

# Making the US LCI Database More User Friendly: The Cradle-to-Resin Database for Plastics

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# US LCI Database

- Working “library” of life cycle unit process data
- Developed with government and industry funding
- Available to the public

# US LCI Database

- Contains unit process data relevant to:
  - Agricultural products
  - Building and construction products
  - Electricity generation
  - Fuels and energy precombustion
  - Materials used in durable products
  - Primary fuel combustion
  - Primary fuel production
  - Transformation (fabrication) processes
  - Transportation

# Important Attributes of US LCI Database

- Clear methodology based on ISO 14040 standards
- Unit process modules for transparency and flexibility in customizing data sets
- Consistency with EcoSpold format; facilitates import into LCA software such as SimaPro

# Challenges

- Inherent conflict between transparency and user-friendliness
- Disaggregated unit process approach maximizes transparency and flexibility

BUT

- LCA expertise required to link modules to construct life cycle models
- Not user-friendly for inexperienced modeler

# Benefits of Unit Process Approach

Unit process approach allows user to

- Understand and validate the data used to develop each module
- Customize or adapt individual data sets (e.g., change process energy or transportation to reflect their own process or supply chain)

# Drawbacks of Unit Process Approach

- US LCI database does NOT link all the unit processes together
- Example: Electricity

## Example: Electricity

- Database contains fuel mix for the national average electricity grid, together with 3 regional grids
- Database also includes all unit process data needed to model electricity generation, e.g., coal production, coal precombustion, coal utility combustion, natural gas production, natural gas precombustion, natural gas utility combustion, etc.

## Example: Electricity

- For a process that uses electricity, a user cannot simply select “national average electricity grid”, but must construct the electricity model from the grid information and associated unit processes provided in the database.
- NREL report by Deru and Torcellini contains linked data for electricity

# Solution

- Put both individual unit processes and “rolled-up” data sets in US LCI database
- Skilled users can adjust and combine unit processes as desired to represent product systems customized for specific applications
- Any user can select “generic” rolled-up data sets, minimizing effort and skills required to create a system model.

# American Plastics Council Project

- Collect unit process data on US resin production
- Provide data both in disaggregated unit process form and also “rolled up” cradle-to-resin
- Manufacturers of plastic products can easily carry out cradle-to-gate LCI by selecting cradle-to-resin data set and linking to fabrication energy requirements

# Materials Evaluated

- High-density polyethylene (HDPE)
- Low-density polyethylene (LDPE)
- Linear low-density polyethylene (LLDPE)
- Polypropylene (PP)
- Polyethylene terephthalate (PET)
- Polyvinyl chloride (PVC)
- Acrylonitrile butadiene styrene (ABS)

## Materials Evaluated (cont.)

- General purpose polystyrene (GPPS)
- High impact polystyrene (HIPS)
- Polyurethane precursors
  - Methylene diphenyl diisocyanate (MDI)/PMDI
  - Toluene diisocyanate (TDI)
  - Polyether polyols for flexible polyurethane foam
  - Polyether polyols for rigid polyurethane foam

# Multi-Step Process

- Design LCI survey form to collect primary data
- Submit to APC member companies
- Review surveys for each unit process provided by individual companies
- Follow up with data providers for clarifications, fill data gaps, etc.
- Develop unit process data set from each survey and submit to provider for review, modify as necessary

# Multi-Step Process

- Develop industry average data set for each unit process
- Minimum of 3 data sets required for each unit process in order to show as separate unit process data set and still protect confidential data
- Submit to contributing data providers for review, modify as necessary

