

# USEEIO State Models and Applications

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# Disclaimer

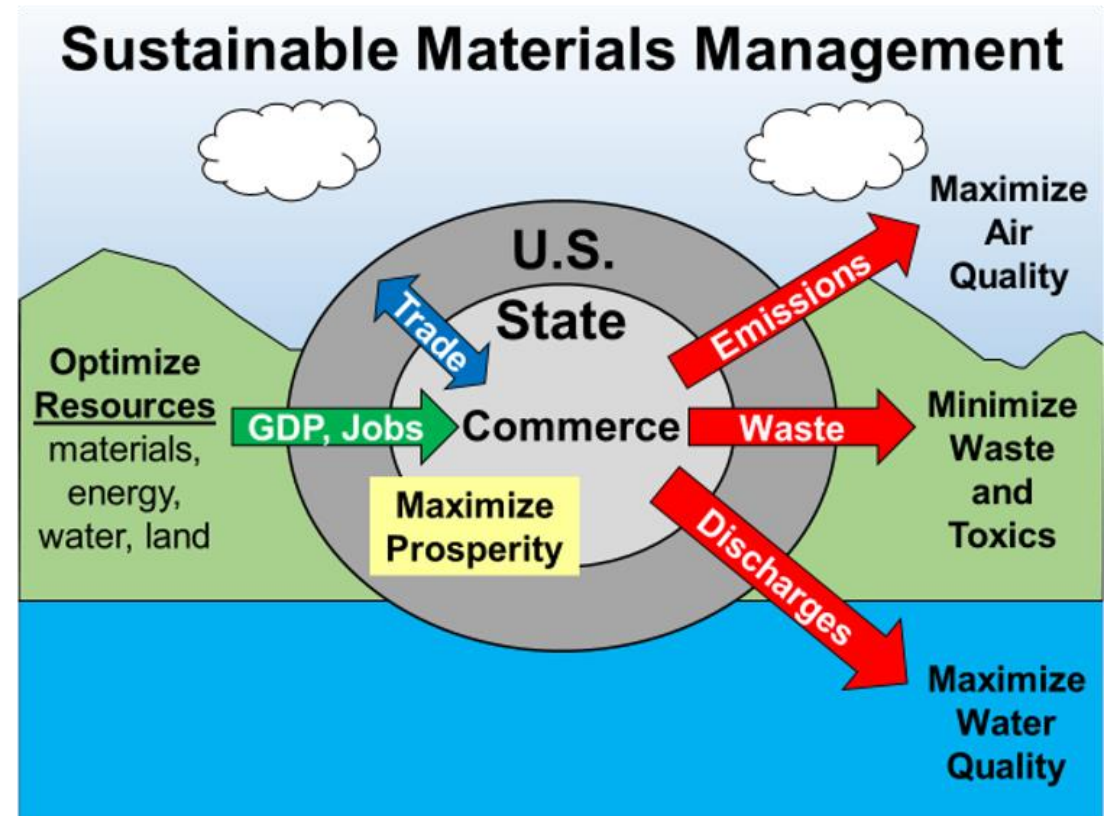
The U.S. Environmental Protection Agency, through its Office of Research and Development, funded and conducted the research described herein under an approved Quality Assurance Project Plan (K-LRTD-0030017-QP-1-3). It has been subjected to the Agency's peer and administrative review and has been approved for publication as an EPA document. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

# Outline

1. Motivation
2. Methods and tools to build state USEEIO models
3. Applications
  - SMM State Tool
  - Consumption-based state GHG inventories
  - County and metro-area based work
4. Collaborators and Team

# Motivation

- Support EPA's efforts to promote sustainable materials management by states
- Provide state-specific EEIO models
- Maintain full transparency and reproducibility



