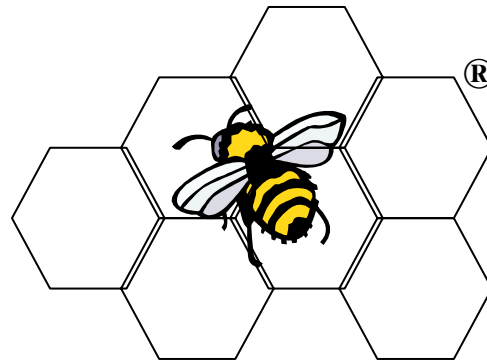


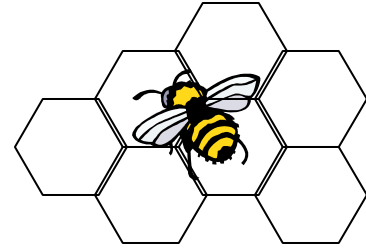
NIST Sustainability Performance Metrics and Tools



Barbara Lippiatt

National Institute of Standards and Technology

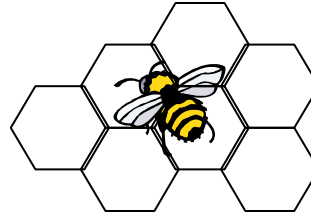
U.S. Department of Commerce



BEES Sponsors

- n U.S. Department of Agriculture
- n U.S. Department of Energy
- n U.S. Environmental Protection Agency
- n National Institute of Standards and Technology (NIST)

