

Support for Sustainability Decision Making: Framework, Methods, Tools

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The Institute for Sustainability

- A community of sustainability “practitioners”
 - Companies (Center for Sustainable Technology Practices)
 - Professionals—industry and academic (Sustainable Engineering Forum)
 - Youth (Youth Council for Sustainable Technology Practices)
- Organized under the American Institute of Chemical Engineers (AIChE)
 - Professional membership organization
 - Non-profit 501c(3)

IfS

Practitioners, students & companies

Sustainability Engineering Forum

745 AIChE members
950 additional non-
AIChE members
\$25 dues

Center for Sustainable Technology Practices

Industry Group
10 companies, growing

Air Products, BASF, Cytec,
Dow, FMC, Honeywell
Interface Inc. ,
Middough (WalMart)

Youth Council on Sustainable Sciences & Technologies

Partnership w/ SustainUS
9750 students, growing

Incorporates sustainability
into undergrad research,
sponsors awards & student
chapters

Projects of IfS 1. Sustainability Index

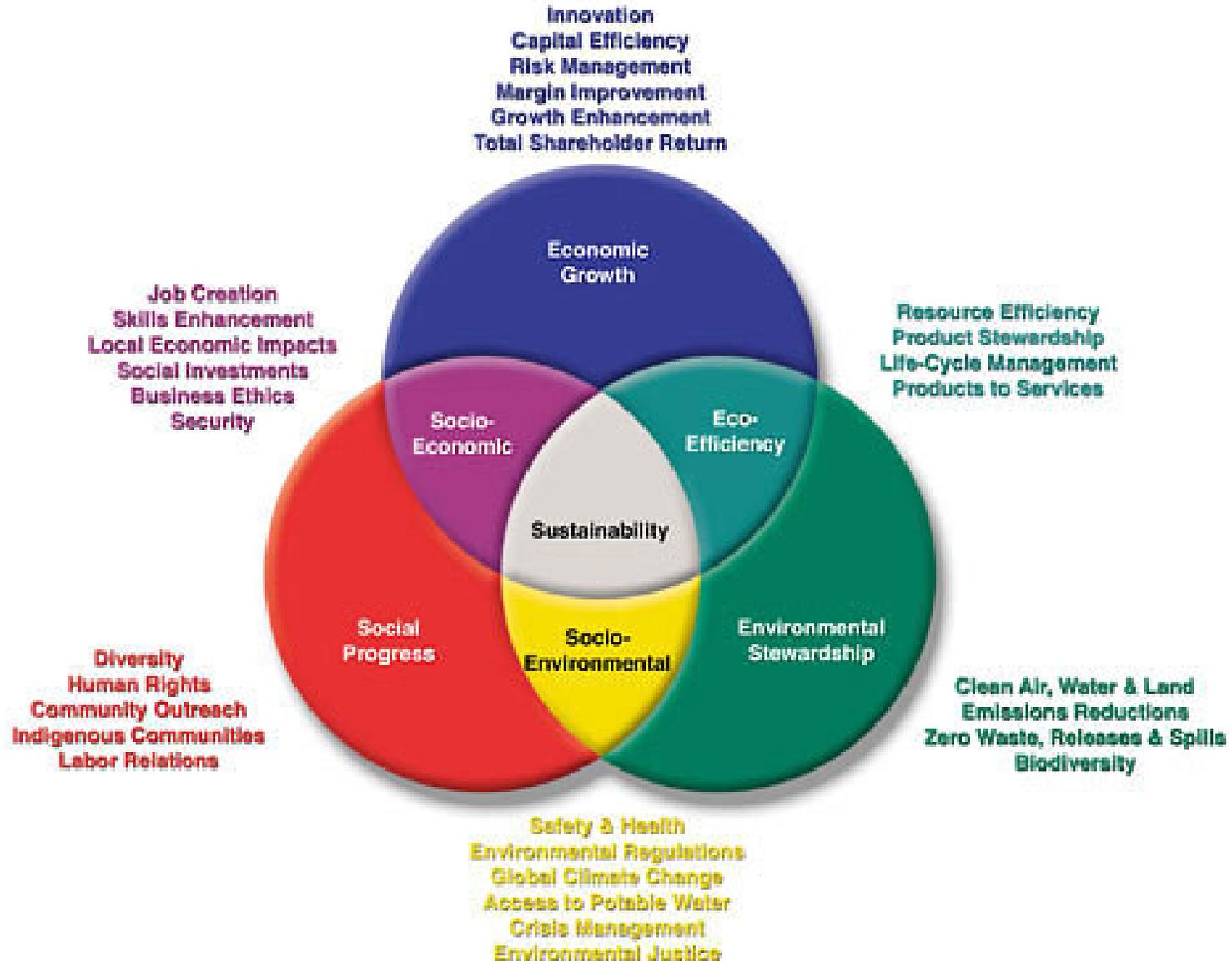
Purpose of financial guidance,
benchmarking & management
Differential to other indices
Potential for high profitability

2. ICOSSE Aug 09

Mission: to serve the needs of and influence the efforts of professionals, academes, industries, and governmental bodies that contribute to the advancement of sustainability and sustainable development.

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Triple Bottom Line: A Business View of Sustainability



“Sustainability is a path of continuous improvement, wherein the products and services required by society are delivered with progressively less negative impact upon the Earth”

The Road To Sustainability

Impact Assessment
Risk Assessment
Risk Management

Benign
by Design

WASTE
MINIMIZATION



Computer
Modeling

Green
Chemistry
CLEAN CATALYSTS

SEPARATION
TECHNOLOGIES

Clean
Products

Ecosystems
Modeling

CLEAN ENERGY
Renewable Sources
Electrochemistry
Solar, Wind, Biomass

Credit Trading
Design

Watershed
Protection

Industrial
Ecology

SLOW
Roadwork
Ahead

Life Cycle
Assessment
(LCA)

