Valorizing MSW into Conversion Ready Feedstocks

Vicki Thompson
Idaho National Laboratory

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Idaho National Laboratory

MSW Valorization - Why and How?

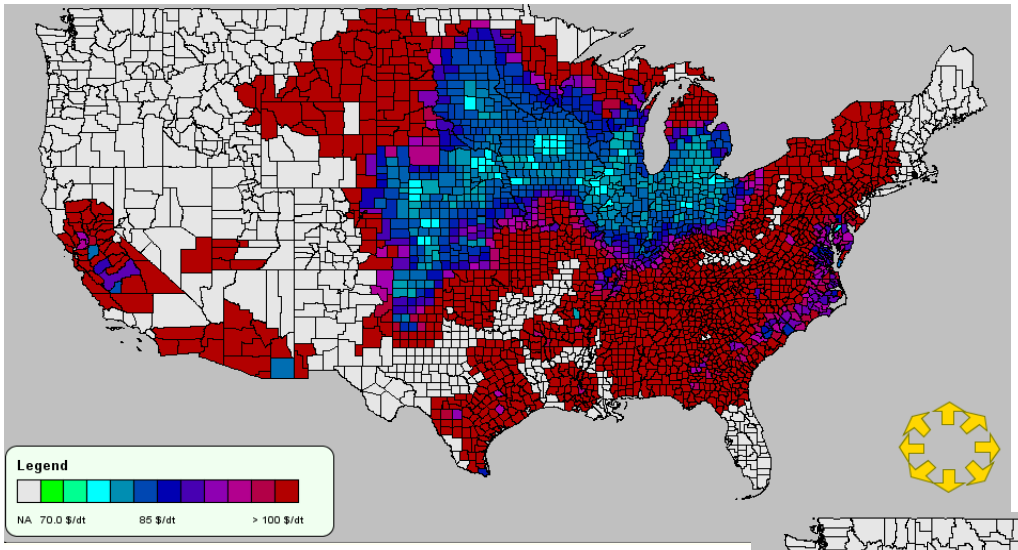
- MSW as a feedstock
  - Cost
  - Quality
  - Quantity
- Valorization
  - Technical
  - Economic
  - Sustainability
  - Society
- INL Bioenergy Feedstock Projects (Funded by DOE-BETO)
  - Suitability of MSW as feedstock blending agent
  - Issues with MSW
  - Solutions
- INL REMADE Projects (Funded by DOE-AMO)
  - Modeling
  - Supply chain

MSW Opportunities and Challenges

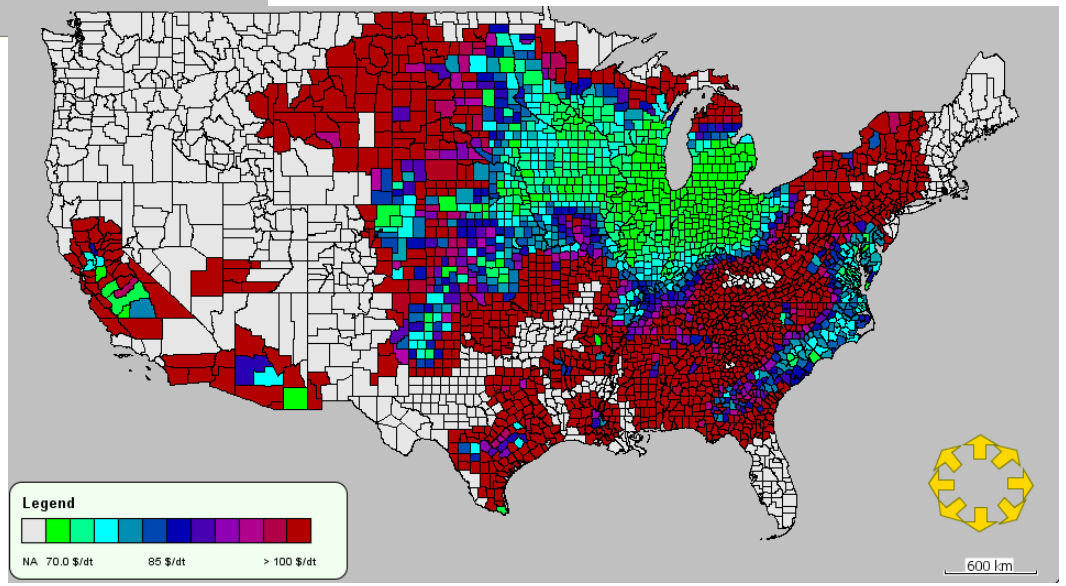
- U.S. waste and recycling industries have changed
  - China Green Fence/National Sword policy
  - 2018 ban on many types of materials
  - Accumulation of wastes
- Many states implementing food and yard waste bans from landfills
- Need to understand how these changes impact availability of wastes
- Need to understand MSW contamination issues
- Need to develop strategies to remove problematic contaminants

