Impact of Uncertainty in Activity Data and Emissions Factors on Firm Scope 3 Greenhouse Gas Emissions Estimates

Jeremy Gregory[1], Pauline Jeong[2], Elsa Olivetti[1], Randolph Kirchain[1], and Edgar Blanco[1]

[1]Engineering Systems Division, Massachusetts Institute of Technology

[2]Ocean Spray Cranberries, Inc.

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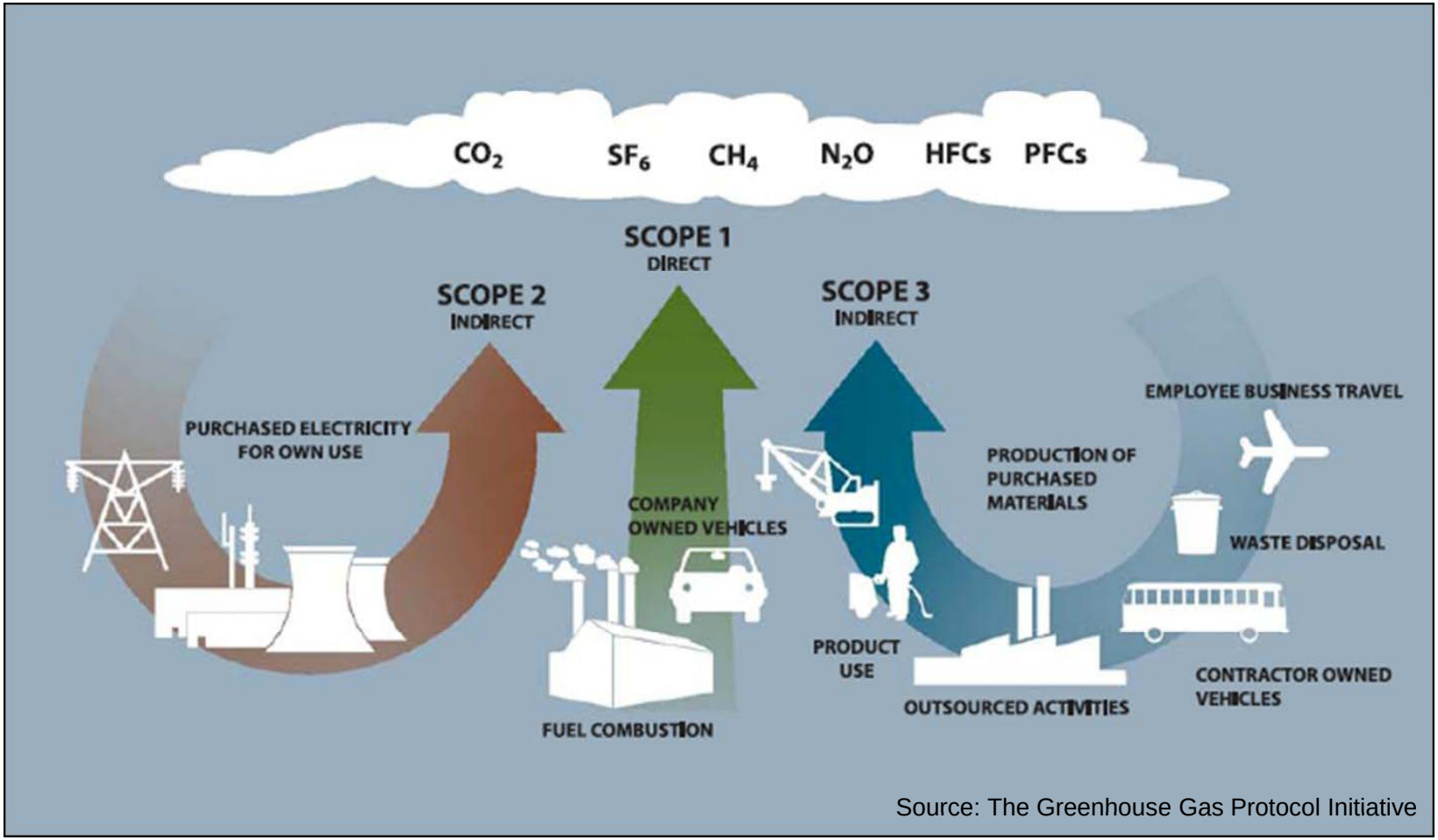
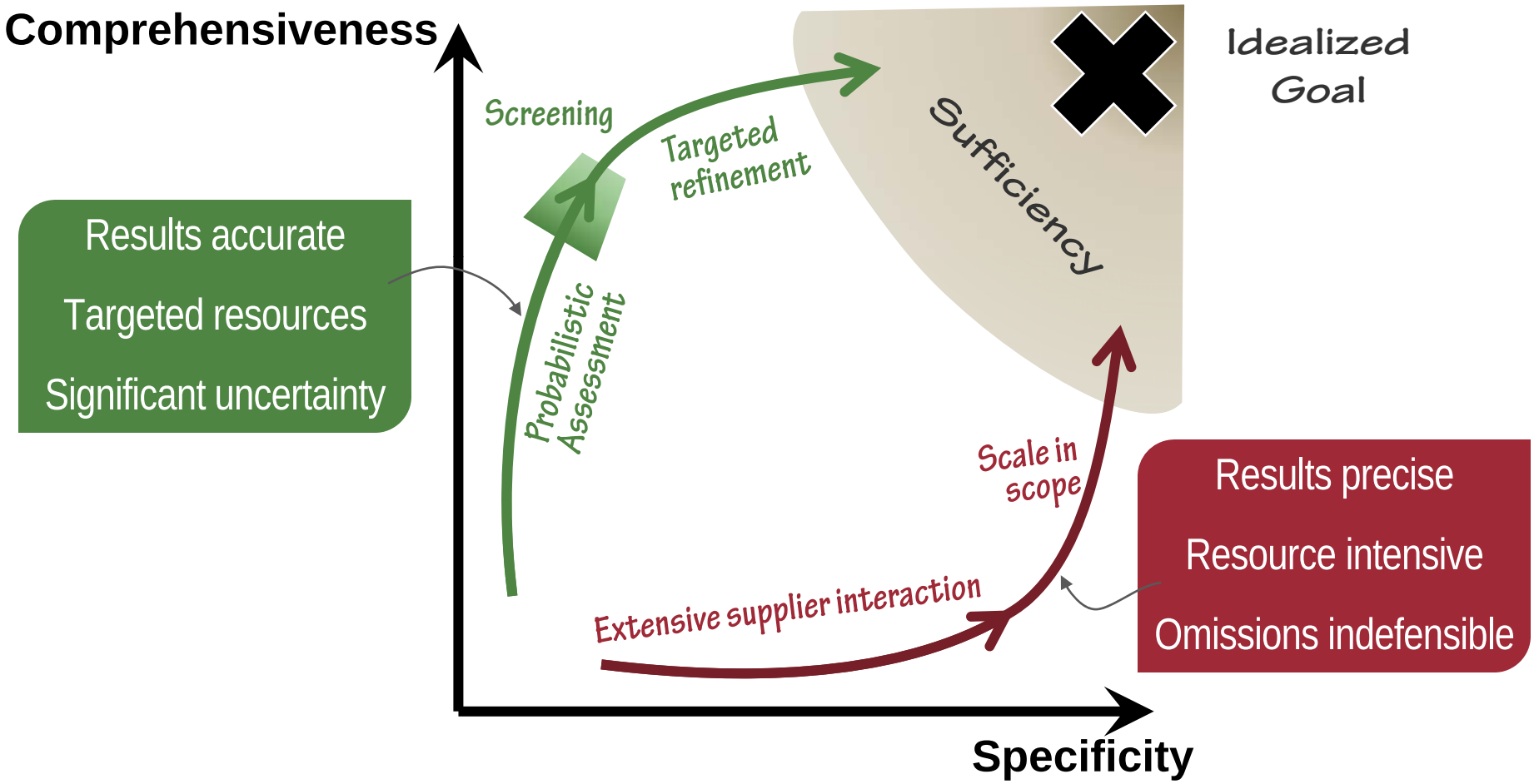
The challenge of quantifying firm greenhouse gas emissions



