

Study on Effects of Installation, Operation, Removal, and Disposal of Certain Equipment

SB 1290 Study Kickoff Meeting

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Draft Agenda from TCEQ

- 1) Introduction – David Greer, TCEQ External Relations Division
 - S.B. 1290 Overview
 - Requirements of Study
 - Plan for submitting Legislative report
- 2) Study Plan Review – Michael H. Young and Team – University of Texas at Austin, Bureau of Economic Geology
- 3) Questions and Feedback

Study Plan Review

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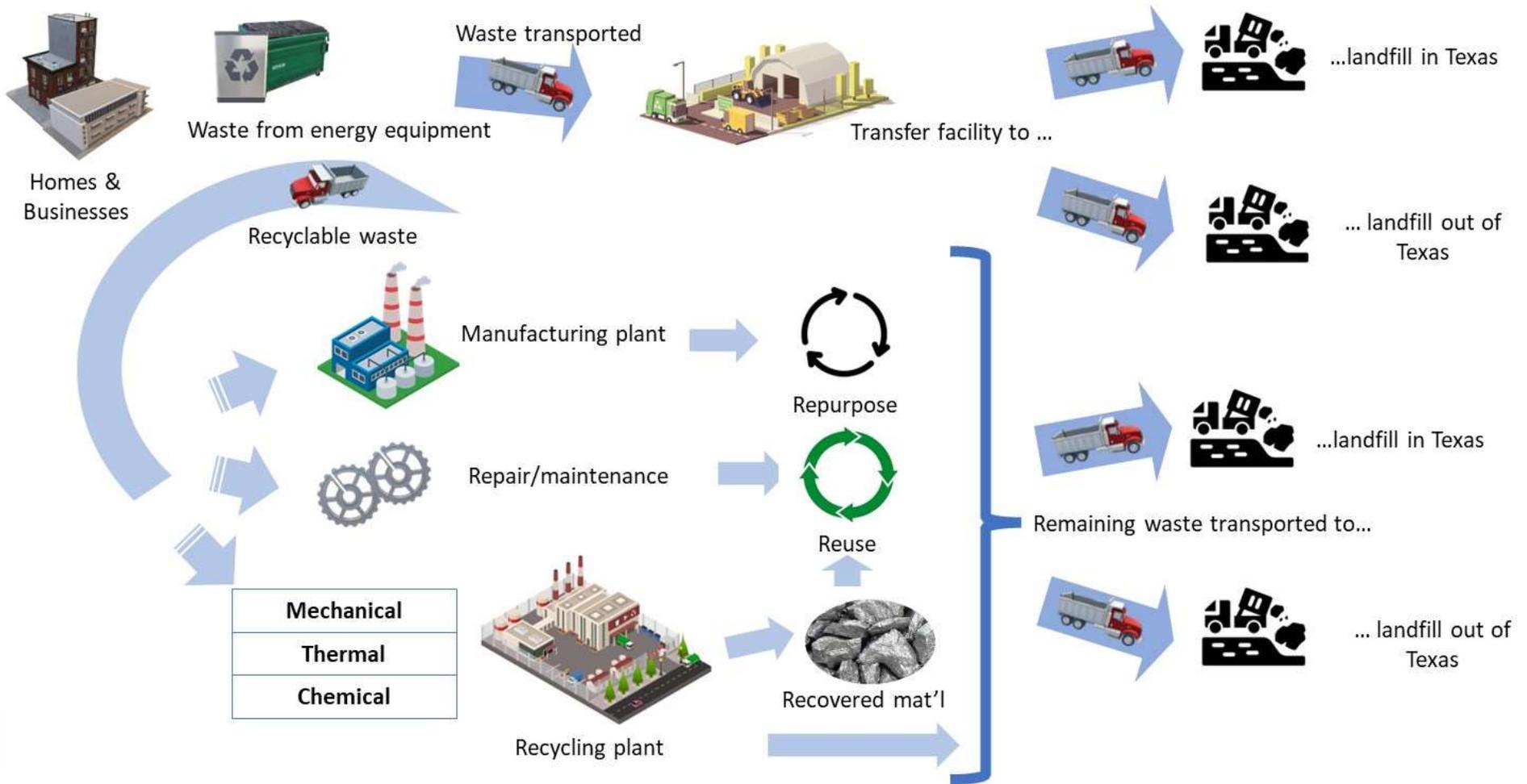
Study Plan Review

- SB 1290, under Section 2 (a), “The commission shall conduct a study on the current and potential effects of the installation, operation, removal, and disposal of solar, wind turbine, and energy storage equipment on the environment and watersheds.”
- As described in the Scope of Work to TCEQ, the Bureau will investigate end-of-life alternatives that include:
 - (a) Landfill disposal
 - (b) Recycling of components
 - (c) Repurposing or reusing wind, solar and battery technologies.

How Are We Thinking About This?

- Focus on SB 1290 is on the installation, operation, removal and disposal of wind turbines, solar panels and energy storage equipment
 - **Installation and operation** of these technologies is relatively known through many years of experience and study. These can be incorporated herein
 - Restoration of land to mitigate impacts from **removal** of wind equipment is covered by HB 2845, signed in 2019
 - Restoration of land to mitigate impacts from **removal** of solar PV and energy storage equipment is not currently studied. Land impacts from other industrial processes could be used as examples
 - **Disposal** of equipment needs to be studied; to be broken down into landfilling, recycling, and repurposing, inside and outside of Texas

