



# GMIC Site Assessment Case Study



# Company Description

- Mid-Sized Manufacture
- Materials:
  - Steel
  - Aluminum
  - Various wood products
  - Some Plastics
- Processes:
  - Welding
  - Grinding
  - Forming
  - Painting (E-coat, Powder)

# Step 1: Pre-Assessment

- Supplied Company X with pre-assessment
  - Forms completed by company employees
  - Returned within two weeks
- Preliminary meeting
  - Discussion of process
  - Identify problem area in the company's eyes
  - Tour and safety brief of GMI personnel

# Step 2: Site Assessment

- Student evaluations
  - 3 Graduate evaluators
  - 2 Undergraduate evaluators
- Focusing on
  - Material Waste\*
  - Compressed Air\*
  - Heat processes\*

***\*Identified in step 1***



# Material Waste- Wood

Typ of Wood	Size	Unit of Measure	Unit Price	2010 Purchase Qty	Cost (\$)	Total Wast Cost (\$)	
Type 1	8/4	BF	\$ 4.39	\$ 50,338.00	\$ 220,983.82	\$ 143,639.48	
Type 1	6/4	BF	\$ 4.26	\$ 43,831.00	\$ 186,720.06	\$ 121,368.04	
Type 1	4/4	BF	\$ 4.17	\$ 15,636.00	\$ 65,202.12	\$ 42,381.38	
Type 2	16/4	BF	\$ 7.10	\$ 2,601.00	\$ 18,467.10	\$ 12,003.62	
Type 2	3x8	BF	\$ 6.89	\$ 10,116.00	\$ 69,699.21	\$ 45,304.51	
Type 3	8/4	BF	\$ 5.07	\$ 1,892.00	\$ 9,592.44	\$ 6,235.09	
Type 4	2x6	BF	\$ 6.60	\$ 12,383.00	\$ 81,727.80	\$ 53,123.07	
Type 2	2x8	BF	\$ 5.99	\$ 54,506.00	\$ 326,490.94	\$ 212,219.11	
Type 2	2x6	BF	\$ 5.99	\$ 77,745.00	\$ 465,692.55	\$ 302,700.16	
Type 2	5/4	BF	\$ 5.99	\$ 7,037.00	\$ 42,151.63	\$ 27,398.56	
Type 5	8/4	BF	\$ 2.75	\$ 8,869.00	\$ 24,389.75	\$ 15,853.34	
Type 5	4/4	BF	\$ 2.48	\$ 1,027.00	\$ 2,546.96	\$ 1,655.52	
Type 6	8/4	BF	\$ 2.69	\$ 7,364.00	\$ 19,809.16	\$ 12,875.95	
Type 7	-	BF	\$ 6.60	\$ 4,472.00	\$ 29,515.20	\$ 19,184.88	
Type 8	-	BF	\$ 3.39	\$ 3,028.00	\$ 10,264.92	\$ 6,672.20	
Waste Rate (%)		65%		Totals		\$ 1,573,253.69	\$ 1,022,614.90
# of Board Feet		300845					

5% Increases save \$78k



# Material Waste- Hazardous and Structural Plastic (SP)

Type	Units	Qty	Cost/Unit	Total Cost
Chemical Waste Stop Charge	Stop	2	\$ 200.00	\$ 400.00
Personnel Time (on-site)	Time	3.75	\$ 115.00	\$ 431.25
Fluourescent Light Bulbs	kg	235	\$ 2.95	\$ 693.25
Dry Cell Batteries (alkaline; nickel-cadnium)	Kg	9	\$ 3.40	\$ 30.60
Lead-acid Batteries	kg	96	\$ 0.85	\$ 81.60
Paints/Paint Related Materials	Charge Units	102	\$ 2.30	\$ 234.60
Paints/Paint Related Materials (Bulk)	5-gallon drums	17	\$ 45.00	\$ 765.00
Refrigeration Machines (compressors, air co	kg	82	\$ 3.95	\$ 323.90
Electronic Components	kg	26	\$ 1.65	\$ 42.90
Lamp Ballasts (non-PCB)	kg	6	\$ 1.65	\$ 9.90
Spent Oils	Charge Units	69	\$ 5.50	\$ 379.50
Oil/Water Mixture	55-gal drums	2	\$ 120.00	\$ 240.00
Oil-contaminated Rags	kg	13	\$ 5.50	\$ 71.50
Water-soluble Coolants	55-gal drums	3	\$ 165.00	\$ 495.00
Fire Extinguisher Powder	kg	17	\$ 2.50	\$ 42.50
Aerosol Cans	Cans	45	\$ 0.80	\$ 36.00
Organic Peroxide (Dibenzoyl Peroxide)	Charge Units	4	\$ 33.20	\$ 132.80
Cooling Oils (Bulk)	55-gal drums	2	\$ 120.00	\$ 240.00
Hydraulic Oils (Bulk)	55-gal drums	1	\$ 120.00	\$ 120.00
Pesticide Solutions	Charge Units	2	\$ 15.75	\$ 31.50
Propylene Glycol Solutions	Charge Units	4	\$ 12.60	\$ 50.40
Antifreeze/Diesel Fuel Mixture (Bulk)	55-gal drums	1	\$ 140.00	\$ 140.00
14-gallon Plastic Overhead Drum	Drum	1	\$ 32.66	\$ 32.66
Fluourescent Light Bulb Boxes (4')	Boxes	4	\$ 13.98	\$ 55.92
Fluourescent Light Bulb Boxes (8')	Boxes	4	\$ 19.76	\$ 79.04

