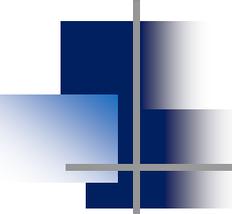


Life Cycle Assessment for Lime

NLA Sustainability Committee
Meeting (via Zoom)

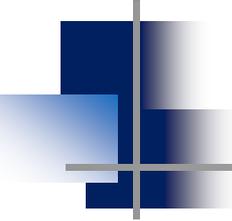
May 3rd, 2023



What is a Life Cycle Assessment?

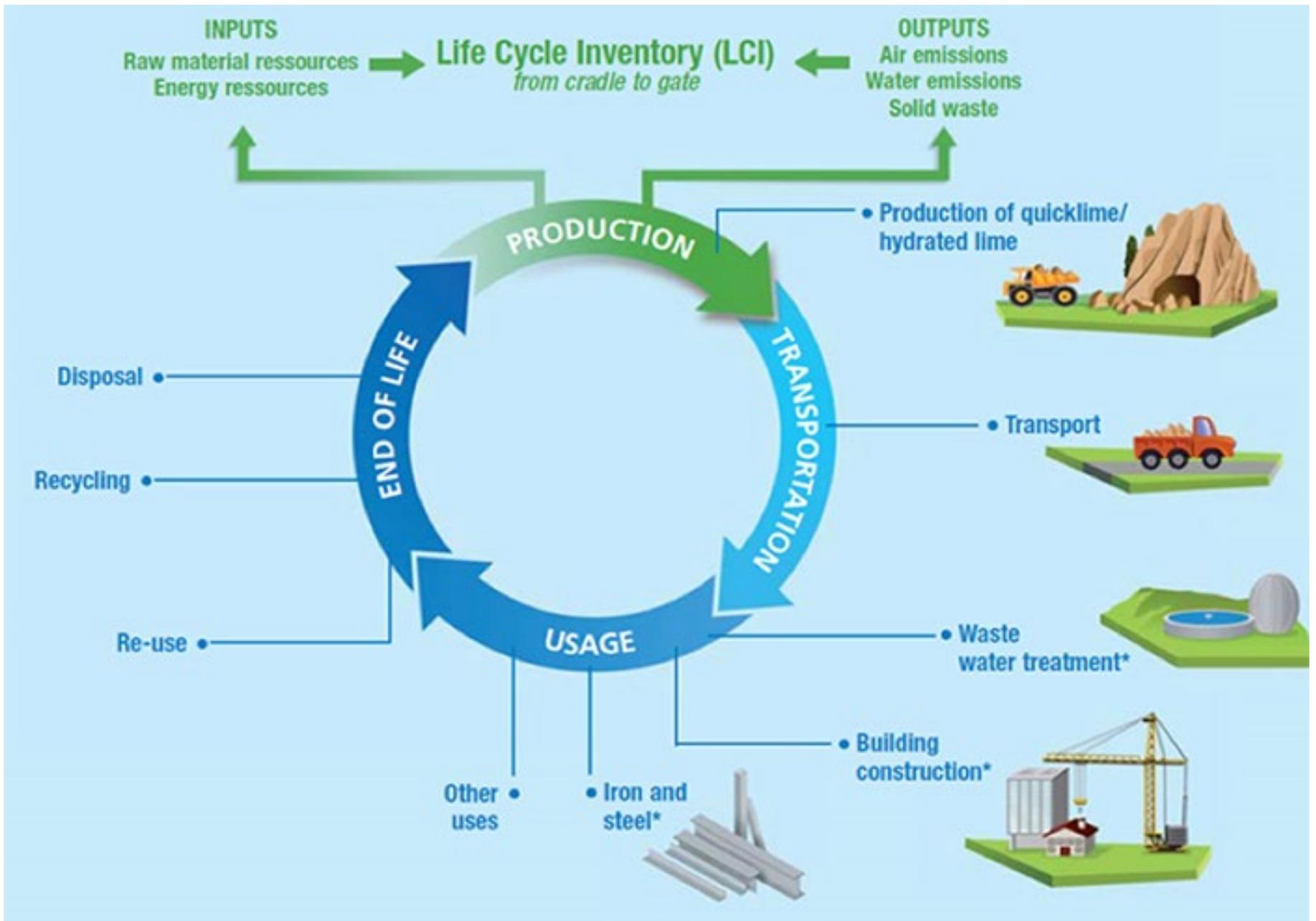
A Life Cycle Assessment (LCA) is a tool to review the environmental impact of products along its entire value chain.

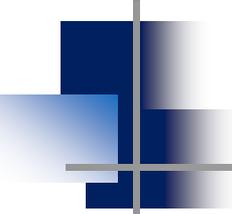
- Acquisition of raw materials
- Manufacturing
- Transport of raw materials/product
- Product use
- End-of-life treatment (landfill, recycle, etc.)



