NDCEE

National Defense Center for Environmental Excellence

DoD Executive Agent
Office of the Assistant Secretary of the Army (Installations and Environment)

Evaluating the Environmental Impact, Cost, and Performance of Biobased Alternatives

Joint Services Environmental Management Conference
May 21-24, 2007

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BioPreferred – Background

- 2002 Farm Security and Rural Investment Act (FSRIA)
  - a.k.a. 2002 Farm Bill
  - H.R. 2646/P.L. 107-171
- Section 9002 Federal Procurement of Biobased Products
  - USDA: develop and implement program for designating biobased products
  - Federal Agencies: purchase designated biobased products when annual amount purchased ≥ $10,000 and a product meeting their requirements is readily available at a reasonable price
- Implemented by USDA Office of Energy Policy & New Uses

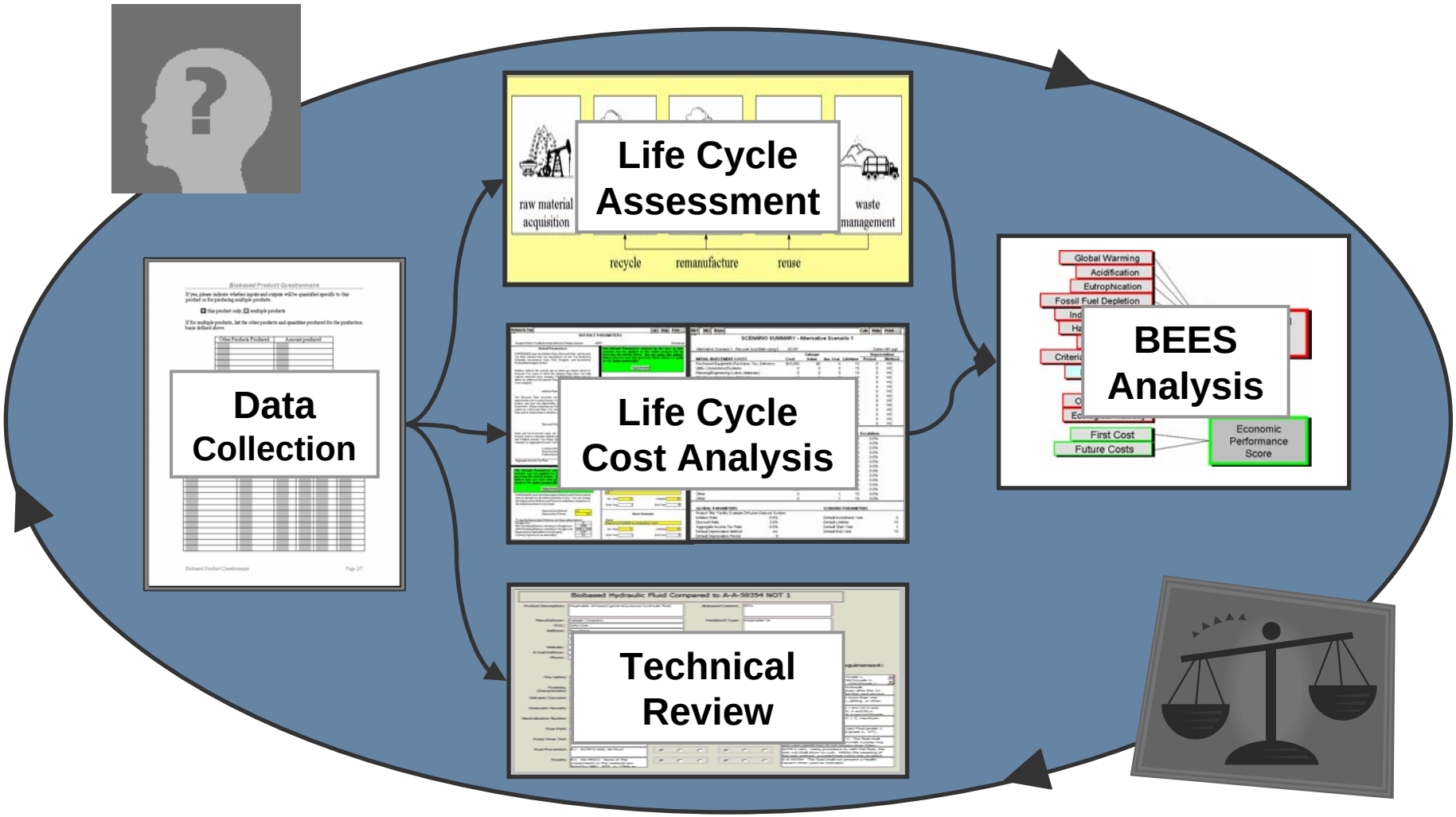
BioPreferred – Goals

- Create new jobs for rural communities
- Provide new markets for farm commodities
- Increase national security by lessening our dependence on foreign oil
- Improve the environment through the use of non-toxic, renewable resources
- Increase the government's purchase and use of biobased products

