REDUCING ELECTRICAL CONSUMPTION IN THE FOREST PRODUCTS INDUSTRY USING LEAN THINKING

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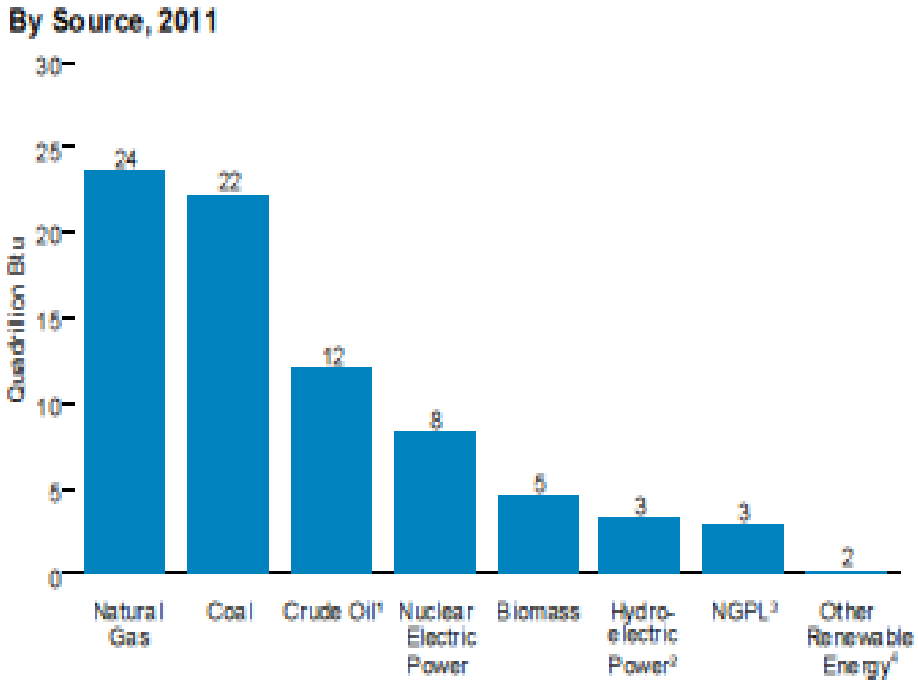
Overview

Background	• Eliminate waste = decreased operation cost
Problem	• No research dedicated to measuring the impact "lean thinking" has on electrical consumption
Purpose and Objective	• Use lean tools to estimate and reduce electrical waste
Methods	• Value Stream Mapping (VSM)
Results	• Future State Value Stream Map
Conclusions	• "Lean thinking" impacts electrical consumption

Background

Energy in the Forest Products Industry

- Industrial 26%
- U.S. electrical 14%
- Forest Products Industry < 1%
- Large majority of the industry generates onsite energy



Background

Process Improvements

- Total Productive Maintenance (ideology)
- Continuous Improvement (ideology)
- Six Sigma (tool)
- Lean (ideology)

Service Performance

- Improve quality and reduce cost
- Minimize the use of assets
- Track performance improvements
- Decrease waste

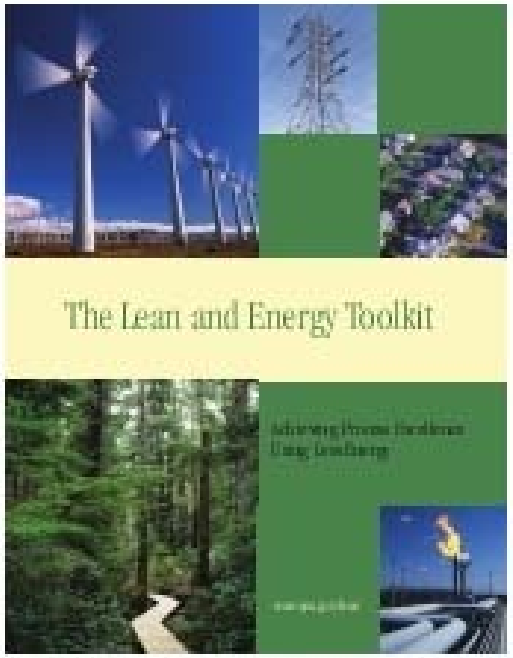
Background

Why Lean?

- Lean is customer oriented
- Lean thinking is reducing waste by focusing on value-added processes
- Value is defined by the customer
- "Lean thinking is basically doing more with less." – James Womack

Lean and Energy Toolkit

- Energy Treasure Hunts
- Value and Energy Value Stream Mapping
- Energy Kaizen Events



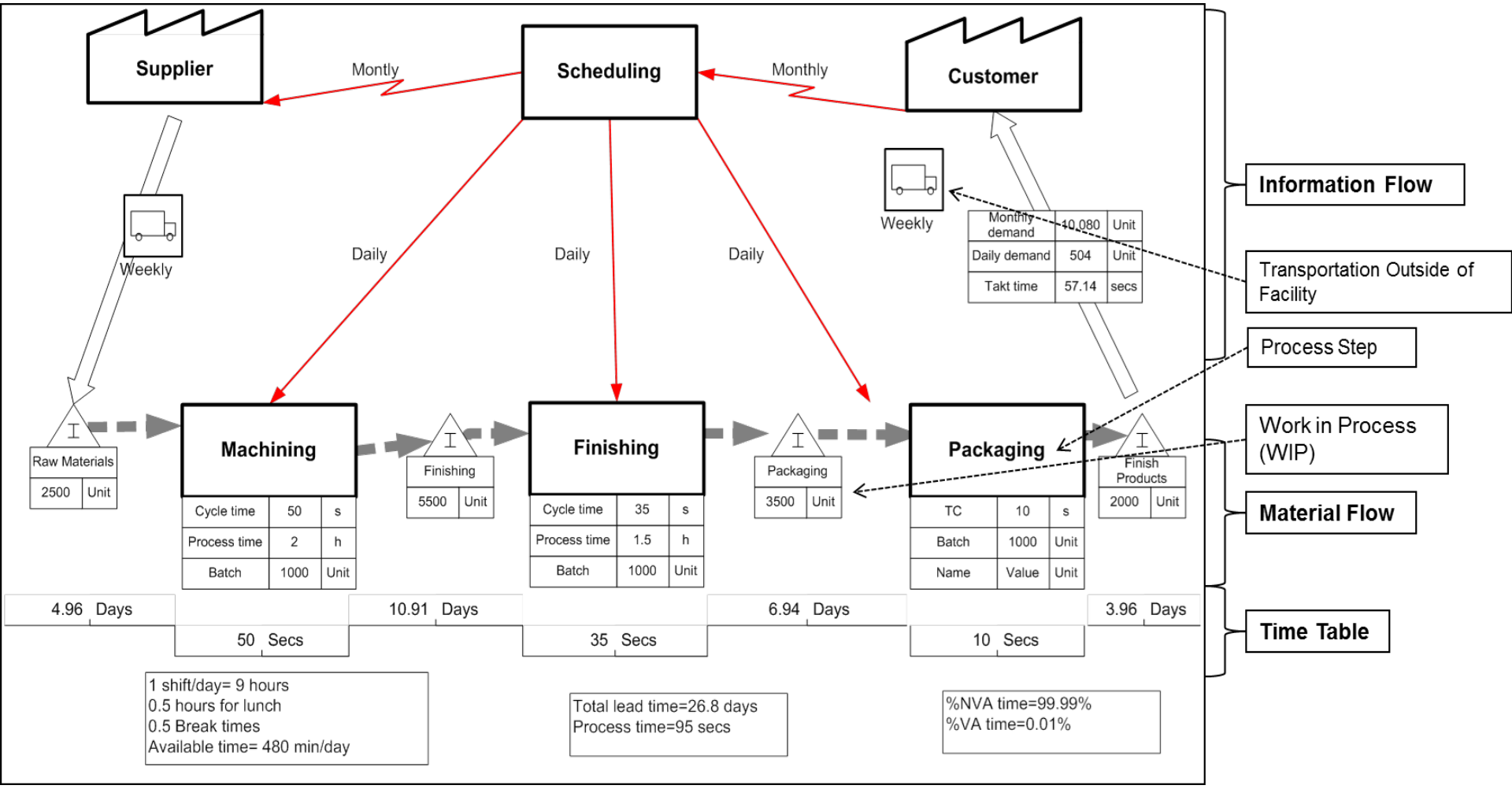
(EPA, 2007)

