NETL CO2U LCA Toolkit Overview

Global CO2 Initiative TEA/LCA Workshop

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Solutions for Today | Options for Tomorrow

Disclaimer and Attribution

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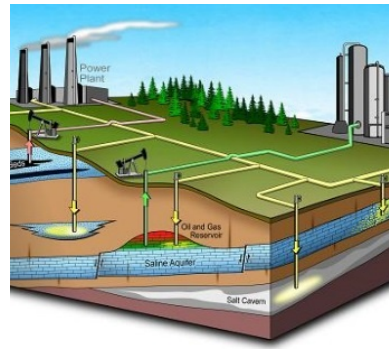Attribution

NETL Core Competencies
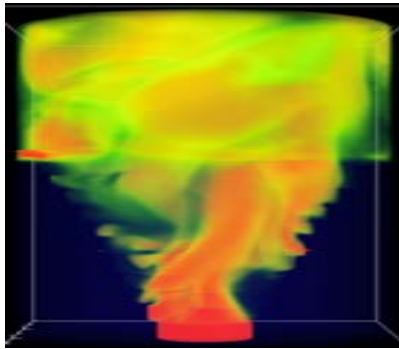
Computational Science & Engineering
- High Performance Computing
- Data Analytics

Materials Engineering & Manufacturing
- Structural & Functional
- Design, Synthesis, & Performance

Geological & Environmental Systems
- Air, Water & Geology
- Understanding & Mitigation

Energy Conversion Engineering
- Component & Device
- Design & Validation

Systems Engineering & Analysis
- Process & System
- Optimization, Validation, & Economics

Program Execution & Integration
- Technical Project Management
- Market & Regulatory Analysis

Effective Resource Development • Efficient Energy Conversion • Environmental Sustainability

LCA is Well Suited for Energy Analysis

- Draws a more complete picture than one focused solely on stack or tailpipe emissions

- Allows direct comparison of dramatically different options based on function or service

- Includes methods for evaluating a wide variety of emissions and impacts on a common basis

- Brings clarity to results through systematic definition of goals and boundaries
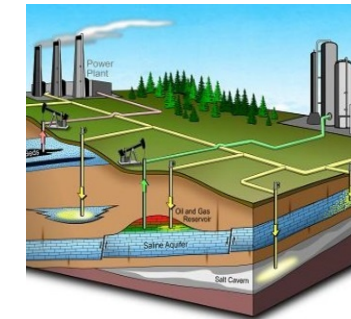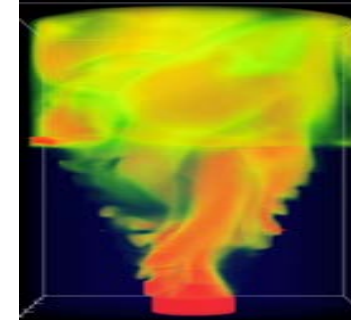
Energy Life Cycle Analysis at NETL

Extraction → Processing → Transport → Conversion → Delivery → Use

Constr.

Mfg.
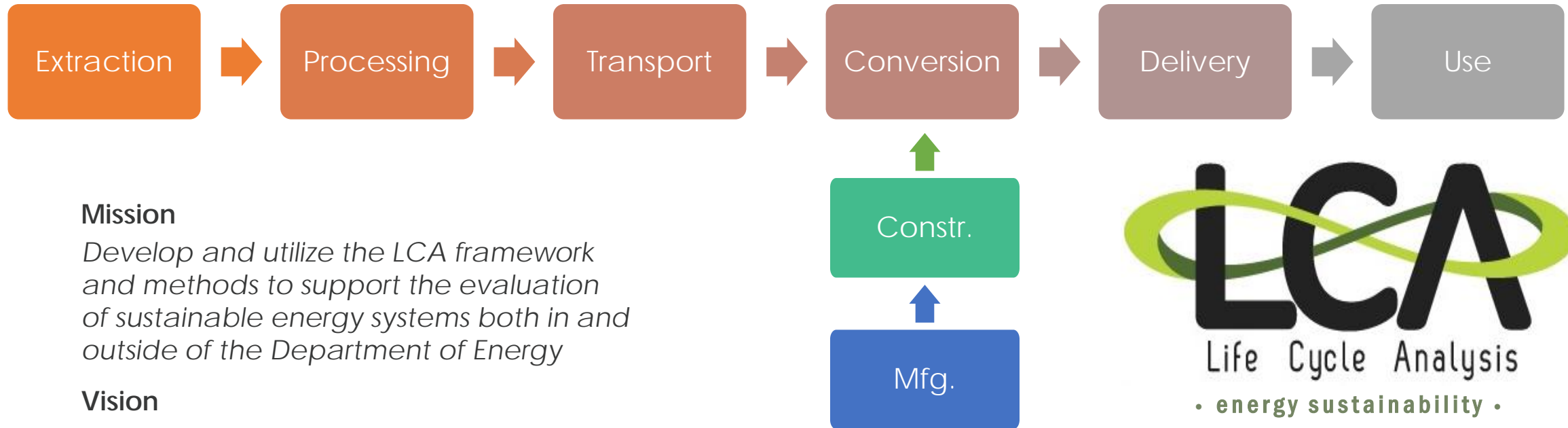
Mission

Develop and utilize the LCA framework and methods to support the evaluation of sustainable energy systems both in and outside of the Department of Energy

