Materials Management Task Force Recommended Climate Strategies, Actions and Measurable Outcomes

Introduction

The Materials Management Task Force was convened to ensure that future climate planning efforts considered and integrated the emissions associated with all of the materials that flow through the state's economy, as well as the waste generated by that economic activity. Our work builds upon existing strategies outlined by Maine Won't Wait, the State's first four-year action plan.

There are significant opportunities to reduce the emissions associated with the materials we use and dispose of by creating more efficient, less wasteful, circular economic systems. In contrast to the take-make-waste status quo, circular strategies reduce materials use and associated emissions by designing waste out of our economic systems. These strategies include the reduction of emissions through source reduction and waste prevention, repair, reuse, food rescue, recycling, composting, and energy recovery from materials not suitable for better uses. Many of the solutions to reduce materials management emissions through efforts to build a more circular economy also provide economic benefit, strengthen community fabric, and are more equitable; meaning that they are also important strategies for building adaptive capacity and community resilience.

Opportunities for addressing the emissions associated with materials management fall into one of two categories:

1. Direct Emissions: Emissions from waste decomposition and combustion in Maine, such as carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), or biogenic CO2.
2. Avoided Emissions: Emission ‘‘savings” associated with material efficiencies or avoidance.

Direct emissions occur within Maine and are part of our emissions inventory. Direct waste emissions were estimated to comprise roughly 2% of Maine’s emissions inventory. However, there is growing awareness that emission estimation tools are likely underestimating methane, a climate “super pollutant” with approximately 30 times more warming power than carbon dioxide. Satellite-derived data collected by researchers in 2019 showed methane landfill levels 50% higher on average than reported to EPA, while samples from a “subset of 70 high-emitting landfills” were 77-200% higher than reported to EPA.[1] With an “estimated 58% of fugitive methane emissions” attributed to landfilled food,[2] reducing food sent to landfills is an important focus of the Task Force’s recommendations for reducing methane emissions, along with better tracking and monitoring. In addition, hauling and processing waste within Maine consumes energy and generates emissions; reducing transport miles and the amount of material being processed can reduce these direct emissions.

[1] https://earthobservatory.nasa.gov/images/152825/satellite-data-suggest-us-methane-emissions-underestimated#:~:text=The%20science%20team%20zoomed%20in,200%20percent%20greater%20than%20reported.
[2] https://www.epa.gov/land-research/quantifying-methane-emissions-landfilled-food-waste#:~:text=Due%20to%20its%20quick%20decay,are%20from%20landfilled%20food%20waste.

Avoided emissions or emissions reductions associated with materials management are realized through avoided resource extraction, efficiencies along the supply chain, resource recovery, and rescue, repair, or reuse of existing goods and materials. Emissions reductions referred to as "indirect" occur outside of Maine's territorial boundary. Indirect emissions may include "consumption based" emissions, which are generated through production to meet consumer demand for goods and services. These emissions may be more commonly referred to as a "carbon footprint," and reflect consumption and lifestyle choices. For example, a smartphone or other electronic device purchased at a retail store in Maine generated greenhouse gas emissions during every stage of its production from mining rare metals to extraction and refining of petroleum for plastic components, to the energy used to manufacture, package, and transport that device to its point of sale. The only emissions from this device that "count" in Maine's emissions inventory result from in-state transport to a consumer and energy used while charging the device.

The emissions generated over the lifetime of a smartphone are heavily concentrated in the resource extraction and production phase of its lifetime, which makes up 85-95% of a phone's total carbon footprint.[3] Most of these emissions were generated outside of Maine but were driven by economic demand from a Maine consumer. A consumption-based emissions inventory considers these economic drivers to allocate emissions based on demand for goods and services and can also support policies to reduce these "outsourced" emissions. For example, extending the lifetime of phones and other electronic devices by "50%–100% can mitigate up to half of the total GHG emissions."[4] Prioritizing smartphone repair over replacement reduces emissions globally, but doesn't reduce Maine's direct, in-state emissions.

Lastly, while GHG annual inventories assess in-boundary emissions generated by sector during a one-year timeframe, emissions reductions from materials management are typically assessed from a lifecycle perspective to determine the total emissions impact and benefits (emissions reductions) over the lifetime of a product or good from resource extraction to end-of-life management.[5] Due to complex supply chains and global production processes, these benefits often extend to more than one sector and are tied to the lifespan of the product or good rather than a one-year timescale.

To more accurately estimate these lifecycle emissions, EPA "reallocated the GHG Emissions Inventory using a systems-based approach"[6] in 2009. Through this method, EPA found that 42 percent of U.S. GHG emissions result from materials management, including "production, transportation, use, and disposal of material goods."[7] International climate policy discussions taking place more recently

[3] See: https://www.weforum.org/agenda/2021/07/repair-not-recycle-tackle-ewaste-circular-economy-smartphones/
[4] See: https://www.sciencedirect.com/science/article/pii/S2773167722000115?via%3Dihub
[5] See EPA documentation on Life-Cycle GHG Accounting Versus GHG Emission Inventories: https://www.epa.gov/sites/default/files/2016-03/documents/life-cycle-ghg-accounting-versus-ghg-emission-inventories10-28-10.pdf
[6] https://archive.epa.gov/greenbuilding/web/pdf/ghg_land_and_materials_management.pdf
[7] *Ibid*.

through the IPCC, [8] COP 28, [9] and the UN Environment Programme (UNEP)[10] have also been increasingly focused on waste and materials management. The 2024 UNEP report 'Beyond an Age of Waste: Turning Rubbish into a Resource,' details how waste contributes to the triple planetary crises of climate change, pollution, and biodiversity loss. The report cites an "urgent need" to move towards a circular economy, as "taking a zero-waste approach is the only route to a safe, affordable and sustainable future." [11]

To understand how Maine might begin tackling this work to grow its circular economy and reduce emissions and waste, the Task Force explored opportunities for increasing efficiency in materials management programs and infrastructure, scaling up and increasing waste diversion and prevention programs, reducing emissions related to materials use and end-of-life management, and technologies and processes for reducing greenhouse gas emissions from waste.

The Task Force used several guiding questions in assessing strategies:

- Does it reduce greenhouse gas emissions globally?
- Does it reduce greenhouse gas emissions in Maine?
- Does it improve resiliency in Maine?

The Task Force identified the following key focus areas for developing policy recommendations for the Maine Climate Council:

- How can we reduce food loss and waste?
- How can we support and scale up efforts to reuse/repair/refill?
- How can we reduce consumption-based emissions?
- How can we address gaps and drive innovation around materials reuse for multiple sectors to increase community resiliency including with managing storm/disaster debris and household hazardous waste?
- How can we increase equitable access to services that divert waste from disposal, like recycling and composting, along with waste diversion programs to reuse, repair, and share goods and other resources?
- How can we transport waste and recovered materials more efficiently?
- How can we reduce methane emissions, capture more methane, and increase the use of waste not suitable for higher and better uses to generate energy?

This review allowed the Materials Management Task Force to evaluate and recommend short- and long-term strategies and actions for advancing programs to reduce emissions from waste and materials management. Many of these recommendations are focused on moving Maine towards a circular

[8] The IPCC report details specific actions to reduce consumption-based and waste emissions and outlines co-benefits including greater equity and societal wellbeing: https://www.ipcc.ch/report/ar6/wg3/
[9] The COP 28 resulted in the launch of The Waste to Zero and The Waste MAP initiatives: https://www.cop28.com/en/news/2023/12/COP28-announces-new-partnerships-and-initiatives
[10] See: https://www.unep.org/events/publication-launch/launch-global-waste-management-outlook-2024
[11] *Ibid*.

economy, which keeps materials and products circulating to avoid the energy-intensive extraction of raw natural resources and conserve energy and materials used in processing and production of goods.

Federal funding resources are available to support thoughtful implementation and further development of this work, including some of the grant programs referenced below. This is not an exhaustive list of all funding sources that may be applicable. For example, The Department of Energy American Made Challenges program provides significant opportunity to secure funding and technical opportunities through financial prizes such as the Re-X Before Recycling prize designed to help decarbonize the supply chain by repurposing and recovering materials.

Funding Opportunity	Source/Agency	Details
Climate Pollution Reduction Grants (CPRG)	IRA - EPA	**$5B** for climate planning & implementation grants to states, local governments, tribes, and territories. Waste is a focus area that can be built out in the **Comprehensive Climate Action Plan (CCAP)**.
Greenhouse Gas Reduction Fund (GGRF)	IRA - EPA	**$20B** to nonprofit financing entities and community lenders to support clean energy and air pollution reducing projects (e.g., landfill methane controls, composting). Financing will be distributed on an ongoing basis to eligible projects.
Community Change Grants (CCG)	IRA - EPA	**$2B** for projects that reduce pollution, increase community climate resilience, and build community capacity to address environmental and climate justice challenges. Waste a focus area.
Solid Waste Infrastructure for Recycling (SWIFR) Grant Program	BIL - EPA	**$275M** to assist states, local governments, tribes, and territories in making improvements to local waste management (including organics).
Methane Monitoring Funding	IRA - EPA	**$20M** to advance landfill methane monitoring, including by loaning out monitoring equipment to states, local governments, and Tribes.
Energy Efficiency and Conservation Block Grant (EECBG) Program	BIL - DOE	**$550M** to assist states, local governments, and Tribes in implementing strategies to reduce energy use, to reduce fossil fuel emissions, and to improve energy efficiency. Landfill methane capture is a focus area.
Clean Heavy-Duty Vehicles Grant Program	IRA - EPA	**$932M** to fund the replacement of existing non-zero-emission Class 6 and 7 heavy-duty vehicles with zero-emission Class 6 and 7 heavy-duty vehicles. Refuse Haulers/Dump Trucks are eligible.

Summary of Strategies and Actions

The Materials Management Task Force notes that most of the recommendations and actions identified below fit well within existing *Maine Won't Wait* strategies. However, due to the cross-cutting nature of materials and their connections to marine resources, forest resources, agriculture, transport and community resilience, we recommend considering an additional strategy specific to materials efficiency and circularity with a title such as "Reduce Emissions and Improve Community Resilience through Materials Efficiency and Waste Reduction" or "Build Resilience by Growing Maine's Circular Economy".

Recommendation A. Advance Policies and Deploy Funding to Reduce Emissions Across Product Lifecycles by Growing Maine's Circular Economy
Actions:
A.1. Establish dedicated sources of funding support for the development of reuse/refillable/repair infrastructure including support for non-packaging related repair and reuse. **A.2.** "Lead by Example" procurement and waste reduction standards for state government should be in place by 2030, prioritizing waste prevention through the extension of product lifetimes through repair and refurbishment, replacing single-use disposables with reusable and refillable options, and implementing food scrap diversion programs. **A.3.** Initiate a statewide residential Save Money and Reduce Trash (SMART) municipal solid waste management program with incentives for waste diversion programs such as recycling and composting as well as other community waste reduction initiatives in alignment with Maine's solid waste and food recovery hierarchies. **A.4.** Align state incentives with materials management processes that reduce greenhouse gas emissions, both direct and indirect (consumption-based), to the maximum extent feasible.
Supporting Information:
A.1. EPR for packaging legislation and the bottle bill modernization act both earmarked support for the development of infrastructure and programming for returnable and refillable packaging that will support waste reduction through the prevention of single-use disposable products. Transitioning to systems of reuse and refill reduces single-use plastics consumption, which is crucial as plastics represent a growing source of greenhouse gas emissions. According to the United Nations Environment Programme, "...the level of greenhouse gas emissions associated with the production, use and disposal of conventional fossil fuel-based plastics is forecast to grow to 19 per cent of the global carbon budget by 2040." The packaging program will include a needs assessment of recycling infrastructure across Maine, which will provide data on where infrastructure to divert materials from disposal is lacking. This data will support other waste prevention and diversion programs beyond recycling by highlighting where the need for more robust infrastructure is greatest, and where there are opportunities for creating economies of scale for diversion through regionalized programs developed with hub-and-spoke infrastructure. EPR for packaging funds can be used for developing reusable food service ware and packaging (e.g. reusable cutlery and service ware in school cafeterias or in institutions) and will incentivize private investments (e.g. to develop the infrastructure for the

sanitation of reusable/refillable packaging systems). However, additional dedicated support is needed to fund community-based projects to improve reuse, sharing/lending programs, and repair infrastructure for non-packaging products such as textiles and consumer goods (e.g. tool or gear libraries, repair cafes, washing and collection hubs), to investigate opportunities for industrial symbiosis projects and regional materials exchanges), and to support economic growth initiatives in the reuse sector (e.g. develop training and apprenticeship and business incubator programs for repair and refurbishment).