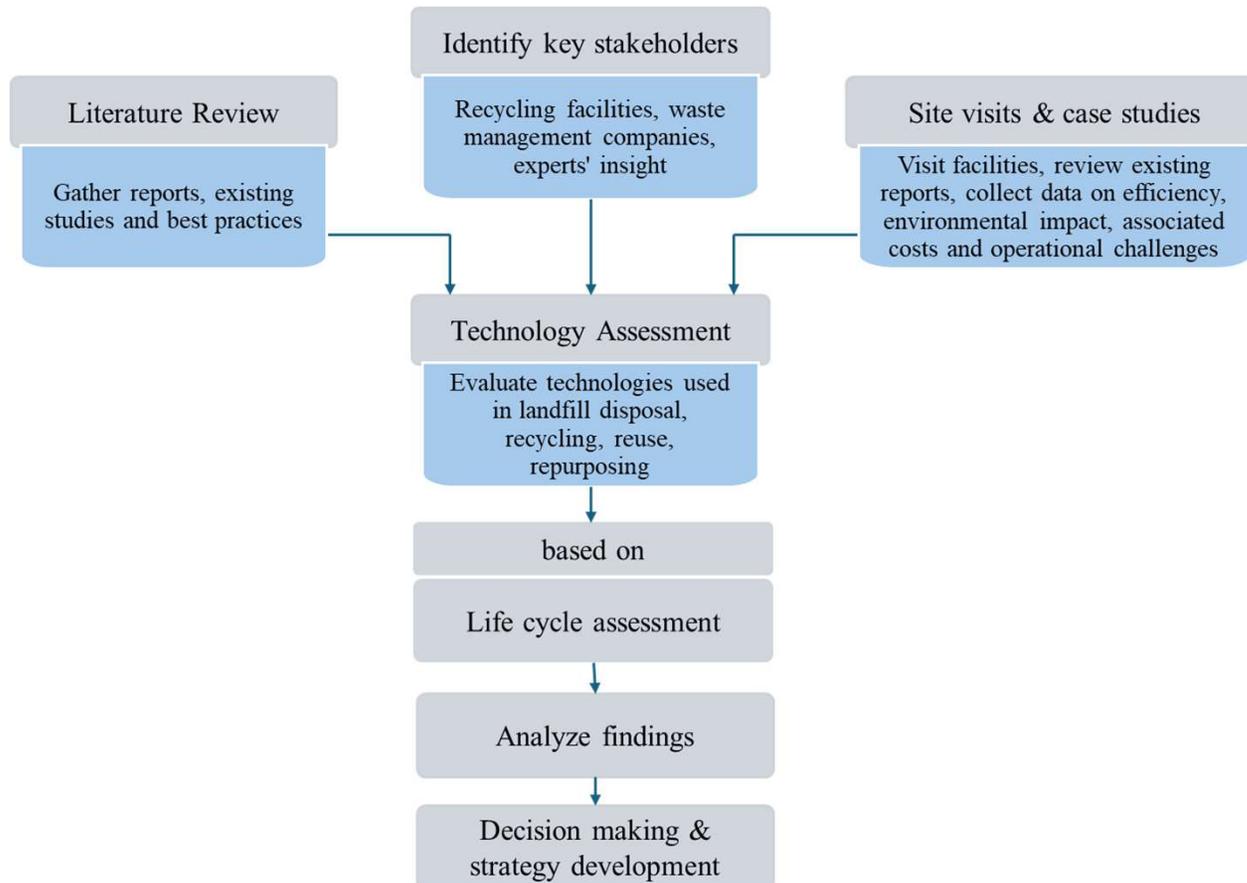
Schematic of Options



Task Description

- Task 1 - Investigate practices for end-of-life alternatives
- Task 2 - Conduct environmental LCA for each life cycle stage relevant for each technology, and assess relative sensitivity of impacts associated with these alternatives and their locations in Texas

Task 1 Description – Investigate Practices



Task 2 Description – Life-Cycle Assessment

Life cycle assessment (LCA) necessitates a systematic process that includes:

- data collection;
- inventory analysis;
- impact assessment;
- result interpretation, and uncertainty analysis.

What is a Life-Cycle Assessment?

