

EPA Tools and Resources Webinar

Sustainable Materials Management Prioritization Tools: National and State Models

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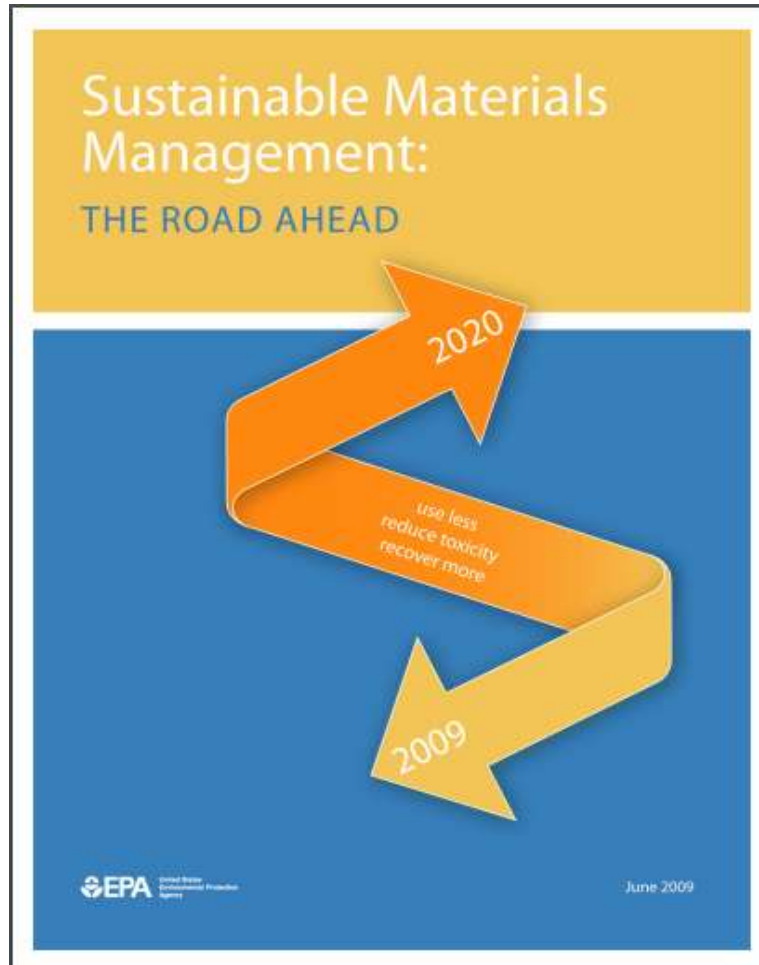
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Outline

- Background on Sustainable Materials Management (SMM) and Georgia SMM Pilot Project
- United States Environmentally-Extended Input-Output (USEEIO) Model Overview
- Georgia SMM Prioritization Tool Demonstration
- SMM Prioritization Tool Findings for Georgia
- Takeaways for states

Sustainable Materials Management



“An approach to serving human needs by using/reusing resources productively and sustainably throughout their life cycles, generally minimizing the amount of materials involved and all associated environmental impacts.”

Sustainable Materials Management: The Road Ahead, EPA (2009)

Georgia SMM Pilot Project



Why tons?

What does “tons”
really tell us?

Georgia SMM Pilot Project

- The goals of the Georgia Pilot were to:
 - Develop a tool to empower stakeholders to make life cycle-informed decisions tailored to their state’s circumstances
 - Align the understanding and incentives of all life cycle players in the state