Background

Process Mapping

- Business Process Re-engineering
- Work Flow/Spaghetti Diagram
- Flow Chart
- Value Stream Mapping

Background


Supplier
Monthly
Scheduling
Monthly
Customer
Weekly
Weekly
Daily
Daily
Daily
Monthly demand 40,080 Unit
Daily demand 504 Unit
Takt time 57.14 secs
Raw Materials 2500 Unit
Machining
Cycle time 50 s
Process time 2 h
Batch 1000 Unit
Finishing 5500 Unit
Finishing
Cycle time 35 s
Process time 1.5 h
Batch 1000 Unit
Packaging 3500 Unit
Packaging
TC 10 s
Batch 1000 Unit
Name Value Unit
Finish Products 2000 Unit
4.96 Days
50 Secs
10.91 Days
35 Secs
6.94 Days
10 Secs
3.96 Days
1 shift/day= 9 hours
0.5 hours for lunch
0.5 Break times
Available time= 480 min/day
Total lead time=26.8 days
Process time=95 secs
%NVA time=99.99%
%VA time=0.01%
Information Flow
Transportation Outside of Facility
Process Step
Work in Process (WIP)
Material Flow
Time Table

Problem

Sector	Opportunity for Improving Energy Efficiency				
	Cleaner Fuels	Combined Heat and Power	Equipment Retrofit/Replacement	Process Improvement	Research and Development
Cement	Medium	Low	High	High	Medium
Forest Products	Medium	Low	Medium	High	High
Integrated Steelmaking	Low	Medium	Low	Medium	High
Metal Casting	Low	Low	Medium	Medium	Medium
Metal Finishing	Low	Medium	Medium	High	Medium
Petroleum Refining	Low	High	Medium	Medium	Medium

(EPA, 2007)

Purpose and Objectives

Purpose:

- Estimate the impact "lean thinking" has on electrical consumption

Objectives

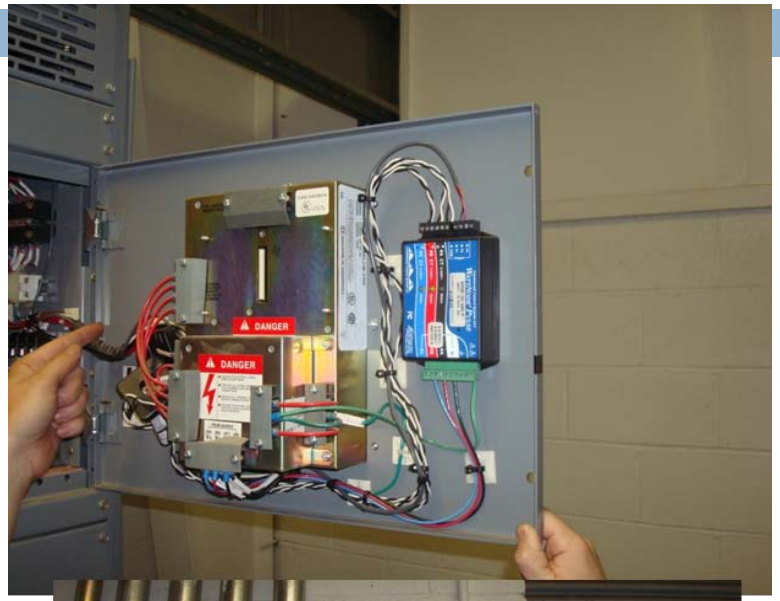
1. Install Energy Management System
2. Identify Product/Value Chain
3. Map Current Process and Energy Consumption Using Value Stream Mapping (VSM)
4. Create Future State Value Stream Mapping (VSM)

Methods

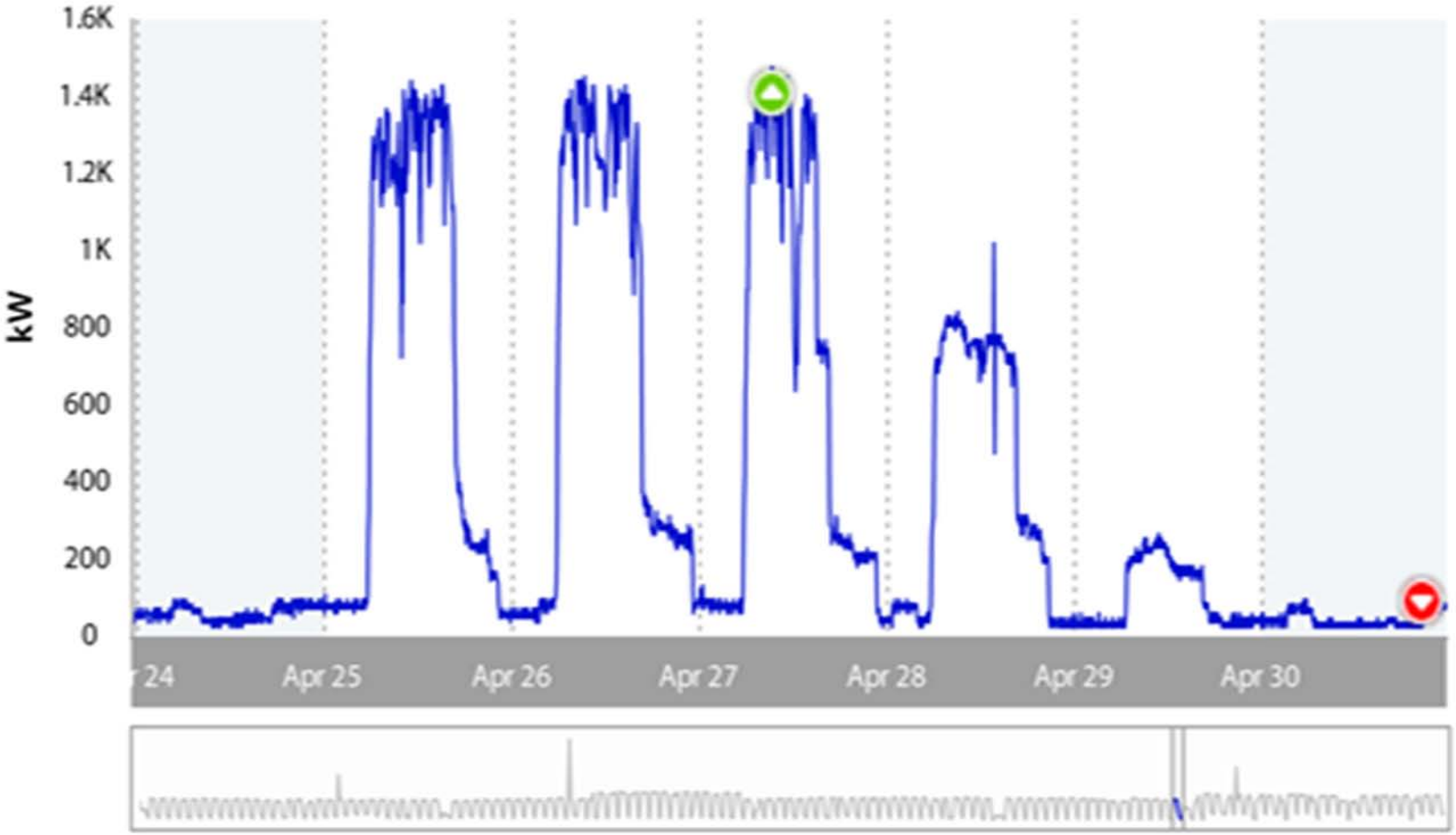
Install EMS	• Energy Management System (EMS) • Installation done by EnerNOC • Test EnerNOC system
Identify Product/Value Chain	• Evaluate historical data • Highest volume product
Current State VSM	• Flow chart high volume product process steps • Current state VSM of high volume product • Incorporate electrical consumption
Future State VSM	• Develop auditing tool • Come up with two-three electrical energy saving recommendations • VSM implementing electrical savings recommendations