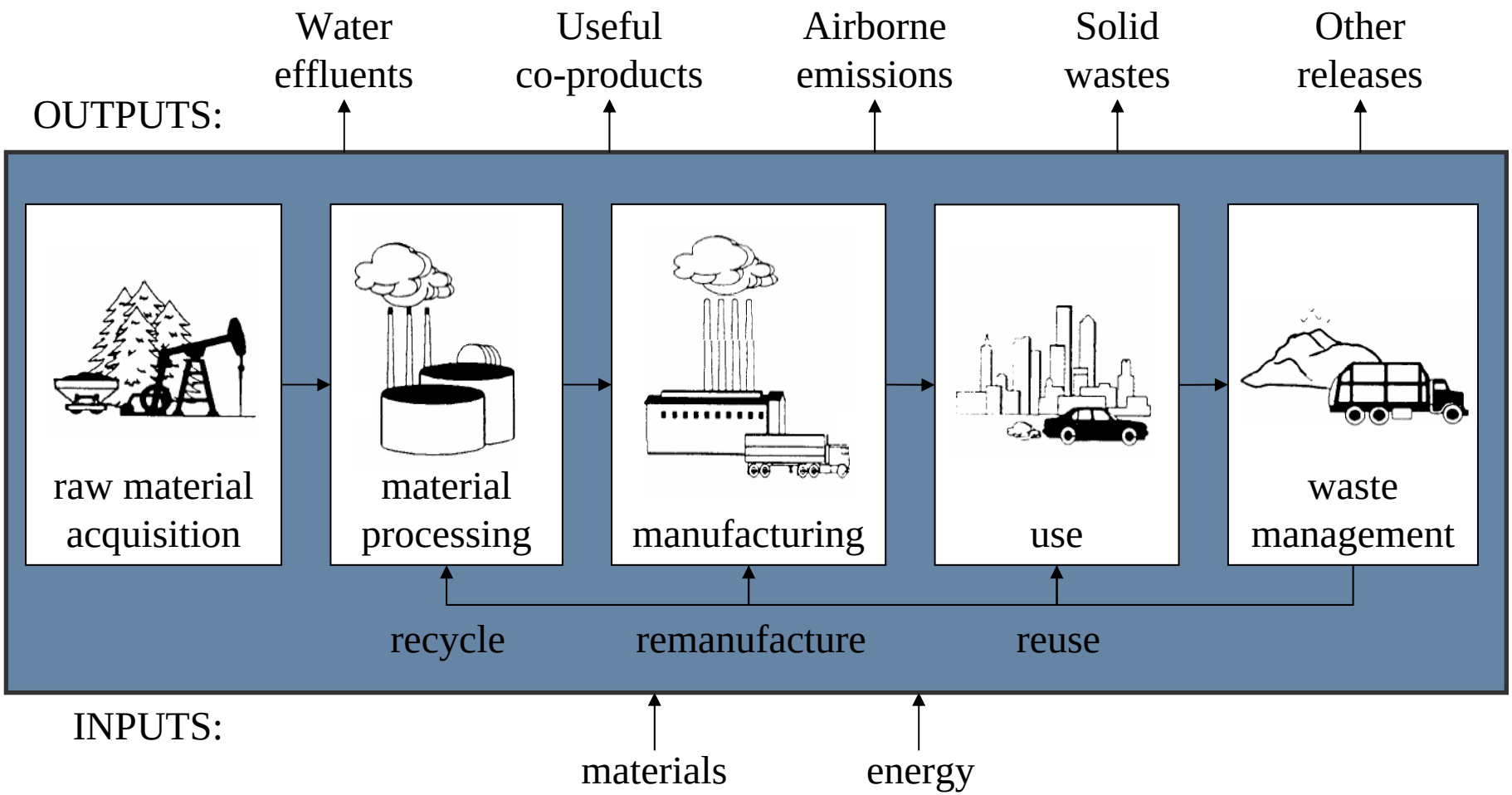
BioPreferred – Designation Items

- Categories of biobased products designated as preferred
  - Commercially available products identified
  - products evaluated against non-biobased counterparts
    - cost effectiveness
    - accessibility
    - performance
  - Sample products test for biobased content using ASTM D6866-04
  - Sample products evaluated using life cycle assessment (LCA) and life cycle cost analysis (LCCA) approaches used by the Building for Economic and Environmental Sustainability (BEES) tool

