



# ***COMPRESSED AIR MANAGEMENT MASTER CLASS***

***A ROADMAP TO TURNING COMPRESSORS OFF***



# A Taste of Things to Come

**What would happen if you operated your electric utility like you run your compressed air system?**

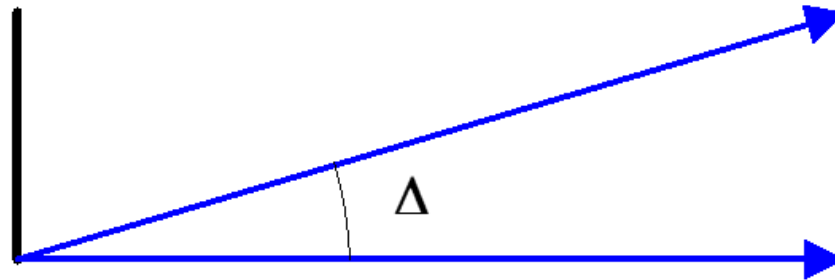
1. Throw out the national electric code
2. Take the nameplate off electric motors and starters
3. Get rid of circuit Breakers, Transformers, capacitors, starters, etc
4. Buy electric using equipment at any voltage or amps including primary voltage. That's what you have, that's what you can take... right?
5. Always alter the supply in order to make a particular application work if anyone in production thinks that is a good idea
6. if you take a user is important, install a rheostat for the operator to play with period if it's not critical don't put in anything.
7. Use one wire size for all applications regardless of voltage and amperage. Let the stores department determine the size of connection items based on lowest price. Remember, if it doesn't work, the supply can be altered
8. Assign the local power company responsibility for how the production equipment works. Give all the production personnel the phone number of the local power plant. If they can't force it to work the way that production wants it, ask them to build a new power plant.

Scot Foss, 1993

# The Business of Air

## Cost Reduction in Compressed Air Systems

### A Better Process



**It's About Money, Not Air**

Paul Edwards  
Compressed Air Consultants

# Why Do Systems Run So Poorly?



*For every complex problem, there is a solution that is simple, neat and wrong.*

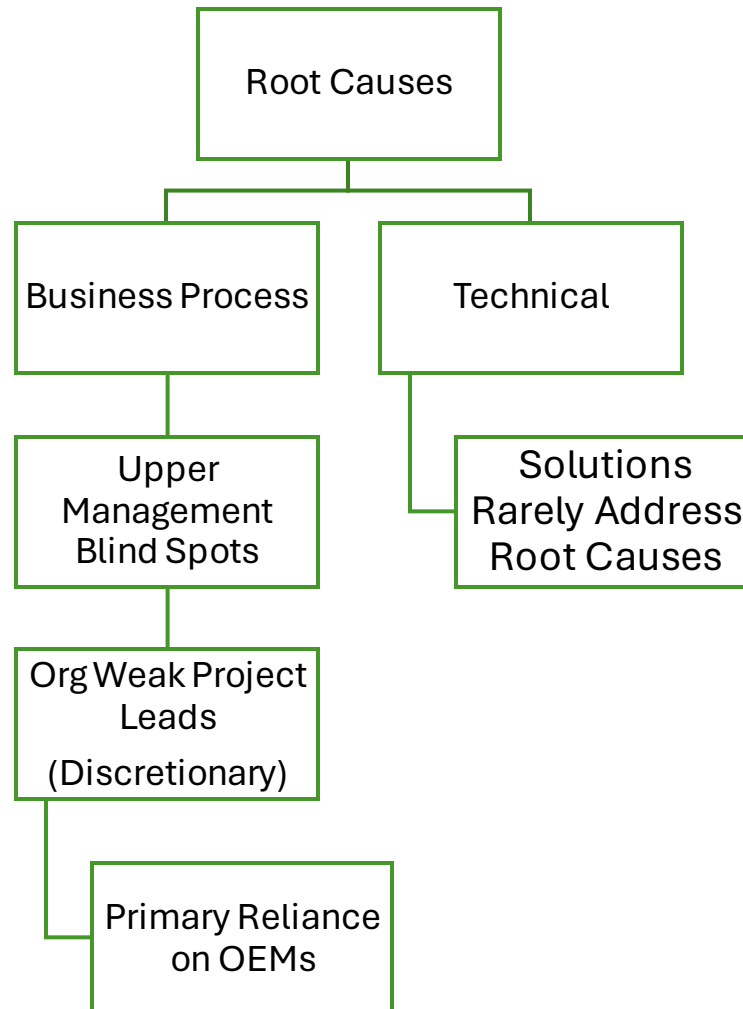
## Who and How are Decisions Made?