A.2. In order to reduce waste and the emissions associated with disposable products, all state-funded institutions should eliminate the use of single-use disposable products when durable, reusable options are available. This would entail the re-adoption of reusable food service ware (cutlery/trays) in all state-funded cafeterias and at all state-sponsored events and include procurement standards for reusable packaging. It would also entail the placement of water refilling stations and efforts to support a state exchange for reusable durable goods. Despite higher up-front costs for initial purchases, reusable food service ware has consistently been shown to result in significant cost savings over time. See case studies at https://upstreamsolutions.org/reuse-in-food-service.

A.3. SMART waste management programs are effective and equitable solutions to reduce waste through unit-based waste disposal pricing - "people who produce less pay less". Such programs are governments' most effective tools for reducing waste, cutting waste disposal costs, and encouraging landfill diversion. Paying for a waste disposal service based on usage aligns with water and electric utility billing. In Massachusetts, SMART waste management households reduced their waste by 30% over those who used conventional systems. In 2017, an NRCM program guaranteed 35% reduction in waste when using their unit-based pricing approach; the 42 participating towns averaged a 44% reduction. Today more than 138 Maine towns use SMART programs (NRCM Toolkit). SMART programs are most effective when households have easy access to alternatives for waste disposal, such as recycling and/or organics recycling. Because food is generally the largest and heaviest component of household waste, SMART programs are especially effective at reducing food waste sent to landfills or waste-to-energy facilities. Local impact is reduced waste sent to landfills and waste-to-energy facilities; this decreases local GHG emissions and improves resiliency across the state.

A.4. Provide financial incentives, technical assistance, education and outreach to support waste reduction and diversion efforts (in support of the legislated solid waste management and food recovery hierarchies). Subsidies for reuse, refill, repair (replacing single-use disposable items with reusable and prolonging the useful life of consumer goods), food rescue, composting, anaerobic digestion, and other alternatives to waste disposal should be greater than those for energy generation where materials are destroyed to recover energy in order to drive materials to processes with the lowest levels of GHG emissions and align with Maine's Waste Management Hierarchy.

Recommendation B. Prevent Food Loss and Waste to Reduce Food Waste by 50% by 2030 (base year 2016) for Maximum Emissions Reduction (Local and Global). Prevention is the best strategy for climate impact.

Actions:

B.1. Legislate large food waste generator annual reporting with ≥1 ton/week generators and expanding to ≥½ ton/week generator to support increasing diversion of food waste from landfills by 10% annually through 2030.

B.2. Develop or adopt an official, statewide integrated Consumer Food Waste Education Campaign required to change consumer food waste beliefs and drive policy innovation.

B.3. Maximize food rescue, recovery and donation of all good, edible food to feed people through state tax credits, clearer liability protections, and support for donation infrastructure (storage, freezing, distribution). Prevent any mandated disposal of good, edible food in compliance with updated Maine food code guidelines.

Supporting Information and Timeframe, if Relevant:

B.1. Preventing food waste and loss is the most impactful way to reduce GHG emissions and other environmental damage - as well as cut food waste costs. Prevention includes (but is not limited to) changing food purchasing, storage, preparation, and serving practices to prevent wasted food. Prevention is at the top of the Maine Food Recovery Hierarchy and the EPA's Wasted Food Scale because it reduces the resources used to make the food; it reduces the amount of food wasted; and it reduces the amount of money spent on food disposal - a real triple play! Food Rescue MAINE research has shown that the best prevention action is tracking and measuring food waste. Through pilots tracking and measuring food waste with businesses, institutions and households, the data helped them to understand and take action to prevent the waste. Requiring large food waste generators to report their food waste annually is a food waste reduction policy recommended by the Zero Food Waste Coalition as well as the 2024 Maine Food Waste Generation Study - and is similar to successful action taken in other states. Finally, our goal "to reduce food waste by 50% by 2030 over 2016 levels" aligns our state effort with other state and national food waste goals allowing us to leverage shared resources and promote collaboration for greater impact.

B.2. Only with a broad, statewide consumer education is there potential for lasting, sustainable food waste change. EPA and NRDC research have identified the stand-alone need for a national consumer education campaign. In the UK, WRAP's "Love Food Hate Waste" national consumer campaign has been the single most successful, long-term food waste reduction effort, decreasing UK household food waste by 26%. The recent 2024 Maine Food Waste Generation Study states "education is essential"; ReFED says Consumer Education Campaigns are the most cost-effective solution for food waste. Champions 12.3, the leading international food waste solutions organization, highlights building "awareness" as a key food waste solution. Vermont has a successful statewide consumer education campaign, "Let's Scrap Food Waste".

B.3. Putting food to its best and highest use by feeding people can help to prevent food waste and alleviate food insecurity. Great examples of food rescue and donation are already happening across Maine, strengthening communities and avoiding GHG emissions from wasting food. But NRDC

research, "Modeling the potential to increase food rescue" showed that there is significant untapped food donation potential in cities which could further reduce wasted food and food loss while closing the meal gap by almost 50% and reducing emissions. To facilitate more efficient food recovery, Maine needs more and better use of existing infrastructure for processing, storing and transporting surplus (e.g. cold storage, freezers, dehydrators, efficient transport routes); building pathways between surplus food generators and feeding partners (e.g. connecting farms and institutions like schools, prisons, and food pantries) to make sure good, edible food goes to feed people. Federal liability protections for food donors and the updated 2022 Food Code support food donation, but Maine could follow California and Vermont in providing direct legislation, additional liability protections, and additional state tax credits to boost donation rates. Technologies to aid tracking and reporting of food donated are available, as are smartphone apps that connect food businesses directly with consumers to offload unsold food.

Recommendation C. Track and Measure Emissions Reductions via Maine's Consumption-Based Emissions Inventory

Actions:

C.1. By 2028, include consumption-based emissions in the Maine Department of Environmental Protection (DEP) Biennial Report on Progress toward Greenhouse Gas Reduction Goals.

C.2. Support ongoing study and analysis of Maine's consumption-based emissions and identify strategies that reduce and internalize consumption-based emissions over time.

C.3. Establish subgroup of experts within the Science and Technical Subcommittee to study the emissions reduction potential (and co-benefits) of policies for waste reduction, reuse, refillables and repair.

Supporting Information and Timeframe, if Relevant:

C.1. EPA is developing a consumption-based emissions inventory for the Northeast States and has prepared a preliminary consumption-based emissions inventory for Maine. The Sixth Assessment Report released by the IPCC in March 2022 stated that changing consumption patterns and lifestyles will be crucial for achieving the reductions needed to reverse the emissions curve. According to the IPCC report, the greatest potential to achieve rapid emission reductions is through behavioral changes in the wealthiest countries where overconsumption is greatest, and residents in North America have significantly higher per-capita consumption-based emissions than residents in other countries (https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_SPM.pdf).

There are also significant equity opportunities related to reducing consumption-based emission: "The design of regulatory instruments and economic instruments and consumption-based approaches, can advance equity. Individuals with high socio-economic status contribute disproportionately to emissions and have the highest potential for emissions reductions. Many options are available for reducing emission-intensive consumption while improving societal well-being. Socio-cultural options, behaviour and lifestyle changes supported by policies, infrastructure, and technology can help end-users shift to

low-emissions-intensive consumption, with multiple co-benefits." (https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_FullVolume.pdf)

C.2. Consumption-based emissions data sets typically support materials management decisions in alignment with Maine's solid waste management and food recovery hierarchies. Tracking Maine's consumption-based emissions over time will provide a tool by which emissions reductions fostered by circular economy initiatives can be measured over time.

C.3. Potential legislative actions this subgroup may study include but are not limited to state-wide "skip the stuff" proposals (require all food service institutions to only include convenience items on request); requirements that all restaurants with dine-in options serve on reusables; requirements for refillable/bulk purchase food and beverage sales; and bans on carbon intensive single-use products. There may be mental health and community benefits attributed to greater materials efficiency as shifting to a circular economy can help address inequality with socio-cultural shifts away from "status consumption" and towards holistic wellbeing. Co-benefits of policies including community resilience and mental health improvements should be considered along with the emissions reductions.

Recommendation D. Invest in Maine's Circular Workforce

Actions:

D.1. Support and grow new and existing workforce development, "train the trainer" programs, and business incubators through strategic partnerships with Maine tech and vocational schools, community colleges, universities, and businesses to grow the circular economy in Maine supporting activities such as reuse, repair, refill, food rescue, upcycled foods production, composting, and deconstruction.

D.2. Leverage key community partners to enhance research, analysis, education and outreach opportunities and provide technical assistance (e.g. Mitchell Center, DOE, MRRA, MMA, Maine Library Association) for consistent statewide messaging about the climate benefits of advancing Maine's circular economy through workforce development, with a specific focus on historically disadvantaged workers.

Supporting Information and Timeframe, if Relevant:

D.1. In general, repurposing, repairing, and reusing create more jobs than recycling, which in turn creates more jobs than disposal. There is significant economic potential in growing Maine's circular economy while reducing consumption-based emissions. A 2021 report estimated that, "Reuse creates almost 200 times as many jobs as landfills and incinerators. Recycling creates around 60 times as many jobs as landfills and incinerators. Remanufacturing creates almost 30 times as many jobs as landfills and incinerators."

D.2. Develop Maine's circular workforce by leveraging community partners to support data-driven statewide education on the climate and resilience benefits of a strong circular workforce. It will be necessary to identify and target different audiences with appropriate, relevant information - policymakers (state and local) schools, municipalities, businesses and commercial sector, industry, residents, etc. Provide financial incentives, technical assistance, education and outreach to support waste reduction and diversion efforts (in support of the legislated waste and food recovery hierarchies) and promote businesses and organizations that participate in and support the growth of Maine's circular economy and workforce development.

Recommendation E. Regionalize and Scale Up Access to Waste Prevention and Diversion Services (reduce transport miles)
Actions:
E.1. Create funding for additional staff capacity for technical assistance and materials management planning support within regional planning commissions, councils of government, and similar entities providing regional support. **E.2.** Provide state level coordination, technical assistance, and planning support to regional and local entities to encourage regionalization and hub-and-spoke infrastructure to reduce transport milage and increase beneficial electrification and provide municipalities with decision-making tools on climate implications of materials management pathways to encourage more consistency in materials management programs across municipalities. **E.3.** Develop model municipal ordinances and best practice guides to ensure equitable access to waste prevention and diversion programs and services including but not limited to reuse and lending programs, and recycling and food scrap collection for low-income households, renters, new Mainers, and rural communities.
Supporting Information and Timeframe, if Relevant:
E.1 This recommendation strongly links with resilience for dealing with storm debris and has equity implications. Planning and technical support to disadvantaged communities would include making concrete examples of accessible program options available that will reduce emissions and waste. For example, sharing electric tools reduces direct emissions as well as consumption-based emissions by allowing people to share tools rather than each household purchasing their own, in addition to making costly, climate-friendly tools widely available regardless of income and ability to purchase. South Portland is an example of an electric lawn tool lending program. Assemble a network of partnerships with existing programs and entities to support diversion through volunteer and/or intern work in accordance with existing state regulations. Establish revolving funds for community sustainability projects, overseen by municipal or regional entities such as Regional Councils. Through the development of local comprehensive plans, municipalities should consider opportunities to expand and improve materials management practices, particularly for prevention, diversion, and safe management of HHW, UW, food scraps, recyclables, and demolition debris. Consider waste surcharges to fund diversion (best not to do this for household waste if a SMART plan is implemented, although surcharges could apply to specific, non-residential waste streams to encourage reduction. **E.2.** The Stewardship Organization tasked with Maine's EPR for Packaging program may be a natural vehicle for state-level coordination of materials management programs, particularly for convening municipalities and helping to identify opportunities for regionalization and economies of scale with diversion programs. This action includes a goal to ensure that municipalities developing climate plans are provided resources that they use to assess the emissions impact of their materials management processes and programs. Municipalities may also benefit from support in understanding the viability, cost, and climate, health, and environmental impacts of various technologies for materials management. See City of Portland Climate Action Trust Fund for an example.