Framework – Evaluating Alternatives



Life Cycle Assessment



Life Cycle Cost Analysis

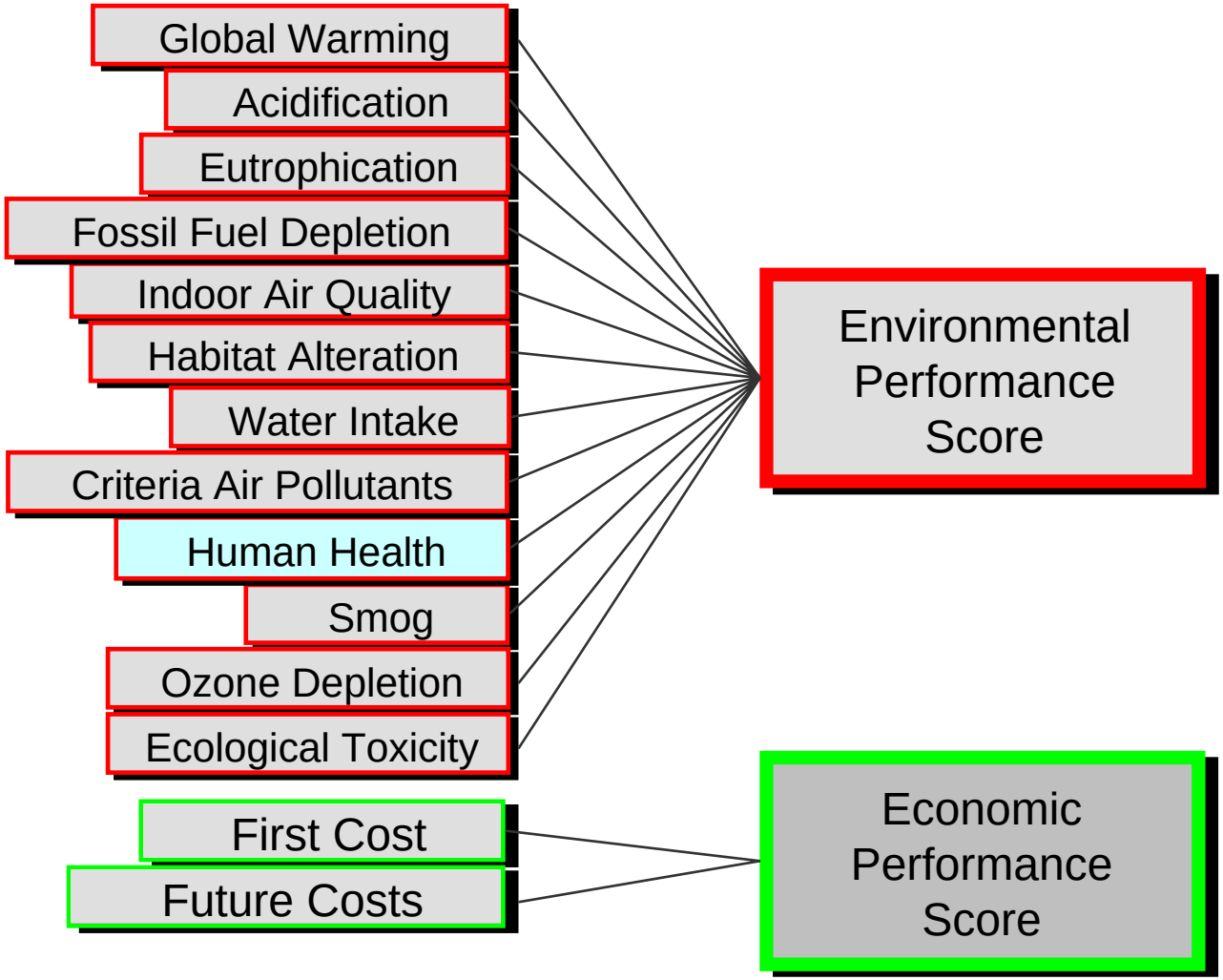
An economic analytical tool for estimating the total cost of acquisition and ownership of a system over its full life, including the cost of planning, development, manufacturing, acquisition, installation, operation, support, decommissioning, and disposal.