Source: The Greenhouse Gas Protocol Initiative

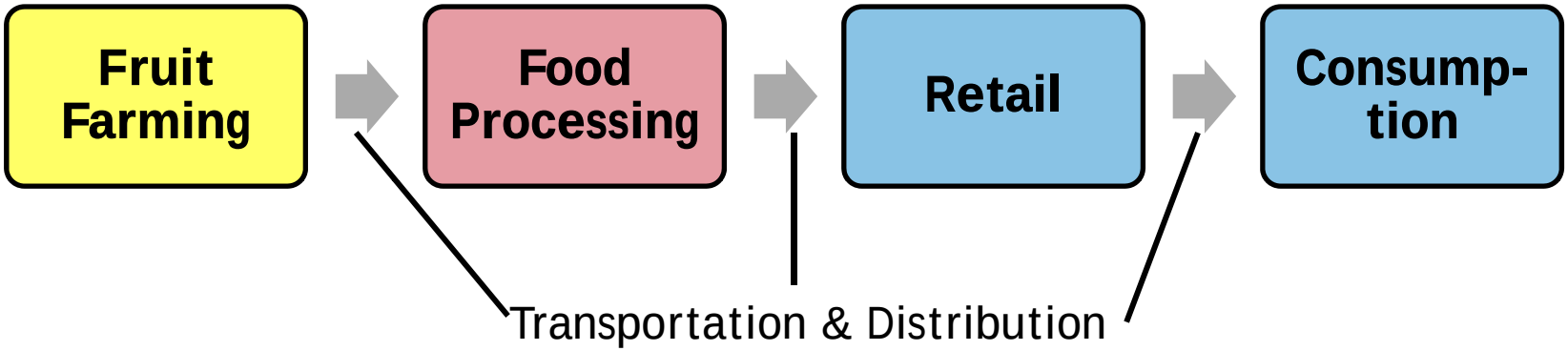
A complete scope 3 analysis is a balancing act within resource constraints



Firm greenhouse gas accounting in action: Ocean Spray Cranberries

- **Products: beverages, dried cranberries, fresh fruit, oatmeal, trail mix, and more**
- **$2B annual revenues worldwide**
- **2,000 employees**

