

**Mission:**

*To advance economic prosperity, health and quality of life  
in Indiana and beyond.*

**PURDUE**  
UNIVERSITY

MANUFACTURING EXTENSION  
PARTNERSHIP



ECONOMY  
ENERGY  
ENVIRONMENT

# E3 Program in Indiana

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a NIST | Network  
MEP | Affiliate

# Agenda

- **Introduction**
- Program Overview
- Value Stream Mapping
- Waste Stream Mapping
- Energy Assessment
- Carbon Footprint
- Case Study #1
- Case Study #2



# Introduction

***Mission:***  
***Advancing economic prosperity, health, and  
quality of life in Indiana and beyond.***



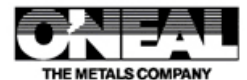
# Lifetime Economic Impact\*

Description	Totals
Jobs Created and Retained _____	9,912
Sales Created and Retained _____	\$900 Million
Cost Savings _____	\$104 Million
Investment _____	\$237 Million
Total Impact _____	\$1.2 Billion

\*July 1, 2005 to Sept. 30, 2014



TI Automotive



Endress+Hauser  
People for Profit



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# E3: Economy, Energy, and the Environment

**E3 is an innovative, community-based effort to establish self-sustaining initiatives that simultaneously increase the sustainable practices and profitability of manufacturers.**



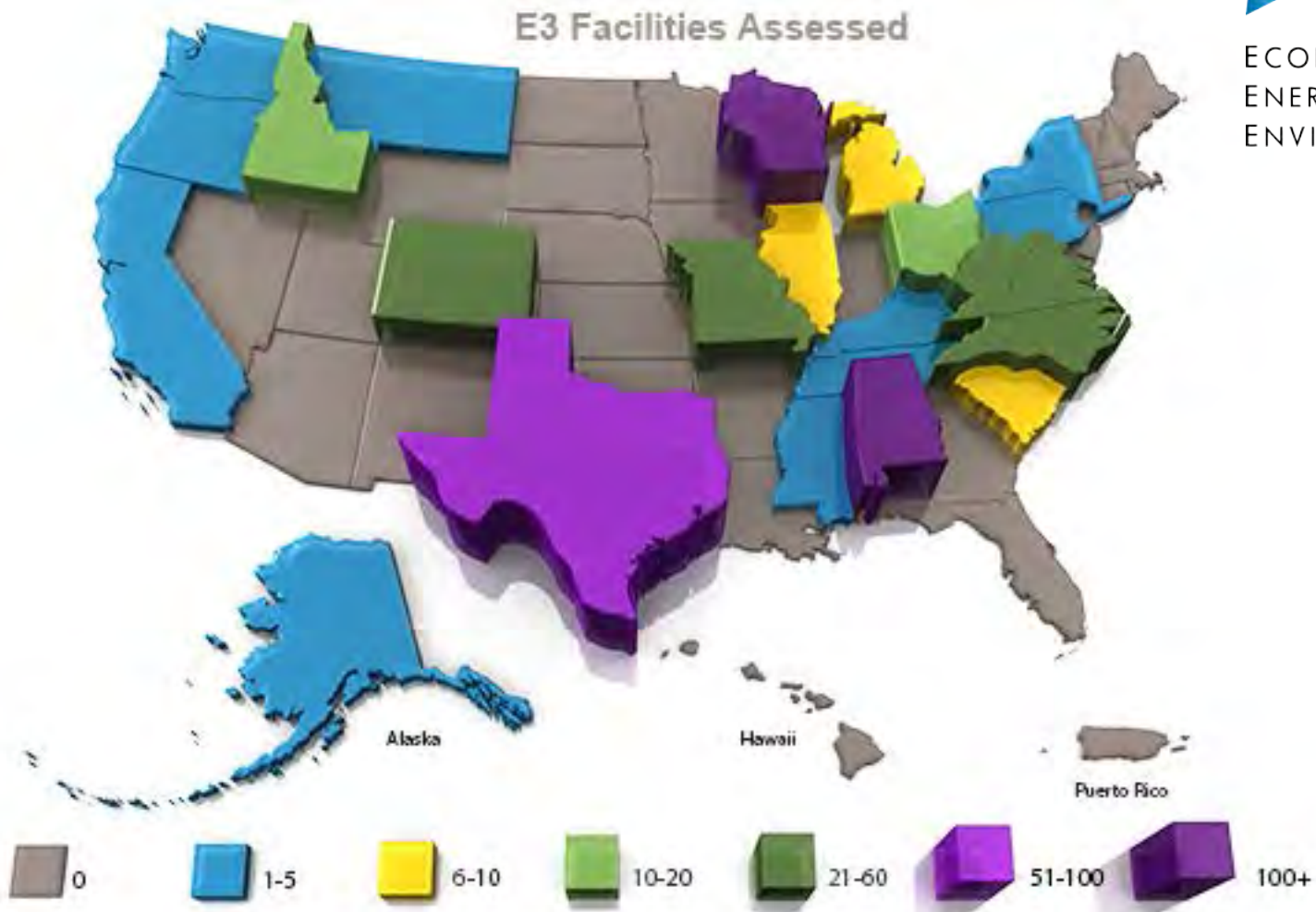
ECONOMY  
ENERGY  
ENVIRONMENT



# Strengthening U.S. Manufacturing



ECONOMY  
ENERGY  
ENVIRONMENT



August 2014



# E3 Metrics

## Economic Metrics:

- Environmental savings identified
  - Lean savings identified
  - Other cost savings
- One time potential cost savings identified
  - Individuals trained
    - Jobs created
    - Jobs retained
- Total annual potential impact identified

## Energy Metrics:

- Energy conserved (MM BTU/kWh)
- Energy intensity per unit of production
  - Carbon reductions (tons)
- Carbon intensity per unit of production

## Environment Metrics:

- Air emissions reduced (lbs)
  - Solid waste reduced (lbs)
- Material intensity per unit of production
  - Hazardous waste reduced (lbs)
- Hazardous materials reduced (lbs)
  - Water pollution reduced (lbs)
  - Water used/conserved (gal)
- Water intensity per unit of production





# Time & Personnel Commitment

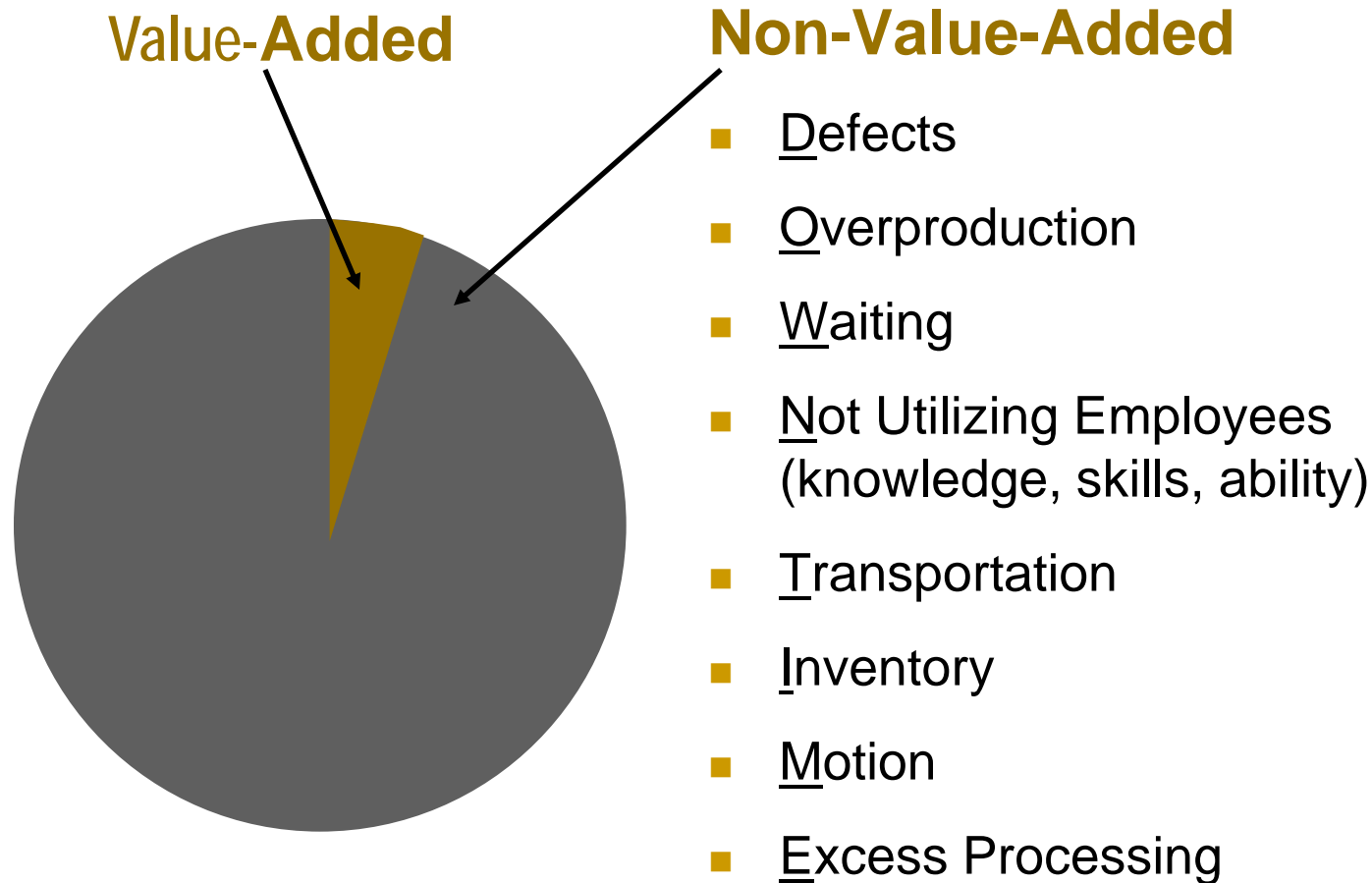
Assessment	# of days	# of Participants	Participant Type	Prep Work Required
<b>Lean VSM Training &amp; Assessment</b>	1-2 days (depending on size and complexity of the process chosen)	6 - 16 people	People involved in the process to be Value Stream Mapped are needed. Others may include top management, department heads, associates from area, etc.	E3 Pre-Assessment Survey
<b>Environmental Waste Stream Training &amp; Assessment</b>	1-2 days (depending on size and complexity of the process chosen)	6 -16 people	People involved in the process to be Value Stream Mapped are needed. Others may include top management, department heads, associates from area, etc.	Discuss possible processes/ waste streams to be analyzed
<b>Carbon Footprint Analysis</b>	0.5 - 1 day	1 person	Person(s) knowledgeable in the facility systems and energy use	Energy Data
<b>Facility Energy Assessment</b>	1 - 2 days (depending on size of the facility)	1 person	Person(s) knowledgeable in the facility systems to escort energy assessment team	Energy Data
<b>Intro to Energy/ Environ. Management Systems Training</b>	0.5 day	6-16 people	People involved in mid- to upper-level management from various departments	N/A