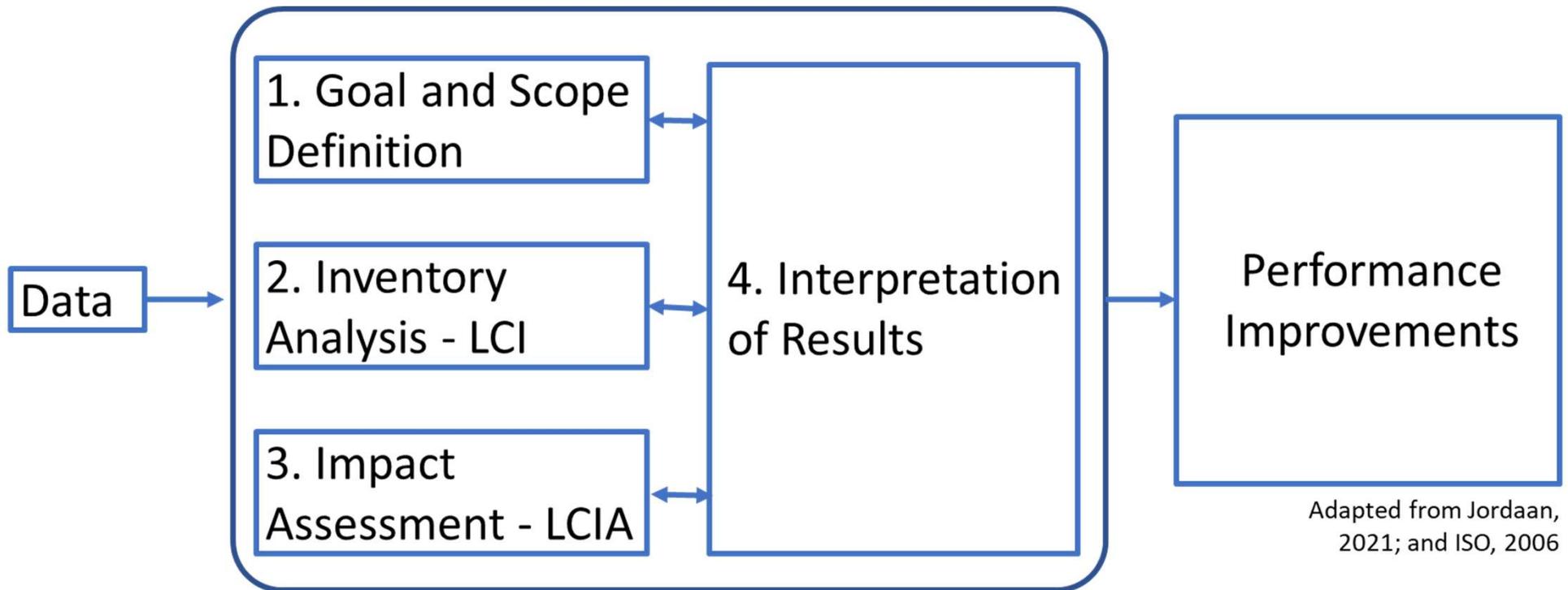
- **Definition –**

- Decision support tool for assessing environmental aspects associated with a product over its life cycle

- **History –**

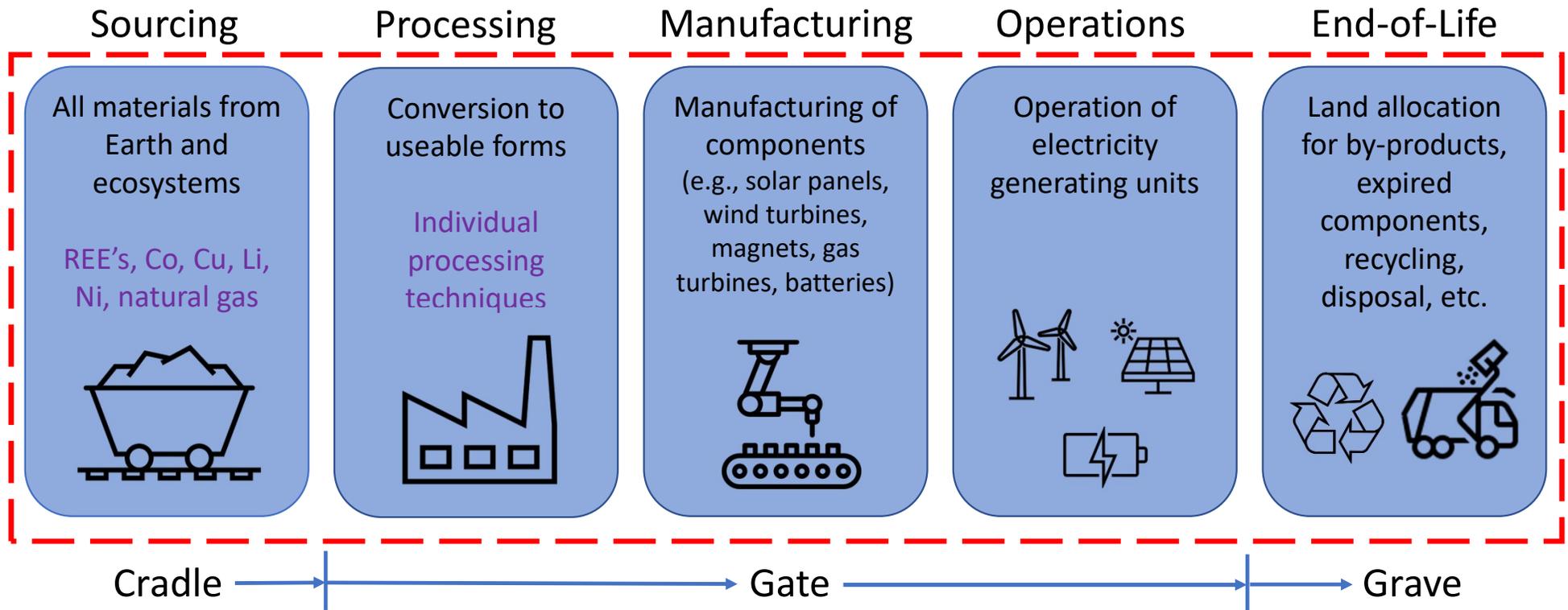
- First discussion of LCA's dates back to 1970's-1980's, used mostly for consumer products
- International standards organizations have been involved in since mid-90's
- LCA now commonly used in analyzing aspects of energy systems, but they still focus on limited aspects of the supply chain

