLAND, for instance, the commercial sector generates 80 percent of the city's waste.
- Some 80 percent of municipal waste in BERLIN is domestic waste, and the remaining 20 percent is trade or industrial waste.[80]
- **Waste to Energy.** In some cities, waste-to-energy is strongly tied into building heating systems as a primary supplier of energy needed by the city's district system.
- In OSLO, the waste-to-energy agency provides 50 percent of the district heating energy.

Vision for Redesigned Solid Waste Systems

Solid waste system transformation is guided by a vision with three main elements:

- Zero Waste
- Sustainable Consumption
- Producer Responsibility
  - **Zero Waste**—This describes the goal of a system that instead of just managing "downstream" waste conducts "materials management" for the full-life cycle of all materials, from extraction to the design and production of materials, their use, and "end of life" management. In effect, the system is a "closed loop" that maximizes the efficient use of all resources. In this system, among other radical changes, products are designed and packaged for durability, reuse, and recyclability, and producers take responsibility for the costs of resource recovery and disposal.

79 Berlin Senate Department for Urban Development and the Environment, "Municipal waste management in Berlin," 2013, p. 45.

80 Berlin Senate Department for Urban Development and the Environment, "Municipal waste management in Berlin," 2013, p. 7.

Vision for Redesigned Solid Waste Systems

- Zero Waste
- Sustainable Consumption
- Producer Responsibility

- **SAN FRANCISCO** has a goal of sending zero waste to landfill by 2020, and with a 80 percent diversion rate at present, is well on the way to meeting it.
- **SEATTLE** has adopted a zero waste goal and since 1990 waste emissions declined 22% total and 37% per person due to progressive and highly effective waste reduction, recycling and composting programs. In addition to providing curbside recycling. Seattle has implemented bans on recyclable and compostable materials in garbage, including a ban on food waste.
    - **Sustainable Consumption** — The vision is for a comprehensive shift in consumption to a widespread and sustained culture of sustainable purchasing, reuse, recovery, etc. The public approaches consumption quite differently — "Buy less, buy better, keep longer," said Oslo's communications on this. What residents buy and use, and how they use it, is radically different.
- **PORTLAND:** "Recycling and composting are helpful steps in reducing carbon emissions associated with the things we buy... but the majority of carbon emissions are generated before we even purchase the products. Close to 70 percent of the carbon emissions from the food and goods that we buy are associated with producing, transporting and selling those products."
    - **Producer Responsibility.** In the redesigned system, products are designed and packaged for durability, reuse and recyclability, and producers take responsibility for the costs of resource recovery and disposal.
- **BERLIN:** "Waste prevention is the first priority of waste management. Key instruments are the principle of producer responsibility and waste prevention programmes."

Barriers to Solid Waste System Change

- **Behavior Change** — Reuse, recycling and composting depend on decisions of hundreds of thousands and millions of city residents, workers, and visitors — influencing these choices is possible, but is not easy. For residents whose waste is collected and processed as a part of their tax bill, there is little visible financial incentive to modify behaviors.
- A report for **NEW YORK CITY** described the challenge of unlocking the potential to reduce waste emissions: "New Yorkers would need to improve recycling habits, which will be aided by the recent simplification of rules and improved messaging. Waste processing infrastructure improved significantly this fall with the opening of the new Sims recycling facility in South Brooklyn — but the infrastructure to process organic waste would need to be expanded. Plants in New Jersey convert some of the waste-to-energy — but newer, cleaner, and more efficient plants are yet to be built."[81]

81 GreeNYC, http://s-media.nyc.gov/agencies/planyc2030/pdf/nyc_pathways.pdf.

- **New Infrastructure** — Progressing toward zero waste requires local facilities for processing, not just landfilling, waste in different ways, but few cities have sufficient processing capacity on hand. This means new capital investment will be required, decisions about which processing technologies to use will have to be made, and siting of facilities throughout the city will have to be determined. At the same time, to make the investments worthwhile, the city has to ensure sufficient waste stream will be delivered — and often this requires mandates, rather than promotion or incentives.

Levers, Strategies and Actions for **Transforming Solid Waste Systems**

LEVERS	STRATEGIES	ACTIONS
Voluntary Action	Encourage Reductions in Waste-Making Behaviors	• Promote waste reduction awareness (e.g., use of paper, plastics) • Support food waste reduction programs: e.g., gleaning and donation of unused and excess food; waste reduction challenges for restaurants, large hotels, banquet halls, cafeterias, food wholesalers • Encourage reduction of plastic food-service packaging • Promote consumption-reduction approaches such as renting, sharing, fixing and reusing goods, as well as choosing products with lower emissions across the entire lifecycle • Support "product stewardship" programs (e.g., product and packaging design, reuse of recovered materials) by leveraging city and/or corporate purchasing to encourage suppliers to reduce packaging waste and end-of-life disposal costs • Promote alternatives to traditional building demolition such as relocation, deconstruction and salvage • Educate households and businesses about why and how to separate materials for recycling • Small financial incentives for resident and business recycling: providing discounts/gift certificates at retailers • Provide technical assistance to multi-family rental property owners and managers to increase onsite recycling collection
Price Signals	Increase Cost of Waste Disposal to Encourage Waste Prevention	• Impose "Pay As You Throw" fees charged for non-recyclable waste • Increase the cost of using landfills • Impose fees on disposable plastic and paper bags (if not banned) • Increase penalties for failing to recycle

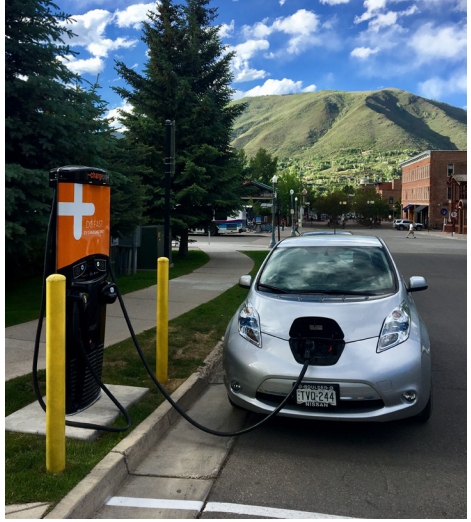
Public Investments	Expand and Improve Existing Waste Processing Infrastructure and Services	• Invest in infrastructure, collection services, and public awareness (including children) for recycling and composting, including neighborhood-based composting and recycling in public spaces (e.g., recycling compactors) • Expand waste-to-energy capacity • Expand separation and processing of organic waste (includes waste-to-energy) and make storage and pickup available to all sectors • Increase methane capture in existing landfills and reuse (flare, feed back into natural gas grid, convert to electricity onsite)
	Pilot New Technologies (Proof of Concept)	• Test small-scale anaerobic digestion facilities for organic waste • For waste-to-energy, pilot small-scale plasma gasification with district heating • Pilot on-site processing of food waste
Mandates	Mandate Waste Prevention	• Ban disposable plastic and paper bags • Mandate that waste that can be incinerated cannot be sent to landfill • Redesign city purchasing rules to favor sustainable consumption and support improved materials management by city agencies • Require use of recycled asphalt in new streets • Require recycling of construction and demolition waste • Require a minimum percentage of recycled concrete in certain building materials • Require new and fully renovated buildings of certain size to include a designated waste and recycling room
	Redesign Waste Hauling	• Re-route haulers to increase energy efficiency and convert haulers to no- to low-carbon fuels (e.g., use of biodiesel) • Shift hauling from truck to rail and barge • Require fuel efficiency/clean fuel from commercial haulers operating in city

Resources

Municipal Waste Management in Berlin 2013	Berlin	Discusses how municipal waste in managed in Berlin, relevant legislation, various model projects that have led to the reduction of waste in Berlin and potential plans to reduce waste in the future.
Resource and Waste Management Plan 2018	Copenhagen	In order to become a zero waste city by 2050, the Resource and Waste Management Plan provides specific initiatives and measures to take in order to help achieve Copenhagen's sustainability goals.
City of Seattle Climate Action Plan Waste GHG Emissions Reduction Strategies	Seattle	A compilation of various recommendations and strategies to reduce emissions from the waste sector for the 2013 Seattle Climate Action Plan
"Picking up the Pace to Zero Waste"	Seattle	Seattle's Solid Waste Management Plan
City of Sydney Advanced Waste Treatment Master Plan 2013-2030 (2014)	Sydney	Discusses Sydney's waste treatment strategies and targets to help reach the Sustainable Sydney 2030 targets.
San Francisco Climate Action Strategy (2013)	San Francisco	San Francisco's climate and zero waste action plan.
Commercial Waste Scan	USDN	A scan and roadmap to reduce commercial waste. (Innovation Fund, 2013).
Materials Management Approaches for State and Local Climate Protection	Linked from the International Sustainability Professional site	This toolkit is a product of the West Coast Climate and Materials Management Forum. The Forum was convened in 2008 by U.S. Environmental Protection Agency Regions 9 and 10, and is a partnership of federal, state and local government stakeholders from the western states committed to advancing materials management strategies to reduce GHG emissions.
Recycling and Waste Resources	National League of Cities Sustainable Communities Institute	A public space recycling program serves high traffic areas that fall outside the coverage of other diversion programs. These places include: parks, stadiums, transit hubs, shopping centers, along streets and at special event sites. Usually these programs can be integrated into existing public space waste services and/or residential recycling programs. Coordination among multiple city or county departments and agencies is often required.