# State questions to be answered

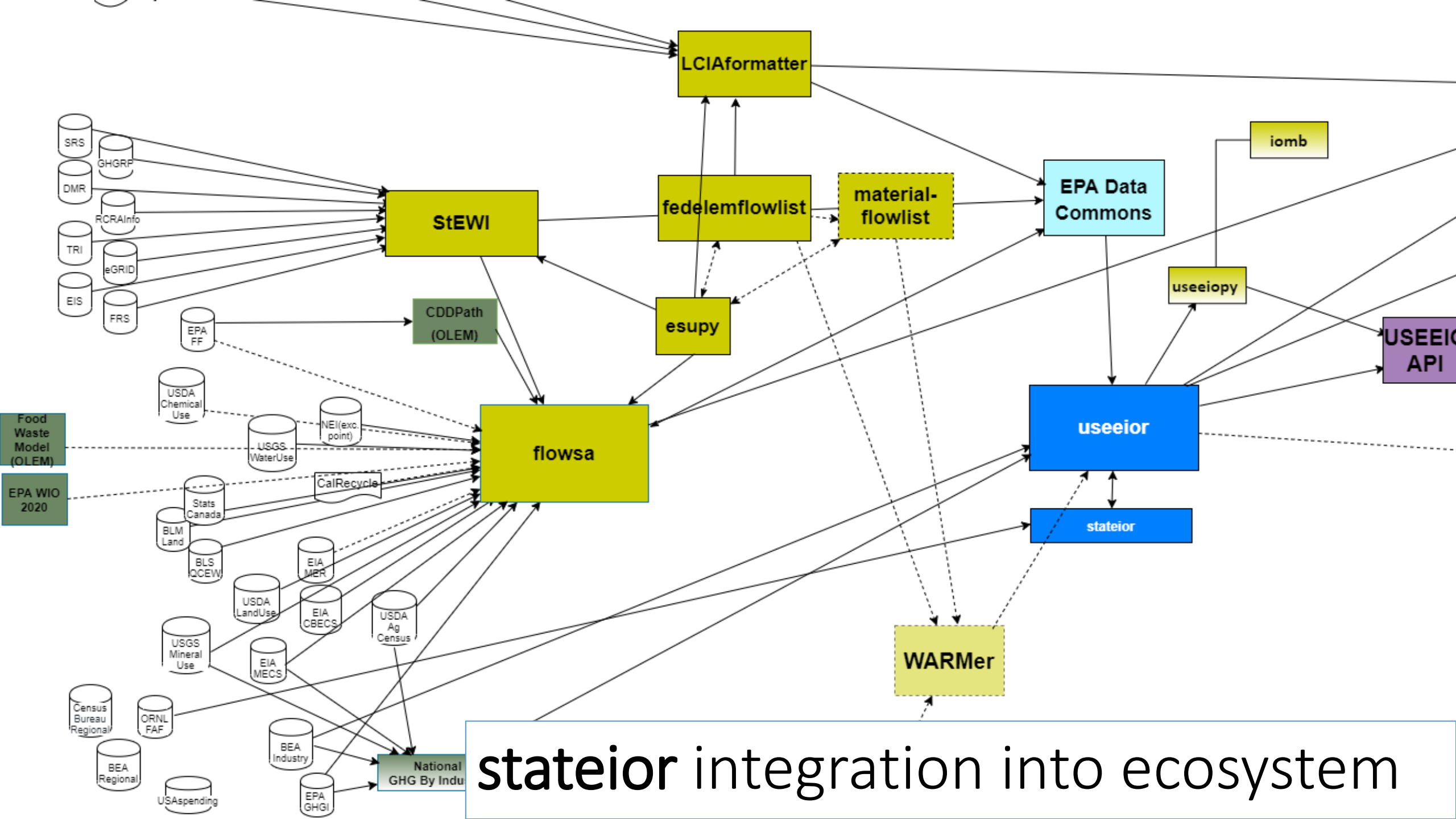
- What are the in-state impacts?
- How much of state consumption impacts are occurring in our state?
- Where could we influence direct emissions or resources use?

# State IO Modeling Needs

- Economic input-output tables for states
  - Annual tables with best possible sector resolution
  - Must pass all balance, consistency, and reality checks
- Environmental data by industry and state
- Comparable and able to integrate with the USEEIO tool ecosystem

# USEEIO State – Progress

- Method for state IO tables completed (Li et al. 2021)
- Software tool `stateior` created to produce all state IO tables for all recent years and two-region models





# Structure of USEEIO State Models

## **73 commodities, 2 regions**

1. State of Interest (e.g. GA)
2. Rest of US (RoUS)

The Rest of World (RoW) is not explicitly represented, but proportion of impacts from RoW can be determined

# Applications

# SMM State Prioritization Tool

## National & State

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- Georgia >**
- Hawaii >

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## Organizational

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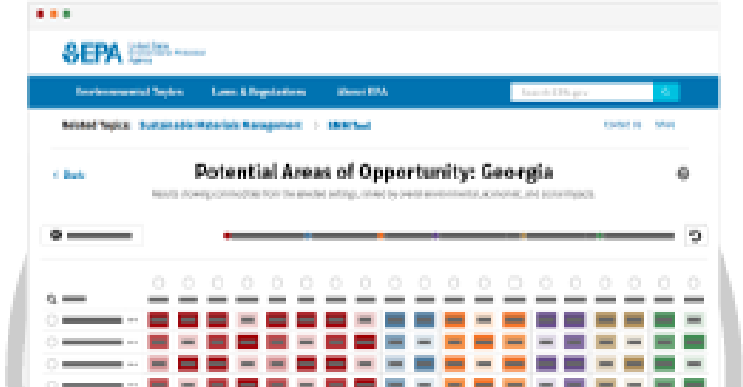
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The tool enables a user to explore and compare the potential environmental impacts, including resource use, of goods and services. The user can examine all goods and services used in the United States or a particular state.