**GA
Environmental
Protection
Division**



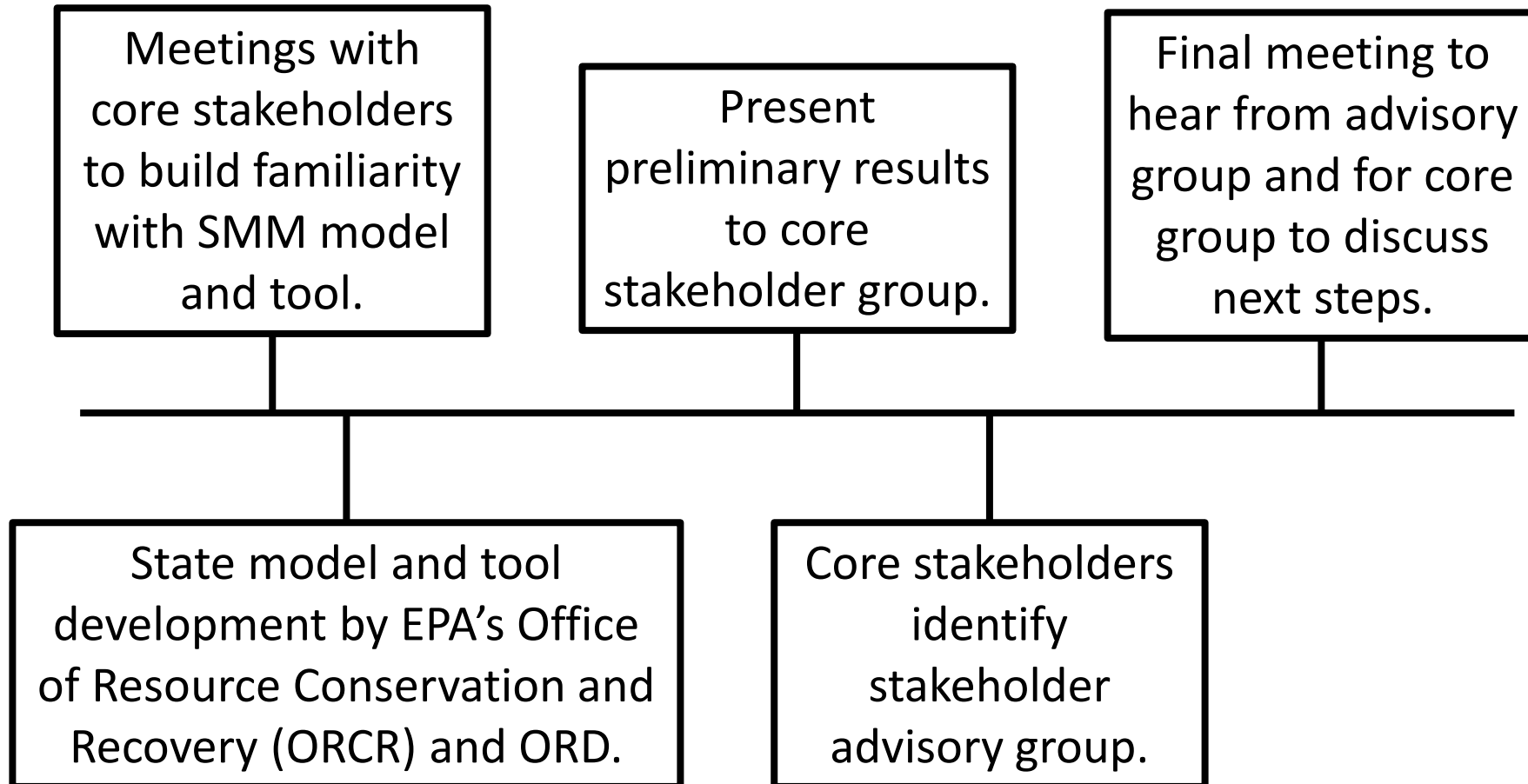
**Georgia
Recycling
Coalition** INC.

**GA Department of
Economic Development**



Advisory panel from industry and academia

Georgia SMM Pilot Project



United States Environmentally-Extended Input-Output (USEEIO) Model

SMM Model Needs: Comprehensive and Directional

1. Whole system perspective

- Full economy
- Supporting (resource) and receiving (release) environments
- Life-cycle based (cradle-to-grave)
- Report human health, environmental impact, resource use and economic indicators

2. Provide evidence for directional SMM-related action

Identify opportunities to steer economy towards more effective material use with reduced impact and prosperous economy