Systems
Analysis

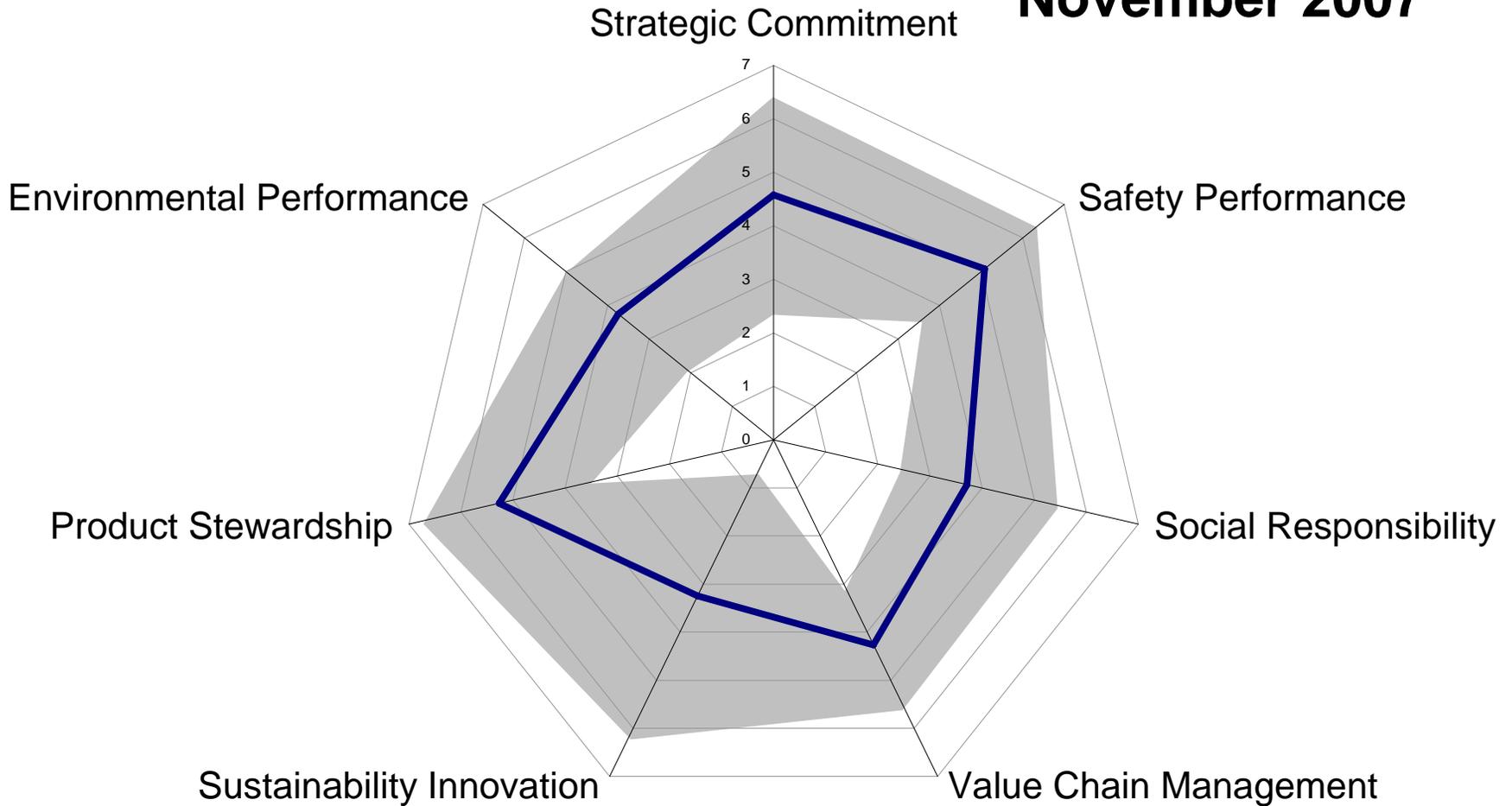
How is your Company's Sustainability Performance Viewed?

- By the community?
- By your shareholders?
- By your customers?
- Versus your peers?

The AIChE Sustainability Index™

AIChE Sustainability Index™ for the Chemical Industry

November 2007



Gray Shading = Ranges of individual company scores

Blue Line = Simple average of 11 representative companies

Purpose of a Sustainability Index

- Investment guides
 - » Ethical investment/SRI
 - » Long-term return (“stock picks”)
- Stock market indices
- Stakeholder ratings
- Benchmarks for company management

