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USEEIO National Models and Applications

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Disclaimer

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SHC 7 - LCIM

7.1. USEEIO Models

7.2. Data and Methods to Advance Facts & Figures

7.3. USEEIO Applications

7.4. Food Waste

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Outline

1. Overview
2. Uses
3. Tools to build USEEIO and components
4. Accessing USEEIO
5. Applications
    - Supply Chain GHG Factors
    - SMM Tools
    - Sustainable Communities Web Challenge
6. Vision in Support of EPA SMM Program
7. Work in Progress
8. Collaborators and Team

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USEEIO Models

A family of environmentally-extended input-output (EEIO) models of the US

- Depict environmental and economic performance of all commodities and industries in the US in 400+ or 70+ categories
- Track >2000 unique releases or resource types
- Report 20+ environmental, resource and socio-economic impact indicator scores
- Built on >10 million data points
- Include formal data quality characterization of results
- Open source data and modeling framework
- Most recent version (v2.0)
- Technical article for USEEIOv1 and slide overview

USEEIO Versions

Name	Model Form*	# of Sectors	Input-Output Data Year	USD Year	Indicators §	Availability
USEEIOv2.0	Commodity	411	2012	2012	ACID, CCDD, CMSW, CRHW, ENRG, ETOX, EUTR, GHG, HAPS, HCAN, HNCN, HRSP, HTOX, JOBS, LAND, MNRL, NNRG, OZON, PEST, RNRG, SMOG, VADD, WATR	full matrices
USEEIOv1.2	Commodity	386	2007	2013	ACID, CCDD, CMSW, CRHW, ENRG, ETOX, EUTR, GHG, HAPS, HCAN, HNCN, HRSP, HTOX, JOBS, LAND, METL, MNRL, NNRG, OZON, PEST, RNRG, SMOG, VADD, WATR	waste satellite tables API
USEEIOv1.1	Commodity	385	2007	2013	see indicators in elementary flows and indicators	full matrices elementary flows and indicators satellite tables openLCA
USEEIOv1	Commodity	385	2007	2013	see indicators in elementary flows and indicators	Not available

Full details on USEEIO Technical contents page

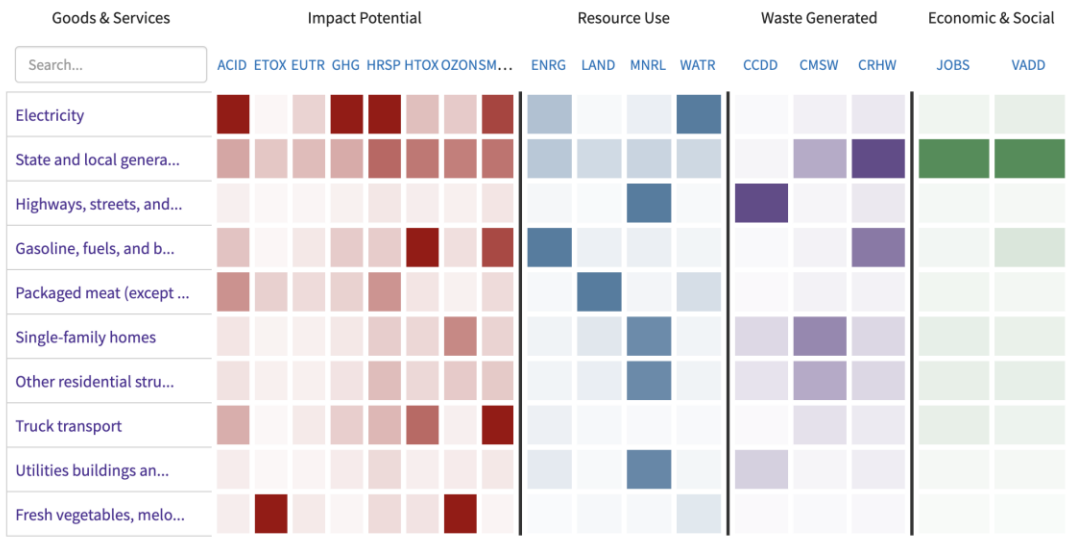
USEEIO Uses at EPA

Existing

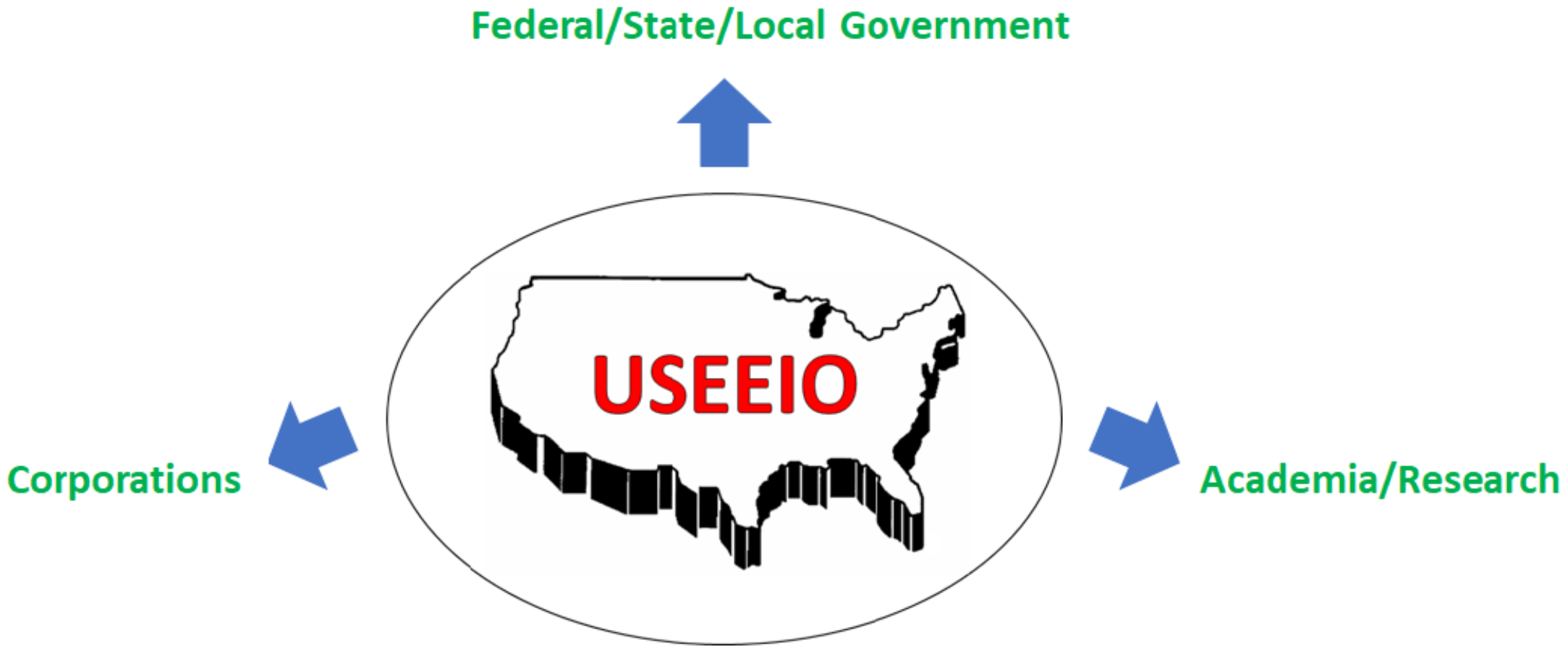
- Sustainable Materials Management Prioritization Tools

In Development

- GHG Emission Factors Hub
- Recycling Economic Information Report
- WARM
- GHG Reductions Through Materials and Land Management
- Smart Sectors Program



