

Wind Generation Systems –Use of Life Cycle Information



Michael Overcash, Evan Griffing,
Jan Twomey, and Devi Kalla
Wichita State University
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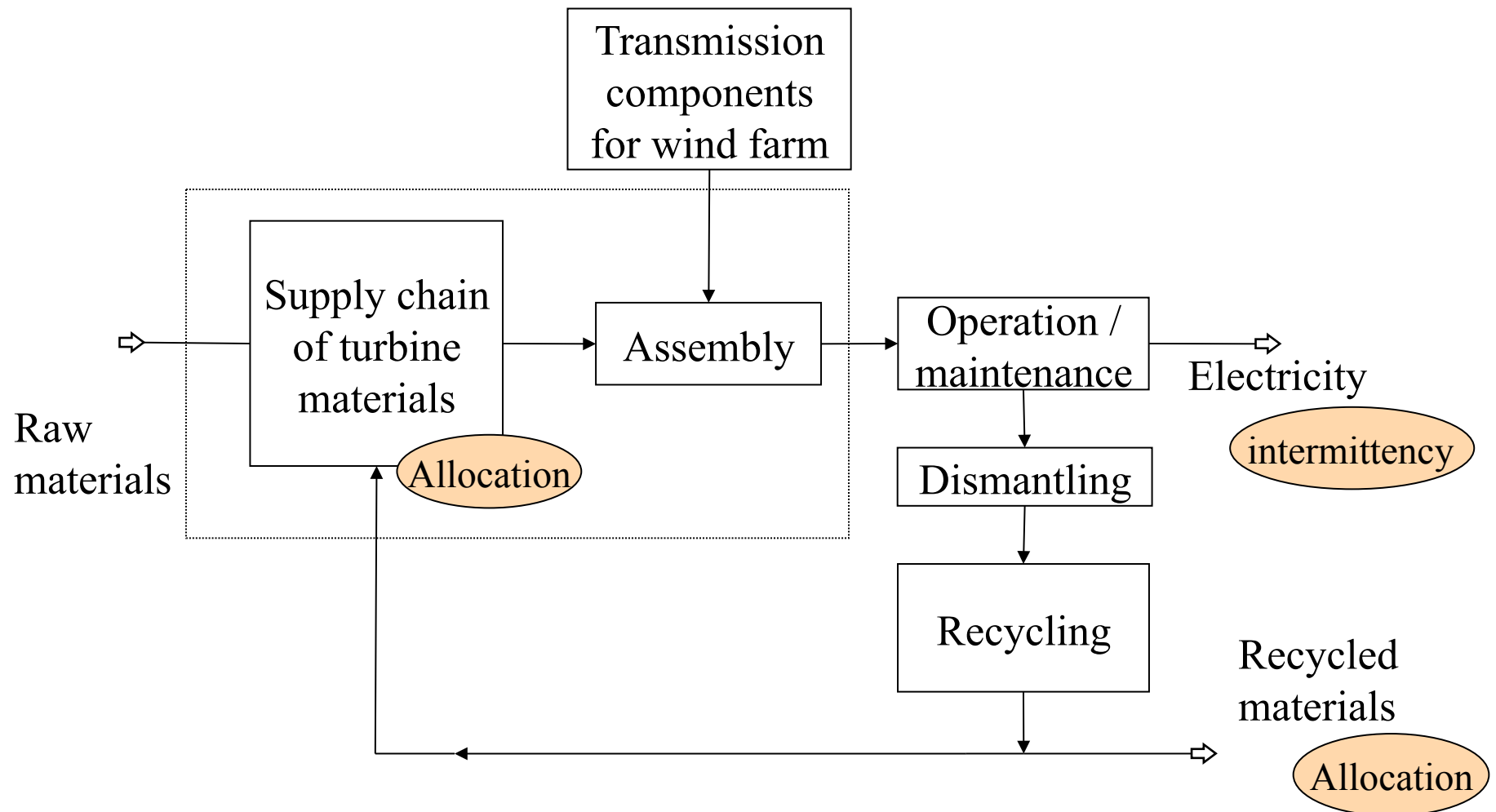
Objectives