Examples of Financial SI's

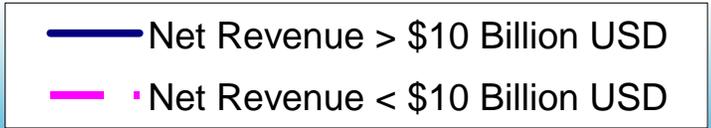
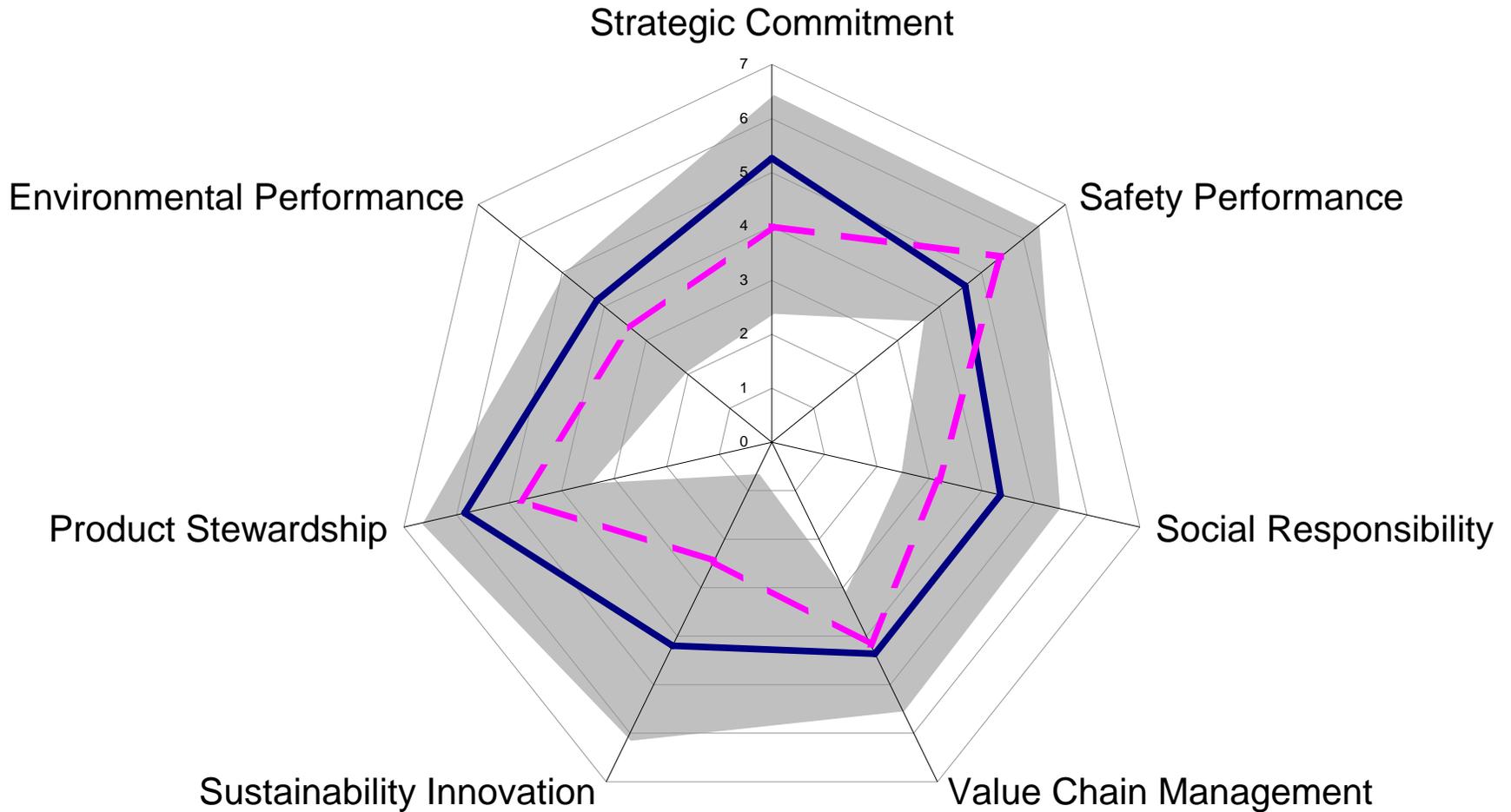
	Investment Guide?	Market Index?	Management Benchmark?	Consult to Companies?
DJSI	✓	✓	✓	✓
FTSE-4Good	✓	✓	✓	✓
GS- Sustain	✓	✗	✓	✗
Innovest	✓	✗	✓	✓

What a Company Can Get from Financial SI's

- Dow Jones Sustainability Indexes
 - Benchmarking with peers, advisory
- FTSE4Good
 - “Guidance and support” for companies to work towards inclusion in FTSE4Good – through EIRIS
- GS SUSTAIN
 - (none specific to sustainability and its ESG analysis)
- Innovest
 - “Confidential custom benchmarking studies” for companies – operational efficiency and business opportunities per peer analysis

Concept of the AIChE Sustainability Index™

- Based on the Wright Killen Refinery Survival Index (Oil and Gas Journal)
- Meant to fill a gap:
 - Relies more heavily on quantitative performance indicators
 - Provides a *heavier weighting* applied to various indicators of safety and environmental performance and to technological innovation towards SD
 - Available to range of sectors, company size
 - The scoring: robust methodology designed to account for subjectivity in a transparent manner.
- Designed to avoid the ‘black box’ problem of other indices
- Intended for executives and directors to manage company business lines
- Global, initially focusing on major chemical companies
- Publication remains silent on individual company ratings
- Companies find it useful to benchmark themselves relative to a set of companies



How is your Company's Sustainability Performance Enhanced?

- Via the value chain?
- by corporate decision making?
- by job function?

The CSTP Sustainability Roadmap

A Process for Sustainable Decision Making



- CSTP formed in 2004 as part of the AIChE's Institute for Sustainability
- Supported by member companies
- Tailored collaborative projects and pre-competitive research
- Monthly sustainability education "virtual" sessions
- Utilize members to conduct project work
 - Project: Development of Case studies and evaluation of Decision Support Tools in industrial Use
 - Project: Focus Groups for Survey of Sustainability in the Chemical Industry (PriceWaterhouse Coopers)
 - Project: R&D Checklist for Sustainability
 - Project: [Sustainability Roadmap](#)

- **Project: EPA Grant 2005: Case Studies of Industry Decision Support tools for Sustainability**
- *Identified gaps & challenges*
 - Great tools, not widely used
 - Need for better integration of sustainability into business processes
 - Understand context of management and technology decisions along value chain
 - Understand key decision points, relevant SD considerations, and key functional areas/decision makers involved
 - Need to understand the broader set of tools, approaches, and other resources to help integrate SD into the organization

Potential for Improvement

SD Roadmap Summary Table

- 192 Key Sustainability Questions
- Where to ask them during process and product development
- Who should be included in the “answers?”

Microsoft Excel - Summary Table Completed.xls				
A	B	C	D	E
1	CSTP SD Roadmap - Summary Table			
2	Revised July 17, 2007			
3				
4	Sustainability Considerations	Assessment	Rating ■ Serious Concerns ■ Some Concerns ■ Good	Assessed by
14	<ul style="list-style-type: none"> What policies and processes are in place to assure sustainable performance of the supply chain (e.g. EMS requirements)? 	Gov. and private regulations on sustainable agriculture practices	Green	
15	<ul style="list-style-type: none"> What tools are available to evaluate the sustainability performance of the supply chain? 	Few formal tools, Net Energy Balance gives good, comprehensive evaluation, GREET model measures air/CHG emissions	Yellow	Certification & Services n.d., Code o
16	Supply Chain & Product Stewardship			
17	<ul style="list-style-type: none"> Which supply chain partners are aware of and interested in sustainability and what are their sustainability standards and needs? 	Oil/automotive companies who dictate end use of product may not support sustainability, Process otherwise sustainable in many aspects	Yellow	Pimentel (2003), Ethanol: Energy W
18	<ul style="list-style-type: none"> Which potential supply chain partners are positioned to support a sustainable technology initiative/product/process? 	BP energy company has invested millions in biofuel research, Some oil companies oppose ethanol	Yellow	Brower (2007)
19	<ul style="list-style-type: none"> What opportunities exist for industrial symbiosis and shared information? 	Process/Product more at a development stage, Much symbiosis among supply chain and by product use	Green	Energy Efficiency and (2006)
20	Stakeholder Engagement			
21	<ul style="list-style-type: none"> Who are the key SD stakeholders (internal & external, along the supply chain) and how does the company communicate with them (e.g. employees, shareholders, NGOs, governments)? 	Government organizations, private farmers, etc., The breadth of the operation may limit communication possibilities	Yellow	Neuhauser et al. (1999)
22	<ul style="list-style-type: none"> Does the company participate in external SD organizations/coalitions/initiatives that can provide guidance or input? 	CSTP	Green	About the WBCSD n.d, Strengtheni
23	<ul style="list-style-type: none"> What are the sustainability standards of your business partners? 	Oil/automotive companies are key partners	Red	
24	Resource Usage: energy, land, water			
25	Energy Use			
26	<ul style="list-style-type: none"> How energy intensive is the feedstock? Which feedstock materials are the most energy intensive and are there energy-efficient alternatives? 	High NEB reflects low energy intensity, Small use of fertilizers and almost non-resistant use of pesticide/herbicide	Green	
27	<ul style="list-style-type: none"> Can the feedstock be produced using renewable energy? 	Biodiesel for farm equipment, but no good alternative for fertilizer	Yellow	Positive Impacts n.d.
28	<ul style="list-style-type: none"> Can any byproducts be used as energy? 	Lignin, ground and burned to produce electricity	Green	Brower (2007)

