

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**

Dr. Shannon Lloyd, NDCEE
Mr. George Handy, NDCEE

The views, opinions, and/or findings contained in this briefing are those of the author(s) and should not be construed as an official Department of the Army position, policy, or decision unless so designated by other official documentation.

The NDCEE is operated by:  *Concurrent Technologies Corporation*

Technology Transfer—Supporting DoD Readiness, Sustainability, and Transformation

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE MAY 2007		2. REPORT TYPE		3. DATES COVERED 00-00-2007 to 00-00-2007	
4. TITLE AND SUBTITLE Evaluating the Environmental Impact, Cost, and Performance of Biobased Alternatives				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) National Defense Center for Energy and Environment, Operated by Concurrent Technologies Corporation, 100 CTC Drive, Johnstown, PA, 15904				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES Joint Services Environmental Management (JSEM) Conference, May 21-24, 2007, Columbus, OH.					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 19	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

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 $\geq$ \$10,000 and a product meeting their requirements is readily available at a reasonable price
- Implemented by USDA Office of Energy Policy & New Uses

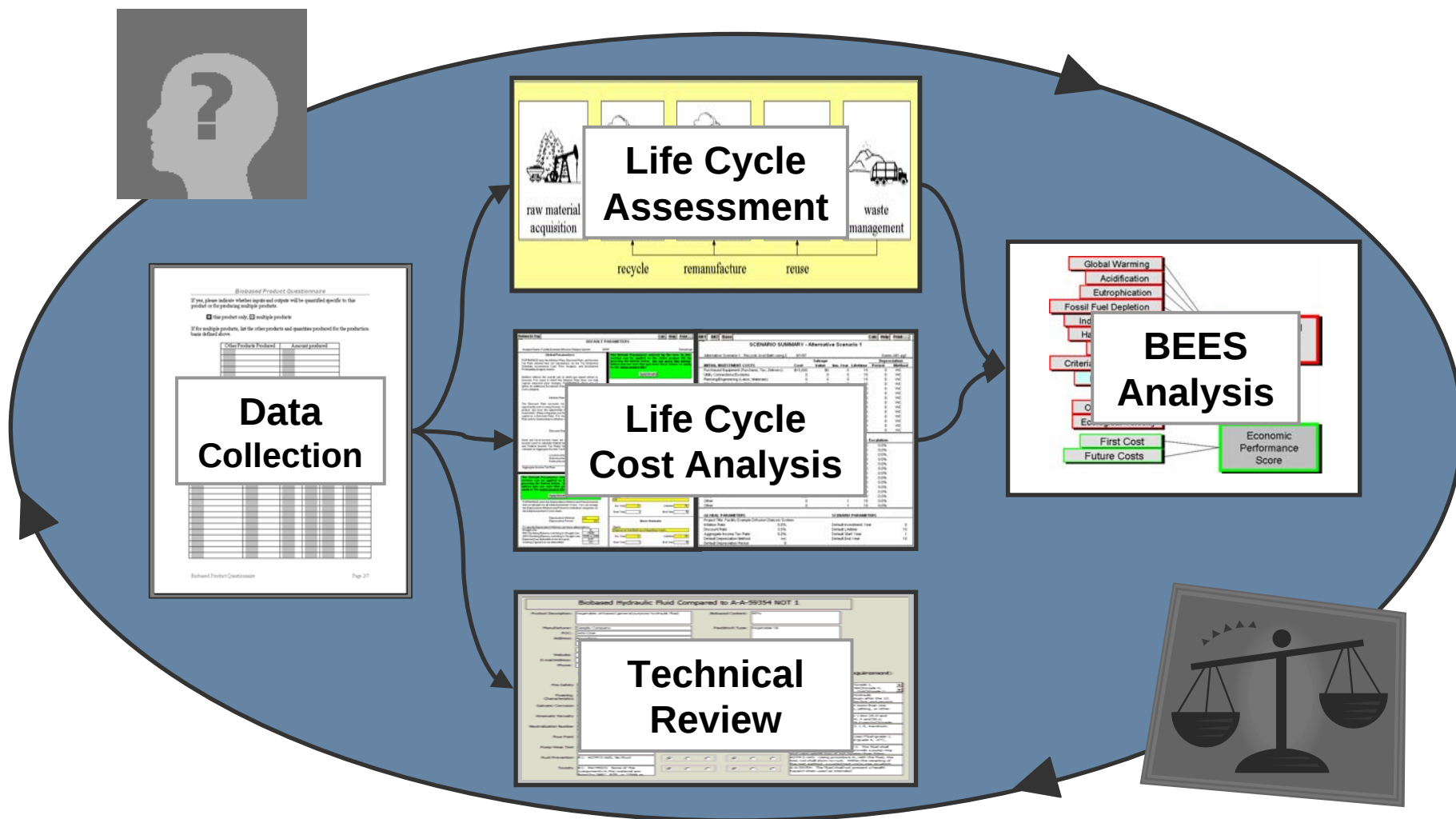
BioPreferred – Goals

- 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

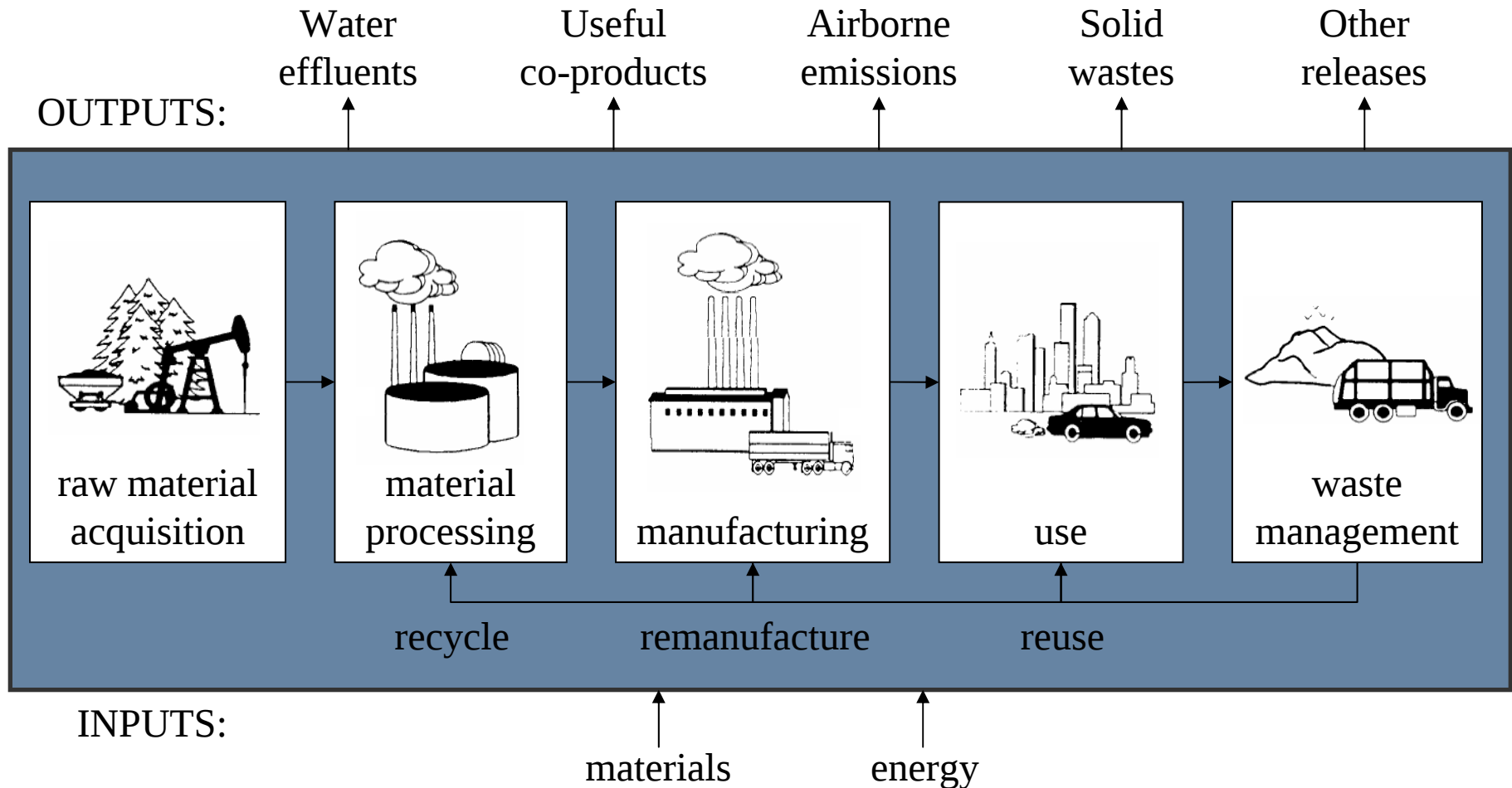
BioPreferred – Designation Items

- 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

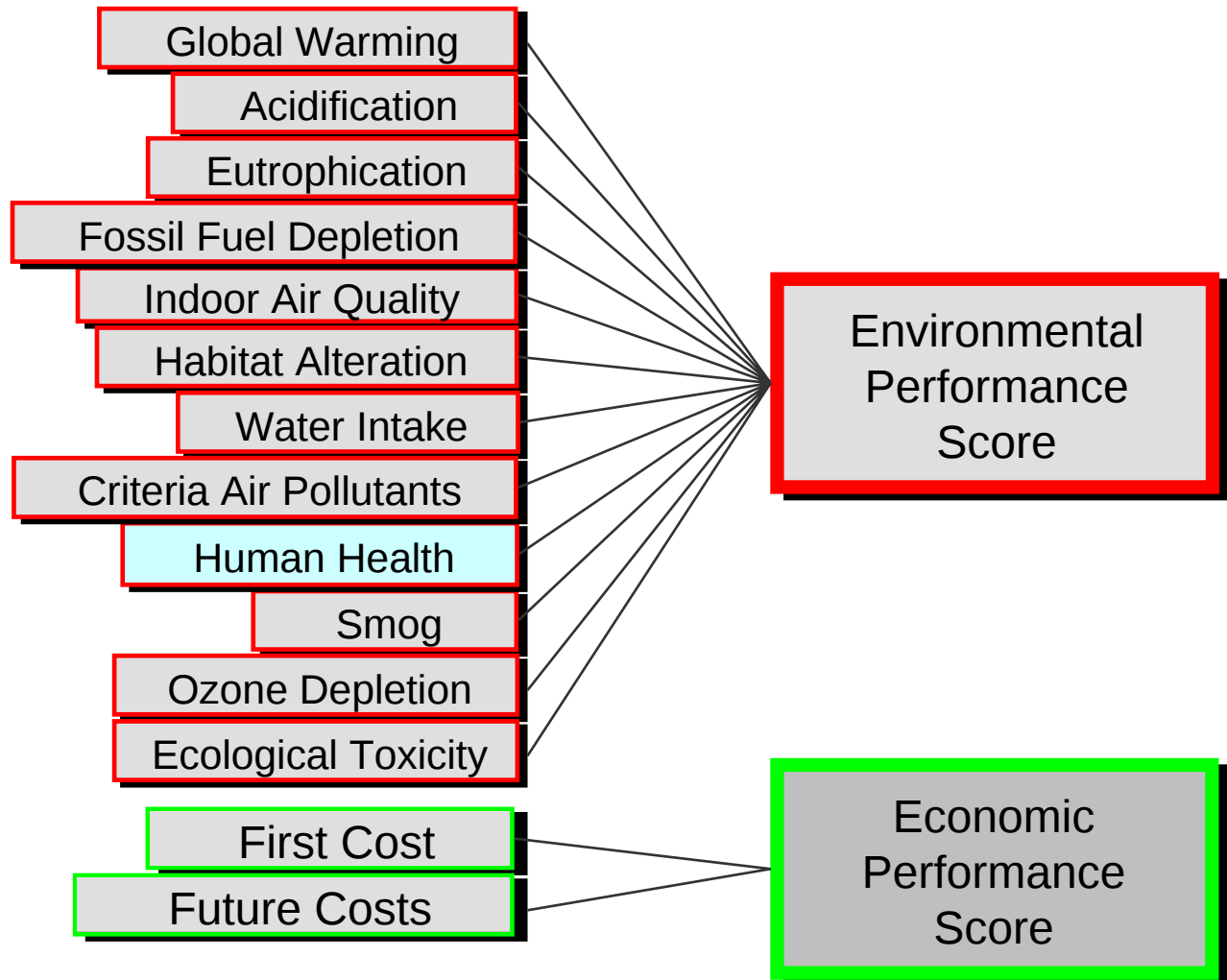
An economic analytical tool for estimating the total cost of acquisition and ownership of a system over its full life, including the cost of planning, development, manufacturing, acquisition, installation, operation, support, decommissioning, and disposal.