Solid Waste Management in the World's Cities: Water and Sanitation in the World's Cities 2010	UN-Habitat	In our rapidly urbanizing global society, solid waste management will be a key challenge facing all the world's cities. Solid Waste Management in the World's Cities provides a fresh perspective and new data on one of the biggest issues in urban development. Using the framework of Integrated Sustainable Waste Management (ISWM), the report brings together unprecedented research from 22 cities across six continents. It uncovers the rich diversity of waste management systems that are in place throughout the world, and draws out the practical lessons for policymakers.
Waste Management	Smart Cities Council	With the total volume of waste generated globally expected to increase by nearly 50% over the next decade, the adoption of innovative technologies will result in more integrated waste management solutions that move beyond the traditional use of labor, diesel trucks and conventional landfills. In this section you'll read about the technologies driving the emerging smart waste market and how they will lead to more sustainable cities.
Integrated sustainable waste management in developing countries	Wilson, David C.; Velis, Costas A.; Rodic, Ljiljana (Institution of Civil Engineers Journal Article)	This paper uses the lens of 'integrated sustainable waste management' to examine how cities in developing countries have been tackling their solid waste problems. The evidence suggests that efficient, effective and affordable systems are tailored to local needs and conditions, developed with direct involvement of service beneficiaries. Despite the remaining challenges, evidence of recent improvements suggests that sustainable solid waste and resources management is feasible for developing countries.
New Waste Technologies Scan	USDN	A study of innovative waste diversion systems to redefine municipal solid waste from a liability to a valuable asset. (Innovation Fund, 2014).
Solid waste management and sustainable cities in India: the case of Chandigarh	Gupta, Namita (Environment & Urbanization Journal Article)	This paper presents research on solid waste management in the city of Chandigarh, well known in India for its achievements in this regard. It provides an overview of the situation, discussing the strategies adopted and the continued and emerging challenges in waste management, as well as suggesting measures for possible solutions.

Solid Waste Management Initiative: **Sustainable Solid Waste Systems**	C40 Cities	The Sustainable Solid Waste Systems Network aims to transform C40 cities' holistic approach to waste management through source reduction, improved collection and transportation, resource and energy recovery, recycling, organics utilization, landfill diversion and alternative disposal. By understanding the benefits and disadvantages of various management technologies, local decision makers can best allocate resources, select processes and vendors, and develop policies and procedures to meet the community's needs.
Compostable Plastics Toolkit	USDN	A toolkit for how cities can manage compostable plastics in local solid waste programs. (Innovation Fund, 2014).
Developing Solid Waste Management Plans	U.S. EPA	Planning is the first step in designing or improving a solid waste management system. A SWMP assists in taking institutional, social, financial, economic, technical, and environmental factors into consideration when managing solid waste systems. A SWMP is a practical document that can help guide solid waste management effort.
Seattle Solid Waste Recycling, Waste Reduction, and Facilities Opportunities	City of Seattle, Washington	This study, completed in 2007, evaluated both new strategies and existing programs adopted previously under the guiding principle of "zero waste" as originally laid out in the 1998 Seattle Solid Waste Comprehensive Plan, "On the Path to Sustainability." Zero Waste and collection strategies with the potential to divert significant tonnage away from landfill disposal were identified in this five month comprehensive study.
Library of Resources	Zero Waste Alliance	The Zero Waste Alliance is a bridge between an organization's needs and the capabilities available through universities, national labs, state, federal and local government resources and private consulting firms. ZWA promotes and supports the concept of Zero Waste through education and supporting services.



GREENHOUSE GAS REDUCTION TOOLKIT

How to Take Action in Your Community

TABLE OF CONTENTS

INTRODUCTION TO THE GREENHOUSE GAS REDUCTION TOOLKIT

The Greenhouse Gas Reduction Toolkit (Toolkit) is designed to support cities, counties, and regions as they work to advance their emissions reduction programs. It identifies best-practices, strategies and actions that reduce greenhouse gas (GHG) emissions while enhancing quality of life and helping create thriving communities.

The menu of over 250 actions from six emission sectors reflect input from a diverse group of experts. The actions are adaptable to fit the unique needs of communities and vary in terms of carbon reduction potential, feasibility, cost, associated co-benefits and more.

HIGH-IMPACT SECTORS

The Toolkit provides readers with ideas to reduce emissions stemming from the six GHG sectors common to most Colorado communities[1]:

Full descriptions of these sectors are provided in their respective chapters.

ENERGY SUPPLY

How electricity powering the community is generated

RESIDENTIAL ENERGY

How energy is used in residential buildings

COMMERCIAL ENERGY

How energy is used in commercial buildings

VEHICLES & TRANSPORTATION

The on-road movement of people, goods and services in private, transit and fleet vehicles

WASTE & LANDFILL

The solid waste generated by the community and how it is transported to the landfill

AVIATION & AIRPORT

Aircraft operations as well as energy use and transportation directly attributable to airport operations and passengers

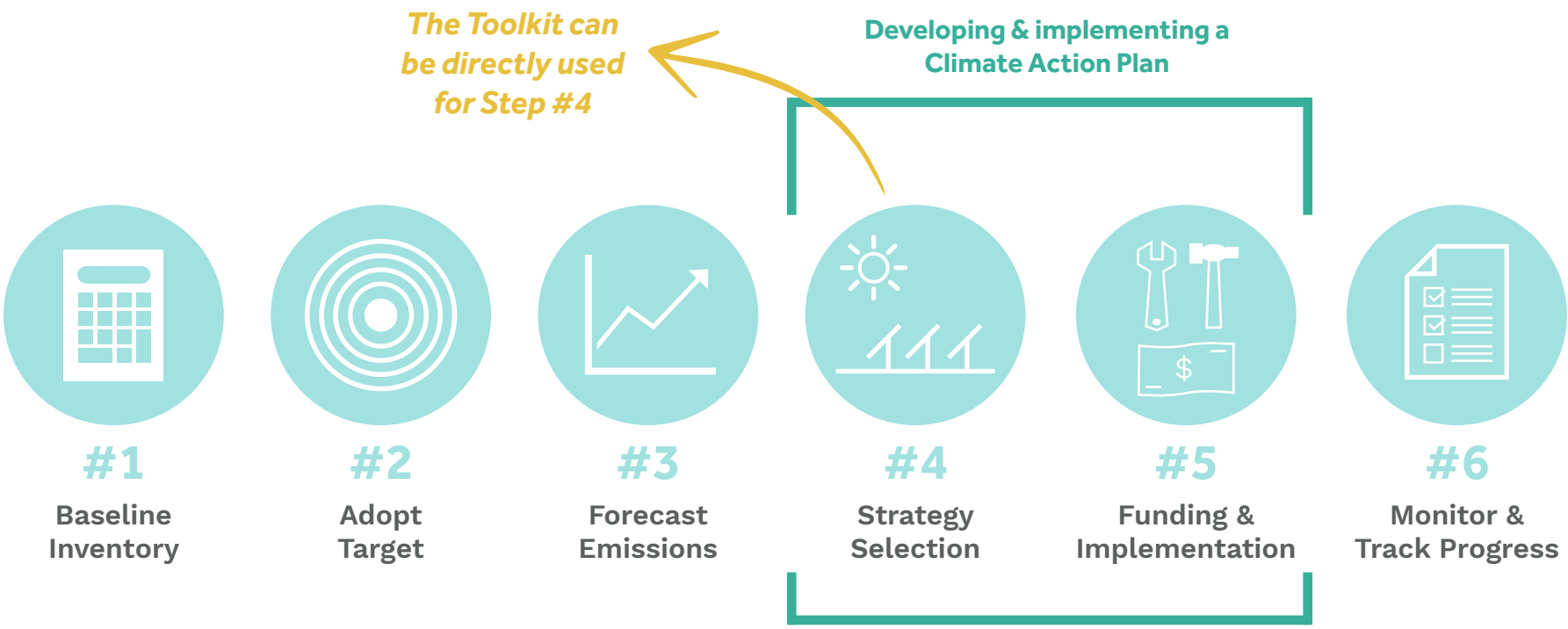
[1] These sectors also align with national and international best practices. Both the *US Community Protocol* and the *Global Protocol for Communities* suggest tracking and mitigating emissions associated with these activities.

HOW TO USE THE TOOLKIT

Fundamentally, the Toolkit is a shortcut and resource communities can use to develop climate action plans that fit their unique conditions. By listing potential actions in addition to defining the associated GHG reduction potential and co-benefits of each one, the priorities that are most important to a given community are identifiable.

The most effective way to use the Toolkit is to identify actions for implementation during the "strategy selection" phase of the climate action planning process[2]. Once actions have been selected, communities can get into the detailed deliberation necessary to move selected actions towards implementation. The Toolkit itself is a type of workbook and provides the user with space to take notes and brainstorm key considerations like implementation timeframe and partners. Since the actions detailed throughout the document are generalized, it is likely that communities will choose to modify, customize and specify Toolkit language into their own.

As actions are identified and moved towards implementation, a wide variety of considerations will likely be evaluated. Among these, it is especially beneficial to compare preferred climate actions with other strategic planning documents to identify complementary priorities. It is also especially helpful to consider opportunities for regional collaboration, given that efforts at the multijurisdictional scale can lead to efficiencies and greater impact.



[2] Detailed information and resources for completing each of these steps is available at http://www.coolcalifornia.org/local-government/toolkit and http://icleiusa.org/programs/emissions-management/5-milestones.
Page 4 figure is based on the Climate Action Resource Guide graphic on CoolCalifornia.org from the California Air Resources Board, http://www.coolcalifornia.org/local-government/toolkit.