Results: Install EMS

- Provides real time electrical feedback
- Rate of 5 minute intervals
- Manage energy daily instead of monthly

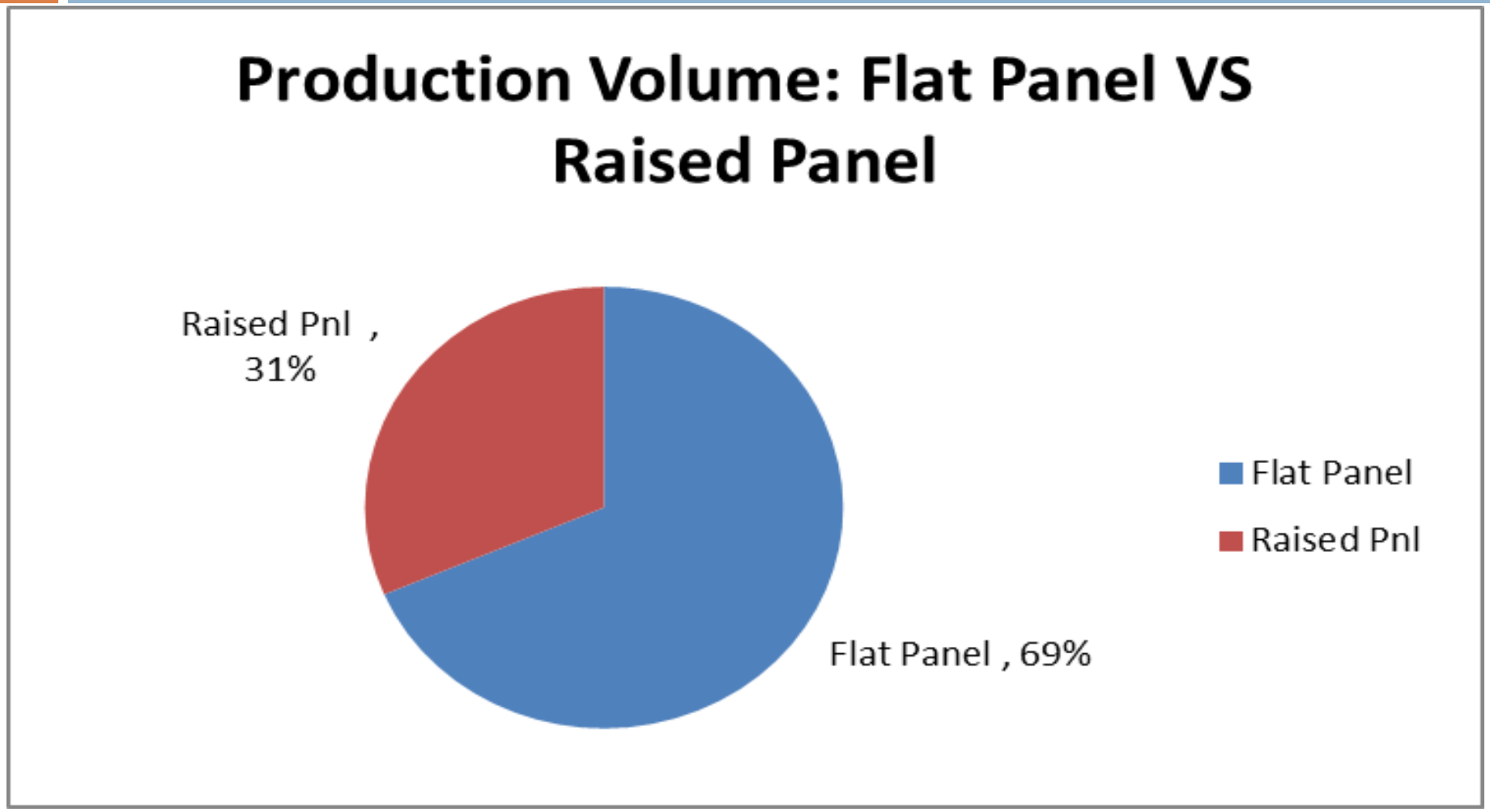


Results: Install EMS

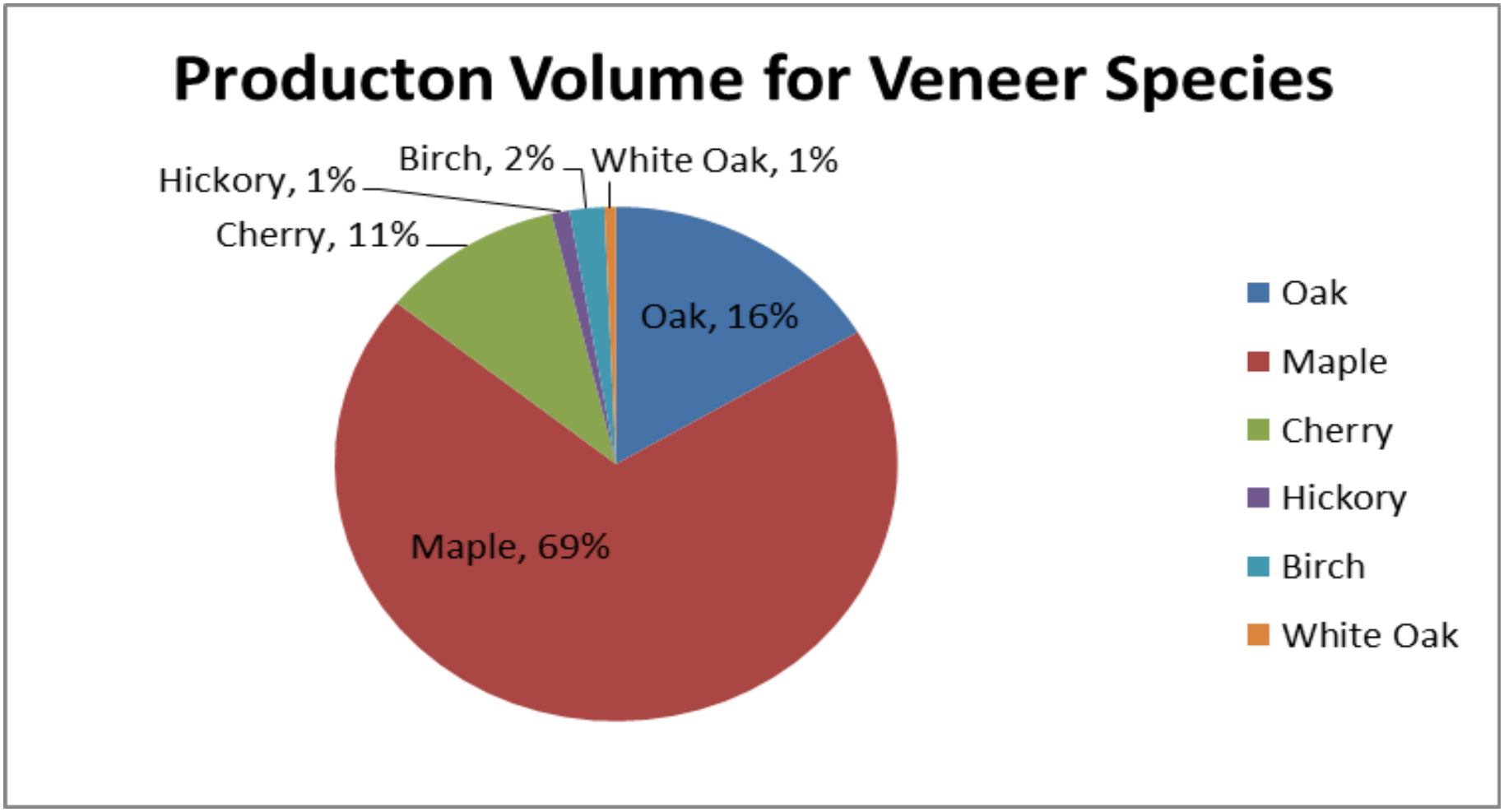


(Enernoc, 2011)

Results: Identify Value Chain

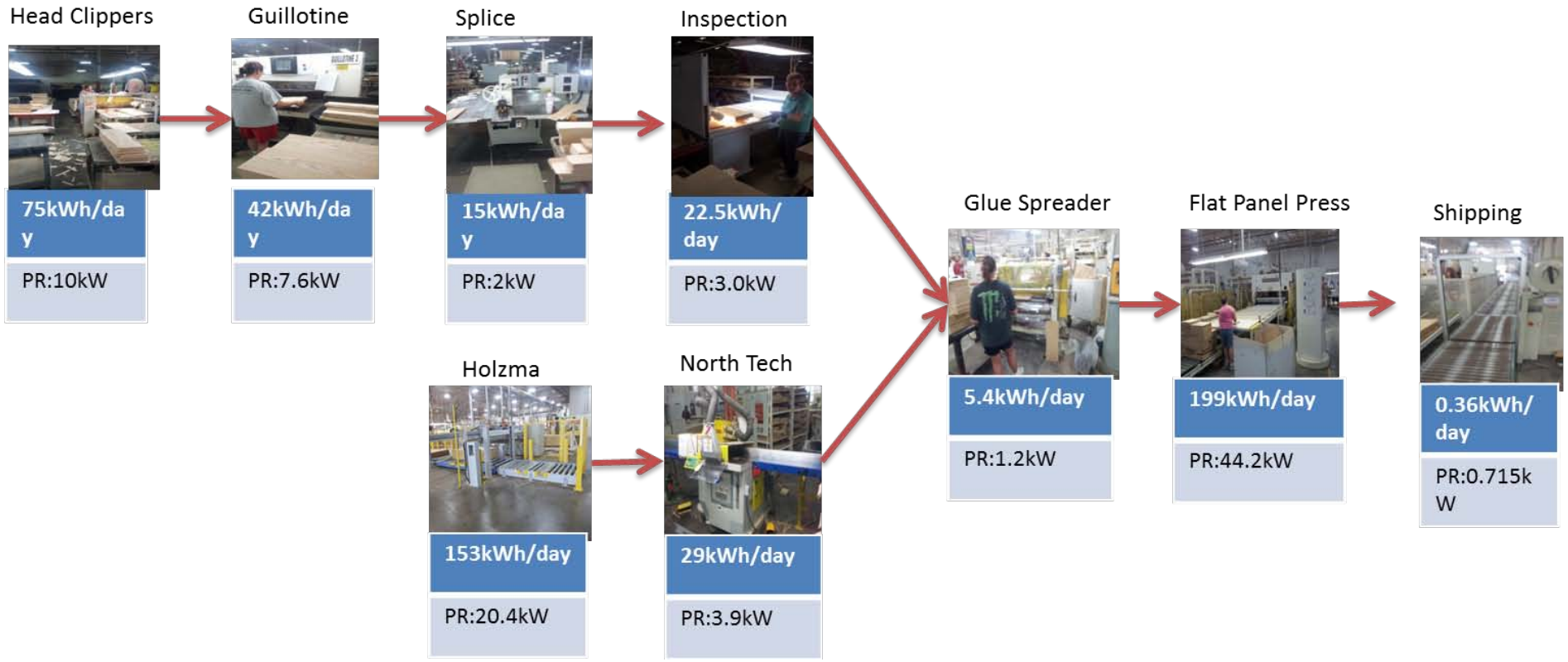


Results: Identify Value Chain