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

The BEES Model

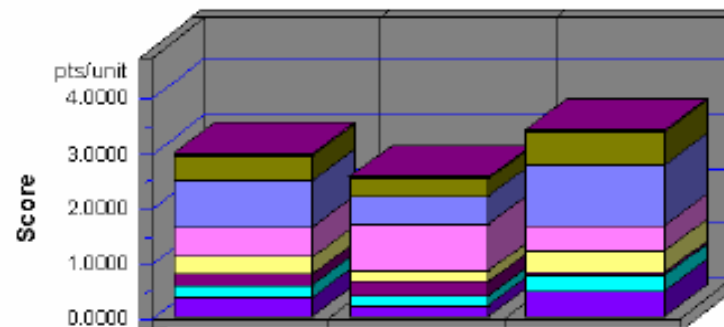
- BEES = Building for Environmental and Economic Sustainability
- Developed by National Institute of Standards and Technology (NIST)
 - Systematic methodology for selecting building projects
 - Methodology now applied to evaluate biobased materials
- Based on Consensus Standards
 - Life-Cycle Costing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

The BEES Model

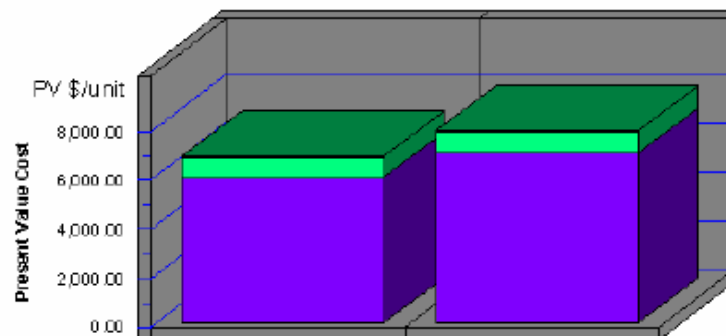
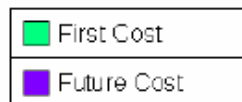