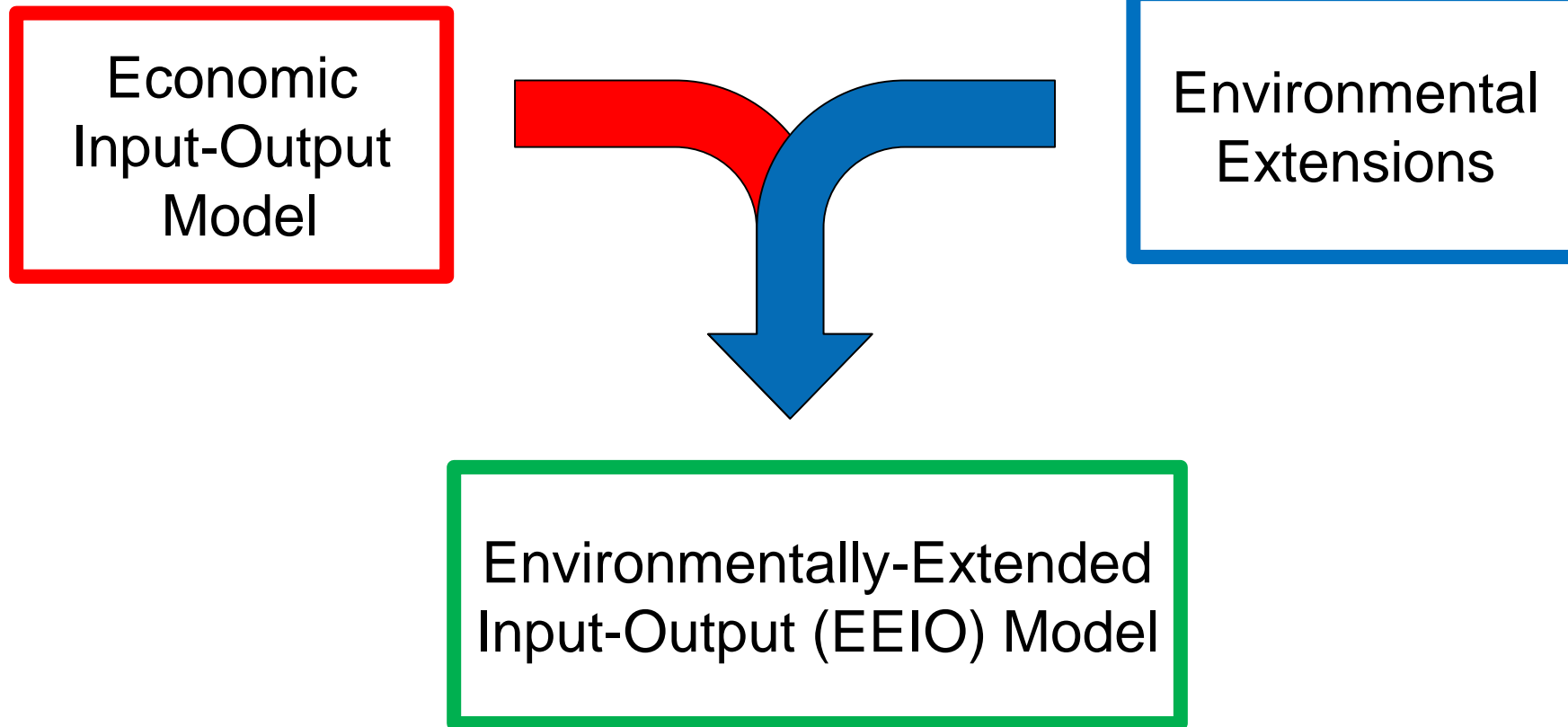
SMM Model Needs: Support Multiple Scales

1. National
2. State
3. Organizational

SMM Model Needs: Transparency and Availability

1. Based on public data
2. Support transparency of modeling choices and uses of data
 - Standardized supporting documentation
3. Report data quality
4. Publicly Accessible
 - Model and documentation publicly available

SMM Model: Economic- Environmental Model



Use of EEIO Models

- Established, accepted type of environmental-economic model for use at global, national and regional scales
- Modeling consumption, or production-related life cycle impacts or footprints
- Can be used for single product supply chain hotspot analysis
- Prioritization of goods and services, or industry sectors