Policies to ensure sustainable community planning for materials management should be wrapped into state level guidance as well.

E.3. Equitable access to diversion will also increase the amount of material diverted from disposal, thereby reducing emissions from landfill disposal and preserving resources in recyclables and food scraps for higher and better use. A 2023 report from the Alliance of Mission-Based Recyclers noted that, "Recycling across the US is generally more convenient in more affluent communities and among single-family homes. Apartment residents often lack onsite recycling services, creating a service inequity between single-family homes and multifamily residences. Only 4% of multifamily properties have recycling on site compared to 52% of single-family homes with curbside recycling. In addition, many communities cannot afford to provide recycling drop-off centers and rural areas face significantly higher costs." The report also noted that, "EPR can create a sustainable funding system to support convenient, equitable recycling for all residents regardless of income, housing type, or demographics. A common goal of EPR is for all residents to have recycling that is as convenient as their trash service..." Maine's EPR for Packaging Program can take learnings from ecomaine's EPA grant-funded program to scale up services and ensure equitable access to underserved populations and communities. While that program has a particular focus on multi-family dwelling units (apartments, condos, multiplexes, fourplexes), rural areas should also be considered from a statewide perspective. Creating statewide translated and/or image-based outreach materials will ensure language and cultural differences are not a barrier in clear communications.

Recommendation F. Foster Resilience in the Built Environment through Materials Collection and Reuse

Actions:

F.1. Ensure that municipalities require permits for demolitions taking place within their borders and post a minimum of two-weeks public notice of pending demolitions so people can request rights to salvage materials first, in conjunction with support to ensure liability is not a risk for the community (provide waiver language and require salvagers to sign a waiver)

F.2. Require commercial construction and state-funded construction projects that meet certain thresholds (embodied carbon, structure size, etc.) to be designed for deconstruction and reuse by 2030, and to be sourced from materials with lower Global Warming Potential (GWP) based on Environmental Product Declarations (EPDs).

F.3. Increase capacity for collaborative infrastructure to manage storm debris (from local to federal level) and decrease risk of environmental contamination during storm and flooding events by addressing toxicity through ensuring hazardous and household hazardous waste streams are properly managed.

Supporting Information and Timeframe, if Relevant:

F.1. Demolition is the typical method for disposing of buildings that are either in the way of a new project or structure or have reached their end-of-life, resulting in a significant loss of potentially useful and valuable material. In terms of embodied carbon, this is most impactful for buildings constructed of high-carbon materials such as concrete, but also results in a loss of high value materials that cannot be replaced when old homes are demolished, such as heritage timber from old growth lumber.

F.2. Researchers have identified the fact that existing commercial buildings aren't designed for easy deconstruction as a key barrier to circular systems for building materials. As noted in a 2022 Resourceful ME

policy briefing from the University of Maine on Exploring multiple forms of value in Maine's reuse sector, "One study, for example, estimated that up to 95% of building materials landfilled each year could be reused. The authors estimate that if buildings were designed with reuse rather than recycling in mind, 88% of the global warming potential of these materials could be avoided." Buildings are a key target for reducing emissions; "the building sector alone accounts for nearly 40 percent of global energy-related CO2 emissions, 50 percent of extracted materials, and one-third of global waste." (*COP28 announces new partnerships and initiatives to advance sustainable urban development,* see press release*)*

F.3. Volunteer networks can be leveraged during and after storm events for immediate cleanup, but comprehensive planning around storm debris would reduce future risk including environmental contamination from stored wastes and ensure adequate capacity to safely manage storm debris in future disasters. An Extended Producer Responsibility (EPR) program for household hazardous waste (HHW) would help communities build resilience by decreasing the risk of environmental contamination from flooded basements and garages and ensuring affordable, accessible and regular HHW collections. The subgroup reviewing resilience for the improving storm debris management recommended a suite of potential actions for a comprehensive approach: incentivize towns to submit registration for temporary debris management site; create a user friendly statewide storm debris management plan; include summary and additional communication materials on storm debris recovery which can be considered by the new Commission on Infrastructure Rebuilding and Resilience and can based on the MEMA Debris Management Plan; build capacity among COGs and Regional Planning Orgs to provide robust technical assistance and education about storm preparedness and debris and management, in close collaboration with state and federal agencies like MEMA, DEP, DMR, EPA, FEMA, Maine Municipal Association, county EMAs; incentivize municipalities to implement a storm warning system to notify coastal residents and property owners to prepare to reduce the potential for storm debris; incentivize municipalities to help residents separate storm debris and enhance coordination with private businesses, like scrap metal dealers, to reduce emissions through recycling and reduced transportation; and lastly, create volunteer network through existing entities like Volunteer Maine, to be deployed post-storm to assist in debris management.

Recommendation G. Reduce and Capture Methane Emissions from Maine's Waste Sector

Actions:

G.1. By 2030, develop and implement a strategic plan to reduce and capture methane by keeping food and other organic materials out of landfills and other key actions identified by the US Climate Alliance methane scoping project conducted in 2024 and supported by existing data sources and enhanced monitoring and data collection to guide decisions.

G.2. Provide subsidies to make methane capture system installation more feasible for small landfills and to incentivize new anaerobic digestion facilities or support diversion programs to move food waste, manure, and other high methane producing materials from landfill to anaerobic digestion.

Supporting Information and Timeframe, if Relevant:

G.1. The US Climate Alliance Methane scoping study is being developed by the end of 2024 and will focus on opportunities to reduce and capture non-fossil methane emissions from wastes in Maine, including municipal solid waste and wastewater treatment. This study will allow Maine to develop a strategic plan to reduce and capture methane in Maine based on the methane scoping study's assessment. According to NASA, "Methane is a climate "super pollutant," causing 30 times more warming per ton than carbon dioxide. The short-lived but

potent greenhouse gas is currently responsible for approximately one third of global warming from all greenhouse gases." Recent advancements in monitoring technologies suggest methane levels have been drastically underestimated, with detection results showing emissions "77 percent higher on median than what these facilities reported to the EPA. For the 38 of the 70 facilities that recovered gas, their emissions averaged 200 percent greater than reported."

The strategic plan should focus on reducing methane emitted from active and closed landfills, developing best practices for reducing and capturing methane at a local and regional levels, evaluation of the use of biologically active cover on landfills as a method to reduce GHG emissions, research on government and industry policies for preventing landfill fires to determine if the State should incentivize additional landfill management practices to prevent fires. The plan should also review state policies regulating use of biosolids to identify beneficial use options that avoid landfilling of methane-generating materials and commit funding for technical assistance to facilities that generate methane emissions, creating voluntary opportunities for eligible facilities to implement mechanisms to reduce or capture emissions.

The plan should include identifying voluntary opportunities for eligible facilities to implement mechanisms to reduce or capture emissions based on feasibility. Prioritized methane reduction actions recommended for facility operators should include a cost-benefit analysis and easy-to-understand terminology such as cost-per-ton of methane to maximize value for facility owners and operators.

G.2. Maine's materials management plan released in January 2024 includes key recommendation to evaluate the concept of subsidies for AD and other processes that can reduce the volume of waste requiring landfilling. Subsidies could be structured either to incentivize construction or expansion of facilities or to subsidize the cost of managing materials/processes other than landfill disposal.

AD facilities can accept all organics, such as food, FOG, manure, and biosolids. Subsidies could target avoidance of materials and/or could provide added value to the gas generated, captured, and utilized in generators or pipeline injection. Project developers need assurance of feedstocks (AD needs to be cheaper than landfilling), regulatory certainty, and financial incentives through programs like RECs, RINs, LCFC to develop projects that will capture and utilize biogas.

EPA estimates that "an estimated 58 percent of the fugitive methane emissions (i.e., those released to the atmosphere) from municipal solid waste landfills are from landfilled food waste." To reduce food sent to landfills, subsidies for anaerobic digestion (AD) and other alternatives to landfilling should be greater than any provided to landfill gas generation, to drive materials, particularly food, to processes with the lowest levels of GHG emissions and align with Maine's Waste Management Hierarchy. AD aligns with recent state-funded Brown & Caldwell study recommendations to reduce the volume of solids needing transport, bulking agents, and landfilling. According to the Brown & Caldwell study, Maine produces 24,300 dry tons/year (approx. 120,000 wet tons/year) of biosolids. Using Lewiston Auburn WPCA anaerobic digestion historical figures of 6,200 tons of biosolids, roughly 50,000,000 cubic feet of biogas and 2,000,000 kw power is produced annually. If all of the biosolids in the State were to be anaerobically digested, an estimated 967,000,000 cubic feet of biogas and 38,680,000 kw of electricity could be produced.

Small landfills are not required to install landfill gas capture systems, and some are disposing of increasing volumes of methane-generating wastes due to restrictions on beneficial reuse of biosolids. Installation of landfill gas capture systems is key to reducing methane emissions and risk of fires. Landfilling large volumes of biosolids and using bulking agents such as construction and demolition debris can increase the risk of landfill fires. Fires can damage landfill gas collection systems and liner systems, increasing fugitive methane emissions, according to the Solid Waste Association of North America 2020 report "Prevention is Key to Landfill Fires." Incentives for

small landfills to install gas capture or taking other steps to reduce fire risk are worth considering in order to decrease risk in the future.

In 2022, Juniper Ridge & Crossroads Landfills were the second and fifth largest industrial methane emitters in Maine, respectively, emitting a combined ~270,000 tons CO2e (GWP20). Maine hosts hundreds of closed landfills that still emit methane. Research indicates that use of biologically active cover – a layer of compost or other organic material over landfills – can reduce methane emissions at landfills, especially closed landfills, by 63% on average.

Sources: Stern, J. C., Chanton, J., Abichou, T., Powelson, D., Yuan, L., Escoriza, S. & Bogner, J. (2007) Use of a biologically active cover to reduce landfill methane emissions and enhance methane oxidation. Waste Management. Barlaz, M. A., Green, R. B., Chanton, J. P., Goldsmith, C. D. & Hater, G. R. (2004) Evaluation of a biologically active cover for mitigation of landfill gas emissions. Environmental Science & Technology.

Appendix A

Preliminary Results of Consumption-Based Emissions Inventory for Maine

(Note: The information which follows is the best available currently but is considered preliminary. Efforts are currently underway to further develop and refine it.)