Simplified OSC value chain



Quantities of interest for scope 1 processes

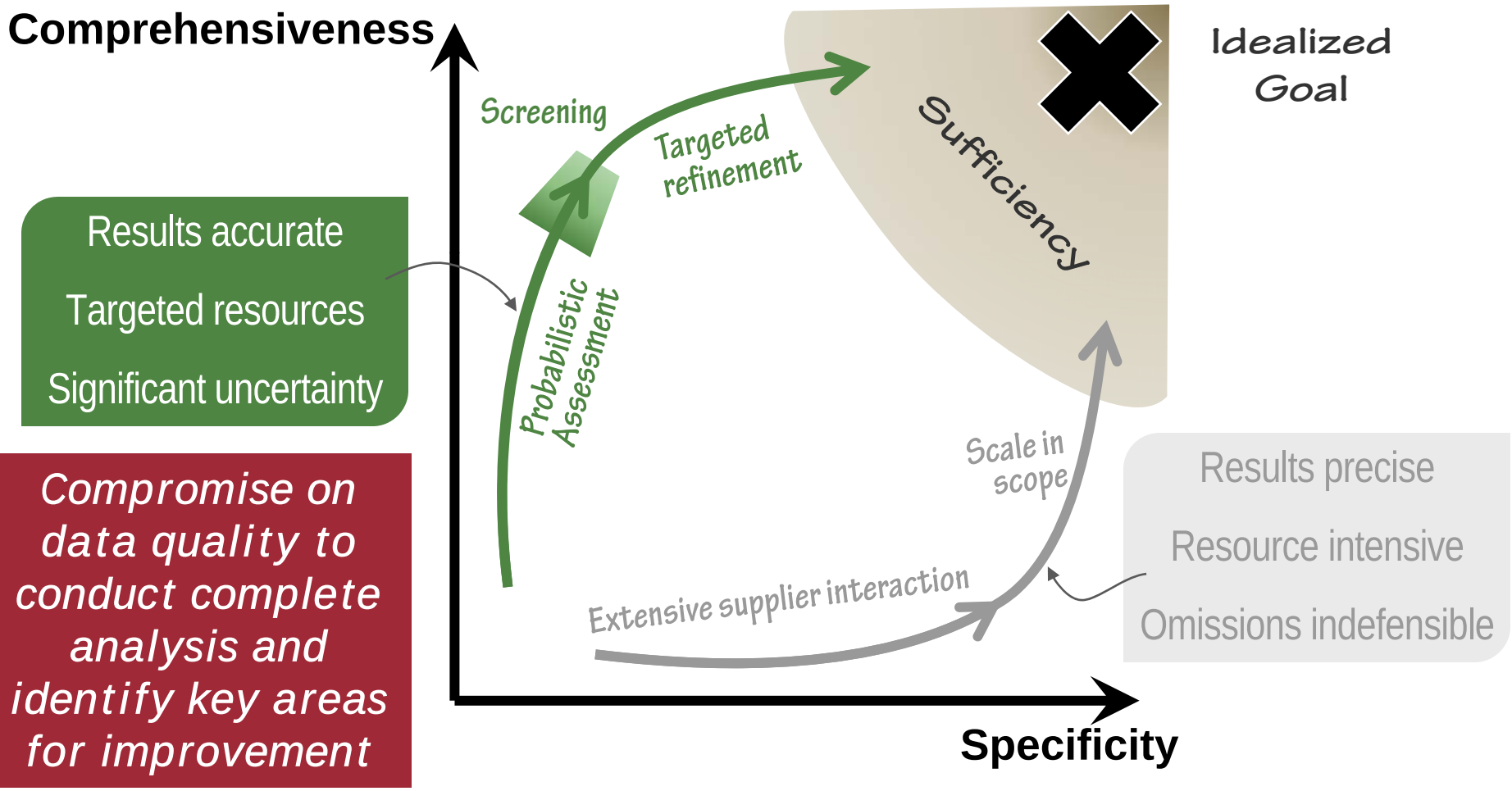
- -Materials & Ingredients
- -Services
- -Energy
- -Capital Equipment
- -GHG Emissions

Data quantity is much greater than product LCAs

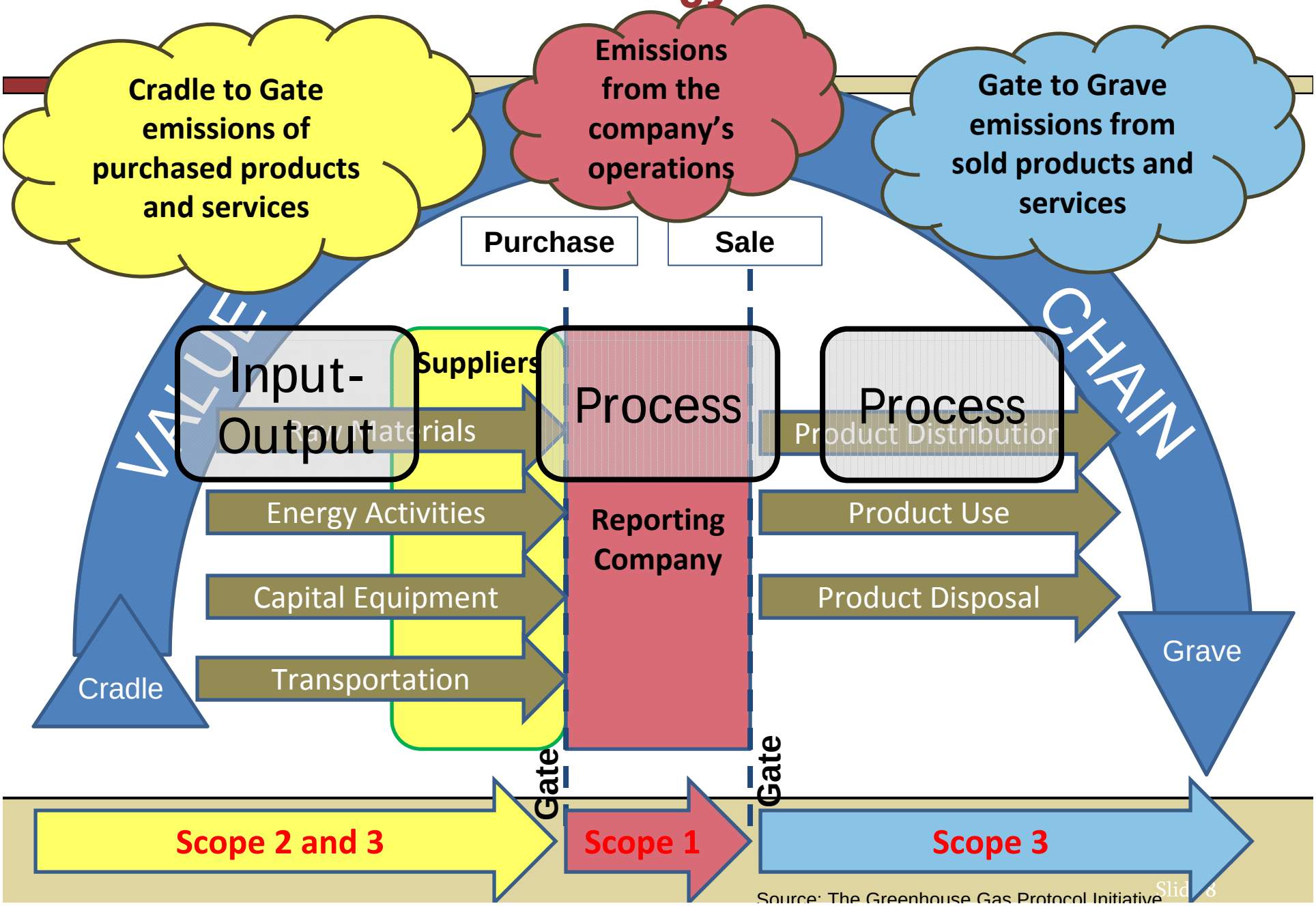
Data Category	Raw Transactions	Condensed Categories
Materials & Ingredients	43,000	1,250
Other Suppliers	368,000	380
Products Sold	206,000	1,200