Results: VSM and Electrical Consumption

Flow Chart Flat Panel



Results: VSM and Electrical Consumption

Direct Estimation= power rating (PR) for process

Holzma

153kWh/day

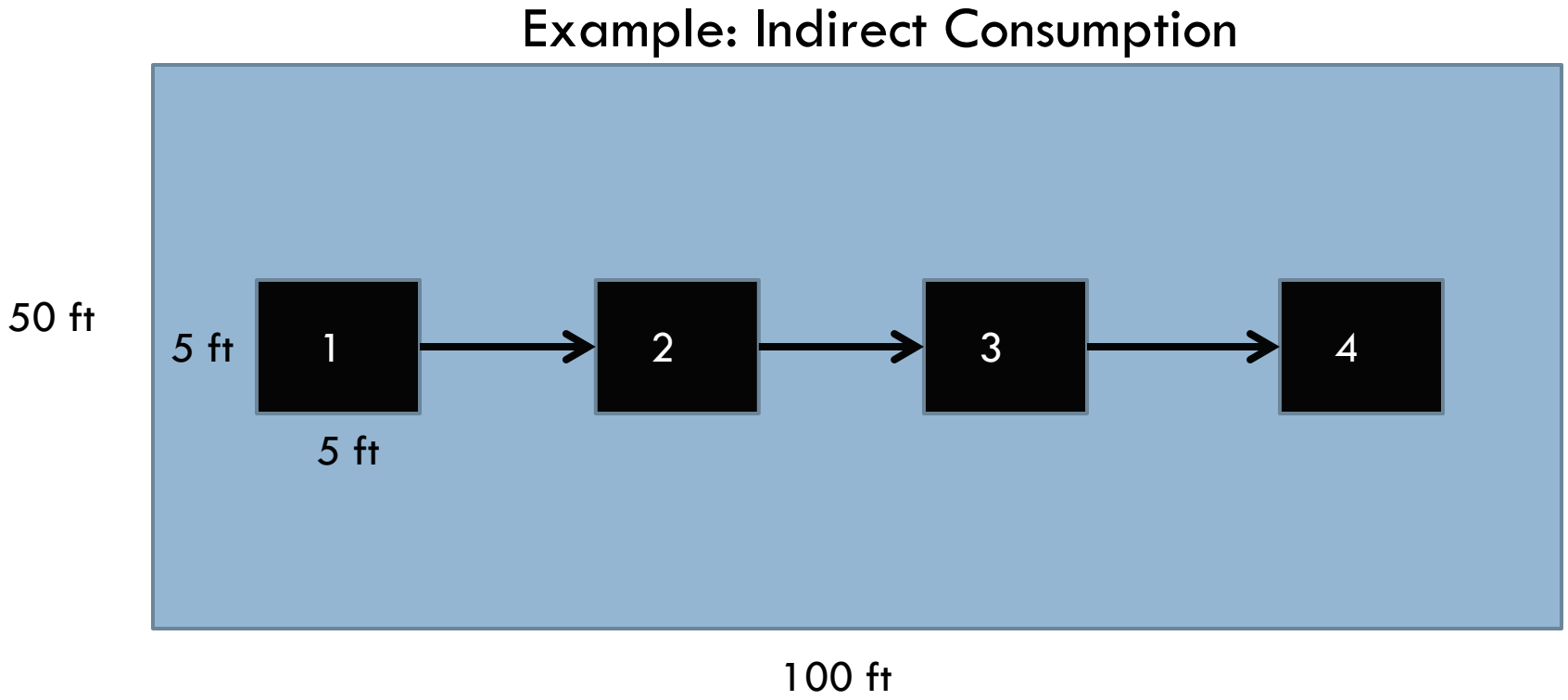
PR:20.4kW

Amps X Volts= PR in kWh

Results: VSM and Electrical Consumption

- Cost allocation technique for electricity
- Driver is area in units of square feet