- Serve the entire wind generator manufacturing complex (materials, components, subassemblies, and generators)
- Discrete lci gate-to-gate reports
- High transparency, quality
- Begin with most used elements – cluster approach
- Support decision-making for improvement
- Expand to include maintenance, replacement, and end-of-life
- Establish a group of corporations to utilize these data and to direct the priorities in generating the lci

LCI Database Strategy

- Begin development with materials and chemicals
- Create the transformation lci to obtain components
- Establish component plant lci for subassemblies
- Aggregate into wind generators
- Create user friendly means to use database to improve wind generation systems
- Develop more powerful tools for product manufacturing through the concept of unit process life cycle inventory

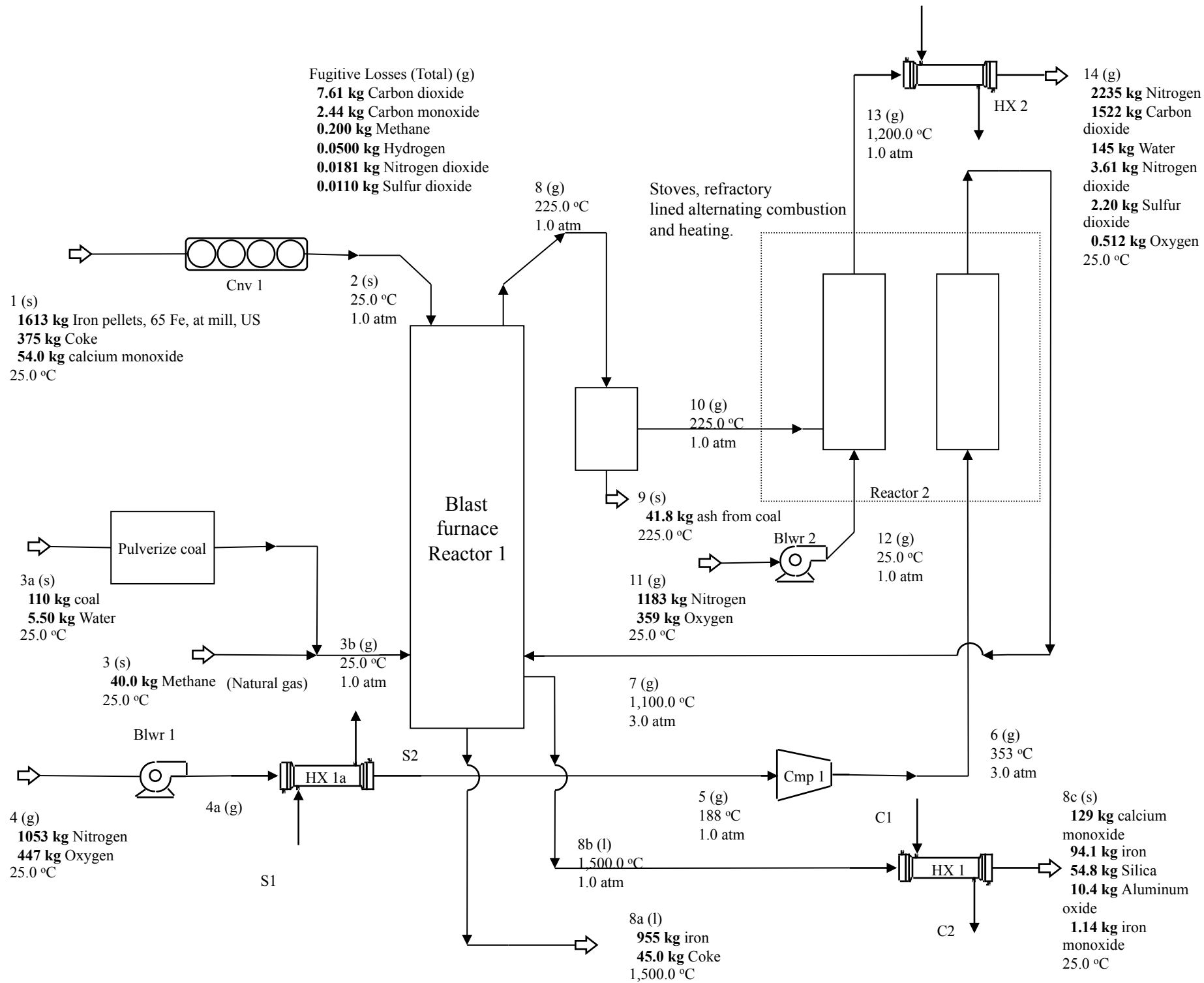
Scope of wind farm / turbine LCI



Architecture

Material, metric tons	Vestas, 3 MW on-shore^1	LG&E 0.34 MW
Iron and Steel	235	26.1
Glass reinforced plastic	40	6.8
Copper	unspecified*	0.073
Concrete	1200	136
Aluminum	unspecified*	unspecified
Neodymium	unspecified	0.02 -0.10

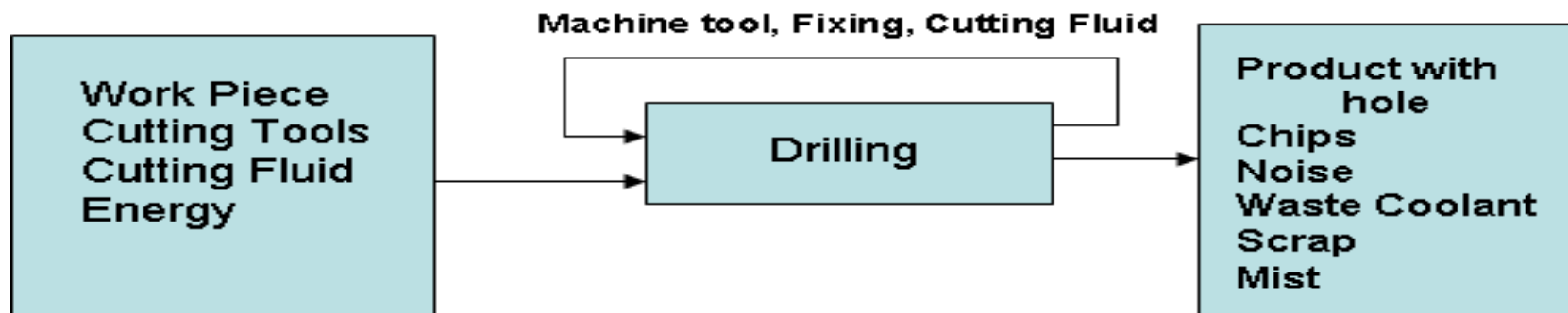
liquid steel 1,000	calcium monoxide 50.0	calcium carbonate 100	limestone(untreated) 108				