TOOLKIT PROCESS

The Toolkit emerged as a by-product of the City of Aspen's most recent climate action planning (CAP) process. During 2016 and 2017, Aspen convened experts under the auspices of an official Advisory Committee (AC) to develop a robust strategy aimed at achieving its long-term GHG reduction goals (30% below 2004 levels by 2020 and 80% below 2004 levels by 2050). This AC is comprised mostly of leadership-level staff, specialists, and elected officials or board members[3].

The deliberative, yearlong process of GHG analysis, stakeholder meetings, and community surveys, led the leadership team to the realization that the refined yet comprehensive list of 250+ actions was far beyond the scope of a 3-5 year CAP. Further, the group realized that the list of actions could be relevant to other communities. Not wanting to limit the accessibility and impact of this impressive body of work, compiling the Toolkit became the solution to provide Aspen and others with an immediate-, mid- and long-term planning resource.

KEY RECOMMENDATIONS FOR COMMUNITY LEADERS

As community members convene to determine which actions to prioritize and refine for implementation, it is important that leaders create a supportive culture and provide resources for success. These recommendations for decision-makers will help ensure success of the overall climate planning and implementation process:

1. **Secure and prioritize the necessary organizational capacity.** This could involve assigning existing staff, hiring new staff, convening advisory commissions or otherwise.

2. Ensure that **stakeholders from all relevant sectors** are included in selecting Toolkit actions for the community's plan.

3. **Identify champions** to guide implementation when the plan is finalized.

4. **Identify and allocate funds** for plan development and implementation. This could include using existing funds, securing a new funding mechanism, or incremental multi-year budgeting. Funding is needed for projects, infrastructure, outreach, and staff capacity.

5. **Develop technical capacity** to do the work and an understanding of the linkages between climate and other local priorities. Joining the Compact of Colorado Communities[4] provides training for all levels of staff from specialists to senior leadership.

6. **Engage in state policy discussions.** Often, local priorities can be bolstered by enabling legislation at the state level. Groups such as Colorado Communities for Climate Action[5] enable municipalities to collectively represent their interests at the state capital.

7. **Collaborate across jurisdictional boundaries.** Regional collaboration in all sectors enhances efficiency and magnifies impact.

8. **Track performance, celebrate successes, and adjust course** when necessary. By measuring progress, building off what works, reevaluating when necessary, trying new things and maintaining a long-term commitment, communities are more likely to be successful in achieving their climate-related goals.

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[3] List of Advisory Committee members provided in the Acknowledgments section of this document.
[4] http://www.compactofcoloradocommunities.org/
[5] http://cc4ca.org/

GHG REDUCTION TOOLKIT: Key & Definitions

In addition to presenting a wide range of options for reducing GHG emissions in each sector, the Toolkit presents a 'GHG reduction potential' ranking and a list of potential co-benefits of each 'Objective' and 'Action'. The schematic below explains the elements of the tables throughout the rest of the document.

OBJECTIVE:

The broad and big picture things that need to happen to make significant progress in reducing community-wide and regional GHG emissions.

ACTION:

The programs, policies and steps that help achieve each Objective.

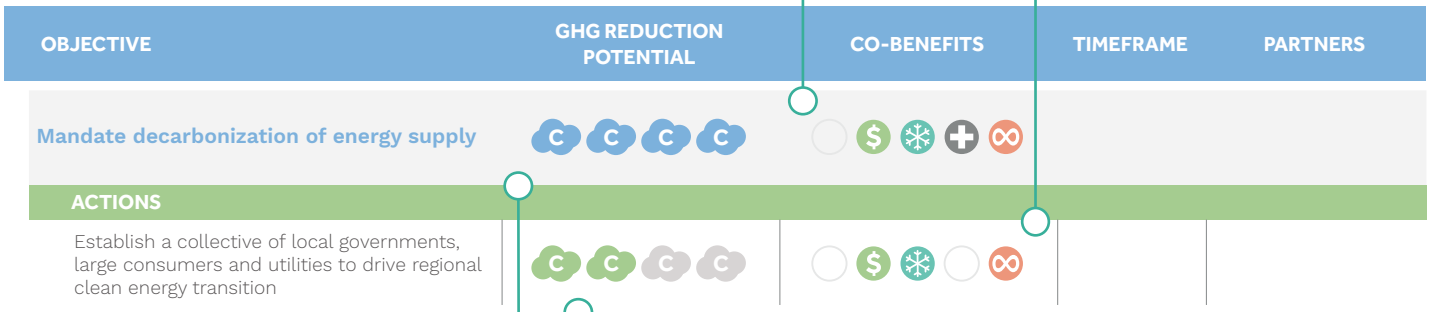
CO-BENEFITS:

Co-benefits are the additional positive benefits related to the reduction of greenhouse gases. Nearly all of the Objectives and Actions in this toolkit have co-benefits that achieve at least one of these measures:

Objective co-benefits:
The primary co-benefits of accomplishing the Objective.

Action co-benefits:
The specific co-benefits of implementing the Action.

- Promotes Equity
- Fosters Economic Sustainability
- Improves Local Environmental Quality
- Enhances Public Health & Safety
- Builds Resilience



GHG REDUCTION POTENTIAL (BLUE):

GHG reduction potential for each **Objective** represents how much it could reduce GHG emissions in the context of the sector it is a part of if fully and successfully implemented. Reduction potential was quantified using a proprietary model and simplified to a scale of 1 to 4 for presentation in the Toolkit:

Marginal

Small

Medium

Large

GHG REDUCTION POTENTIAL (GREEN):

GHG reduction potential for each **Action** represents how much it could reduce GHG emissions in the context of the Objective it is a part of. Reduction potential was approximated and is presented using a 1 to 4 scale:

Marginal

Small

Medium

Large

TIMEFRAME:

Defines whether the action is happening now or whether it should happen in the near, mid- or long-term future.

PARTNERS:

Describes which individuals, groups or organizations are leading and collaborating on implementation.

These columns have been left blank and are to be filled out by Toolkit users to help choose Actions for prioritization and implementation.

GHG REDUCTION TOOLKIT:

Energy Supply

GHG emissions in the **Energy Supply** sector are associated with purchased electricity and the use of natural gas and propane in residential and commercial buildings. The carbon intensity of a given electricity supply is the result of the resources used to generate the power; fossil resources are significantly more carbon intensive than renewable energy sources. Opportunities to reduce emissions in this sector range from fuel switching to decentralizing production. The co-benefits of successfully reducing Energy Supply sector GHGs include widespread improvements to environmental quality and the unleashing of wealth creation and employment opportunities.

GHG REDUCTION TOOLKIT: Energy Supply

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
Mandate decarbonization of energy supply	C C C C	Primary Co-Benefits: $ ❄ ✚ ∞		
ACTIONS				
Participate in regional collaborative of governments, businesses, and utilities to drive clean energy transition	C C C C	$ ❄ ∞		
Establish regional market-based mechanism favoring low-carbon energy (e.g., a price on carbon or a carbon tax and fee)	C C C C	= $		
Pursue retirement, conversion or sale of fossil-fuel plants serving area	C C C C	❄ ∞		
Remove barriers to local renewable energy generation	C C C C	∞		
Establish a local renewable energy generation target	C C C C	$ ❄ ∞		
Communicate to utilities the importance of reducing the carbon content of electricity	C C C C	$ ❄ ∞		
Enable consumers to purchase and produce renewable energy	C C C C	Primary Co-Benefits: = $ ❄ ✚ ∞		
ACTIONS				
Install renewable systems on municipal facilities	C C C C	$ ❄ ∞		

C Level of Potential GHG Reduction
= Promotes Equity
$ Fosters Economic Sustainability
❄ Improves Local Environmental Quality
✚ Enhances Public Health & Safety
∞ Builds Resilience

GHG REDUCTION TOOLKIT: Energy Supply

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
(Cont.) Enable consumers to purchase and produce renewable energy				
ACTIONS				
Expand municipal renewable energy power purchasing when on-site renewables are unsuitable	C C C C	$ ❄		
Pilot microgrid infrastructure to create districts that produce the same amount of energy they consume	C C C C	$ ∞		
Enable consumers to participate in wholesale clean power market (e.g., feed-in tariffs, net metering)	C C C C	= $ ∞		
Promote access to rooftop solar for homes and businesses through code and utility policy	C C C C	= $ ∞		
Assist large entities in implementing clean energy purchasing (e.g., virtual PPAs)	C C C C	$		
Use Property Assessed Clean Energy (PACE) and other financing mechanisms to fund renewable installations	C C C C	= $ ❄ ∞		
Address the soft costs of solar energy installations such as permitting and interconnection fees	C C C C	= $ ∞		
Change land use codes to encourage regional solar development	C C C C	$ ❄ ∞		

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GHG REDUCTION TOOLKIT: Energy Supply

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
Reduce the cost of renewable energy	C C C C	Primary Co-Benefits: = $ ∞		
ACTIONS				
Expand Advanced Metering Infrastructure (AMI)	C C C C	= $		
Facilitate solar PV and/or solar thermal bulk purchase program	C C C C	= $ ❄ ∞		
Provide funding and incentives for residential and commercial solar projects	C C C C	= $ ❄ ∞		
Expand solar programs for low-income households (e.g., GRID Alternatives)	C C C C	= $ ❄ ∞		
Streamline and incentivize rooftop solar installation process (e.g., sales tax legislation)	C C C C	= $ ❄ ∞		
Incentivize local utility owned and operated renewable capacity	C C C C	$ ❄ ∞		
Incentivize community solar	C C C C	= $ ❄ ∞		

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GHG REDUCTION TOOLKIT: Energy Supply