Compromises on data quality are necessary

Ocean Spray objective: Estimate complete firm GHG footprint

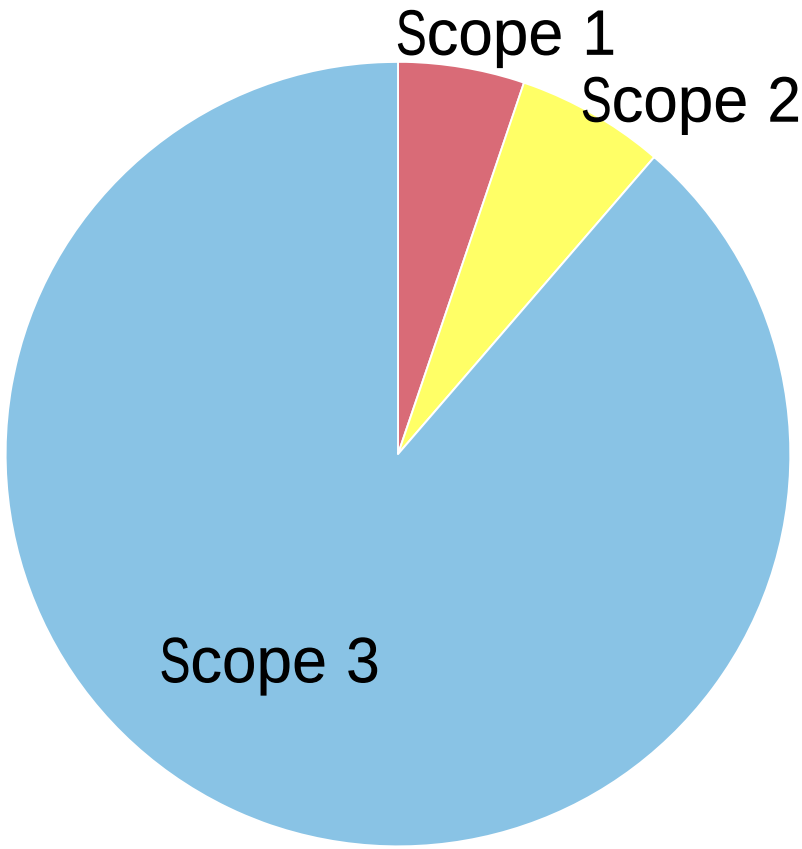


Calculation methodology