Growing Uses of USEEIO

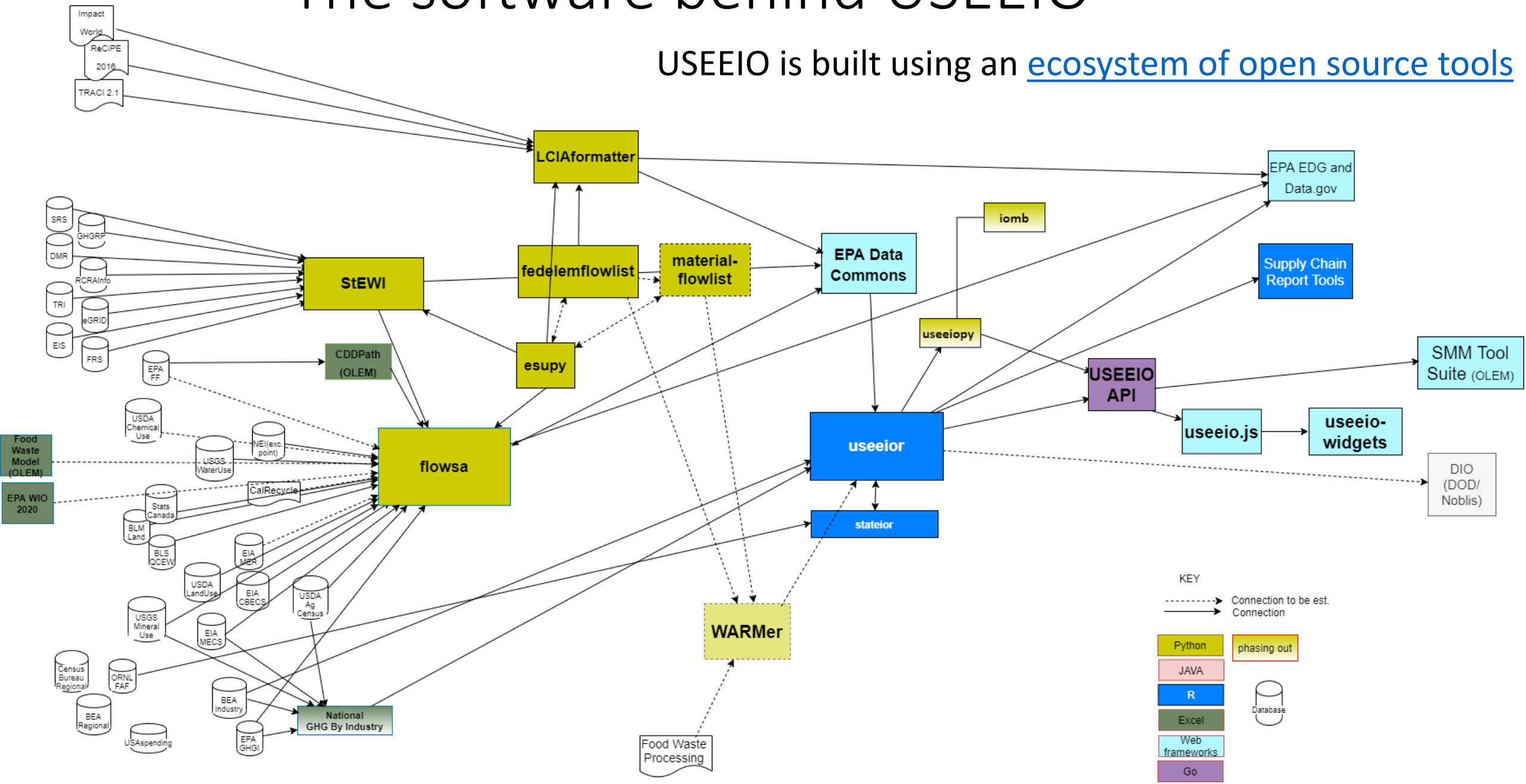


Common Uses of USEEIO

Use Type	Examples
Organizational GHG Scope 3 reporting	General Motors 2021 Carbon Disclosure Report, World Resources Institute GHG Inventory
Sustainable purchasing	Jora app, Alamaeda County Supply Chain Sustainability Report
Industry hotspot analysis	Health Care Pollution And Public Health Damage In The United States
Food and other subsystem life cycle modeling	Integrating Social and Biophysical Models for Exploration of Urban Food, Energy, and Water Systems, Potential Socioeconomic and Environmental Effects of an Expanding US Bioeconomy
Background LCI data for LCA studies and teaching	UMich EAS 573
Footprinting (individual, org, community or region)	Amazon Carbon Footprint

The software behind USEEIO

USEEIO is built using an [ecosystem of open source tools]



Principal Tools for National Model

1. useeior - Model specification, import of econ data, assembly, calculation
2. flowsa - Environmental/employment data preparation
3. LCIAformatter - Indicator data preparation

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Model Formats

1. useeior and supporting ecosystem tools
2. USEEIO API
3. USEEIO widgets
4. Excel
5. openLCA version