USDA BioPreferred Program



biobased content

functional

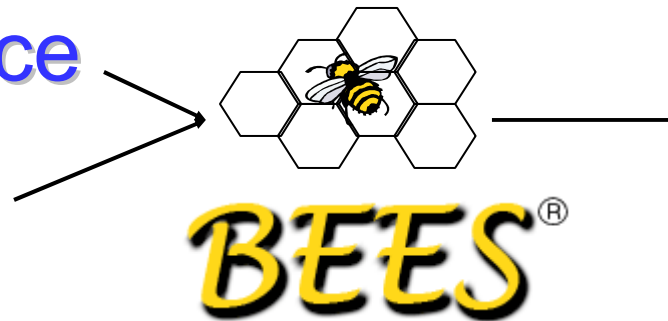
performance

cost performance

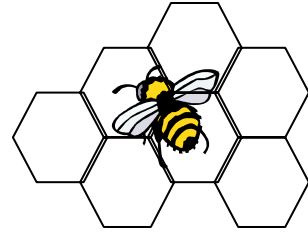
environmental

performance

availability



Item
Designation

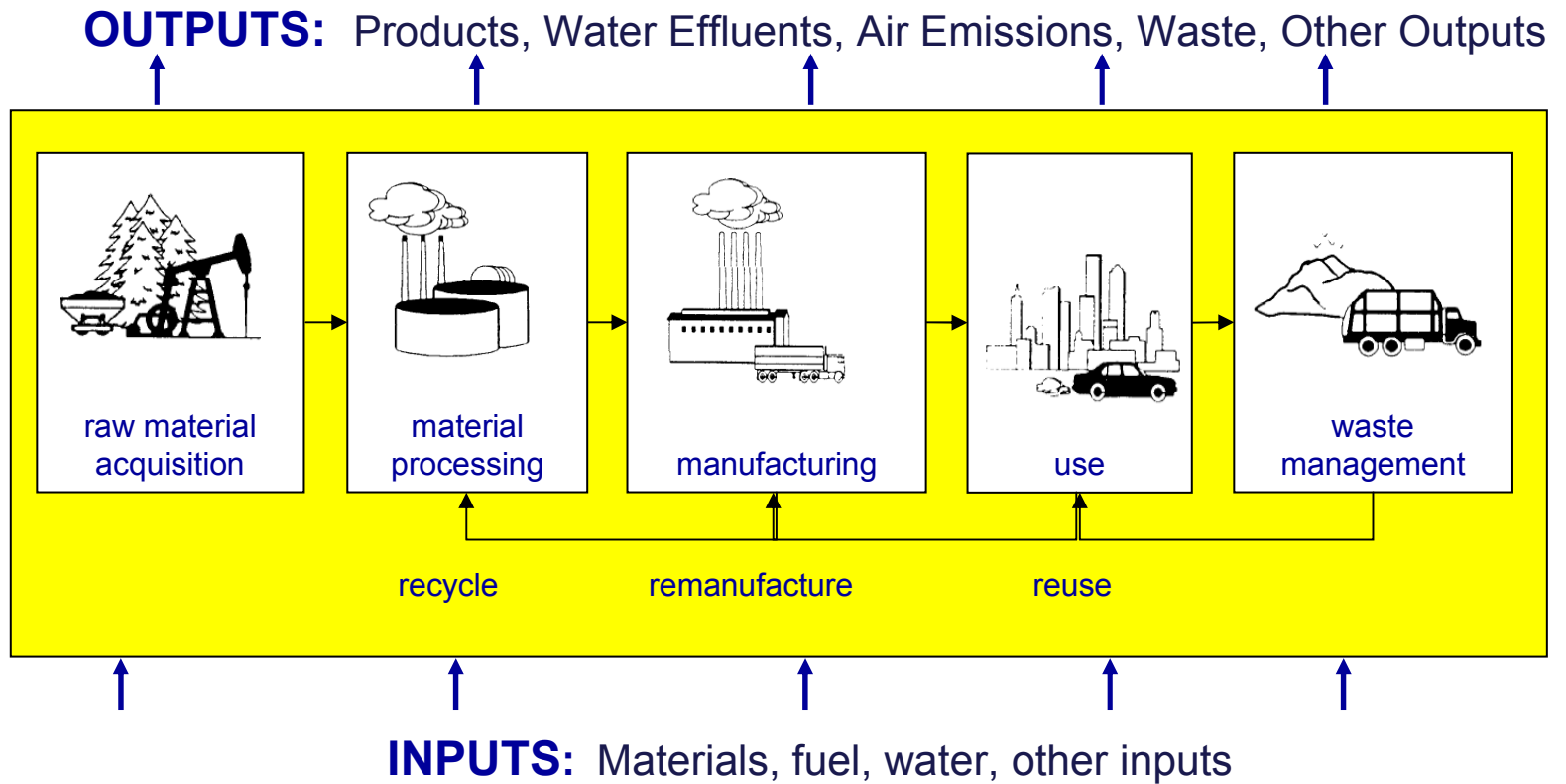
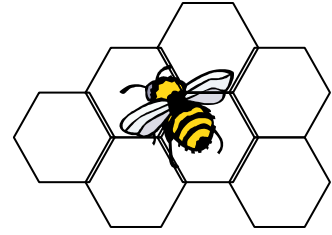