Environmental	Resource Use	Energy use, material intensity, water use, land use
	Environmental Impact	GHG emissions, air emissions, solid waste, (pollutant effects)
Social	Health & Safety	Toxic reduction, hazards, process safety
	Societal Impact	Workers' well-being, local community impacts/QOL, global societal impacts/contributions
Econ.	Economic Impact	Financials along value-chain (corporate, customers, ...)
Business Perspective	Management	Internal process, value-chain partnership, stakeholder engagement
	Business Strategy	Alignment with business strategy, core values & competencies, market & regulatory drivers

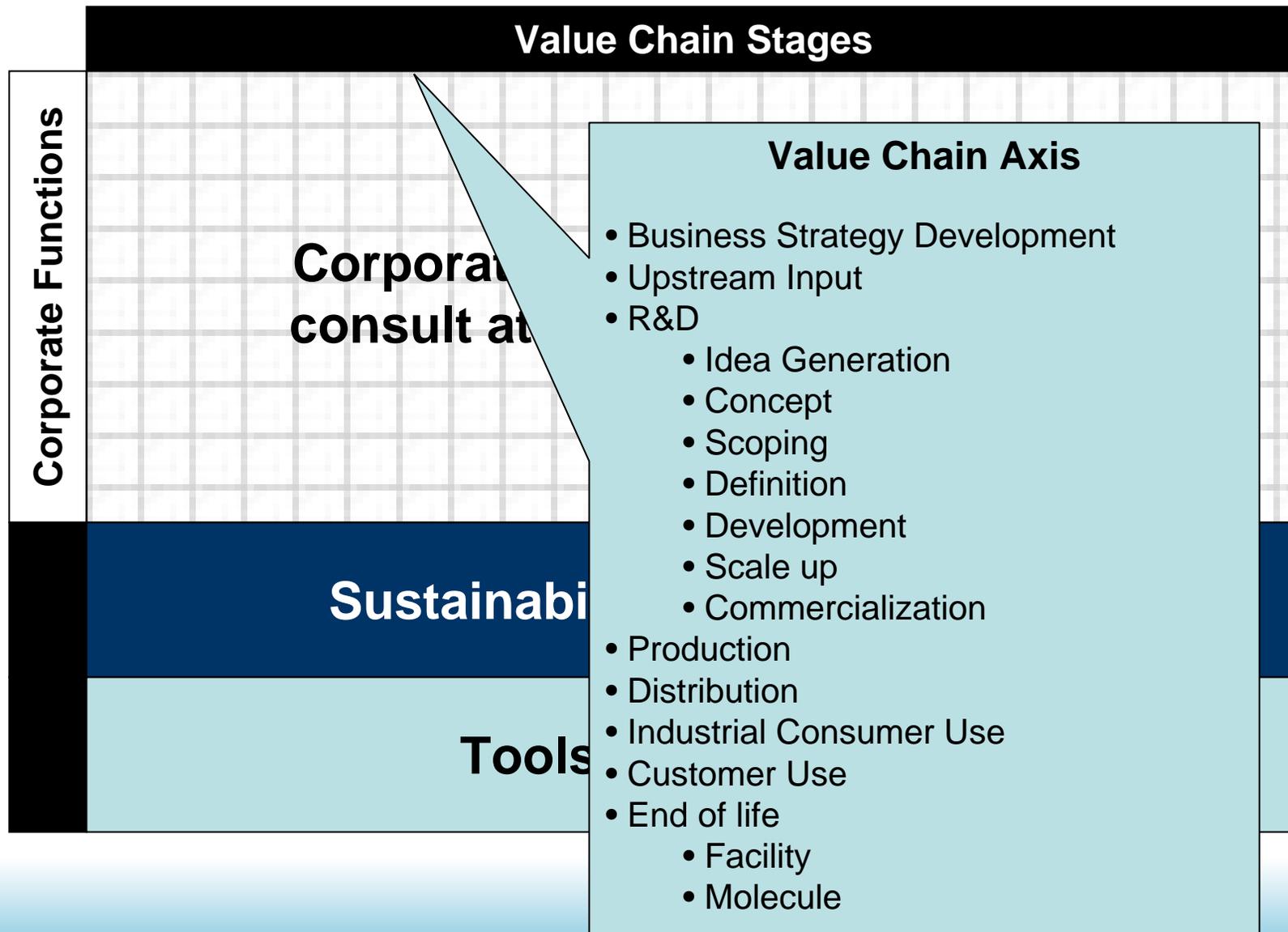
Value Chain Stages

Corporate Functions

**Corporate functions to involve or consult at each value chain stage.
(RACI Chart)**

Sustainability considerations

Tools & Resources



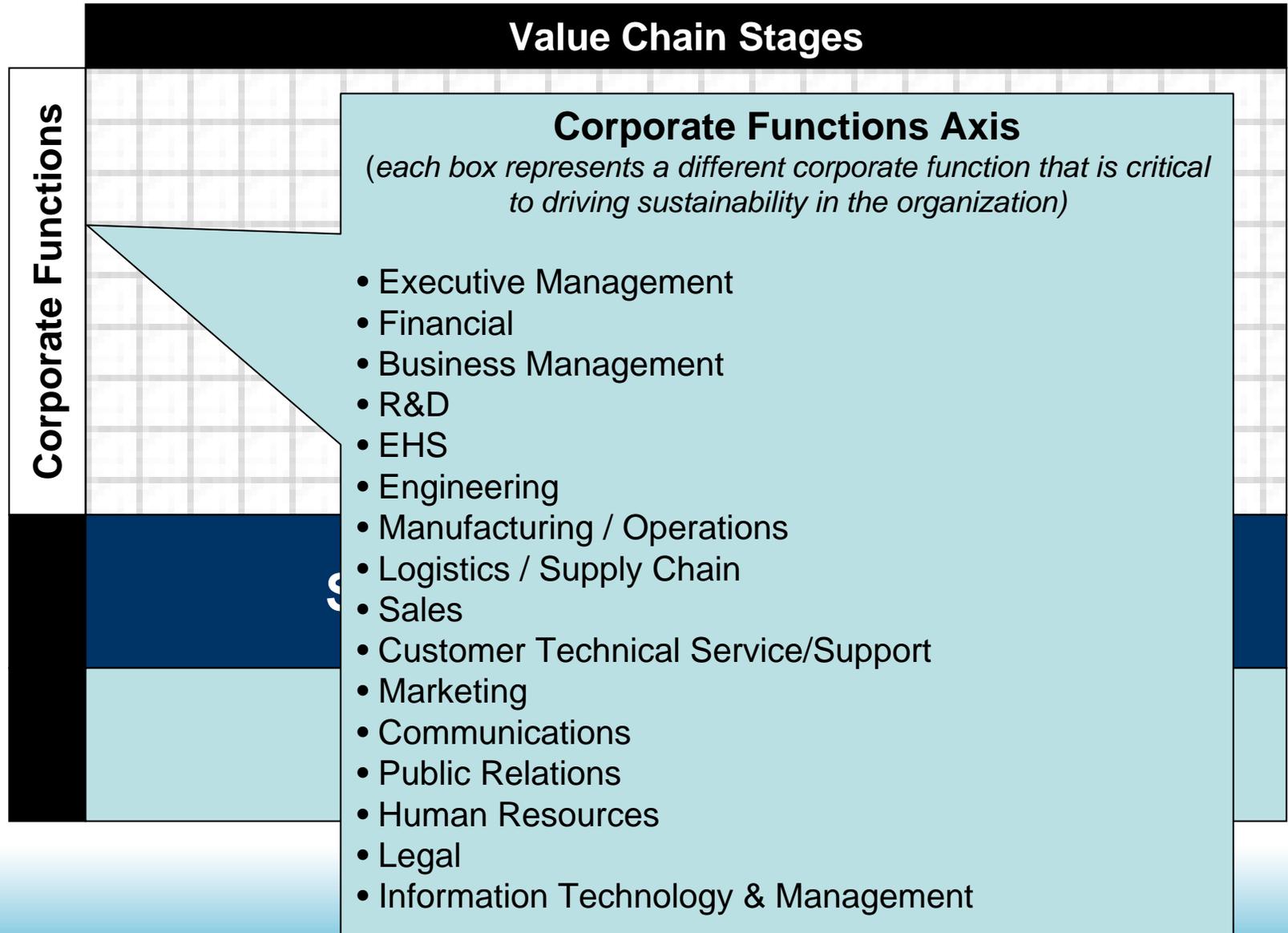
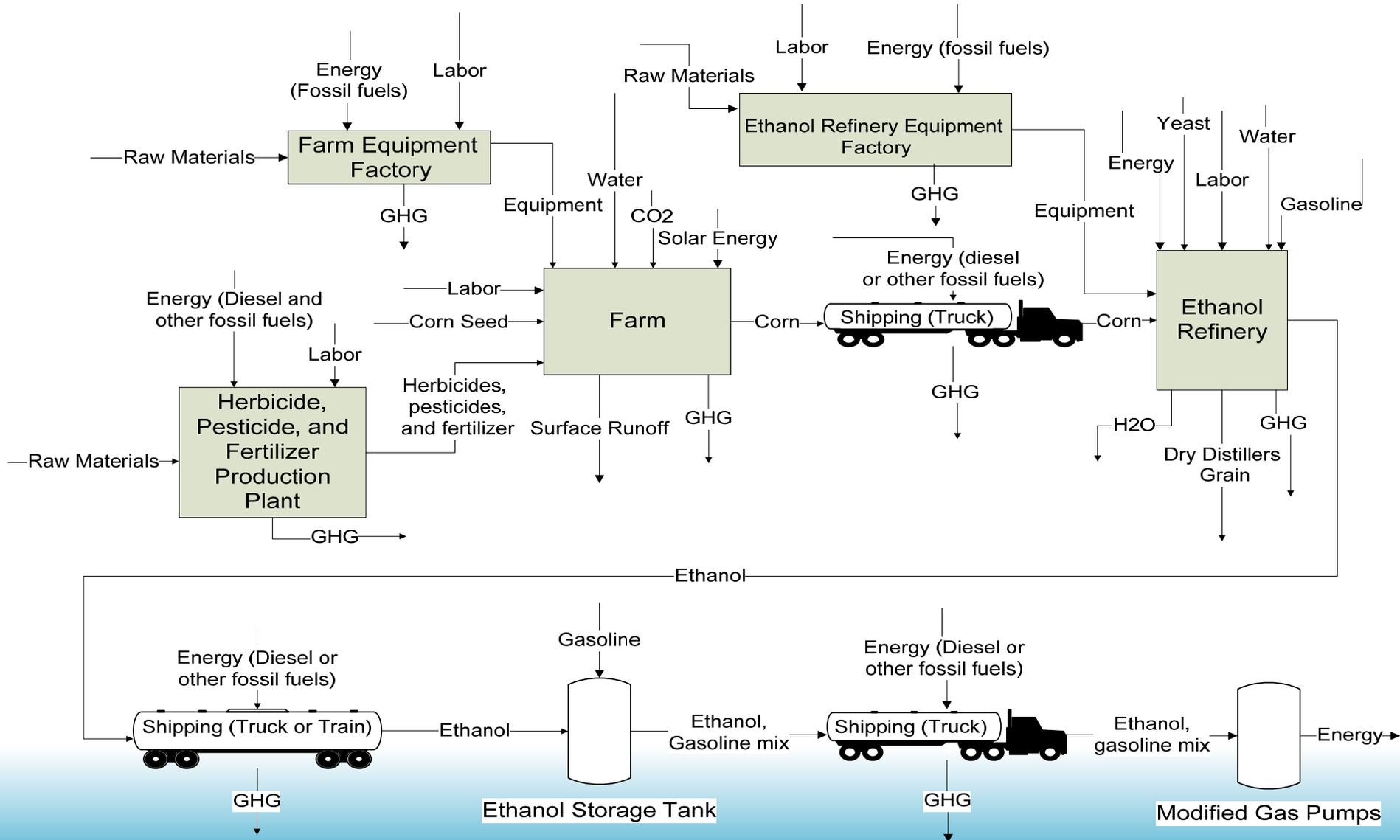