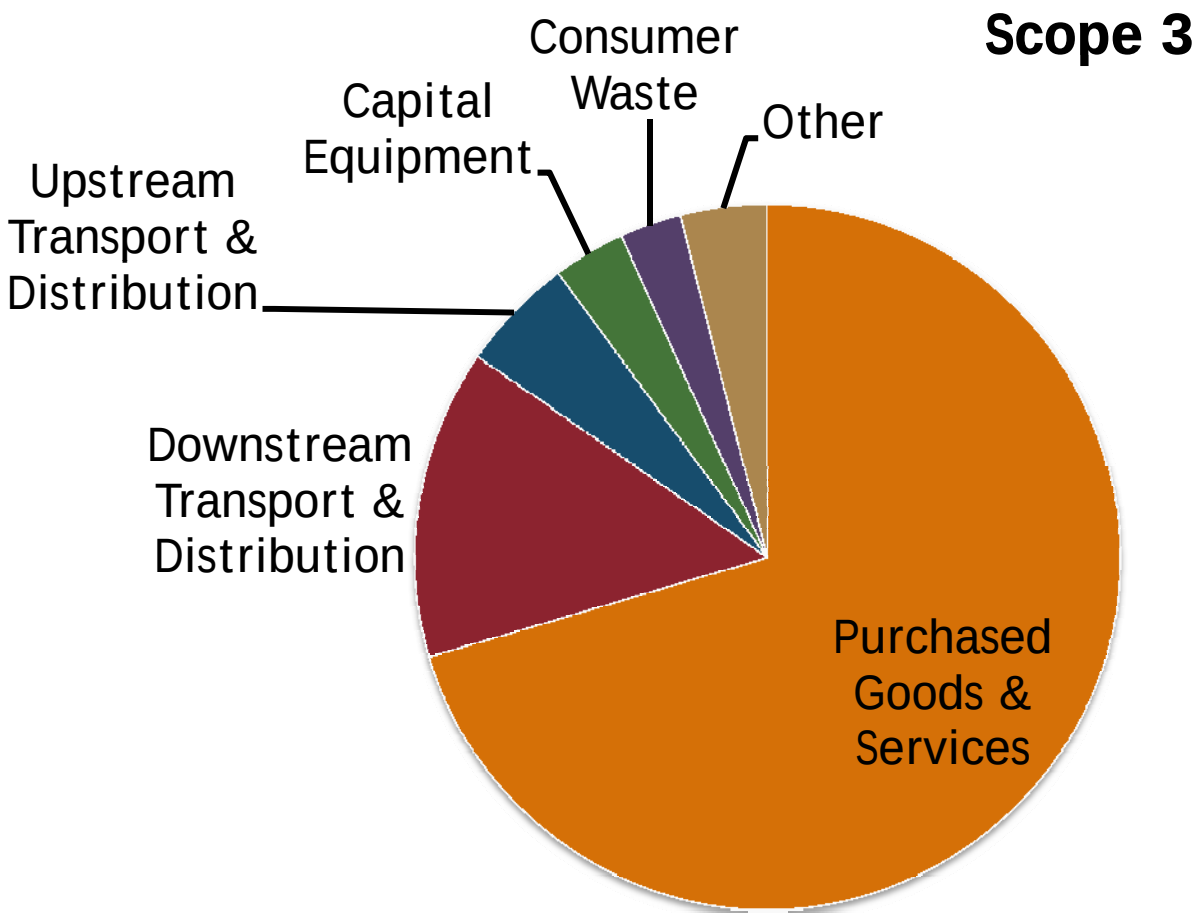


Source: The Greenhouse Gas Protocol Initiative

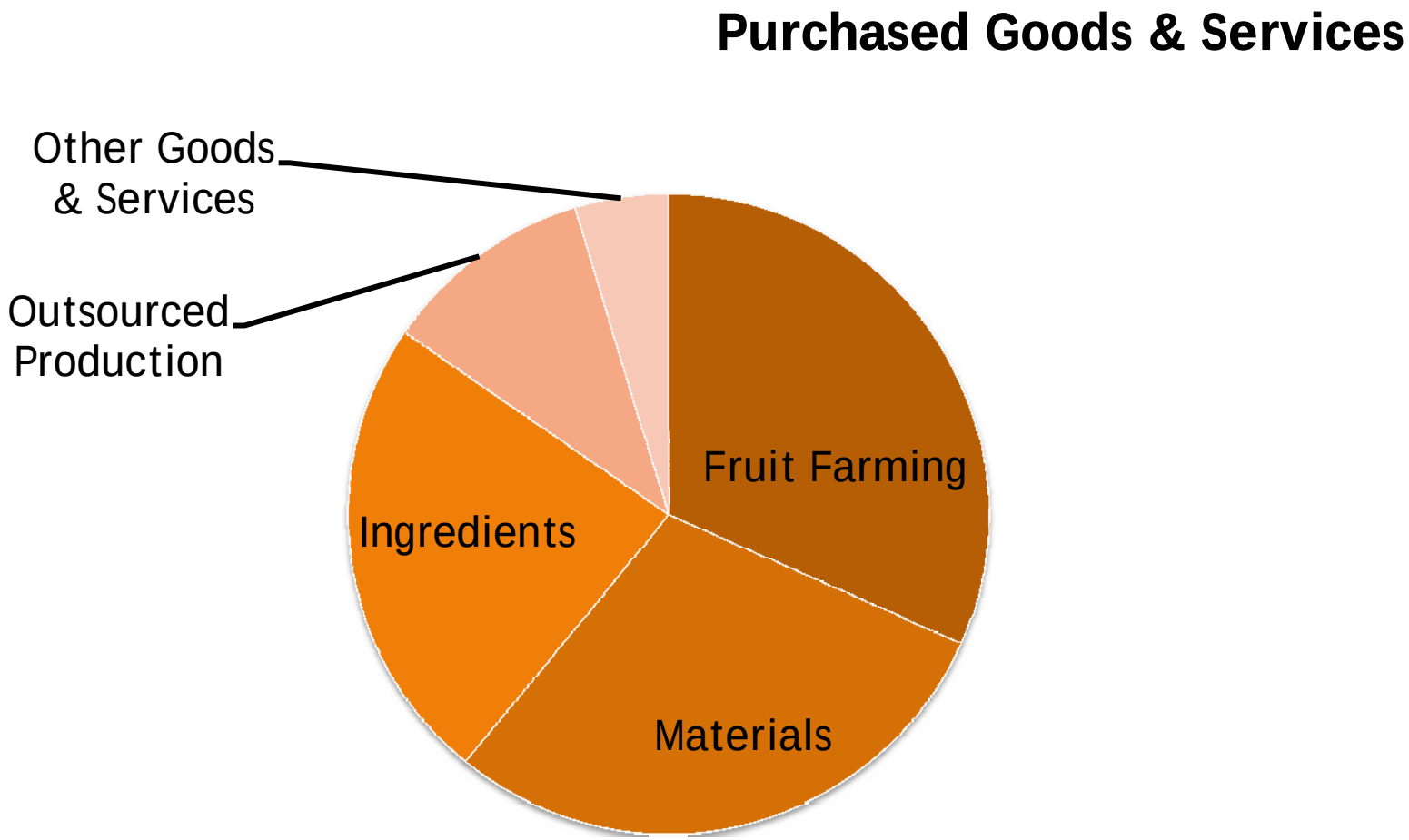
Ocean Spray GHG footprint dominated by scope 3