n Takes Life-Cycle Approach

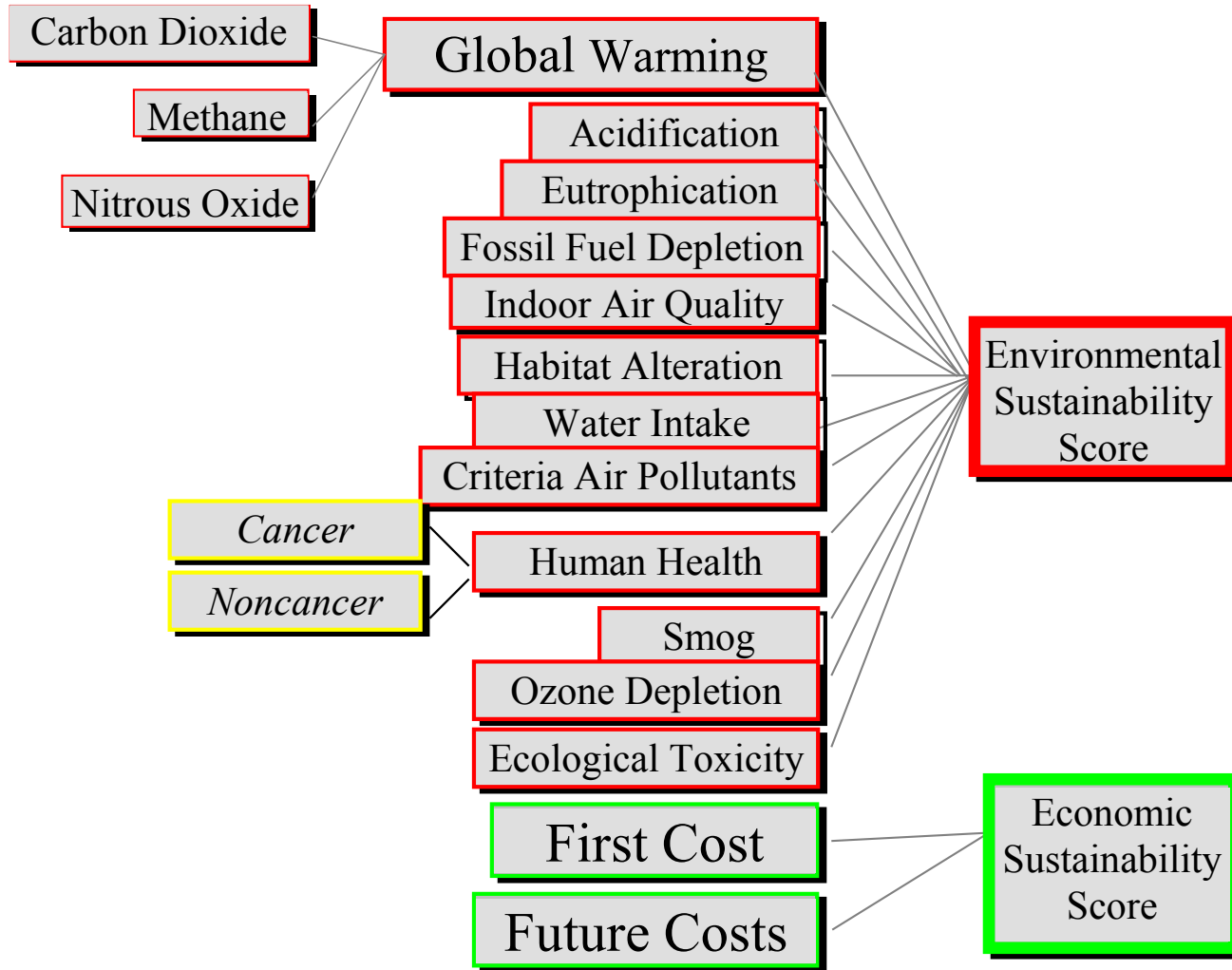
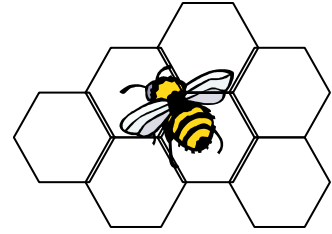
n Based on Consensus Standards

- Environmental Life-Cycle Assessment (ISO 14040)