Least cost formulation for corn stover and MSW

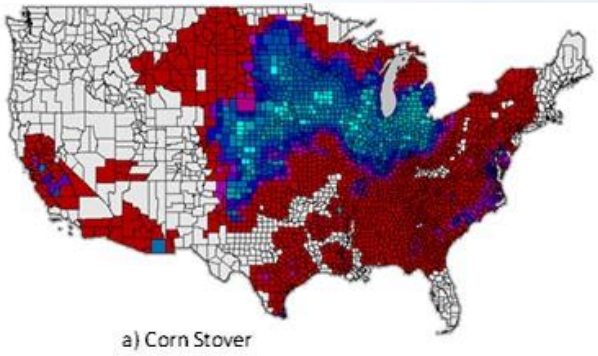
Corn Stover

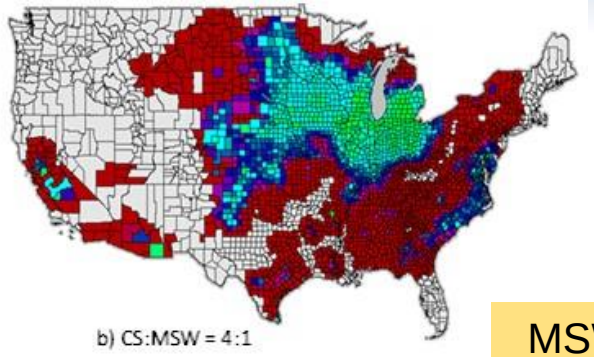


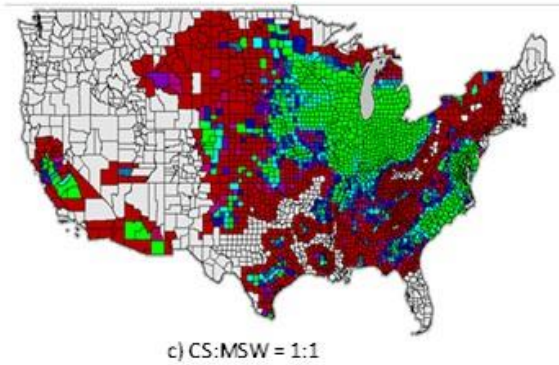
60% Corn stover + 40% MSW



Low-Cost MSW for Preprocessing and Formulation


a) Corn Stover


b) CS:MSW = 4:1


c) CS:MSW = 1:1


DOE target

MSW/CS blends show the great potential to meet the “cost target”

MSW/CS blends show the great potential to meet “quality requirements” for conversion

CS/MSW ratio	Ash (%)	Glucan (%)	Xylan (%)	Glucan+Xylan (%)
10:0	3.0	33.2	20.8	50.8
9:1	3.8	35.5	19.7	55.2
8:2	4.6	37.7	18.6	56.3
7:3	5.4	40.0	17.6	57.6
6:4	6.2	42.2	16.5	58.7
5:5	7.0	44.5	15.4	59.9
0:10	10.9	50.8	10.0	60.8