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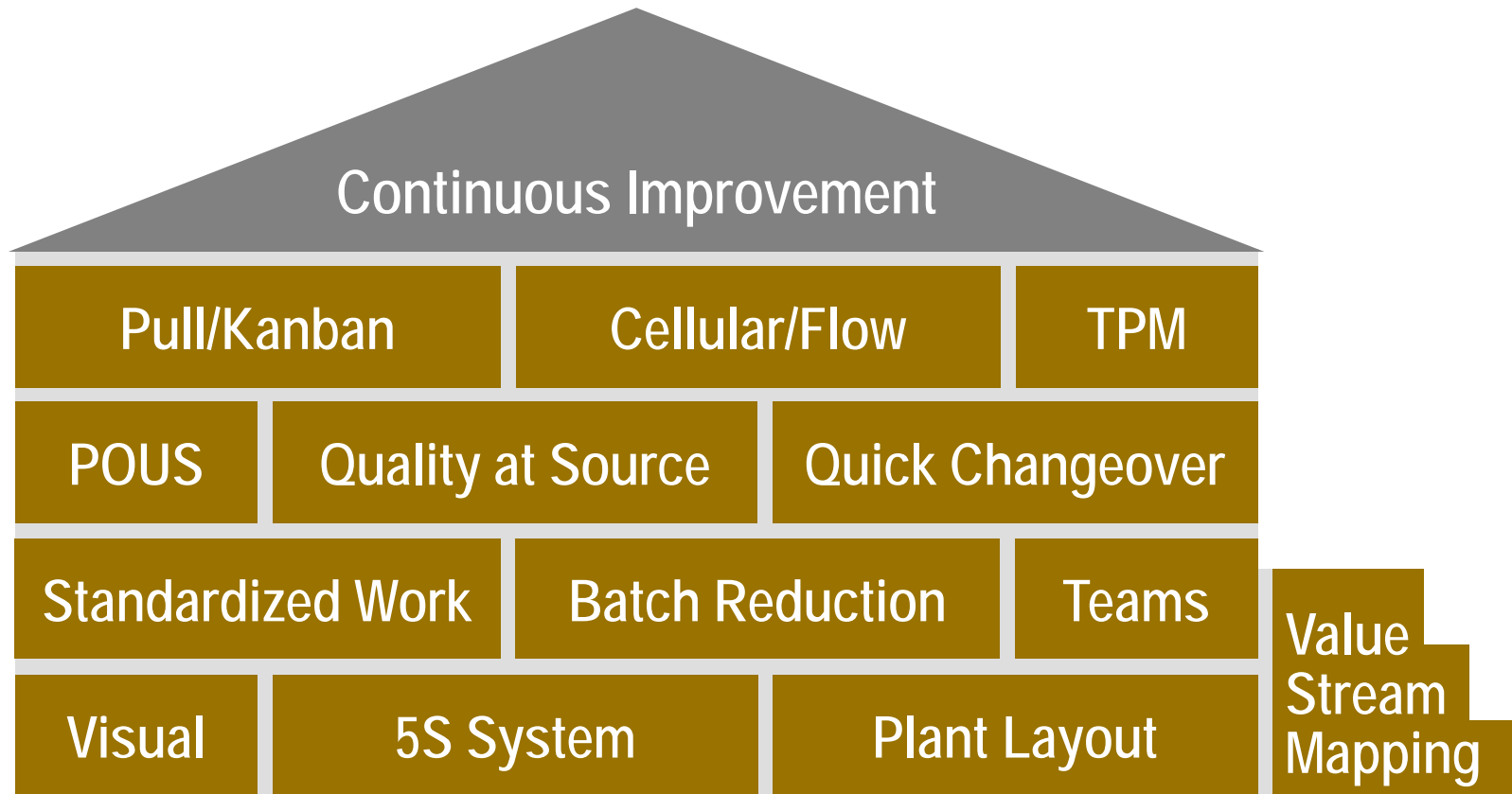
# Lean = Eliminating Waste



Typically 95% of all lead time is non-value-added.



# Lean Building Blocks



# Combining Lean and Green

## DOWNTIME

### Traditional Lean Eliminates

- **D**efects
- **O**verproduction
- **W**aiting
- **N**on-utilized resources
- **T**ransportation
- **I**nventory
- **M**otion
- **E**xtra processing

## FEWER

### Green Strives For

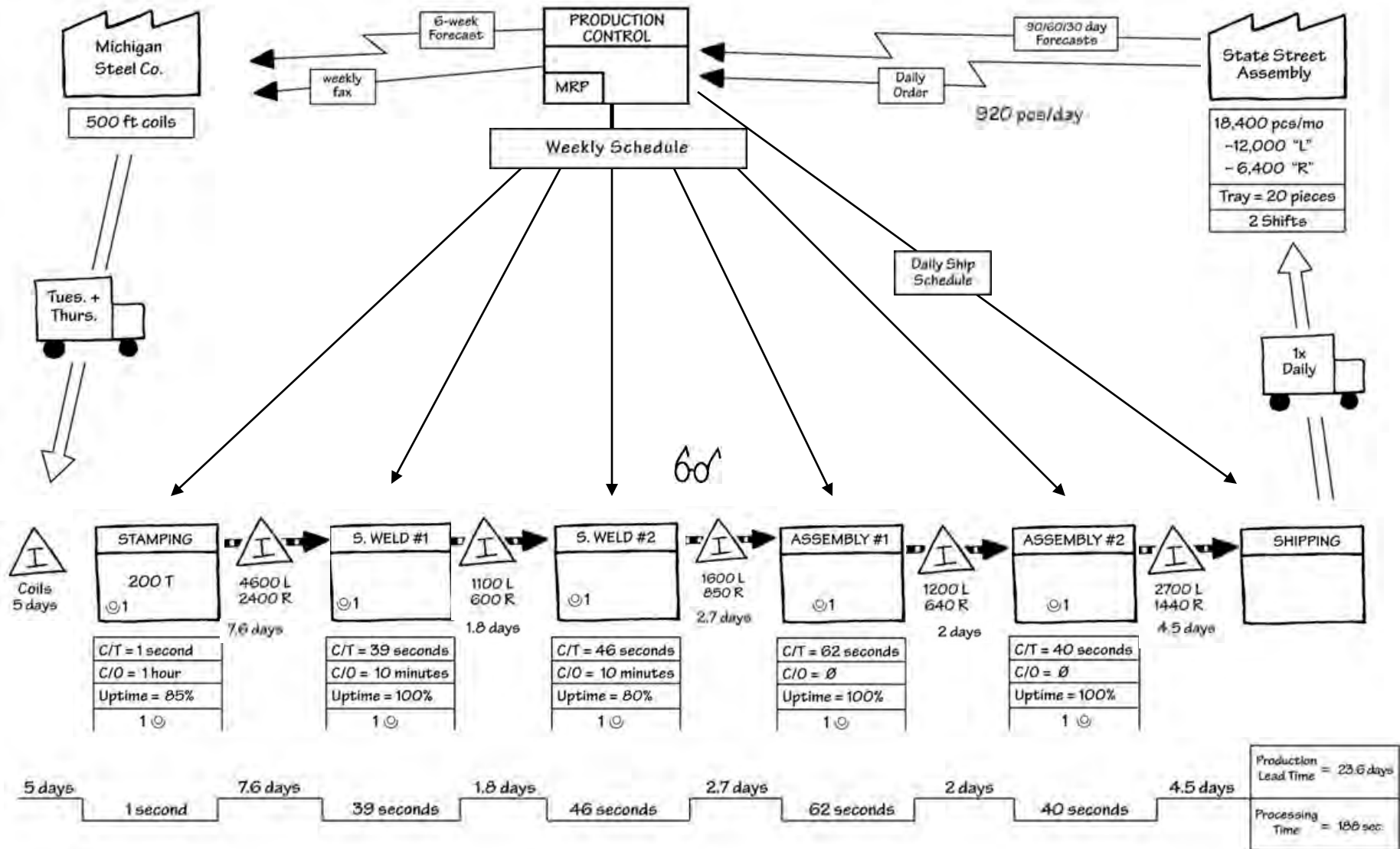
- F**ull use of Raw Material
- E**nergy Efficiency
- W**ater Conservation
- E**liminating Toxic Substances
- R**eduction of:
  - ❑ Packaging Wastes
  - ❑ Air Emissions
  - ❑ Regulatory obligations and risks