Benefits and Limitations of EEIO Models

- Comprehensive (full economy) and data-rich
- Built with public data
- Consistent with economic forecasting, and good/service classification
- Level of resolution limited to national average for a good/service within an aggregated category
- Units of analysis is in \$ of goods/services

EEIO Models and SMM



- A proprietary EEIO model was used for ‘The Road Ahead’
- Need more current, transparent, fully replicable model
- Need non-expert applications for using the model
- Needs to be customizable for smaller regions (e.g states)

US EPA SMM Model: **USEEIO**

USEEIO



USEEIO: A new and transparent United States environmentally-extended input-output model

Yi Yang ^{a, **, 1}, Wesley W. Ingwersen ^{b, *, 1}, Troy R. Hawkins ^c, Michael Srocka ^d,
David E. Meyer ^b

- Peer-reviewed EEIO model of the US using most currently available public data
- **385** goods and services
- **1,875** unique releases or resource types
- **20** environmental, resource and socio-economic impact indicators
- Formal data quality characterization
- Open source data and modeling framework

USEEIO Economic and Job Data

Bureau of Economic Analysis (BEA)

- Benchmark Input-Output Tables
- Gross industry output
- Price-index

Census Bureau

- NAICS-level output
- Number of establishments
- Trade data

Bureau of Labor Statistics (BLS)

- Quarterly employment

**Department of Energy (DOE)
Oak Ridge National Laboratory (ORNL)**

- FAF Commodity Flow Model

US Department of Agriculture (USDA)

- Agricultural production

USEEIO Environmental Extensions

US Environmental Protection Agency (EPA)

- National Emissions Inventory: CAPs and HAPs
- Toxics Release Inventory: Toxic substances
- Greenhouse Gas (GHG) Reporting Program: GHGs
- Discharge Monitoring Report: Nutrients and toxic substances

US Department of Agriculture (USDA)

- Agricultural Chemical Use Program: Pesticides and nutrients
- Census of Agriculture: Land occupation
- Farm and Ranch Irrigation Survey: Water withdrawal and release

US Geological Survey (USGS)

- Major Uses of Land in the United States
- Minerals Commodity Survey
- Water Use in the United States

Department of Energy (DOE) Energy Information Administration (EIA)

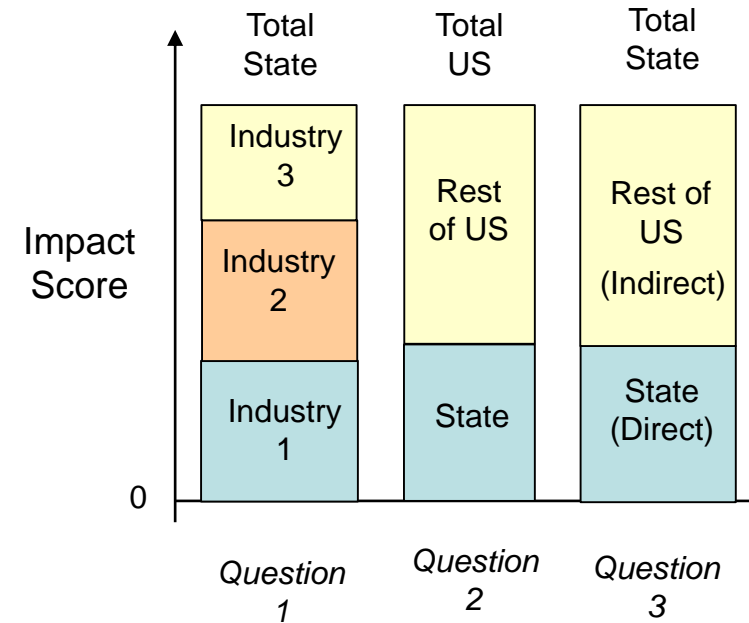
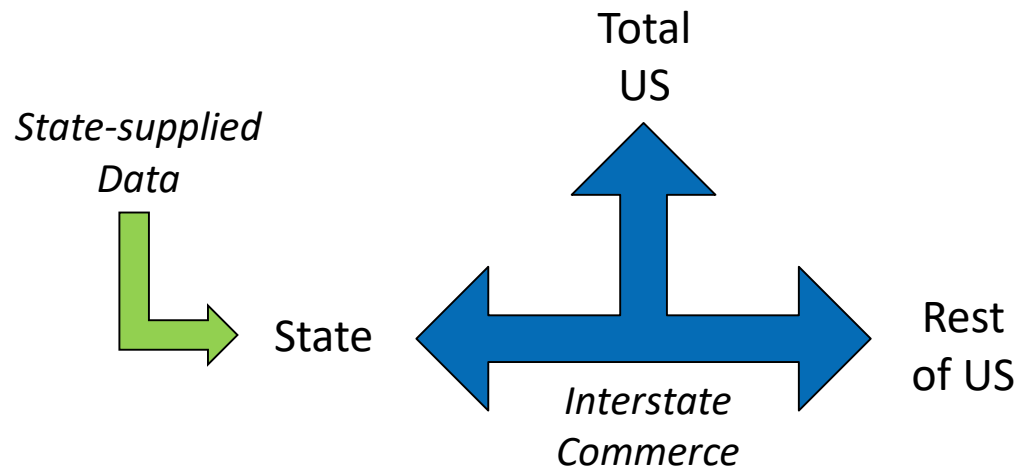
- Monthly and Annual Energy Review: Energy use