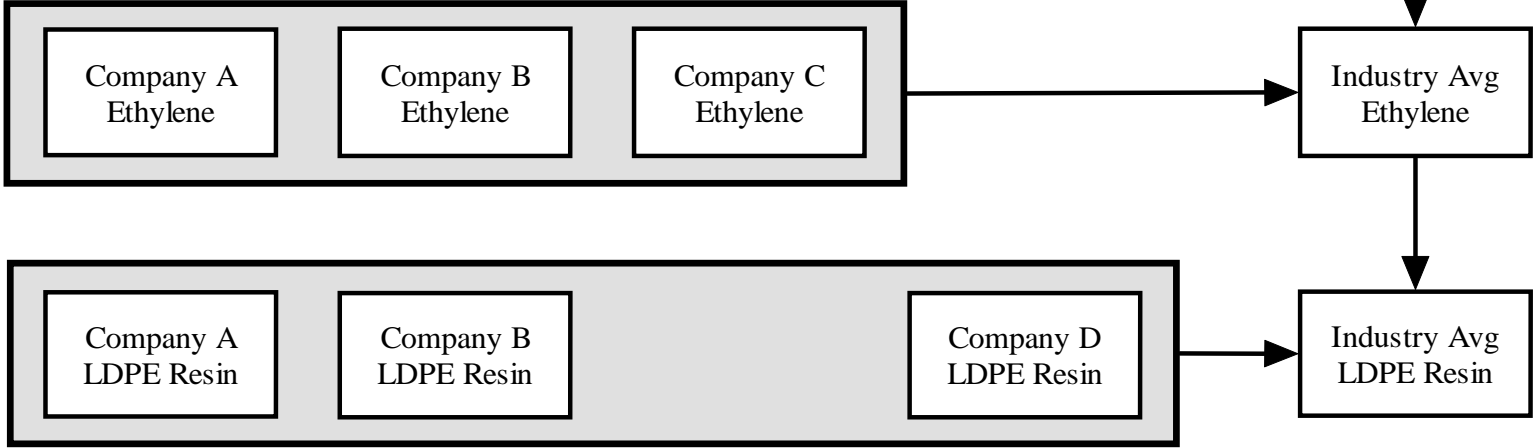
# Multi-Step Process

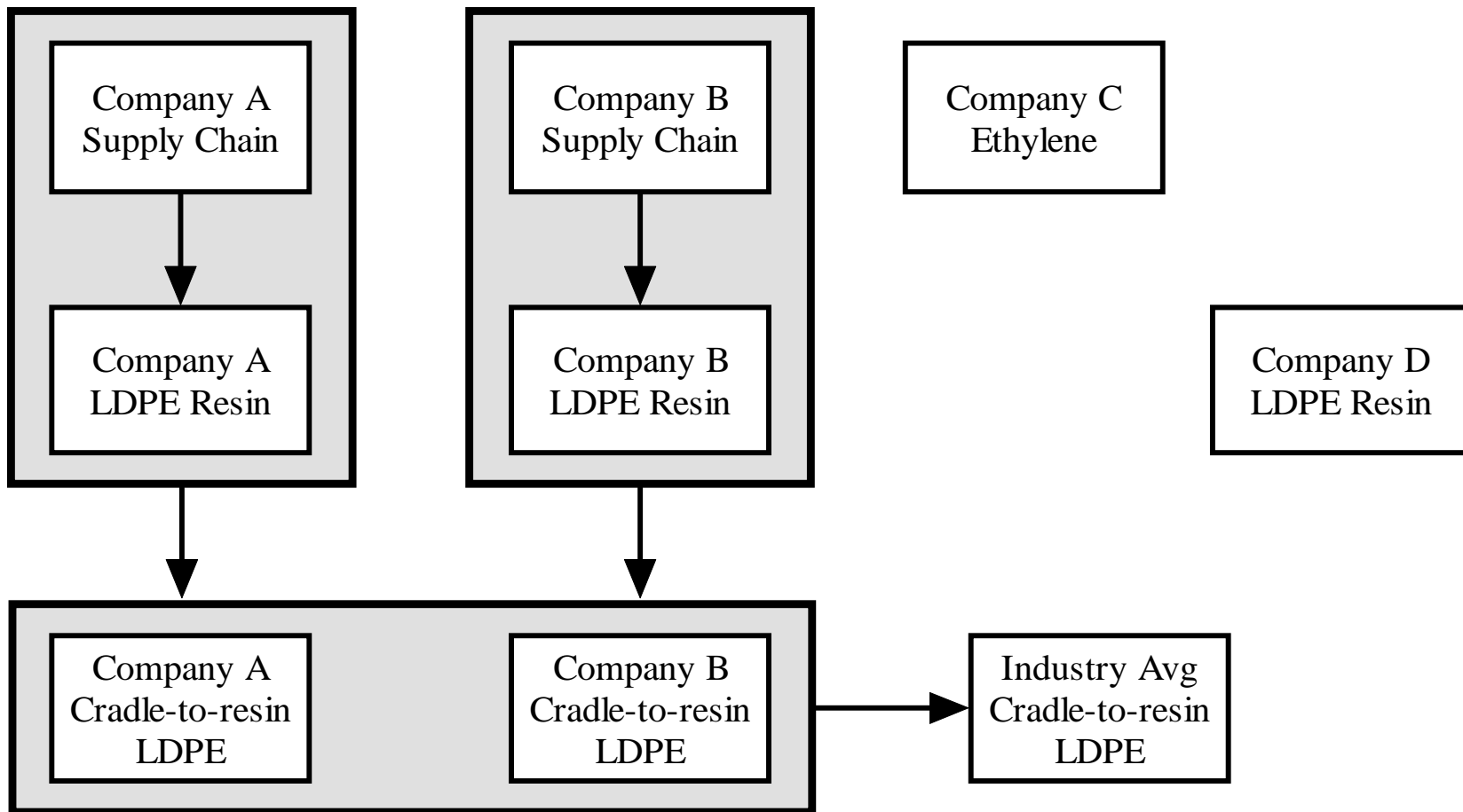
- Each unit process reviewed independently of linked model in order to avoid any bias
- Link industry average unit processes to construct cradle-to-resin model

# Challenges

- Accounting for complex flows of materials and energy into/out of other plant processes
- Limited producers for some intermediates, resins (aggregate sequential unit processes to protect confidentiality)
- Less than 100% participation by producers
- Implications for cradle-to-resin aggregation

Industry Avg Upstream Processes  
(Petroleum extraction & refining,  
Natural gas extraction & processing)





# Status

- Final stages of comparison with Plastics Europe (PE) data
  - Differences in aggregation (horizontal vs. vertical)
  - Independent practitioner (PE data developer) validated different results for horizontal and vertical averaging

# Other Efforts to Improve User-Friendliness of US LCI Database

- Electricity (Deru and Torcellini)
- Rolled-up data sets for other materials?
- Progress on other materials limited by lack of funding
- Availability of new rolled-up plastics data will encourage use of the database and spur interest in similar efforts for other materials