USEEIO Excel - Outlet

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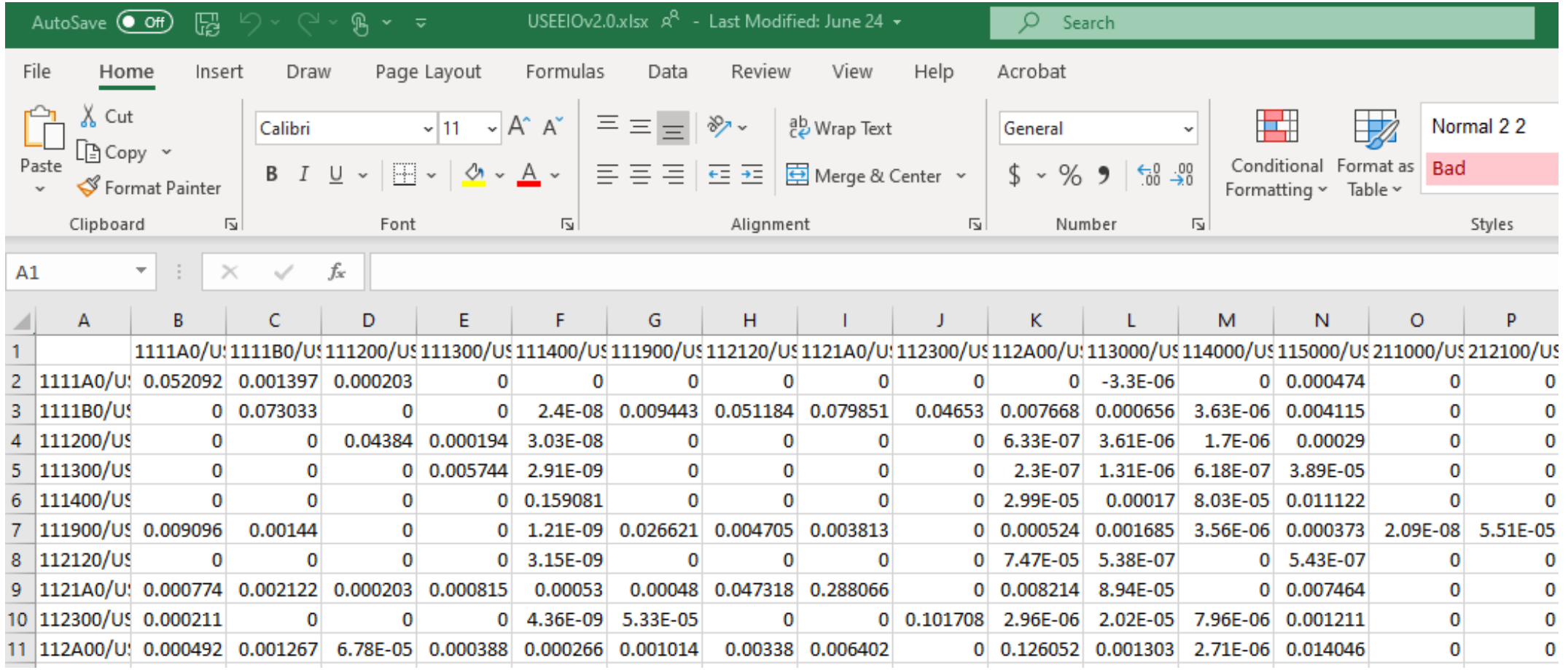
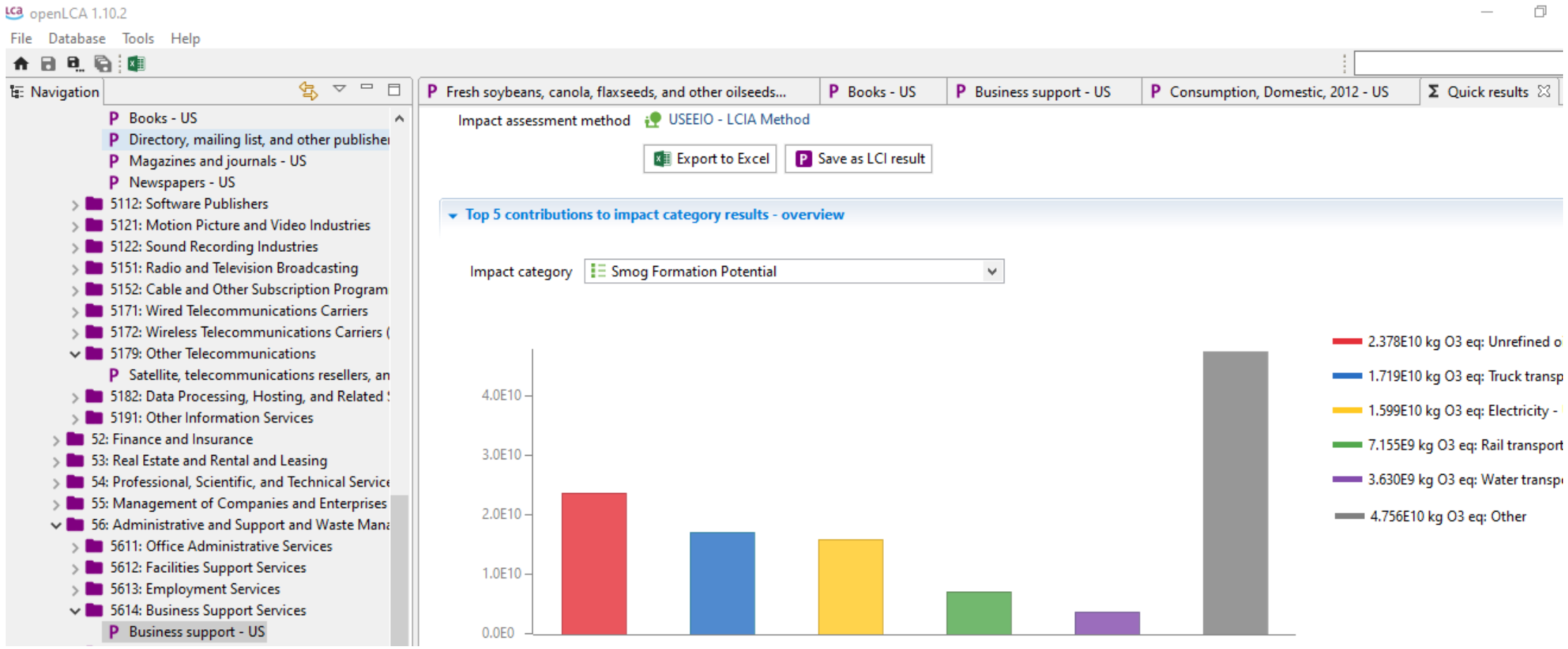
USEEIO Excel - A matrix



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1		1111A0/US	1111B0/US	111200/US	111300/US	111400/US	111900/US	112120/US	1121A0/US	112300/US	112A00/US	113000/US	114000/US	115000/US	211000/US	212100/US
2	1111A0/US	0.052092	0.001397	0.000203	0	0	0	0	0	0	0	-3.3E-06	0	0.000474	0	0
3	1111B0/US	0	0.073033	0	0	2.4E-08	0.009443	0.051184	0.079851	0.04653	0.007668	0.000656	3.63E-06	0.004115	0	0
4	111200/US	0	0	0.04384	0.000194	3.03E-08	0	0	0	0	6.33E-07	3.61E-06	1.7E-06	0.00029	0	0
5	111300/US	0	0	0	0.005744	2.91E-09	0	0	0	0	2.3E-07	1.31E-06	6.18E-07	3.89E-05	0	0
6	111400/US	0	0	0	0	0.159081	0	0	0	0	2.99E-05	0.00017	8.03E-05	0.011122	0	0
7	111900/US	0.009096	0.00144	0	0	1.21E-09	0.026621	0.004705	0.003813	0	0.000524	0.001685	3.56E-06	0.000373	2.09E-08	5.51E-05
8	112120/US	0	0	0	0	3.15E-09	0	0	0	0	7.47E-05	5.38E-07	0	5.43E-07	0	0
9	1121A0/US	0.000774	0.002122	0.000203	0.000815	0.00053	0.00048	0.047318	0.288066	0	0.008214	8.94E-05	0	0.007464	0	0
10	112300/US	0.000211	0	0	0	4.36E-09	5.33E-05	0	0	0.101708	2.96E-06	2.02E-05	7.96E-06	0.001211	0	0
11	112A00/US	0.000492	0.001267	6.78E-05	0.000388	0.000266	0.001014	0.00338	0.006402	0	0.126052	0.001303	2.71E-06	0.014046	0	0

USEEIO in openLCA



Accessible via [Federal LCA Commons]

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USEEIO API

USEEIO-API

Base URL: `/api`, **Version:** `1.0.2`, **The USEEIO API Wiki on github provides more information on using the API.**

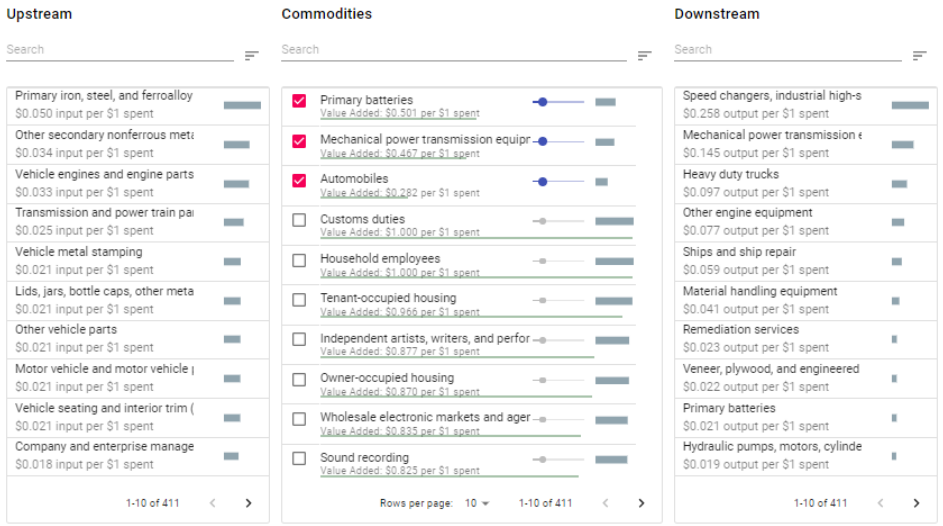
A RESTful API that provides access to versions of the USEEIO models. Results are returned as JSON objects.