# Value Stream Mapping

- ❖ 2 Day Onsite Training and Review:
  - Current state mapping
  - Waste walk
  - Generation of Lean OFI's
  - Prioritization of OFI's
    - Capture Cost Savings and Environmental Impact











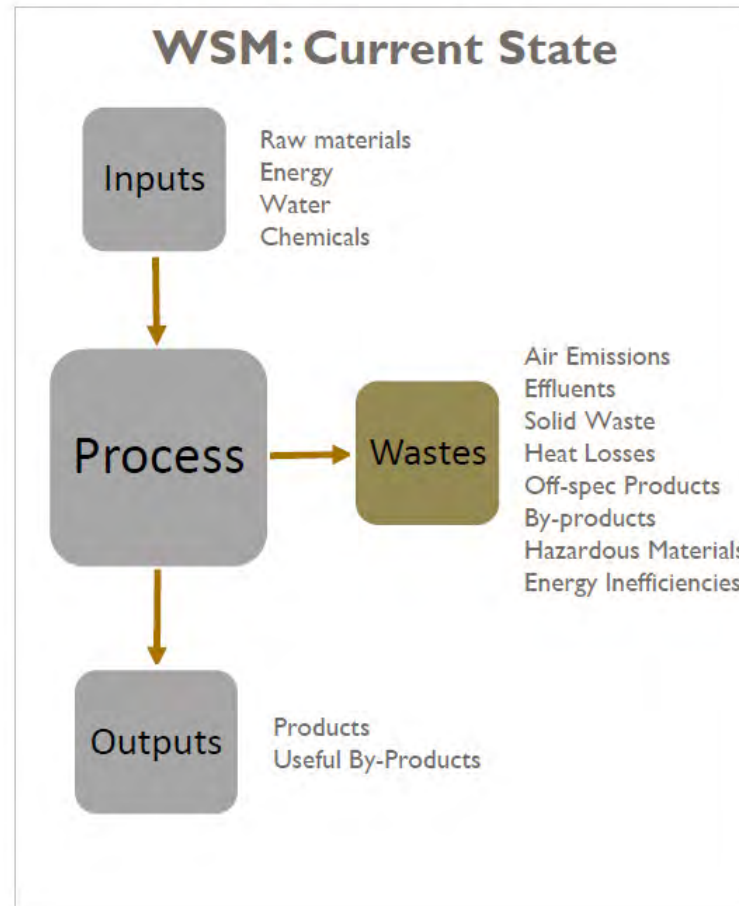


# Agenda

- Introduction
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- **Waste Stream Mapping**
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# Waste Stream Mapping



# Environmental WASTE Categories

Water



Air



Solids



Toxicity  
(Chemicals)



Energy



# WASTE Stream Mapping Approach



# Levels & Approaches to Scope

## ■ **Overall System WSM**

- ❑ High Level, looks at all processes and all waste types/categories
- ❑ Provides overall assessment
- ❑ Used to identify and prioritize opportunities

## ■ **Specific Process WSM**

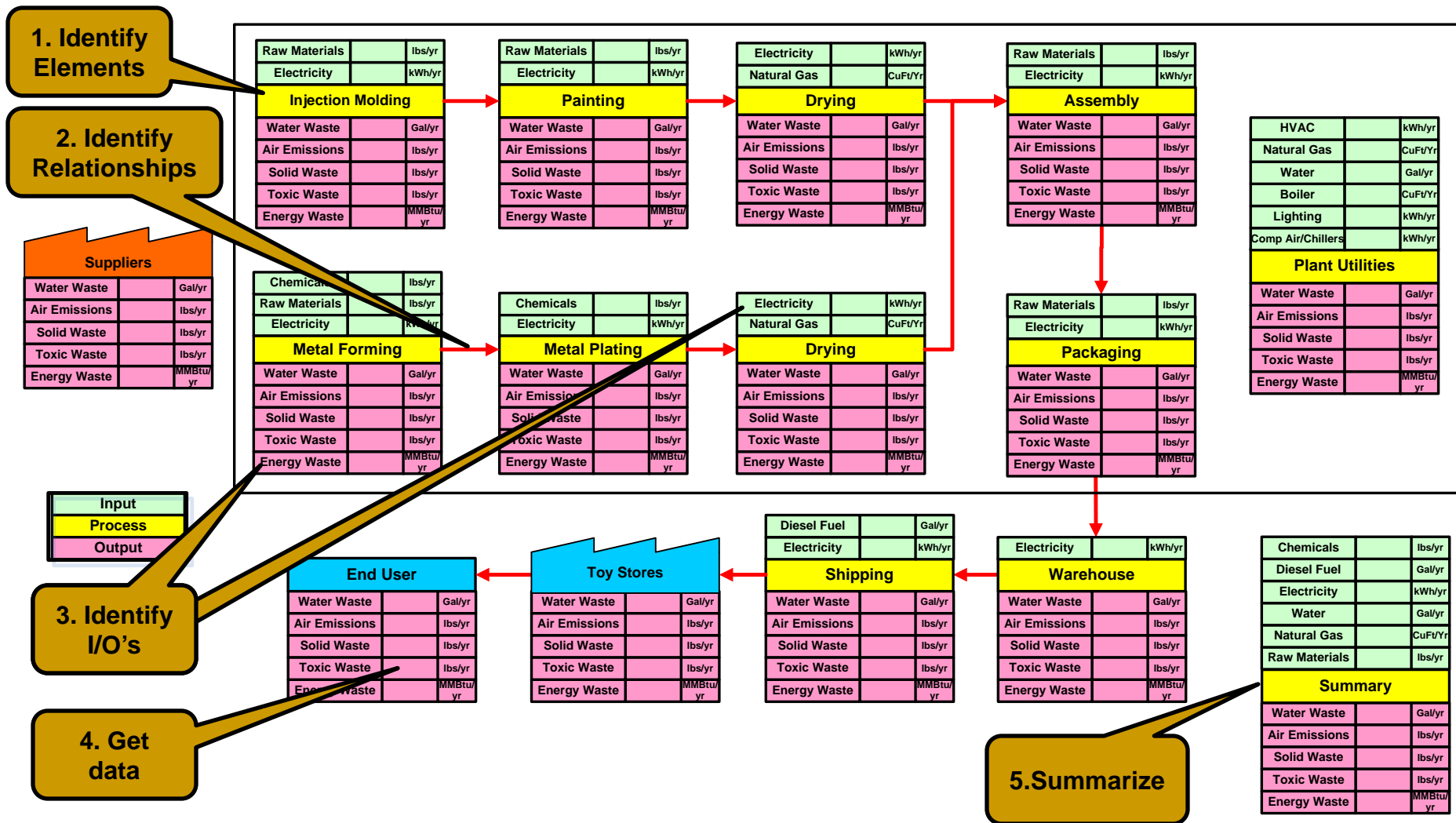
- ❑ Detailed look at all categories of waste within a specific process
- ❑ Example: Map the Water, Air, Solid, Toxic, and Energy Wastes for an injection molding process

