



Strategies for Life Cycle Thinking and Product Sustainability at GE


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Introduction



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Aspire Sustainability
Albany, NY

BS Chemical Engineering, Virginia Tech
MS Chemical Engineering, University of Connecticut
PhD Chemical Engineering, University of Connecticut


Founder & Director, GE Ecoassessment Center of Excellence
26 years at GE; 10+ years focused on product sustainability


Chair, Board of Directors
American Center for Life Cycle Assessment (ACLCA)

GE Ecoassessment Center of Excellence

- Expertise and guidance
 - ✓ Life cycle assessment (LCA)
 - ✓ Life cycle management (LCM)
 - ✓ Carbon, energy, water footprint
 - ✓ Eco-design/Design for Environment principles & processes
- Tools and resources
- Education and awareness
- External networks


Cast of Characters (left-to-right):
Ron Wroczynski
Angela Fisher
Bill Flanagan
Matt Pietrzykowski



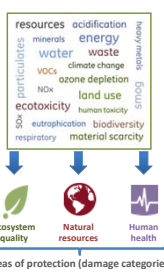


Life Cycle Assessment (LCA)

Assess overall environmental impact throughout a product or service's life cycle




More than just
carbon footprint



A method to understand the net environmental impact of a product/service across its value chain, how and where to make improvements

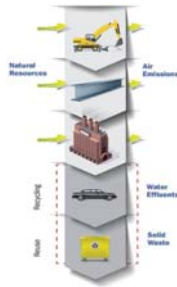
- Differentiate products
- Evaluate alternatives
- Prioritize opportunities for improvement
- Mitigate environmental issues

Areas of protection (damage categories)



What can LCA do?

- Highlight value chain efficiency opportunities
- Promote understanding of product manufacture and delivery systems
- Identify areas in value chain that need improvement
- Ensure that changes do not "shift the burden"
- Identify trade offs
- Compare two systems that deliver same service
- Benchmark progress
- Provide footprinting data
- Support environmental claims



Source: Executive Guide – How to Know If and When It's Time to Commission a Life Cycle Assessment, International Council of Chemical Associations (ICCA)

Life cycle approaches: what works best

Basic Questions

- What are you trying to accomplish?
- What questions are you answering?
- Who will use the results?

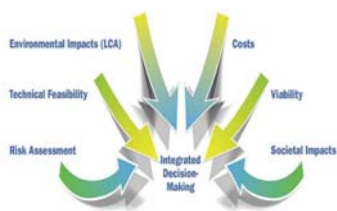
Types of life cycle studies

- Qualitative approaches
- Scoping, Screening and Simplified LCAs
- Comprehensive Complete LCAs
- Product Comparisons
- Attributional and Consequential LCAs
- Economic Input-Output LCAs



Adapted from: Executive Guide – How to Know If and When It's Time to Commission a Life Cycle Assessment, International Council of Chemical Associations (ICCA)

Integrated decision making



Source: Executive Guide – How to Know If and When It's Time to Commission a Life Cycle Assessment, International Council of Chemical Associations (ICCA)

Context is important



GE Diversity

~300,000
Employees
~170
Countries



Power



Energy Connections



Oil & Gas



GE Renewables



Healthcare



Aviation



Transportation



Current

Digital • Global Operations • Global Research
Global Growth Organization • Capital

Variety of internal stakeholders & products

Ecomagination launched in 2005



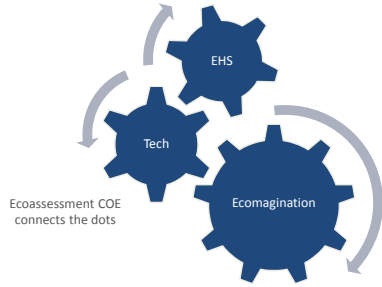
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Bridging the divide...



Why is life cycle thinking important to GE?

The world has changed. Environmental pressures are increasing. Product environmental policies are emerging. Sustainability requirements are being incorporated into procurement processes.

Companies need to be prepared for emerging life cycle-based regulatory and stakeholder expectations.

Direct value creation

- Product differentiation (market share)
- Market access (meet customer requirements)

Indirect value creation

- Prepare for changing regulatory landscape
- Risk avoidance / due diligence
- GE credibility and reputation
- Policy influencing
- Customer engagement



Two quick examples of LCA in action!