SP: \$92,972.69

Waste: \$ 60,411.11

Total Cost (\$): \$ 5,159.82



# Landfill & Recycling

Date	Landfill Waste Qty (yd)	Recycle Waste Qty (yd)	Total Cost (\$)
12/1/2010		120	\$ 662.81
12/1/2010		72	\$ 505.18
11/16/2010		72	\$ 512.88
11/1/2010	40	72	\$ 1,246.88
11/1/2010		120	\$ 746.13
10/16/2010		72	\$ 503.72
10/1/2010	40	102	\$ 1,508.15
10/1/2010		120	\$ 741.78
9/16/2010	42	30	\$ 897.74
9/1/2010	40	72	\$ 1,239.92
9/1/2010		120	\$ 686.73
8/16/2010		72	\$ 500.49
8/1/2010	40	102	\$ 1,506.23
8/1/2010		120	\$ 686.10
7/16/2010		72	\$ 501.44
7/1/2010	40	72	\$ 1,240.75
7/1/2010		80	\$ 459.22
6/16/2010	40	72	\$ 1,128.79
6/1/2010		72	\$ 614.58
6/1/2010		80	\$ 460.46
5/16/2010	40	72	\$ 1,139.02
5/1/2010	40	30	\$ 1,001.29
5/1/2010		120	\$ 681.48
4/16/2010		72	\$ 476.08
4/1/2010	40	30	\$ 899.73
4/1/2010		80	\$ 452.46
3/16/2010		72	\$ 447.37
3/1/2010	40		\$ 659.17
3/1/2010		80	\$ 450.82
2/16/2010		102	\$ 680.02
2/1/2010	40		\$ 657.41
2/1/2010		40	\$ 225.60
1/16/2010		72	\$ 445.57
1/1/2010		80	\$ 447.16
1/1/2010	40	30	\$ 891.11
<b>Totals</b>	<b>522</b>	<b>2594</b>	<b>\$ 25,904.07</b>
Waste/Recycle Ratio	20%		

Month	CCF Consumption	Gallons of Water	Water Cost	Sewer Cost
January-10	61	45628	\$ 22.57	\$ 41.48
February-10	63	47124	\$ 23.56	\$ 47.69
March-10	67	50116	\$ 25.02	\$ 50.72
April-10	70	52360	\$ 26.18	\$ 52.99
May-10	292	218416	\$ 109.21	\$ 221.04
June-10	257	192236	\$ 96.12	\$ 194.55
July-10	300	224400	\$ 112.20	\$ 227.10
August-10	335	250580	\$ 125.29	\$ 253.60
September-10	368	275264	\$ 137.63	\$ 278.58
October-10	144	107712	\$ 53.86	\$ 109.01
November-09	86	64328	\$ 31.82	\$ 58.48
December-09	72	53856	\$ 26.64	\$ 48.96
<b>Totals (averaged)</b>	<b>2115</b>	<b>1582020</b>	<b>\$ 790.10</b>	<b>\$ 1,584.20</b>
CCF (Gallons) =	748			
<b>Total Cost (\$)</b>	<b>\$</b>	<b>2,374.30</b>		