## ■ **Specific WASTE Type WSM**

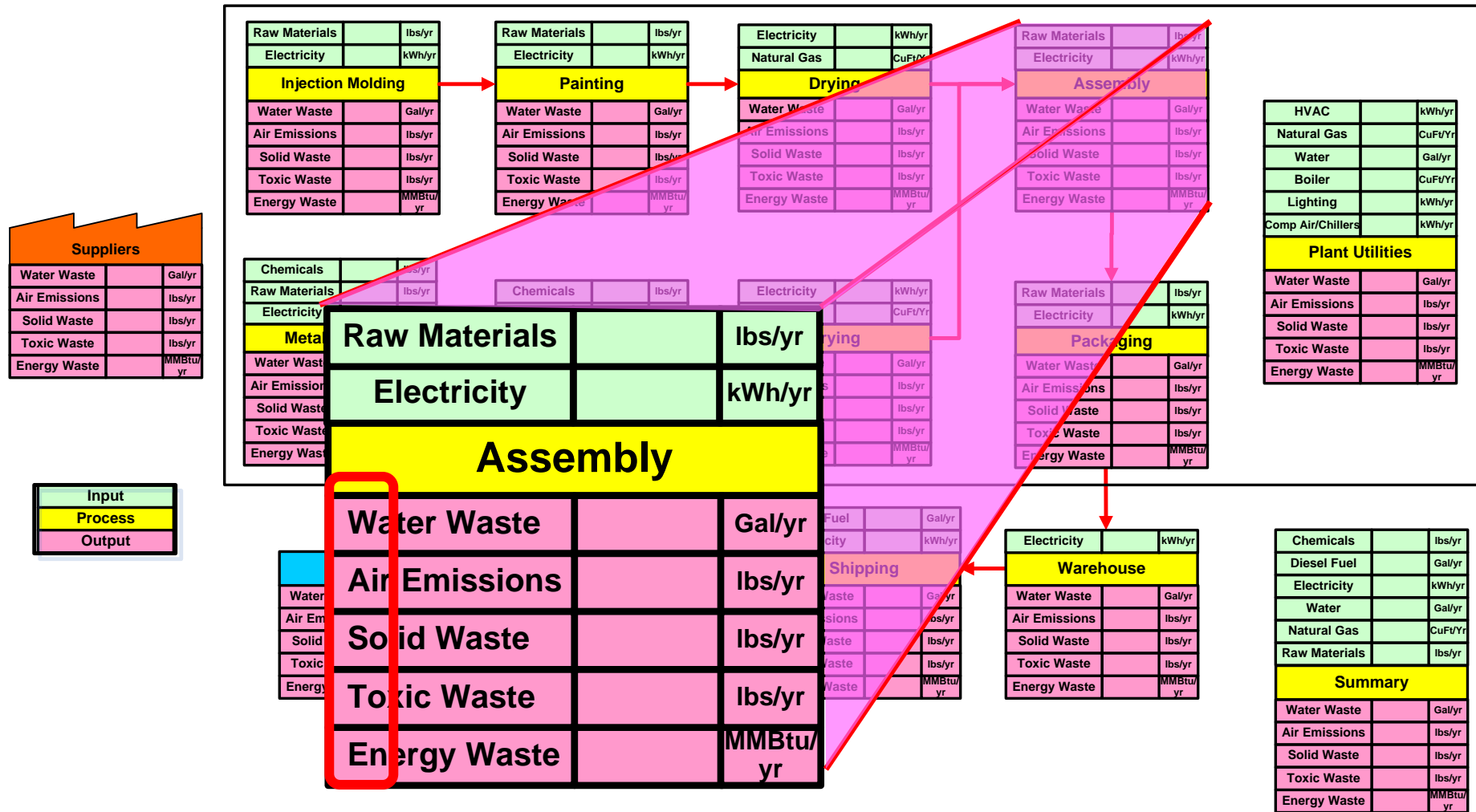
- ❑ Detailed look at one waste categories across multiple/all processes
- ❑ Example: Map the Solid Waste Stream for a toothbrush manufacturing operation