Steps Used in Life Cycle Assessment

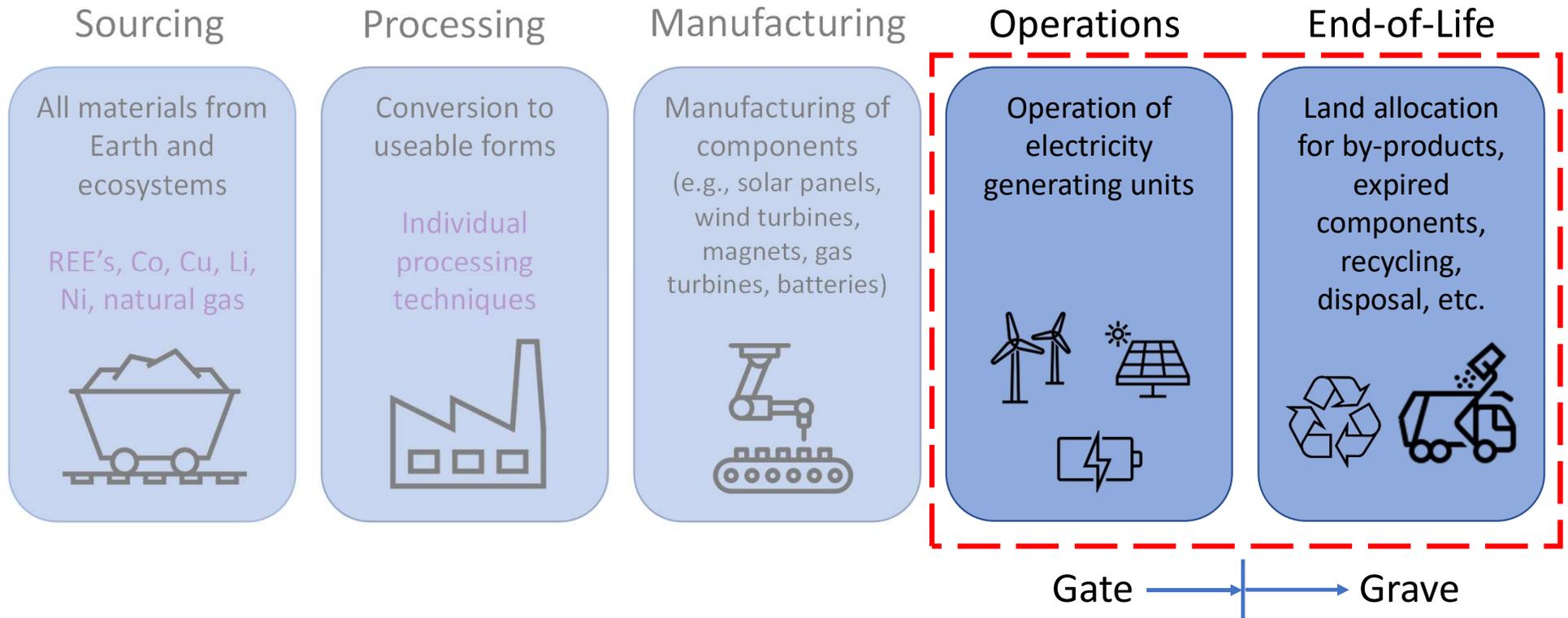


Adapted from Jordaan, 2021; and ISO, 2006

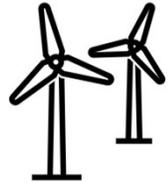
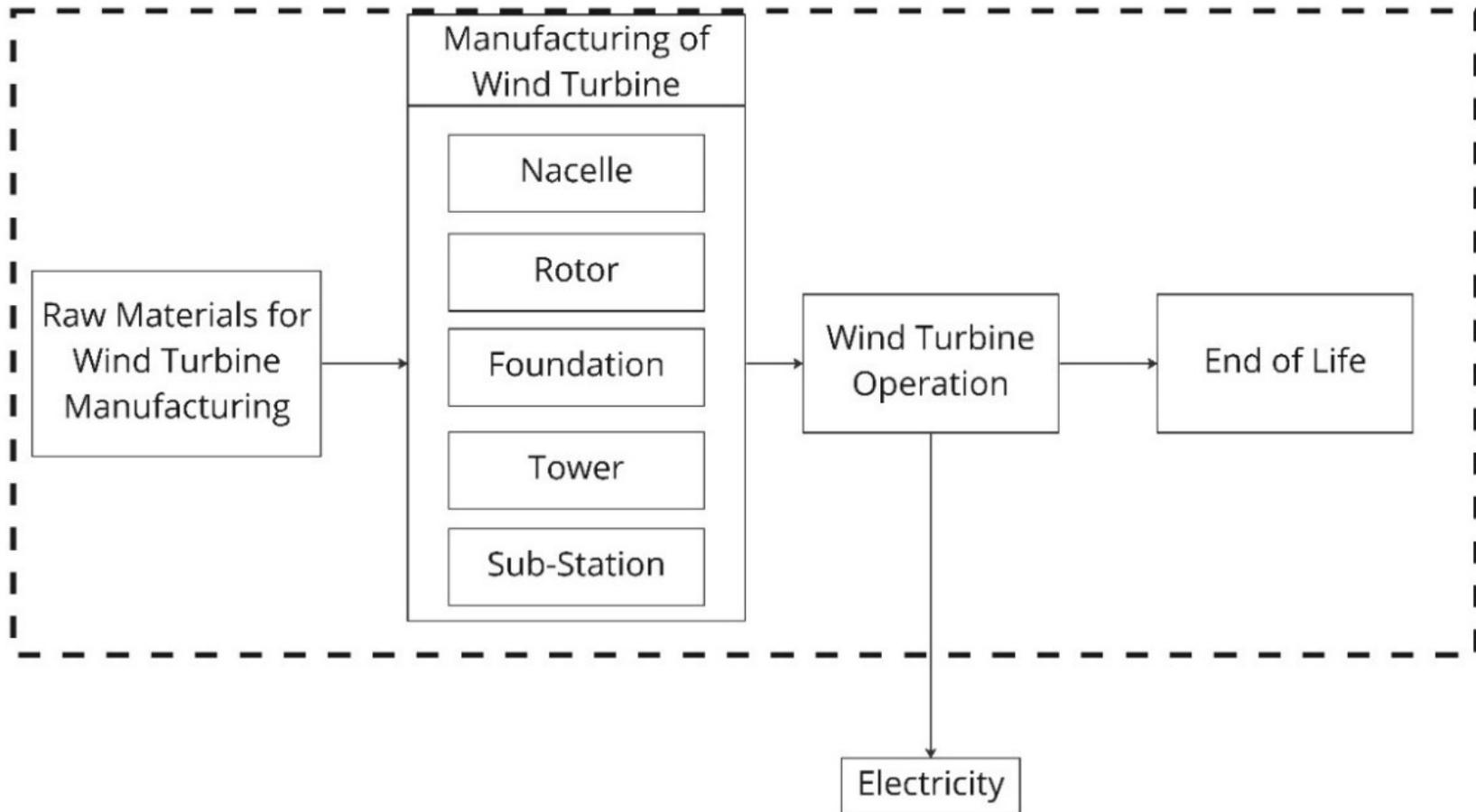
System Boundaries Used in LCA