Vision

A world-class research and analysis team that integrates results which inform and recommend sustainable energy strategy and technology development

Life Cycle Analysis Team

Tim Skone – 20 years
Federal Team Lead
BS Chem Engr | P.E. Env. Engr

Greg Cooney – 10 years
Contractor Team Lead
MS Env Engr | BS Chem Engr

James Littlefield – 17 years
Natural gas, system & process design
BS Chemical Engineering

Matt Jamieson – 9 years
Power systems, CO_2-EOR
BS Mechanical Engineering

Michele Mutchek – 6 years
Loan program office, CO2U
MS Civil/Env/Sust Engr | BS Env Sci

Michelle Krynock – 4 years
Natural gas, fuel cells, coal
BS Civil/Env Engr & Public Policy

Derrick Carlson – 7 years
I/O LCA, Energy efficiency
PhD/MS Civ/Env Engr | BS Chem

Greg Zaimes – 4 years
Energy analysis; fuels
PhD Civ/Env Eng; BS Physics

Selina Roman-White – 1 year
Energy/environment
BS Chem. Engr.

Joseph Chou – 1 year
Energy/environment
MS Civil & Env Engr

Srijana Rai– 1 year
Energy/environment
MS Civil & Env Engr

Joe Marriott – 12 years
Senior Advisor
PhD Env Engr & Public Policy

Motivation – U.S. DOE Carbon Use and Reuse Program FOA Requirements

Applications for Technologies Directed at Utilizing Carbon Dioxide from Coal Fired Power Plants (DE-FOA-0001622), states that the *Principal Investigator* (PI) shall provide

"…Life Cycle Analysis further demonstrating the potential of the proposed process to be a substantive CO_2 mitigation option, by verifying the **lifecycle GHG reduction potential of the products(s) and technology (on a percent reduction basis) relative to current state-of-the-art pathways**"

CO2U LCA Requirements in U.S. Federal Programs and Policy

- **26 USC 45Q: Credit for carbon oxide sequestration (aka, 45Q)**
  - LCA (GHG analysis) required for tax credit (non-EOR utilization)
  - "(B) Measurement
    - (i) In general For purposes of determining the amount of qualified carbon oxide utilized by the taxpayer under paragraph (2)(B)(ii) or (4)(B)(ii) of subsection (a), such amount shall be equal to the metric tons of qualified carbon oxide which the taxpayer demonstrates, based upon an analysis of lifecycle greenhouse gas emissions and subject to such requirements as the Secretary, in consultation with the Secretary of Energy and the Administrator of the Environmental Protection Agency, determines appropriate…