# Example: Overall System WSM

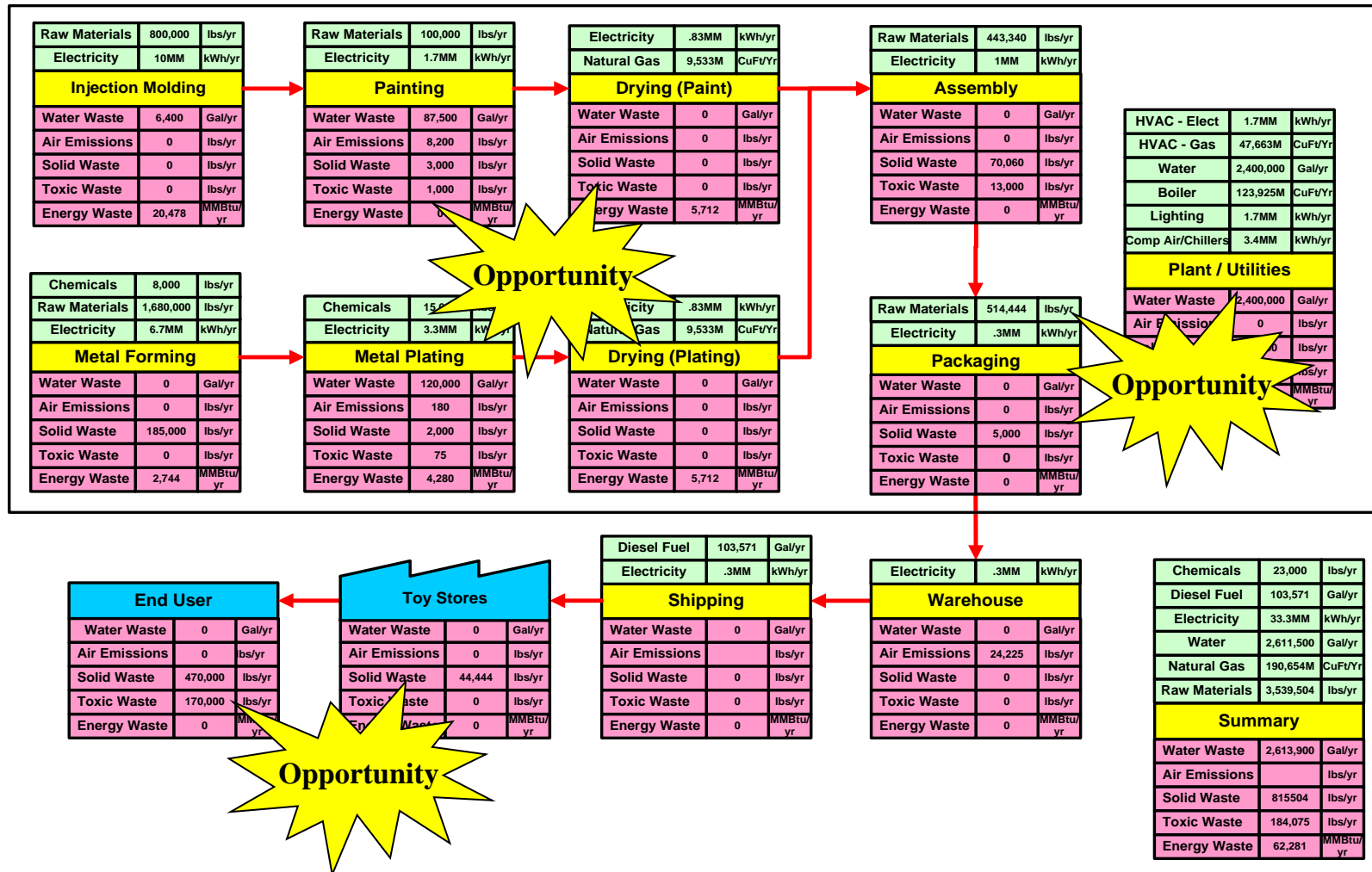


# Waste Stream Mapping

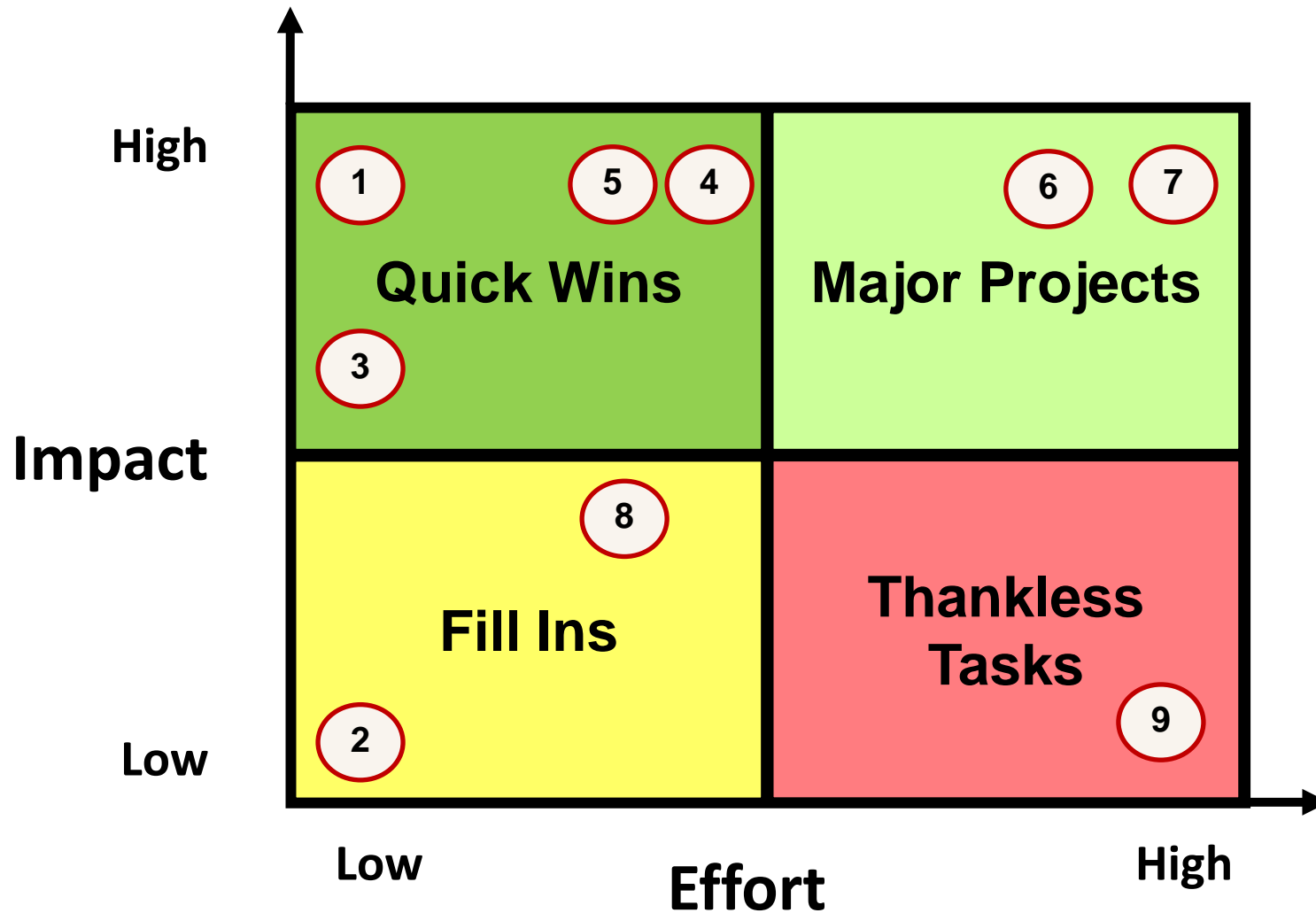




# Waste Stream Mapping



# Evaluating Options



# Agenda

- Introduction
- Program Overview
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- Waste Stream Mapping
- **Energy Assessment**
- Carbon Footprint
- Case Study #1
- Case Study #2



# Energy Assessment



A comprehensive look at energy systems



# Energy Assessment

## ■ Final Report

- Executive Summary including summary of Recommendations
- Plant Description
- Process Description
- Resource Charts and Tables
- Major Energy Consuming Equipment
- Best Practices
- Description of Individual Energy Saving Recommendations

Pre-Assessment Form  
**Industrial Assessment Center**  
IUPUI  
INDIANA UNIVERSITY-PURDUE UNIVERSITY  
INDIANAPOLIS

Please complete this survey as best as possible and return/email it to the address below.

Jie Chen, PhD, Director of the IAC  
Email: [jchen2@iupui.edu](mailto:jchen2@iupui.edu) [iupuiac@iupui.edu](mailto:iupuiac@iupui.edu)  
Fax: (317)274-9744  
Indiana University Purdue University of Indianapolis  
723 W. Michigan St. SL260  
Indianapolis, IN 46202-51603

**Contact Information**

Company Name: \_\_\_\_\_

Mailing Address: \_\_\_\_\_

Street Address: \_\_\_\_\_

Contact Person: \_\_\_\_\_

Title Position: \_\_\_\_\_

Phone: \_\_\_\_\_

Email: \_\_\_\_\_

**General Information**

Principal products: \_\_\_\_\_

SIC code: \_\_\_\_\_

Annual Sales: \$ \_\_\_\_\_

Number of Employees: \_\_\_\_\_ million

Number of buildings: \_\_\_\_\_

NAICS code: \_\_\_\_\_

Total Plant Area (ft<sup>2</sup>): \_\_\_\_\_

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Revised 1/12/14

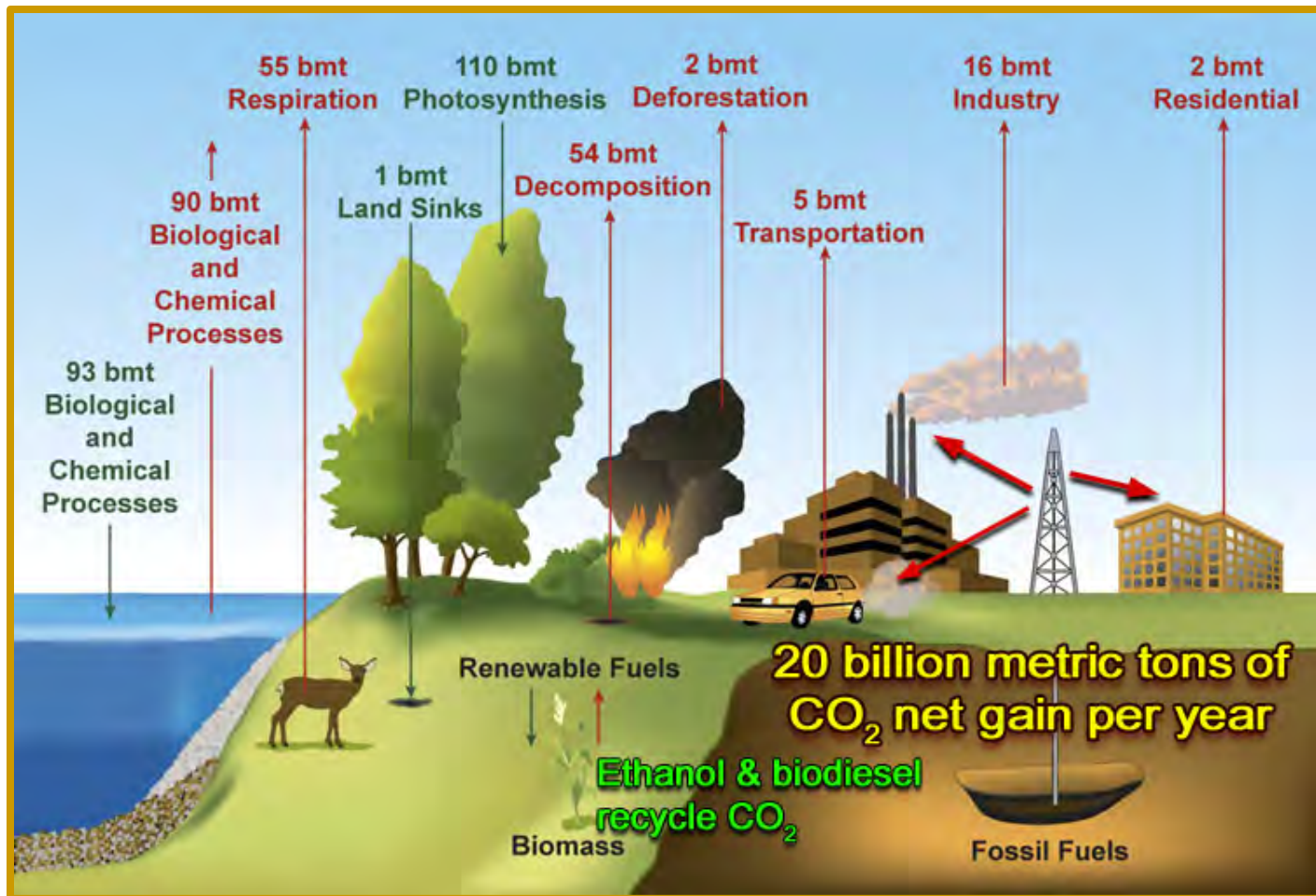


# Agenda

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# Carbon Sources & Sinks





# Risk Management

- Manage your business liabilities
  - ❑ Reduce dependency on uncontrollable forces
  - ❑ Minimize risk by reducing processes that are **reliant on cheap/abundant** water or energy
  - ❑ Prepare for increasing insurance rates due to more extreme weather patterns
  - ❑ Adapt to changing business climate
  - ❑ Attract larger investors and customers





