**PROJECT TITLE:** An economy-wide, sub-regional tool for economic and environmental decision-making in Minnesota

**I. PROJECT STATEMENT**

Regional sustainable development analyses require detailed and accurate information about dynamics happening within and between regional economies that create benefits and burdens across economic, social and environmental dimensions. It is critical that public and private decision-makers have access to relevant and timely information to facilitate sustainable development interventions and evaluate potential mitigation or adaptation policies affecting Minnesota and its sub-regions. **We propose to create a regionalized, commodity flow enhanced, environmentally extended input-output (EEIO) model for Minnesota, to inform State and local decision makers across a wide range of applications from regional sustainable development to sustainable product and procurement-oriented policy and legislation.** The model will assess where changes to economic activity in a particular industry and region is likely to create benefits and burdens, across its supply chain, as well as within and between regions. For example, it can provide information to stakeholders on the regional economic and environmental trade-offs associated with the expansion of copper-nickel mining or agriculture in Greater Minnesota, while also guiding enterprise-level consumption of state agencies and local governments addressing energy and water efficiency, emissions reductions or sustainable procurement targets.

EEIO models track inputs (energy, materials, capital, labor) and outputs (shipments, emissions and waste) for industries across an economy, and are used to inform sustainable production and consumption policies. EEIO models are currently being built around the world. In the U.S., EPA has recently developed a national-scale EEIO model (USEEIO), with leadership from key personnel of our research team (Yang et al., 2017), and is exploring a pilot “State” model to support Sustainable Materials Management. The EEIO model we propose for the State of Minnesota will build upon the national USEEIO model, extending it by incorporating recent advancements in sub-regional commodity flow analysis developed at the University of Minnesota (Smith et al. 2017). Working with key stakeholders across the State, a user-inspired user interface will be designed and integrated into NRRI’s MN Natural Resource Atlas for wide dissemination and use.

Among its many uses, our multi- and sub-regional MN-US EEIO tool will be used to 1) evaluate regional economic and environmental trade-offs associated with creation or expansion of a particular industrial activity (e.g. mining, agriculture); 2) prioritize regional economic development opportunities that balance the economy and environmental impacts; 3) provide insight on the impacts of major disruptions or changes in commodity supply chains due to government policies, best management practices, or economic conditions; or, 4) provide guidance to agencies for assessing potential options for meeting newly established targets for energy and water efficiency, emissions reductions or sustainable procurement.

**II. PROJECT ACTIVITIES AND OUTCOMES**

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| **Activity 1 Title:** *build MN environmentally extended input-output model*  | **ENRTF BUDGET: $ 239,189** |
| **Description:** *We will collaborate with the USEPA and MNPCA to develop a regionalized EEIO model for MN (MN-US EEIO), taking into account the unique economic and environmental performance situations in the State for major sectors (e.g. electricity, agriculture, and mining). Outputs of this activity will include an MN-US input-output table which captures transactions between industries within and without MN, and an MN-specific environmental table which records environmental releases from industries within MN.*  |

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| **Outcome** | **Completion Date** |
| *1. Produce an economy-wide input-output (IO) table for Minnesota, nested within the national IO table developed by the Bureau of Economic Analysis*  | *Jan 1st, 2021* |
| *2. Quantify pollutants released by productive sectors in Minnesota, based primarily on EPA’s toxic release inventory (TRI) and national emissions inventory (NEI)* | *Aug 1st, 2021* |

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| **Activity 2 Title:** *further regionalize the MN-US EEIO model by estimating and integrating inter-county flows of major economic sectors* | **ENRTF BUDGET: $ 179,392** |
| **Description:** *We will expand on previous work done at the University of Minnesota* (Smith et al. 2017) to estimate flows of major economic sectors within the State and to other states (e.g., mining and agricultural commodities). We will apply *the commodity flow enhanced MN-US EEIO to several case studies of interest to stakeholders to understand benefits and environmental burdens of regional economic planning in the State.* |

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| **Outcome** | **Completion Date** |
| *1. Estimate inter-county flows of major sectors (e.g., mining, agriculture)* | *Feb 1st, 2022* |
| *2. Engage stakeholders on application of the commodity flow enhanced model in sustainable development and supply chain decision-making* | *Sep 1st,2022* |

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| **Activity 3 Title:** *Identify drivers of pollution, develop mitigation strategies, and incorporate results into the MN Natural Resource Atlas* | **ENRTF BUDGET: $ 179,392** |
| **Description:** *Besides engaging stakeholders on case studies of their interest, we will apply the model to 1) identify major drivers of pollution in the State, and 2) develop supply chain mitigation strategies for reducing pollution. We will also incorporate the model results into the MN Natural Resource Atlas, and disseminate the model for public policy and managerial use.* |

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| **Outcome** | **Completion Date** |
| *1. Analyze major social-economic drivers of air, water, soil pollution in Minnesota*  | *Jun 30th, 2023* |
| *2. Develop economy-wide and sector-specific supply chain pollution mitigation strategies* | *Jun 30th, 2023* |
| *3. Incorporate results into the MN Natural Resource Atlas* | *Jun 30th, 2023* |

**III. PROJECT PARTNERS AND COLLABORATORS:**

**A. Partners receiving ENRTF funding**

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| **Name** | **Title** | **Affiliation** | **Role** |
| Dr. Timothy Smith | Professor | UMN Dept of Bioprod Biosys Eng | PI |
| Dr. Yi Yang | Research associate | UMN Dept of Bioprod Biosys Eng | Co-PI |
| Dr. Lucinda Johnson | Associate director  | UMD, NRRI | Co-PI |
| Dr. Christopher Wright | Research associate | UMN, NRRI | Coordinator |

**B. Partners not receiving ENRTF funding**

|  |  |  |  |
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| **Name** | **Title** | **Affiliation** | **Role** |
| Dr. Wesley Ingwersen | Environmental engineer | USEPA | Supporter/collaborator |
| Colleen Hetzel | Planner Principal | MPCA | Supporter/collaborator |
| Madalyn Cioci | Water prevention specialist | MPCA | Supporter/collaborator |

Our colleagues at the US EPA will provide data and technical support, especially with respect to religionizing the national USEEIO model to the State. Our colleagues at Minnesota Pollution Control Agency (MPCA) will provide data support and feedback on potential applications of the model at the agency.

**IV. LONG-TERM IMPLEMENTATION AND FUNDING:**

The MN-US EEIO model proposed is the first of its kind in Minnesota. It will be of immediate value to state environmental policy making, such as MPCA, corporate sustainability management, and research institutes. We expect this to be a long-term project. We will work with EPA to assure compatibility with future state EEIO version, so the EPA state models are advanced, the MN-specific enhancements will remain compatible, and we will document how data updates can be seamlessly integrated. Future cost is expected to be much less, and may be financed by stakeholders interested in continuous use of the model.

Yang, Y., Ingwersen, W. W., Hawkins, T. R., Srocka, M., & Meyer, D. E. (2017). USEEIO: A new and transparent United States environmentally-extended input-output model. Journal of cleaner production, 158, 308-318.

Smith, T. M., Goodkind, A. L., Kim, T., Pelton, R. E., Suh, K., & Schmitt, J. (2017). Subnational mobility and consumption-based environmental accounting of US corn in animal protein and ethanol supply chains. Proceedings of the National Academy of Sciences, 114(38), E7891-E7899.