Development Timeline

- **2016**
  - Funding Opportunity Announcement for CO2U projects establishes requirement for life cycle greenhouse gas (GHG) analysis
- **2017**
  - **August** - First exploratory draft of the guidance document is completed
  - **October** - A workshop was held in D.C. with subject matter experts and CO2U project principal investigators
- **2018**
  - Second draft of guidance document is finalized based on stakeholder feedback
- **2019**
  - **March** – Soft release of guidance document
  - **April** – Final release incorporating feedback from Global CO_2 Initiative TEA/LCA Workshop
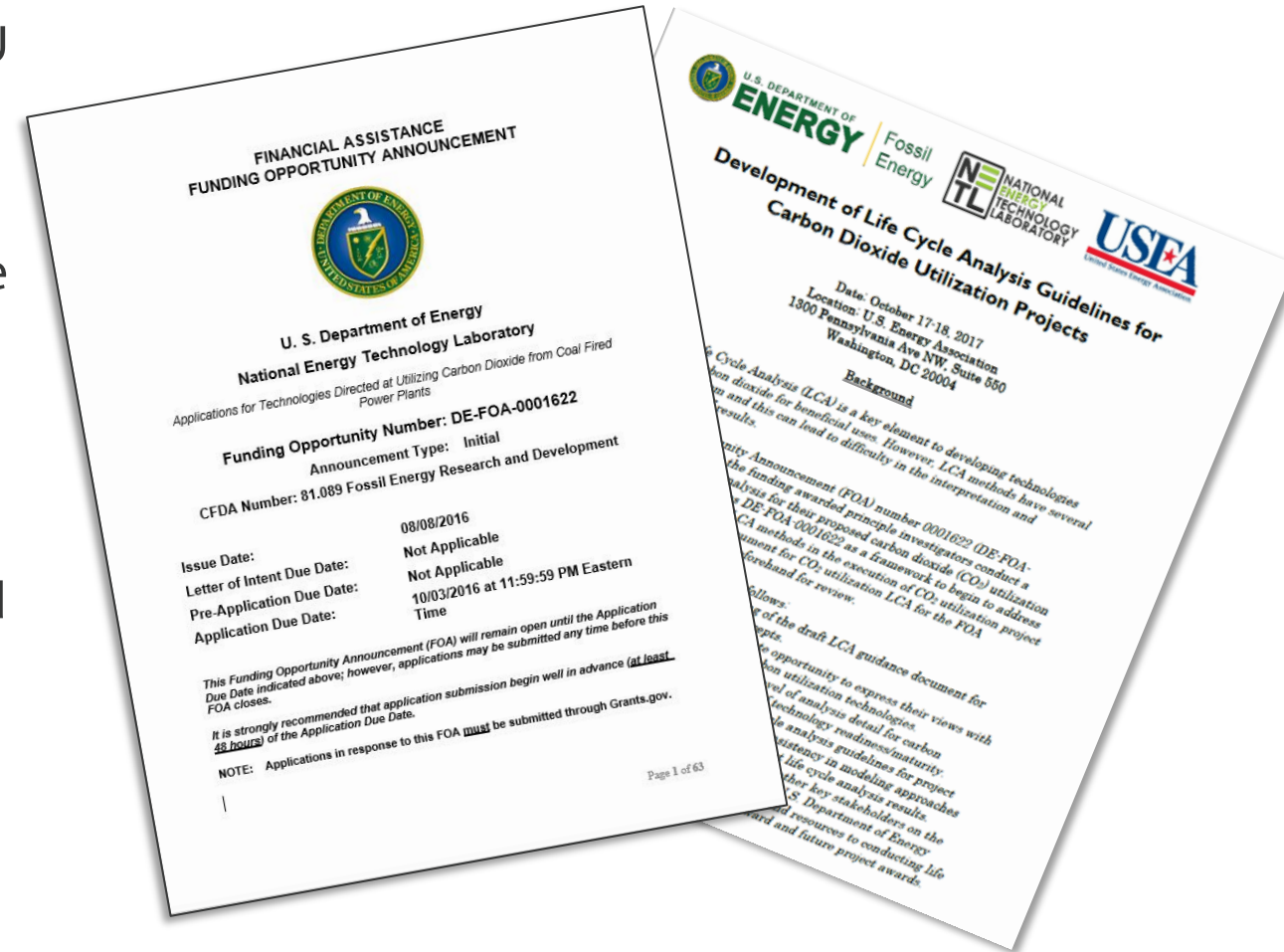
Why the need for additional guidance beyond ISO 14040/14044?

- All of the guidance included in the NETL CO2U LCA Toolkit is ISO compliant
- Additional guidance is helpful for handling CO2U systems
 1. **Projects are diverse**

     CO2U projects are varied, touching multiple sectors from fuels to building products. This guidance is intended to be broad enough to be valid for all project types, yet specific enough to account for variations.
  2. **Projects represent emerging technologies**

     There can be a lot of unknowns in the life cycles of emerging technologies. This guidance aims to assist principal investigators with the completion of the required LCA for their projects. the life cycle boundaries and appropriate comparison technologies.

NETL CO2U LCA Toolkit Goals

1. Provide LCA guidance, data, and tools to U.S. DOE Carbon Use and Reuse Program project PIs to complete their project LCA and documentation requirements

2. Foster better decision-making for the U.S. DOE Carbon Use and Reuse Program by providing an analysis and reporting structure for the project LCAs that allows for consistency and transparency