# Agenda

- Introduction
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- Case Study #2

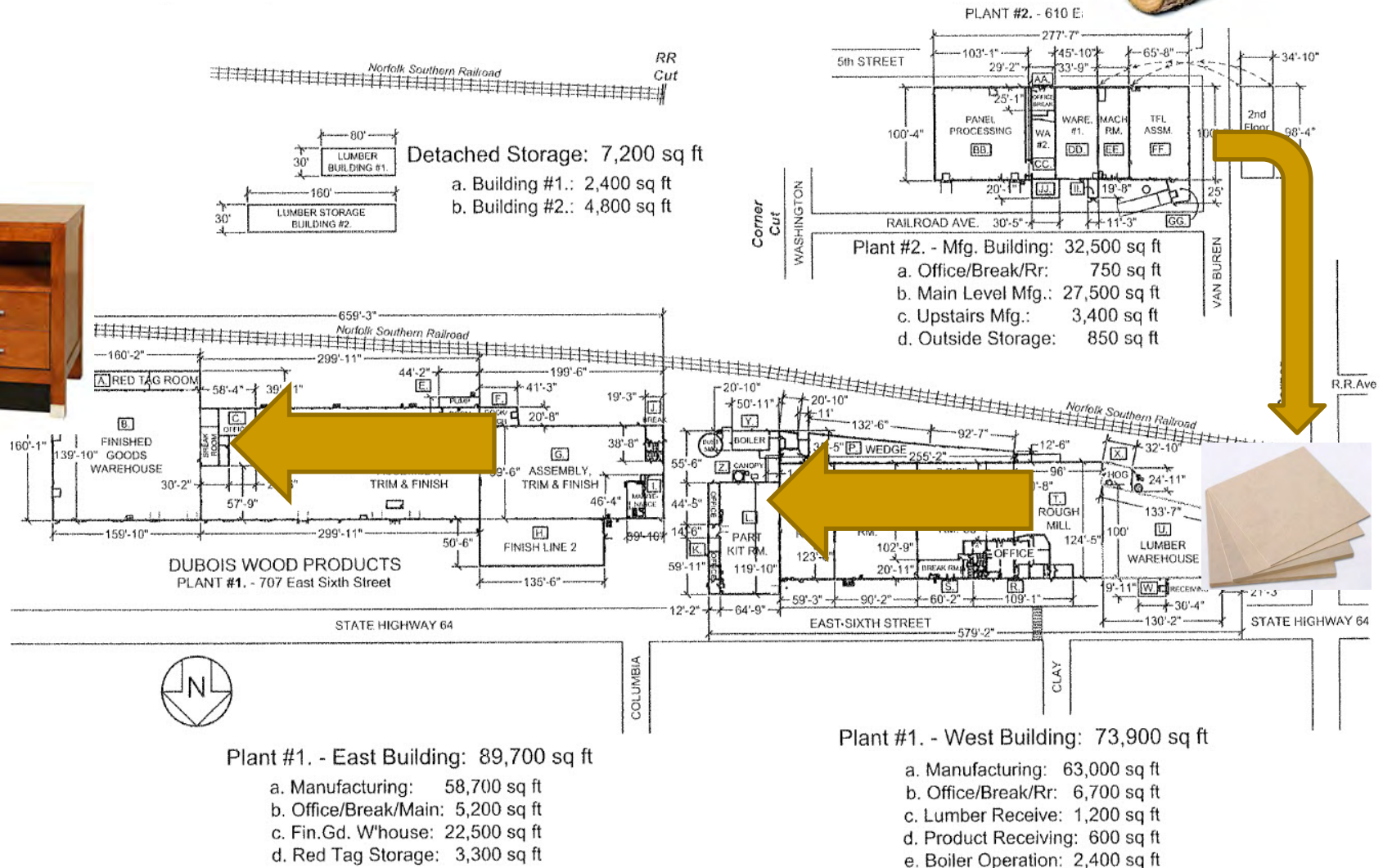


# Case Study #1

## Indiana Wood Product Manufacturer



# Case Study #1



# Case Study #1

## Indiana Wood Product Manufacturer

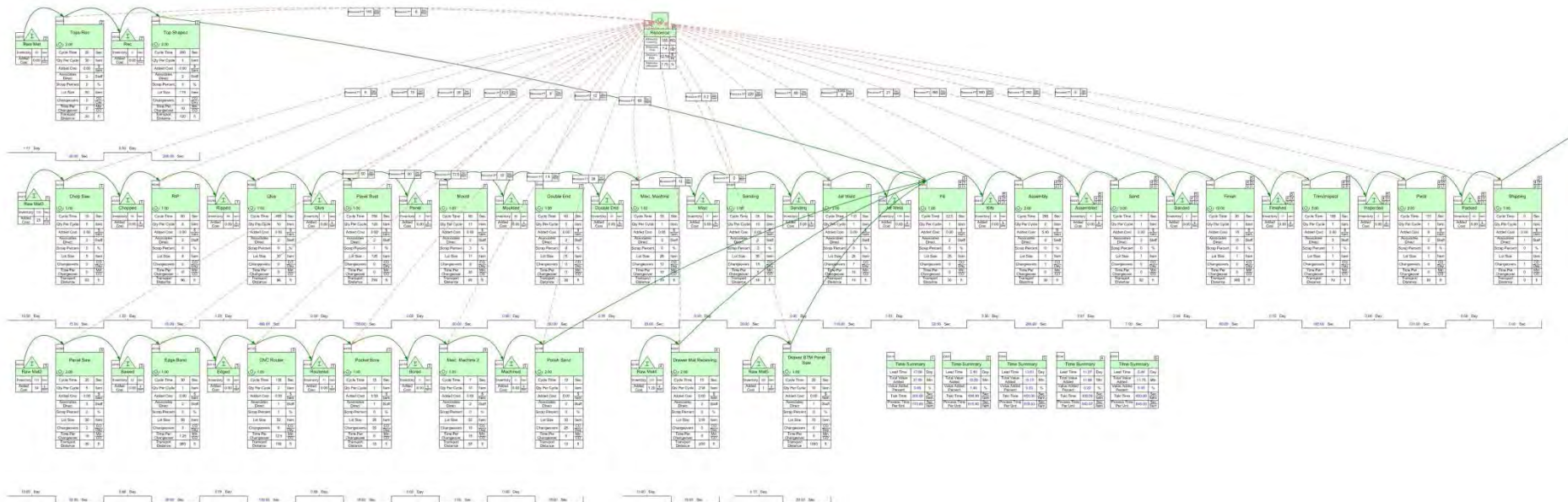
- Working 6:30am-4pm 5-6 days/wk
- Annual production= 233,000 pieces
- No. Employees = 200
- Annual Elec. Cost = \$293,280
- Annual Nat. Gas Cost = \$150,726



# Case Study #1

## Assessment Summary:

### ■ Value Stream Mapping: Current State



# Case Study #1

## Assessment Summary:

### ■ Key Lean Opportunities

- ❑ Install FIFO Lanes
- ❑ Set up Supermarkets
- ❑ Rearrange into cells
- ❑ Set up QCO
- ❑ Develop Visuals & Standardize work