USEEIO Indicators

- **Potential Environmental Impacts** – acidification, respiratory effects of criteria pollutants, carcinogenic and non-carcinogenic toxicity effects, climate change, eutrophication, freshwater ecotox, smog formation, ozone depletion
- **Resource Use** – water, land, minerals
- **Environmental Releases** - Hazardous Air Pollutants (HAPs), metals, pesticides
- **Economic & Social indicators** – value added, jobs
- **Waste Generated** – Hazardous waste, municipal solid waste (MSW)*, construction and demolition (C&D)*

Customization: State-based USEEIO Models

Create a state model within USEEIO



Unique goods and services profiles from 2 regions

- 1. Where are our hotspots?**
- 2. How do we compare with other states?**
- 3. Where are our impacts?**

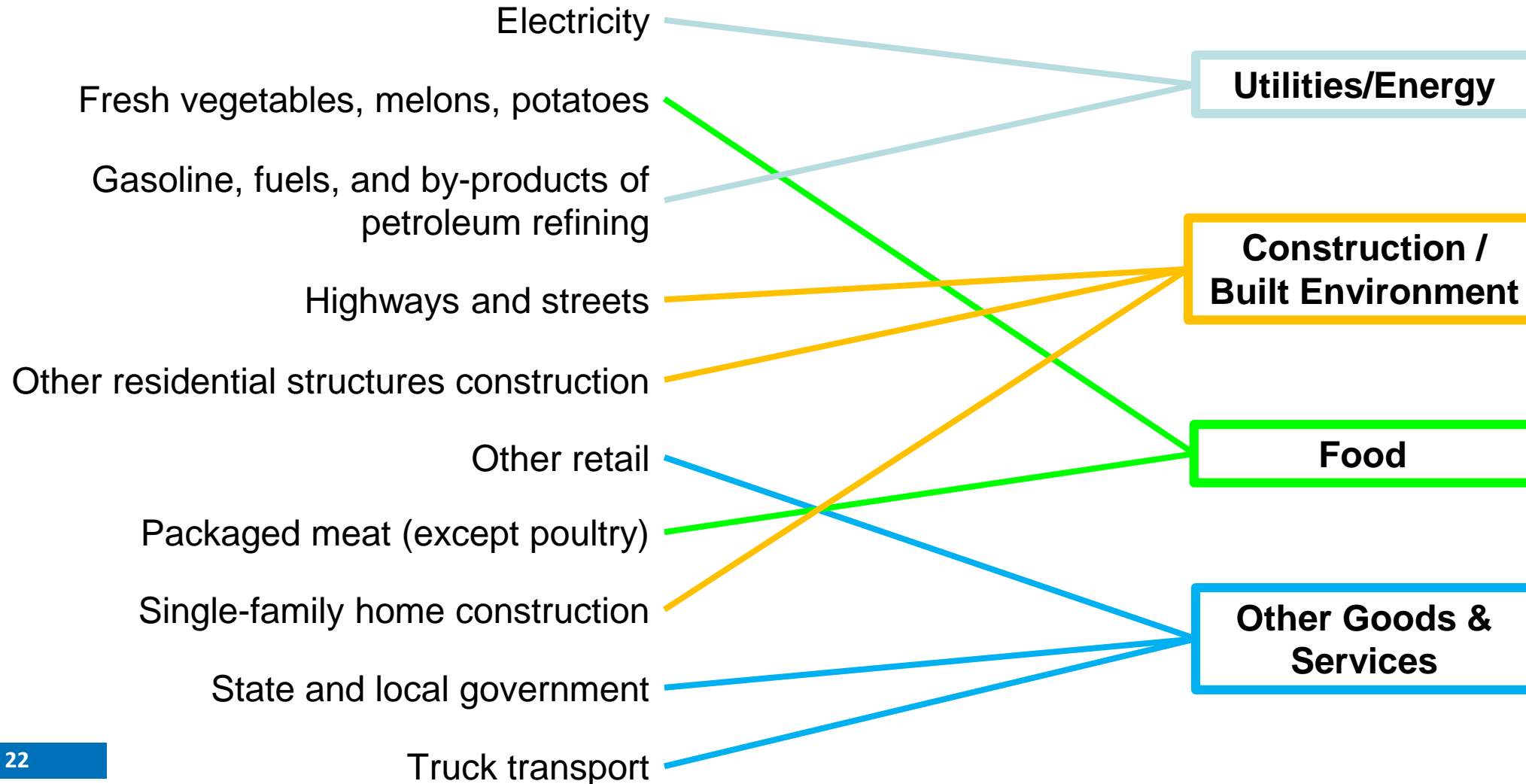
A model for GA is the current state model prototype

Georgia SMM Prioritization Tool Demonstration



Georgia SMM Prioritization Tool Findings

Top 10 Impactful Goods & Services Consumed in GA





Georgia SMM Prioritization Tool Findings

Top 10 Impactful Goods & Services Consumed in GA

Significant Associated Issues

Electricity	→	GCC, ACID, WATR, ENRG, SMOG, HRSP, HTOX, EUTR, MINE
Fresh vegetables, melons, potatoes	→	ETOX, OZON, WATR, EUTR