+PLUSPAK™

"GE Healthcare's new polymer bottle 'possesses far superior ecological benefits' than glass equivalent"
-Victoria Knowles, 2degrees

"From creation to disposal: Why switching to polymer bottles may help protect the environment... and hospital budgets"
-Business Wire



GE Healthcare +PLUSPAK™ polymer bottle

Product Overview

GE Healthcare's +PLUSPAK™ polymer bottle for contrast media offers significant advantages over traditional glass packaging, including decreased cost of waste disposal, reduced storage, and improved workplace safety for health care workers who administer contrast media to patients.

Purpose/Driver of LCA

Provide detailed insight about environmental benefits and trade-offs to customers

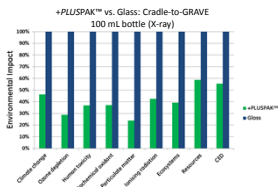
Scope of LCA

Detailed LCA reviewed by third-party critical review panel per ISO 14044



Value creation = Product differentiation

Results: +PLUSPAK™ polymer bottle



Results normalized relative to glass bottle within each impact category

+PLUSPAK™ has lower environmental impacts compared to glass bottles for all impact categories studied

Results/Lessons learned
+PLUSPAK polymer bottle environmentally preferable over glass packaging alternative

Impacts/Successes

- Study published in the premiere peer-reviewed *International Journal of Life Cycle Assessment*
- Conference paper at European Congress of Radiology 2015
- White paper available
- Keynote: Sustainable Packaging Symposium 2012



Single-use process technology for monoclonal antibody production

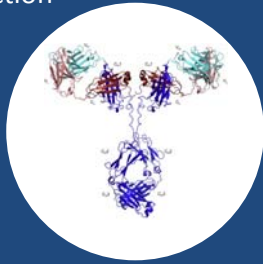


Image credit: R. Rosett, D. Lowe, D. Christ, "Stability engineering of the human antibody repertoire," FEBS Letters, 588(2): 269-272, 2014.

Single-Use bioprocess technology

Product Overview

GEHC's full process train solution for monoclonal antibody production

Purpose/Driver of LCA

To compare the potential environmental impacts of multi-use vs. single-use process technology, and to use the results in marketing (industry-wide messaging and direct customer engagement)

Scope of LCA

Detailed LCA with 3rd-party panel critical review to ISO 14040-44 standards

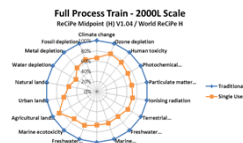


Value Creation = Product Differentiation: single use process more environmentally beneficial than traditional process



20

Results: Single-use bioprocess technology



Results/Lessons Learned

Single Use technology exhibits lower environmental impact across the full life cycle

- reduction of WFI, process water, steam
 - less requirement for CIP/SIP
- Single Use technology does show larger environmental burdens at end of life, but these impacts are minor relative to use phase energy and water savings

Impacts/Successes

- Used quantitative LCA to change industry perception regarding a non-intuitive result
- Published in peer-reviewed *Journal of Cleaner Production*
- Published in *BiPharm International*
- White Paper available

Transforming industry perception



21

Back to our story...



Appropriate use of LCA

- ✔ **A tool that supports a broader product sustainability strategy**
- ✔ **A quantitative method to understand life cycle impacts**
 - Understand environmental impacts across life cycle
 - Identify most impactful materials, processes, activities
 - Design new products/processes with reduced impacts
 - Communicate life cycle environmental benefits
- ✔ **Most powerful when used comparatively**
 - Different technologies (e.g., CFL vs. incandescent)
 - Design choices (materials, processes, business models)
 - Tradeoffs (e.g., mercury in CFL vs. energy savings)
 - Burden shifts (e.g., EV shifts energy demand from gasoline to grid)

LCA is **NOT**:

- ❌ An environmental risk assessment tool
- ❌ A chemical hazards management tool
- ❌ A product regulatory compliance management tool



What about chemical hazards and substances of concern in LCA?