Consumption-Based GHG Inventory for Maine

Part 2 - Results

Wesley Ingwersen, USEPA

Maine Materials Management Task Force

May 10, 2024

Disclaimer

The U.S. Environmental Protection Agency, through its Office of Research and Development, funded and conducted the research described herein under an approved Quality Assurance Project Plan (K- LRTD-0030017-QP-1-3). It has been subjected to review by the Office of Research and Development and approved for publication. Approval does not signify that the contents reflect the views of the Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

EPA CBEI Project for NE States

CBEI = ***C****onsumption-****B****ased* ***E****missions* ***I****nventory*

Goals

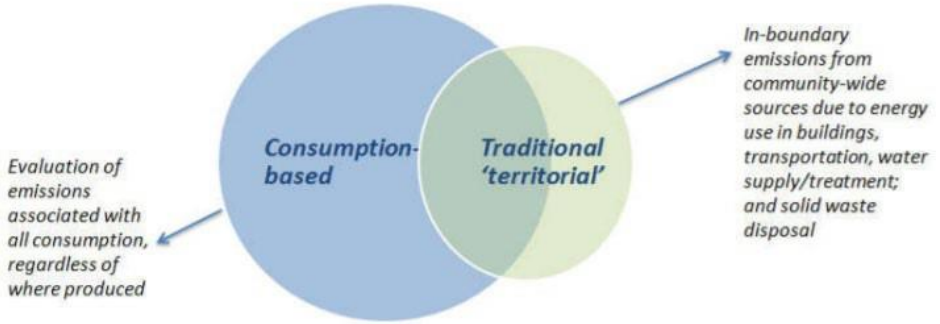
- Prepare CBEIs for northeast states
- Solicit GHGI data and feedback from state partners

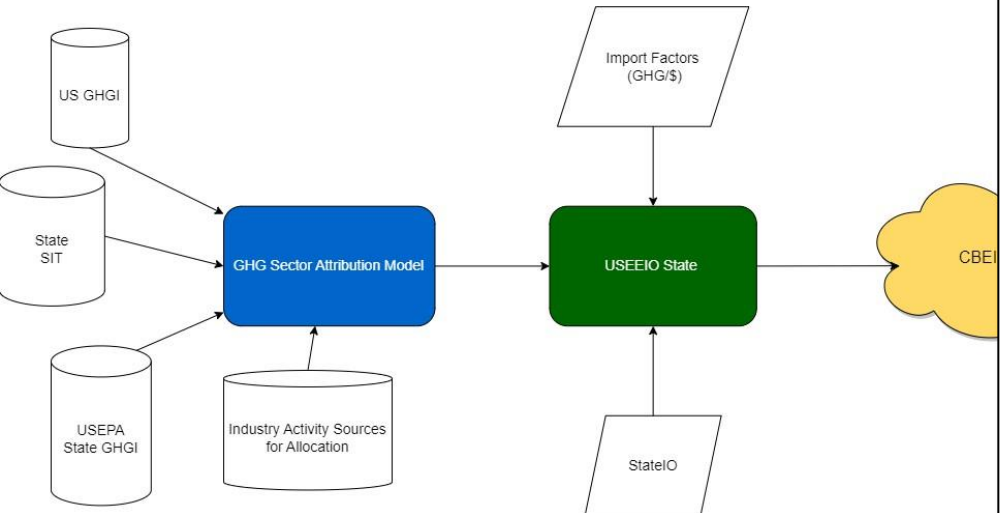
Timeline

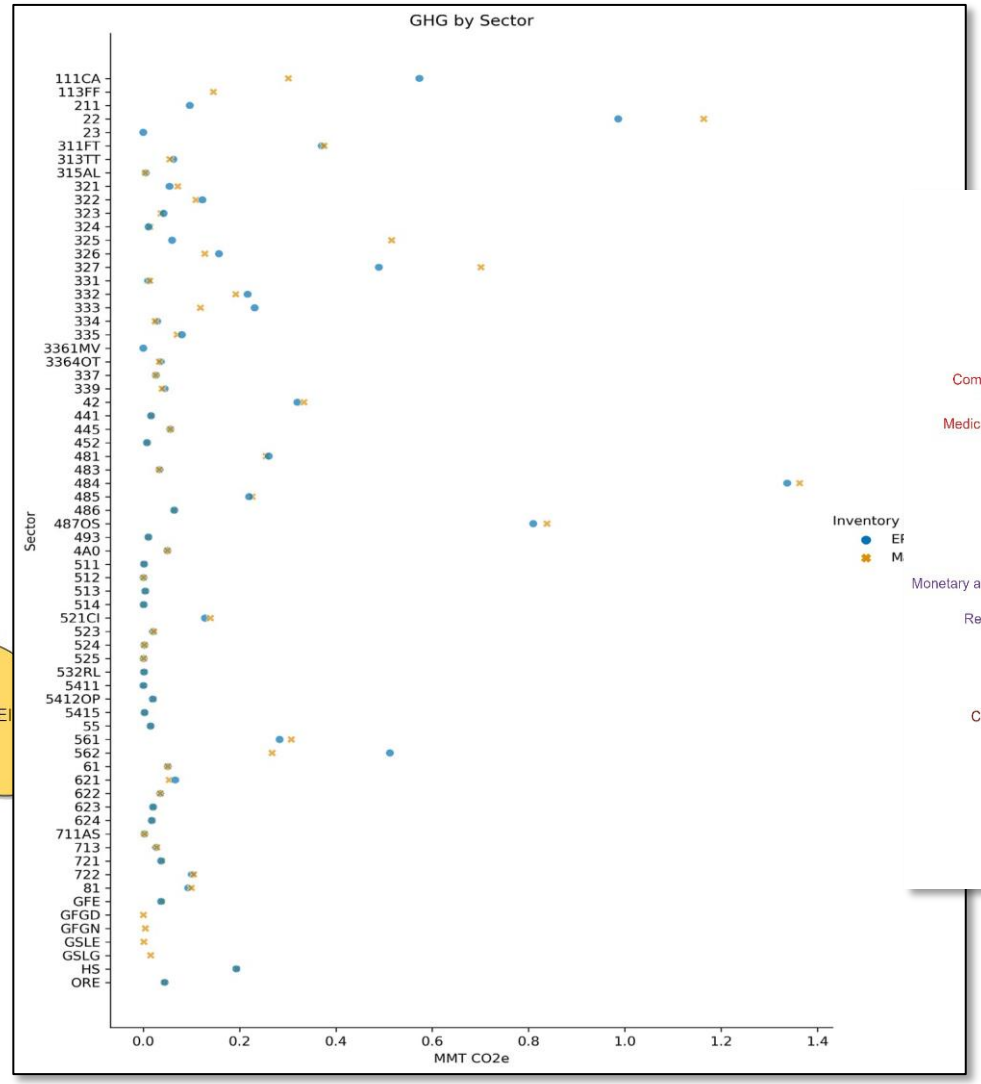
- Produce report and tools by mid-2024

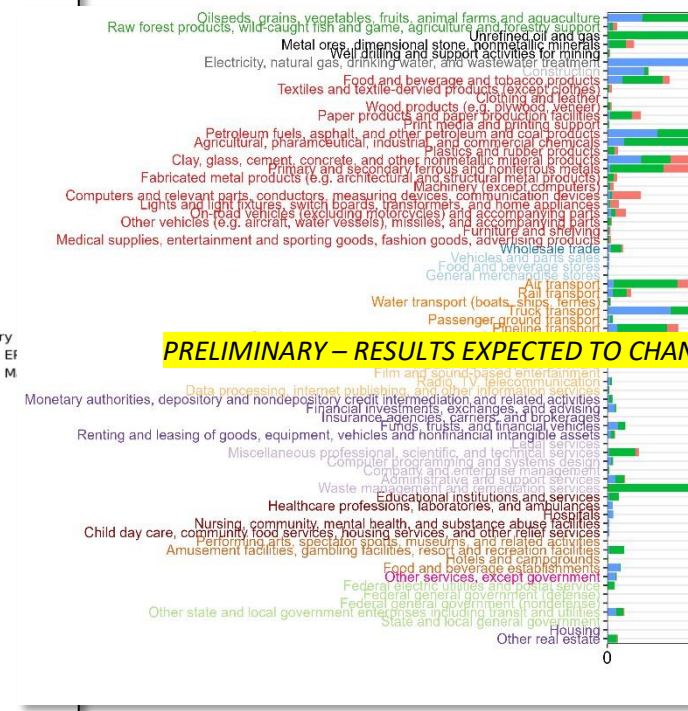
NORTHEAST WASTE MANAGEMENT OFFICIALS' ASSOCIATION

January Meeting for MMTF (Part I)









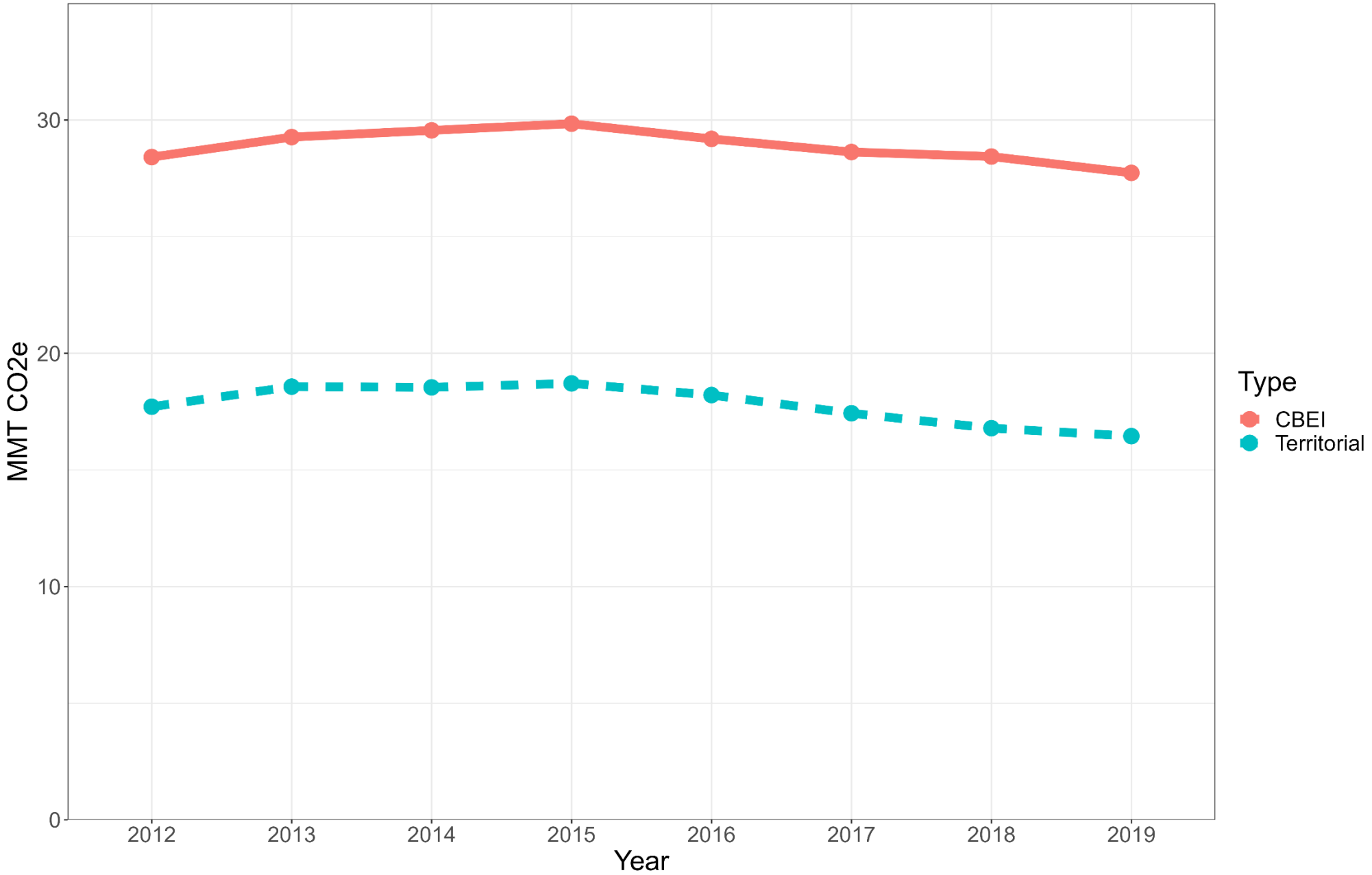
Progress Since January Meeting

- CBE from international imports added
- “Household” emissions added
- Started the deep dive
- Results are still preliminary

EPA United States Environmental Protection Agency

Consumption-based Emissions (CBE) Results (Preliminary)