$$C_{LC} = C_R + C_P + C_U + C_R$$

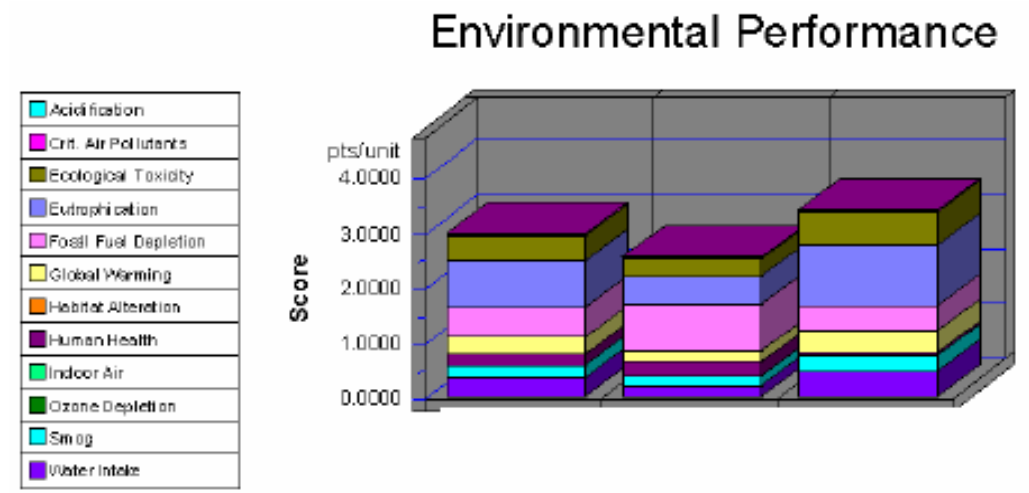
The BEES Model

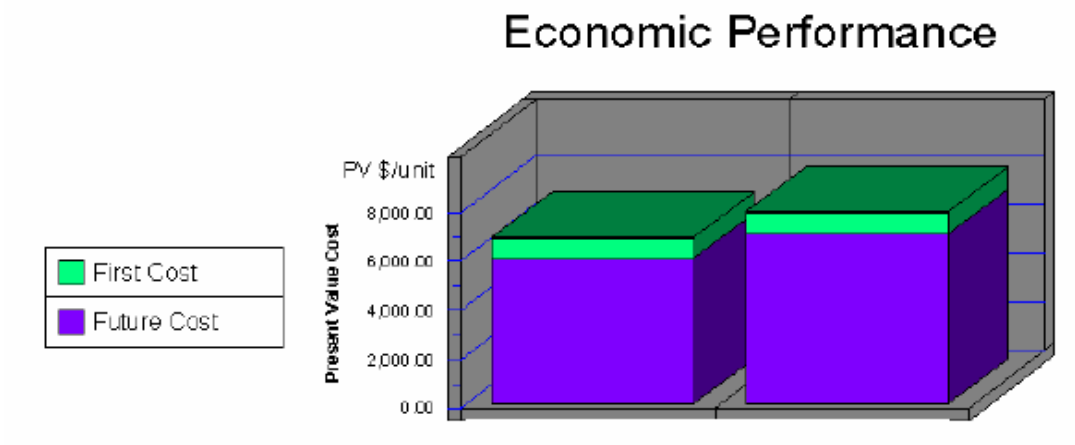
- BEES = Building for Environmental and Economic Sustainability
- Developed by National Institute of Standards and Technology (NIST)
  - Systematic methodology for selecting building projects
  - Methodology now applied to evaluate biobased materials
- Based on Consensus Standards
  - Life-Cycle Costing (ASTM E917)
  - Building Element Classification (ASTM E1557)
  - Environmental Life-Cycle Assessment (ISO 14040)
  - Multi-Attribute Decision Analysis (ASTM E1765)
- Publicly available