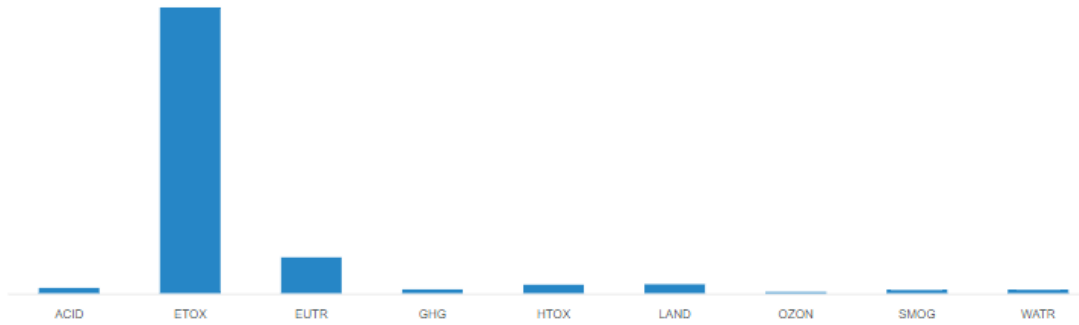
Schemes: http

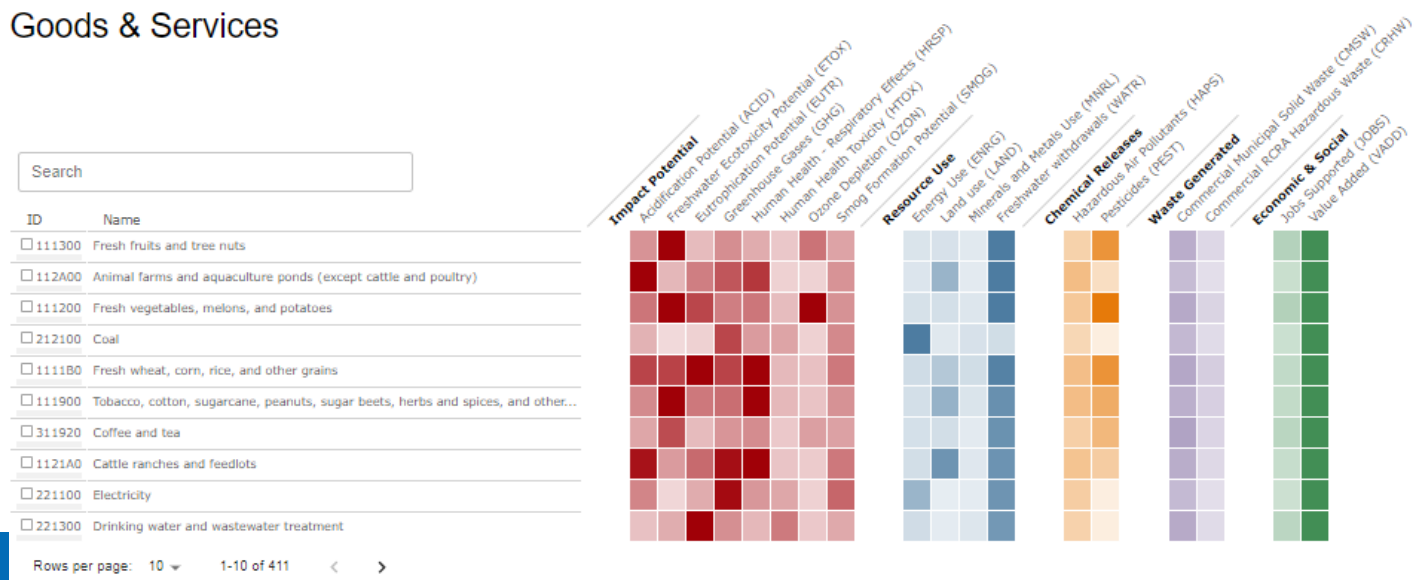
Summary

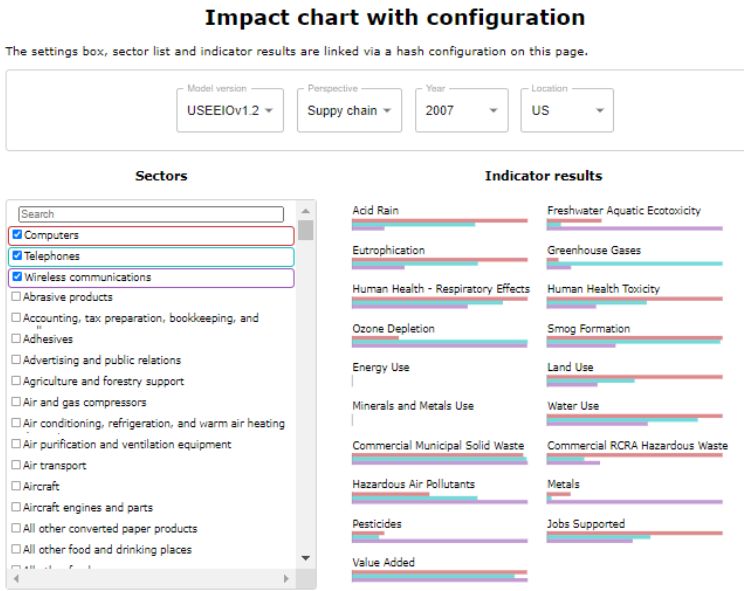
Path	Operation	Description
/models	GET	Get the available models from the server.
/{model}/calculate	POST	Calculate the result for a given demand and perspective.
/{model}/demands	GET	Returns a list with all available demand vectors from a model
/{model}/demands/{demandID}	GET	Returns a demand vector from the model
/{model}/indicators	GET	Get all indicators of the model.
/{model}/indicators/{indicatorID}	GET	Get indicator information by ID.
/{model}/matrix/A	GET	Get the direct requirements matrix of the IO model.
/{model}/matrix/B	GET	Get the satellite matrix of the IO model.

USEEIO Widgets









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USEEIO Widgets - About

- Drop-in components for displaying USEEIO model data for web pages open to anyone
- Created for web developers without the model/domain expertise to use USEEIO directly
- Simplify process of integrating model results
- Configurable to work with any USEEIO family model available on the USEEIO API

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Widgets Links

- List of widgets with standalone implementation
- Example integration with local data

Widgets summarized in webinars

- Industry Comparison Tools for Sustainable Communities
- SMM Prioritization and Web-Enabled Tools Session