Illustration of Roadmap

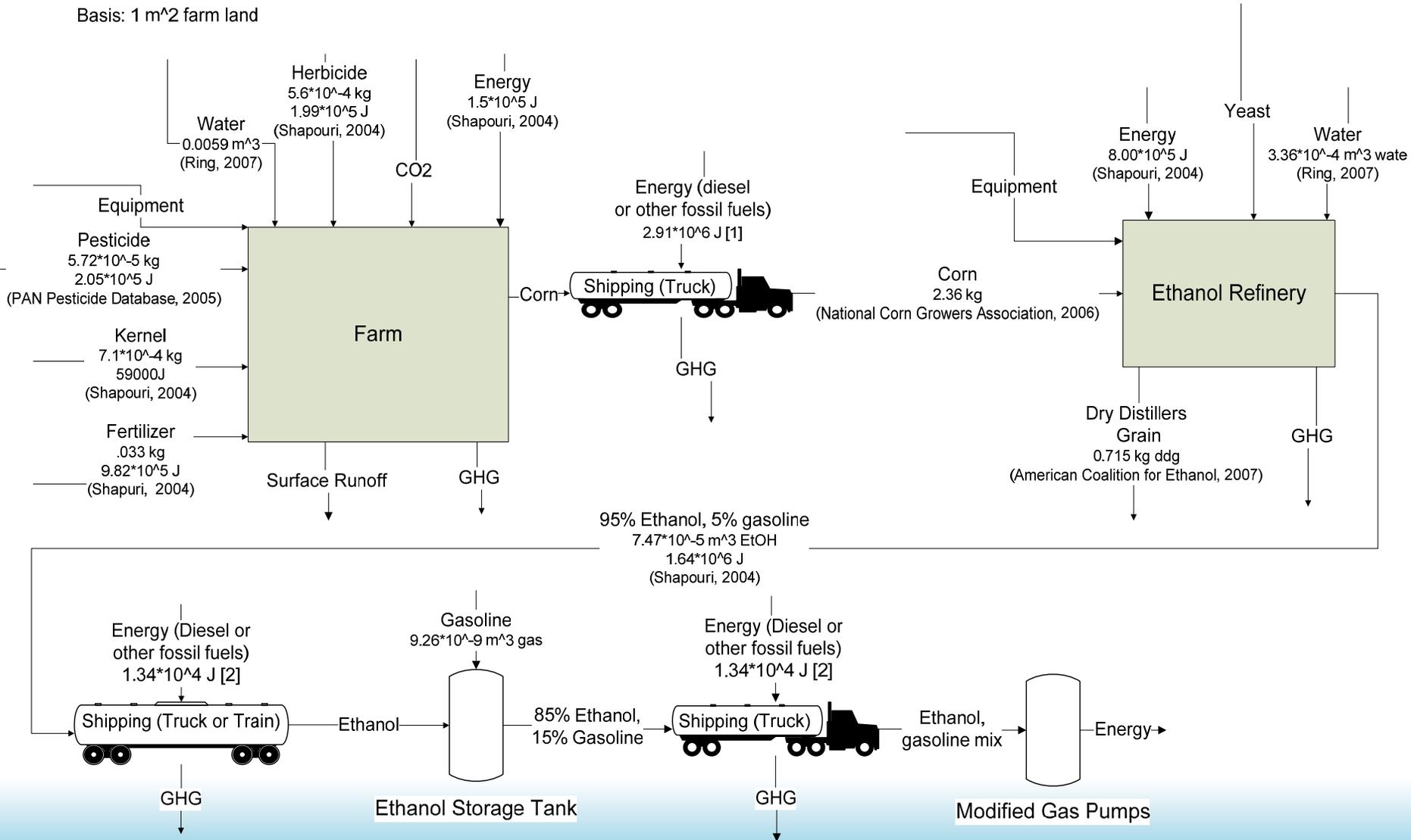
- “Evaluation of Biofuels Processing Plant—Upstate New York”.
 - Reuse of existing brownfields site
 - Possible Feedstocks: Corn; Willow
- Stages of Roadmap to Illustrate:
 - Upstream Input Stage (show examples)
 - Commercialization Stage (in progress)
- Provide feedback on criteria, questions
- Partner with Lafayette College cross functional team