- Multiattribute Decision Analysis (ASTM E1765)
- Life-Cycle Costing (ASTM E917)

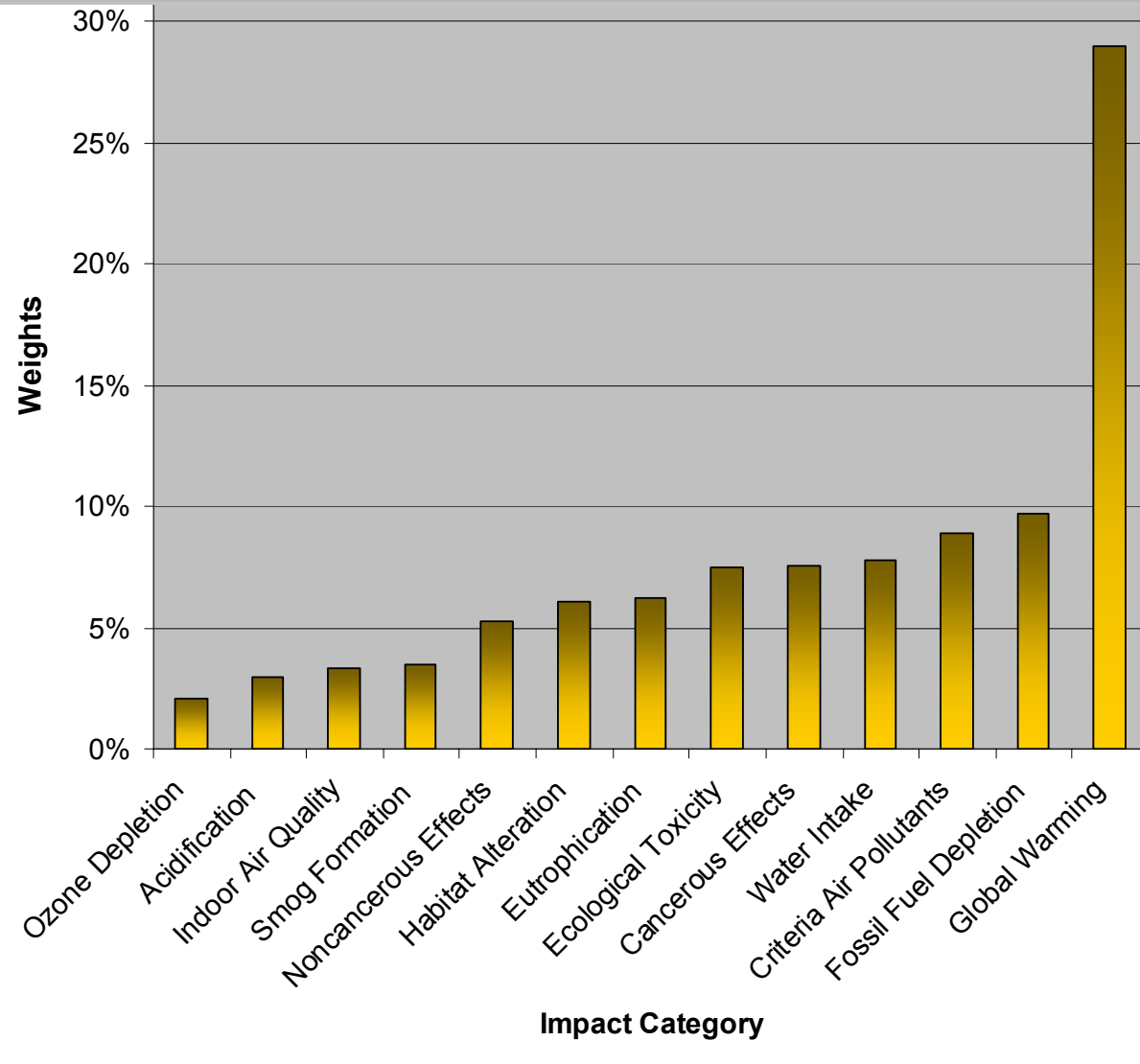
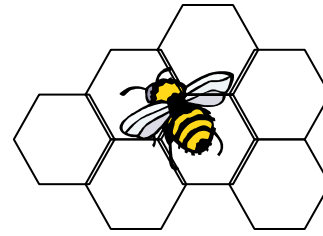
Life Cycle Assessment

