# DYNAMIC FIBER FLOWS MODEL

## Understanding the effects of changes in paper recovery and recycling

American Forest & Paper Association

Dynamic Fiber Flows Model research sponsored by the American Forest & Paper Association at Massachusetts Institute of Technology's Department of Materials Science & Engineering.

# WHY THE PROJECT WAS INITIATED

**The benefits of replacing virgin wood pulp with recovered paper have been the subject of debate for years**

- Policy makers and stakeholders have a longstanding belief that increased recycled content is always better
- Increasing recycled fiber use in all paper products is a bedrock advocacy principle for environmental campaigners
- Tools most often used to quantify the benefits of recycled content have a limited perspective and lack a comprehensive understanding of economic and environmental tradeoffs
- Simplistic tools cannot adequately capture the effects that occur in a complex recovered fiber system

# THE CHALLENGE

- Changes to paper recovery and the substitution of recovered paper for virgin pulp in products do not occur in isolation- multiple interactions cascade throughout the system
- The fiber value chain is vast and complex, with many interconnected links in the chain
- The benefits of recovered paper utilization can vary widely, depending on the source and use of different types of recovered paper
- Life Cycle analysis alone cannot quantify the consequences and trade-offs that occurs system-wide

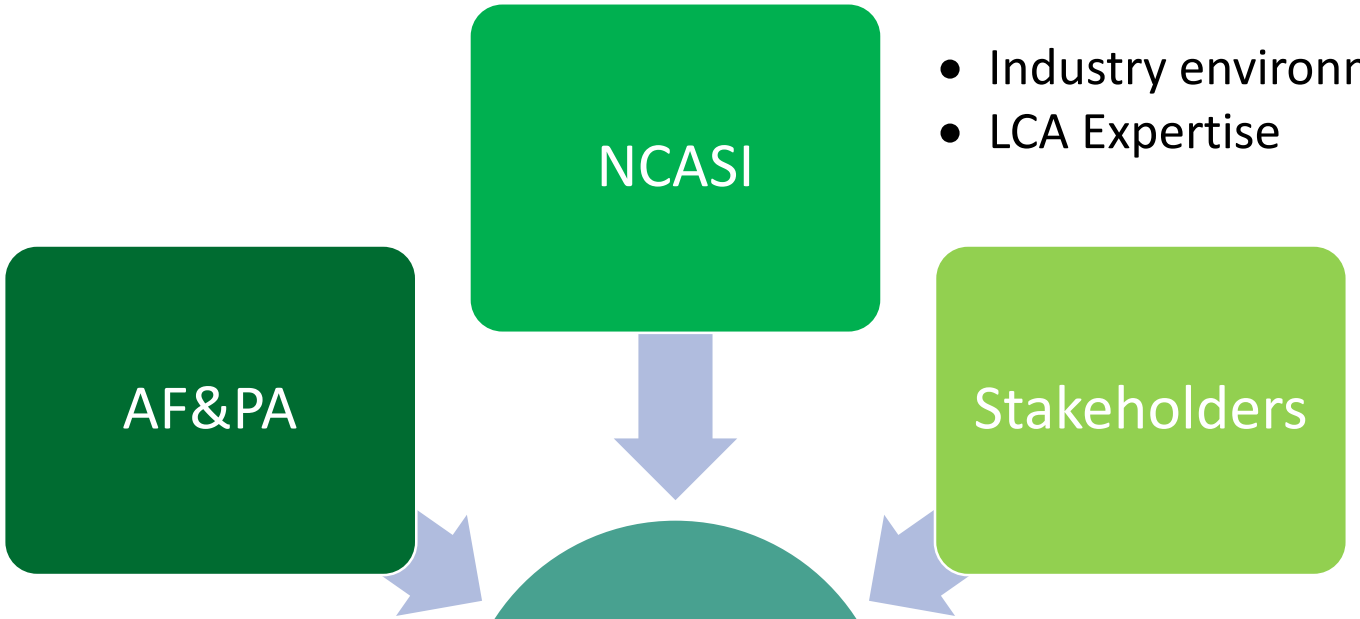
# A NEW APPROACH BY MIT RESEARCHERS

## Combining Life Cycle assessment with Systems Dynamics Thinking

### Why MIT?

- Experience in examining complex systems
- Pioneer in Systems Dynamics Thinking
- Materials expertise
- Modeled other industries