BEES Results

Environmental Performance



Economic Performance



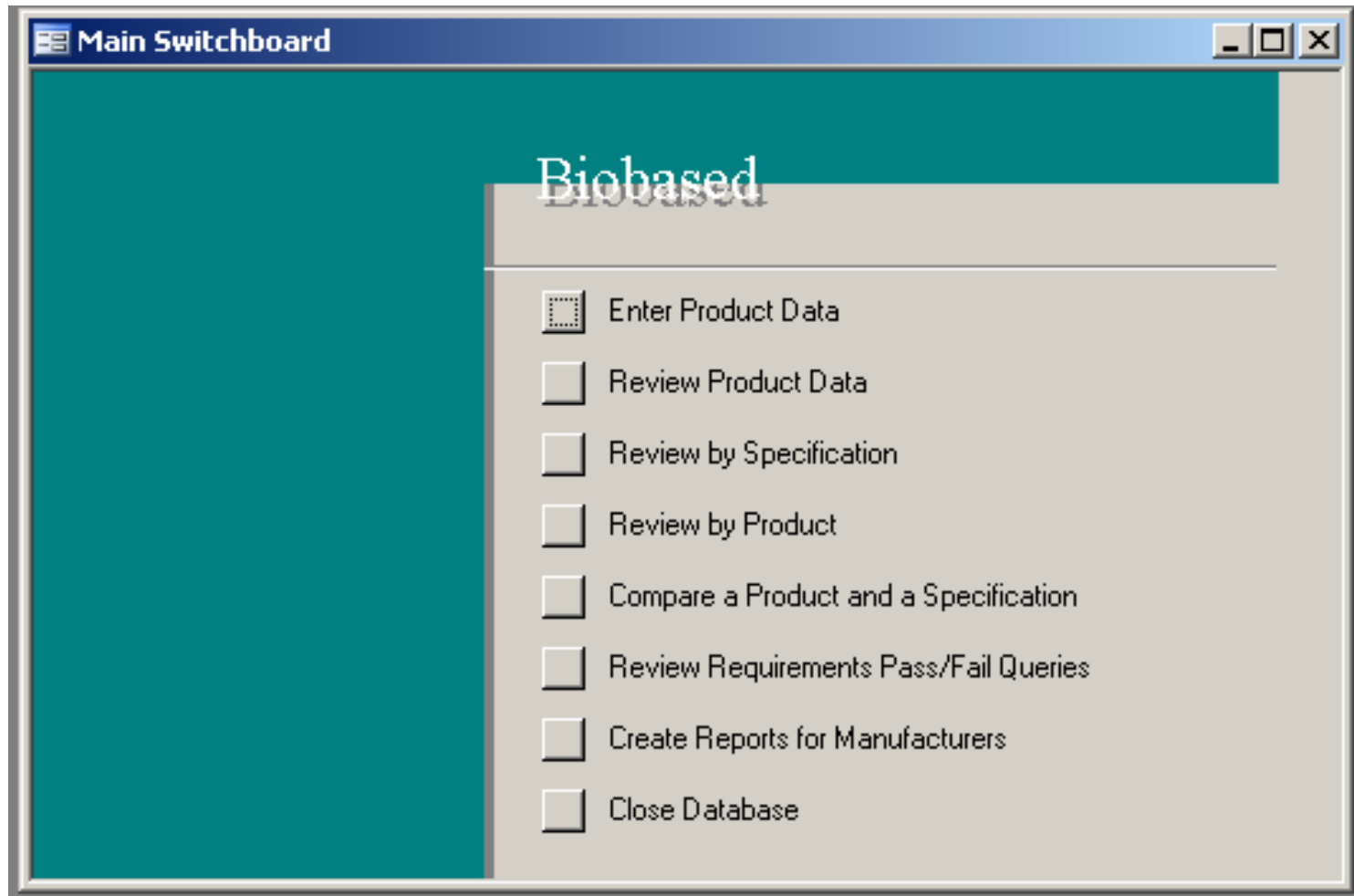
Technical Review

- 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
---	---

Meets Req.	Does Not Meet Req.	Not Enough Info	Select Property:	
			Kinematic Viscosity	