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
Invest in renewable generation at the community and utility scales	C C C C	Primary Co-Benefits: $ ❄ ∞		
ACTIONS				
Develop goal to self-generate a given percentage of government, public, and nonprofit buildings' energy needs and install corresponding renewable capacity	C C C C	$ ❄ ∞		
Develop geothermal energy	C C C C	$ ∞		
Develop local hydropower capacity (ideally micro, pico-hydro or run of the river)	C C C C	$ ❄ ∞		
Site and develop utility-operated renewable capacity in local service area	C C C C	$ ❄ ∞		
Advance regional grid flexibility to enable a predominantly renewable electricity supply	C C C C	= $ ❄ + ∞		
Invest in energy storage to address the intermittency of wind and solar	C C C C	= $ ❄ + ∞		
Install methane digesters	C C C C	$ ❄		
Encourage customers of electric cooperatives to vote in board elections	C C C C	=		

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GHG REDUCTION TOOLKIT: Energy Supply

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
Support relevant federal and state policies through active legislative and regulatory engagement	C C C C	Primary Co-Benefits: = $ ❄ + ∞		
ACTIONS				
Promote and share success of local climate initiatives as local narrative for broader climate action	C C C C			
Cultivate elected officials as local champions for state and federal climate and energy policy	C C C C	$ ❄ + ∞		
Track state and federal climate and energy policy and engage when appropriate	C C C C	= $ ❄ + ∞		
Advocate for grid modernization and flexibility policies	C C C C	$ ❄ ∞		
Support continuation and strengthening of Colorado's Renewable Energy Standard	C C C C	$ ❄ ∞		
Support State Energy Office	C C C C	= $ ❄ + ∞		
Become a member of Colorado Communities for Climate Action to support state climate/ energy policies	C C C C	=		

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GHG REDUCTION TOOLKIT: Energy Supply

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
(Cont.) Support relevant federal and state policies through active legislative and regulatory engagement				
ACTIONS				
Join coalition of communities advocating for federal climate/energy policies (e.g., Mountain Pact)	C C C C	= $ ❄ + ∞		
Support state or national price on carbon	C C C C	= $ ❄ + ∞		
Help defend the Clean Air Act and continued EPA regulation of CO_2 as a pollutant	C C C C	= $ ❄ + ∞		

Notes:

C Level of Potential GHG Reduction

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GHG emissions in the **Residential Energy** sector are associated with the use of electricity, natural gas and propane in ownership and rental units. These units vary widely in age, quality, size and occupancy, and include single-family homes, multifamily properties, mobile homes and residences in mixed use buildings. Residential units are typically served by both electric and natural gas utilities, and opportunities to reduce GHG emissions are tied to decarbonizing the supply of energy flowing to the unit and consuming less of it. The co-benefits of successfully reducing Residential Energy sector GHGs include direct consumer savings and improved dwelling comfort and safety.

GHG REDUCTION TOOLKIT:

Residential Energy

GHG REDUCTION TOOLKIT: Residential Energy

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
Increase the efficiency of natural gas space and water heating, and convert to electric	C C C C	Primary Co-Benefits: ○ ○ ❄ ✚ ∞		
ACTIONS				
Convert natural gas heating system to electric or renewable energy	C C C C	○ $ ❄ ✚ ∞		
Convert natural gas water heating systems to electric or renewable energy	C C C C	○ $ ❄ ✚ ∞		
Heat buildings with geothermal heat pumps, air source heat pumps, or other heat exchange technology	C C C C	○ $ ❄ ○ ∞		
Integrate space and water heating equipment standards into building codes	C C C C	○ ○ ❄ ○ ∞		
Promote energy efficiency improvements such as adding insulation and pipe wrap to water heaters	C C C C	= $ ○ ✚ ○		
Offer technical assistance to determine natural gas heating alternatives	C C C C	= ○ ○ ○ ∞		
Encourage integration with air conditioning systems if future AC need is anticipated (e.g., dual ground/air-source heat pumps)	C C C C	○ ○ ○ ✚ ∞		

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GHG REDUCTION TOOLKIT: Residential Energy

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
Mandate no- to low-carbon standards for new construction and major remodels	C C C C	Primary Co-Benefits: = $ ❄ + ∞		
ACTIONS				
Incentivize above-code buildings	C C C C	$ ∞		
Adopt the latest energy codes with specific local requirements to exceed minimum standards	C C C C	$ ❄ + ∞		
Adopt net zero (or similar) building and energy conservation codes	C C C C	= $ ❄ + ∞		
Require net zero (or near net zero) for all new development	C C C C	= $ ❄ + ∞		
Require net zero (or near net zero) for houses over a certain square footage	C C C C	$ ❄ ∞		
Strengthen building codes and standards to move toward net zero energy	C C C C	$ ❄ ∞		
Conduct community trainings on updated code requirements	C C C C	= +		

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GHG REDUCTION TOOLKIT: Residential Energy

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
Improve the energy efficiency performance of existing buildings	C C C C	Primary Co-Benefits: = $ ❄ + ∞		
ACTIONS				
Retrofit buildings to meet current building codes	C C C C	= $ ❄ + ∞		
Provide incentives for energy efficiency retrofits (e.g., tax abatement, rebates, etc.)	C C C C	= $ ❄ + ∞		
Enact ordinances to drive and support deep energy retrofits and align regionally	C C C C	$ ❄ ∞		
Facilitate education and accreditation for contractors, architects and property managers	C C C C	= ∞		
Require and incentivize measurement and verification (to gauge efficacy of energy efficiency programs)	C C C C	= $ ❄ + ∞		
Mandate sleep mode technology for second homes when unoccupied	C C C C	❄ ∞		
Encourage adoption of building automation systems	C C C C	❄ +		
Conduct energy efficiency challenges and provide incentives to drive energy retrofits	C C C C	$ ∞		
Expand number of cool roofs (white coating on rooftops) to reduce cooling needs	C C C C	= $ ❄ ∞		
Expand number of green roofs (covered in soil and vegetation) to reduce heating and cooling needs	C C C C	$ ❄ ∞		

C Level of Potential GHG Reduction

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GHG REDUCTION TOOLKIT: Residential Energy

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
(Cont.) Improve the energy efficiency performance of existing buildings				
ACTIONS				
Facilitate peer-to-peer information sharing among building owners	C C C C	= ∞		
Improve access to Property Assessed Clean Energy (PACE) and other specialized financing mechanisms	C C C C	= ❄ ∞		
Provide regulatory and zoning relief for projects that meet verifiable high energy standards (e.g., LEED, Net Zero Energy Building, etc.)	C C C C	= $ ∞		
Provide energy consulting services	C C C C	= $		
Support low-income households with energy upgrades and onsite renewable energy (e.g., Colorado's Affordable Residential Energy program, GRID Alternatives)	C C C C	= $ ❄ ✚ ∞		
Reduce energy consumption in rentals, apartments and multifamily buildings	C C C C	**Primary Co-Benefits:** = $ ❄ ✚ ∞		
ACTIONS				
Encourage and incentivize energy efficiency retrofits in rental housing	C C C C	= $ ❄ ✚ ∞		
Partner with seasonal housing providers to deploy large-scale energy efficiency retrofits	C C C C	= $ ❄ ✚ ∞		

C Level of Potential GHG Reduction | = Promotes Equity | $ Fosters Economic Sustainability | ❄ Improves Local Environmental Quality | ✚ Enhances Public Health & Safety | ∞ Builds Resilience

GHG REDUCTION TOOLKIT: Residential Energy

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
(Cont.) Reduce energy consumption in rentals, apartments and multifamily buildings				
ACTIONS				
Partner with utilities to improve tenants' access to energy-usage data	C C C C	○ ○ ○ + ∞		
Implement mandatory, phased energy efficiency upgrades for rental units (e.g., SmartRegs in Boulder)	C C C C	= ○ ❄ ○ ∞		
Support building automation to optimize efficiency and effectiveness	C C C C	○ $ ○ ○ ○		
Deploy a targeted outreach strategy to engage renters	C C C C	= ○ ○ + ∞		
Adopt building energy reporting and disclosure ordinances	C C C C	○ ○ ○ ○ ○		
Require energy performance disclosure at point of lease or sale	C C C C	= $ ❄ ○ ○		
Implement sub-metering for multifamily buildings for more granular building energy data	C C C C	= ○ ○ ○ ∞		
Promote energy efficiency opportunities through outreach, workshops, and neighborhood challenges	C C C C	= ○ ○ ○ ∞		
Pilot green leasing strategies to address the landlord and tenant split incentive	C C C C	= $ ❄ + ∞		

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GHG REDUCTION TOOLKIT: Residential Energy

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
Anticipate and mitigate likely expansion of air conditioning use	C C C C	Primary Co-Benefits: ∞		
ACTIONS				
Avoid or delay the need for air conditioning through building design and management	C C C C	$ ∞		
Require high efficiency air conditioning systems as AC use becomes more prevalent	C C C C	$		
Coordinate with efforts to adopt high efficiency electric heating systems (e.g., dual ground/air-source heat pumps)	C C C C	+ ∞		

Notes:

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∞ Builds Resilience

GHG emissions in the **Commercial Energy** sector are associated with the use of electricity, natural gas and propane in owner-occupied and tenant-occupied businesses in single occupancy and mixed-use buildings. These properties vary widely in age, quality, size, occupancy and use. All are typically served by both electric and natural gas utilities. Opportunities to reduce GHG emissions are tied to decarbonizing the supply of energy flowing to commercial properties and consuming less energy in them. The co-benefits of successfully reducing Commercial Energy sector GHGs include direct financial savings for businesses and enhancing the health, safety and comfort of the built environment.