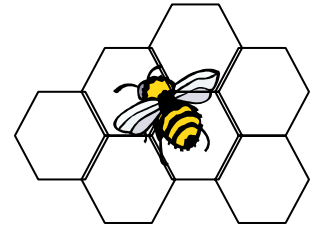


BEES Indicators and Metrics



Environmental Weights: BEES Stakeholder Panel





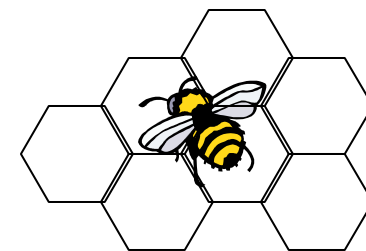
BEES Products

n230+ Building Products

n100+ Biobased Products

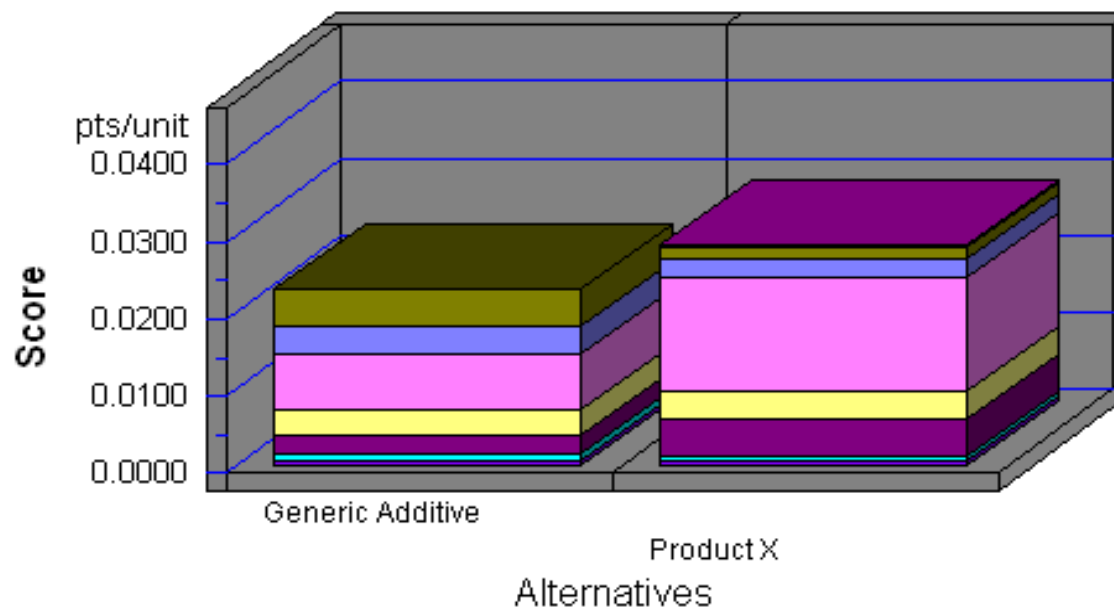
- Gasoline Fuel Additives
- Diesel Fuel Additives
- 2-Cycle Engine Oils
- Hydraulic Fluids
- Transformer Fluids
- Lubricants
- Electronic Components Cleaners
- Air Craft Cleaners
- Blast Media
- Fuel Conditioners
- Erosion Control
- and more...