- Keep it running and keep the phone from ringing
- Control Maintenance Cost
- Anticipate and Prevent Failure

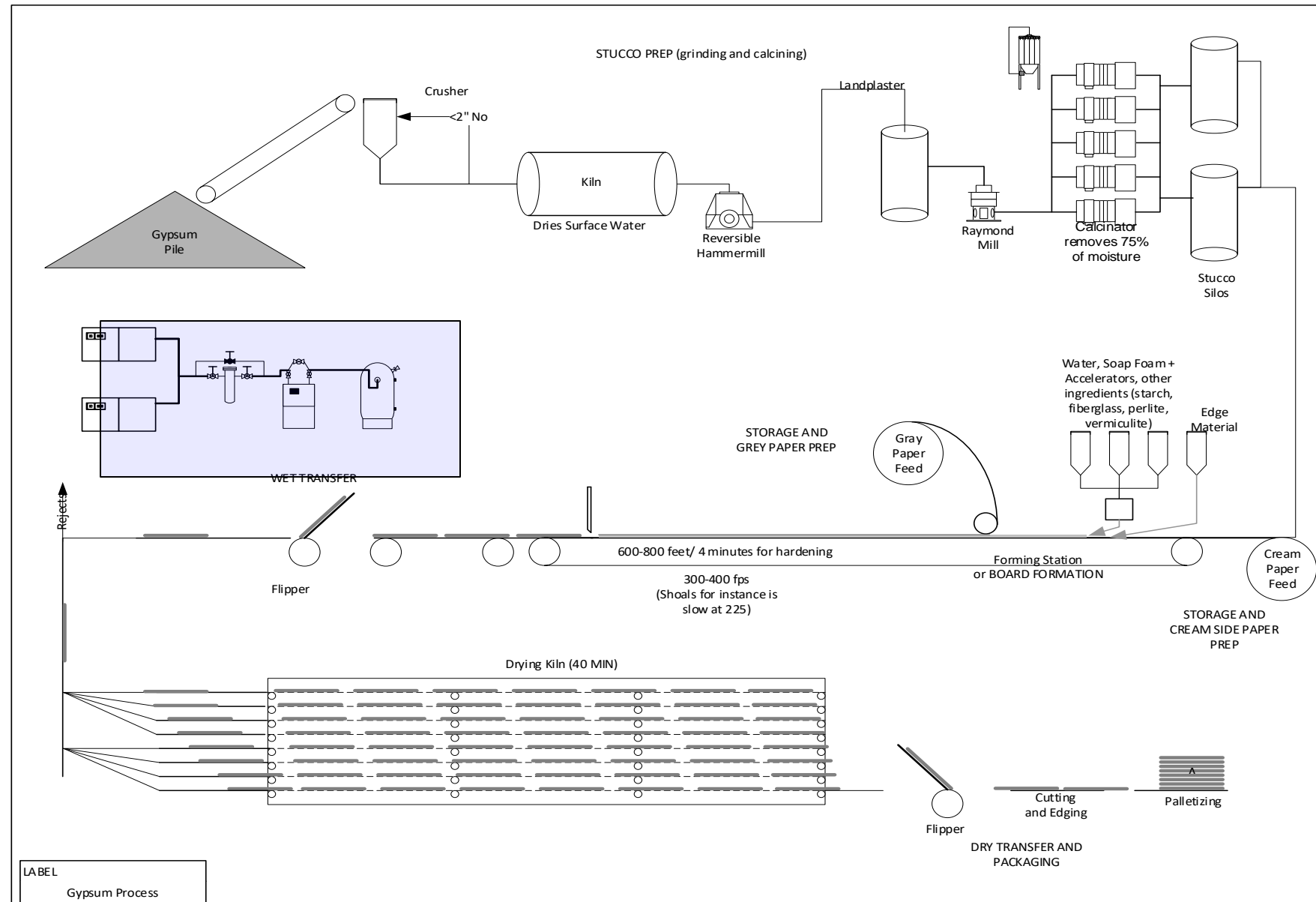