A-A-59290	☐ Meets ☐ Does Not Meet ☐ Not Enough	☐ Meets ☐ Does Not Meet ☐ Not Enough	☐ Meets ☐ Does Not Meet ☐ Not Enough	ASTM D 445: 9.0 cSt, minimum at 37.7°C (100°F)
A-A-59354	☐ Meets ☐ Does Not Meet ☐ Not Enough	☐ Meets ☐ Does Not Meet ☐ Not Enough	☐ Meets ☐ Does Not Meet ☐ Not Enough	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	☐ Meets ☐ Does Not Meet ☐ Not Enough	☐ Meets ☐ Does Not Meet ☐ Not Enough	☐ Meets ☐ Does Not Meet ☐ Not Enough	ASTM D 445: At 40°C: 38.5 - 45.5 cSt□At 100°C: min 4.8 cSt
MIL-H-81019	☐ Meets ☐ Does Not Meet ☐ Not Enough	☐ Meets ☐ Does Not Meet ☐ Not Enough	☐ Meets ☐ Does Not Meet ☐ Not Enough	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	☐ Meets ☐ Does Not Meet ☐ Not Enough	☐ Meets ☐ Does Not Meet ☐ Not Enough	☐ Meets ☐ Does Not Meet ☐ Not Enough	ASTM D 445: At 40°C & at -15°C, conform to the specified requirements for each grade. (see NOTE 1)

MIL-PRF-22072	☐ Meets ☐ Does Not Meet ☐ Not Enough	☐ Meets ☐ Does Not Meet ☐ Not Enough	☐ Meets ☐ Does Not Meet ☐ Not Enough	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	☐ Meets ☐ Does Not Meet ☐ Not Enough	☐ Meets ☐ Does Not Meet ☐ Not Enough	☐ Meets ☐ Does Not Meet ☐ Not Enough	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	☐ Meets ☐ Does Not Meet ☐ Not Enough	☐ Meets ☐ Does Not Meet ☐ Not Enough	☐ Meets ☐ Does Not Meet ☐ Not Enough	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	☐ Meets ☐ Does Not Meet ☐ Not Enough	☐ Meets ☐ Does Not Meet ☐ Not Enough	☐ Meets ☐ Does Not Meet ☐ Not Enough	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	☐ Meets ☐ Does Not Meet ☐ Not Enough	☐ Meets ☐ Does Not Meet ☐ Not Enough	☐ Meets ☐ Does Not Meet ☐ Not Enough	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

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.

Manufacturer: Sample Company

POC: John Doe

Address: Anywhere

Website:

E-mail Address:

Phone:

Biobased Content: 95%

Feedstock Type: Vegetable Oil

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

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

		Round 1:			Round 2:			Specification Requirement:
Product's Data:		Meets Req.	Does Not Meet Req.	Not Enough Info	Meets Req.	Does Not Meet Req.	Not Enough Info	
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, 221
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 4
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 TARC, MTP, 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
P.O.C: 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.