BioPreferred BEES Results: Diesel Fuel Additives

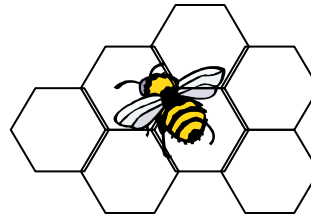


Environmental Performance

Acidification
Crit. Air Pollutants
Ecological Toxicity
Eutrophication
Fossil Fuel Depletion
Global Warming
Habitat Alteration
Human Health
Indoor Air
Ozone Depletion
Smog
Water Intake

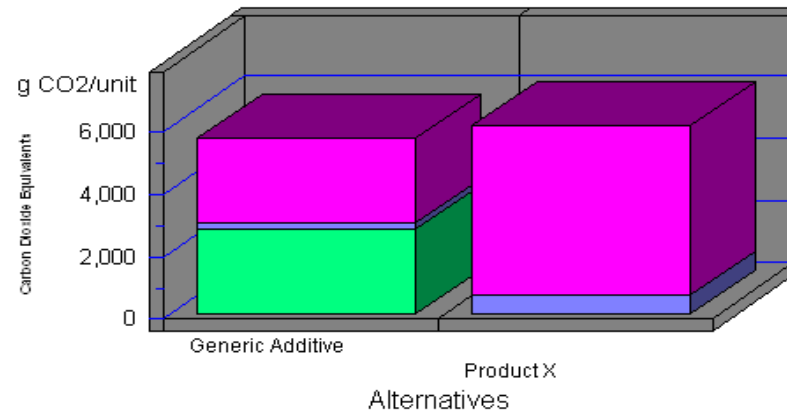


BioPreferred BEES Results: Diesel Fuel Additives



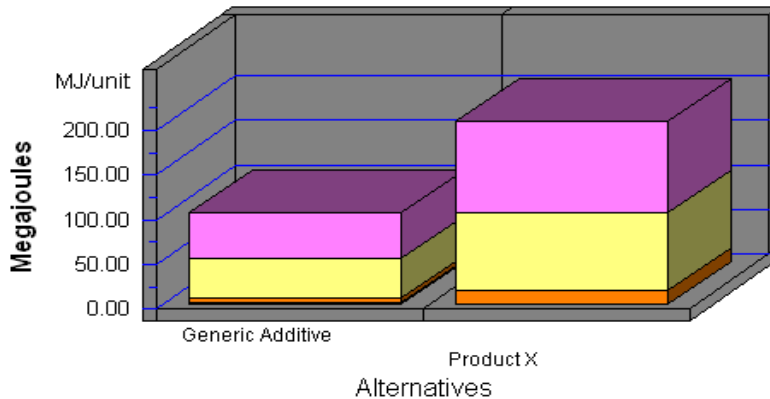
Global Warming by Flow

Carbon Dioxide
Carbon Tetrachloride
Carbon Tetrafluoride
CFC 12
Chloroform
Halon 1301
HCFC 22
Methane
Methyl Bromide
Methyl Chloride
Methylene Chloride
Nitrous Oxide
Trichloroethane