LCA Methodologies

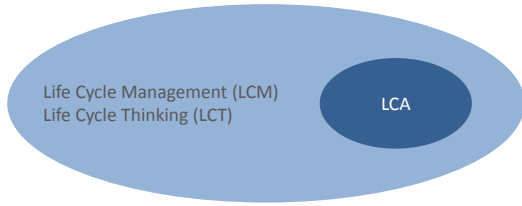
Global rather than local perspective
Life Cycle Impact Assessment (LCIA) methods do include human and ecological toxicity impact categories
Characterization factors may not be available for your specific substances of interest
Focused toxicological methodologies have been developed (e.g., USETox)

Data collection

LCA can involve collecting a LOT of data
Minor constituents can be overlooked
Specific data collection on substances of concern CAN be coupled with LCA data collection



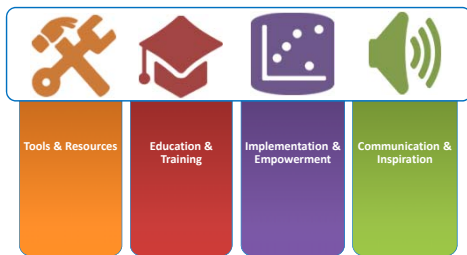
A "broader product sustainability strategy"...



Product Sustainability Roadmap – Four Pillars



Product Sustainability Roadmap - Four Pillars



Tools & Resources

Time Investment

Level of Detail / Extensiveness

- Level 1 offers ability to apply qualitative life cycle thinking early and broadly
- Level 2 screening LCA available to all
- Level 3 & 4 LCA expert resources available

4 Detailed LCA per ISO 14044

3 Streamlined ICA

2 Screening LCA

1 Product LCM Tool

Strategic | Comprehensive | Efficient | Effective

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1 Product LCM tool

Simple, quick, yet comprehensive

- Provides early awareness
- opportunities & issues
- Provides directional guidance:
 - when to dig deeper
 - where to seek answers and support

Product Evaluation

Qualitative inputs organized by life cycle stage

- Topic areas based on external stakeholder mapping
- Compare baseline vs. new product
- Compare product design alternatives

Business Filters

Customizable business context filters

- Calibrate tool responses based on relevancy per product category or business application

Detailed Insights

Graphical results

- Quickly identify opportunities or problem areas
- Results organized by:
 - (1) life cycle stage
 - (2) impact categories: energy, GHGs, water, wastes & emissions, toxicity, land, natural resources, EHS


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Factsheets

- Biodiversity
- Biobased
- Chemical regulatory compliance
- Circular Economy
- Climate Change
- Design for Environment
- Ecosystem Services
- Energy Efficiency
- Environmental Labeling
- Green Advertising Guides
- Green Buildings
- Greenhouse Gases
- Green Supply Chain
- Hazardous Materials
- Hazardous Chemicals
- Landfill & Incineration
- Material Recovery
- Material Scarcity
- Nanomaterials Stewardship
- Noise, Odor, Vibration, Dust
- Other Disabling Substances
- Packaging
- Product Regulatory Compliance
- Product Stewardship
- Remanufacturing
- Renewable Energy
- Sustainable Harvesting
- Toxics, Heavy Metals, Persistent Compounds
- Transport Logistics
- Water Footprint Reduction
- Water Stress

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2 GE LCA screening tool




Key design insight


- Use broad materials categories to prevent over-collection of data
- Develop average impact factors per materials category

Tool features


- Rapidly assess relative magnitude of life cycle stages
- Enter % material composition based on broad materials categories
- Automatically self-populates with manufacturing process impacts based on materials type



Tool intended for high-level screening • 1st entry point into LCA • Life Cycle Costing added in 2017



Streamlined and Detailed LCA



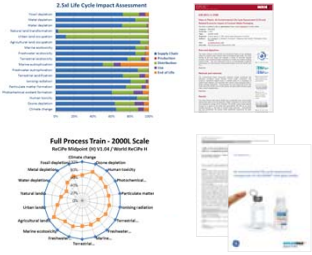
3 Streamlined LCA
4 Detailed LCA per ISO 14044

LCA tools infrastructure


- Commercial LCA software
- Secondary LCI data sets

Trained expertise required


- GE Ecoassessment COE
- External network



LCA Experts Needed | Commercial LCA Software and Datasets



GE Supply Chain Priority Assessment





Goal

- Gain high-level insights to help set targeting priorities
- "Where should we focus?"