The Value Chain

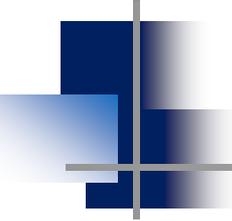
- Cradle to Grave
- Cradle to Gate
- Gate to Gate





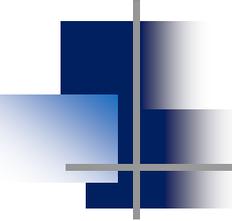
What are Key LCA Drivers?

- Requests/Interest in Carbon Footprint
 - Key customer interest in contribution from suppliers to overall company's carbon footprint
 - Environmental Footprint Declarations and Environmental Product Declarations
- Marketing/Customer Procurement Programs
 - Comparing rival products
 - Public image and Green marketing
- Product Development – Considering alternate manufacturing options



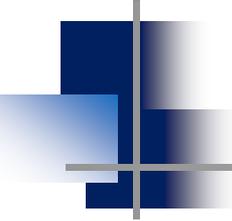
Key LCA Drivers (cont.)

- GHG Reporting such as Carbon Disclosure – Scope 3 emissions characterization
- ISO 14001: 2015 Environmental Management System
 - Incorporates life cycle perspective in evaluating environmental aspects and operational controls



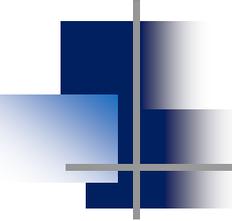
Key LCA Drivers (cont.)

- Federal Initiatives funded by the Inflation Reduction Act
 - Federal “Buy Clean” program – currently EPA developing program for standardizing EPDs scheduled for 2024
- California Assembly Bill 262 – “Buy Clean California Act” (2017)
 - Requires contractors bidding on state infrastructure/construction projects to submit EPD’s for their suppliers of concrete, asphalt, steel, glass, etc.



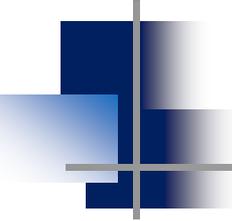
Key LCA Drivers (cont.)

- Colorado is implementing a buy clean program beginning January 1, 2024 which covers steel, asphalt and asphalt mixtures:
<https://osa.colorado.gov/energy-environment/buy-clean-colorado-act>
 - This law requires the Office of the State Architect to establish a maximum acceptable global warming potential (GWP) limit for each category of eligible materials
- Other states developing Buy Clean programs are MN, WA and OR



Basic Process

- A first step in the LCA process is the production of a Life Cycle Inventory (LCI) (cradle to gate)
 - Essentially, a set of data on the relevant energy and material inputs and environmental outputs
- NLA conducted a LCI in 2001....time for an update.



LCI Development

- NLA working with Trinity to develop a standard data collection tool to collect cradle to gate LCI data (beta version)
 - Note, data already provided to NLA under GHG Protocol (e.g., emissions data, lime production, LKD sales etc.) will not be asked for again
- Data anonymity and CBI protocols will be observed

BETA VERSION ONLY

Table 1. Facility Information

Facility Name	
Street Address	
City	
Zip Code	
Country	
State, Province, or Territory	

Table 2. Kiln Products

Kiln	Lime Type
Kiln 1	High Calcium
Kiln 2	Dolomitic
Kiln 3	Both
Kiln 4	
Kiln 5	

Table 3. Facility Emissions

Emissions	CO	Units	SO2	Units
Kiln 1		Metric Tons		Metric Tons
Kiln 2		Metric Tons		Metric Tons
Kiln 3		Metric Tons		Metric Tons
Kiln 4		Metric Tons		Metric Tons
Kiln 5		Metric Tons		Metric Tons
Other On-site Processes		Metric Tons		Metric Tons

Table 4. Electricity

Electricity	Facility-Wide Total	Unit
Site-Wide Electricity Purchased		kWh

Table 5. Inbound Raw Limestone (Transported to Facility)

Raw Limestone	Limestone for Dolomitic Lime	Limestone for High Calcium Lime	Total	Unit	Transport Distance to Quarry via Truck	Unit	Transport Distance to Quarry via Ship/Barge	Unit	Transport Distance to Quarry via Rail	Unit
Limestone from Quarry 1			0	Metric Tons		Miles		Nautical Miles		Miles
Limestone from Quarry 2			0	Metric Tons		Miles		Nautical Miles		Miles
Limestone from Quarry 3			0	Metric Tons		Miles		Nautical Miles		Miles
Limestone from all other suppliers			0	Metric Tons		Miles		Nautical Miles		Miles