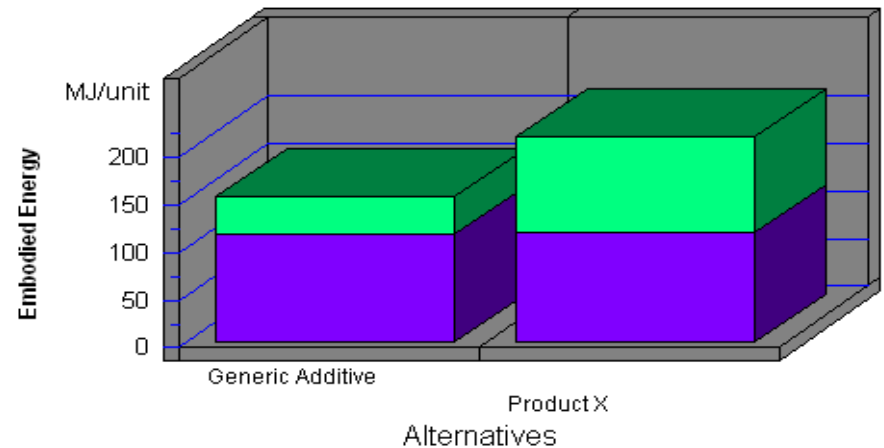
Nonrenewable Energy
Renewable Energy

Fossil Fuel Depletion by Life-Cycle Stage

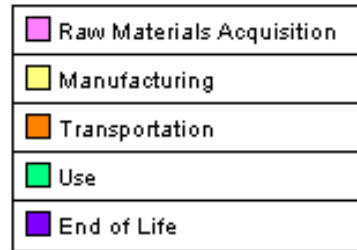
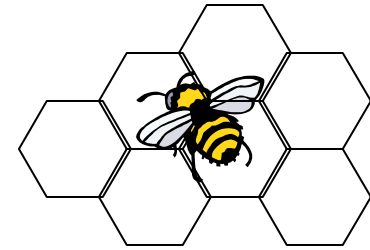


Raw Materials Acquisition
Manufacturing
Transportation
Use
End of Life

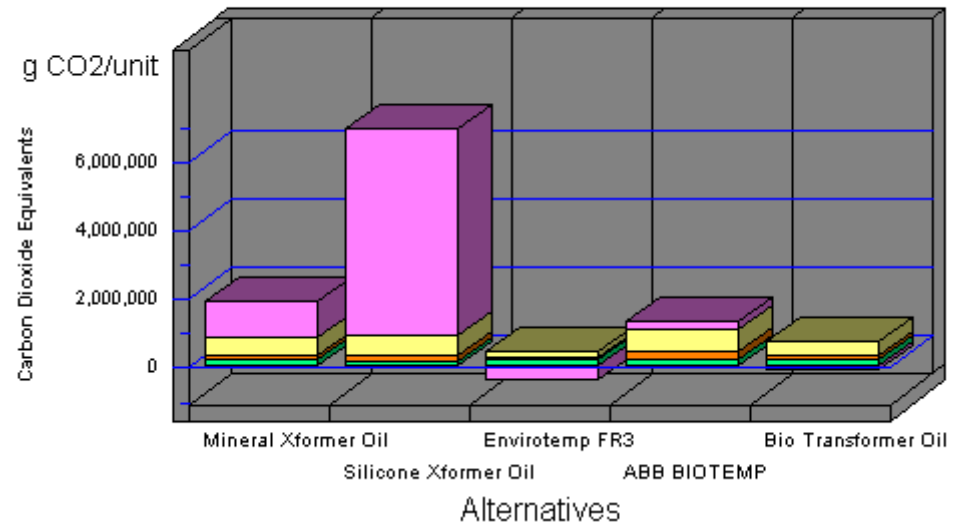
Embodied Energy by Fuel Renewability



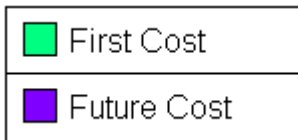
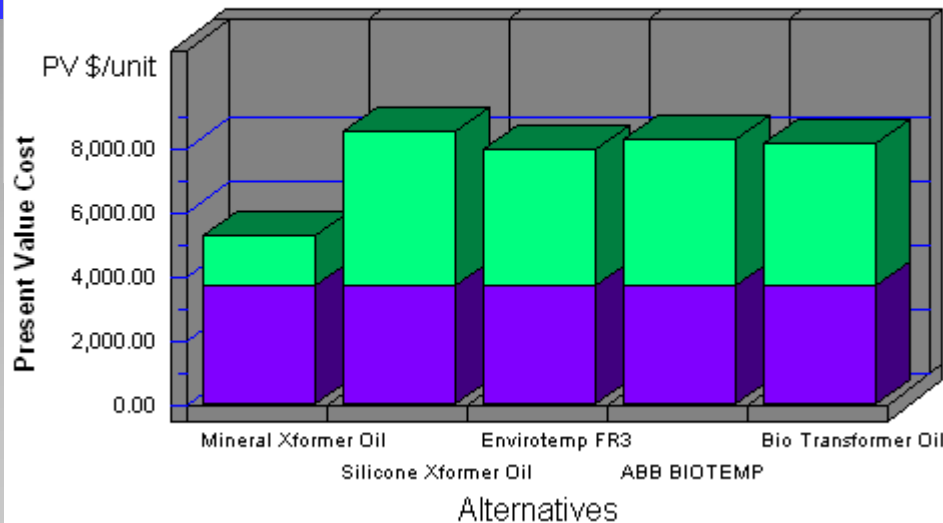
BEES 4.0 Results: Transformer Fluids