The screenshot shows the EPA website interface for the SMM State Prioritization Tool. The header includes the EPA logo and navigation links for Environmental Topics, Laws & Regulations, and About EPA. A search bar is also present. The main content area is titled 'Potential Areas of Opportunity: Georgia' and features a horizontal bar chart and a table of data. The table has multiple columns with colored cells (red, orange, yellow, green, blue) representing different data points. The table is titled 'Potential Areas of Opportunity: Georgia' and includes a subtitle 'Identify emerging opportunities from the product settings, sorted by least environmental, economic, and social impacts'.

- Analogous to the national tool
- Ready and waiting for USEEIO state models

# Consumption-based GHG Inventories for States

## Acronyms

GHGI = territorial GHG inventory (traditional)

CBEI = consumption-based GHG emission inventory

# CBEI Origins

- Consumer orientation for an inventory/footprint (Hertwich 2005; Larsen and Hertwich 2009; Peters 2008)

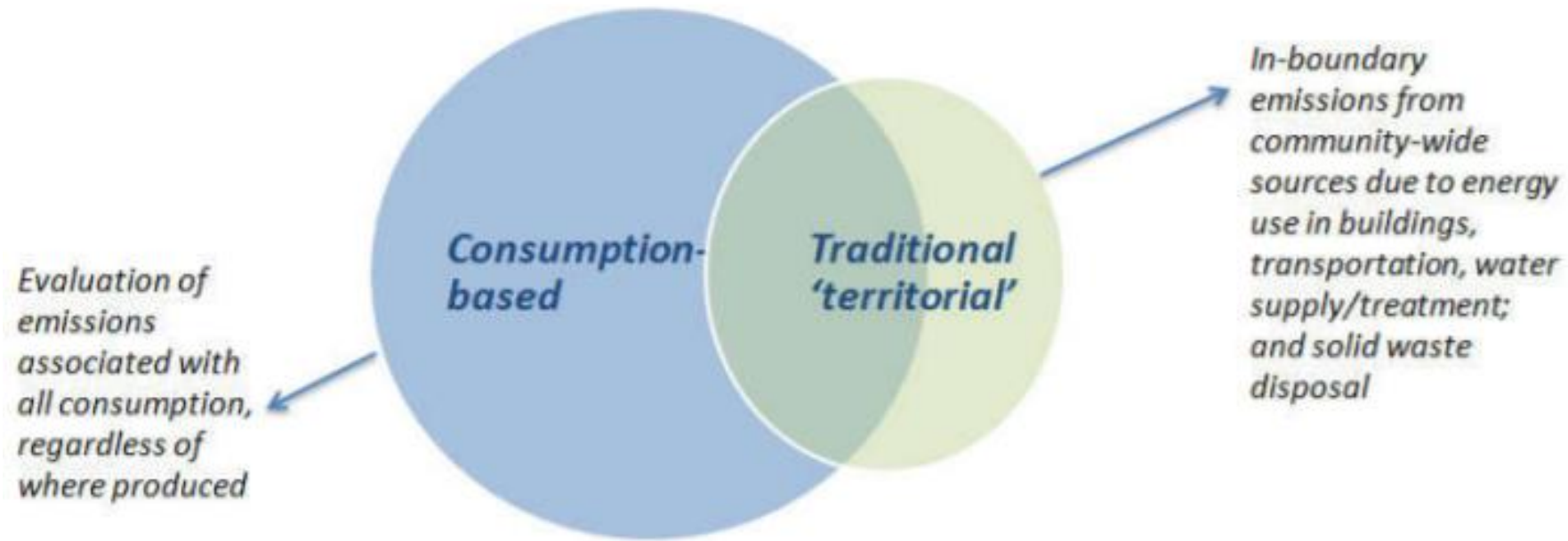
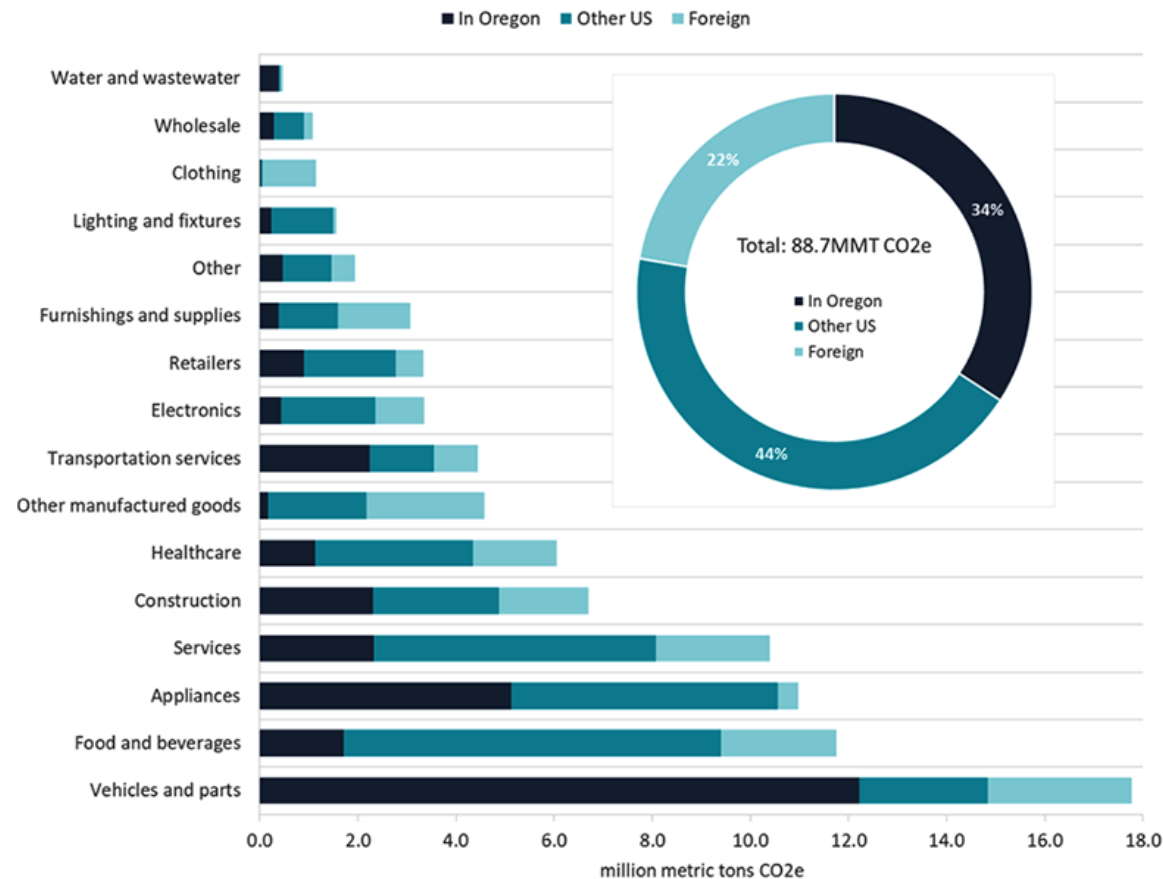


Image source: (BCIT and Consulting 2017)

# First US State CBEI

- Oregon CBEI (Erickson et al. 2012)



$$\text{CBEI} = \text{GHGI} + \text{EEIO}$$

- Most common approach to CBEI is to use the GHGI together with an EEIO model
- EEIO models - Single region or multi-region

## CBEI for State or Community - Challenges

- Missing GHGI
- Missing IO data for EEIO

# CBEI Approach with USEEIO

## Inputs

1. Either state-provided GHGI or new (2021) EPA state GHGI
2. USEEIO State Models
3. Imports CO<sub>2</sub>eq multipliers from a global EEIO model

## Benefits

1. Consistency with supply chain GHG factors and national models for SMM
2. Fully reproducible/open source
3. Models can provide other results beyond GHGs (air quality, water quality, human health)

## Constraints

1. Concurrent ongoing USEEIO state model completion
2. Year range selection



# County and State Region Analysis

- Need to estimate sub-state level impacts
- Use state models with county level data to estimate county final demand and the calculate impact
- Will work with existing widgets

**Water Use and Quality**

West Central Georgia

Specific impact areas...

Input and Output per Dollar Spent - Based on 2017 BEA and EPA data displayed for the top industries in 2021.