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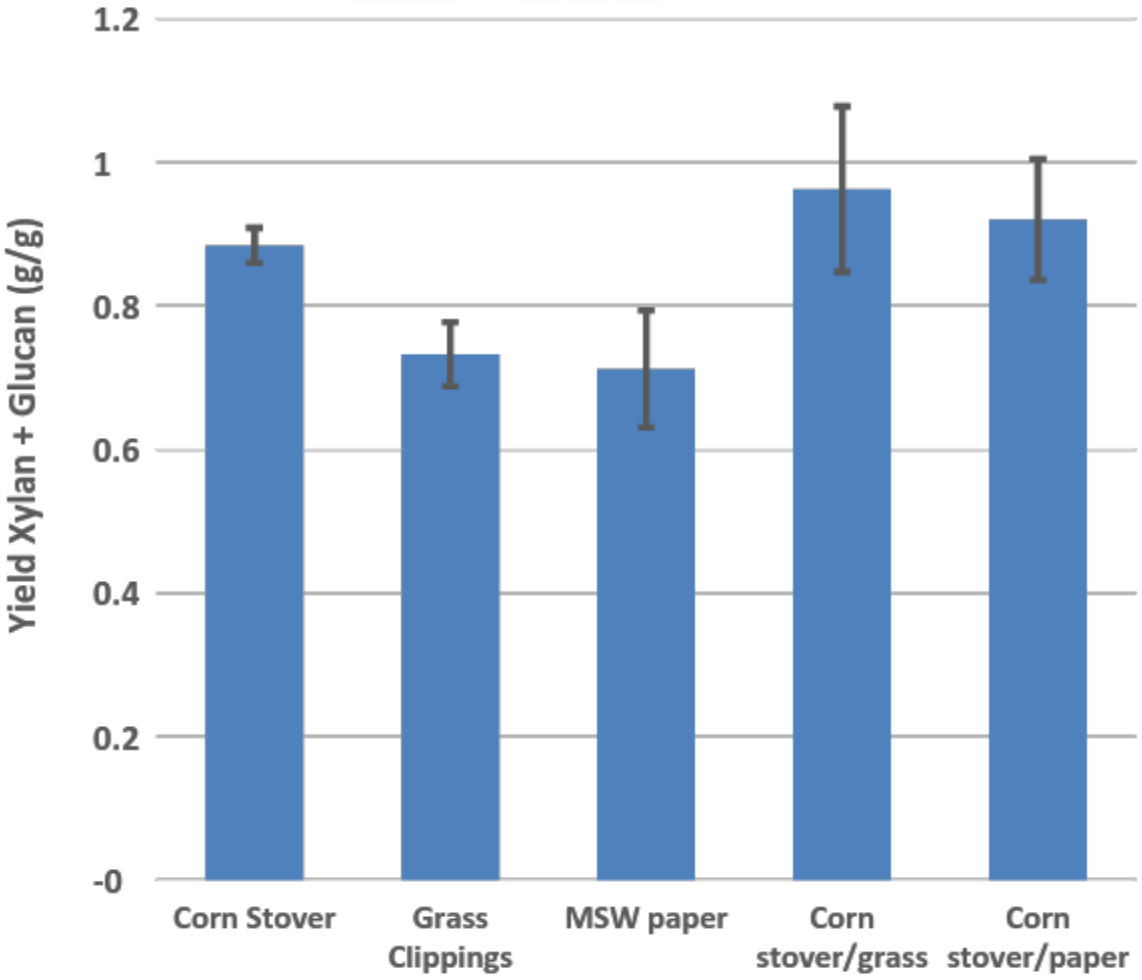
MSW Types/Sources for Biochemical Conversion

- Aseptic and Polycoats
  - Juice boxes
  - Milk containers
  - Wax coated
- Food soiled paper/cardboard
  - Pizza boxes
  - Paper towels
- Shredded paper
- Yard waste
  - Grass clippings
  - Leaves

MSW Performance in Biochemical Conversion

- Waste materials had lower yields compared to stover
  - Coatings
  - Contaminants
- Blends had comparable yields to stover
  - Predicted yield is lower
  - Synergy?

