

# Environmental Analysis of Complex Assemblies

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# What are Complex Assemblies?

(Humans are excluded!)

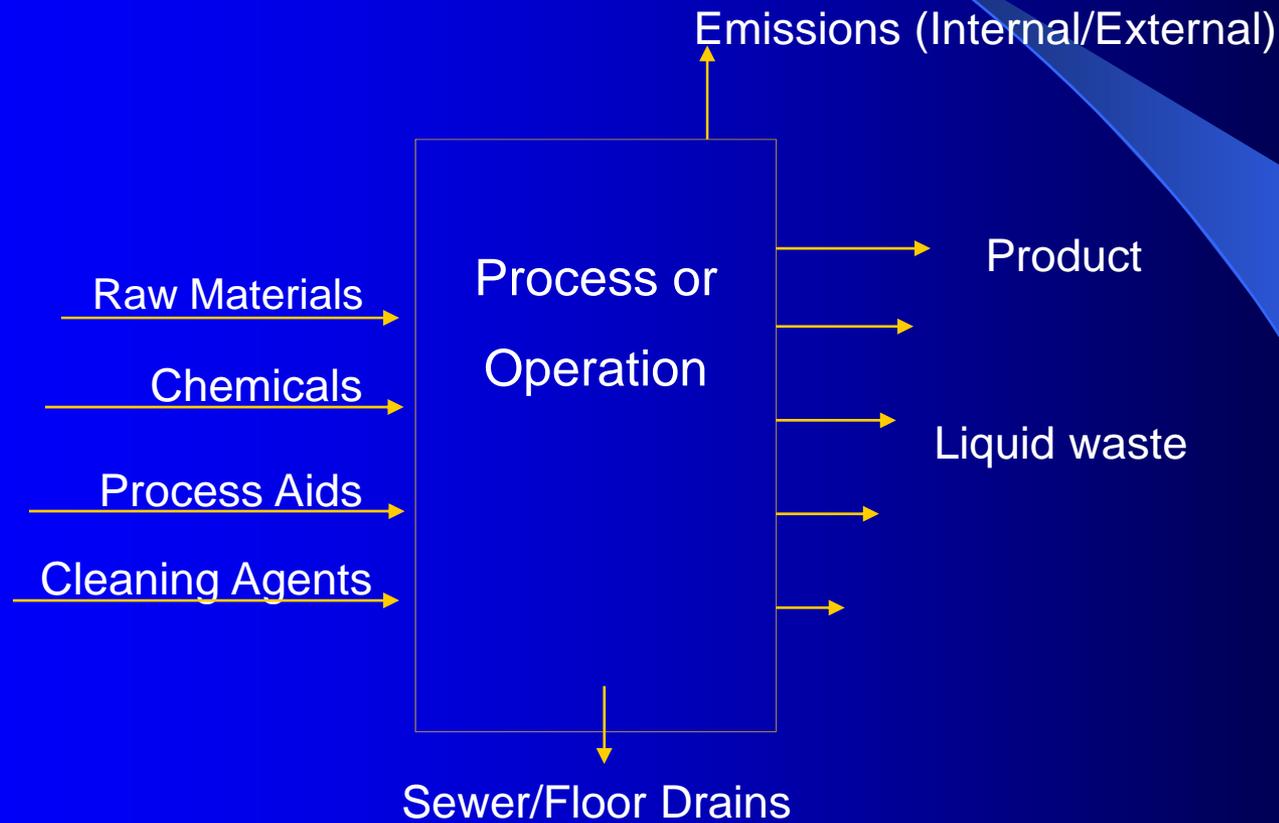
- Complex assemblies are made with various materials and energy inputs
  - Inorganic – metal, glass, silicon, etc.
  - Organic – hydrocarbon based
  - Biobased – derived from biomass
- Complex assemblies are not homogeneous

# What are environmental aspects?

An environmental aspect is:

- An element of a product that can interact with the environment
- Emissions to the atmosphere
- Water effluent to surface or groundwaters
- Solid and liquid wastes
- Natural resource use

# Identifying & Assessing E H & S Risks



# Environmental impacts

- Air quality
  - Global warming – CO<sub>2</sub> equivalents
  - Ozone depletion – CFC -11 eq
  - Smog formation – NO<sub>x</sub> eq
  - Criteria air pollutants (particulates, CO, NO<sub>x</sub>, SO<sub>x</sub>, Pb & O<sub>3</sub>) – NO<sub>x</sub> eq
  - Acidification – H<sup>+</sup> ions
  - Human health – toluene/benzene eq