# MULTI-STAKEHOLDER PROCESS



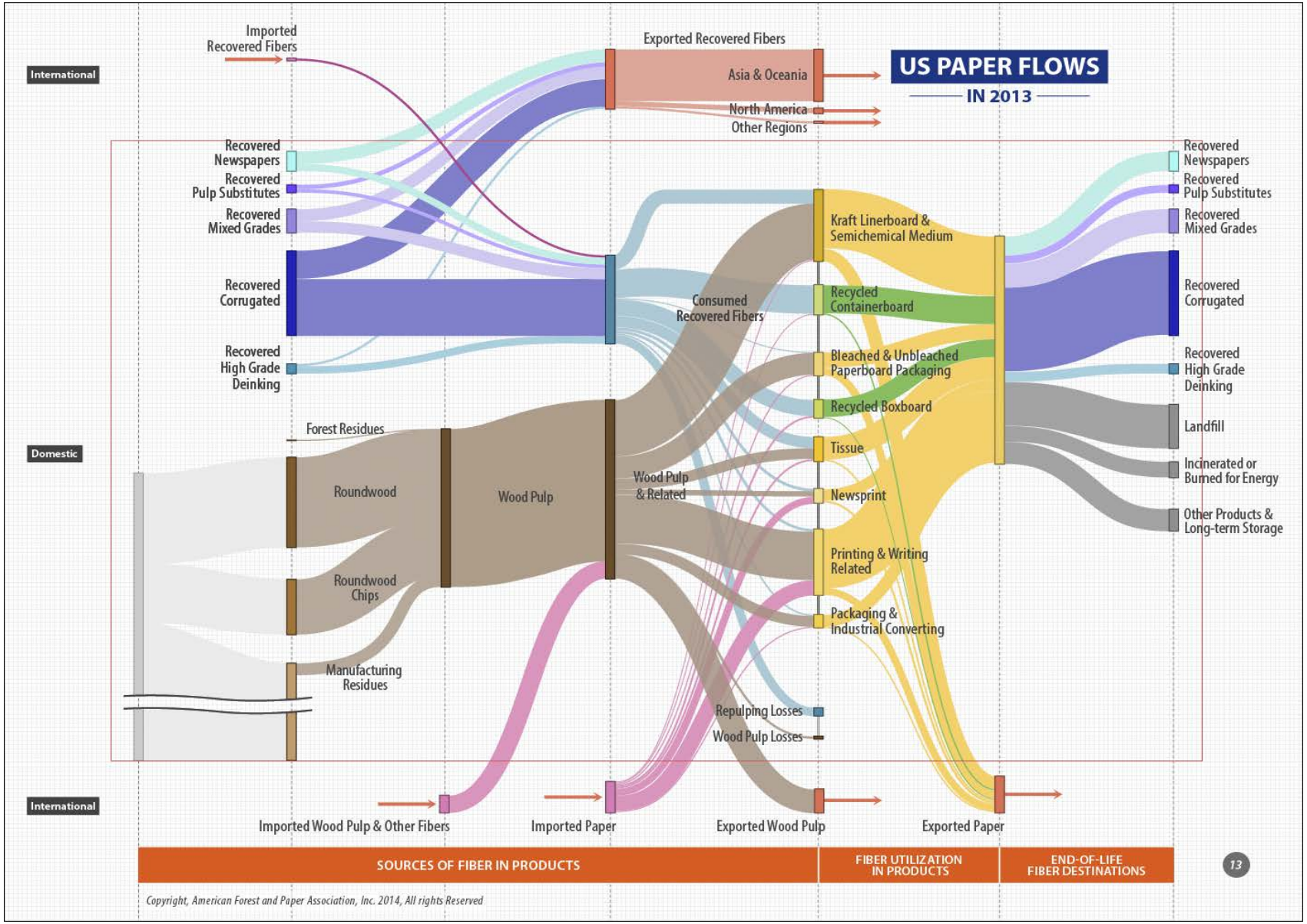

- Industry environmental data
- LCA Expertise

- Industry Statistics

- Quantitative Analysis
- Model Development

- Technical Advisory Group
- Workshop Participants (Entire value chain)
- Interested parties (EPA, ENGOs)
- Subject Matter Experts
- Peer review panel

# Phase 1: Mapping the complex fiber flow system

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# SIMULATION MODEL DESIGN

2. A scenario is introduced ( example- what are the effects of increasing the average recycled content of P-W paper by 15%?