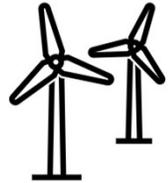
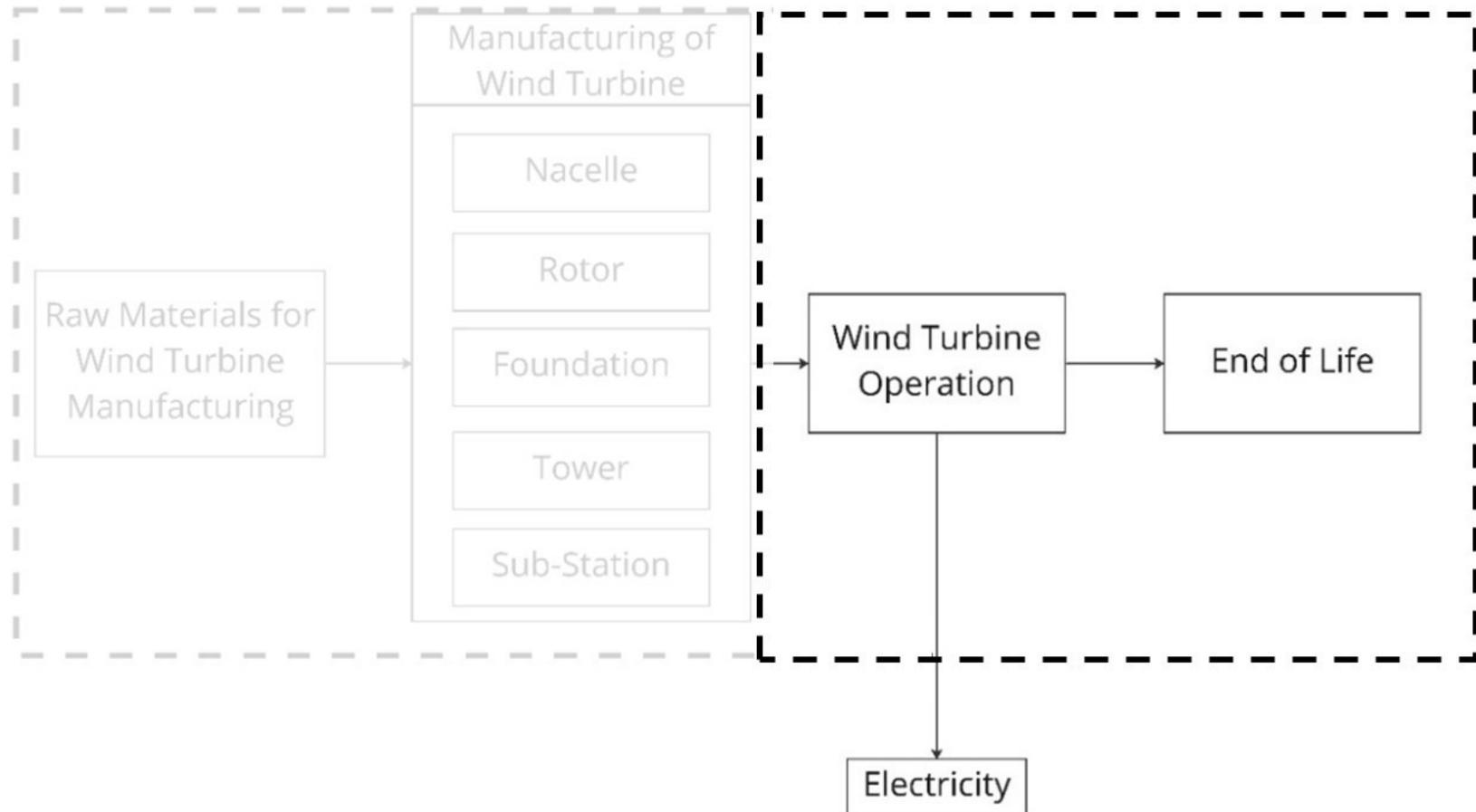
System Boundaries Used in Task 2 – Gate-to-Cradle