Tool features

- Based on Economic Input-Output LCA
- 2014 GE spend
- GHGs, Water Intake
- Excel dashboard
- Filterable by:
 - Direct vs. indirect spend
 - GE business unit
 - NAICS sector
 - Country
 - Vendor

Angela Fisher
Co-Founder & Director
Aspire Sustainability

An example of how we are thinking about supply chain prioritization



Education & Training



- LCA & Ecodesign modular course structure
- Accessible by 60,000 technologists



LCA & Ecodesign overview (executive) training module in development for EHS Learning platform

- Edison Engineering A-Course
- In-class engagement, discussion, reinforcement of self-paced learning
- Developed in web-based software
- Available to global Edison programs:
 - 123 GE sites
 - 70+ countries



Implementation & Empowerment



Understand & Translate

Understand emerging stakeholder expectations and translate into effective business and compliance strategies that create value, competitive advantage, and external credibility

Build Capability

Develop core capability / expertise aligned with evolving external requirements; broadly communicate and educate

Implement

Conduct and support business projects, leverage success stories internally and externally

Communicate

Continue to build GE credibility (sustainability community, green rankings surveys, policy makers, NGOs, customers, etc.)



Strategies for Internal Engagement

Internal stakeholders and project situations can be substantially different from one another and therefore require different engagement strategies. Key stakeholder differences include:

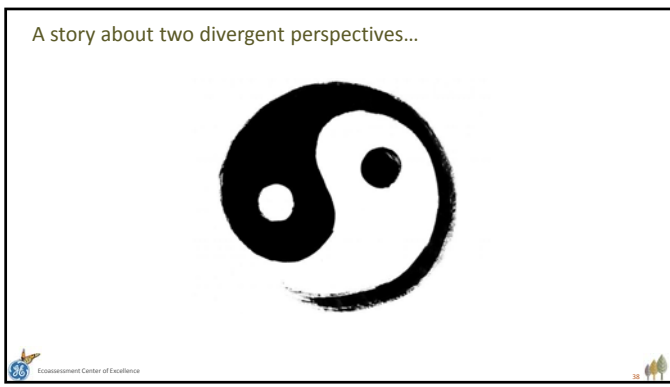
- Project goals
- Business drivers & contexts
- Information management capability
- Sustainability maturation of business unit
- Individual orientation towards sustainability

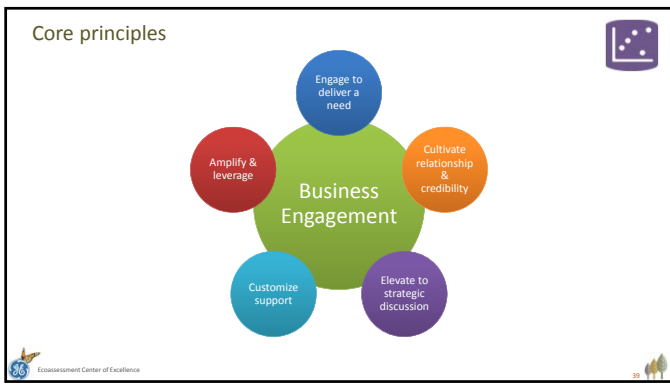
Our internal engagement strategies focus on a number of key concepts including:

- Flexible operating models
- Calibrate to stakeholder needs
- Adapt to stakeholder orientation towards sustainability
- Adjust to sustainability maturation
- Creatively leverage internal and external resources
- Empower and inspire
- Leverage extended internal networks beyond organizational boundaries









Communication & Inspiration 

Empower & Inspire

- Employee engagement
- EcoAwards
- EcoWeek

Connect & Communicate

- Ecodesign
- Green Teams
- Packaging







Ecodesign Work Group

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Enabling principles



Enabling principles

Focus on value creation

- o For any idea to thrive within industry, it must create value


Customize to business context

- o No "one size fits all" tool or strategy
- o Enhances relevance, uptake, ownership

Leverage power of innovative thinking

- o Invite active engagement
- o Great ideas can come from anywhere

Identify Areas for Real Improvement | Create Value | Avoid Distraction



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Thank you!



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Source acknowledgments

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