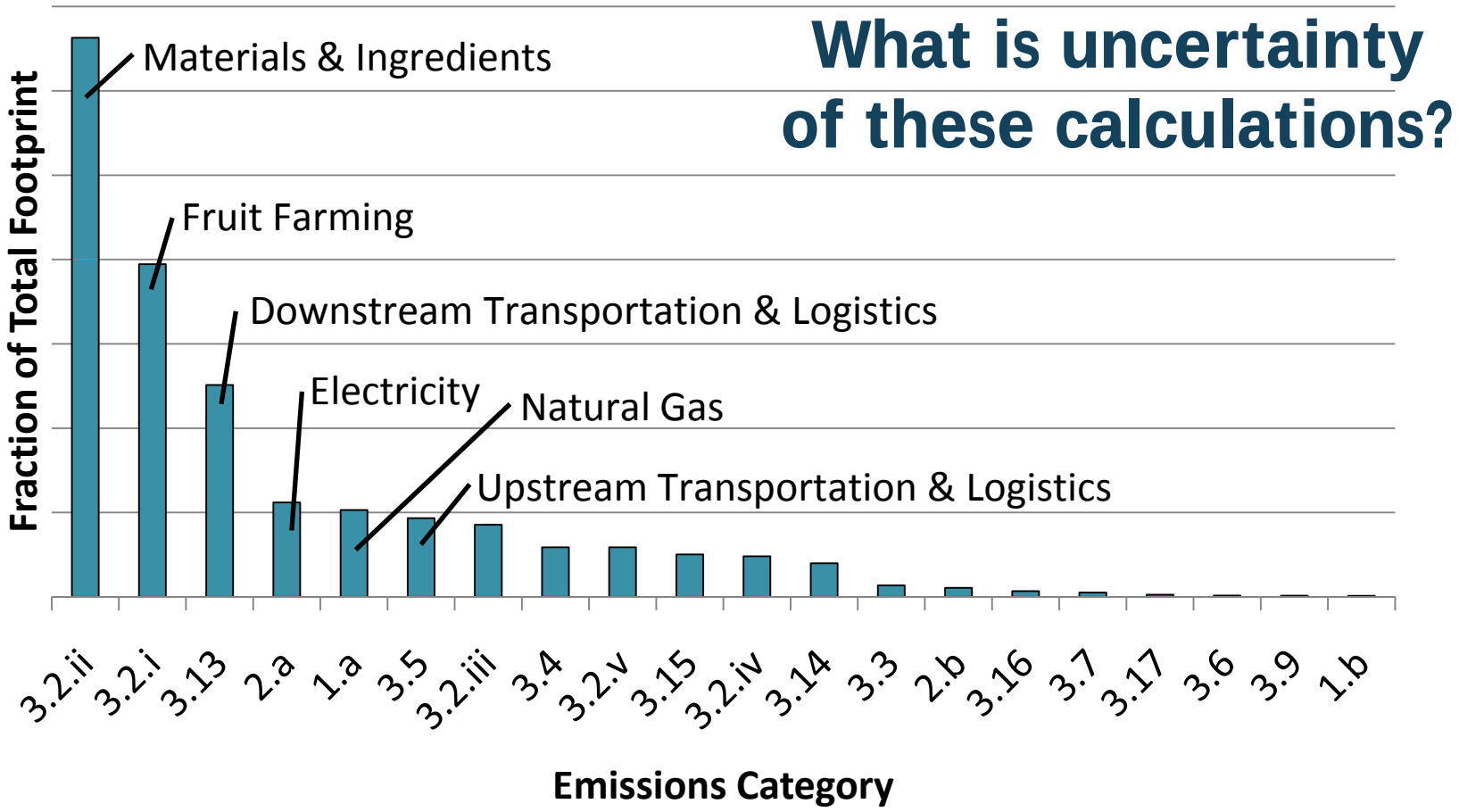
Scope 3 dominated by purchased goods & services



Purchased goods & services dominated by raw materials, ingredients, and fruit



A few categories dominate total footprint



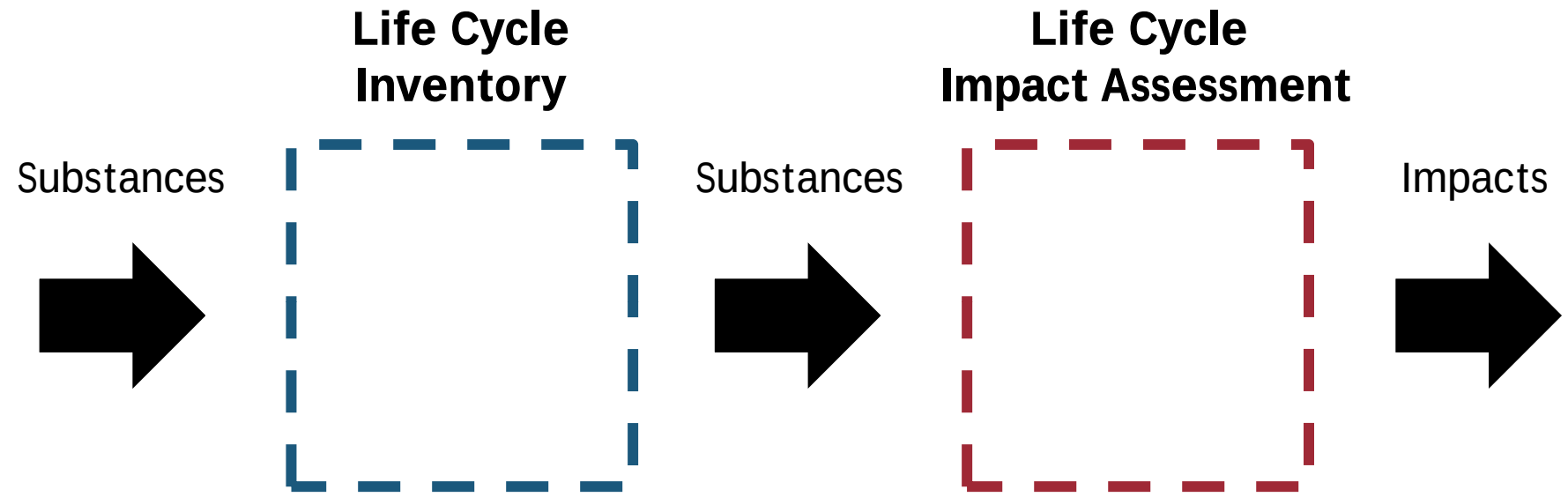
Why characterize uncertainty?