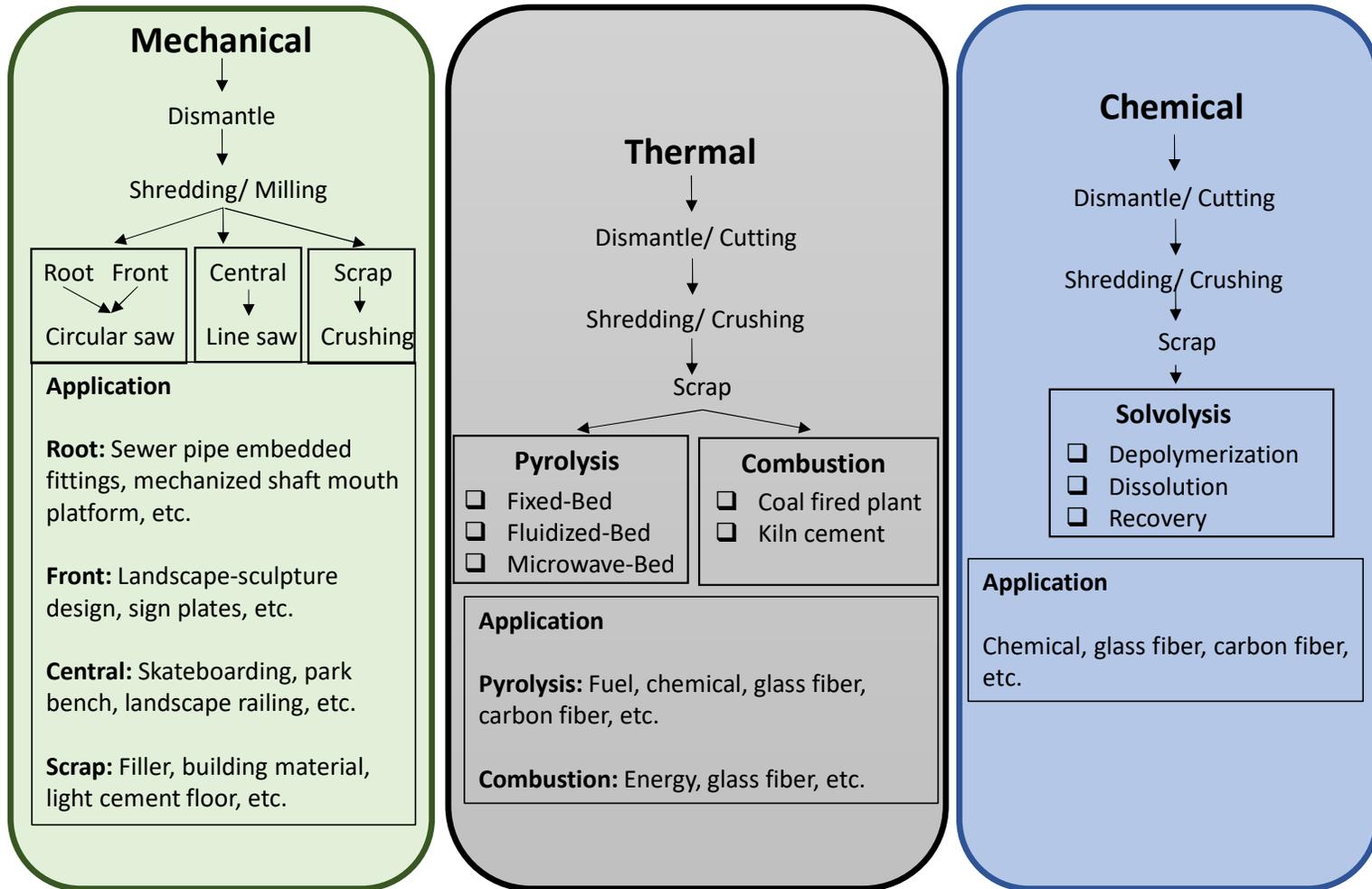
Example of System Boundary: Wind Turbine