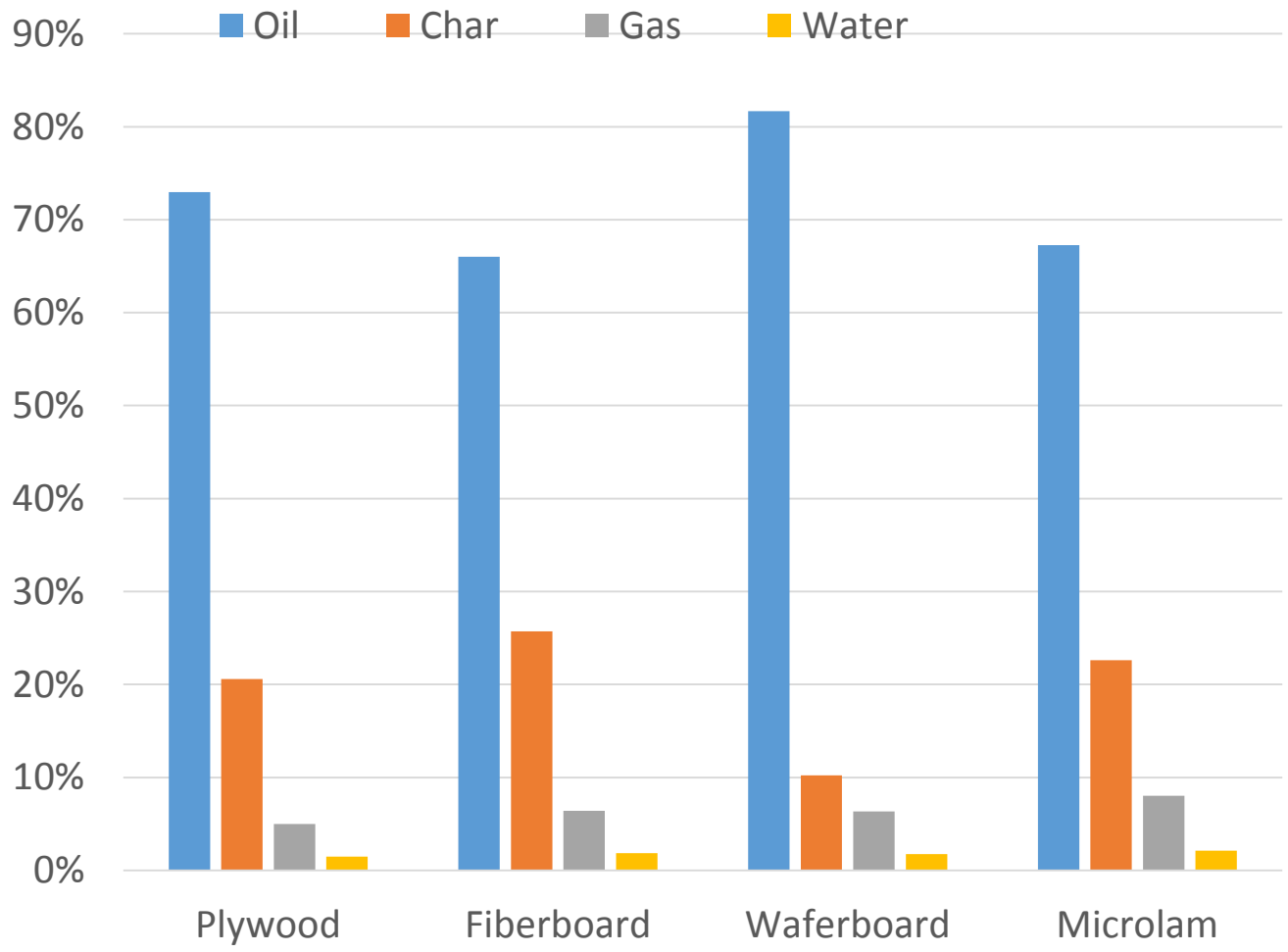


MSW Types/Sources for Themochemical Conversion

- Yard waste
  - Branches
  - Tree trimmings
- C&D waste
  - Plywood
  - Microlams
  - Waferboard
  - Fiberboard
- New construction versus demolition
- RINS