ME CBE Compared to Territorial

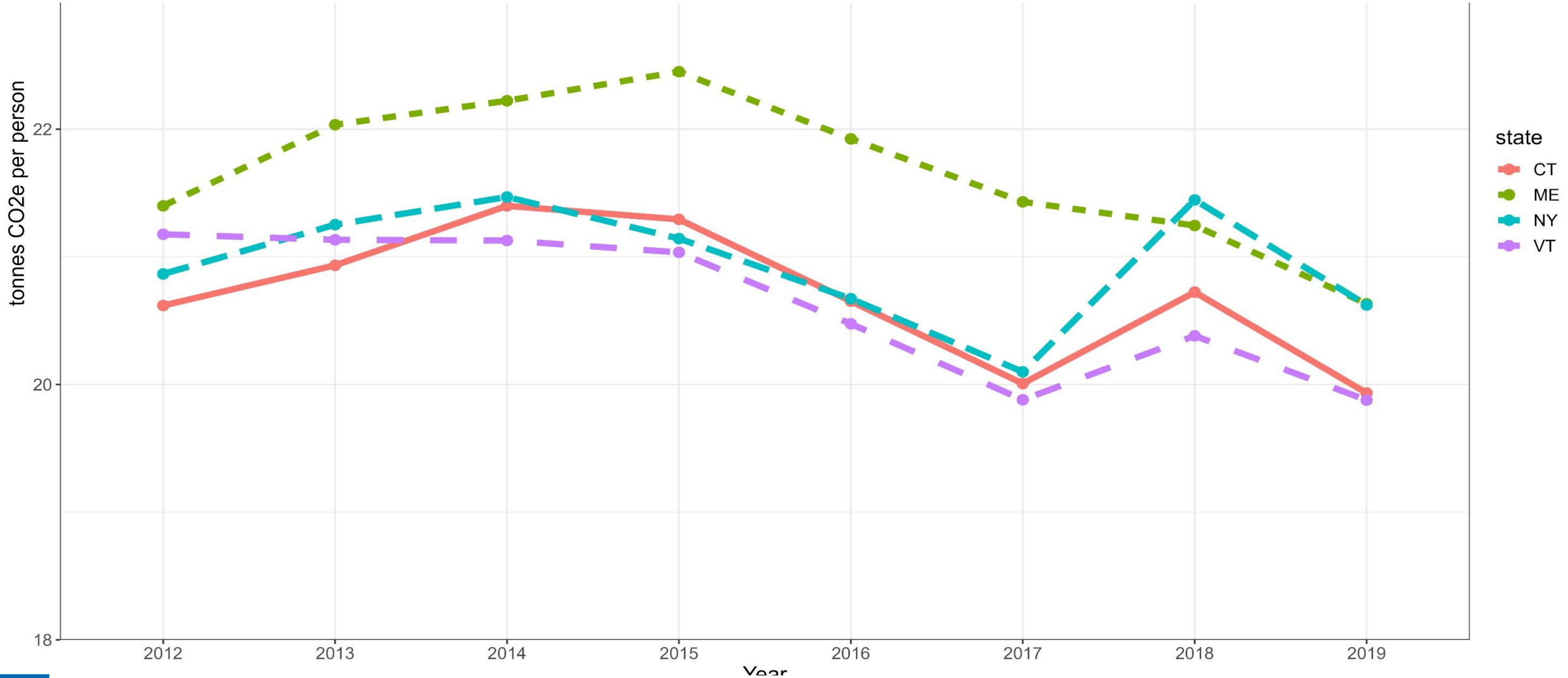


ME CBE in a Regional Context

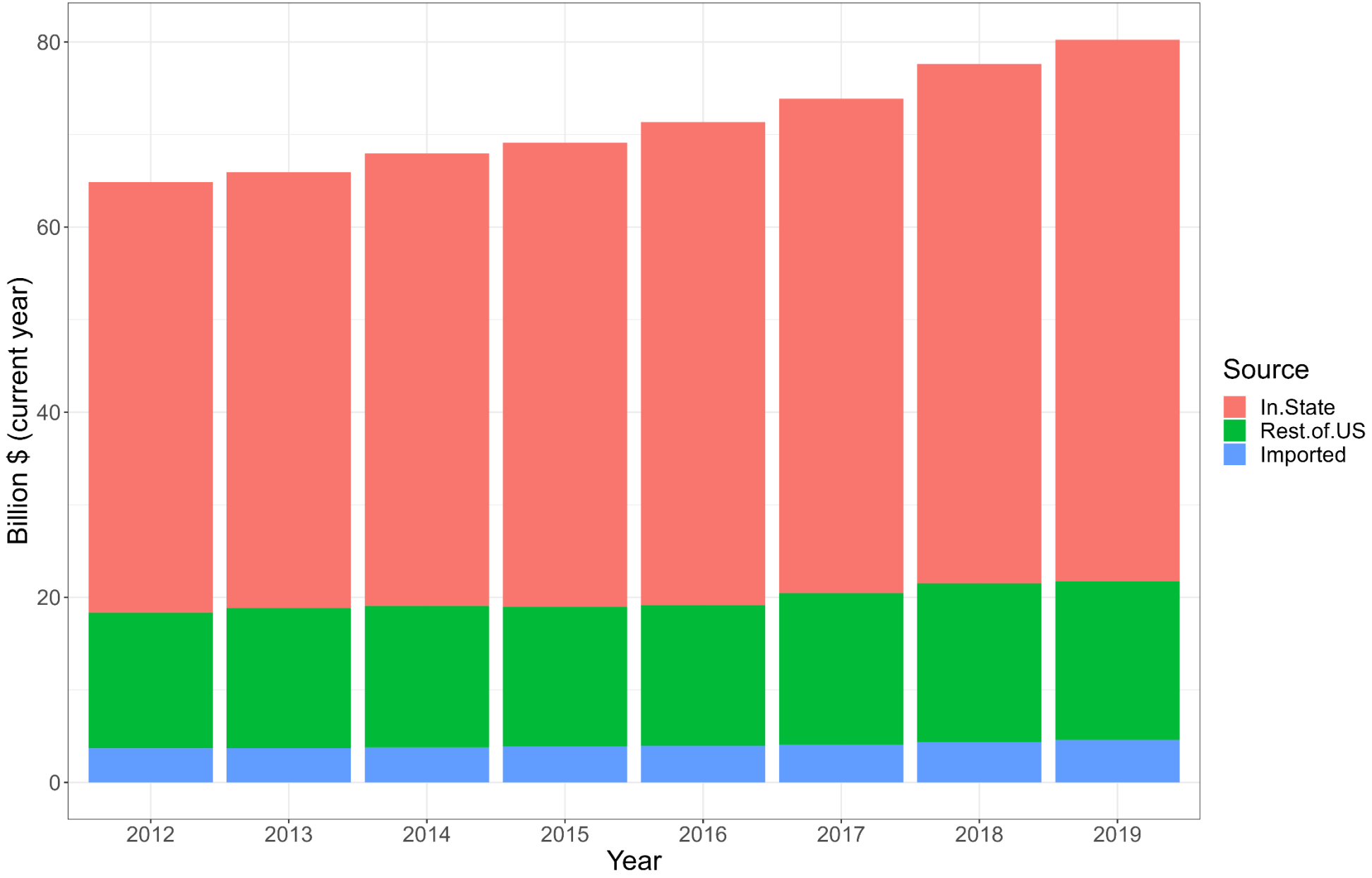
State	2012	2013	2014	2015	2016	2017	2018	2019
CT	74.1	75.3	77	76.5	73.9	71.7	74.1	71.1
ME	28.4	29.3	29.5	29.8	29.1	28.6	28.4	27.8
NY	408.4	417.6	423.9	418.6	408.2	398.9	419	401.2
VT	13.3	13.3	13.2	13.1	12.8	12.4	12.7	12.3

Annual CBE by state for NE states of interest for years 2012-2019. Units are in Million Metric Tons (MMT) of CO2-equivalents.

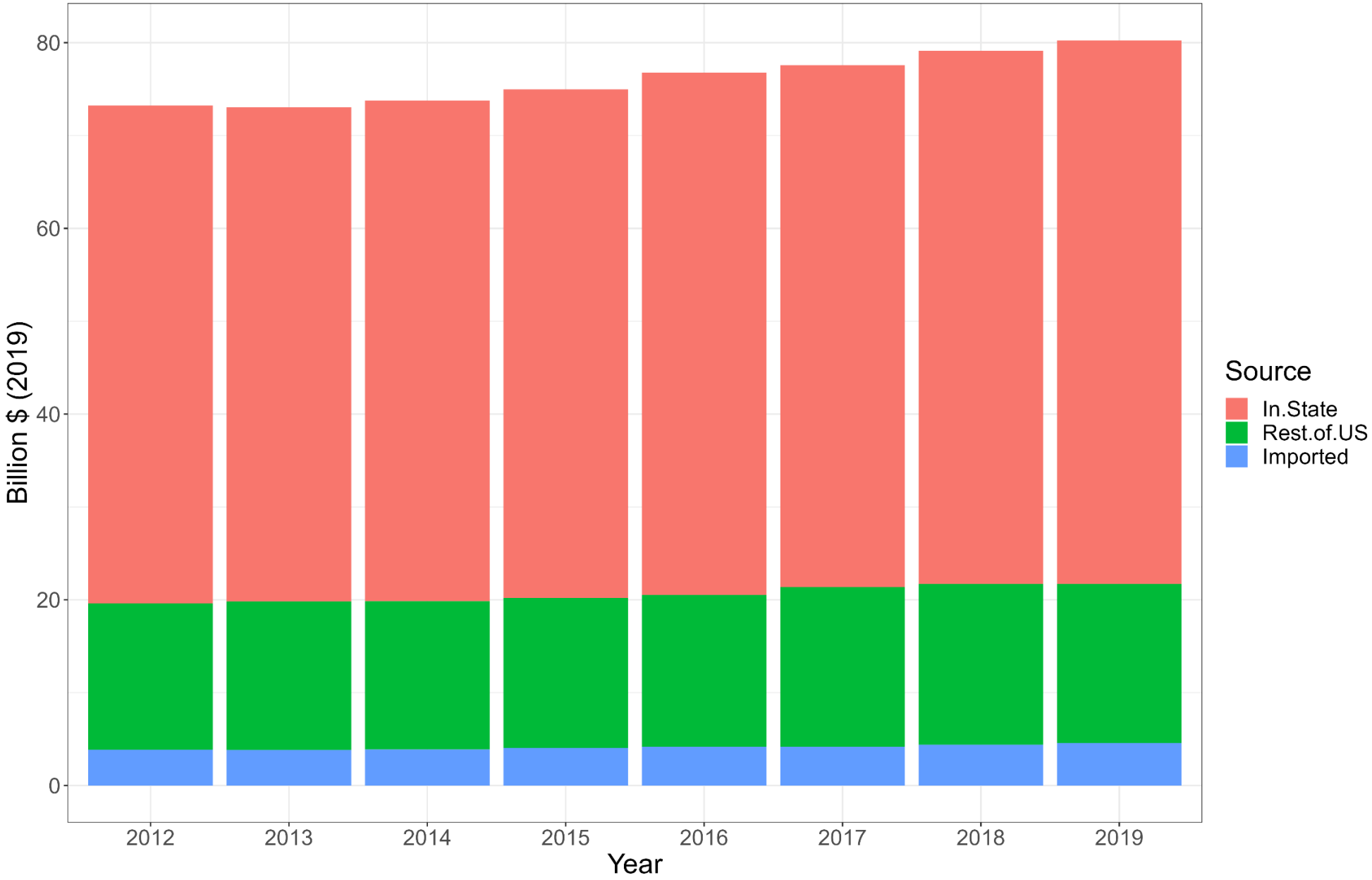
Comparison Across States – Trends in CBE Per Person