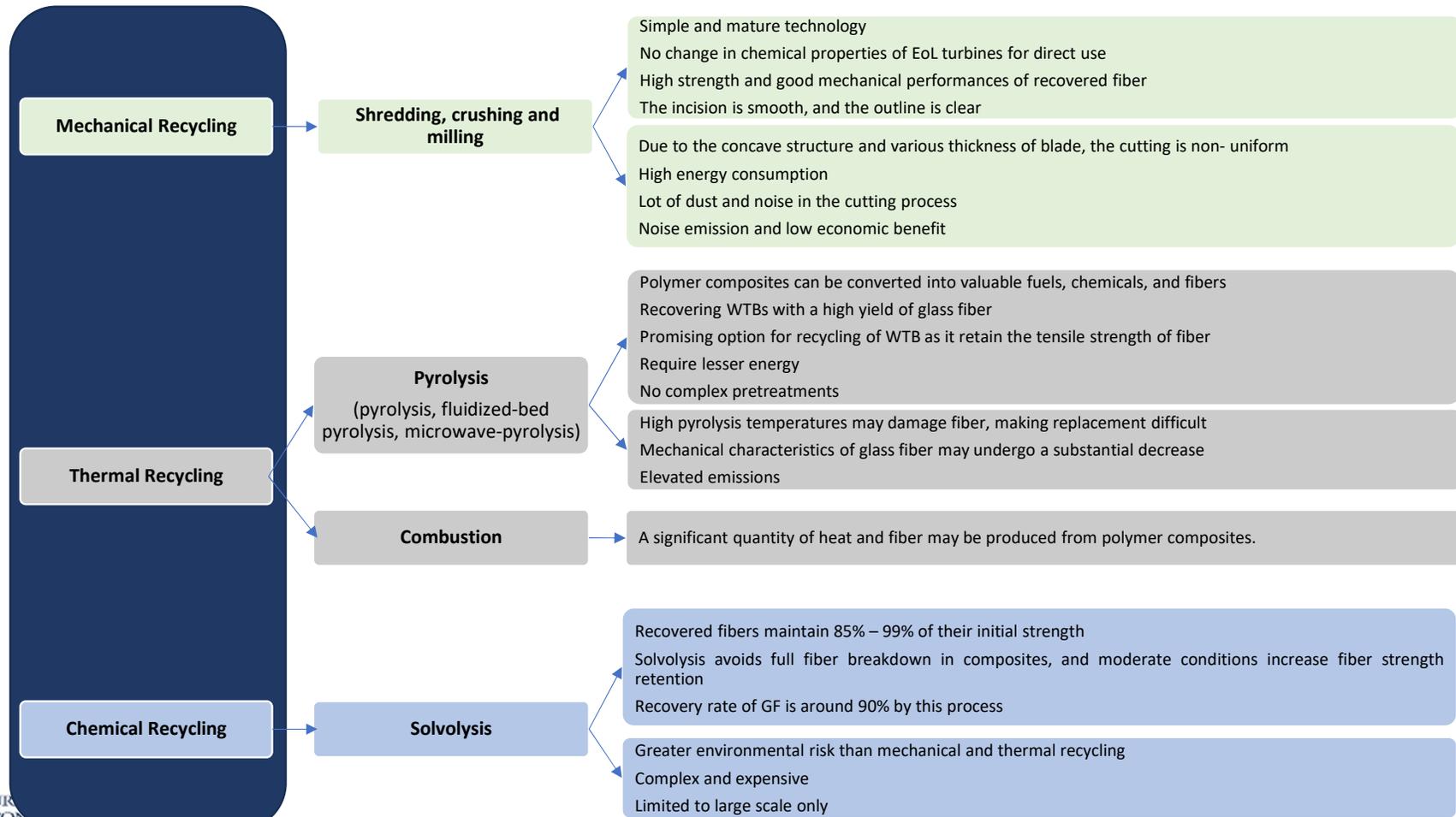
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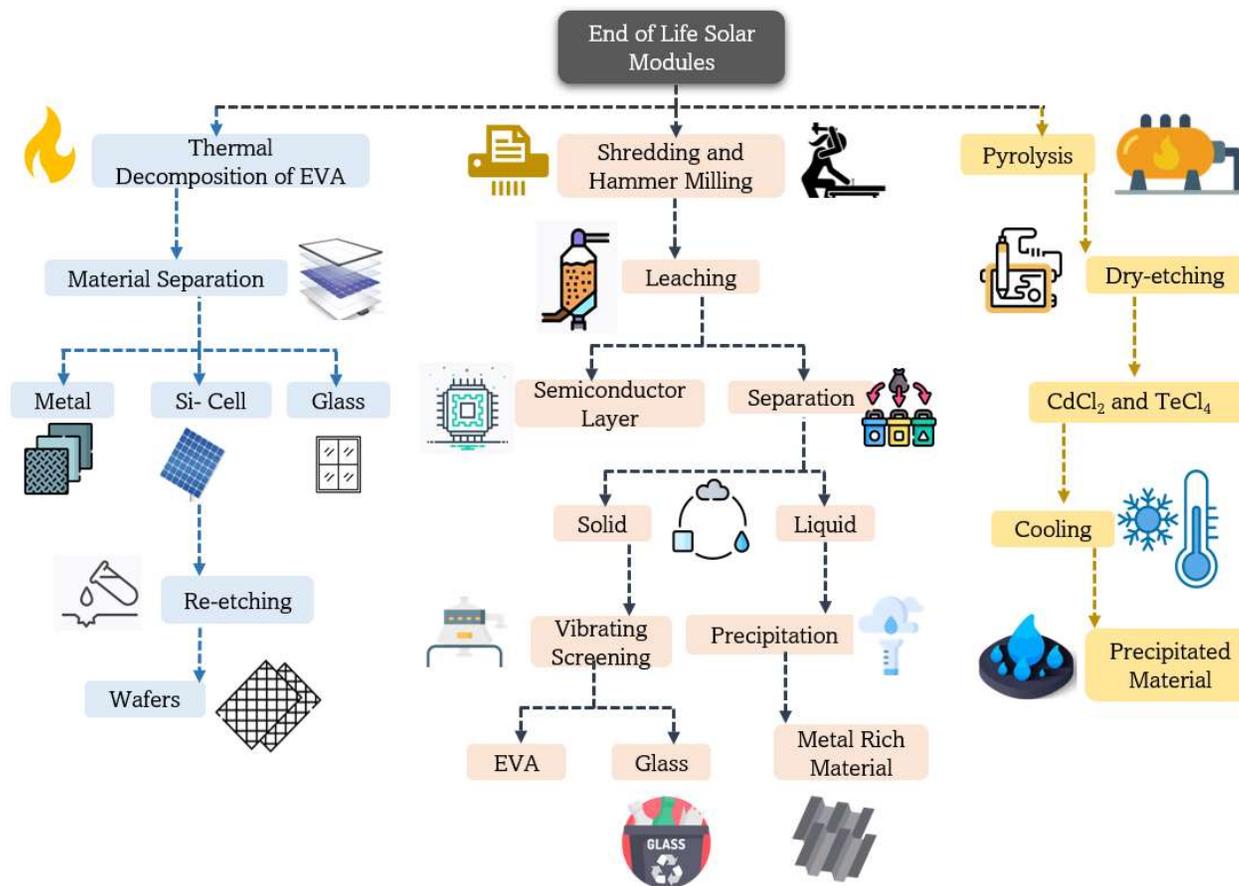
Commonly Used Recycling Methods for Wind Equipment