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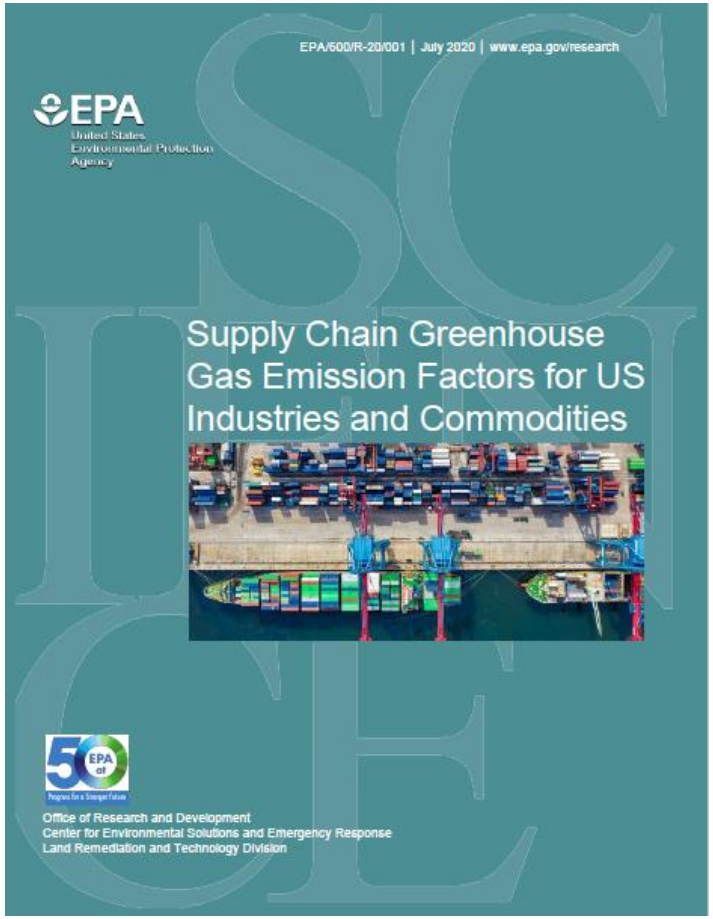
Applications

Supply Chain Factors (SEFs)

[Report]

[Factors Dataset]

[National GHG Industry Attribution Model]



Supply Chain Factors (SEFs) Details

GHGs Included

- CO_2
- CH_4
- N_2O
- Other GHGs (SF_6,NF_3,CFCs/HFCs)