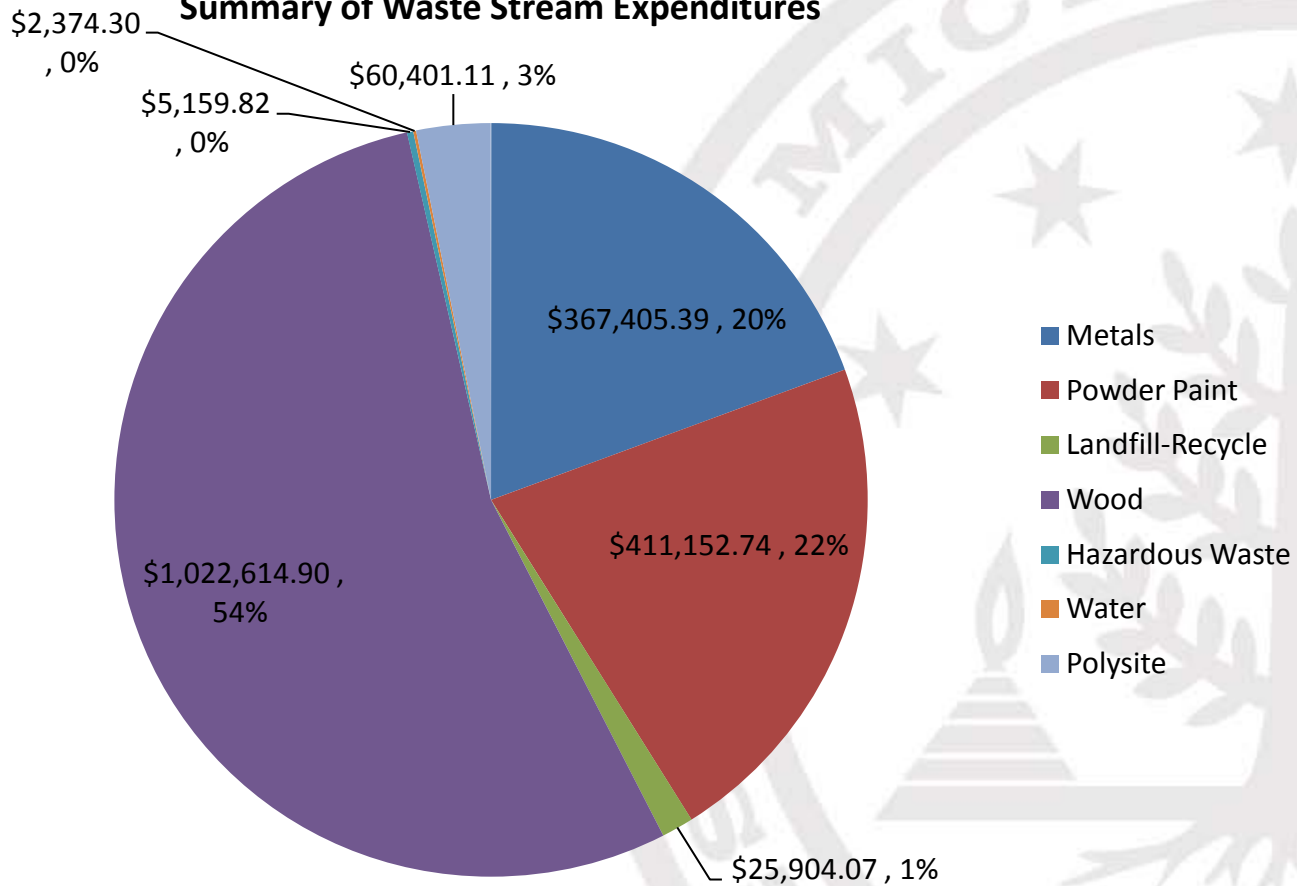
# Possible Projects Identified

- Improve wood router nesting
- Evaluate powder paint application/efficiency
- Study metal cutting practices to see if alternative processes could be used
  - Castings
  - Ordered parts
  - Nesting



# Opportunities

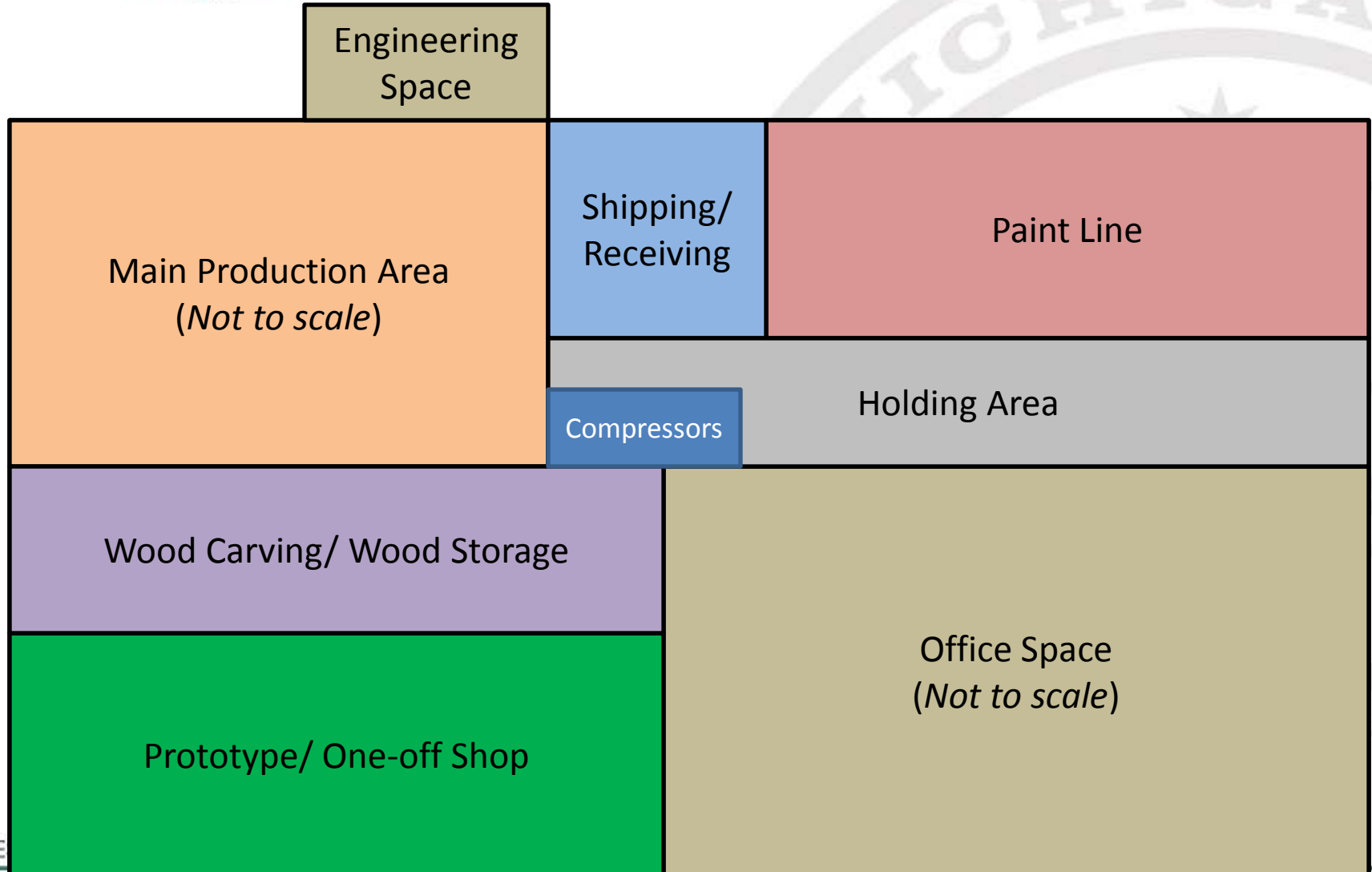
**Summary of Waste Stream Expenditures**