The BEES Model



BEES Results





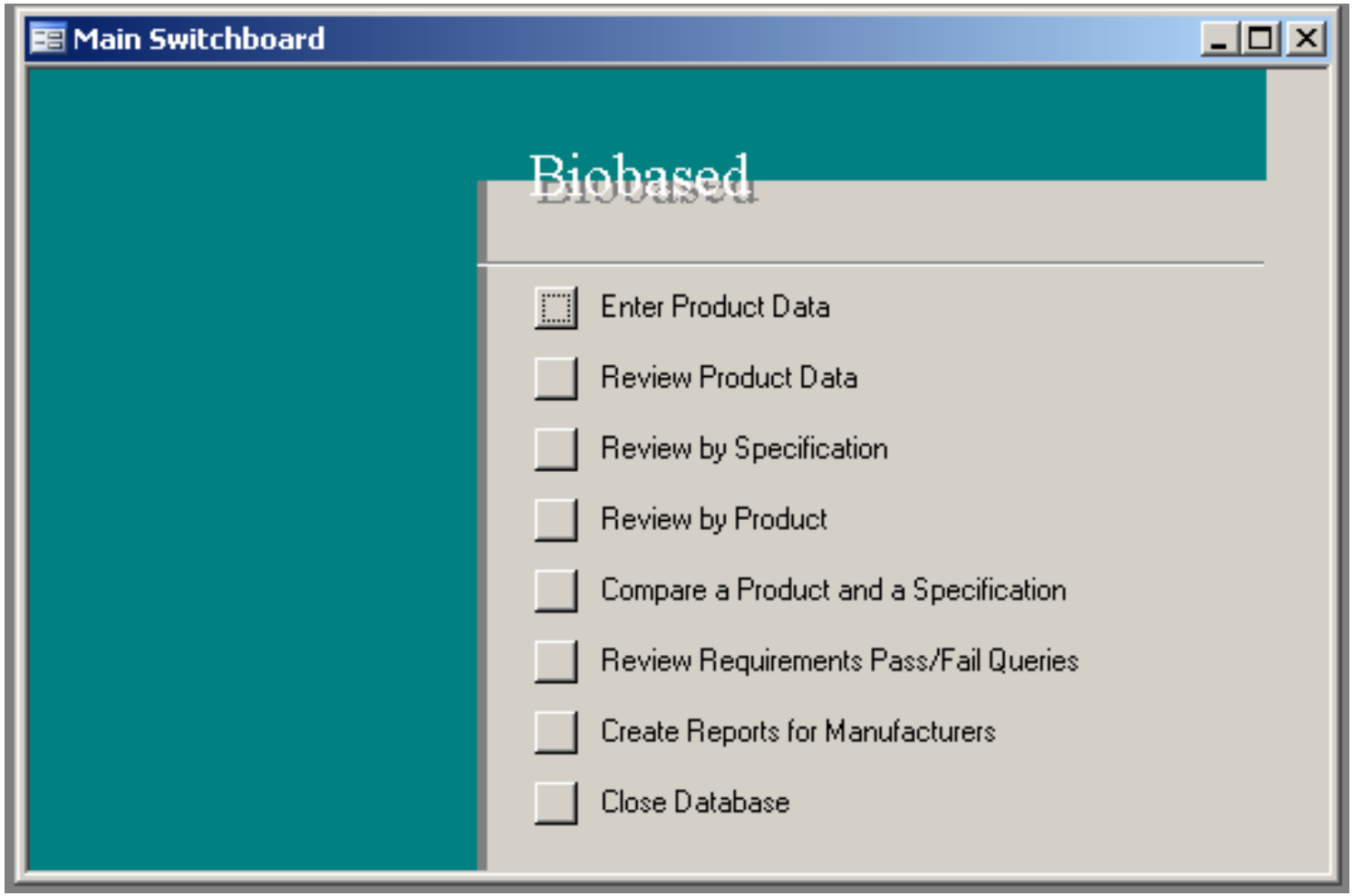
Technical Review

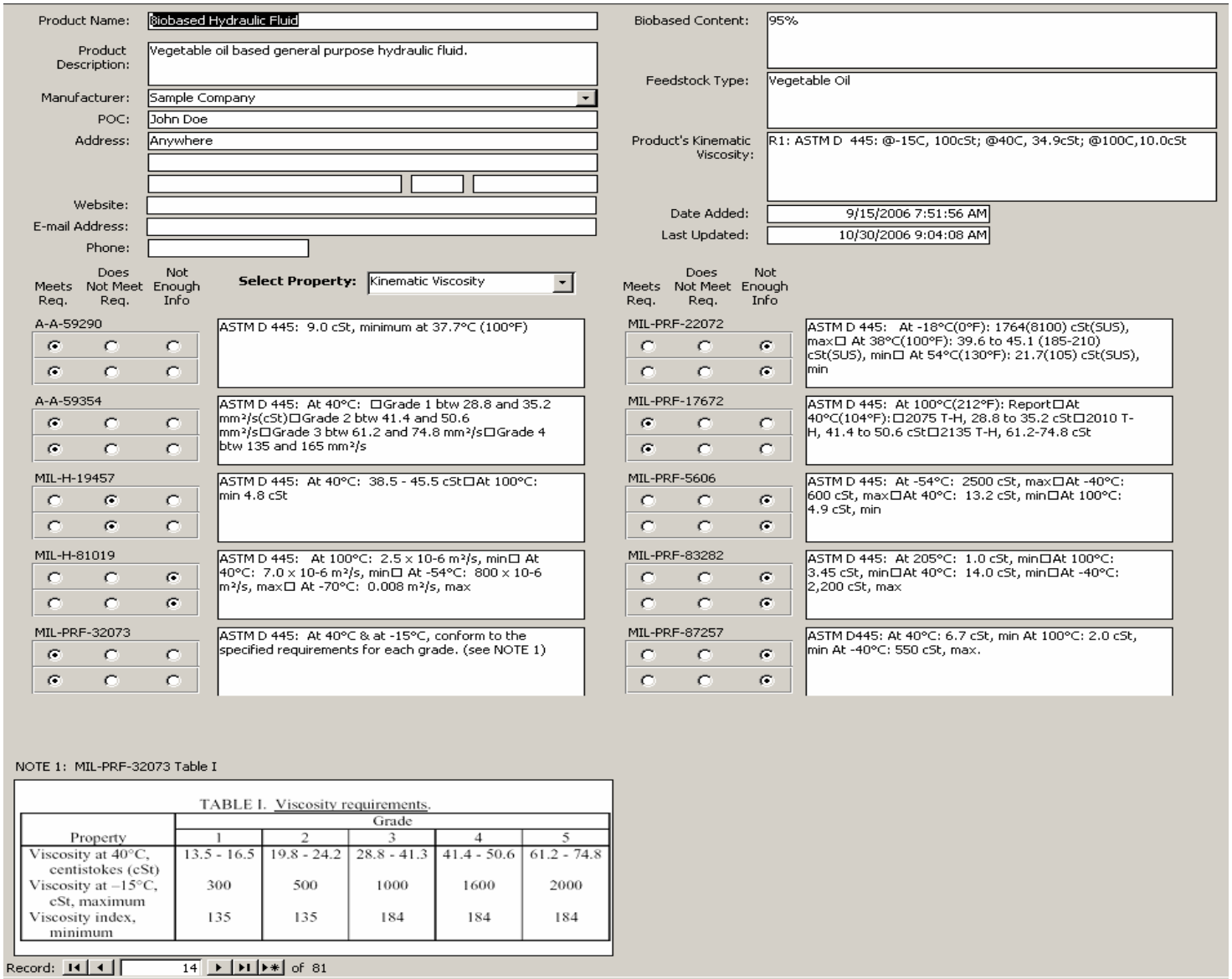
- Work with purchasing agency to identify corresponding Military Specifications and other Government purchasing requirements
- Identify biobased manufacturers and products
- Contact biobased manufacturers to collect product performance data on commercially available biobased products
- Collect information on biobased material content (minimum content levels established by USDA)

Technical Review

- Develop database containing product performance data, Government requirements
- Compare performance data to specifications
- Assign meets, does not meet or not enough information provided determination for each property of the specification or requirement
- Identify gaps between performance data and requirements
- Provide product performance reports to Agency and manufacturers

Biobased Product Database





Product Name: Biobased Hydraulic Fluid

Product Description: Vegetable oil based general purpose hydraulic fluid.