Form of the Factors

kg of GHG per **$** purchased of a commodity or from an industry

where $ are in 2018 USD in purchaser price

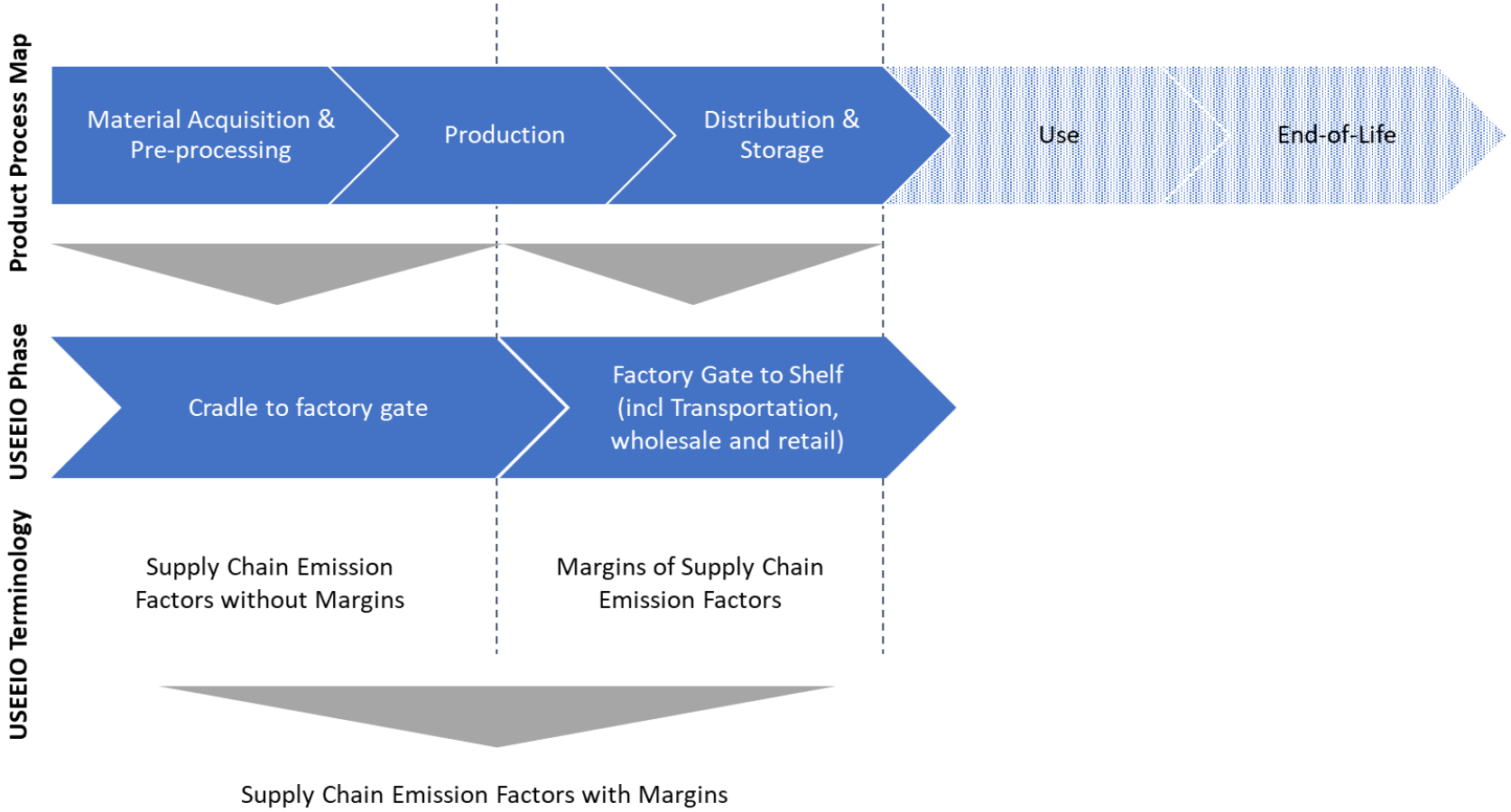
Examples

0.467 kg CO_2/$ of farm commodities

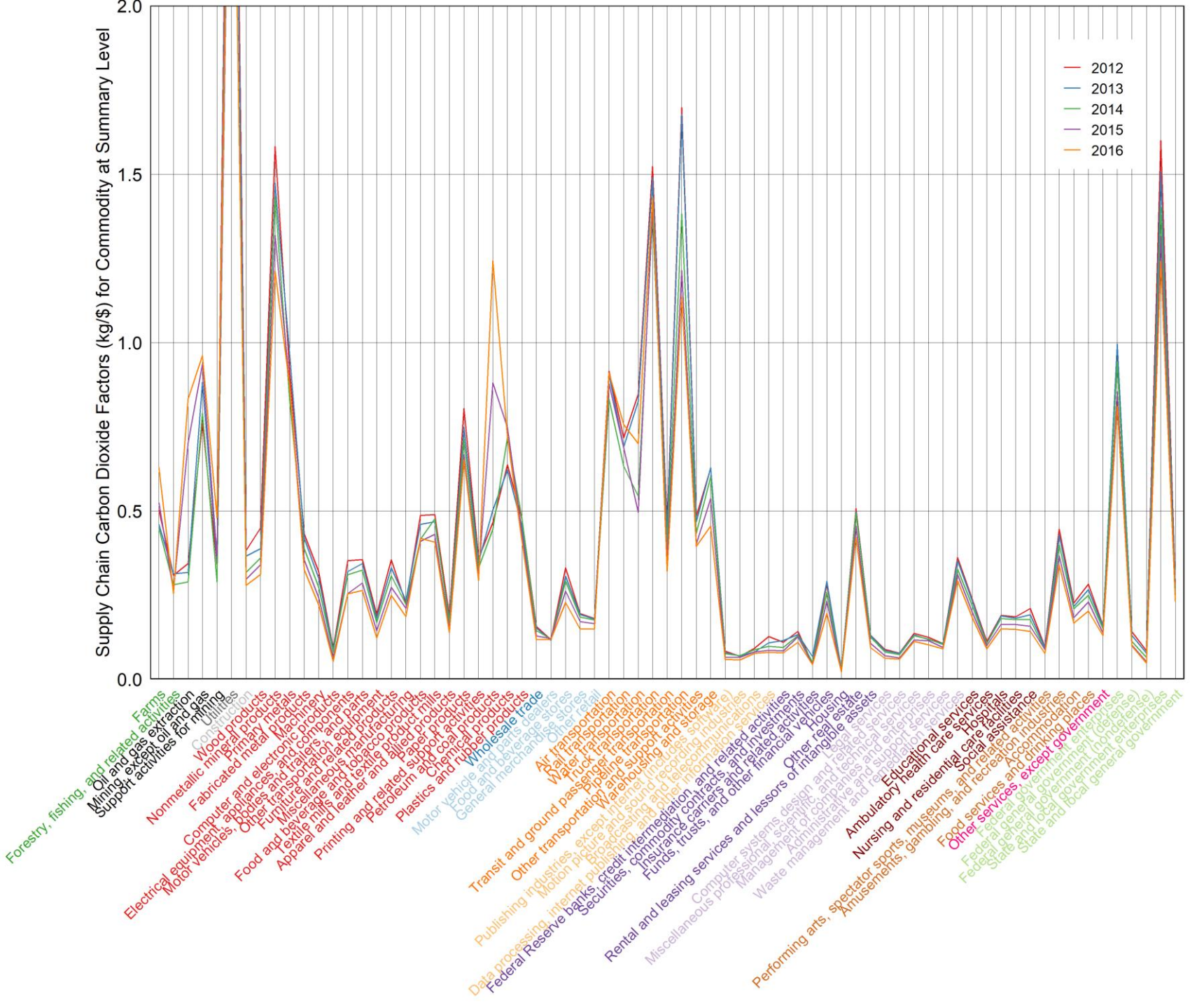
0.008 kg CH_4/$ of fresh wheat, corn, rice and and other grains

0.21 kg CO_2/$ from the ship building industry

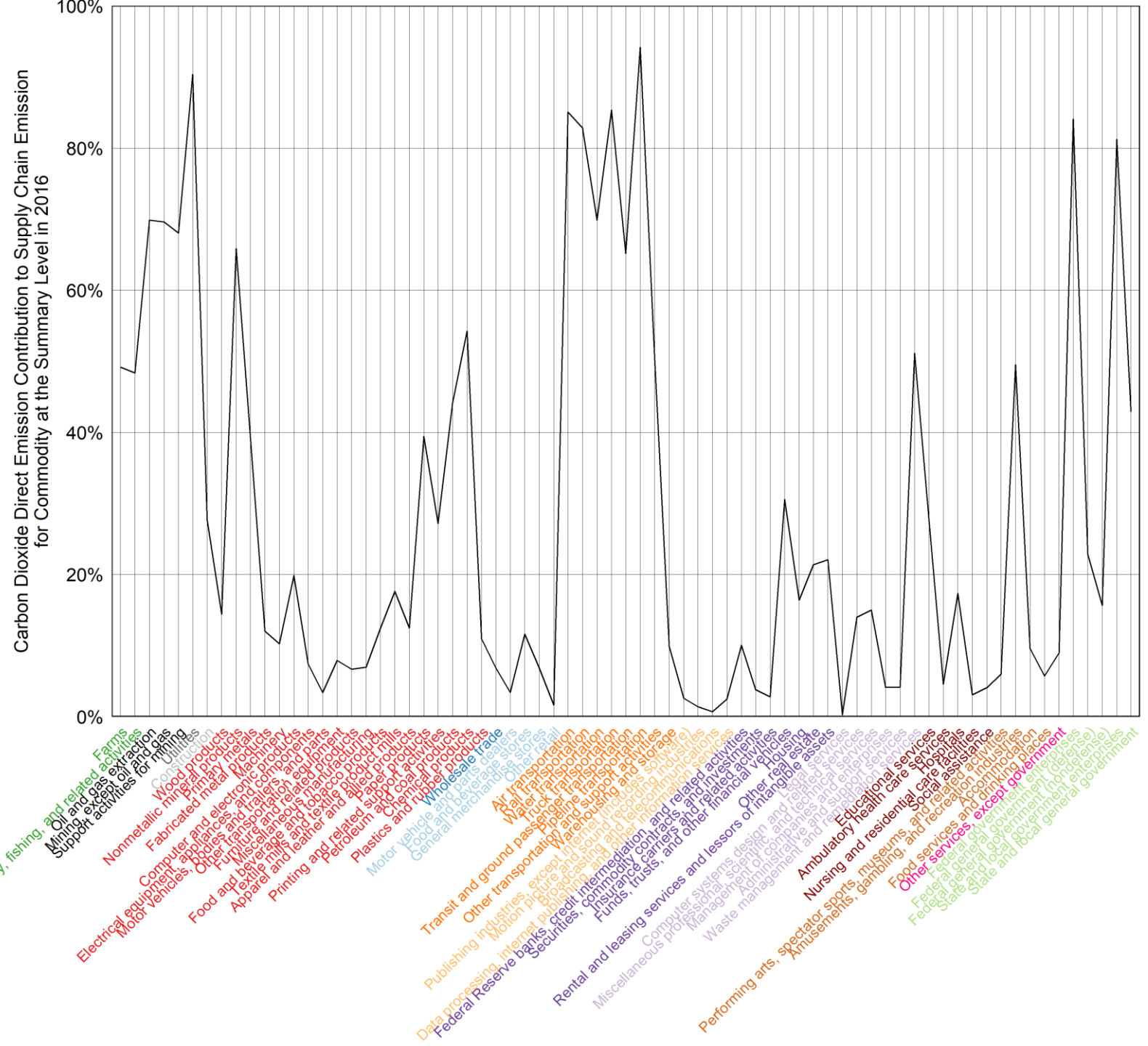
The Coverage of the Factors in the Product Life Cycle