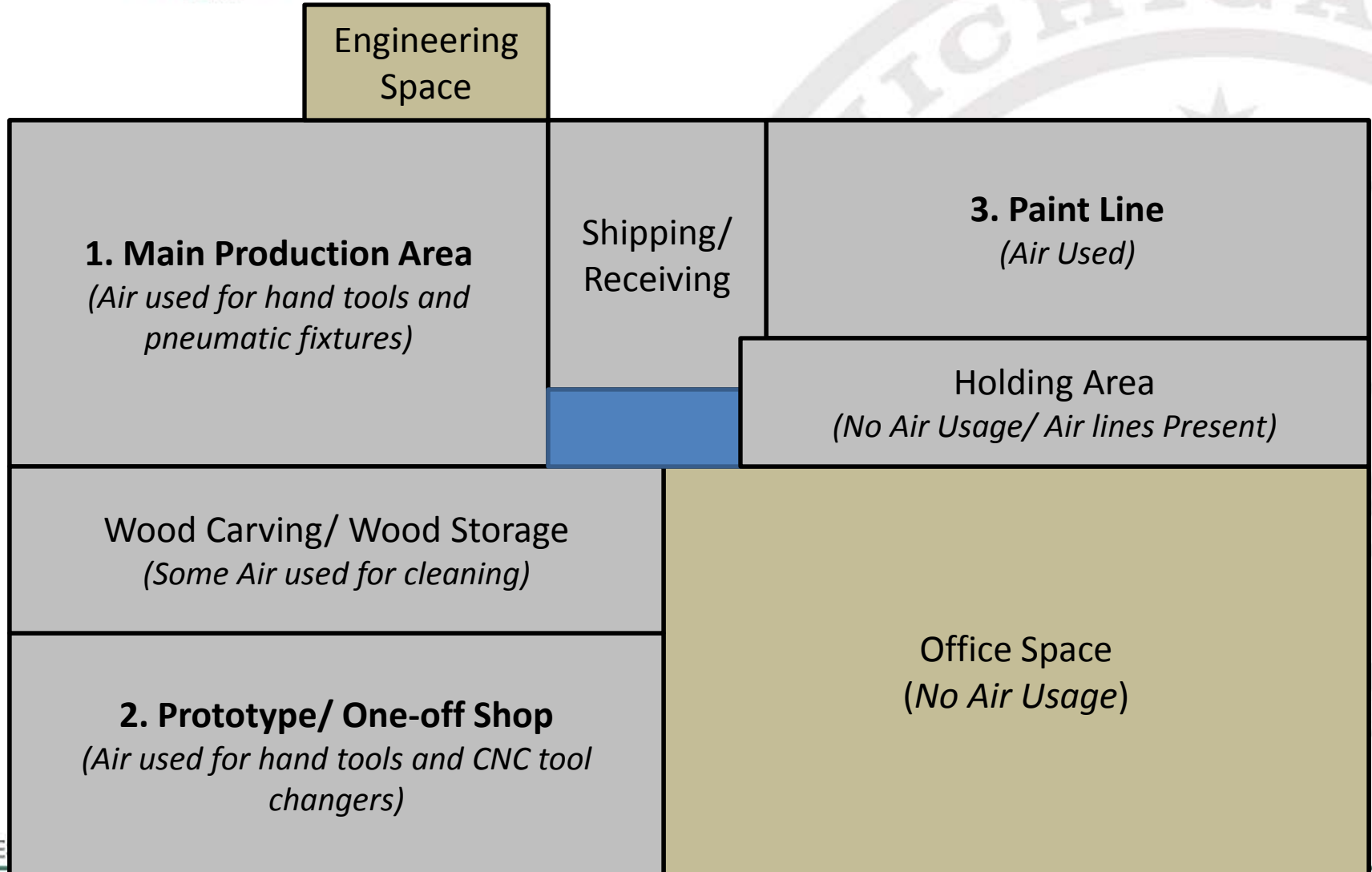
# Compressed Air (Current System)