Consumption Over Time in Current $



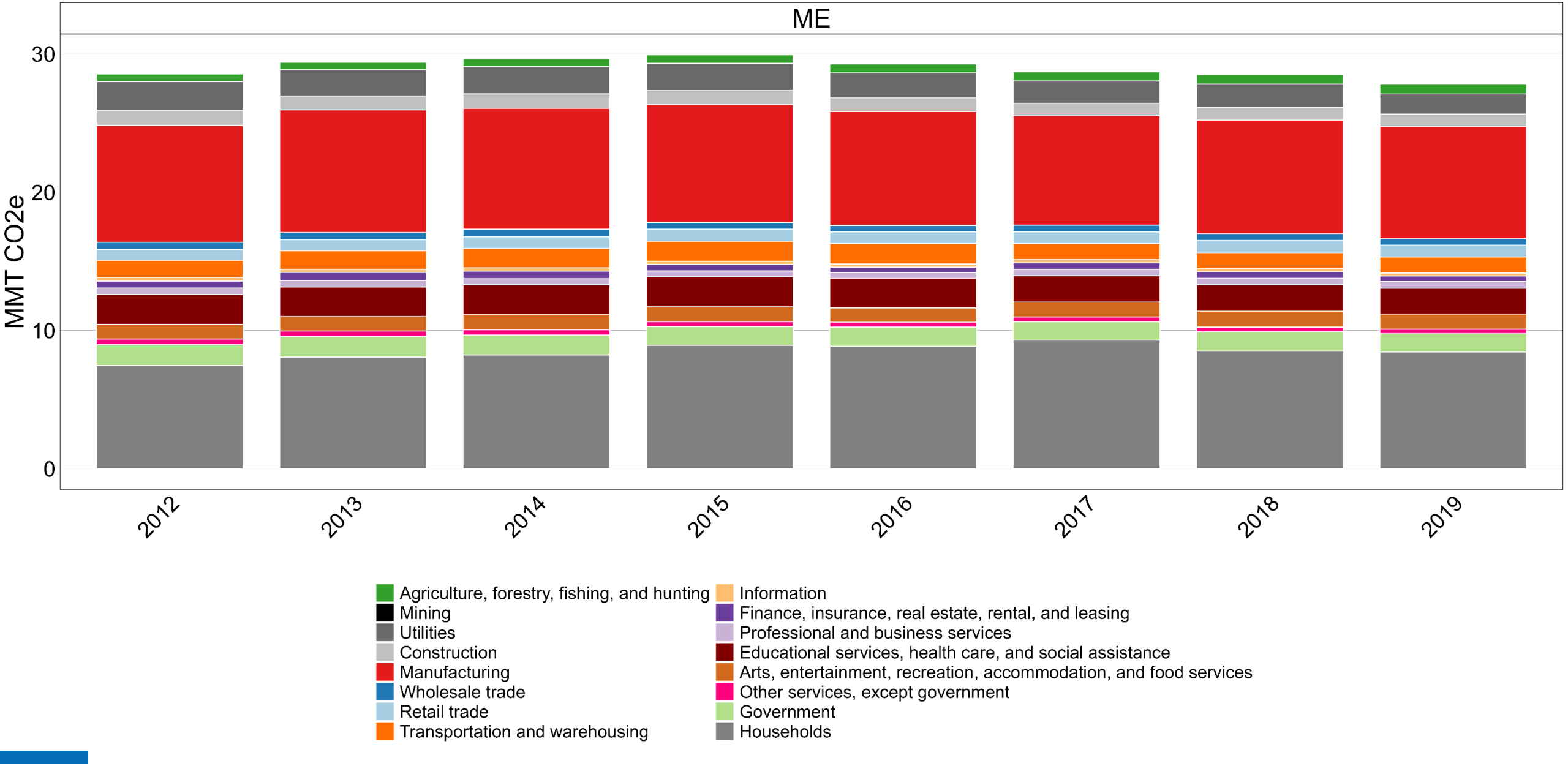
Consumption Over Time in 2019 $


80
60
40
20
0
Billion $ (2019)
2012
2013
2014
2015
2016
2017
2018
2019
Year
Source
In.State
Rest.of.US
Imported

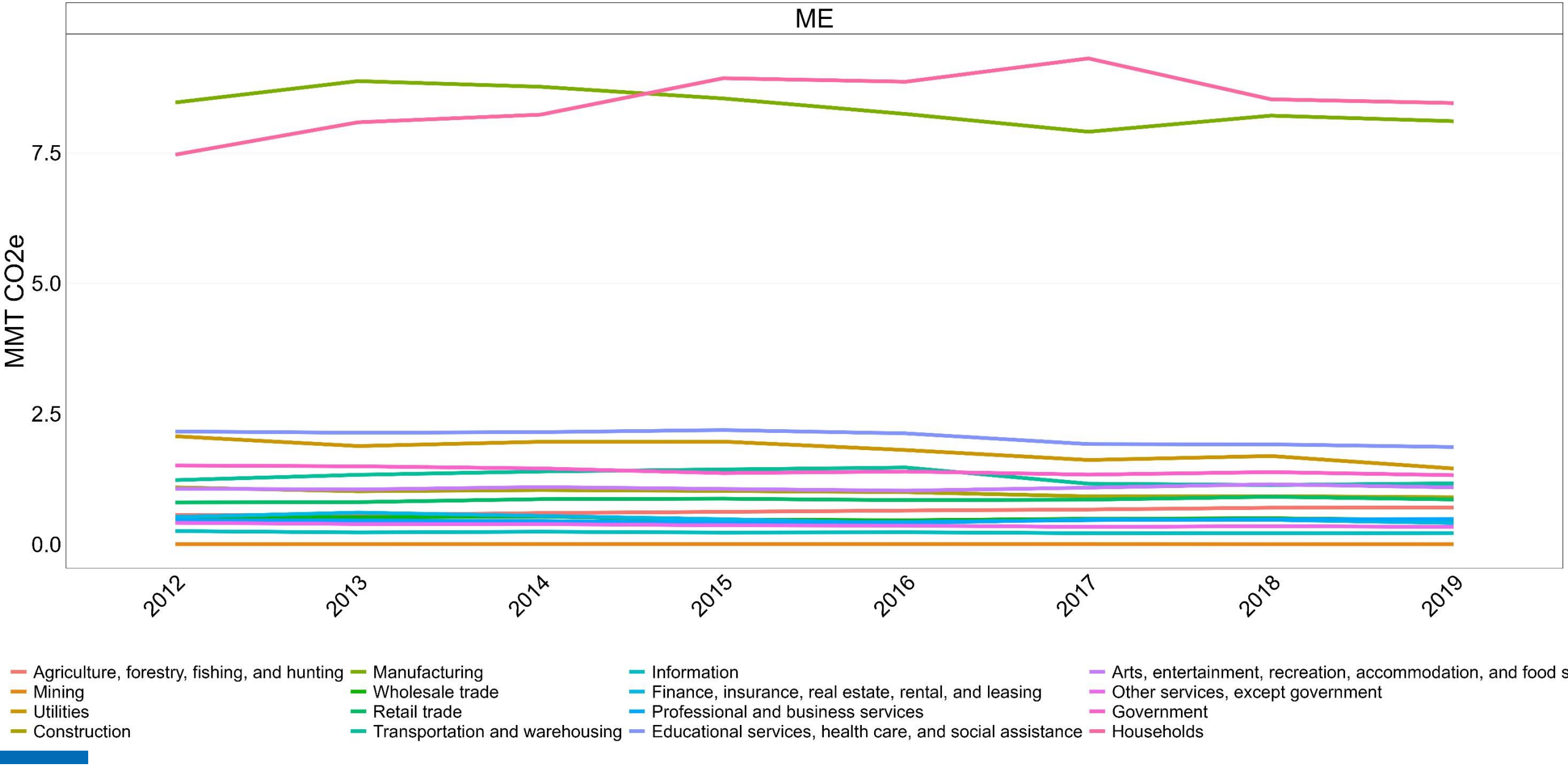
ME GHGs Per $ Consumed Over Period

Metric	2012	2013	2014	2015	2016	2017	2018	2019
CBE (MMT Co2e)	28.4	29.3	29.6	29.8	29.2	28.6	28.4	27.7
Spending (Billion USD 2019)	73.2	73	73.8	75	76.8	77.6	79.1	80.3
CBE/$ (grams per $)	388	400	400	398	380	369	359	345