MSW Pyrolysis Performance

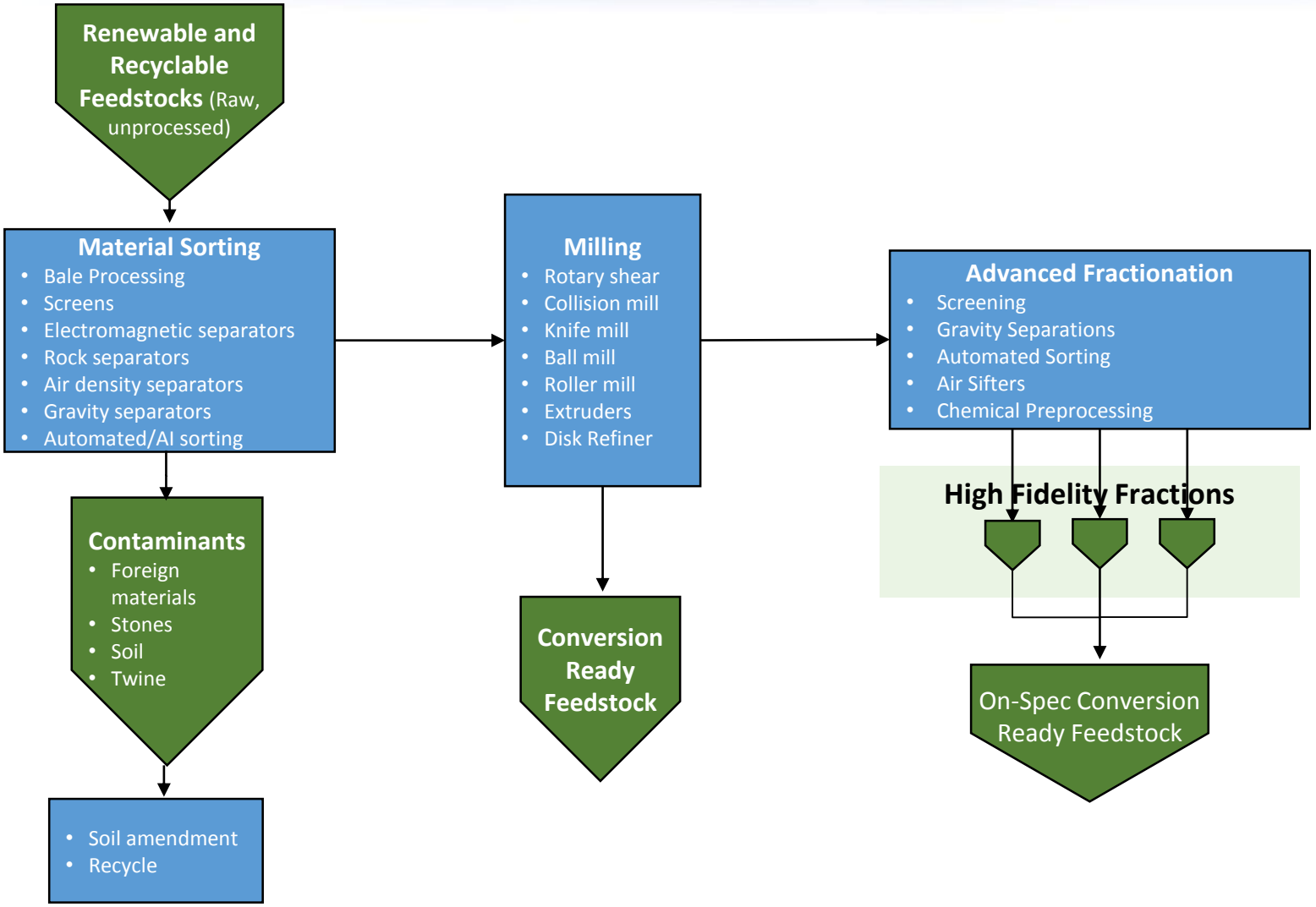
- Oil yields 65-82%
- Char yields 10-25%
- Contaminants
  - Glue
  - Wax
  - Adhesive



INL Biomass Feedstock National User Facility (BFNUF) – Mechanical and Chemical Fractionation