Example: Indirect Consumption



Results: VSM and Electrical Consumption

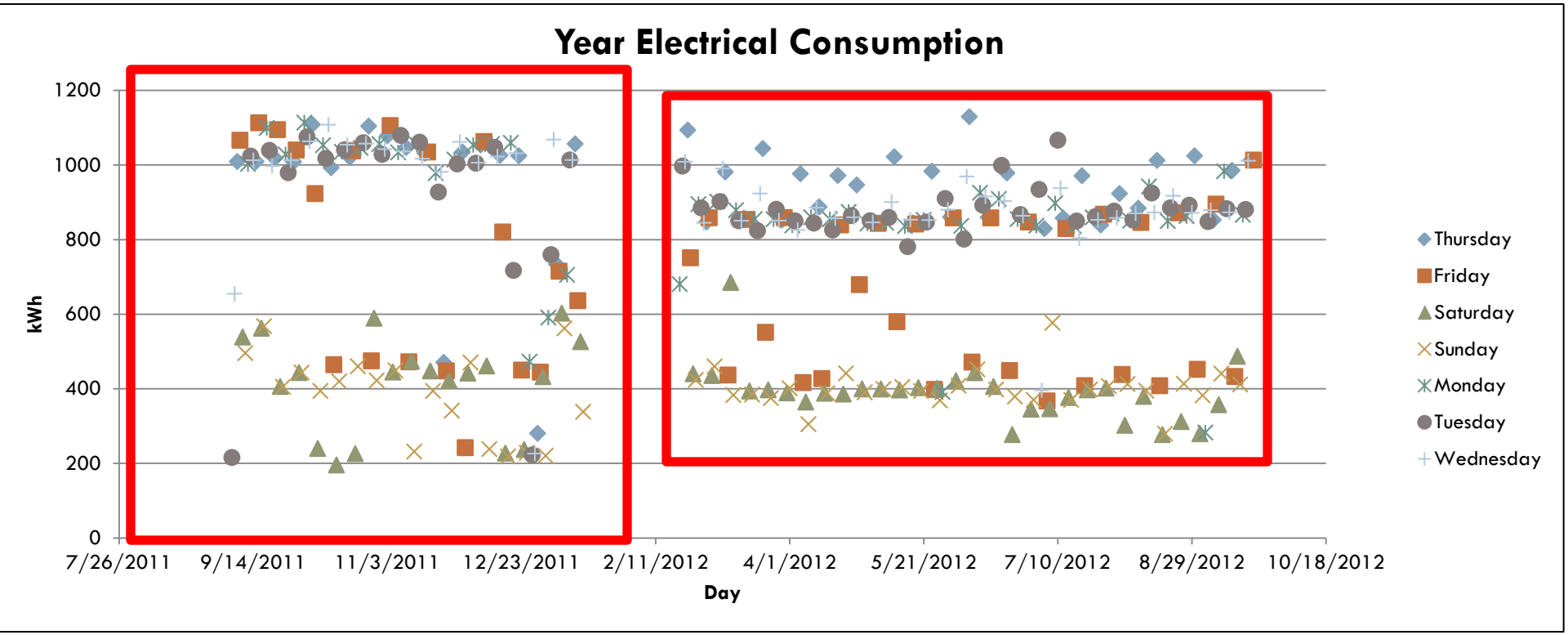
- Indirect Consumption= Lighting and HVAC
- Indirect Estimation=

$$\frac{Value\ Chain\ SqFt}{Total\ SqFt}\ x\ Average\ Electrical\ Consumptio$$

$$\text{Indirect Estimation} = \frac{2{,}869 SqFt}{140{,}610 SqFt}\ x\ 866 kWh$$

- =17.32 kWh

Results: VSM and Electrical Consumption



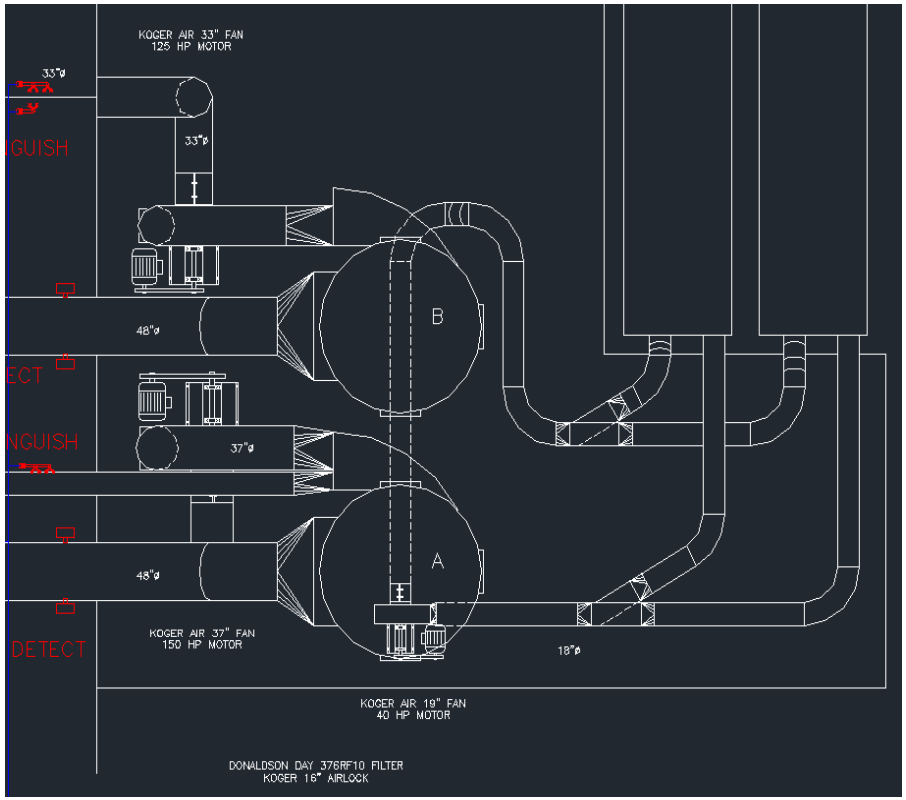
Results: VSM and Electrical Consumption

Before:

- Fan A and B= 219.7kW

- Fan A= 93.2kW
- Lock Valve= 1.5kW
- Cleaning Pump= 5.8kW
- Total= 100.5kW

- Fan B= 111.9kW
- Lock Valve= 1.5kW
- Cleaning Pump= 5.8kW
- Total= 119.2kW



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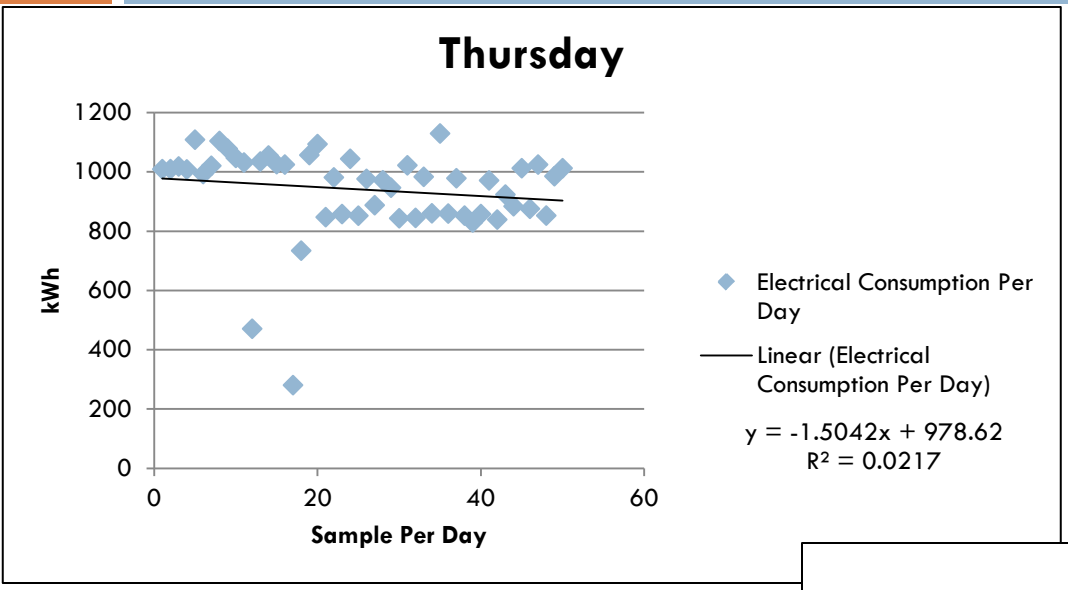

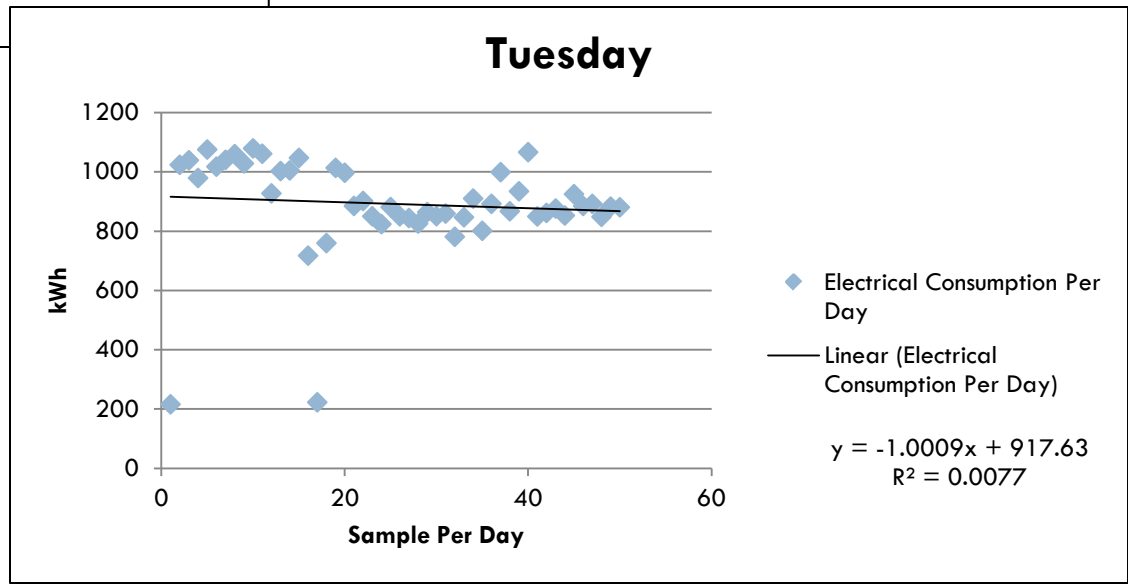

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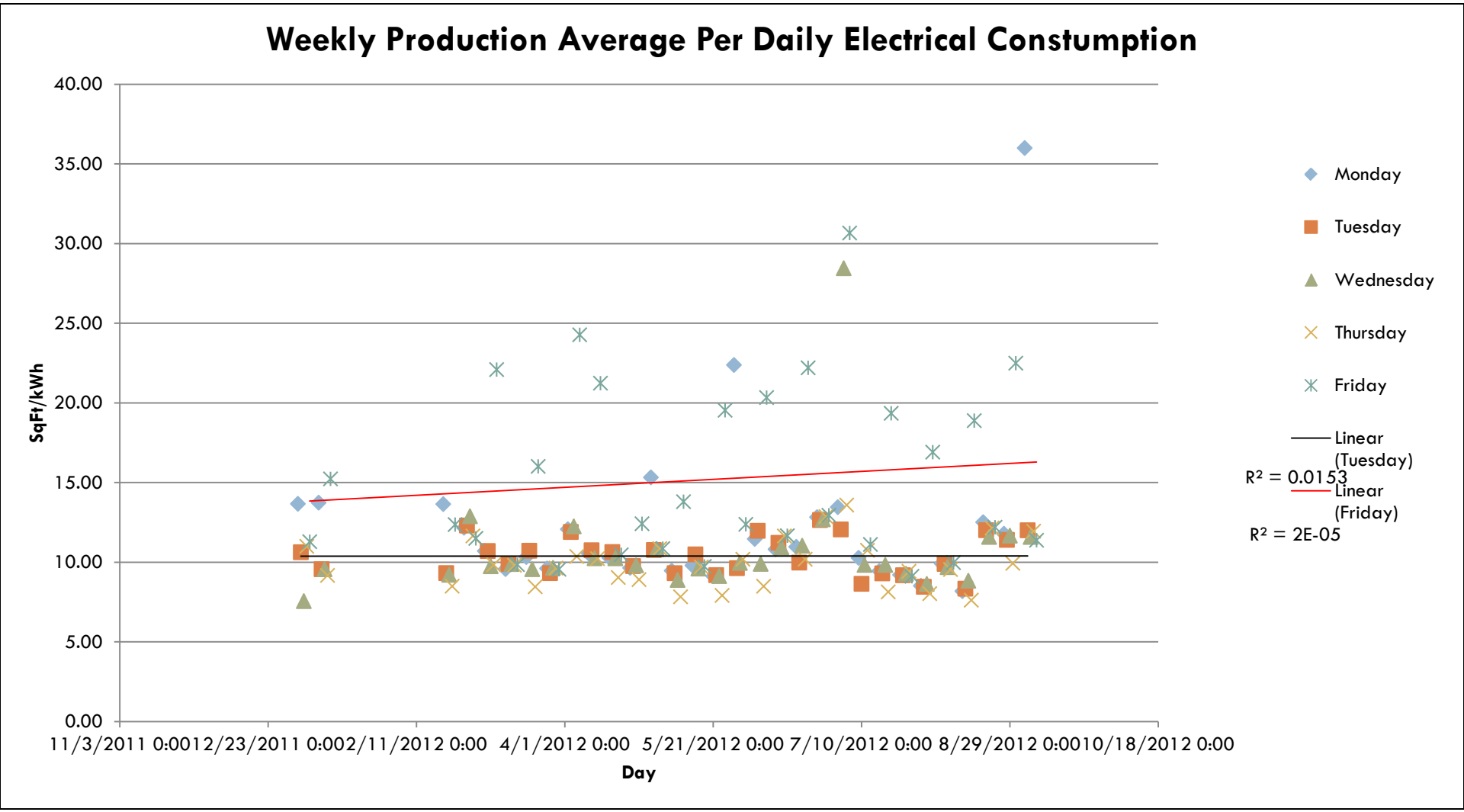