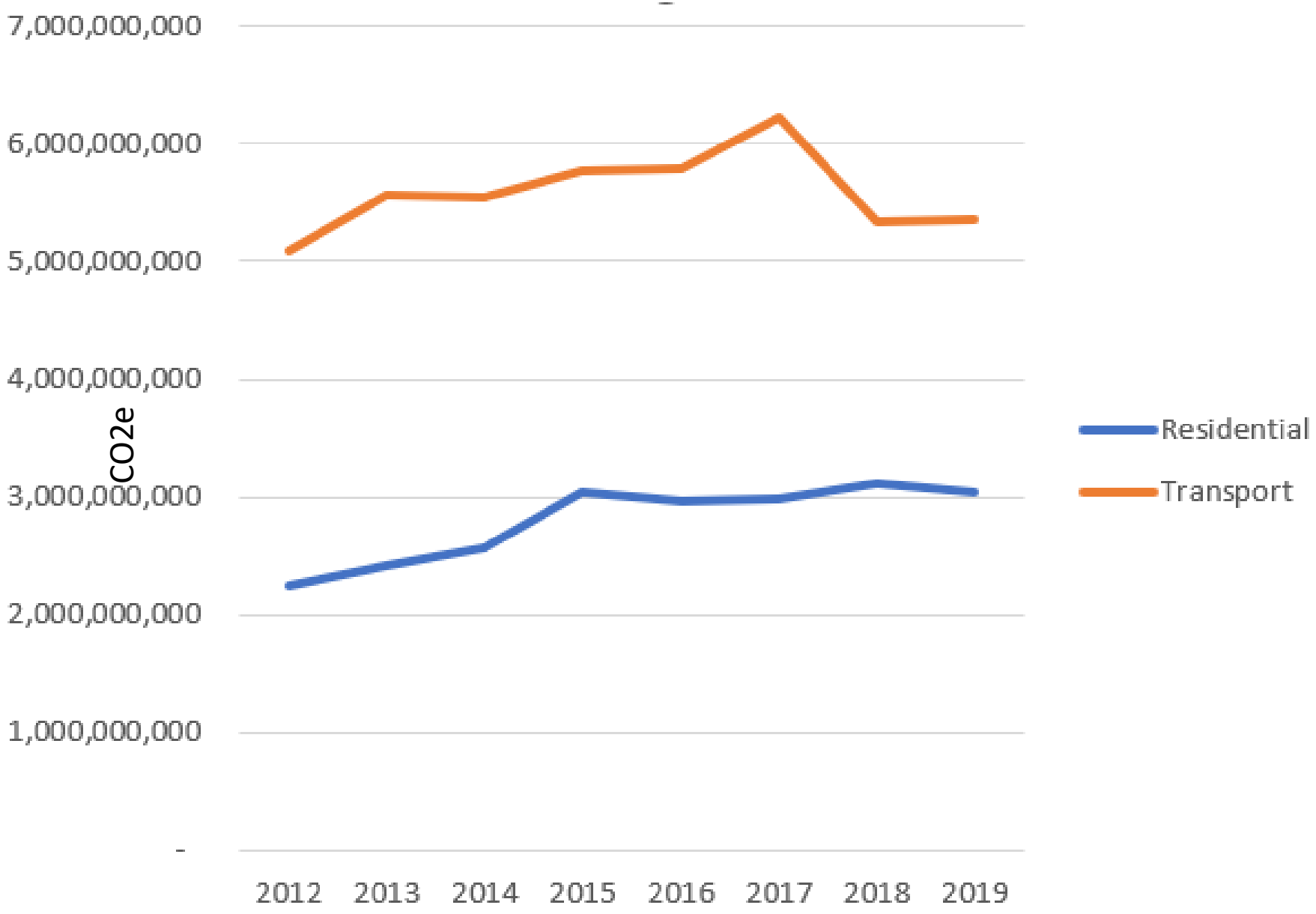
CBE by purchase category over time



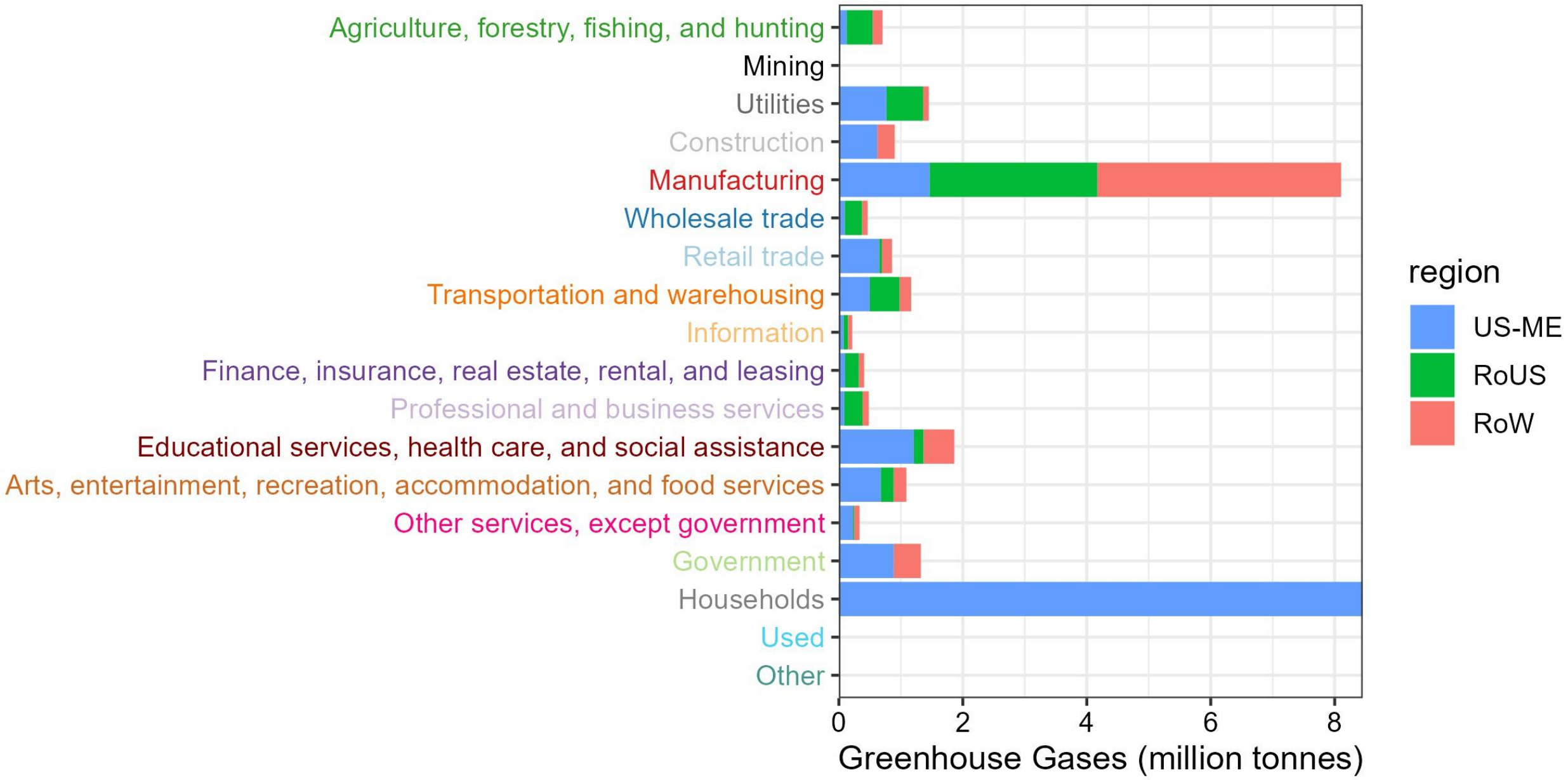
CBE by purchase category over time



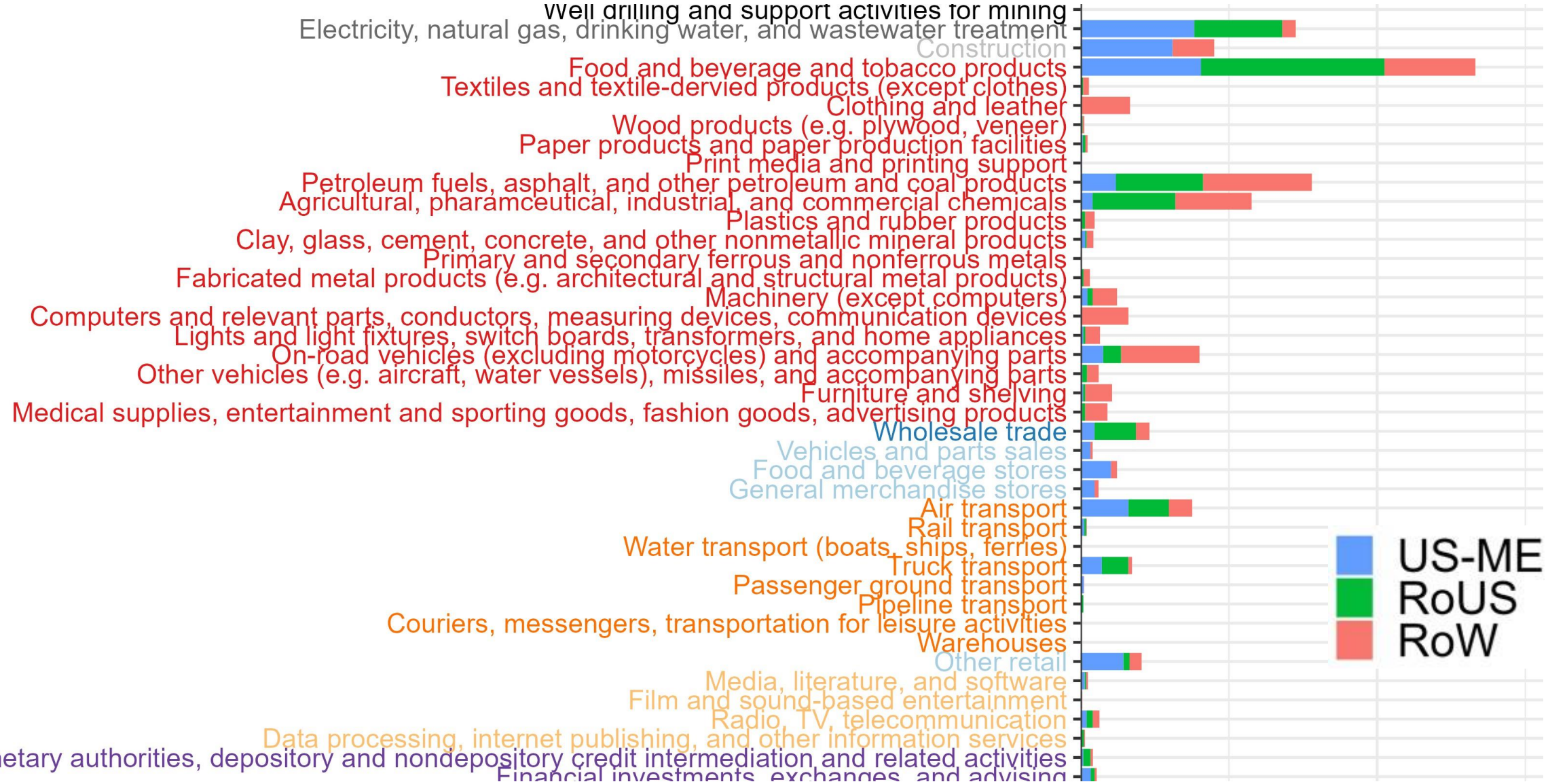
“Household GHGs”: Transport vs Residential (HVAC/cooking)



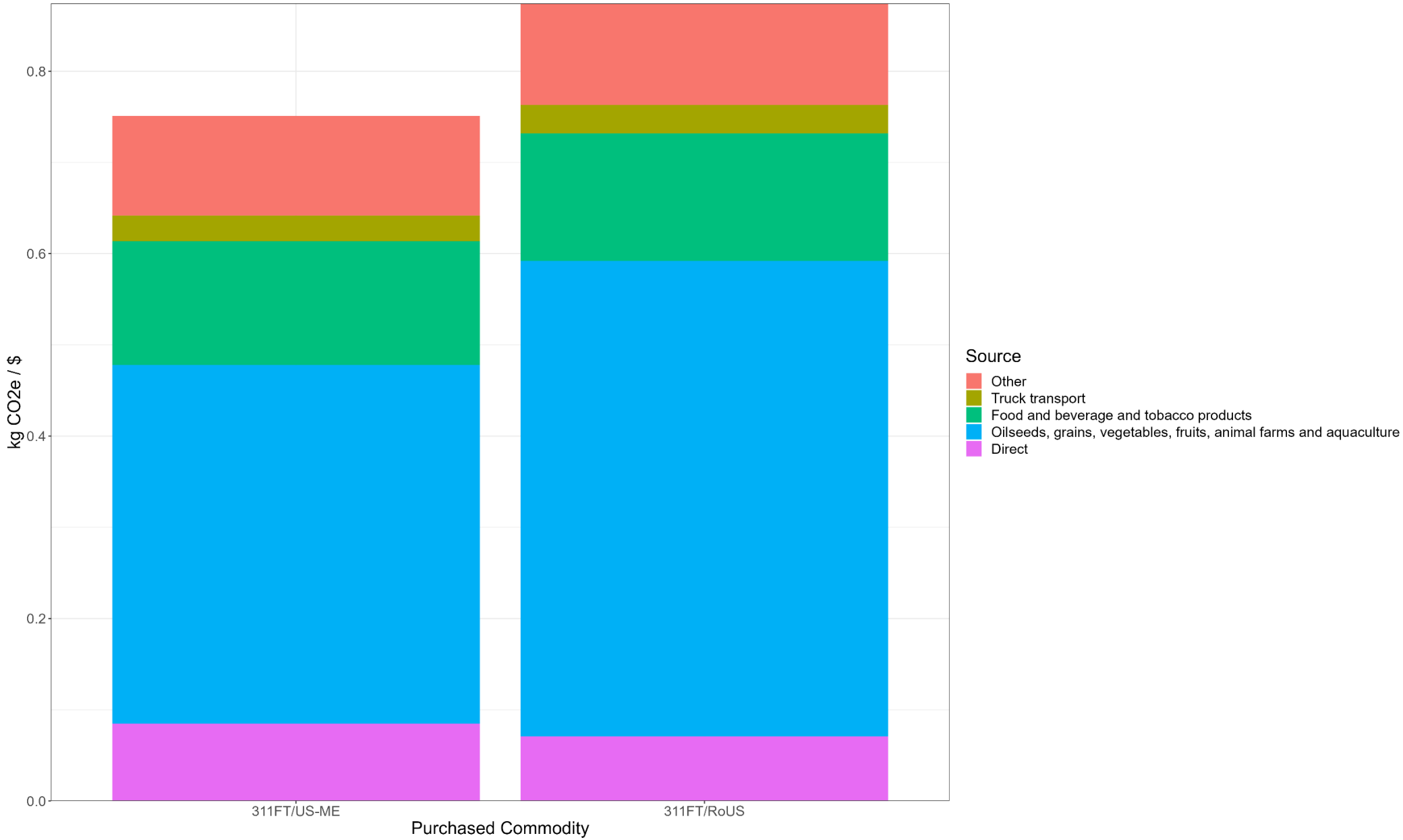
CBE by purchase category and source region