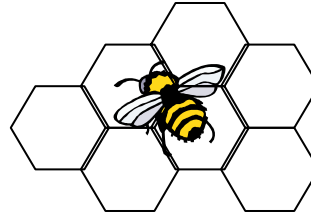


Global Warming by Life-Cycle Stage

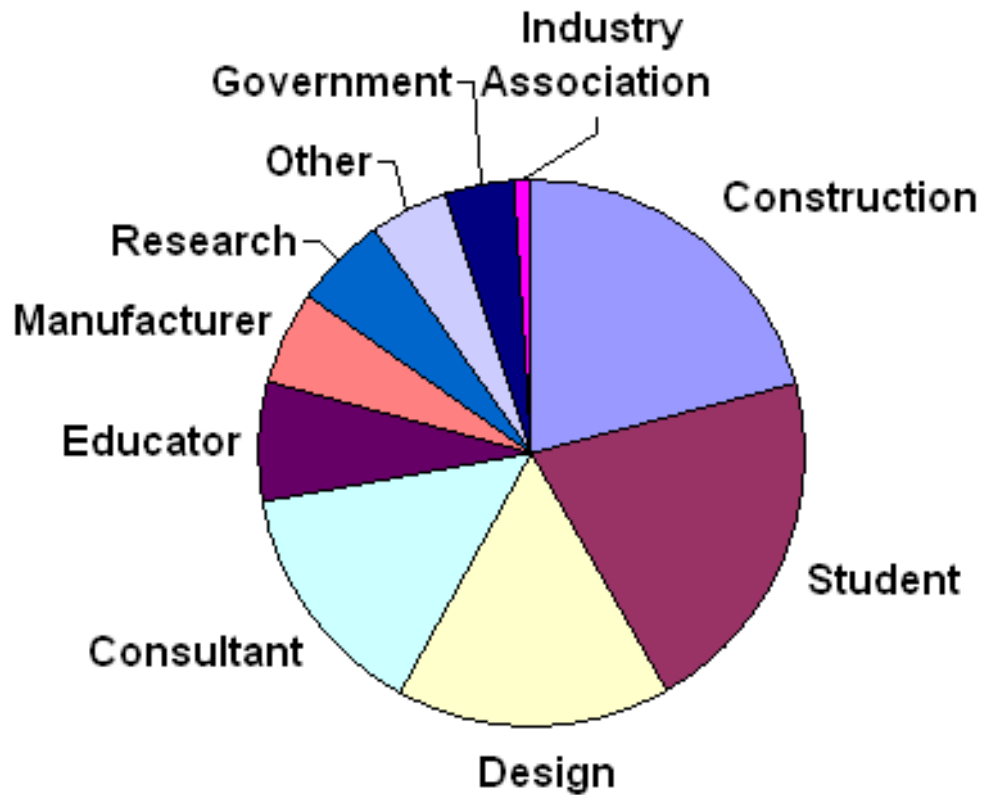


Economic Performance





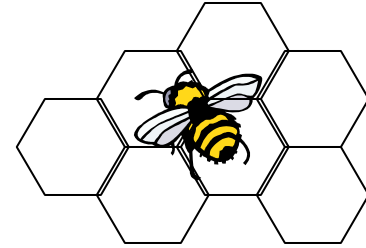
BEES Software Users



**•24,000+ users
from 80 countries**

**•650,000 website
hits since 5/07**

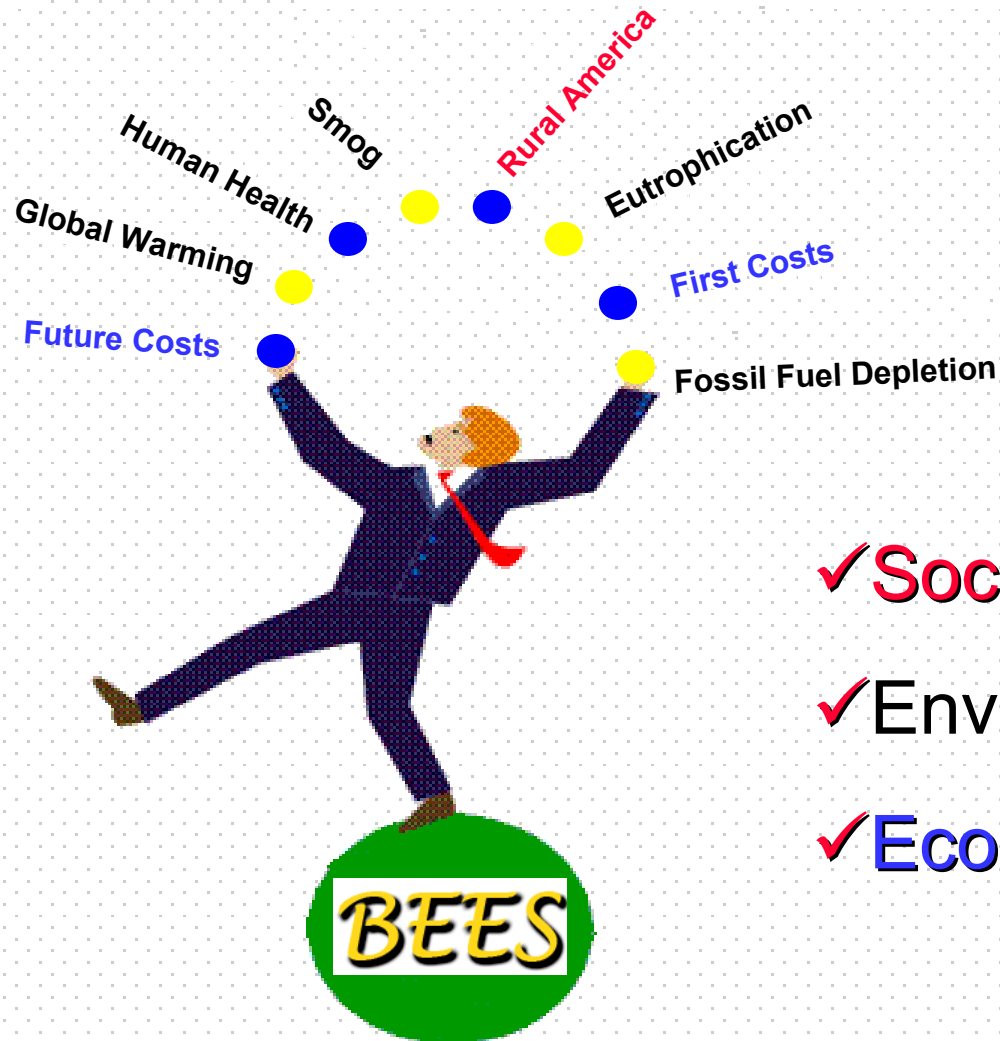
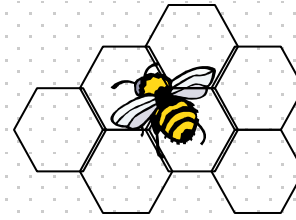
BEES Sustainability Metrics



- n Provides Scientific Integrity
- n Permits Comparability
- n Promotes Innovation



What Makes a Product Sustainable? *The Answers Lie in the Tradeoffs*

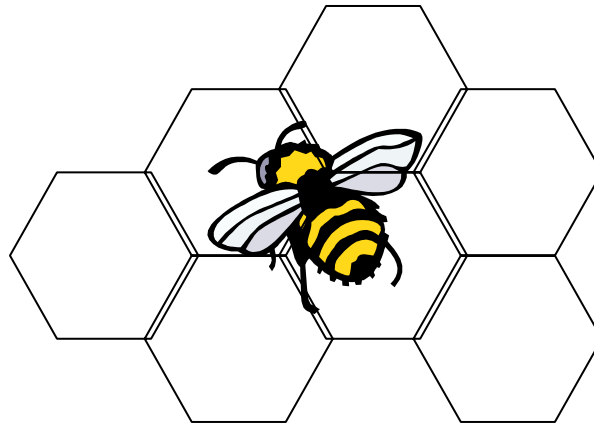


✓ **Social**

✓ **Environmental**

✓ **Economic**

For More Information...



www.bfrl.nist.gov/oae/bees

www.biopreferred.gov