Page 1 of 27

A-A-59354 NOT 1

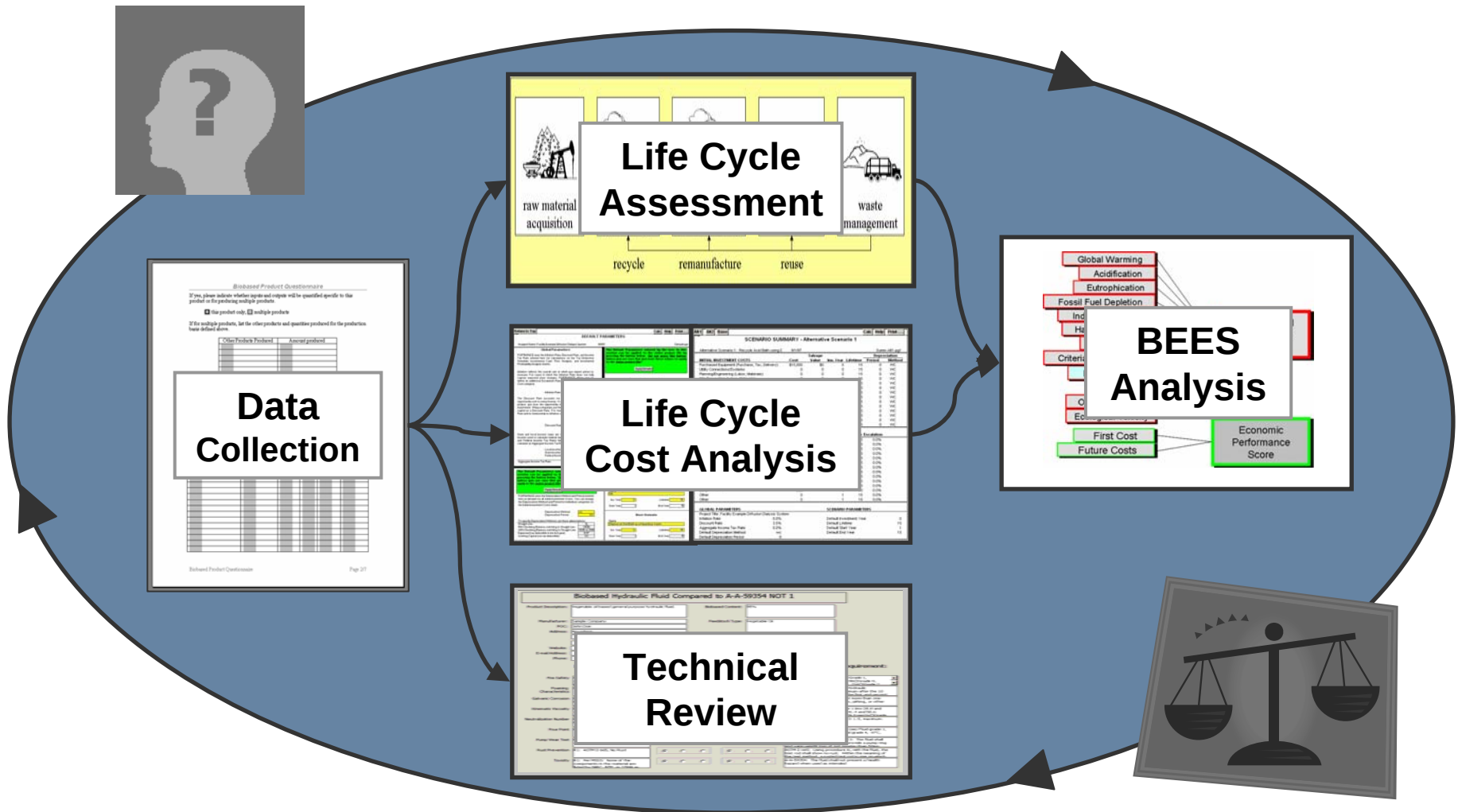
Biobased Hydraulic Fluid

	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:Flash 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 D 97, 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.

Page 2 of 27

Summary



Questions

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

Dr. Shannon Lloyd, CTC/NDCEE
614-444-5481
lloyds@ctc.com

Mr. George Handy, CTC/NDCEE
803-641-0203
handyg@ctc.com

Stakeholders

- **NDCEE Executive Agent** Mr. Tad Davis, DASA (ESOH)
- **NDCEE Program Director** Mr. Hew Wolfe, ODASA (ESOH)
- **NDCEE Program Manager** Dr. Charles Lechner, ODASA (ESOH)
- **Government Technical Monitors** Ms. Barbara Lippiatt, NIST
Mr. Linwood Gilman, DLA-DSCR
- **Government Stakeholders** Dr. Marvin Duncan, USDA
Dr. Roger Conway, USDA
Mr. Steven Devlin, ISU
Ms. Jessica Reidl, ISU
- **NDCEE Team Members** Mr. George Handy, CTC/NDCEE
Dr. Shannon Lloyd, CTC/NDCEE
Ms. Anne Kaltenhauser, CTC/NDCEE
Ms. Anne Landfield-Greig, Four Elements

This work was funded through the Office of the Assistant Secretary of the Army (Installations and Environment) and conducted under contract W74V8H-04-D-0005, Task N.0439.