	iron 842	calcium monoxide 45.5	calcium carbonate 90.9	limestone(untreated) 90.9			
		coal 92.6	unmined coal 92.6				
		coke, metallurgical 316	coal 368	unmined coal 368			
			sulfuric acid 1.64	sulfur trioxide 1.33	oxygen from air 0.829	air (untreated) 0.829	
					sulfur 0.575	oil (in ground) 0.593	
					water (untreated) 0.0502	water (untreated) 0.0502	
		water for rxn 0.334			water (untreated) 0.334		
		iron pellets, 65 Fe, at mill, US 1,358	iron pellets, 65 Fe, at mine, US 1,358	calcium carbonate 103	limestone(untreated) 111		
				iron ore (in ground) 3,509			
		natural gas 33.7	natural gas (unprocessed) 34.3				
		oxygen 107	air (untreated) 148				
		oxygen from air 572	air (untreated) 572				
		oxygen 77.5	air (untreated) 107				
		steel scrap 250	steel, at collection 250				



Methodology for unit process life cycle inventory model

In order to assess a manufacturing process efficiently in terms of environmental impact, the concept of a unit operation is applied. The unit process lci consists of

- Input materials
- Energy required
- Losses of materials (that may be subsequently recycled or declared waste)
- Major machine and material variables relating inputs to outputs
- Resulting characteristics of the output product that often enters the next unit process.