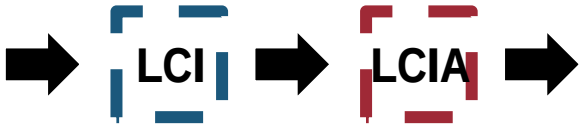
1. **Identify important areas requiring improvement in footprint** *with confidence*

2. **Improve fidelity of overall footprint**

Uncertainty must be characterized within resource constraints

Uncertainty Framework for LCA





Sources of Uncertainty in Life Cycle Inventories

Parameter (input data)

Scenario (normative choices)

Model (mathematical relationships)

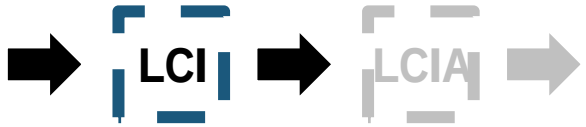
Variation & Stochastic Error
Geographic, temporal, & process variation; measurement uncertainties

Appropriateness of Amounts
Appropriateness of input/output amounts from data sources

Appropriateness of Intermediate Flows
Appropriateness of other LCIs to represent intermediate flows
Preferable choices available

Incomplete or Missing Data
Exclusion of input or output processes or substances

Human Errors
Mistakes in data entry



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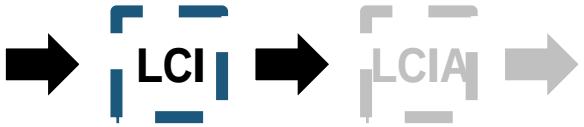
Basic Uncertainty

Additional Uncertainty

Aggregation Uncertainty

Cutoff Error



Sources of Uncertainty in Life Cycle Inventories

Parameter (input data)

Scenario (normative choices)

Model (mathematical relationships)

Framing
- Functional Unit
- System boundary
- Allocation method
- Secondary data sources

Product/process
- Performance
- Location

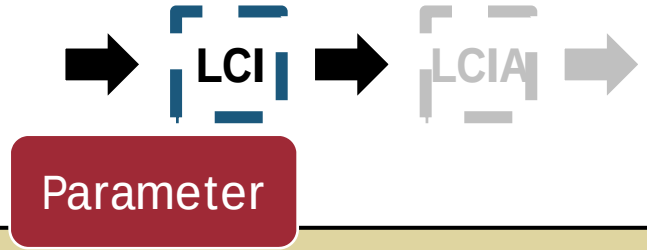
Appropriateness of Intermediate Flows

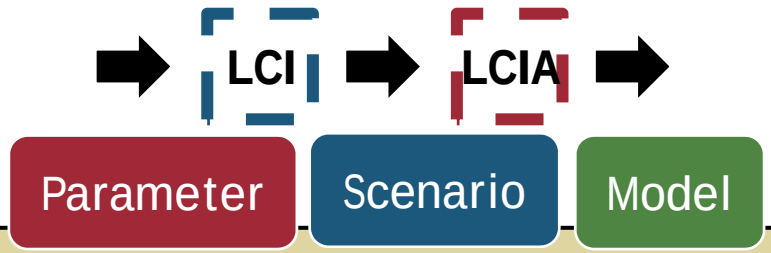
Appropriateness of other LCIs to represent intermediate flows

Meaningful choices are equivalent

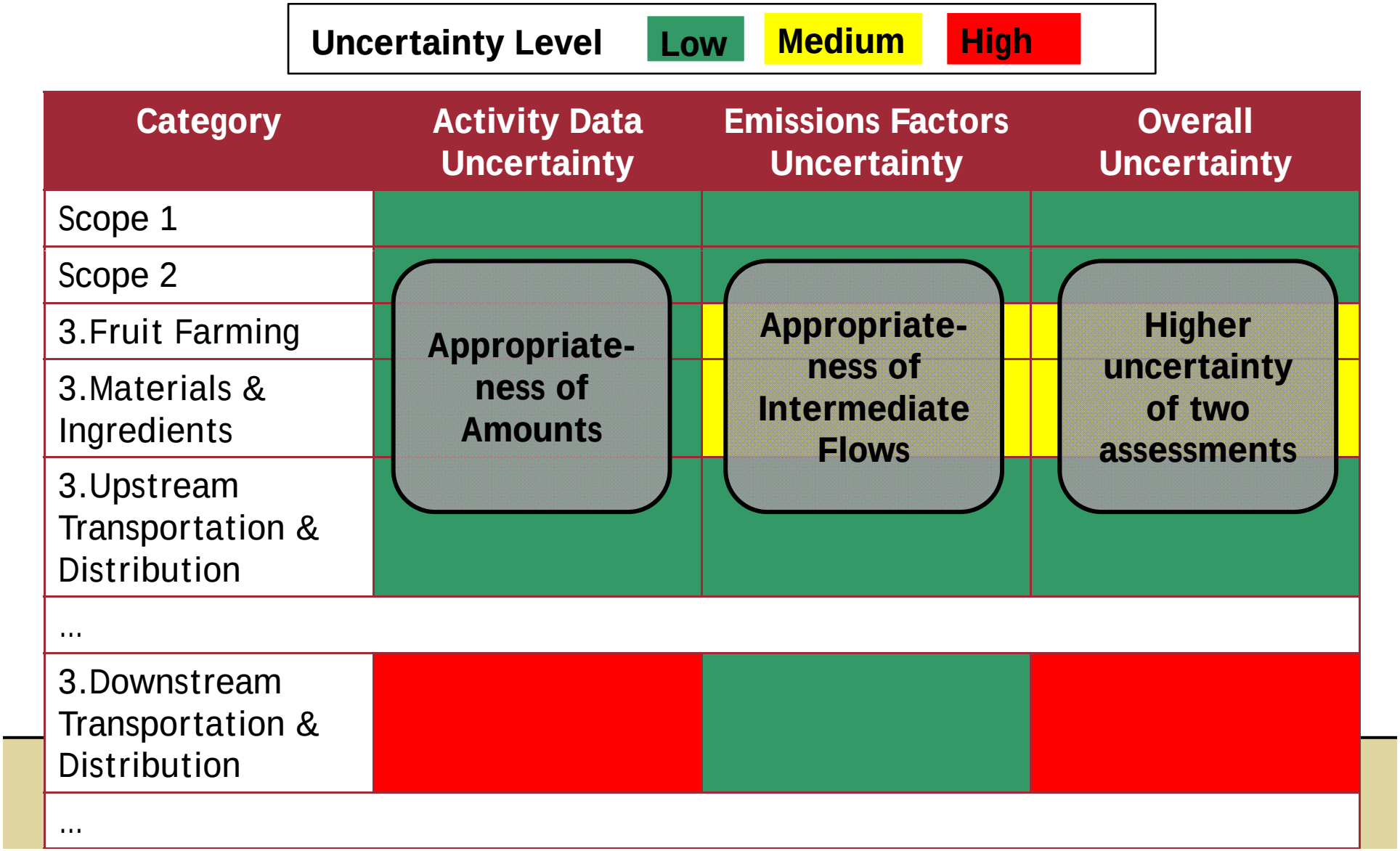
The scale of scope 3 analyses necessitates simple data requirements