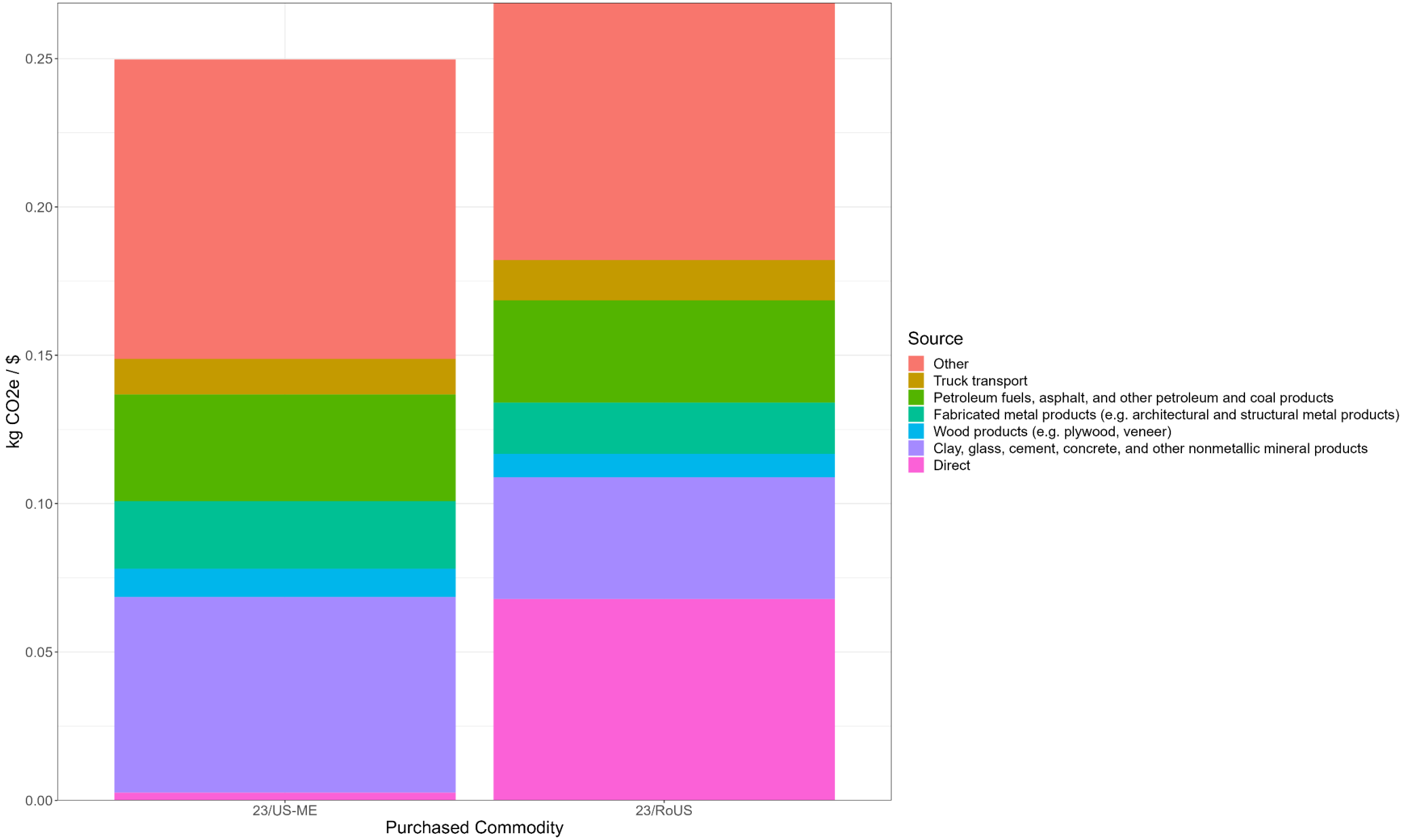
Source of GHGs Emissions for ME Consumption: Detailed Purchase Category



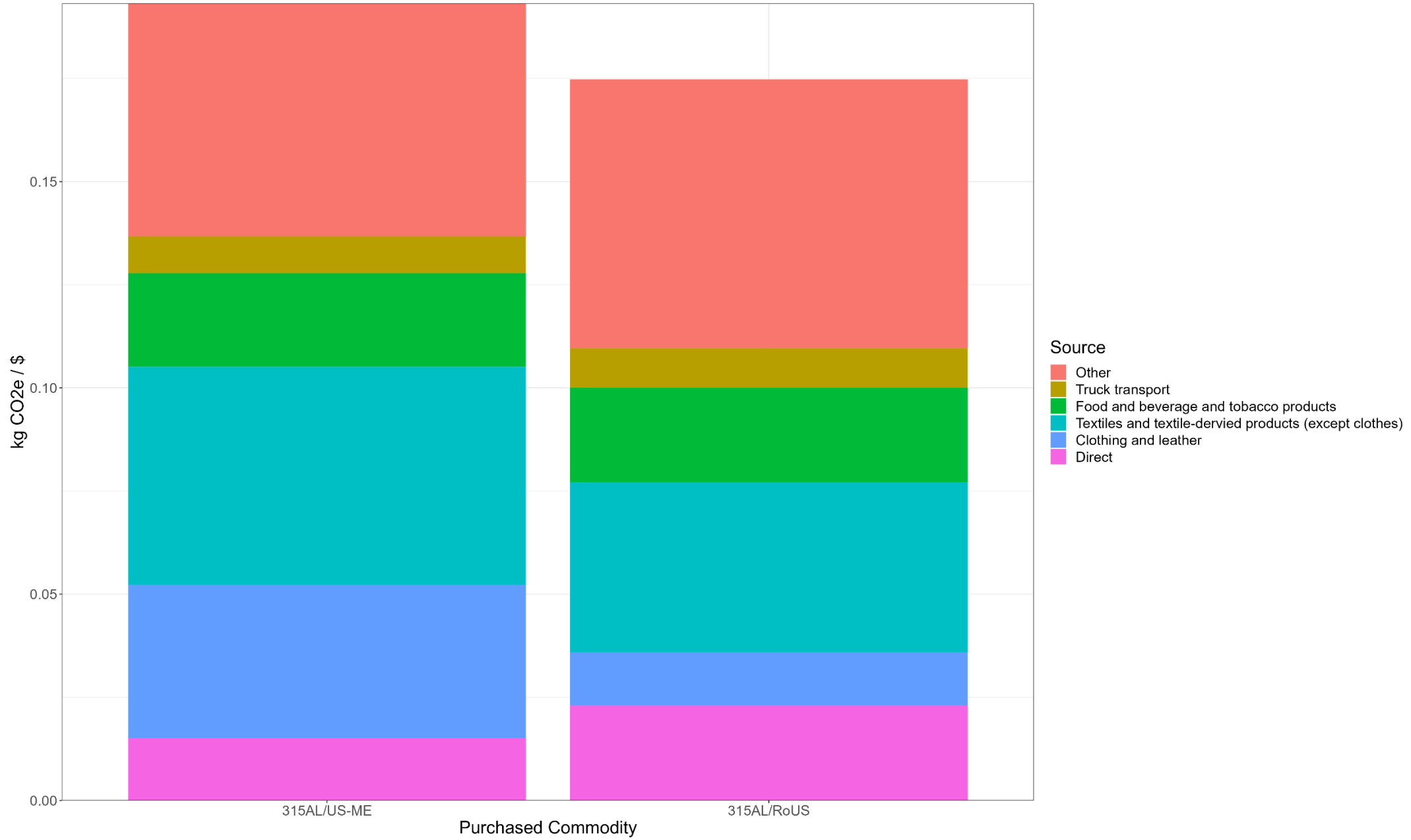
What Contributes to Food CBE (Made in ME vs ROUS)


0.8
0.6
0.4
0.2
0.0
kg CO2e / $
311FT/US-ME
311FT/RoUS
Purchased Commodity
Source
Other
Truck transport
Food and beverage and tobacco products
Oilseeds, grains, vegetables, fruits, animal farms and aquaculture
Direct

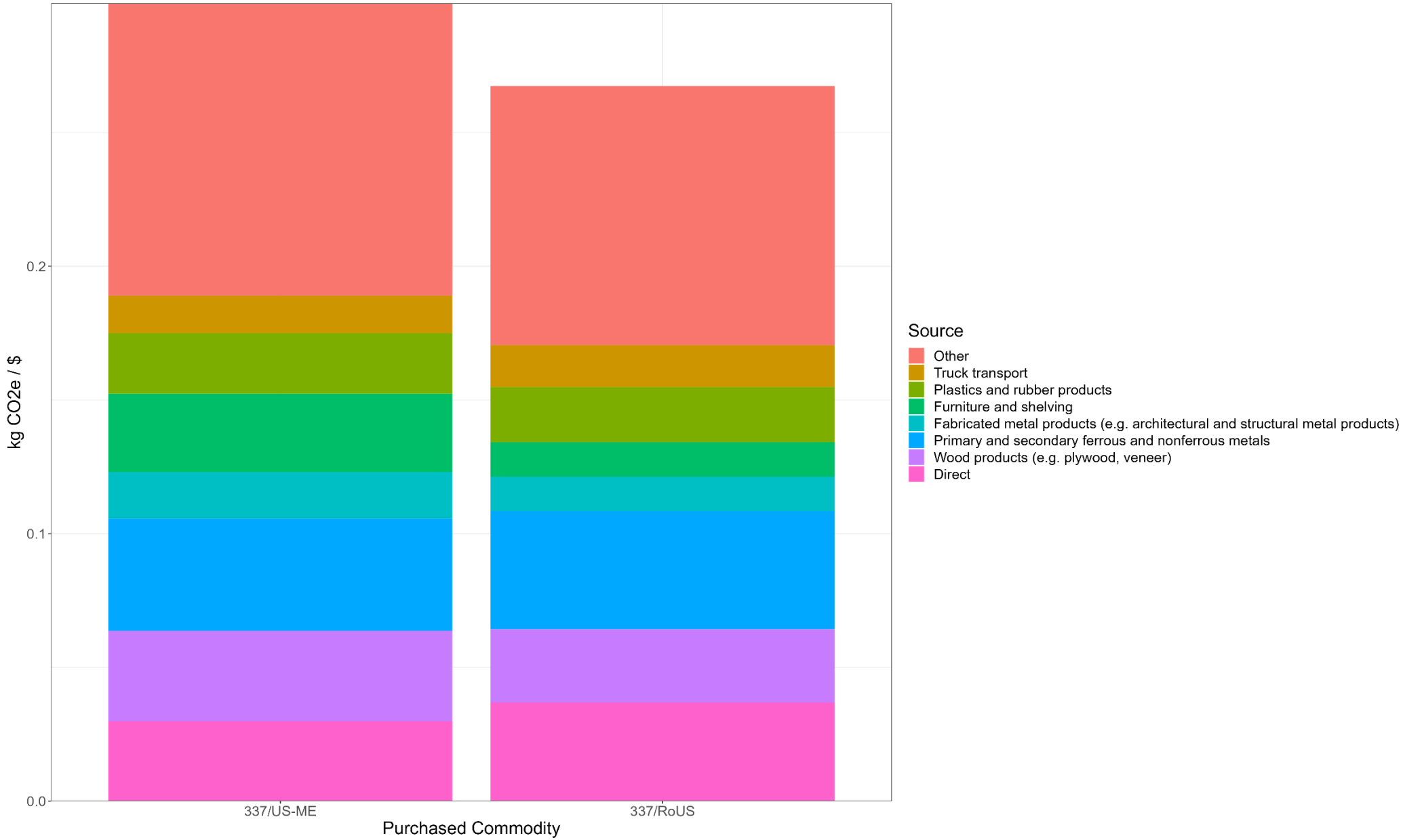
What Contributes to Building CBE (Made in ME vs ROUS)


0.25
0.20
0.15
0.10
0.05
0.00
kg CO2e / $
23/US-ME
23/RoUS
Purchased Commodity
Source
Other
Truck transport
Petroleum fuels, asphalt, and other petroleum and coal products
Fabricated metal products (e.g. architectural and structural metal products)
Wood products (e.g. plywood, veneer)
Clay, glass, cement, concrete, and other nonmetallic mineral products
Direct

What Contributes to Clothing CBE (Made in ME vs ROUS)



What Contributes to Furniture CBE (Made in ME vs ROUS)


0.2
0.1
0.0
kg CO2e / $
337/US-ME
337/RoUS
Purchased Commodity
Source
Other
Truck transport
Plastics and rubber products
Furniture and shelving
Fabricated metal products (e.g. architectural and structural metal products)
Primary and secondary ferrous and nonferrous metals
Wood products (e.g. plywood, veneer)
Direct

EPA United States Environmental Protection Agency

Next Steps

- Add factory gate to shelf impacts into results
- Carefully review/vet data driving results outcomes
- Produce EPA report to be externally reviewed

EPA United States Environmental Protection Agency

Project Team

- Wesley Ingwersen, Chris Beling (EPA)
- Ben Young, Jorge Vendries, Eric Bell, Sarah Cashman (ERG)
- Andy Bray (former), Shaina Cohen, Melissa Lavoie (NEWMOA)
- NEWMOA Climate and Materials Workgroup (ME, VT, NY, MA, CT, NH, RI)

Send questions or comments to useeio@epa.gov

23