Gasoline, fuels, and by-products of petroleum refining	→	ENRG, HTOX, SMOG, HAZW, GCC, WATR, ACID, EUTR, MINE
Highways and streets	→	MINE, HRSP
Other residential structures construction	→	MINE, SMOG, LAND, HTOX, HAZW
Other retail	→	MSW, GCC, SMOG, ACID, HTOX, ENRG
Packaged meat (except poultry)	→	LAND, ACID, EUTR, GCC, WATR, ETOX, HRSP
Single-family home construction	→	MINE, SMOG, LAND, HTOX, HRSP, ACID, OZON, ENRG
State and local government	→	HAZW, EUTR, ENRG, HTOX, GCC, SMOG, LAND, WATR, ACID, MINE, HRSP, MSW, ETOX, OZON
Truck transport	→	SMOG, HTOX, ACID, GCC, EUTR



Georgia SMM Prioritization Tool Findings

Top 10 Impactful Goods & Services Consumed in GA

Over 50% of these significant associated issues are happening **IN-STATE**:

Electricity	→	GCC, ACID, WATR, ENRG, SMOG, HRSP, HTOX, EUTR
Fresh vegetables, melons, potatoes	→	<50%
Gasoline, fuels, and by-products of petroleum refining	→	HAZW, WATR
Highways and streets	→	MINE, HRSP
Other residential structures construction	→	MINE, SMOG
Other retail	→	MSW, GCC, SMOG, ACID, HTOX
Packaged meat (except poultry)	→	<50%
Single-family home construction	→	MINE, SMOG, HTOX, HRSP, ACID
State and local government	→	<50%
Truck transport	→	SMOG, HTOX, ACID, GCC, EUTR