**Baseline Background Data**
(multiple stakeholders and data sources)

- Fiber Balance
- Fiber characteristics
- LCA studies
- Recovery Rates and Collection Channels
- Exports
- Industry Data
- Tech. Advisory Group
- Subject Matter Expert Interviews

1. 2017 data established as baseline based on multiple data inputs

Case Study Scenario

Simulation Model

- Printing-Writing
- Newsprint
- Paperboard
- Containerboard
- Tissue

Revised Fiber Distribution

Impact on paper manufacturing, End-of Life

GHG Impact on Forest, Agricultural

3. The model redistributes fiber flows based on the scenario, then calculates life cycle effects , from forest to end-of-life

**Case Study Results**
(Relative to Baseline)

- Virgin and recycled fiber distribution change (per Sector)
- Energy Use change*
- Biogenic GHG change*
- Fossil GHG change*

* *Industry wide*

4. Case study summarizes and interprets the quantitative results compared to baseline levels

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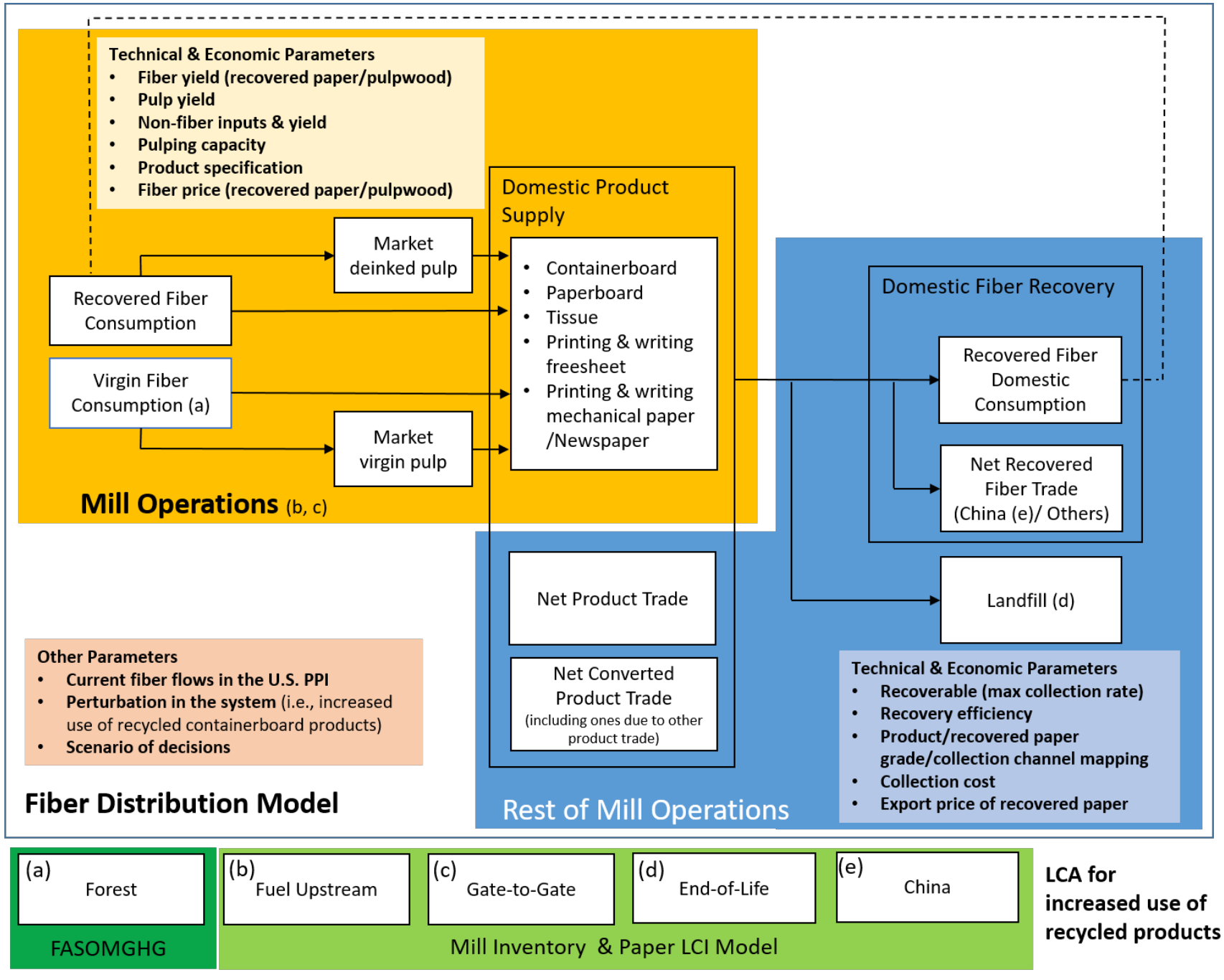
# Dynamic Fiber Flows Model Scope