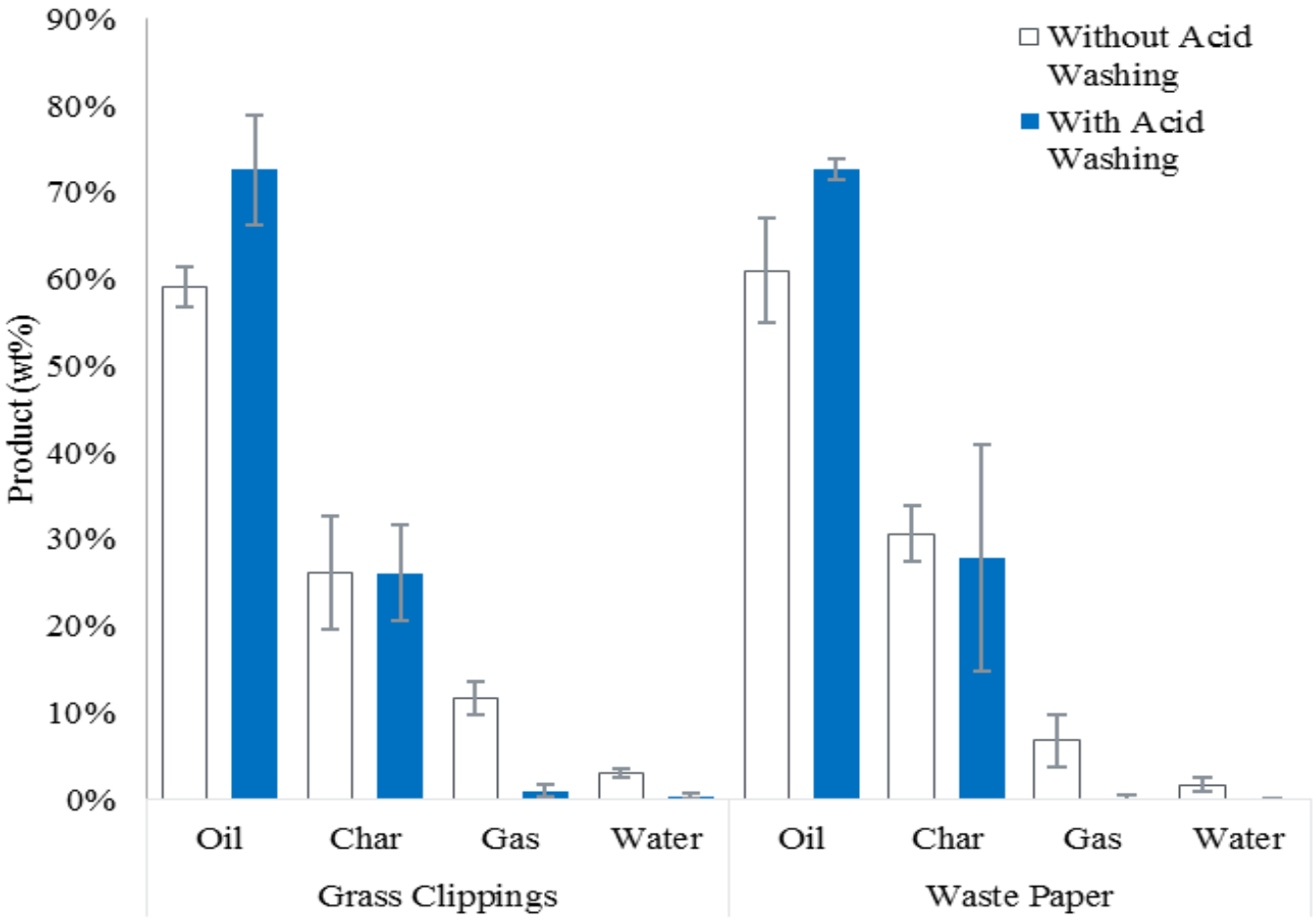
- Air classification
  - Removal fines
  - Density separations
  - High moisture materials
- Chemical Preprocessing System
  - pH 1-14
  - Up to 200°C
  - Solvents
  - Ammonia

Upgraded BFNUF Capabilities



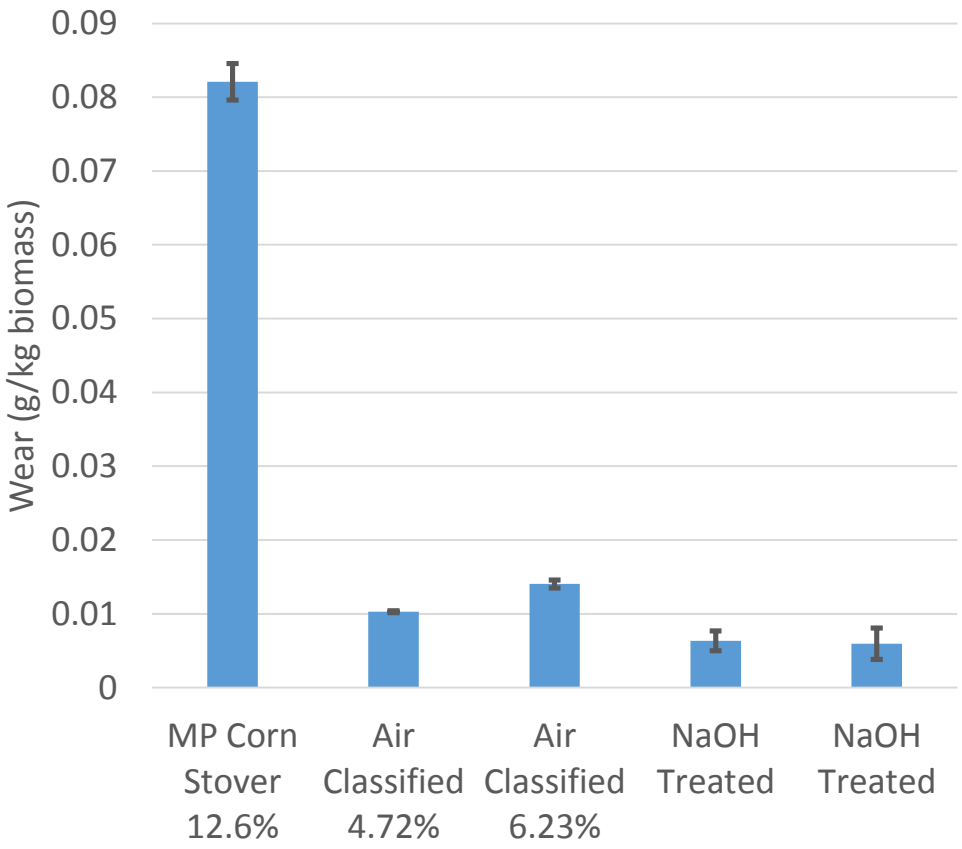
Chemical Preprocessing of MSW Improves Bio-oil Yields

