EPA Tools and Resources Webinar

Sustainable Materials Management
Prioritization Tools:
National and State Models

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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?
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

Advisory panel from industry and academia

GA Department of Economic Development

US EPA
United States Environmental Protection Agency

GA Environmental Protection Division

Georgia Recycling Coalition Inc.
Meetings with core stakeholders to build familiarity with SMM model and tool.

State model and tool development by EPA’s Office of Resource Conservation and Recovery (ORCR) and ORD.

Present preliminary results to core stakeholder group.

Core stakeholders identify stakeholder advisory group.

Final meeting to hear from advisory group and for core group to discuss next steps.
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

Economic Input-Output Model

Environmental Extensions

Environmentally-Extended Input-Output (EEIO) 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

• 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
| 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) | • FAF Commodity Flow Model |
| Oak Ridge National Laboratory (ORNL) | • Agricultural production |
| US Department of Agriculture (USDA) | • |
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)*

* in development
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
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

Utilities/Energy

Construction / Built Environment

Food

Other Goods & Services
Georgia SMM Prioritization Tool Findings

Top 10 Impactful Goods & Services Consumed in GA

- 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**

<table>
<thead>
<tr>
<th>Item</th>
<th>Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>GCC, ACID, WATR, ENRG, SMOG, HRSP, HTOX, EUTR</td>
</tr>
<tr>
<td>Fresh vegetables, melons, potatoes</td>
<td>&lt;50%</td>
</tr>
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</tr>
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<td>&lt;50%</td>
</tr>
<tr>
<td>Truck transport</td>
<td>SMOG, HTOX, ACID, GCC, EUTR</td>
</tr>
</tbody>
</table>

Over 50% of these significant associated issues are happening IN-STATE:
Georgia SMM Prioritization Tool Findings

Top 10 Impactful Goods & Services Consumed in GA

- 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%
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
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 | Other residential structures construction
Hospitals
- Other retail | 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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