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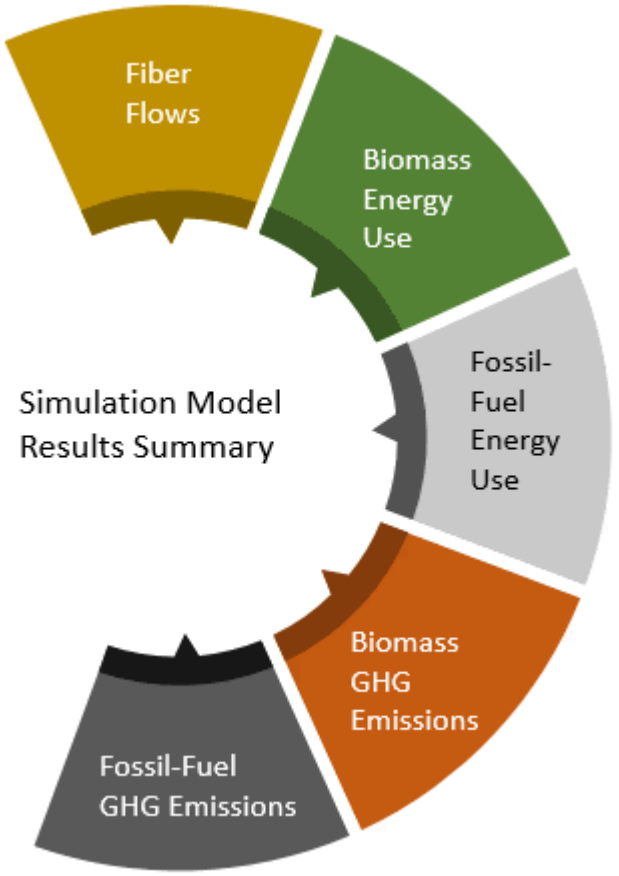
# CASE STUDIES: PRESENTING THE DYNAMIC FIBER FLOWS MODEL RESULTS

**Simulation model complexity and the need to interpret quantitative output makes case studies the best way to convey the  Dynamic Fiber Flows Model results**

**Case Study Framework**

- Establish the scenario
- Summary Results
- Detailed results for fiber flows, energy use and GHG emissions
- Summarize the major take-away messages
- Indicate constraints or other information that might be considered relevant to the scenario
- Data tables



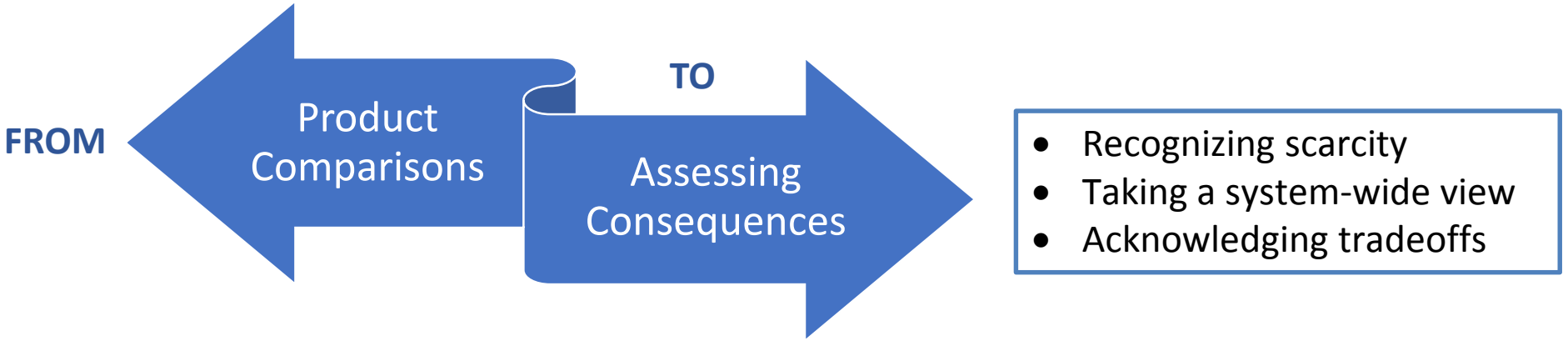

DYNAMIC FIBER FLOWS MODEL

# WHY THIS MODEL IS UNIQUE

- Focus is on broad consequences on an industry-wide scale based on changes in recovered paper utilization and paper recovery, not product comparisons
- Takes a system-wide, global view across the entire paper value chain for major paper product categories
- Considers technical and economic factors, including raw material costs, fiber availability, quality, fiber yield, and processing capability.
- Identifies GHG consequences across complete product life cycle stages, from forest to end-of-life.

# HOW WILL THIS MODEL BENEFIT STAKEHOLDERS?

- Case studies may be useful to better inform policymakers and corporate decision makers regarding system-wide environmental effects within their supply chains.
- Creates a new, groundbreaking approach to respond to an age-old debate




- Credibility: Published, peer reviewed MIT research, supported by the American Forest & Paper Association, the National Council for Air and Stream Improvement, the National Science Foundation, Research Triangle Institute International

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These case studies examine current and emerging real-world issues within our industry. The Dynamic Fiber Flows Model may be used to explore new questions and are designed to be updated to include future industry data and system dynamics assumptions. Please direct inquiries to info@afandpa.org