GHG REDUCTION TOOLKIT:

Commercial Energy

GHG REDUCTION TOOLKIT: Commercial Energy

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
Promote building energy benchmarking and reporting	C C C C	Primary Co-Benefits: $ ❄ + ∞		
ACTIONS				
Create commercial energy benchmarking and disclosure ordinance	C C C C	$ ❄ +		
Leverage the business license renewal process as a way to increase benchmarking participation and performance	C C C C	= + ∞		
Facilitate submetering for more granular building energy data and improve building owners' access to utility data	C C C C	$ ∞		
Provide technical support to help building owners begin benchmarking	C C C C	=		
Increase the efficiency of natural gas heating systems and appliances	C C C C	Primary Co-Benefits: $ ❄ + ∞		
ACTIONS				
Expand participation in voluntary incentive programs for upgrading old or inefficient equipment	C C C C	$ ❄ + ∞		
Identify opportunities for and implement district heating projects	C C C C	$ ❄ + ∞		

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GHG REDUCTION TOOLKIT: Commercial Energy

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
Replace NG heating and appliances with electric and/or renewable systems	C C C C	Primary Co-Benefits: ○ ○ ❄ ✚ ∞		
ACTIONS				
Eliminate natural gas connections for all new commercial developments	C C C C	○ ○ ○ ✚ ○		
Integrate geothermal heat or ground heat to offset natural gas use	C C C C	○ $ ❄ ✚ ∞		
Promote solar thermal for water heating	C C C C	○ $ ○ ✚ ∞		
Provide rebates and incentives to replace old or inefficient boilers with electric	C C C C	= ○ ○ ✚ ○		
Encourage integration with air conditioning systems if future AC need is anticipated (e.g., dual ground/air-source heat pumps)	C C C C	○ ○ ○ ✚ ∞		
Enhance energy and resource efficiency in new commercial developments	C C C C	Primary Co-Benefits: = $ ❄ ✚ ∞		
ACTIONS				
Strengthen building codes to promote energy and resource efficiency in new commercial developments	C C C C	○ ○ ❄ ✚ ∞		
Provide above-code incentives for new commercial developments	C C C C	○ ○ ❄ ✚ ○		

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GHG REDUCTION TOOLKIT: Commercial Energy

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
(Cont.) Enhance energy and resource efficiency in new commercial developments				
ACTIONS				
Require new buildings achieve LEED standards, mandating that criteria focus on energy efficiency	C C C C	∞		
Require new buildings meet net zero energy building (NZEB) standards	C C C C	∞		
Use land use planning to encourage density in development	C C C C			
Allow an outcome-based compliance path (target) to promote build/design flexibility	C C C C	∞		
Coordinate regional alignment of building energy codes and beyond code preferences	C C C C	= $		
Bring all buildings up to current building codes or retrofit a majority of existing buildings	C C C C	**Primary Co-Benefits:** $ ∞		
ACTIONS				
Require or incentivize remodels to meet current energy code	C C C C	∞		
Require commercial lighting retrofits in existing buildings	C C C C	$ ∞		

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GHG REDUCTION TOOLKIT: Commercial Energy

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
(Cont.) Bring all buildings up to current building codes or retrofit a majority of existing buildings				
ACTIONS				
Require or incentivize refrigeration upgrades	C C C C	$ ❄ ∞		
Ban or disincentivize open doors while heating or cooling is happening	C C C C	❄ ✚		
Conduct energy assessments	C C C C	= $ ✚ ∞		
Provide energy efficiency and renewable energy incentives for large consumers	C C C C	$ ❄ ✚ ∞		
Develop programs targeting specific commercial users (e.g., small lodges, restaurants, etc.)	C C C C	$ ❄		
Require deep energy retrofits at designated points, such as time of sale or major renovation	C C C C	= $ ❄ ✚ ∞		
Establish incremental timeline to require that all commercial buildings meet current building energy codes	C C C C	❄ ✚ ∞		
Develop and implement program for energy efficiency and renewable energy in historical buildings	C C C C	$ ❄ ✚ ∞		

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GHG REDUCTION TOOLKIT: Commercial Energy

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
Model best practices through energy retrofitting of government buildings and properties	C C C C	Primary Co-Benefits: $ ❄ + ∞		
ACTIONS				
Implement energy efficiency measures on government buildings, offices and facilities	C C C C	$ ❄ + ∞		
Improve energy efficiency in affordable housing units and complexes	C C C C	= $ ❄ + ∞		
Require green capital needs assessment for renovation projects financed by local government	C C C C	$ ❄ + ∞		
Train building operators and facility managers in energy efficiency best practices	C C C C	$ +		
Ensure new government buildings achieve high performance green building standards (e.g., NEZB, LEED, etc.)	C C C C	$ ❄ + ∞		
Identify opportunities for and implement district heating in new construction, remodels and campuses	C C C C	$ ❄ + ∞		
Improve education and infrastructure; optimize utility rates	C C C C	Primary Co-Benefits: = $ ∞		
ACTIONS				
Integrate carbon sequestration practices and infrastructure into built environment	C C C C	❄ + ∞		

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GHG REDUCTION TOOLKIT: Commercial Energy

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
(Cont.) Improve education and infrastructure; optimize utility rates				
ACTIONS				
Provide contractor education programs on green building and energy efficiency upgrades	C C C C	$ + ∞		
Require certification of building operators	C C C C	$ ❄ + ∞		
Redesign utility rates to incentivize and balance current and future priorities (e.g., electric vehicles, fuel switching, time of use, peak shaving, energy efficiency, demand side management)	C C C C	= $ ❄ + ∞		
Establish a green business certification program to recognize buildings that achieve energy efficiency and sustainability thresholds	C C C C	$ ❄		
Create green business corridors	C C C C	$ ❄		
Require higher energy efficiency standards for major appliances	C C C C	❄ + ∞		
Optimize water distribution system to make it as efficient as possible	C C C C	$ + ∞		
Increase public works oversight in construction to prevent continual reconstruction due to poor initial construction quality	C C C C	= $ ∞		

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GHG REDUCTION TOOLKIT: Commercial Energy

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
(Cont.) Improve education and infrastructure; optimize utility rates				
ACTIONS				
Promote optimal thermostat settings to couple comfort with efficiency	C C C C	=		
Expand messaging and communication on energy programs	C C C C	= $		
Anticipate and mitigate likely expansion of air conditioning use in buildings	C C C C	**Primary Co-Benefits:** $ + ∞		
ACTIONS				
Avoid or delay the need for air conditioning through building design and management	C C C C	$ ∞		
Require high efficiency air conditioning systems as AC use becomes more prevalent	C C C C	$		
Coordinate with efforts to adopt high efficiency electric heating systems (e.g., dual ground/air-source heat pumps)	C C C C	+ ∞		

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GHG REDUCTION TOOLKIT: Commercial Energy

Notes:

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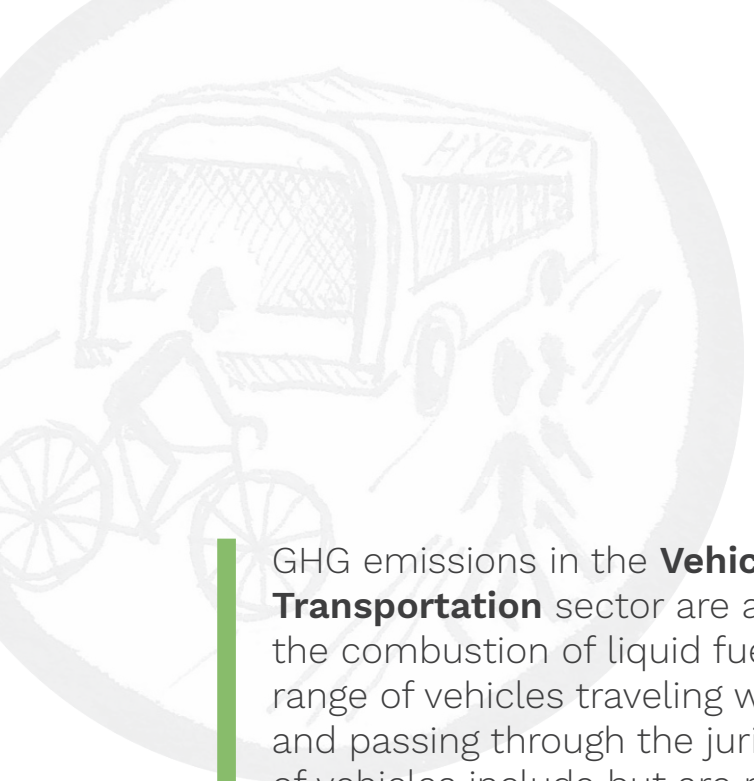

GHG emissions in the **Vehicles and Transportation** sector are associated with the combustion of liquid fuels in the wide range of vehicles traveling within, to, from, and passing through the jurisdiction. Types of vehicles include but are not limited to personal vehicles, light trucks, transit buses, commercial transport vehicles, heavy duty vehicles, and motorcycles. Opportunities to reduce emissions in this sector are diverse, and include shifting transportation modes away from single occupancy vehicle use and transitioning personal and commercial vehicle fleets to low or zero-emission options like electric vehicles. The co-benefits of successfully reducing Transportation sector GHGs include reduced congestion and improved air quality.