SEFs for CO_2 2010-2016



SEFs for CO_2 2016 Direct vs Indirect



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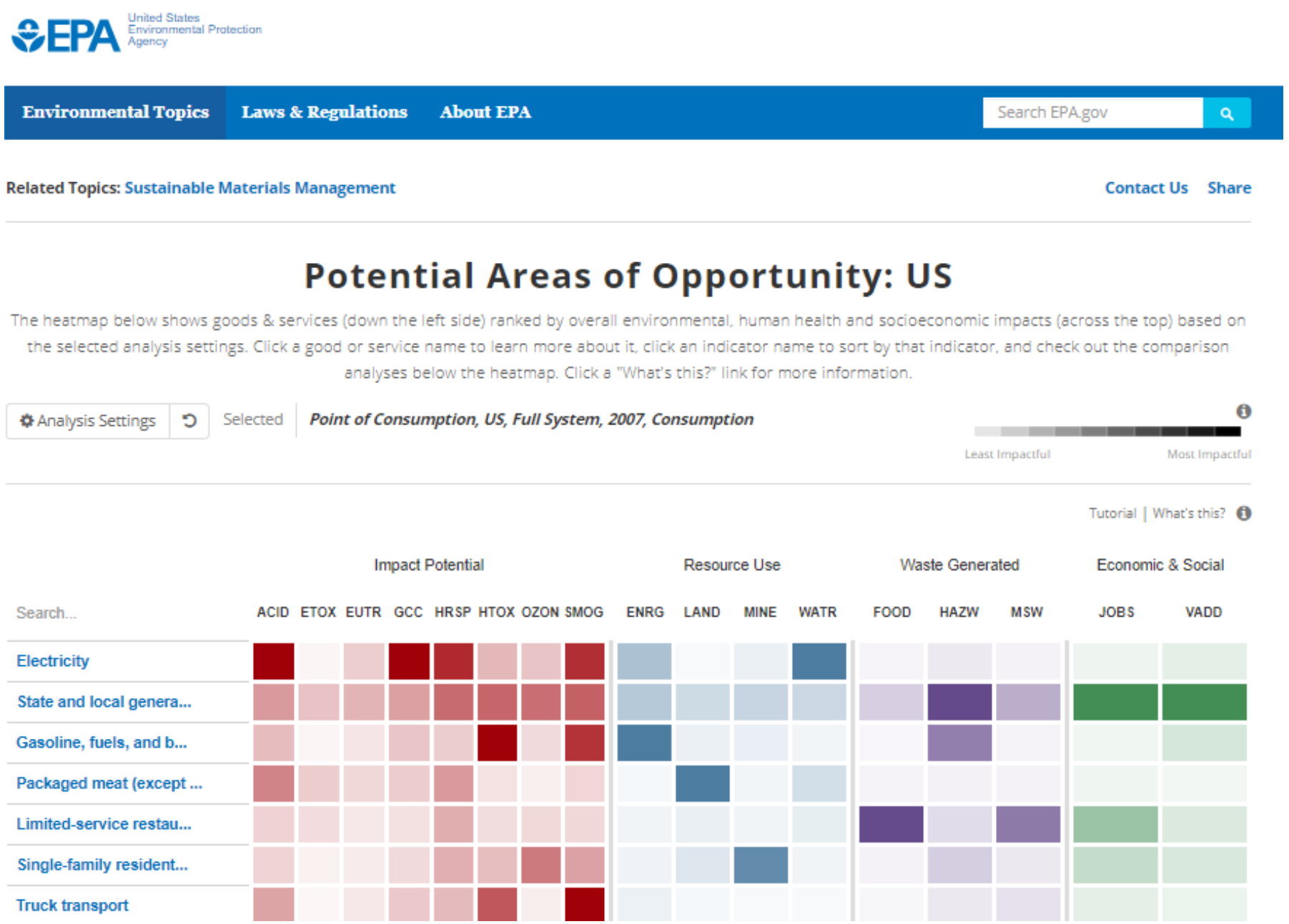
SMM Tools

- National Prioritization Tool

- Organizational Tool



Sustainable Communities Web Challenge 2021

A virtual Federal Challenge event that culminated on 10/2/2021 for web developers, designers and students to build off the model.earth community platform, awarding $9,000 in prizes

Objective: To develop, customize and improve the look-and-feel of community-specific web resources on model.earth that integrate the USEEIO widgets with other data sources useful to inform assessment of community sustainability.

Background

EPA Science Matters July 2020; SMARTer Together Industry Comparison Tools webinar

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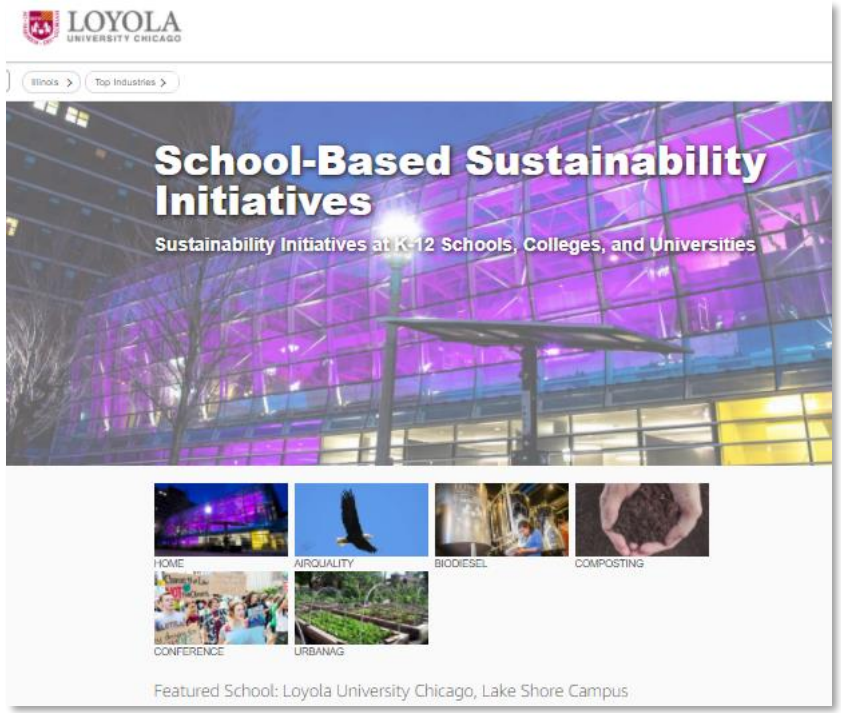
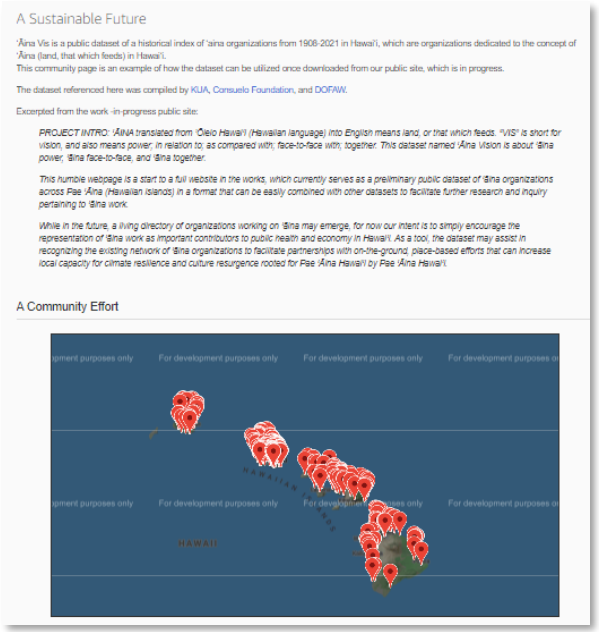
Challenge Partners

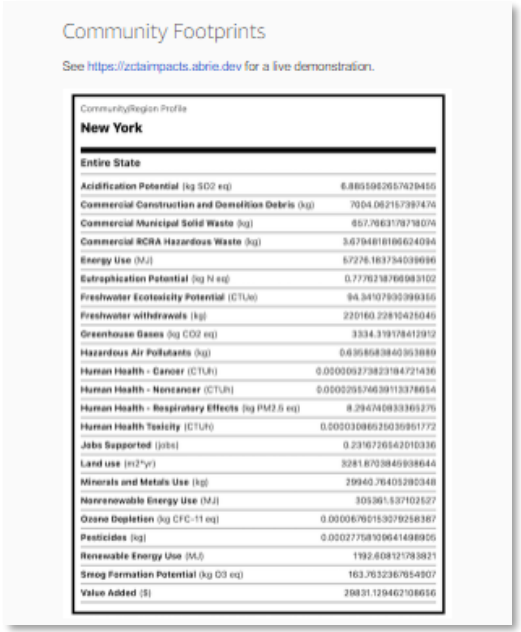
- EPA ORD and Region 4
- GA Economic Development Center for Innovation
- GDIT and Code for America