- 1 ~100Hp sigma type screw compressor
  - Kaeser Model DS141
  - 114psig @ full
  - 520 acfm rated
- Runs load/unload cycles (*All or Nothing*)
- Well maintained system
  - Serviced by supplier 1 to 2 times per year
  - Designated manager

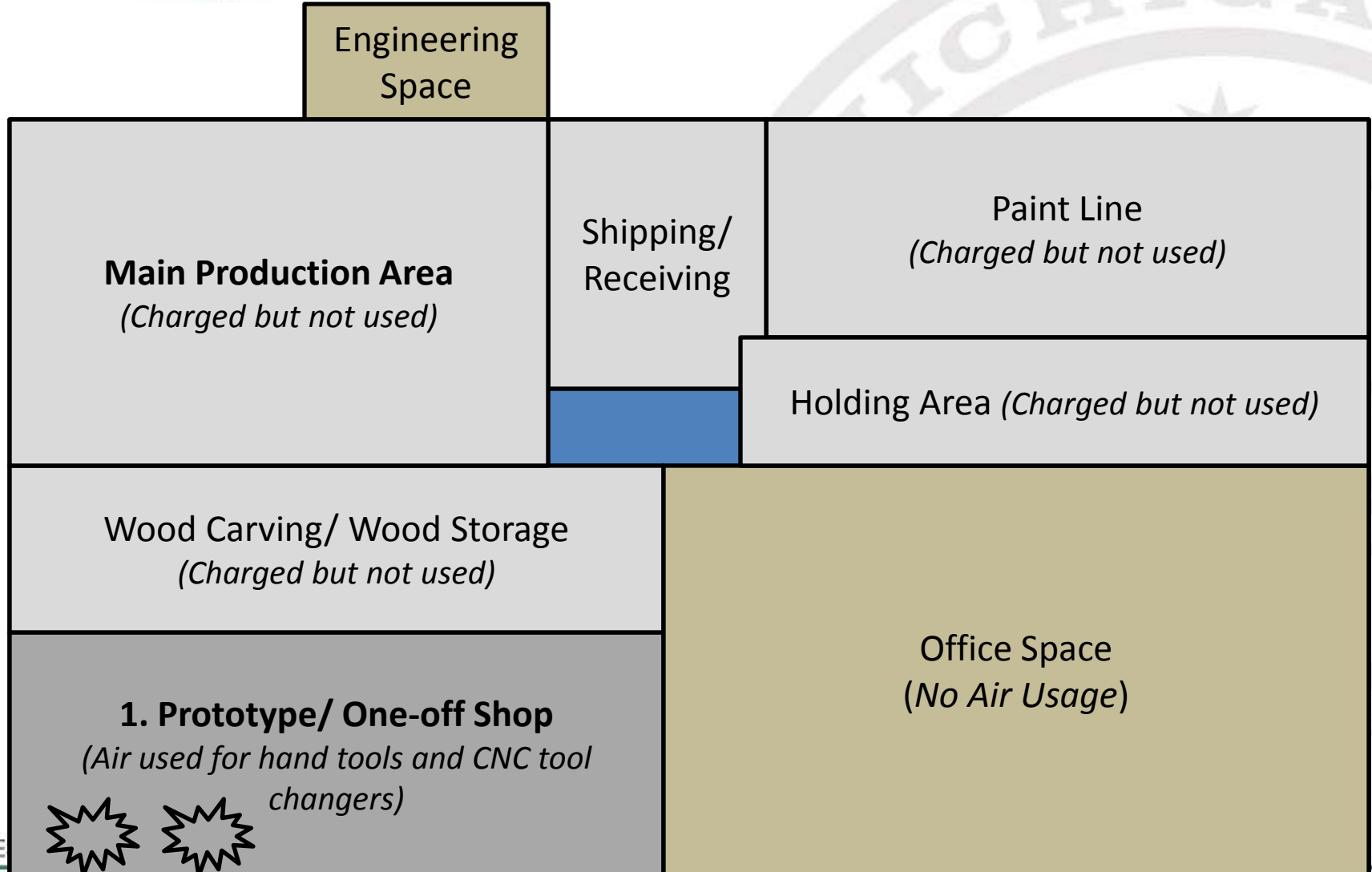
# (Plant layout)



# Air Layout



# Air Layout-Friday



## • Current System Usage

End Use	Location	Required Airflow (Acfm)	Regulated (Y/N)	Required Pressure (psig)	Measured Pressure (psig)
Spray booth north	P.C.	N/A	y	90	99/114
Spray booth south	P.C.	N/A	y	90	99/114
Sanders, grinders	Plant	4.5	N	90-114	99/114
CNC	Combo cell	4	y	80	99/114
CNC	Combo cell	4	y	80	99/114
CNC	Combo cell	4	y	80	99/114
CNC	Chair cell	4	y	80	99/114