Process of Evaluation Corn Ethanol Process Flow Diagram

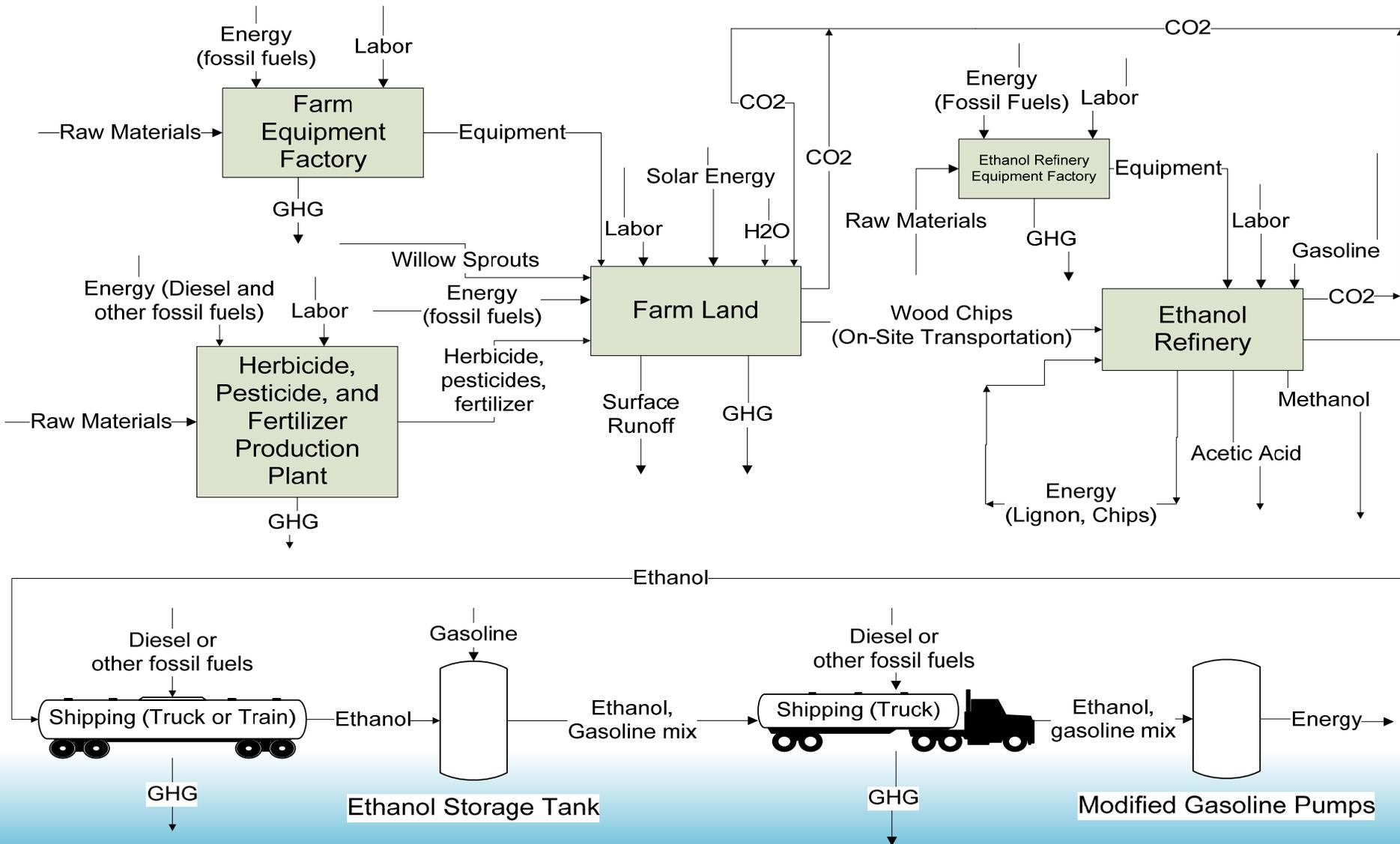


Process of Evaluation Corn Ethanol Energy Balance

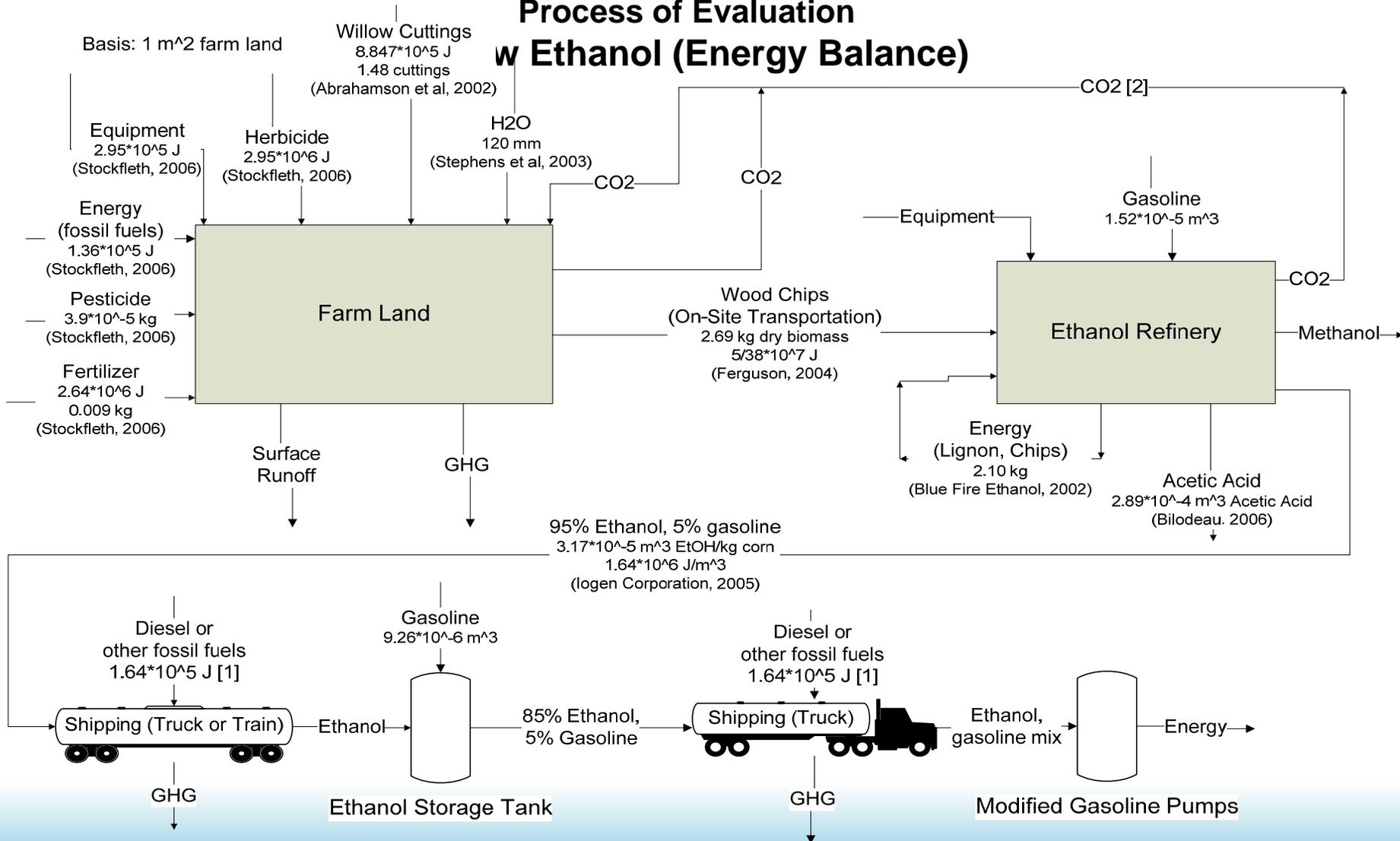
Basis: 1 m² farm land



Process of Evaluation Willow Ethanol Process Flow Diagram



Process of Evaluation w Ethanol (Energy Balance)