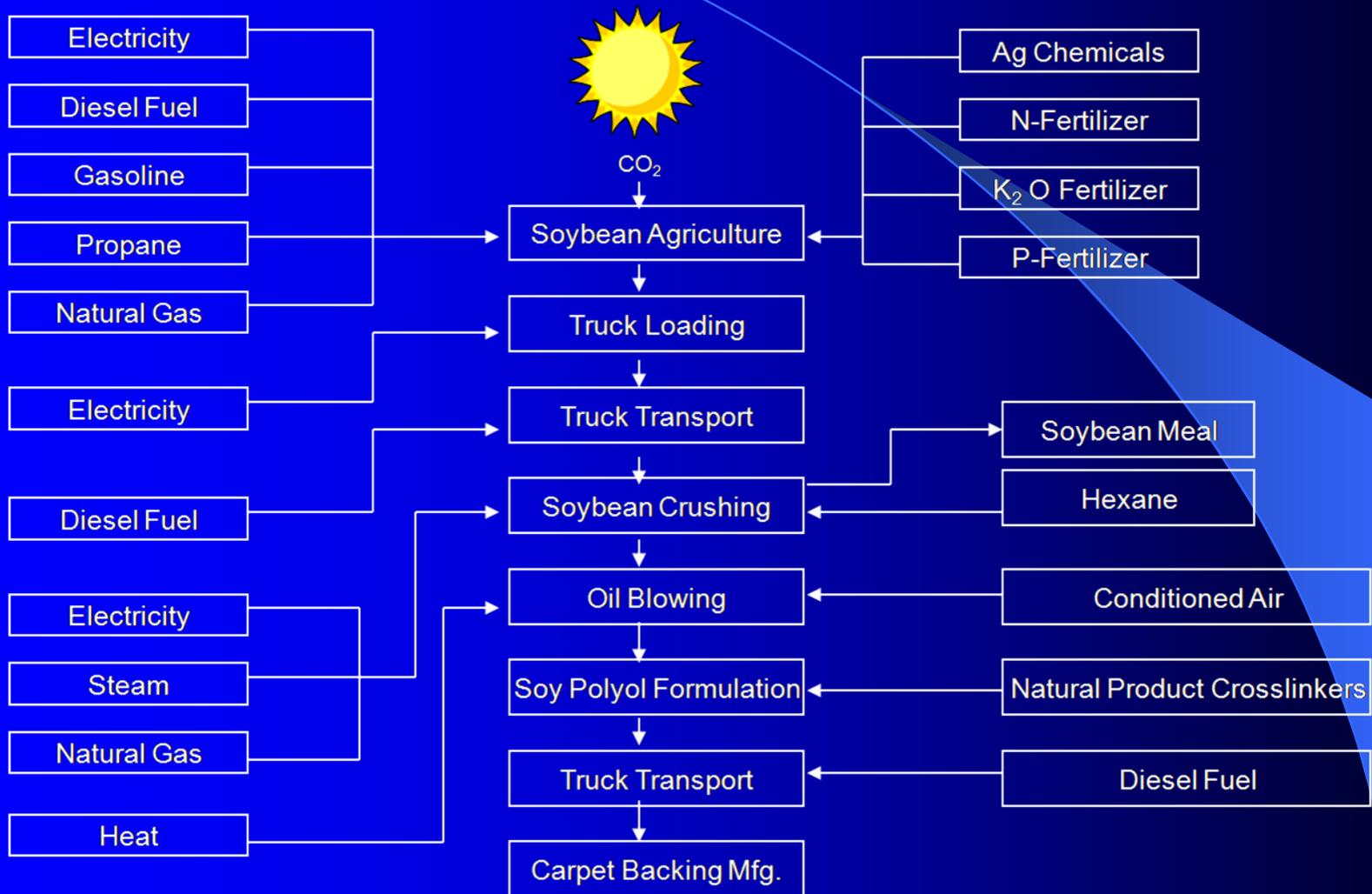
# Environmental impacts (con't)

- Water quality
  - Eutrophication – nutrients to surface water
    - N eq
  - Acidification
  - Ecotoxicity – 2,4-D eq

# Environmental impacts (con't)

- Natural resource use
  - Fossil fuel depletion – MJ surplus eq
  - Water intake – Liters
  - Total fuel energy – MJ eq

# LIFE CYCLE OF SOY POLYOL



# How does one analyze these aspects & impacts ?

- Individual or group review – subjective – how does one rank aspects & impacts by importance?
- Checklist – somewhat subjective
- Modeling tools – less subjective, peer reviewed
- Carbon analysis – estimate for CO<sub>2</sub> & fossil fuel replacement. No energy CO<sub>2</sub>

# Example

## Bookcase choices

- All metal
- All wood
- Composite boards
  - Particle board with biobased content and adhesive
  - Finished with biobased coating

# How would you evaluate choice?

- Biobased carbon content would show 100% new carbon for all wood item and perhaps lower new carbon for composite item
- This type of item can be modeled and compared to a non-biobased one
- A checklist could also be used

# Typical checklist questions (Y/N)

- Will item emit less VOCs?
- Has item been successfully used at other federal facilities?
- Is biobased content higher than competitively performing items?
- Are there any known or perceived safety benefits of the biobased item?
- Can the item be recycled?

# Can Modeling Be Used for Complex Assemblies?

YES!

LCA can be used for either modeling the variable portion of the complex assembly or the entire assembled item

Ex. Model foam cushion of a chair, not the metal frame since cushions could differ (biobased vs. petro feedstock) or model the entire chair

# Summary

- For analyzing environmental aspects of complex assemblies, either the biobased portion or entire assembly can be analyzed and compared to an assembly having no biobased component.
- Biobased carbon content can provide estimate for carbon footprint. It does not provide carbon impact for energy used to produce an item or its feedstocks

# Summary (con't)

- A checklist can be used as a “quick” assessment or screening tool for evaluating and comparing aspects/impacts of competing products
- LCA is the only comprehensive tool to quantify energy usage and environmental impacts throughout the production and use of any product

# Recommendations

- Pilot an analysis process for selected complex assemblies (w & w/o a biobased component) using three suggested analytical tools
  - Biobased carbon content
  - Checklist
  - LCA model

# Recommendations (con't)

- Examine findings to determine:
  - Ease of use
  - Value of information
  - Cost to implement
- Impact importance
  - Let procurement person choose