Challenge Winners

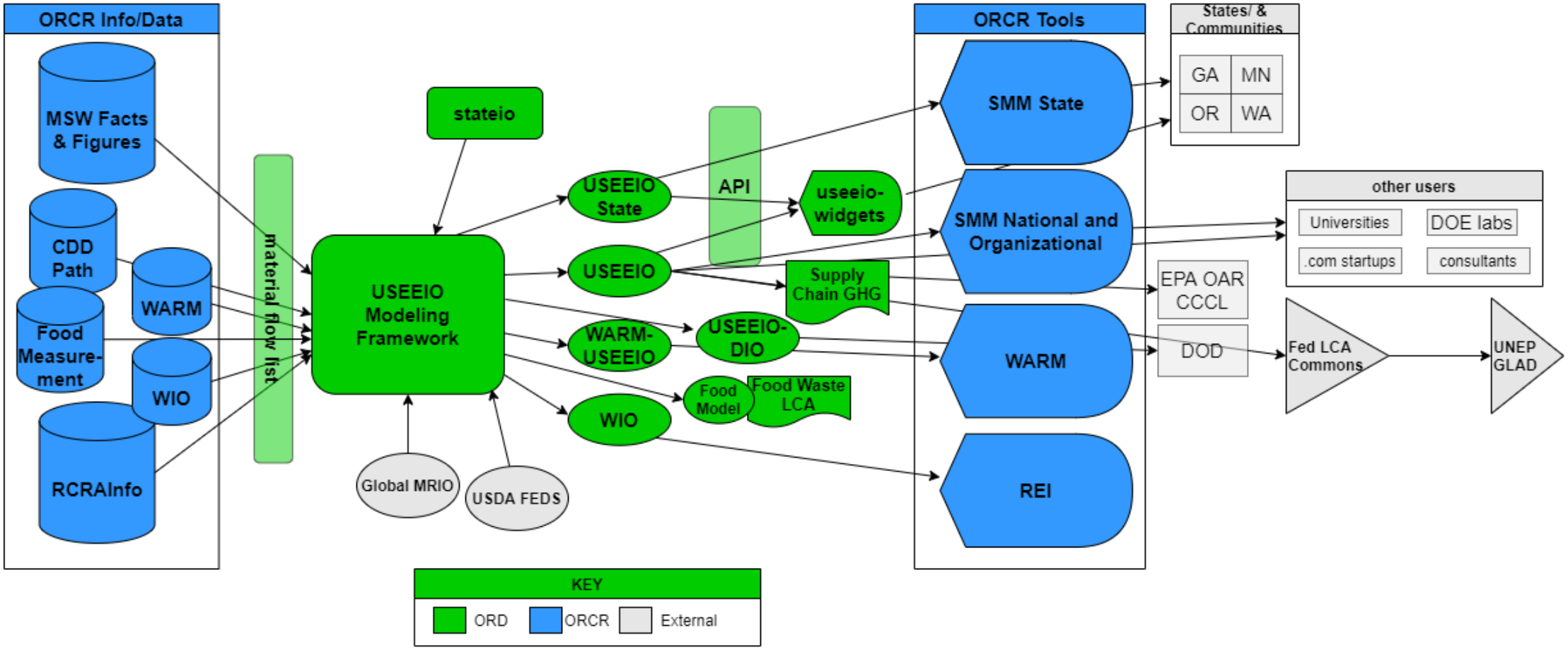
- School-based sustainability initiatives, Loyola Chicago
- Āinaviz Data Viewer, Code for Hawaii
- Impact Profiles for Communities, Abrie Badenhorst
- Get Involved Within Your Community, Ryan Marohn
- Nature's Lifecycle: Parks and Recreation, Don Adams and Julie Bender







USEEIO Supporting OLEM SMM Program - Building to Future



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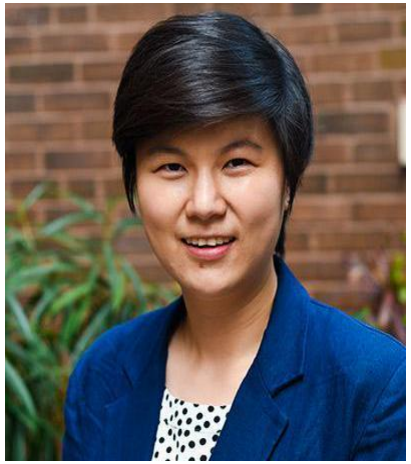
Work in progress with near-term delivery

- v1 release with peer-review documentation for supporting software:
  - useeior
  - FLOWSA
  - StEWI
- New technology addition to economy
- Electricity sector disaggregation
- Add model hybridization capability to useeior
- Update of EPA's Systems-Based GHG Inventory

Work in progress with medium-to-long term delivery

- Update national flow by industry models for:
  - GHGs
  - Nutrient releases
  - Pesticide releases
  - Mineral and materials use
  - Criteria and hazardous air pollutants
- Foreign import GHG coefficients for USEEIO commodities
- WARM-USEEIO
- Waste Input-Output (WIO) Model
- US food system model (see '*Food waste management applications...' presentation*)
- Add final consumer (households, government) satellite tables

USEEIO Team



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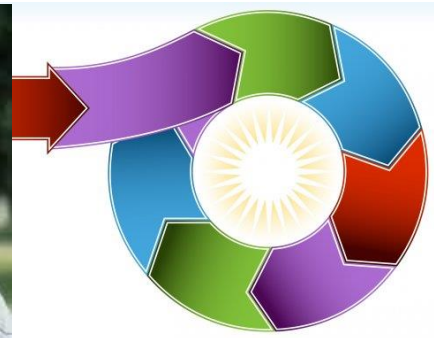
Jorge Vendries, ERG

Léo Jan, GreenDelta

David Meyer, EPA

Loren Heyns, GA Center for Innovation

Michael Srocka, GreenDelta



Wes Ingwersen, EPA

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External Collaborators and Friends

Amazon Sustainability, ANL GREET team, BONSAI, Brightway LCA software, Cornell Food Environmental Data System Project, DataFEWSVision team, DOE Advanced Manufacturing Office Strategic Energy Analysis Center, Georgia Center of Innovation, Federal LCA Commons Working Group, NETL Energy Analysis Group, NREL BEIOM Team, National Capital Accounting Working Group, National Socio-Environmental Synthesis Center (SESYNC), Office of the Assistant Secretary of Defense for Sustainment, openLCA software, Sustainable Industrial-Natural Coupled Systems (SINCS) lab, USGS Materials Flow Analysis Section, USDA ERS Food Dollar Team, Thomas Group @ Georgia Tech, Yale Center for Industrial Ecology

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Additional Slides

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v2.0 Basic Specs

- 2012 IO data, ~2012-2017 physical flows
- 411 commodities
- 2668 physical flow types
- 23 environmental and economic indicators
- Total US Consumption, Production and Household Consumption vectors (2012)

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v2.0 New Features

- Disaggregation of `Waste and Remediation` sector
- Domestic vs. foreign input and result distinction
- Price adjustment matrices
- Production and consumption demand vectors
- Validation proofs

v2.0 Improved Data Description & More Data Distribution

- National Totals by Sector by NAICS-6 datasets in lieu of separate satellite tables
- Harmonization with Federal LCA Commons Elementary Flow List
- Additional data provision
  - Make and Use tables
  - Industry and commodity output
  - USEEIO<->BEA<->NAICS crosswalk
  - Domestic versions of matrices
  - More metadata

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Updated Environmental Data Inputs

Dataset
National Water Withdrawal Totals By Industry 2015
National Criteria and Hazardous Air Pollutant Totals By Industry 2017
National Point Source Releases to Ground By Industry 2017
National Point Source Releases to Water By Industry 2017
National Commercial Hazardous Waste Totals by Industry 2017
National Land Occupation Totals By Industry 2012
National Employment Totals By Industry 2017