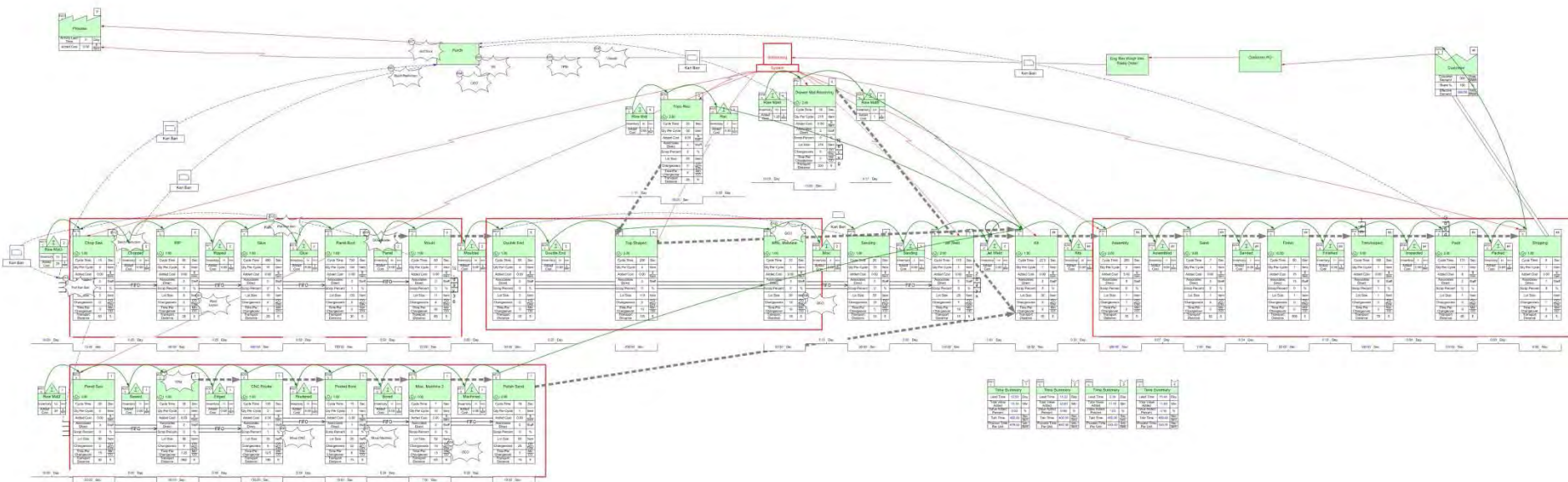




# Case Study #1

## Assessment Summary:

### ■ Value Stream Mapping: Future State



# Case Study #1

## Assessment Summary:

- **Key Lean Opportunities**

**\$87,500+**  
**annual savings**

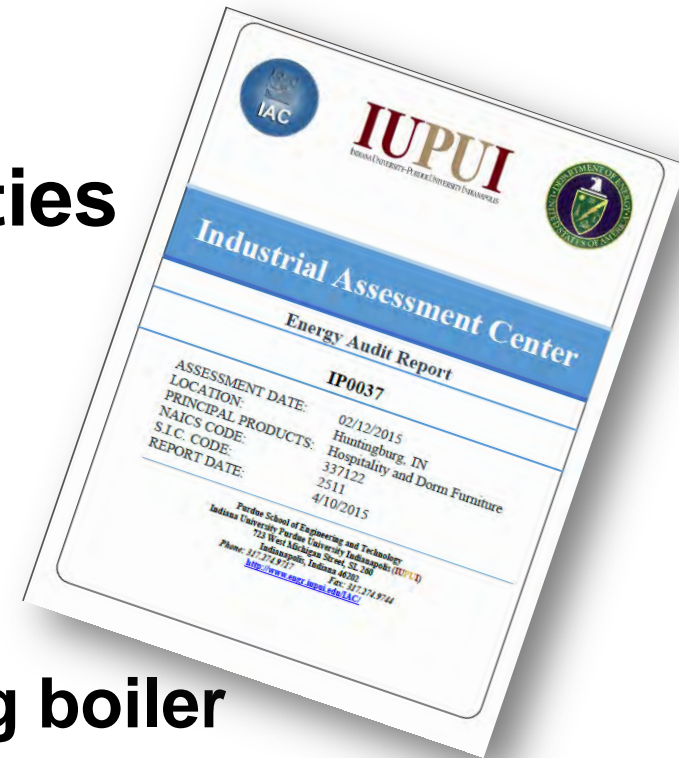




# Case Study #1

## Assessment Summary:

- **Energy Savings Opportunities**
  - ❑ Lighting
  - ❑ Compressed Air
  - ❑ HVAC
  - ❑ Heat Recovery
  - ❑ **Switching from wood burning boiler**
  - ❑ Other – manufacturing tax incentive



# Case Study #1

## Assessment Summary:

### ■ Wood Burning Boiler Opportunity

- ❑ Insufficient heating and poor controls using existing sawdust boiler
- ❑ Market value of sawdust = \$25/ton x 1,000 tons = \$25,000 new income
- ❑ Old boiler requires \$20,000 in repairs + \$15,000 in water treatment
- ❑ Replace with (4) natural gas heaters
- ❑ *Annual Savings* = \$32,642



# Case Study #1

## Assessment Summary:

- **Energy Savings Opportunities**

**\$81,600+**  
**annual savings**



# Case Study #1

## Assessment Summary:

### ■ W.A.S.T.E. Stream Opportunities

- ❑ Divert solid waste to be recycled
- ❑ Reduce solid wood waste
- ❑ Reduce emissions from paints & sealants

**W**ater



**A**ir



**S**olids



**T**oxicity  
(Chemicals)



**E**nergy



# Case Study #1

## Assessment Summary:

### ■ W.A.S.T.E. Stream Opportunities

- ❑ Buying 8,250 annual cardboard strips
- ❑ Throwing away plastic banding
- ❑ Test new method of securing parts
- ❑ Yearly savings of **\$1,435** plus reduced disposal cost



# Case Study #1

## Assessment Summary:

### ■ W.A.S.T.E. Stream Opportunities

- ❑ Rip saw yield study
- ❑ Soft pine wood has high scrap rate of 40% due to defects in wood
- ❑ Investigate cost of higher grade versus reduced scrap



# Case Study #1

## Assessment Summary:

### ■ W.A.S.T.E. Stream Opportunities

Opportunity: Rip Saw Yield Study

Objective: Minimize overall solid wood production costs by analyzing savings of purchasing higher grade lumber to reduce labor, electricity, machine wear

<b>Current: Study</b> (Small time study)						
Description	Total Purchased (Bd Ft)	Cost (\$/Ft)	Total Cost	Yield (Bd. Ft.)	% of Total	
Lower Grade Soft Maple with knots	132	\$ 1.28	\$ 168.96	132.00		
Soft Maple Table Legs			\$ 74.88	58.50	44%	
Scrap at Moulding due to defects in wood- 10%				5.85	4%	
Soft Maple Glue Up			\$ 34.56	27.00	20%	
Total Product Output			\$ 101.95	79.65	60%	
Waste			\$ 67.01	52.35	40%	

\* May be able to extrapolate data study to other wood types

<b>Current: Annual</b> (Extrapolated from study & data gathered)						
Description	Total Purchased (Bd Ft)	Cost (\$/Ft)	Total Cost	Yield (Bd. Ft.)	% of Total	
Lower Grade Soft Maple with knots	180,000.00	\$ 1.28	\$ 230,400	180,000.00	100%	
Soft Maple Table Legs			\$ 102,109	79,772.73	44%	
Scrap at Moulding due to defects in wood				7,977.27	4%	
Soft Maple Glue Up			\$ 47,127	36,818.18	20%	
Total Product Output			\$ 139,025	108,613.64	60%	
Waste			\$ 91,375	71,386.36	40%	





# Case Study #1

## Assessment Summary:

### ■ W.A.S.T.E. Stream SAVINGS

- ❑ Rip saw yield study
- ❑ Premium grade lumber projected to reduce scrap rate to **10%**
- ❑ Annual savings of **\$27,654** in material
- ❑ Plus savings in reduced machine operating costs, including electricity, labor, and maintenance



# Case Study #1

## Assessment Summary:

- **W.A.S.T.E. Stream Opportunities**

**\$40,300+**  
**annual savings**



# Case Study #1

## Assessment Summary:

### ■ Greenhouse Gas Emissions Opportunities

- ❑ Current GHG emissions = 5,028.7 Metric Tons of CO<sub>2</sub>-equivalent
- ❑ Minimize burning of fossil fuels
- ❑ Increase energy efficiency via energy improvement projects
- ❑ Switch fuel from wood boiler to cleaner natural gas
- ❑ Explore potential of solar photovoltaic for zero-emissions electricity generation
- ❑ Reduce solid wood waste generation
- ❑ Reduce emissions from paints & sealants



# Case Study #1

## Assessment Summary:

### ■ Greenhouse Gas Emissions SAVINGS

	Electric (kWh)	Nat. Gas (MMBtu)	Wood Waste (tons)	Water (gal)	GHG (MTCO2-eq)
1. Lean Opportunities					
1. Energy Efficiency Opportunities	148, 886	596	10,500		
1. WASTE Opportunities			516		
1. Solar PV Installation	112,913				
Total Usage					
GHG (MTCO2-eq)	250 tons	3.2 tons	15,637 tons		15,890 tons