Input-Output Diagram of a Drilling Process

DRILLING PROCESS

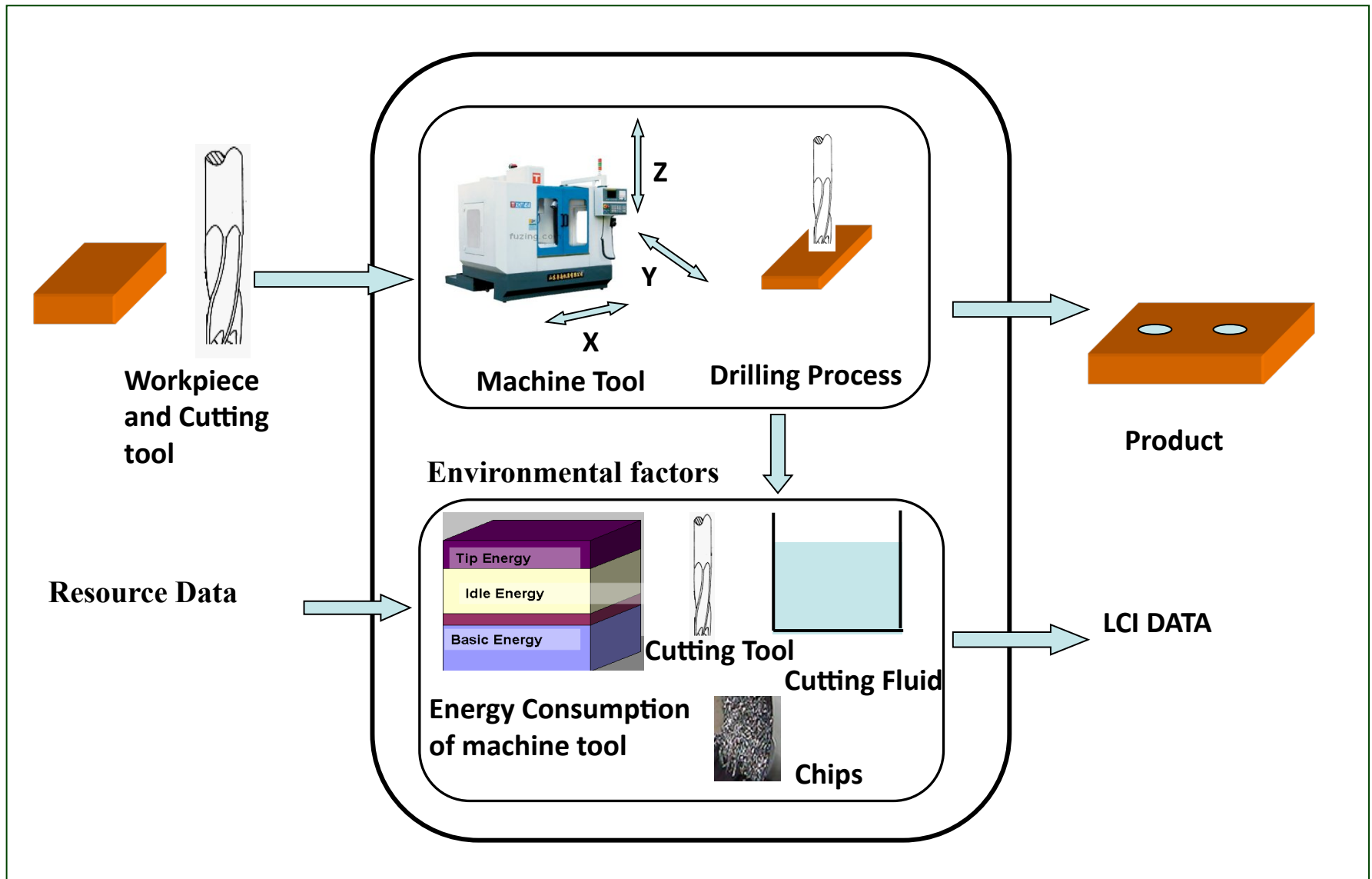


Figure LCI data for Drilling process

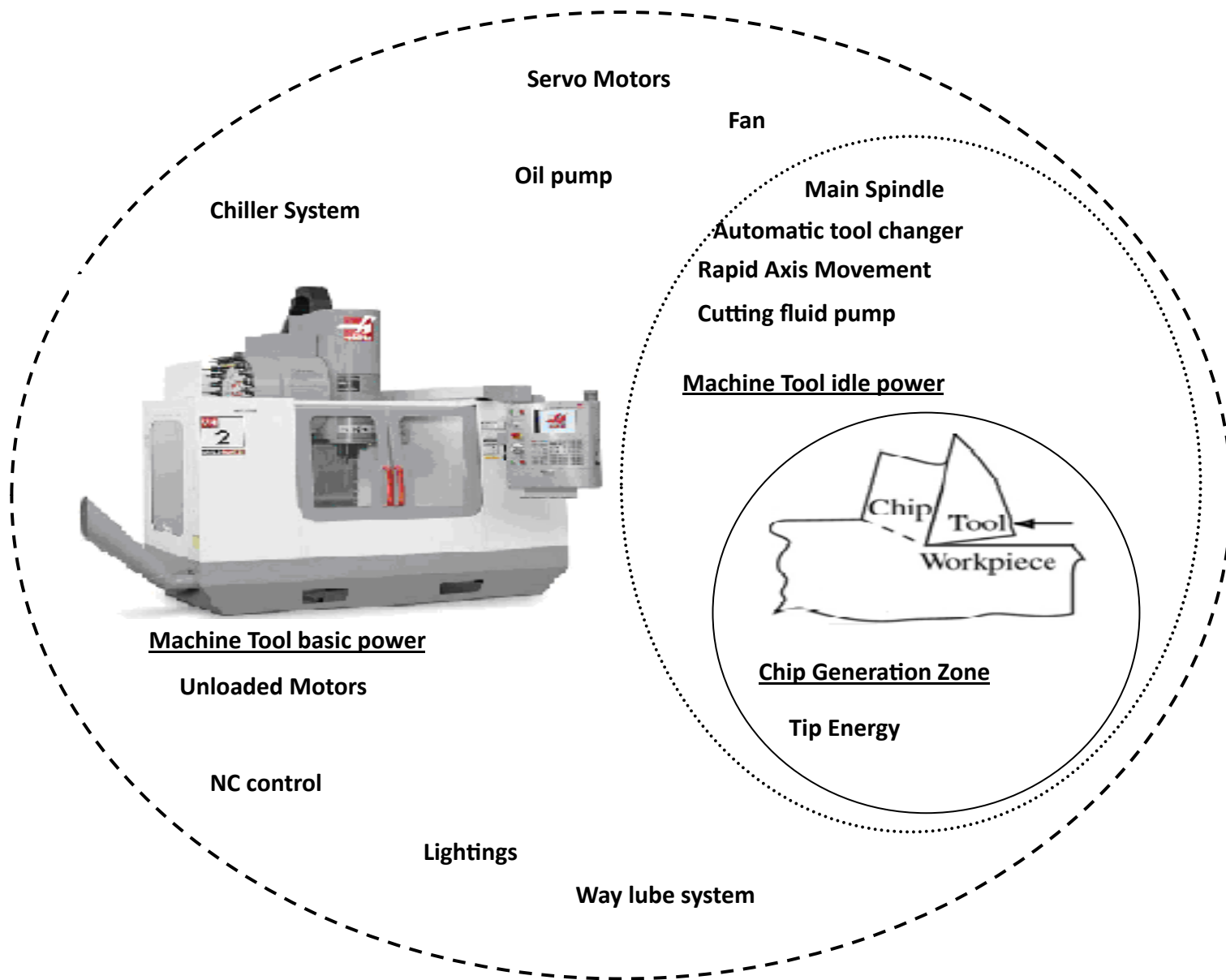
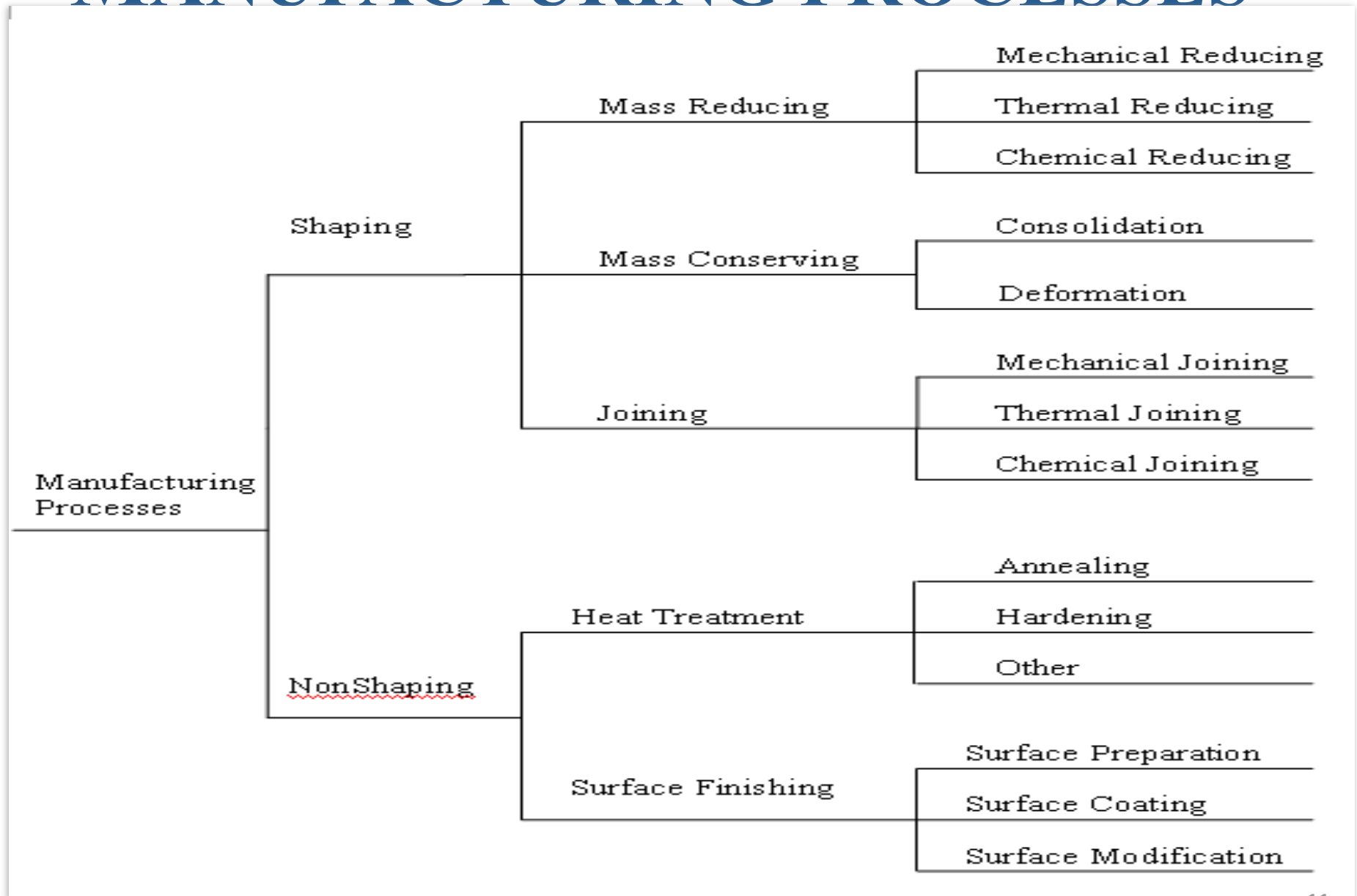


Figure. System boundary of the Drilling process

MANUFACTURING PROCESSES



Conclusions

1. Life cycle inventory data are critical to improvement and communication of wind generator manufacturing
2. The standard for lci are now require much more transparency, scientific quality, and usability
3. A new set of tools necessary for life cycle information in relation to product manufacturing plants