Table 6. Other Inbound Materials (Transported to Facility)

Other Materials	Facility-Wide Tonnage	Unit	Transport Distance to Supplier via Truck	Unit	Transport Distance to Supplier via Ship/Barge	Unit	Transport Distance to Supplier via Rail	Unit
Refractories		Metric Tons		Miles		Nautical Miles		Miles
		Metric Tons		Miles		Nautical Miles		Miles
		Metric Tons		Miles		Nautical Miles		Miles
		Metric Tons		Miles		Nautical Miles		Miles

Table 7. Water Use

Water Use	Water for Hydrating Dolomitic Lime (ON-SITE)	Water for Hydrating Dolomitic Lime (OFF-SITE)	Water for Hydrating High Calcium Lime (ON-SITE)	Water for Hydrating High Calcium Lime (OFF-SITE)	Water for All Other Processes (e.g. PM Control)	Total	Unit
Ground Water						0	Gallons
Surface Water						0	Gallons
Municipal Water (Tap water)						0	Gallons

Table 8. Outbound Waste (Transported to Waste Processing)

Wastes	Waste Disposal Method	Facility-Wide Tonnage	Unit	Transport Distance to Disposal via Truck	Unit	Transport Distance to Disposal via Ship/Barge	Unit	Transport Distance to Disposal via Rail	Unit
Scrubber Sludge	Landfill, other/unknown		Metric Tons		Miles		Nautical Miles		Miles
Municipal Solid Waste (MSW)	Landfill, MSW		Metric Tons		Miles		Nautical Miles		Miles
Lime Kiln Dust (Waste)	Landfill, ferrous metals		Metric Tons		Miles		Nautical Miles		Miles
Other waste			Metric Tons		Miles		Nautical Miles		Miles

Table 9. Off-Site Hydrating of Finished Products

Finished Product	Tonnage Hydrated Off-Site	Unit	Transport Distance to Hydrator via Truck	Unit	Transport Distance to Hydrator via Ship/Barge	Unit	Transport Distance to Hydrator via Rail	Unit
Dolomitic Hydrated Lime		Metric Tons		Miles		Nautical Miles		Miles
High Calcium Hydrated Lime		Metric Tons		Miles		Nautical Miles		Miles

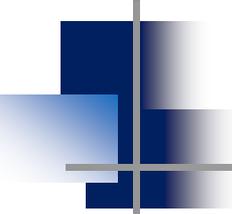
Table 10. Products

Finished Product	Facility-Wide Tonnage	Metric Tons
Dolomitic Lime		Metric Tons
Hydrated Dolomitic Lime		Metric Tons
High Calcium Lime		Metric Tons
Hydrated High Calcium Lime		Metric Tons
Lime Kiln Dust		Metric Tons
Other Product		Metric Tons



Model Inputs

- Facility information
- Lime products
- CO, SO₂
- Purchased electricity
- Inbound limestone (transported to facility)
- Other inbound materials
- Water use
- Outbound waste
- Offsite hydrate
- Finished product

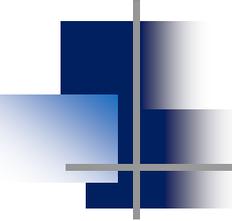


Development of Industry Average LCA

- Industry average LCI data used as model inputs
- LCA's to be developed for HiCal, & Dolo lime and hydrate developed using GaBi[®] modeling software
- Note, Trinity identified one international PCR which specifically includes lime used in the construction industry

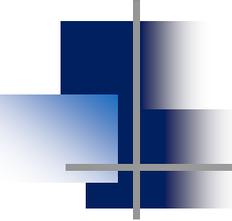
Proposed Impact Categories

Category	LCI Data	Factor	Quantification
Climate Change	GHG emissions	Global Warming Potential (GWP)	CO ₂ e Qty of energy used
Stratospheric O ₃	CFCs, other ODCs	Ozone Depleting Potential (ODP)	CFC-11 equivalents
Eutrophication	PO ₄ , NO, NO ₂ , NH ₄	Eutrophication Potential (EP)	PO ₄ equivalents
Acidification	SO _x , NO _x , HCl, HF, NH ₄	Acidification Potential (AP)	Hydrogen (H ⁺) ion equivalents
Smog	NMHC	Photochemical oxidant creation potential (POCP)	Ethane (C ₂ H ₆) equivalents
Resource Depletion	Qty of minerals, fossil fuels	Abiotic depletion potential for fossil resources (ADP _{fossil})	Qty resource used/Qty left in reserve



LCA Results

- The LCA results will be reported based on a functional unit of one metric ton of lime or one metric ton of hydrated lime (plus lime kiln dust LKD sold as co-product)



Questions