In the ranked "Commodities" column below, click the yellow menu to choose multiple impact areas, or choose an impact set above. Move sliders to emulate the effects of changes to production levels per dollar spent. Data source: U.S. Bureau of Economic Analysis commodities combined with EPA indicators. - [About Widgets](#)

**Upstream**      **Commodities**      **Downstream**

Search

Insurance agencies and brokerages \$0.030 input per \$1 spent	<input checked="" type="checkbox"/> <b>Other plastic products</b> Freshwater withdrawals: 3.106 Kilograms Acidification Potential: 0.00002 Kilograms Sulphur Dioxide (SO2) Freshwater Ecotoxicity Potential: 0.00007 Comparative Toxic Unit for Ecosystem (CTUe) Eutrophication Potential: 0.0000008 Kilograms Nitrogen (N) Freshwater withdrawals: 3.106 Kilograms	Insurance agencies and brokerages \$0.021 output per \$1 spent
Company and enterprise management \$0.023 input per \$1 spent	<input checked="" type="checkbox"/> <b>Custom computer programming</b> Freshwater withdrawals: 0.688 Kilograms Acidification Potential: 0.00002 Kilograms Sulphur Dioxide (SO2) Freshwater Ecotoxicity Potential: 0.001 Comparative Toxic Unit for Ecosystem (CTUe) Eutrophication Potential: 0.000008 Kilograms Nitrogen (N) Freshwater withdrawals: 0.688 Kilograms	Insurance carriers, except direct life \$0.012 output per \$1 spent
Advertising and public relations \$0.019 input per \$1 spent	<input checked="" type="checkbox"/> <b>Limited-service restaurants</b> Freshwater withdrawals: 0.475 Kilograms Acidification Potential: 0.00006 Kilograms Sulphur Dioxide (SO2) Freshwater Ecotoxicity Potential: 0.001 Comparative Toxic Unit for Ecosystem (CTUe) Eutrophication Potential: 0.000003 Kilograms Nitrogen (N) Freshwater withdrawals: 0.475 Kilograms	Computer storage device readers \$0.008 output per \$1 spent
Employment services \$0.015 input per \$1 spent	<input checked="" type="checkbox"/> <b>Motor vehicle and motor vehicle parts and supplies</b> Freshwater withdrawals: 0.078 Kilograms Acidification Potential: 0.00003 Kilograms Sulphur Dioxide (SO2) Freshwater Ecotoxicity Potential: 0.00008 Comparative Toxic Unit for Ecosystem (CTUe) Eutrophication Potential: 0.000002 Kilograms Nitrogen (N)	Photography and photocopying equipment \$0.007 output per \$1 spent
Plastics \$0.013 input per \$1 spent		Other federal government enterprises \$0.007 output per \$1 spent
Management consulting \$0.011 input per \$1 spent		Direct life insurance carriers \$0.006 output per \$1 spent
Electricity \$0.010 input per \$1 spent		Audio and video equipment \$0.006 output per \$1 spent
Insurance carriers, except direct life \$0.008 input per \$1 spent		Telephones \$0.006 output per \$1 spent
Legal services \$0.008 input per \$1 spent		News syndicates, libraries, archives, Internet publishing and all \$0.006 output per \$1 spent
Monetary authorities and depository credit intermediation \$0.006 input per \$1 spent		Office administration \$0.006 output per \$1 spent
Accounting, tax preparation, bookkeeping, and payroll		

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<https://model.earth/apps/beyondcarbon/#state=GA&mapview=state&regiontitle=West+Central+Georgia>

# USEEIO State Team



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# External Collaborators

[Georgia Center of Innovation](#), [Maine DEP Sustainability](#), [MPCA Resource Management](#), [NEWMOA](#), [OR DEQ Materials Management](#), [WA Department of Ecology](#)

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# Additional Slides

# stateior Overview

- **stateior** is an R package that generates and provides US state Make and Use tables for building regionalized IO models and other purposes.
- Public, transparent, reproducible, immediate updates and validation
- Two regions:
  - State of Interest (Sol, e.g. Georgia)
  - Rest of US (RoUS)
- IO data at BEA (Bureau of Economic Analysis) Summary level:
  - 73 commodities, 71 industries, and 10 final demand sectors
  - Single-region Make and Use tables
  - Two-region use tables (Sol2Sol, Sol2RoUS, RoUS2Sol, RoUS2RoUS)
- 2012-2017 annual IO tables for 50 US states that pass balance, consistency, and reality checks