GHG REDUCTION TOOLKIT:

Vehicles & Transportation

GHG REDUCTION TOOLKIT: Vehicles & Transportation

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
Reduce VMT by promoting alternatives to single-occupancy vehicles	C C C C	Primary Co-Benefits: = $ ❄ + ∞		
ACTIONS				
Encourage employers to subsidize bus passes for employees	C C C C	= ❄ +		
Create funding mechanism for free regional bus ridership	C C C C	= $ ❄ +		
Promote and incentivize carpooling	C C C C	= $ ❄ + ∞		
Strengthen enforcement of high occupancy vehicle (HOV) and transit lanes	C C C C	❄ +		
Boost public transit reliability	C C C C	=		
Promote teleworking as an alternative to commuting	C C C C	$ ❄		
Make transit more convenient, affordable and fun than driving (e.g., optimized schedules, dedicated bus lanes, comfortable seats, free wi-fi, etc.)	C C C C	= $ ❄ + ∞		
Increase the number and quality of safe routes and transit options to schools	C C C C	= ❄ + ∞		

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GHG REDUCTION TOOLKIT: Vehicles & Transportation

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
(Cont.) Reduce VMT by promoting alternatives to single-occupancy vehicles				
ACTIONS				
Evaluate high-speed rail to optimize transit coverage and efficiency	C C C C	= $ ❄ + ∞		
Enable growth of on-demand mobility services (i.e., ride-sharing, e-hailing, bike-sharing, car-sharing etc.)	C C C C	○ $ ❄ + ○		
Place 'air pollution disclosure' labels on gas pumps (similar to Surgeon General's warning on cigarettes)	C C C C	○ ○ ○ ○ ○		
Enhance first and last mile connectivity to transit	C C C C	**Primary Co-Benefits:** = $ ❄ + ∞		
ACTIONS				
Expand feeder transit network to primary bus stops (e.g., circulators, 'mobility as a service')	C C C C	= $ ❄ + ∞		
Expand bike share network to better connect neighborhoods and work centers to public transit	C C C C	= $ ❄ + ∞		
Expand rideshare network to better connect people traveling to similar destinations	C C C C	= $ ❄ + ∞		

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GHG REDUCTION TOOLKIT: Vehicles & Transportation

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
(Cont.) Enhance first and last mile connectivity to transit				
ACTIONS				
Promote zero-emission and driverless technologies for expanded mobility services	C C C C	$ +		
Expand bicycle network to better connect neighborhoods and work centers to public transit	C C C C	= $ ❄ + ∞		
Expand pedestrian infrastructure to better connect neighborhoods and work centers to public transit	C C C C	= $ ❄ + ∞		
Promote adoption of alternate fuel vehicles for individuals and fleets	C C C C	**Primary Co-Benefits:** $ ❄ + ∞		
ACTIONS				
Provide free parking for zero-emissions vehicles in areas that typically charge parking fees	C C C C	❄ +		
Increase the proportion of EVs in fleets (e.g., car share, municipal, rental cars, hotel shuttles, etc.)	C C C C	= ❄ +		
Create EV charging hubs for taxis or other fleets	C C C C	❄ + ∞		
Increase EV charging stations in visible, accessible locations	C C C C	= $ ❄ + ∞		

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GHG REDUCTION TOOLKIT: Vehicles & Transportation

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
(Cont.) Promote adoption of alternate fuel vehicles for individuals and fleets				
ACTIONS				
Encourage off-peak EV charging through electricity rate structure	C C C C	$ ❄ + ∞		
Require EV charging stations (or EV readiness) in all new commercial developments	C C C C	$ ❄ + ∞		
Require EV charging stations (or EV readiness) in all new multifamily developments	C C C C	= $ ❄ + ∞		
Require all new single-family construction to be EV ready	C C C C	$ ❄ + ∞		
Provide incentives to tie PV (and storage battery) installation to EV purchases	C C C C	$ ❄ + ∞		
Provide free public EV charging stations	C C C C	= $ ❄ + ∞		
Support the full spectrum of low emission vehicle technologies, in addition to EVs	C C C C	= $ ❄ +		
Convert transit and government fleets to low-carbon fuel vehicles (e.g., electric buses)	C C C C	❄ + ∞		
Provide financial incentives to convert fleets to low-carbon fuel vehicles	C C C C	= $ ❄ +		
Make transportation fuels at landfill using methane capture	C C C C	$ ❄ ∞		

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GHG REDUCTION TOOLKIT: Vehicles & Transportation

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
(Cont.) Promote the adoption of alternate fuel vehicles for individuals and fleets				
ACTIONS				
Deploy public outreach campaign and give the public opportunities to drive an EV	C C C C	=		
Facilitate EV bulk purchase program	C C C C	$ ❄ + ∞		
Redesign urban form and population density to reduce vehicle use	C C C C	Primary Co-Benefits: ❄ + ∞		
ACTIONS				
Use zoning and transit-oriented development to site new development near jobs and transit	C C C C	= $ ❄ + ∞		
Enable a greater percentage of the workforce to live near work and transit	C C C C	= $ ❄ + ∞		
Improve winter bike and pedestrian options	C C C C	= $ ❄ + ∞		
Improve and expand pedestrian infrastructure (e.g., pedestrian malls, fast walk signals, sidewalks)	C C C C	= $ ❄ + ∞		
Create or expand no car zones	C C C C	$ ❄ + ∞		

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GHG REDUCTION TOOLKIT: Vehicles & Transportation

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
(Cont.) Redesign urban form and population density to reduce vehicle use				
ACTIONS				
Improve and expand bicycle infrastructure (e.g., well-placed bike lanes, find solutions for conflict/hazard areas, etc.)	C C C C	= $ ❄ + ∞		
Build bike racks in strategic locations; consider covered or winter bike racks	C C C C	= $ ❄ + ∞		
Support local food production and sale at scale	C C C C	$ ❄ + ∞		
Change codes to include EV service equipment installations as acceptable transportation demand management (TDM) option	C C C C	❄ ∞		
Limit parking and drop-off permits at schools	C C C C	❄ +		
Eliminate minimum parking requirements for development; instead, require transit and mobility services	C C C C	= + ∞		
Support relevant federal, state and local policy through active legislative and regulatory engagement	C C C C	**Primary Co-Benefits:** = $ ❄ + ∞		
ACTIONS				
Support local, state and federal incentives, policies and programs to grow EV adoption and infrastructure	C C C C	= ❄ +		

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GHG REDUCTION TOOLKIT: Vehicles & Transportation

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
(Cont.) Support relevant federal, state and local policy through active legislative and regulatory engagement				
ACTIONS				
Actively support Colorado transit grants	C C C C	= $ ❄ + ∞		
Support EPA greenhouse gas emissions standards and fuel efficiency standards for medium- and heavy-duty engines and vehicles	C C C C	❄ +		
Promote state fuel economy standards, such as California's standards	C C C C	❄ +		
Advocate for a strengthening of the CAFE standards (the national fuel economy targets)	C C C C	= ❄ +		
Promote new mobility technologies and business models	C C C C	Primary Co-Benefits: $		
ACTIONS				
Integrate a multi-modal mobility system at the regional or state scale	C C C C	= $ ❄ + ∞		
Pilot on-demand bus and/or van share	C C C C	= $ ❄ +		
Implement peak demand service for strategic transit routes	C C C C	= $ ❄ + ∞		

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GHG REDUCTION TOOLKIT: Vehicles & Transportation

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
(Cont.) Promote new mobility technologies and business models				
ACTIONS				
Address regulatory barriers to shared-use mobility and driverless vehicles	C C C C	= $ ❄ + ∞		
Support on-demand parking apps to reduce vehicle circulation and congestion	C C C C	$ ❄		
Deploy real-time public transit data to provide up-to-the-minute information (e.g., bus arrival information, parking availability, etc.)	C C C C	❄ +		
Increase the cost of using fossil-fuel vehicles	C C C C	**Primary Co-Benefits:** ❄ +		
ACTIONS				
Establish CO_2 fees on fossil-fuel vehicles at purchase or registration	C C C C	❄ +		
Establish congestion fees on fossil-fuel vehicles in designated areas or for driving during high-use times	C C C C	❄ +		
Tax gasoline sales locally or regionally	C C C C	$ ❄ +		

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GHG REDUCTION TOOLKIT: Vehicles & Transportation

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
Increase the cost of driving in certain places	C C C C	Primary Co-Benefits: ○ ○ ❄ ✚ ○		
ACTIONS				
Institute new parking pricing models (e.g., performance-based parking, off-street parking tax, dynamic pricing, etc.)	C C C C	○ ○ ❄ ○ ○		
Establish regional road pricing (e.g., toll roads, dynamic pricing)	C C C C	○ ○ ❄ ○ ○		

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GHG emissions in the **Waste and Landfill** sector come from waste generated within the jurisdiction, then transported to, and processed at the landfill. Organic components within the waste stream generate methane as they decompose. Organic components vary but predominantly include food waste and construction and demolition (C&D) waste. Heavy duty vehicles hauling waste to the landfill and processing it on site consume liquid fuels. Opportunities to reduce emissions in this sector include diverting or salvaging organic components of the waste stream and increasing the efficiency of hauling and processing. The co-benefits of successfully reducing Landfill sector GHGs include extending the life of local landfills and improving local environmental quality.