- Micropyrolysis system
- Compared leached to unleached
- Bio-oil yields increase with leaching
- Char unaffected
- Gas yields decreased



Air Classification and Washing Decrease Wear

- Multi-Pass corn stover results in equipment wear
- Air classification removes soil ash
- Alkali treatment removes soil ash and silica
- Results in 6-14 fold less wear



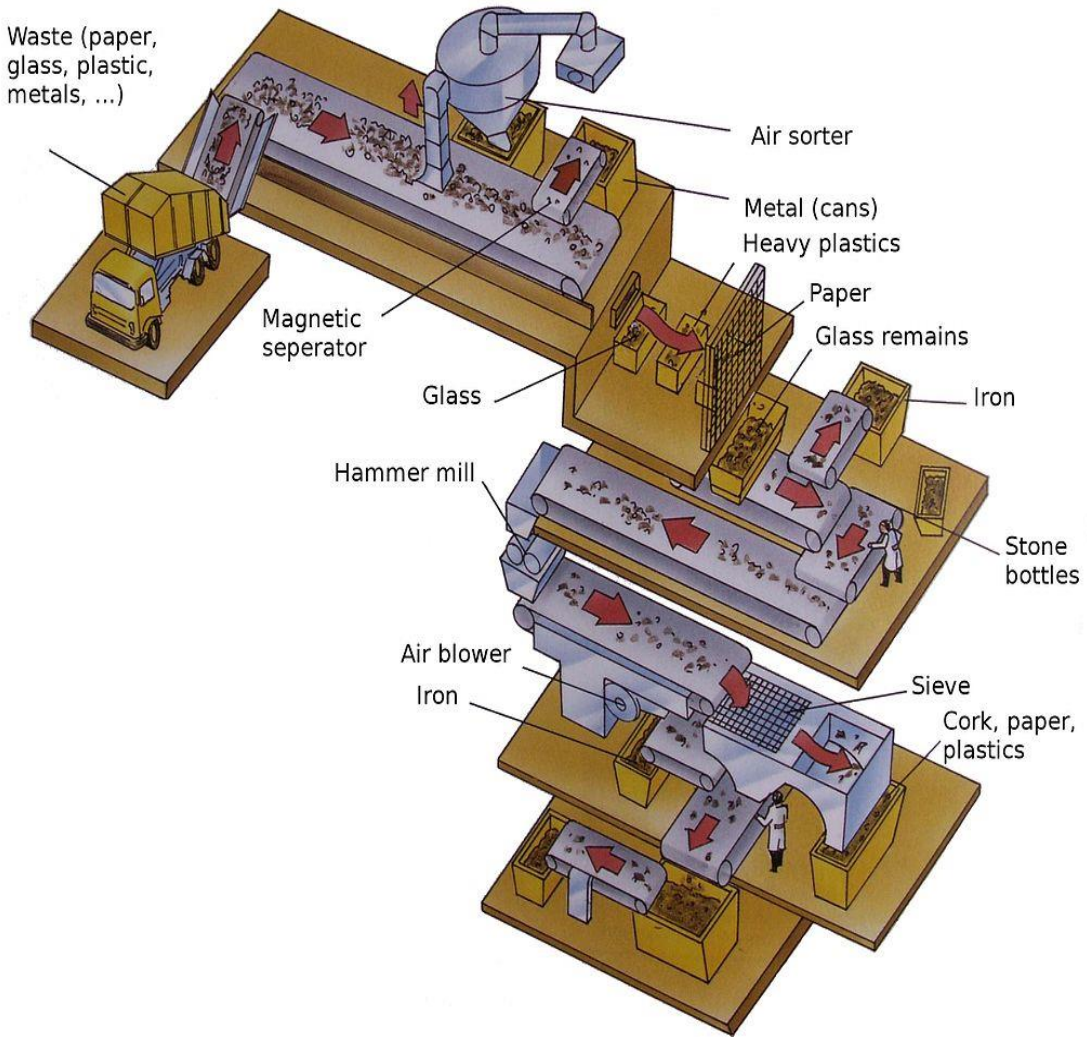
REMADE Impacts

- Provide tools for members to evaluate technology changes
- Improve the business performance of member companies
- Minimize energy usage in material transportation and distribution