## • Biggest Users

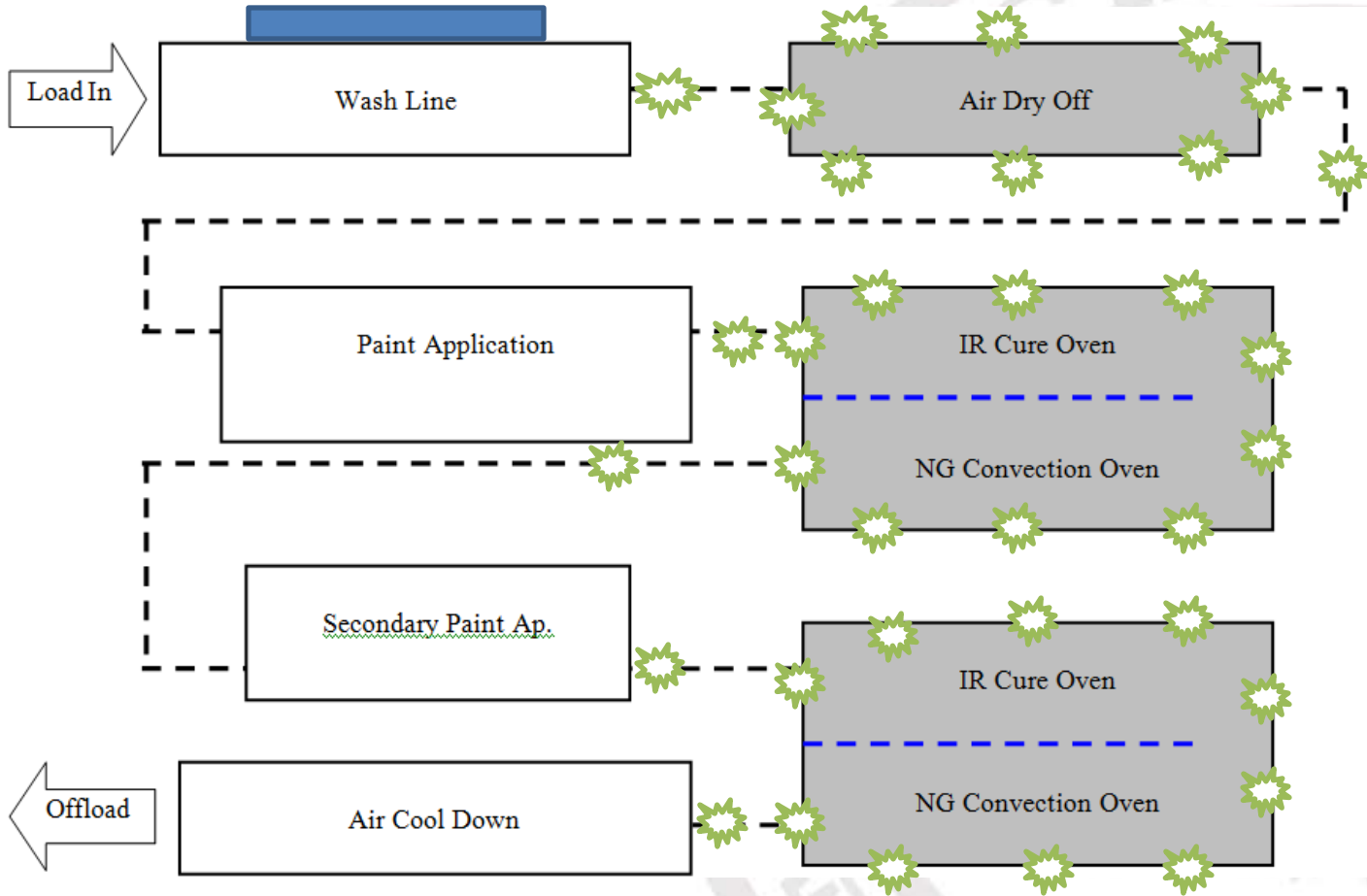
1. Plant (*hand tools, fixtures, forming*)
2. CNC Machines (*tool changers, cleaning, hand tools*)
3. Paint Booth (*changes based on product*)



# Possible Projects Identified

- Secondary compressor system for prototype shop
- Segregated air lines to isolate areas based on production needs
- Evaluation of leaks in quick disconnects