Manufacturer: Sample Company

POC: John Doe

Address: Anywhere

Website:

E-mail Address:

Phone:

Biobased Content: 95%

Feedstock Type: Vegetable Oil

Product's Kinematic Viscosity: R1: ASTM D 445: @-15C, 100cSt; @40C, 34.9cSt; @100C,10.0cSt

Date Added: 9/15/2006 7:51:56 AM

Last Updated: 10/30/2006 9:04:08 AM

Select Property: Kinematic Viscosity

	Meets Req.	Does Not Meet Req.	Not Enough Info	
A-A-59290	●	○	○	ASTM D 445: 9.0 cSt, minimum at 37.7°C (100°F)
A-A-59354	●	○	○	ASTM D 445: At 40°C: ☐Grade 1 btw 28.8 and 35.2 mm²/s(cSt)☐Grade 2 btw 41.4 and 50.6 mm²/s☐Grade 3 btw 61.2 and 74.8 mm²/s☐Grade 4 btw 135 and 165 mm²/s
MIL-H-19457	○	●	○	ASTM D 445: At 40°C: 38.5 - 45.5 cSt☐At 100°C: min 4.8 cSt
MIL-H-81019	○	○	●	ASTM D 445: At 100°C: 2.5 x 10-6 m²/s, min☐ At 40°C: 7.0 x 10-6 m²/s, min☐ At -54°C: 800 x 10-6 m²/s, max☐ At -70°C: 0.008 m²/s, max
MIL-PRF-32073	●	○	○	ASTM D 445: At 40°C & at -15°C, conform to the specified requirements for each grade. (see NOTE 1)
MIL-PRF-22072	○	○	●	ASTM D 445: At -18°C(0°F): 1764(8100) cSt(SUS), max☐ At 38°C(100°F): 39.6 to 45.1 (185-210) cSt(SUS), min☐ At 54°C(130°F): 21.7(105) cSt(SUS), min
MIL-PRF-17672	●	○	○	ASTM D 445: At 100°C(212°F): Report☐At 40°C(104°F):☐2075 T-H, 28.8 to 35.2 cSt☐2010 T-H, 41.4 to 50.6 cSt☐2135 T-H, 61.2-74.8 cSt
MIL-PRF-5606	○	○	●	ASTM D 445: At -54°C: 2500 cSt, max☐At -40°C: 600 cSt, max☐At 40°C: 13.2 cSt, min☐At 100°C: 4.9 cSt, min
MIL-PRF-83282	○	○	●	ASTM D 445: At 205°C: 1.0 cSt, min☐At 100°C: 3.45 cSt, min☐At 40°C: 14.0 cSt, min☐At -40°C: 2,200 cSt, max
MIL-PRF-87257	○	○	●	ASTM D445: At 40°C: 6.7 cSt, min At 100°C: 2.0 cSt, min At -40°C: 550 cSt, max.

NOTE 1: MIL-PRF-32073 Table I

TABLE I. Viscosity requirements.

Property	Grade 1	2	3	4	5
Viscosity at 40°C, centistokes (cSt)	13.5 - 16.5	19.8 - 24.2	28.8 - 41.3	41.4 - 50.6	61.2 - 74.8
Viscosity at –15°C, cSt, maximum	300	500	1000	1600	2000
Viscosity index, minimum	135	135	184	184	184

Record: 14 of 81

Biobased Hydraulic Fluid Compared to A-A-59354 NOT 1

Product Description:	Vegetable oil based general purpose hydraulic fluid.	Biobased Content:	95%
Manufacturer:	Sample Company	Feedstock Type:	Vegetable Oil
POC:	John Doe		
Address:	Anywhere	Date Added:	9/15/2006 7:51:56 AM
		Last Updated:	10/30/2006 9:04:08 AM
Website:			
E-mail Address:			
Phone:			