Georgia SMM Prioritization Tool Findings

Top 10 Impactful Goods & Services Consumed in GA

Over 50% of these significant associated issues are happening in the **SUPPLY CHAIN**:

Electricity → HTOX, MINE

Fresh vegetables, melons, potatoes → <50%

Gasoline, fuels, and by-products of petroleum refining → ENRG, HTOX, SMOG, GCC, ACID, EUTR, MINE

Highways and streets → MINE

Other residential structures construction → MINE, SMOG, LAND, HTOX, HAZW

Other retail → GCC, SMOG, ACID, HTOX, ENRG

Packaged meat (except poultry) → LAND, ACID, EUTR, GCC, WATR, ETOX, HRSP

Single-family home construction → MINE, LAND, HTOX, HRSP, ACID, OZON, ENRG

State and local government → HAZW, EUTR, ENRG, HTOX, GCC, SMOG, LAND, WATR, ACID, MINE, HRSP, MSW, ETOX, OZON

Truck transport → <50%



Georgia SMM Prioritization Tool Findings

Top 10 Impactful Goods & Services Consumed in GA

Electricity

Fresh vegetables, melons, potatoes

Gasoline, fuels, and by-products of petroleum refining

Highways and streets

Other residential structures construction

Other retail

Packaged meat (except poultry)

Single-family home construction

State and local government

Truck transport

Common purchases that bring the issues

- Truck transport
- Gasoline, fuels, and by-products of petroleum refining
- Electricity
- Wholesale trade

Common hotspots

- Truck transport
- Electricity
- Unrefined oil and gas
- Other basic organic chemicals
- Gasoline, fuels, and by-products of petroleum refining
- Waste management and remediation
- Drinking water and wastewater treatment
- Pipeline transport



Top 10 Impactful Goods & Services Consumed in GA and the US

Georgia

United States

Electricity

Electricity

Fresh vegetables, melons, potatoes

Fresh vegetables, melons, potatoes

Gasoline, fuels, and by-products of petroleum refining

Gasoline, fuels, and by-products of petroleum refining

Highways and streets

Highways and streets

Other residential structures construction

Hospitals

Other retail

Other residential structures construction

Packaged meat (except poultry)

Packaged meat (except poultry)

Single-family home construction

Single-family home construction

State and local government

State and local government

Truck transport

Truck transport

On average, Georgia accounts for ~3% of the environmental and human health issues in the United States.

What does this mean for a state?

- The Tool Suite and model(s) can help a state:
 - Start thinking holistically about life cycle environmental issues without being a life cycle assessment expert
 - Consider state environmental performance across a range of indicators
 - Develop an understanding of whether issues are happening in a state or not, or in a supply chain or not
 - Identify parts of government and other stakeholders from across the state with whom to collaborate to get the most benefit

GA Pilot - IMPACTS

- Stakeholders provided feedback that helped EPA improve the SMM Prioritization Tool Suite interfaces
- Stakeholders helped EPA show results in easily understandable way
- Experts vetted the modeling approach and confirmed the general direction and hotspots identified by the GA model results
- GA EPD expressed interest in using the SMM Prioritization Tool Suite to inform the Solid Waste Management Planning
- GA Economic Development expressed interest in using the State tool/GA model in a special program on smart communities
- Stakeholders are willing to provide input on the development of additional features of the Tool Suite, USEEIO, and related training

Next Steps

- Make minor improvements to the state model and provide to GA
- Finalize the set of indicators and options to be included in first release of Tool Suite and model
- Perform final review and posting of the SMM Tool Suite
- Support GA stakeholders with use of the State tool/GA model
- Automate the creation of other state models
- Develop scenario analysis capabilities
- Disaggregate waste management and treatment sectors

USEEIO Model Availability

Documentation

Environmental Extensions

- Satellite tables
- Indicators and their factors

Model components and results in matrix format

Full model in openLCA format

Model code base



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Disclaimer: US EPA through its Office of Research and Development collaborated in the research described here.

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