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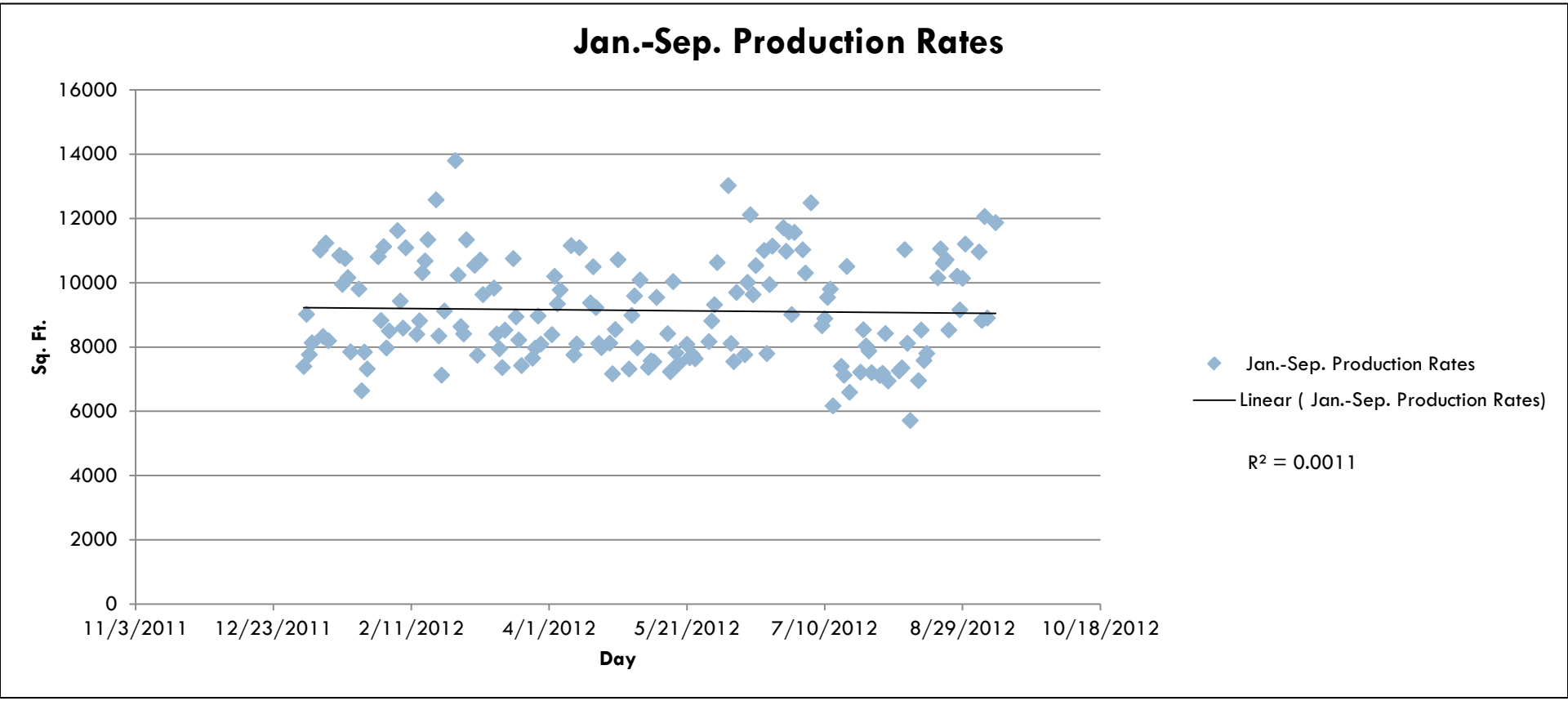

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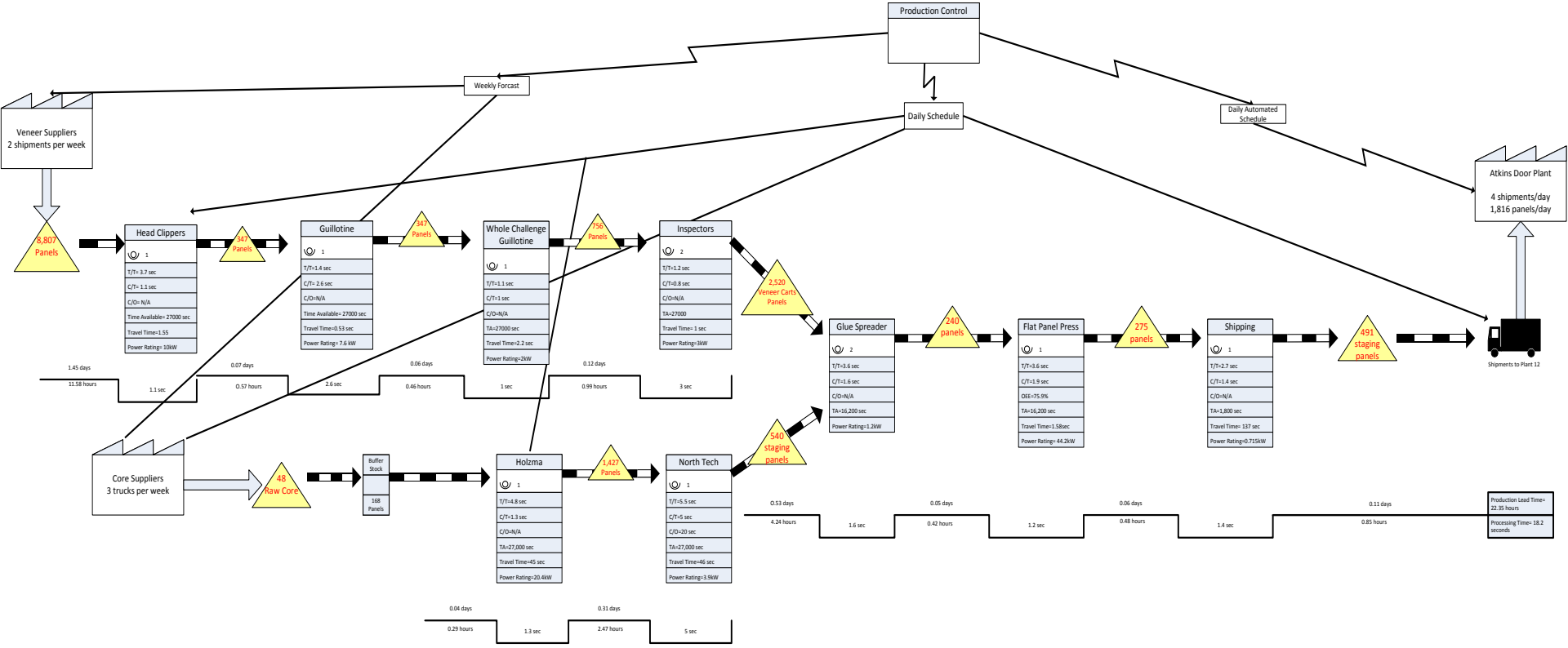