	Activity Data	Emissions Factors
Process	•Material or process quantity •e.g., kg, kWh, km	•Environmental impact per material or process quantity •e.g., kg CO2/kWh
Input-Output	•Economic quantity •e.g., $	•Environmental impact per economic quantity •e.g., kg CO2/$

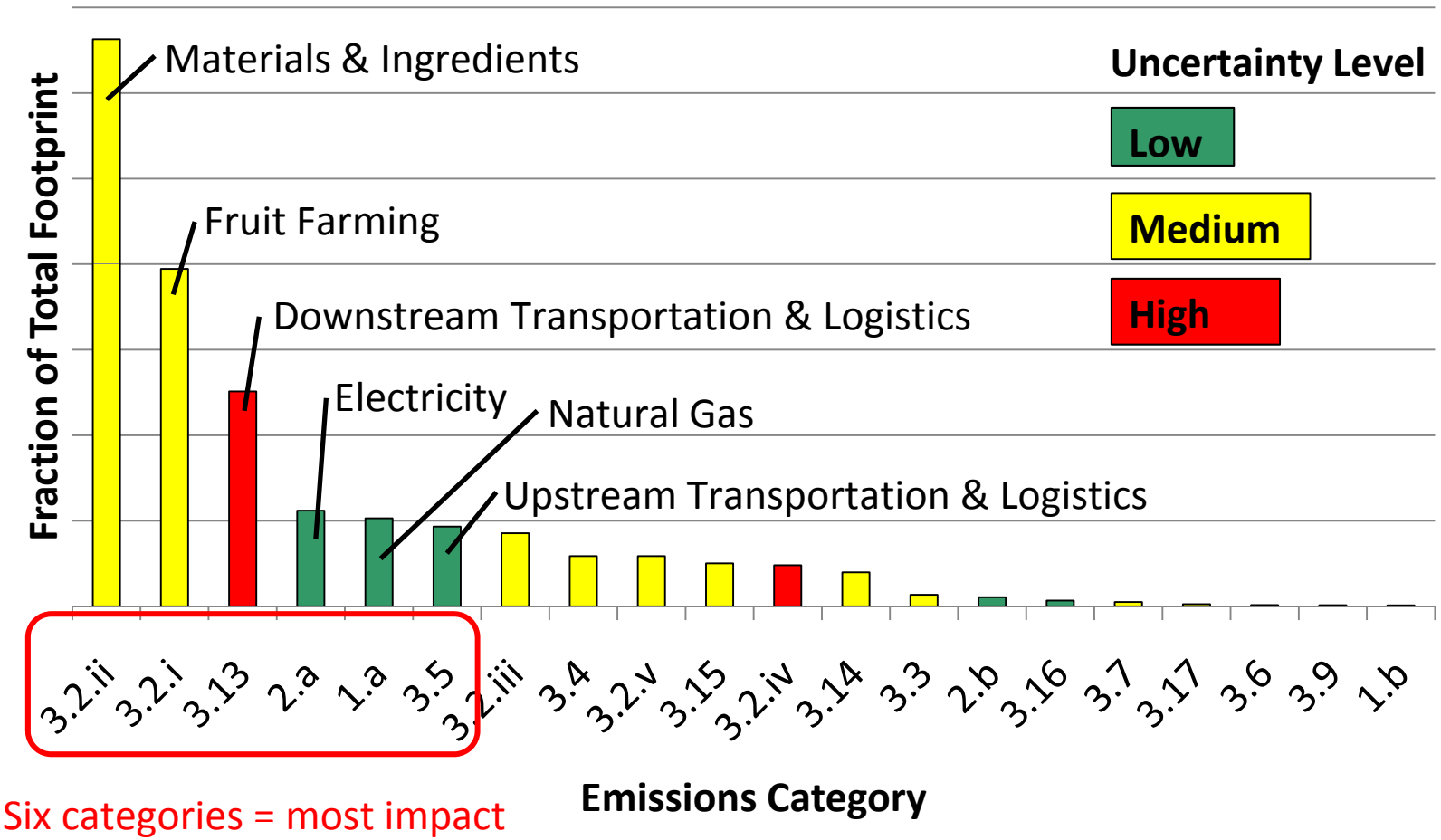




Qualitative uncertainty characterization is efficient as an initial step



Uncertainty characterization facilitates identification of areas for data improvements



Six categories = most impact

Uncertainty characterizations in key categories

	Activity Data (Appropriateness of amounts)	Emissions Factors (Appropriateness of intermediate flows)
Materials & Ingredients	Low – total activity over entire year for company	Medium – aggregation error in IO data
Fruit Farming	Medium – based on average market value of cranberries for one year	Medium – aggregation error in IO data
Downstream Transportation & Logistics	High – all data are estimates	Low – process data on transportation

Reducing uncertainty in key categories

	Activity Data (Appropriateness of amounts)	Emissions Factors (Appropriateness of intermediate flows)
Materials & Ingredients	N/A	Collect more specific process data
Fruit Farming	Determine value/ amounts of all transactions	Collect more specific process data
Downstream Transportation & Logistics	Determine specific downstream activities	N/A

Reducing uncertainty requires further resources

Other uncertainty sources worthy of further investigation

- **Parameter (LCI)**
  - **Quantification of appropriateness of amounts and intermediate flows**
  - **Variation in IO data**
  - **Deflation parameters for IO activity data**

- **Scenario (LCI & LCIA)**
  - **Selection of database**

Recommendations for scope 3 analyses

- **Balance completeness and accuracy**
- **Begin with minimal data quality to conduct complete analysis**
- **Use results *with uncertainty characterization* to identify key areas for improving data quality**