	Product's Data:	Round 1: Meets Req.	Round 1: Does Not Meet Req.	Round 1: Not Enough Info	Round 2: Meets Req.	Round 2: Does Not Meet Req.	Round 2: Not Enough Info	Specification Requirement:
Fire Safety	R1: Flash Point 230C, Fire Point 250C R2: ASTM D56:Flash Point 230C	○	○	◉	◉	○	○	ASTM D 56: Flash Point (°C): ☐Grade 1, 188☐Grade 2, 196☐Grade 3, 196☐Grade 4, 221☐Fire Point (°C): ☐Grade 1, 216☐Grade 2
Foaming Characteristics	Not Provided	○	○	◉	○	○	◉	ASTM D 892: (Protection From Hydraulic Cavitation) 100ml of foam, maximum after the 10 minute settling periods of both the first and second
Galvanic Corrosion	R1: FED-STD-791 Method 5322: No corrosion, pitting, or other attack	◉	○	○	◉	○	○	FED-STD-791 Method 5322: Not more than one disk may show signs of corrosion, pitting, or other attack
Kinematic Viscosity	R1: ASTM D 445: @-15C, 100cSt; @40C, 34.9cSt; @100C 10.0cSt	◉	○	○	◉	○	○	ASTM D 445: At 40°C: ☐Grade 1 btw 28.8 and 35.2 mm²/s(cSt)☐Grade 2 btw 41.4 and 50.6 mm²/s☐Grade 3 btw 61.2 and 74.8 mm²/s☐Grade
Neutralization Number	R1: Neutralization Number 0.3 R2: ASTM D664, 0.3	○	○	◉	○	○	○	ASTM D 664: Grades 1, 2, and 3: 1.5, maximum: Grade 4: < 0.2
Pour Point	R1: ASTM D97, Pour Point -20C	◉	○	○	◉	○	○	ASTM D 97: (Low Temperature Use) Fluid grade 1, 2, and 3: -12°C, maximum. Fluid grade 4, -6°C, maximum
Pump Wear Test	R1: ASTM D 2882: ring and vane weight loss, 10mg.	◉	○	○	◉	○	○	ASTM D 2882: Grades 1,2, and 3: The fluid shall have wear characteristics that provide a pump ring and vane weight loss of not greater than 50mg
Rust Prevention	R1: ASTM D 665, No Rust	◉	○	○	◉	○	○	ASTM D 665: Using procedure A, with the fluid, the test rod shall show no rust. Within the meaning of this test method, a rusted test rod is one on which
Toxicity	R1: Per MSDS: None of the components in this material are listed by IARC, NTP, or OSHA as	◉	○	○	◉	○	○	A-A-59354: The fluid shall not present a health hazard when used as intended

Biobased Hydraulic Fluid

Description: Vegetable oil based general purpose hydraulic fluid.

Manufacturer: Sample Company
POC: John Doe
Address: Anywhere
,
Website:
E-mail Address:
Phone:

Biobased Content: 95%
Feedstock Type: Vegetable Oil

A-A-59290

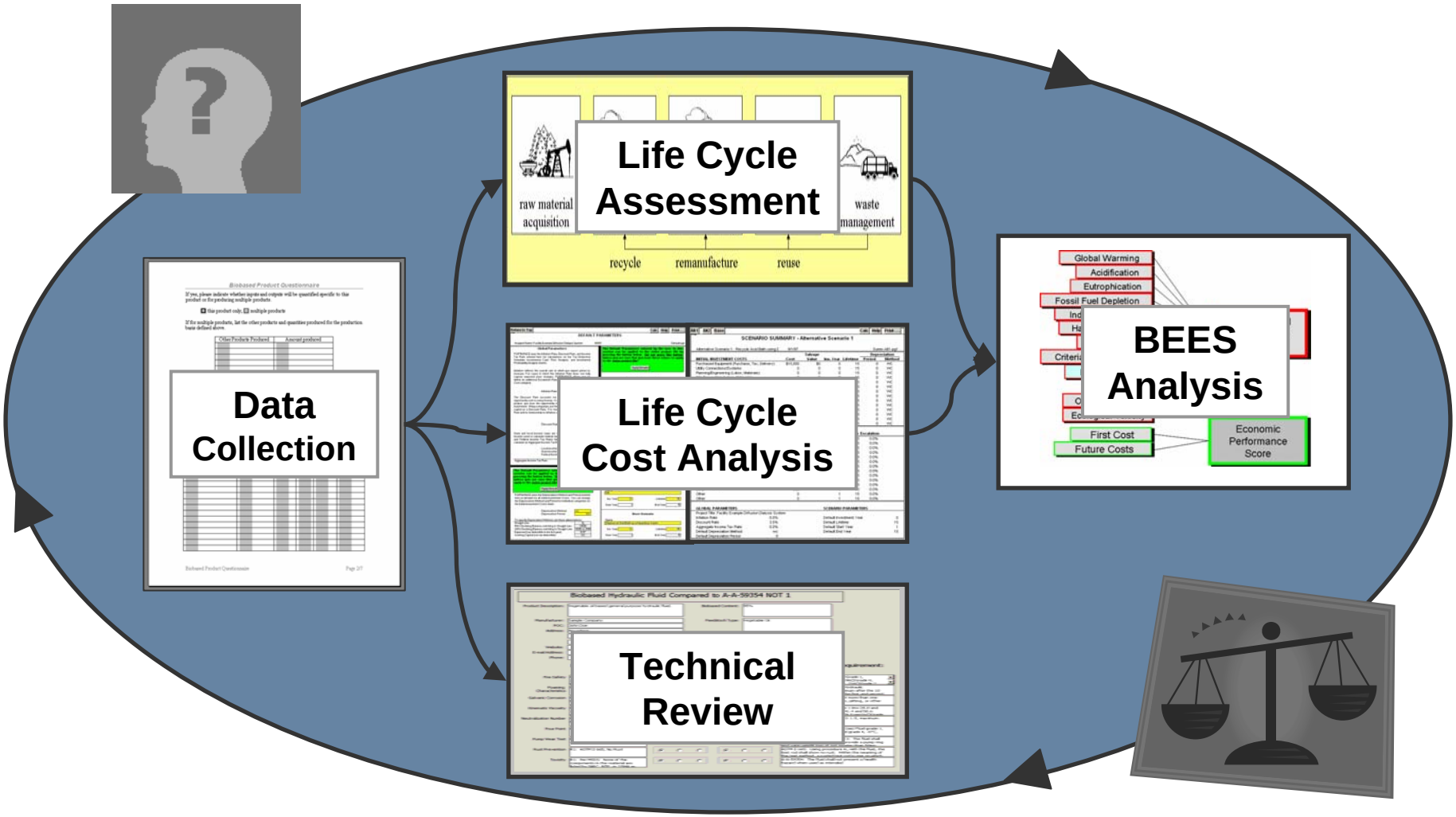
	Specification Requirement:	Product's Data:*	Determination:
Ash content	ASTM D 1119: 0.52 percent by weight, maximum		Not Enough Info
Boiling Point	ASTM D 1120: 165° (329°F), minimum		Not Enough Info
Inhibitor Free alkalinity	ASTM D 1121: 0.05 to 0.75 g NaOH/100ml of sample, @ 25°±3°C (77°±5°F):		Not Enough Info
Inhibitor Specific Gravity	ASTM D 1122: 1.27±0.03 @ 25°C/25°C (77°F/77°F)		Not Enough Info
Kinematic Viscosity	ASTM D 445: 9.0 cSt, minimum at 37.7°C (100°F)	R1: ASTM D 445: @-15C, 100cSt; @40C, 34.9cSt; @100C,10.0cSt	Meets
pH	ASTM D 1287: 7.2 to 7.8, value (50 percent aqueous solution by volume), @ 25° ±3°C (77°±5°F)		Not Enough Info
Phosphate content	A-A-59290: 0.56 percent, minimum. (calculated as phosphoric acid)		Not Enough Info
Specific Gravity	ASTM D 1122: 1.111 to 1.123, undiluted material @ 15°C/15°C (60°F/60°F)		Not Enough Info