- Enhance the efficiency of the E-waste supply chain

REMADE - MSW Sorting

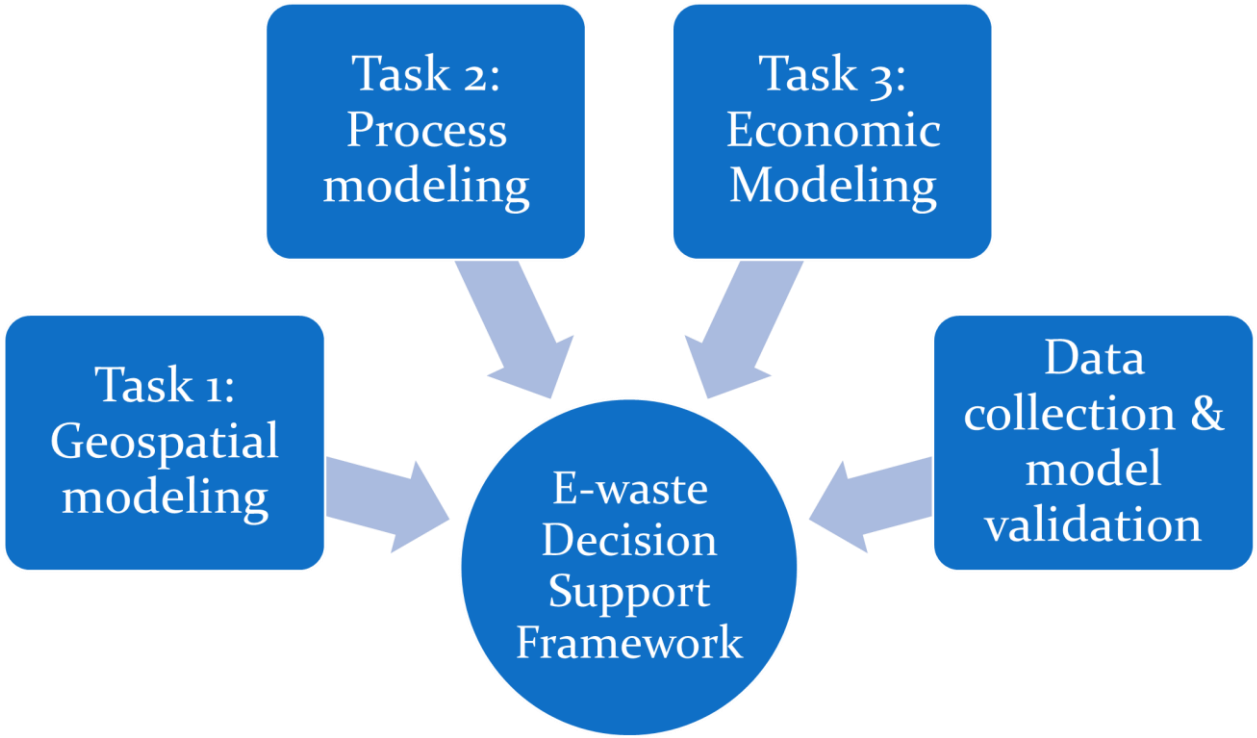
Sorting equipment

- **Screening**
  - **Disc**
  - **Trommel**
- **Conveyors**
- **Separations**
  - **Magnetic**
  - **Eddy current**
  - **Air classification**
  - **Optical sorting**
- **Aspen Plus sorting model**



REMADE Logistics Systems for E-waste Recycling

- Team
  - INL- Expertise in spatial, process and supply chain modeling
  - Sunnking, Inc.- 20 years experience in e-waste recycling



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