Intercomparison of Wind Recycling Techniques

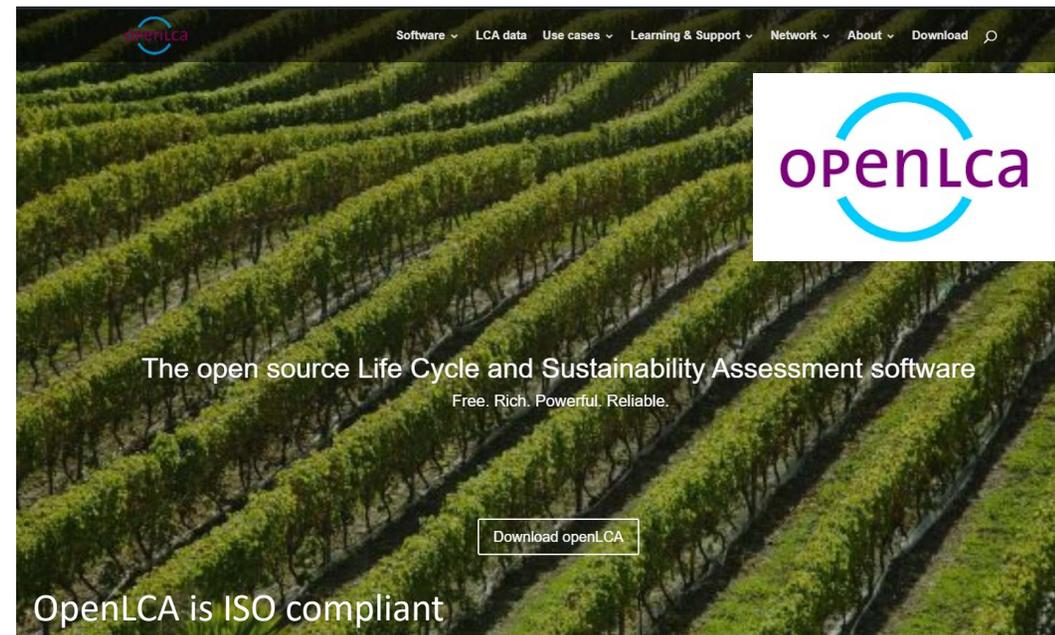


End-of-Life Processes of Solar Modules



Methods – Data Collection and Model

- Peer Reviewed Published Reports
- Peer Reviewed Research Papers
- Expert Consultation – Wind, Solar, Battery
- Model Platform - OpenLCA
- Databases – Ecoinvent (commercially available), DOE National Labs, and others



Some of the Impact Categories Considered in LCA (18 total)



**WATER
CONSUMPTION &
CONTAMINATION**



**GLOBAL WARMING
POTENTIAL**



**RESOURCE
DEPLETION**



LAND USE



ACIDIFICATION



**EUTROPHICATION –
FRESHWATER, TERRESTRIAL**



**ECO-TOXICITY
(FRESHWATER)**

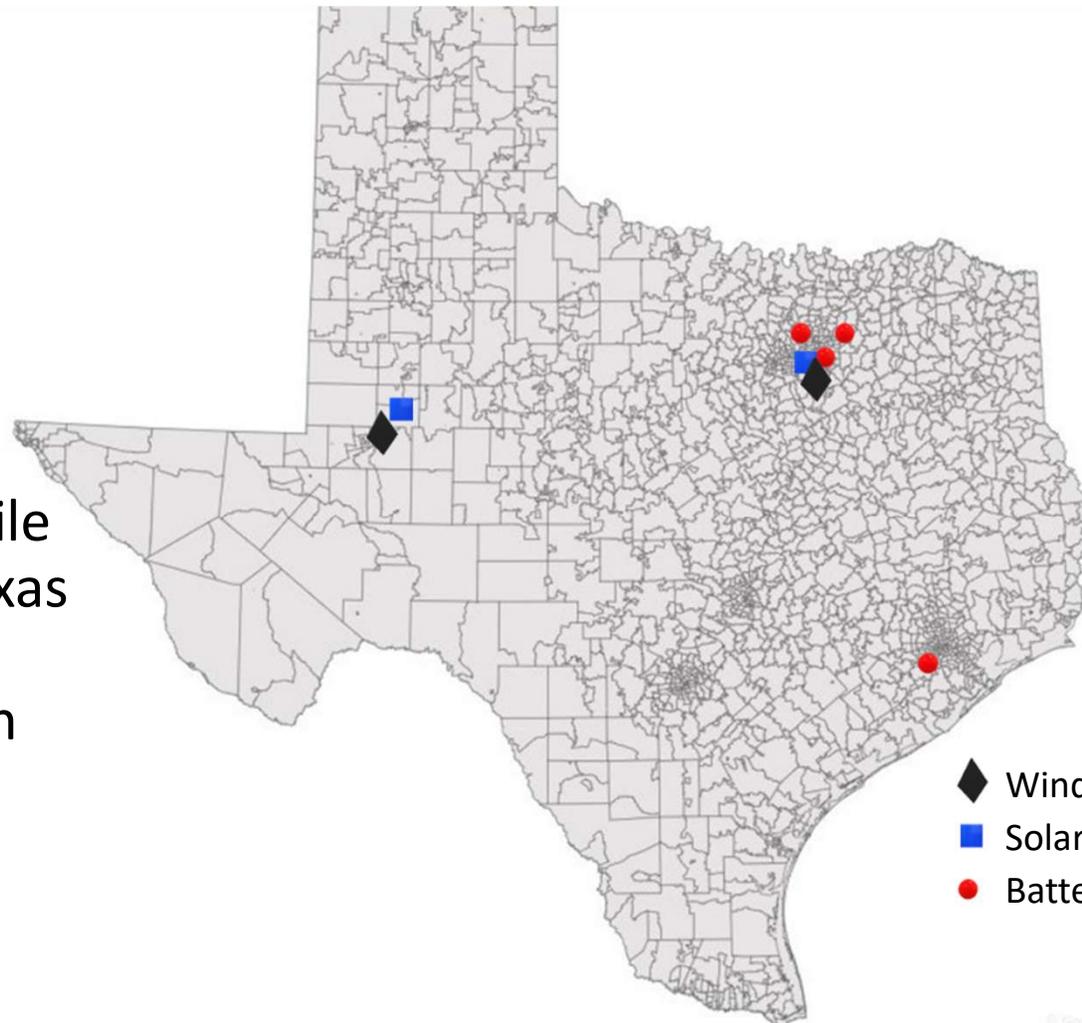


**BIODIVERSITY AND
ECOSYSTEM SERVICES**



Locations of Facilities in Texas – Distances Matter

We will compile facilities in Texas and calculate transportation distances accordingly



- ◆ Wind turbine recycler
- Solar panel recycler
- Battery recycler



Anticipated Results and Timeline

- By adopting this systematic approach, we can obtain a thorough understanding of the end-of-life options for each technology listed in SB 1290.
- Options will be described and results will be provided in a draft technical report to TCEQ on August 30, 2024.
- Final report to be submitted on November 1, 2024

How Can Stakeholders Help?

- Not all data and information are found in publicly available sources
- Information available by stakeholders and industry that would inform out study is extremely important and provide a better study outcome
- If data and information are available and sharable, we would appreciate meeting and discussing!



Thank you for your interest!!



Questions or feedback?

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