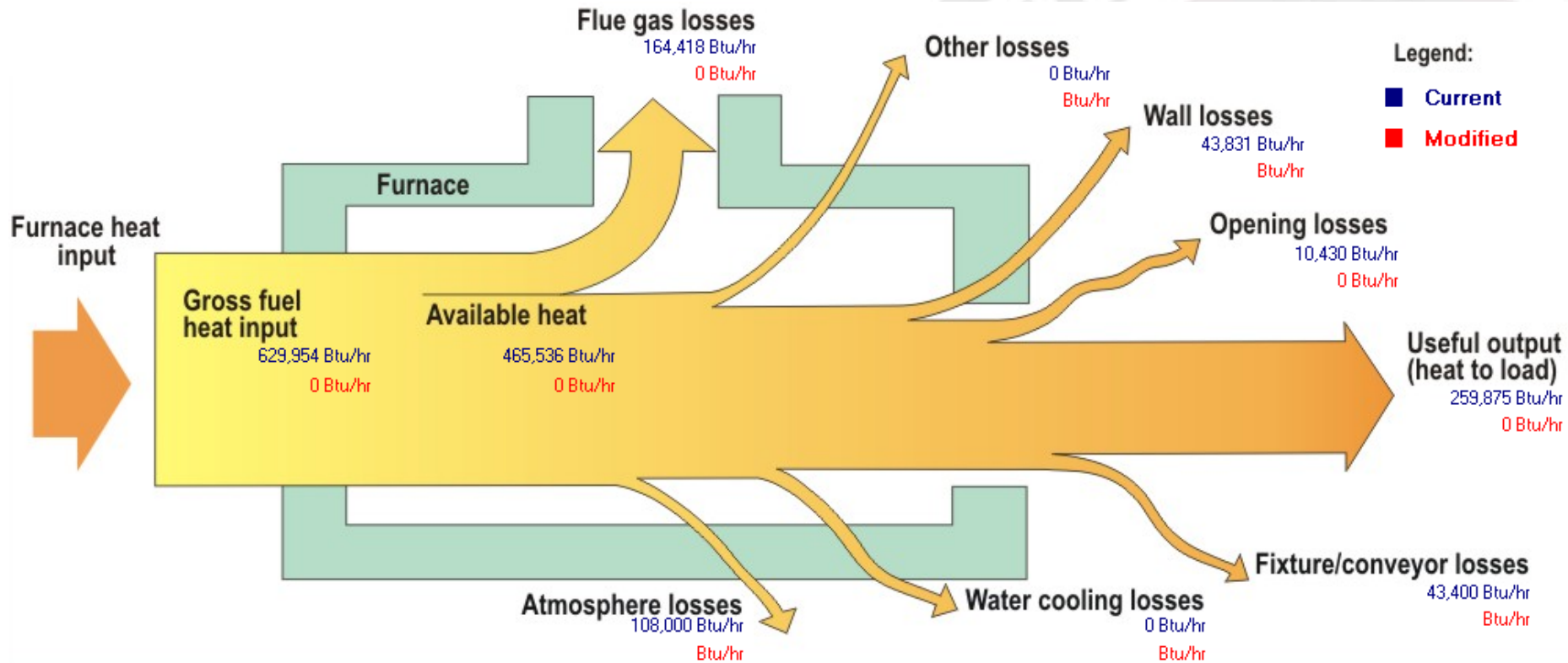
# Process Heating



 = Temperature Locations



# Pathways for Energy Loss



Sankey diagram of oven losses for powder coating cure oven using PHAST

# Calculations Using PHAST

## Dry-off Oven

Description	Current
Net Heat Required (Btu/hr)	225,834
Gross Heat Required (Btu/hr)	283,604
Heat Storage Losses (Btu)	548,714
Entire System Thermal Efficiency (%)	2

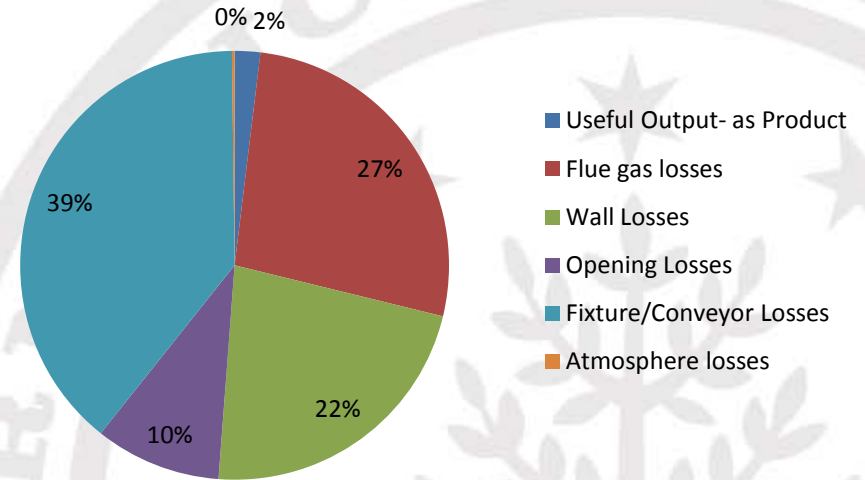
Calculated Losses	(Btu/hr)
Useful Output- as Product	5,600
Flue gas losses	77,770
Wall Losses	64,684
Opening Losses	27,464
Fixture/Conveyor Losses	113,040
Atmosphere losses	590