GHG REDUCTION TOOLKIT:

Waste & Landfill

GHG REDUCTION TOOLKIT: Waste & Landfill

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
Increase rates of and participation in composting and recycling	C C C C	Primary Co-Benefits: $ ❄ ∞		
ACTIONS				
Require composting through codes or regulations	C C C C	= $ ❄ + ∞		
Create convenient, accessible neighborhood compost drop-off locations	C C C C	= ❄ ∞		
Equip an entity like the landfill with resources to turn organic waste into a safe and usable compost product	C C C C	$ ❄ + ∞		
Make finished compost product accessible to gardeners and landscapers	C C C C	$ ❄ ∞		
Require waste haulers to offer compost pickup	C C C C	$ ❄ + ∞		
Require waste haulers to offer recycling pickup	C C C C	= ❄		
Run ongoing public education campaigns to promote composting	C C C C	=		
Ensure buildings have adequate space for composting and recycling collection and storage (e.g., equal space ordinance)	C C C C	❄ +		
Create (or strengthen, if existing) yard waste composting ordinances	C C C C	❄ +		

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GHG REDUCTION TOOLKIT: Waste & Landfill

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
(Cont.) Increase rates of and participation in composting and recycling				
ACTIONS				
Create (or enforce, if existing) ban on burying yard waste in landfill				
Create composting program and infrastructure for multifamily complexes				
Supply local food waste to agricultural operations (e.g., animal feed)				
Provide resources and support for property managers to increase recycling and composting				
Charge more for trash service and reduce trash pickup days				
Implement a single-stream recycling policy				
Expand public recycling and composting infrastructure				
Expand businesses' participation in compost collection services				

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GHG REDUCTION TOOLKIT: Waste & Landfill

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
Maximize diversion of construction and demolition (C&D) waste	C C C C	Primary Co-Benefits: $ ❄ ∞		
ACTIONS				
Create a system for moving C&D waste to markets	C C C C	$ ∞		
Make demolition more expensive than deconstruction	C C C C	$ ❄ ✚ ∞		
Mandate deconstruction	C C C C	$ ❄ ✚ ∞		
Update building codes to ensure deconstruction of buildings is prioritized over demolition	C C C C	$ ❄ ✚ ∞		
Charge a lot more for C&D loads	C C C C	$ ❄ ✚ ∞		
Adopt and enforce C&D waste ordinance	C C C C	$ ❄ ✚ ∞		
Create a salvage yard for deconstructed building materials	C C C C	= $ ❄ ✚ ∞		
Establish reuse center for building materials	C C C C	= $ ❄ ✚ ∞		
Facilitate markets for resale businesses to pre-resell materials	C C C C	$ ❄ ∞		

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GHG REDUCTION TOOLKIT: Waste & Landfill

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
(Cont.) Maximize diversion of construction and demolition (C&D) waste				
ACTIONS				
Offer incentives to encourage reuse of existing structures	C C C C	○ ○ ❄ ✚ ○		
Introduce onboard technology to sort C&D waste at landfill	C C C C	= $ ❄ ✚ ∞		
Provide technical support to contractors to reduce C&D waste	C C C C	= ○ ○ ✚ ○		
Increase community compliance with waste diversion ordinances	C C C C	**Primary Co-Benefits:** = ○ ❄ ✚ ○		
ACTIONS				
Impose tickets and fines for not recycling or for contaminating recycling loads	C C C C	○ ○ ○ ○ ○		
Provide consistent education across relevant target audiences	C C C C	= ○ ○ ○ ○		
Create and enforce zero-waste event requirements	C C C C	= ○ ❄ ○ ∞		
Require recycling and compost bins at public events	C C C C	= ○ ❄ ✚ ∞		
Align city, county and regional waste policies and codes	C C C C	= ○ ○ ○ ○		

C Level of Potential GHG Reduction
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GHG REDUCTION TOOLKIT: Waste & Landfill

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
(Cont.) Increase community compliance with waste diversion ordinances				
ACTIONS				
Perform compliance spot-checks (similar to health code inspections at restaurants)	C C C C	=		
Host community-wide waste collection events to support proper disposal of hard-to-recycle items (e.g., electronics, tires, batteries, etc.)	C C C C	= $ ❄ + ∞		
Consume fewer products and resources	C C C C	Primary Co-Benefits: ❄ ∞		
ACTIONS				
Conduct “buy local” and “consume local” campaigns	C C C C	$ ∞		
Promote reusable mugs and water bottles	C C C C	$ ❄		
Develop and adopt local Styrofoam ban	C C C C	❄ +		
Tax or ban plastic water bottles	C C C C	❄ +		
Develop programs to reduce use of plastic foodservice packaging	C C C C	❄ +		
Incentivize the use of reusable containers over disposable	C C C C	❄ +		

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GHG REDUCTION TOOLKIT: Waste & Landfill

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
(Cont.) Consume fewer products and resources				
ACTIONS				
Promote government and corporate purchasing policies favoring low waste	C C C C	$ ❄ ∞		
Redesign organizational purchasing rules to favor sustainable consumption	C C C C	$ ❄ ∞		
Require improved materials management by businesses and government	C C C C	$ ❄ + ∞		
Increase oversight by public works departments to reduce the need to reconstruct poorly built projects	C C C C	❄ + ∞		
Support food waste reduction programs	C C C C	= $ ❄ + ∞		
Change state regulations to allow food rescue (e.g., food pantry)	C C C C	= $ ❄ + ∞		
Facilitate donation of excess or unused food (e.g., Uber-style app to connect restaurants and private chefs to organizations that feed the hungry)	C C C C	= $ ❄ + ∞		
Require use of recycled asphalt in streets	C C C C	❄ + ∞		
Ban plastic bags	C C C C	❄ +		

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GHG REDUCTION TOOLKIT: Waste & Landfill

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
(Cont.) Consume fewer products and resources				
ACTIONS				
Impose fees on paper bags	C C C C	= ❄		
Promote thrift stores, reuse programs, fix-it clinics and community share programs	C C C C	= $ ❄ ∞		
Increase the cost of waste disposal for MSW and C&D	C C C C	Primary Co-Benefits: ❄ ∞		
ACTIONS				
Implement tiered 'Pay As You Throw' rates to all jurisdictions served by a particular landfill	C C C C	= ❄ ✚		
Expand and improve existing waste hauling practices	C C C C	Primary Co-Benefits: $ ❄ ✚		
ACTIONS				
Combine yard waste and food waste for pickup service	C C C C	$ ❄ ✚		
Re-route haulers to increase operating efficiency	C C C C	$ ❄ ✚		
Require haulers use cleaner vehicles	C C C C	❄ ✚		

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GHG REDUCTION TOOLKIT: Waste & Landfill

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
Pilot new technologies	C C C C	Primary Co-Benefits: ∞		
ACTIONS				
Develop waste-to-energy technologies at regional landfills	C C C C	= $ ❄ + ∞		
Pilot small-scale anaerobic digestion facilities for organic waste	C C C C	$ ❄ + ∞		
Assess feasibility of FastOx Gasification (waste becomes energy via hydrogen, syngas)	C C C C	$ ❄ ∞		
Combine small-scale plasma gasification with district heating	C C C C	$ ❄ ∞		

Notes:

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GHG emissions in the **Aviation and Airport** sector are associated with aircraft operations, airport ground support equipment, on road vehicle use and energy consumed in airport buildings. Aircraft operations include landings and takeoffs. Opportunities to reduce emissions in this sector include increasing the operating efficiency of aircraft, electrifying ground support equipment and ground access vehicles and maximizing the energy efficiency and production of airport buildings. The co-benefits of successfully reducing Airport sector GHGs include improvements to both public health and environmental quality.

GHG REDUCTION TOOLKIT:

Aviation & Airport

GHG REDUCTION TOOLKIT: Aviation & Airport

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
Reduce airport-controlled GHGs	C C C C	Primary Co-Benefits: ❄ ✚		
ACTIONS				
Require EVs and/or cleaner fuels for ground support vehicles and ground support equipment (GSE)	C C C C	❄		
Build onsite PV or PV canopies to power EV service vehicles and EV GSE	C C C C	$ ❄ ∞		
Install alternative fueling sources (would need to be regionally based) at airports to enable airlines to convert ground support equipment to cleaner, lower emission vehicles	C C C C	❄ ✚ ∞		
Maximize the energy efficiency and energy performance of airport buildings	C C C C	$ ❄ ✚ ∞		
Integrate ground heat or geothermal heating into existing buildings and facilities	C C C C	$ ❄ ∞		
Replace airfield lighting with LED lighting	C C C C	$ ❄ ∞		
Increase the efficiency of the airport curbside to reduce vehicle trip lengths and idling	C C C C	❄ ✚		
Prohibit vehicle idling in pickup/drop-off and waiting zones	C C C C	❄ ✚		
Install ground power and preconditioned air systems at gates to reduce the use of the auxiliary power units on aircraft	C C C C	❄		

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GHG REDUCTION TOOLKIT: Aviation & Airport

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
(Cont.) Reduce airport-controlled GHGs				
ACTIONS				
Optimize waste diversion practices and rates at airport facilities and terminal	C C C C	○ ○ ❄ ✚ ∞		
Require taxi and airport shuttles to meet a clean-fuels or MPGe standard for onsite agreements	C C C C	○ ○ ❄ ○ ○		
Reduce aircraft- and aviation-related GHGs	C C C C	Primary Co-Benefits: ○ ○ ❄ ✚ ○		
ACTIONS				
Modernize Air Traffic Control System (NextGen – FAA controlled)	C C C C	○ $ ❄ ✚ ∞		
Encourage continuous descent approaches (CDAs) if possible	C C C C	○ ○ ❄ ○ ○		
Financially incentivize the use of more efficient aircraft serving airport (e.g., through takeoff/ landing fees)	C C C C	○ ○ ❄ ✚ ○		
Incentivize the use of aviation biofuels in aircraft servicing local airport (would require local supply, regional approach or partnership with DIA)	C C C C	○ $ ❄ ✚ ∞		

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GHG REDUCTION TOOLKIT: Aviation & Airport

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
(Cont.) Reduce aircraft- and aviation-related GHGs				
ACTIONS				
Offer targeted offsets through partnerships with industry leaders and airlines serving local airport	C C C C			
Encourage and support Bustang to DIA	C C C C			
Reduce the need for air travel via state/regional high-speed rail	C C C C			
Pressure local airlines to implement their aspirational International GHG goals	C C C C	Primary Co-Benefits:		
ACTIONS				
Inform airlines of local GHG reduction targets, and provide operational incentives connected with facilitating attainment	C C C C			
Educate passengers about 'greener' flying and becoming consumer advocates via airline promotional material	C C C C			
Encourage airlines to continue developing improved Engine and Airframe Technology	C C C C			