3. Provide LCA guidance, data, and tools to others seeking guidance on conducting LCA in the area of CO2U

4. Contribute to the global discussion on CO2U LCA and LCA methods

NETL CO2U LCA Guidance Toolkit

NETL CO2U LCA Guidance Toolkit

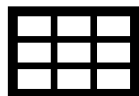**NETL** NATIONAL ENERGY TECHNOLOGY LABORATORY
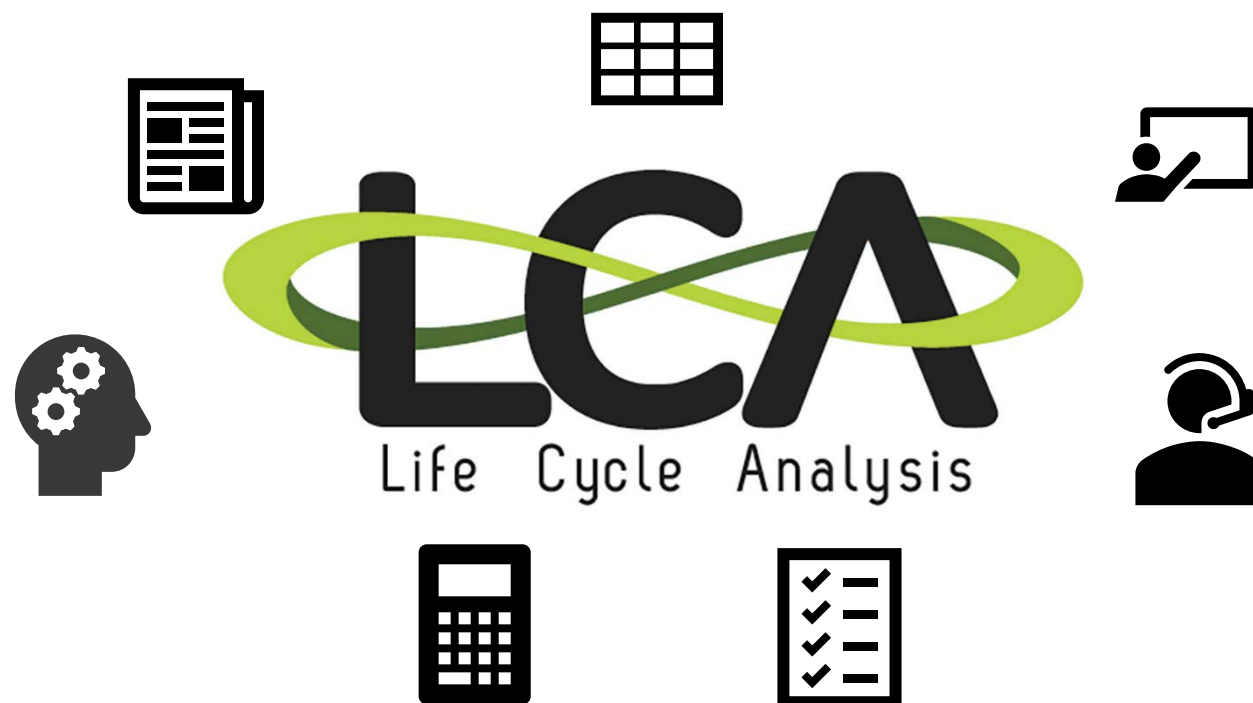
GUIDANCE DOCUMENT

Analysis requirements and how to use the supporting data and tools

DOCUMENTATION SPREADSHEET

Excel file that can be used to document data when not using openLCA

OPENLCA MODEL TRAINING

Provided to PIs to aid in the modeling of their LCA in openLCA

OPENLCA LCI DATABASE

openLCA database that includes NETL unit process data and an example CO2U LCA

LCA
Life Cycle Analysis

SUBJECT MATTER EXPERT SUPPORT

Available to PIs for all phases of the LCA from conception to documentation

OPENLCA CONTRIBUTION TOOL

Excel template that translates openLCA results into required charts

LCA REPORT TEMPLATE

Word report template for summarizing data and results

netl.doe.gov/LCA

LCA@netl.doe.gov

Key Methodological Considerations

- **Definition of comparison system and processes**
  - Technology maturation (TRL)
  - Market penetration
  - Maintain functional equivalence

- **Source of CO$_2$**
  - Focus on coal power generation; though approach is generalizable
  - Maintain functional equivalence

- **Uncertainty**
  - Data!
  - See # 1 and # 2

- **Consistency**
  - Data!
  - Tools

Contact Information

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LCA Life Cycle Analysis
energy sustainability

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Modeling Options

- U.S. DOE Carbon Use and Reuse Program project PIs may model their LCA in one of three ways. The following establishes the reporting requirements depending on this choice:
- Option 1: openLCA (strongly recommended)
  - Modified **NETL CO2U openLCA LCI Database** with project LCA and *sensitivity/uncertainty analysis*
  - Completed **NETL CO2U openLCA Results Contribution Tool**
  - Completed **NETL CO2U LCA Report Template**
- Option 2: PI spreadsheet model
  - Completed **NETL CO2U LCA Documentation Spreadsheet** and supporting materials used outside of the software (e.g., results interpretation spreadsheets)
  - Completed **NETL CO2U LCA Report Template**
- Option 3: Third-party LCA software (not openLCA)
  - Submit LCA data via one of the two methods:
    - Provide final LCA model database file and supporting materials used outside of the software (e.g., results interpretation spreadsheets) with NETL
    - If PIs do not want to provide the LCA model database, submit completed **NETL CO2U LCA Documentation Spreadsheet** and supporting materials used outside of the software (e.g., results interpretation spreadsheets)
  - Completed **NETL CO2U LCA Report Template**