# Case Study #1

## Assessment Summary:

### ■ Greenhouse Gas Emissions SAVINGS

#### Annual greenhouse gas emissions from



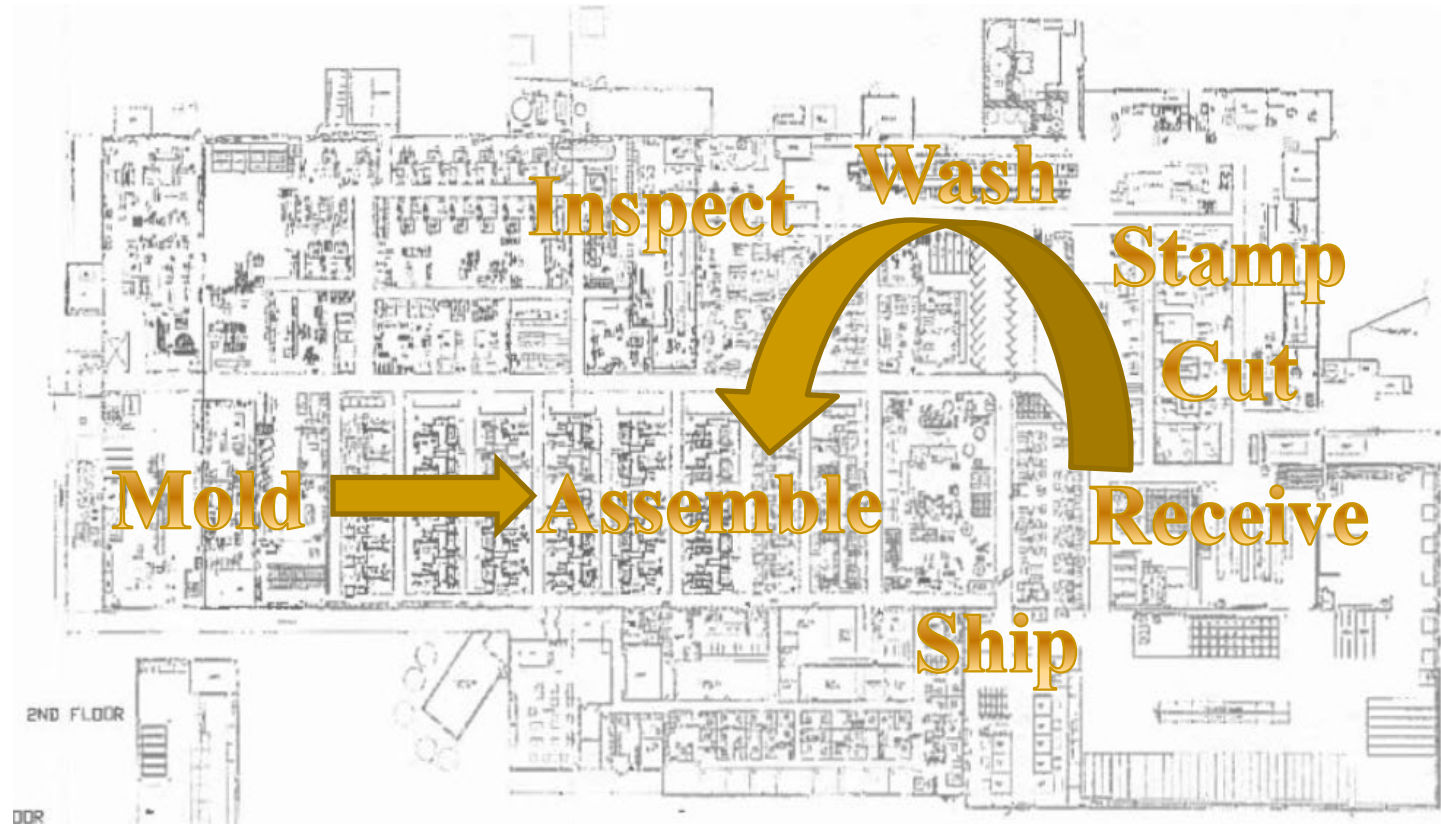
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- **Case Study #2**



# Case Study #2

## Automotive Seal Manufacturer





# Case Study #2

## Automotive Seal Manufacturer

- Working 2 shifts 5-6 days/wk
- Annual production= 24,637,577 pieces
- No. Employees = 493
- Annual Elec. Cost = \$1,816,118
- Annual Nat. Gas Cost = \$254,073



# Case Study #2

## Assessment Summary:

### ■ Key Lean Opportunities

- ❑ Install FIFO Lanes
- ❑ Eliminate banding of metal parts
- ❑ Investigate larger coil size & improved coil layout
- ❑ Improve communication
- ❑ Develop Visuals & Standardize work
- ❑ Change to water-based oil to eliminate 2 week rerun



# Case Study #2

## Assessment Summary:

- Key Lean Opportunities

**\$174,487+**  
**annual savings**



# Case Study #2

## Assessment Summary:

### ■ Key Lean SAVINGS

- ❑ Direct **Labor per part** declines by \$.13 each.
- ❑ **Process bottleneck** would be reduced from .225 minutes per part to .125 minutes per part. This is a 40% reduction on the bottle neck process.
- ❑ The **lead time** was reduced from 3.83 days to 3.43 days. A 10% reduction.
- ❑ The **Value Added time** increased from 3.77% to 4.21%. This is a 12% improvement. With additional effort, further opportunities could be addressed.
- ❑ The **Process Times** was reduced from 40.88 to 24.37. This is a 40% reduction.
- ❑ Potential savings from reduced metal scrap TBD.



# Case Study #2

## Assessment Summary:

- **Energy Savings Opportunities**
  - ❑ Lighting
  - ❑ Compressed Air
  - ❑ HVAC
  - ❑ Other – manufacturing tax incentive



# Case Study #2

## Assessment Summary:

- **Energy Savings Opportunities**

**\$145,800+**  
**annual savings**



# Case Study #2

## Assessment Summary:

### ■ W.A.S.T.E. Stream Opportunities

- ❑ Waste water/ soap alternative
- ❑ Reverse osmosis reject water reuse for cooling tower makeup
- ❑ Reduce rubber waste
- ❑ Reduce & Repurpose oil contaminated metal chips





# Case Study #2

## Assessment Summary:

- **W.A.S.T.E. Stream Opportunities**

**\$239,000+**  
**annual savings**



# Case Study #2

## Assessment Summary:

### ■ W.A.S.T.E. Stream Opportunities

- ❑ Change to PH7 soap with 10x more diluted ratio
- ❑ Aggressively address leaks at presses to reduce oil volume
- ❑ Seek alternatives to chlorinated paraffin oil
- ❑ Reuse soapy greywater for floor scrubbers
- ❑ Reuse Reverse Osmosis reject water for cooling tower



# Case Study #2

## Assessment Summary:

### ■ W.A.S.T.E. Stream SAVINGS

- ❑ Improved safety with less acidic soap (pH 7 vs. 14).
- ❑ Diverts ~65,000 gallons of water from hazardous waste stream.
- ❑ Natural gas no longer burned for evaporator ~ 9,000 MCF.



# Case Study #2

## Assessment Summary:

### ■ Greenhouse Gas Emissions Opportunities

- ❑ Current GHG emissions = 29,296 Metric Tons of CO<sub>2</sub>-equivalent
- ❑ Increase energy efficiency via energy improvement projects
- ❑ Reduce burning of fossil fuels- eliminate evaporator
- ❑ Minimize wasting of hydraulic fluid and other lubricants



# Case Study #2

## Assessment Summary:

### ■ Greenhouse Gas Emissions SAVINGS

	Electric (kWh)	Nat. Gas (MMBtu)	Water (gal)	Hydraulic oils (gal)	GHG (MTCO2-eq)
1. Lean Opportunities				**TBD	
1. Energy Efficiency Opportunities	1,200,819	148			1147
1. WASTE Opportunities		9,000	1,232,000*		
Total Usage					
GHG (MTCO2-eq)	1,147	486.8	3.9	**	1,637.7 tons



# Case Study #2

## Assessment Summary:

### ■ Greenhouse Gas Emissions SAVINGS

#### Equivalency Results

The sum of the greenhouse gas emissions you entered above is of Carbon Dioxide Equivalent. This is equivalent to:

1,638 Metric Tons

#### Annual greenhouse gas emissions from



#### CO<sub>2</sub> emissions from



# Survey

- Purdue TAP will schedule a follow up meeting ~4-6 months after assessment completion





# Questions?



ECONOMY  
ENERGY  
ENVIRONMENT



# Thank you!



## TECHNICAL ASSISTANCE PROGRAM

**Purdue TAP's mission is to help Indiana companies to succeed.  
For more information about other ways that Purdue TAP can assist  
your company, please contact:**

**Kelly Weger, RA, LEED AP**  
**734.320.5908**  
**[weger@purdue.edu](mailto:weger@purdue.edu)**

**Central Office:**  
**8626 E. 116<sup>th</sup> St., #200**  
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