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GHG REDUCTION TOOLKIT: Aviation & Airport

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
If a new terminal is developed, ensure that it represents the pinnacle of energy efficiency and sustainability	C C C C	Primary Co-Benefits: $ ❄ + ∞		
ACTIONS				
Require any new terminal or airport building to be net-zero	C C C C	$ ❄ + ∞		
Mandate 'zero construction waste' and 'sustainable construction' plans for any new terminal or airport facilities	C C C C	❄ +		
Integrate ground heat or geothermal heating into new buildings and facilities	C C C C	$ ❄ ∞		
Plan for and install PV at airport and adjacent areas (e.g., PV parking canopies)	C C C C	$ ❄ ∞		
Ensure terminal encourages next-generation mobility by providing EV and 'mobility as a service' infrastructure	C C C C	= $ ❄		
Encourage passengers to use transit and mobility services to access airport	C C C C	Primary Co-Benefits: = $ ❄		
ACTIONS				
Deploy combined marketing outreach with chamber and lodges regarding transit and mobility options	C C C C			
Provide luggage delivery to hotels or residences so passengers can use the transit and mobility options of their choice	C C C C	= $ ❄		

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GHG REDUCTION TOOLKIT: Aviation & Airport

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
(Cont.) Encourage passengers to use transit and mobility services to access airport				
ACTIONS				
Require rental car companies to have EV options (and require that EVs are a certain percentage of rental fleet); also require an MPGe standard for rental car fleet	C C C C	= $ ❄		
Partner with airport rental car companies to include info card about local mobility options (including option of zero-emissions rental cars)	C C C C			
Provide a dedicated ground transit route with local service into terminal drop-off	C C C C	= ❄ +		
Establish an easy-to-use link from terminal to transit	C C C C	= ❄ +		
Create a luxury bus system to carry people and luggage to and from airport to their accommodations	C C C C	❄		
Install signage and wayfinding from terminal to existing transit	C C C C	+		
Install light rail from airport to city	C C C C	$ ❄ +		
Provide appropriate amount of remote airport parking (including at Park and Rides)	C C C C	= ❄		

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GHG REDUCTION TOOLKIT: Aviation & Airport

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS	TIMEFRAME	PARTNERS
Support relevant federal and state policies through active legislative and regulatory engagement	C C C C	Primary Co-Benefits: $ ❄		
ACTIONS				
Push for federal air quality standards to reduce GHGs associated with jet fuel	C C C C	❄		
Establish an active local government voice in federal aviation policy	C C C C	$ ❄		
Encourage or facilitate the adoption of 'sustainable aviation fuels,' such as biofuels	C C C C	$ ❄ + ∞		
Support federal carbon tax that includes aircraft operations	C C C C	= $ ❄ + ∞		

Notes:

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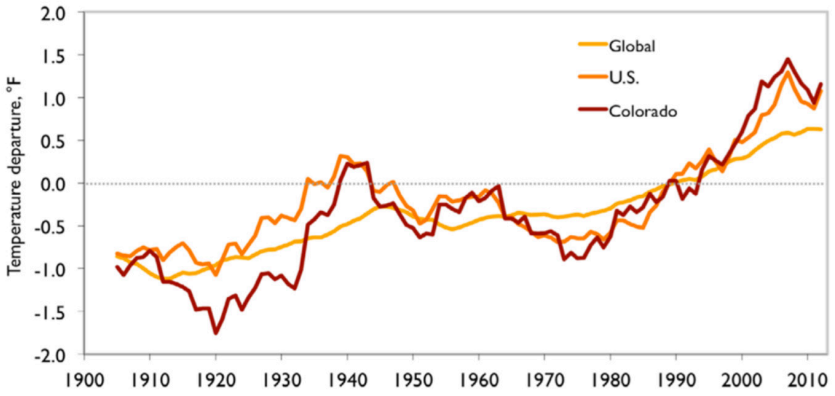
APPENDIX: Notable climate change info for your CAP

While questions remain about the exact specifics of future climate conditions, the basic facts of climate science and solutions are well understood, and more relevant and accessible to local communities than they ever have been. The following insights have been compiled to provide Toolkit users with accessible climate change information that can be drawn for use in their own climate action plans.

Our climate is changing, and more rapidly than at any point on record[i].

- "Every single year since 1977 has been warmer than the 20th century average, with 16 of the 17 warmest years on record occurring since 2001, and 2016 being the warmest year on recorded history."[ii]
- Global temperatures have risen by 1.5°F since 1880[iii] and national temperatures have increased 2°F since 1978[iv].
- In Colorado, average temperatures have risen by 2.5°F since the 1950s[v].
- In Western Colorado, there are 23 fewer frost free than there were before the 1980s and annual snowfall has declined by 10 inches[vi].

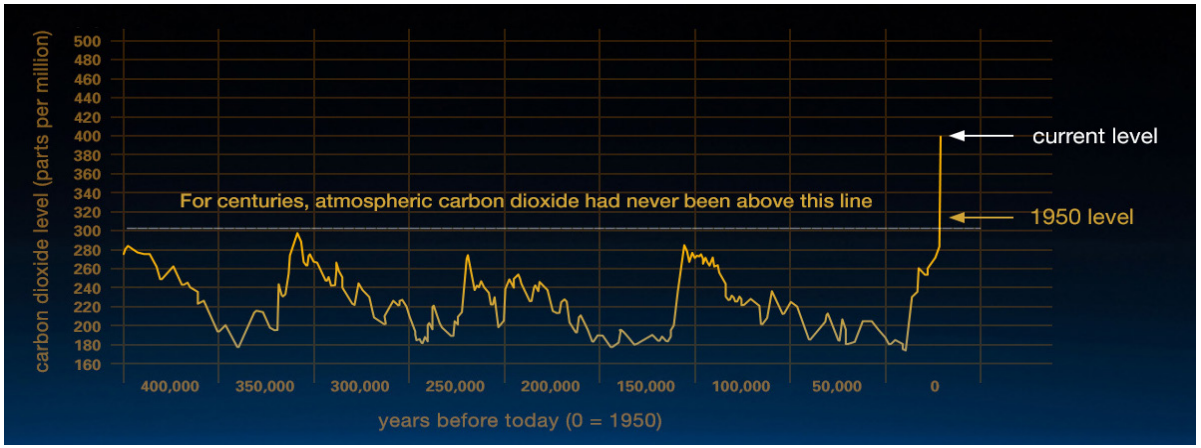
Figure 1. Observational record of annual mean temperature: Global, U.S. and Colorado (Aspen Global Change Institute[v])



Human activity is driving most of this change.

- 97% of climate scientists agree that the warming over the past century is due to human activity. Most leading scientific organizations worldwide have issued public statements affirming this[vii].
- Atmospheric concentrations of CO_2 have risen 40% since the industrial revolution[viii].

Figure 2. Evidence that atmospheric CO_2 has increased since the Industrial Revolution (NASA[vii])



APPENDIX: Notable climate change info for your CAP

The severity of future climate change is directly linked to GHG emissions.

- GHG emissions are the single most significant factor in determining the amount of future global temperature change[ix].
- Currently, the world is on a high emissions trajectory. Unless GHG emissions are mitigated, this could lead to a 9.7°F increase in Western Colorado by 2100[x].
- The best available science indicates that the world, Colorado and communities should reduce GHG emissions 45% below 2005 levels by 2030 and 90% below 2005 levels by 2050, to limit warming to 1.5 to 2°C above preindustrial levels[xi].

We know how to solve it.

- Robust and effective climate solutions are developed and ready for implementation at the international, national, state and local level[xii].

Acting now is less expensive than inaction and can create healthy, thriving communities.

- Dramatically reducing GHG emissions is much less expensive than the anticipated costs of dealing with the impacts of unchecked climate change[xiii] [xiv].
- Effectively addressing climate change at the scale necessary to solve the problem could be the largest wealth creation opportunity of our time[xv].
- In communities, climate action typically creates numerous co-benefits such as increased resilience and economic activity, healthier citizens and improved environmental quality. This Toolkit defines some of the co-benefits that are associated with various actions.
- Climate action is frequently complementary to existing priorities for communities and regions.

Local action matters.

- While future climate will be determined by global GHG emissions, the cumulative impact of local action is significant and meaningful.
- 78% of energy globally is consumed in cities[xvi]. Collectively, local action can significantly accelerate a transition away from fossil fuels.
- Local governments in the US currently have some of the most ambitious climate action commitments. More than 350 US mayors have signed a pledge to uphold the Paris Climate Agreement through local action and necessary policy at the state, federal and international levels[xvii].

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The City of Aspen strives to be an environmental leader and to promote environmental stewardship throughout the Roaring Fork Valley, across the state of Colorado, and around the globe. We recognize Aspen's dependence on climate and natural resources for a thriving economy, healthy ecosystems, and exceptional quality of life. In an effort to do our part to reduce the threat of climate change, Aspen's City Council adopted the Canary Action Plan in 2007, which commits to reducing community-wide emissions 30% by 2020 and 80% by 2050, below 2004 levels.

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The Community Office for Resource Efficiency (CORE) works cooperatively with businesses, individuals, utilities, and government entities to create measurable improvements in energy and water efficiency in order to benefit the environment and develop a more sustainable economy. The non-profit has been serving the Roaring Fork Valley since 1994.