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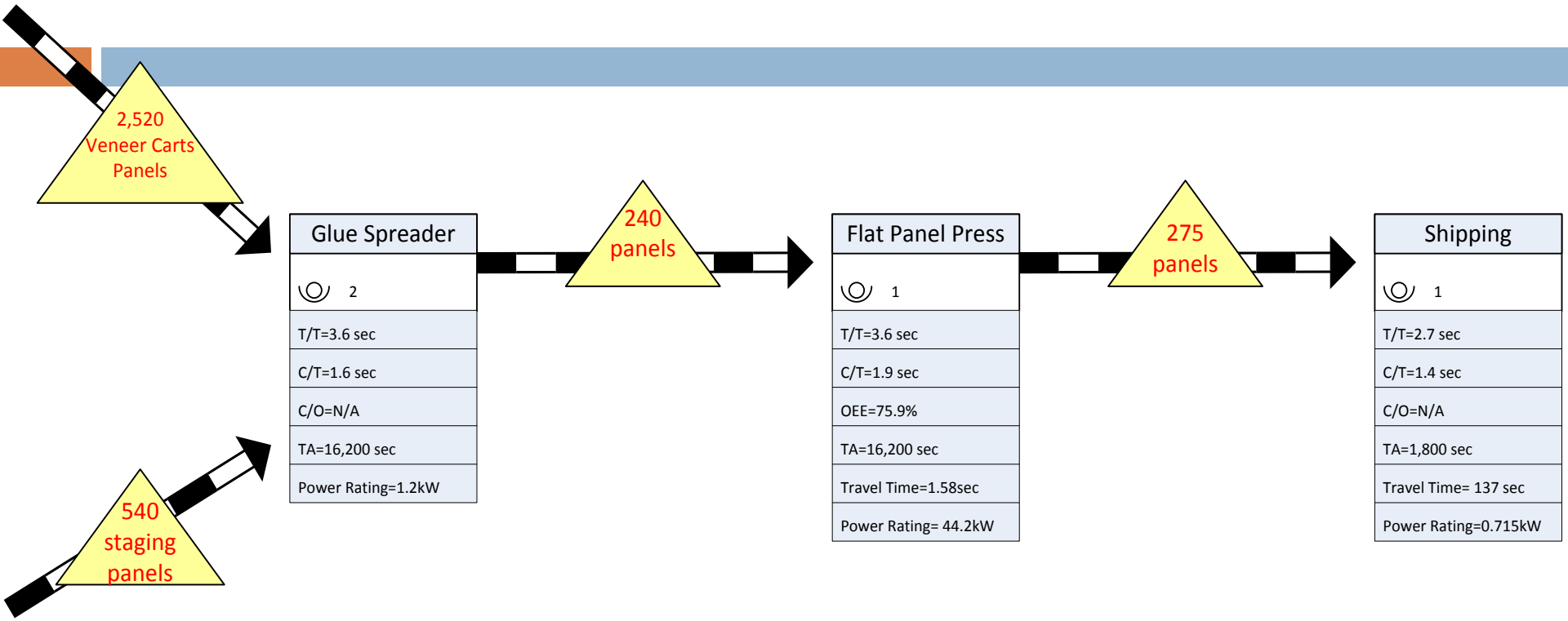

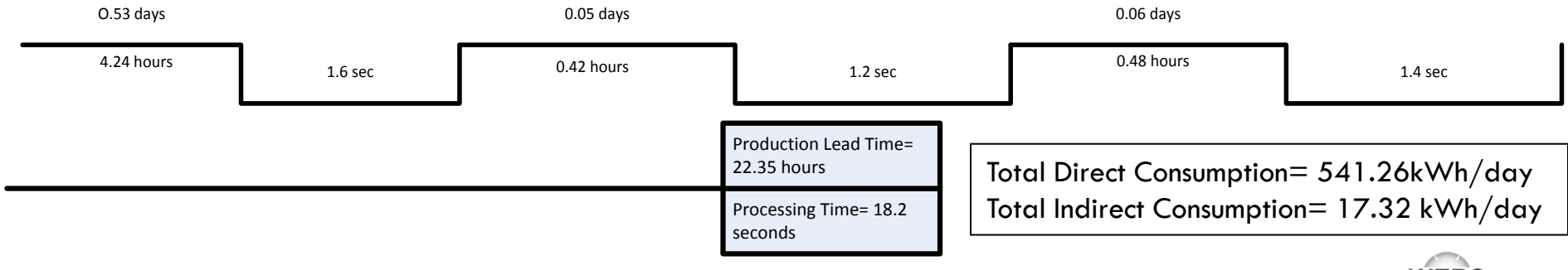

Total Direct Consumption= 541.26kWh/day
Total Indirect Consumption= 17.32 kWh/day

Results: VSM and Electrical Consumption

Select SIC code	24.Lumber and Wood Products, Except Furniture
Input your plant area (ft2)	50,000
Input the number of employees	123

Instructions:

1. Only fill up the black cells. Do not modify or change any of the formulas
2. Select your industry classification (SIC code)
3. Indicate your facility size in terms of square footage and number of employees.
4. Rate every opportunity using the following scale: **5** (No corrective action required), **4** (Evaluation for potential improvement required), **3** (Corrective action required), **2** (Urgent corrective action required), **1** (Inmediate corrective action required). and **0** (Emergency situation)

Factor	ARC code	Item description	Level of compliance	Cost of no compliance (based on ft2)	Cost of no compliance (based on employees)	Average payback (years)	Number of implementation
Furnaces, ovens, and directly fired operations	2.1133	ADJUST BURNERS FOR EFFICIENT OPERATION	4	$1,779	$9,852	0.41	8
	2.1135	REPAIR FURNACES AND OVEN DOORS SO THAT THEY SEAL EFFICIENTLY	1	$0	$0	0.00	0
Boilers	2.1231	ESTABLISH BURNER MAINTENANCE SCHEDULE FOR BOILERS	4	$1,252	$7,292	0.79	9
	2.1232	KEEP BOILER TUBES CLEAN	4	$19,283	$21,410	0.58	12
	2.1233	ANALYZE FLUE GAS FOR PROPER AIR/FUEL RATIO	4	$3,517	$4,420	0.68	84
Steam	2.2113	REPAIR OR REPLACE STEAM TRAPS	3	$16,163	$4,111	0.56	8
	2.2122	INSTALL / REPAIR INSULATION ON CONDENSATE LINES	4	$28	$321	1.16	12
	2.2123	INSULATE FEEDWATER TANK	4	$292	$397	1.04	14
	2.2131	INSULATE STEAM / HOT WATER LINES	2	$1,001	$2,763	1.15	76
	2.2133	REPAIR LEAKS IN LINES AND VALVES	5	$0	$0		
	2.2135	REPAIR AND ELIMINATE STEAM LEAKS	1	$11,502	$39,676	1.53	20
	2.2153	CLOSE OFF UNNEEDED STEAM LINES	4	$344	$610	0.01	2
Heat containment	2.2523	REDUCE INFILTRATION TO REFRIGERATED AREAS; ISOLATE HOT EQUIPMENT FROM REFRIGERATED AREAS	4	$344	$610	0.01	2
Motors	2.4111	UTILIZE ENERGY-EFFICIENT BELTS AND OTHER IMPROVED MECHANISMS	2	$1,157	$2,277	1.07	340
	2.4133	USE MOST EFFICIENT TYPE OF ELECTRIC MOTORS	3	$1,152	$1,780	3.35	337
	2.4151	DEVELOP A REPAIR/REPLACE POLICY	4	$653	$1,491	0.88	26
	2.4157	ESTABLISH A PREDICTIVE MAINTENANCE PROGRAM	1	$2,606	$3,382	0.19	10

Future State VSM

- Kaizen event: Incorporate energy audit tool
- 2-3 energy saving recommendations
- Implement recommendations
- Create future state VSM incorporating energy saving recommendations
- Evaluate impact through energy management system (EMS)

Conclusion

- Identification of best lean practices to save electrical consumption in a wood products manufacturing environment
- Development of an auditing tool based on lean principles to identify energy saving opportunities
- For this specific case study, implementing "lean thinking" reduces monthly electrical consumption by X amount of kWh
- A developed way of incorporating electrical consumption into a VSM

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Thank You

Questions?

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