What the Guide Does

- Provides list of considerations asked as questions by key decision makers at each stage
 - Ability to score responses
 - Track improvement to sustainability concepts through each stage
- Provides list of resources and tools

The Energy Solution in 1974

- World Energy Study – The Pace Company
- Optimized the World's demand/supply/price
- The answer
 - Nuclear and coal for electricity production
 - Natural gas for space heating of homes and businesses
 - Liquid hydrocarbons for transportation fuel and chemical feedstocks
 - The rest doesn't matter much – solar, hydro, geothermal, bio

What if we want to replace 10%?

- 10 Million barrels per day
 - 150 billion gallons per year
 - 1.1 trillion pounds per year
- Ethanol – 200 times the National Energy Plan target
- 550 plants equivalent to a world-scale ethylene plant

How Do you Make A “Sustainable” Decisions?

- Accounts for Intangibles Evaluation
- Provides a more complete evaluation of costs and benefits with associated RISKS
- Aids managers to make informed decisions about
 - Environmental
 - Health
 - Safety
 - Societal opportunities and Impacts

The Total Cost Assessment Methodology

Some Mental Arithmetic – How Big is Oil?

- Demand Forecast (EIA)
 - 2002 78 MMBPD
 - 2015 103 MMBPD
 - 2025 119 MMBPD
- How much is 100 million barrels per day?
 - 4.2 billion gallons per day
 - 36.5 billion barrels per year
 - 1.5 trillion gallons per year
 - 11 trillion pounds per year

What if we want to replace 10%?

- 10 Million barrels per day
 - 150 billion gallons per year
 - 1.1 trillion pounds per year
- Ethanol – 200 times the National Energy Plan target
- 550 plants equivalent to a world-scale ethylene plant

What to measure?

- Energy demand
 - Efficiency
 - Conservation
 - New technology
- Energy supply
 - Innovation
 - New technology development

Five Cost Types Distinguished

- Type I: Direct
- Type II: Indirect
- Type III: Contingent Liability
- Type IV: Intangibles
- Type V: External

Cost Types

<i>Cost Type</i>	<i>Description</i>	<i>Examples</i>
I. Direct costs	Manufacturing site costs	Capital investment, operating, labor, materials, and waste disposal costs
II. Indirect costs	Corporate and manufacturing overhead	Reporting costs, regulatory costs, and monitoring costs
III. Future and contingent liability costs	Potential fines, penalties and future liabilities	Clean-up, personal injury, and property damage lawsuits; industrial accident costs.
IV. Intangible internal costs (Company-paid)	Difficult-to-measure but real costs borne by the company	Cost to maintain customer loyalty, worker morale, union relations, and community relations.
V. External costs (Not currently paid by the company)	Costs borne by society	Effect of operations on housing costs, degradation of habitat, effect of pollution on human health

Total Cost Assessment—How do you do it?

- Step 1 – define goal and scope
- Step 2 – streamline the analysis
- Step 3 – identify potential risks
- Step 4 – conduct financial inventory
- Step 5 – conduct impact assessment
- Step 6 – feedback to decision-making loop

Alternatives → Scenarios

How could decision or course of action impact *timing, likelihood, or relevance* of:

- Future environmental regulations
- Accidents, spills, equipment failures
- Non-compliance incidents
- Worker health/safety incidents
- Interruption of supply for major inputs
- Significant and long-term shifts of costs
- Shifts in market share
- Actions/pressure from one or more stakeholders

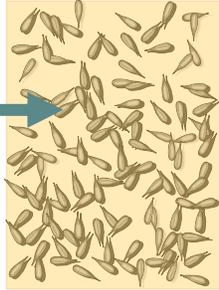
Scenarios → Costs

- For each possible event with altered timing, likelihood, or relevance:
 - What are the possible cost impacts?
 - Direct costs / impacts
 - Long-term / “secondary” impacts
 - Customer loyalty
 - Employee attraction/retention/morale/productivity
 - Brand value
 - “License to operate” (local, state, federal)
 - Timing, duration, magnitudes

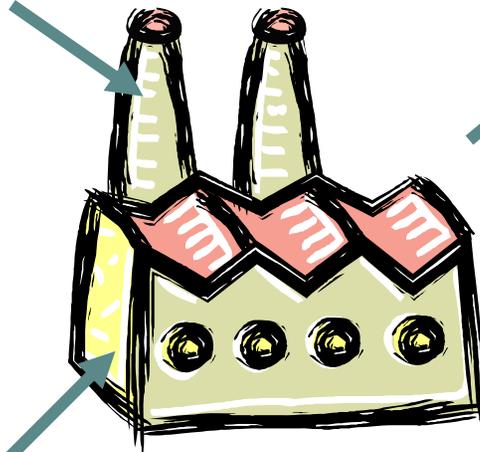
Bio Project Boundaries



Seed Crops



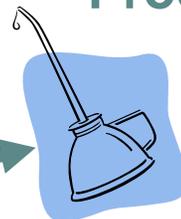
Used cooking oil



Bio Plant



Products



By-Products



Fodder

Summary

- Many decision support tools
 - Overall Company Benchmarks
 - Project development guides
 - Decision making assessments
- Transparent
- Importance of assumptions and boundaries

**All the benefits & blessings
flowing from the use of the
earth were held to be the
rightful heritage of all
generations**

The Old Testament-
Genesis & Deuteronomy

**“...treat the earth as though we
are tenants, rather than
owners”we must leave
behind ‘enough and as good’ for
others”**

John Locke, Two Treatises of
Government, 1689

**“Then I say the earth belongs to
each...generation during its course...no
generation may contract debts greater
than may be paid during the course of its
own existence”**

Thomas Jefferson, 1789

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