## PC- North Oven

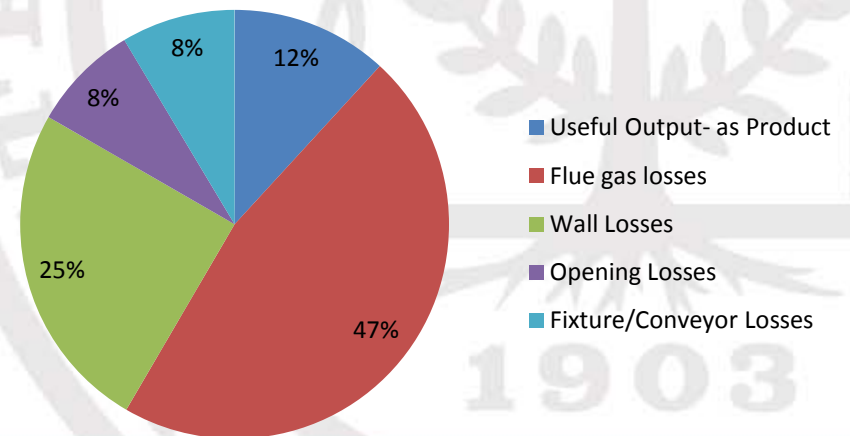
Description	Current
Net Heat Required (Btu/hr)	444,775
Gross Heat Required (Btu/hr)	553,469
Heat Storage Losses (Btu)	2,520,395
Entire System Thermal Efficiency (%)	11.71

Calculated Losses	(Btu/hr)
Useful Output- as Product	64,828
Flue gas losses	255,390
Wall Losses	136,553
Opening Losses	44,369
Fixture/Conveyor Losses	47,025
Atmosphere losses	0.9

## Dry-off Oven Losses



## PC- North Oven Losses



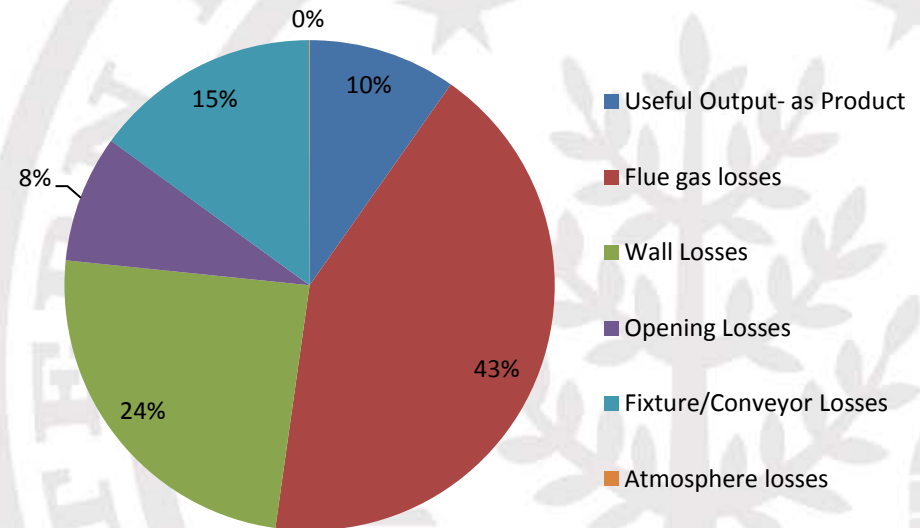
# System Calculations

## Composite System Total

Description	Current	MCF	\$/hr
Net Heat Required (Btu/hr)	1,103,394	1.082	7.438
Gross Heat Required (Btu/hr)	1,353,831	1.327	9.122
Heat Storage Losses (Btu)	5,589,504	5.48	37.670
Entire System Thermal Efficiency (%)	24	N/A	N/A

Calculated Losses	(Btu/hr)	MCF	\$/hr
Useful Output- as Product	135,256	0.133	0.912
Flue gas losses	588,550	0.577	3.966
Wall Losses	337,790	0.331	2.276
Opening Losses	116,202	0.114	0.783
Fixture/Conveyor Losses	207,090	0.203	1.396
Atmosphere losses	592	0.001	0.004
<b>Total</b>	<b>1,385,480</b>	<b>1.358</b>	<b>9.337</b>

## System Composite



*\*Note: \$/hr based on Consumers Energy Bill 9/30/10-10/29/10 billed price \$6.874/MCF  
These numbers reflect all three ovens' performance from 7:30am-9:00am on 12/21/10`*



# Possible Projects Identified

- Reduction of fixture/conveyor mass
- Improved wall insulation on PC ovens North and South
- Integration of heat exchanger to reduce or eliminate NG burner in wash process
- Investigate improved door seal design in ovens



# Project Savings Potential

- Material Waste (5% reduction)
  - Wood Reduction: \$51,130.75/yr
  - Waste Reduction: \$3,020.56/yr
  - Paint Reduction: \$4,648.63/yr
  - Total: **\$58,799.94** \*potential
- Compressed Air
  - Total TBA (based on equipment specs)
- Waste Heat Reduction (10% reduction)
  - Reduction in Flue Gas: \$1,903.68/yr
  - Reduction in Wall Losses: \$1,092.48/yr
  - Reduction in Conveyor/Chain: \$670.08/yr
  - Total: **\$3,666.24** \*potential
  - Recuperater/Heated Wash Replacement: \$12,000.00 /yr



Questions?