* R1 denotes data collected from product's data sheet. R2 denotes data received after a specific request.

	Specification Requirement:	Product's Data:*	Determination:
Fire Safety	ASTM D 56: Flash Point (°C): □ Grade 1, 188□Grade 2, 196□Grade 3, 196□Grade 4, 221□Fire Point (°C): □Grade 1, 216□Grade 2, 218□Grade 3, 218□Grade 4, 246	R1: Flash Point 230C, Fire Point 250C R2: ASTM D 56:Flsah Point 230C, Fire Point 250C	Meets
Foaming Characteristics	ASTM D 892: (Protection From Hydraulic Cavitation) 100ml of foam, maximum after the 10 minute settling periods of both the first and second 24°C tests, and 25ml, maximum of foam after the 10 minute settling period of the 93.5°C test	Not Provided	Not Enough Info
Galvanic Corrosion	FED-STD-791 Method 5322: Not more than one disk may show signs of corrosion, pitting, or other attack.	R1: FED-STD-791 Method 5322: No corrosion, pitting, or other attack.	Meets
Kinematic Viscosity	ASTM D 445: At 40°C: □ Grade 1 btw 28.8 and 35.2 mm^2/s(cSt)□Grade 2 btw 41.4 and 50.6 mm^2/s□Grade 3 btw 61.2 and 74.8 mm^2/s□Grade 4 btw 135 and 165 mm^2/s	R1: ASTM D 445: @-15C, 100cSt; @40C, 34.9cSt; @100C,10.0cSt	Meets
Neutralization Number	ASTM D 664: Grades 1, 2, and 3: 1.5, maximum: Grade 4: < 0.2	R1: Neutralization Number 0.3 R2: ASTM D664, 0.3	Meets
Pour Point	ASTM D 97: (Low Temperature Use) Fluid grade 1, 2, and 3: -12°C, maximum. Fluid grade 4, -6°C, maximum	R1: ASTM D97, Pour Point -20C	Meets
Pump Wear Test	ASTM D 2882: Grades 1,2, and 3: The fluid shall have wear characteristics that provide a pump ring and vane weight loss of not greater than 50mg	R1: ASTM D 2882: ring and vane weight loss, 10mg.	Meets
Rust Prevention	ASTM D 665: Using procedure A, with the fluid, the test rod shall show no rust. Within the meaning of this test method, a rusted test rod is one on which any rust spot or rust streak is visible by the inspection procedure.	R1: ASTM D 665, No Rust	Meets

* R1 denotes data collected from product's data sheet. R2 denotes data received after a specific request.

Summary


Life Cycle Assessment
raw material acquisition
waste management
recycle
remanufacture
reuse
Data Collection
Life Cycle Cost Analysis
Technical Review
BEES Analysis
Global Warming
Acidification
Eutrophication
Fossil Fuel Depletion
First Cost
Future Costs
Economic Performance Score

Questions

Evaluating the Environmental Impact, Cost, and Performance of Biobased Alternatives

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