### ➤ Insufficient Analysis



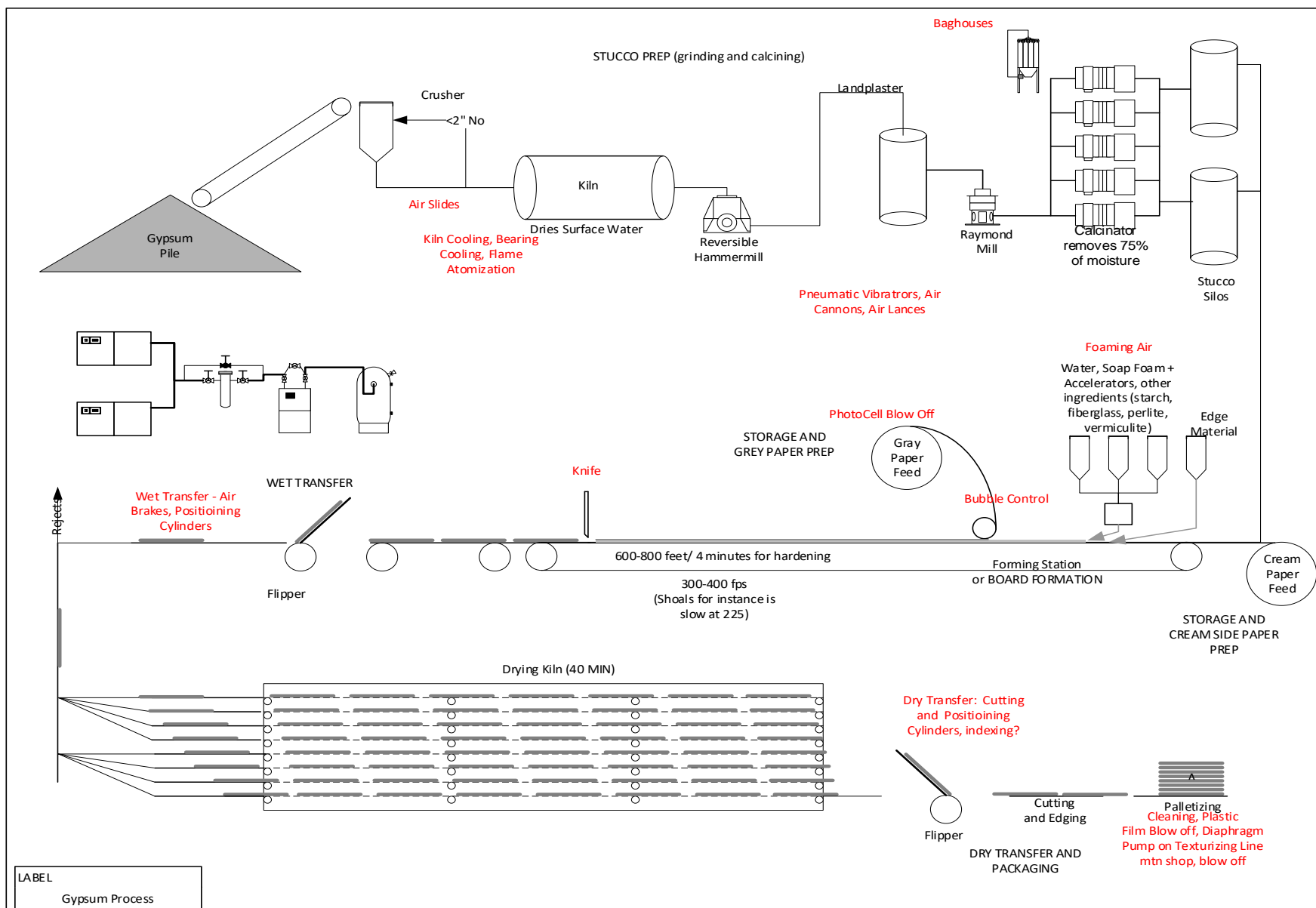
# Why Do Systems Run So Poorly?



# What drives the compressed air system?



# What drives the compressed air system?



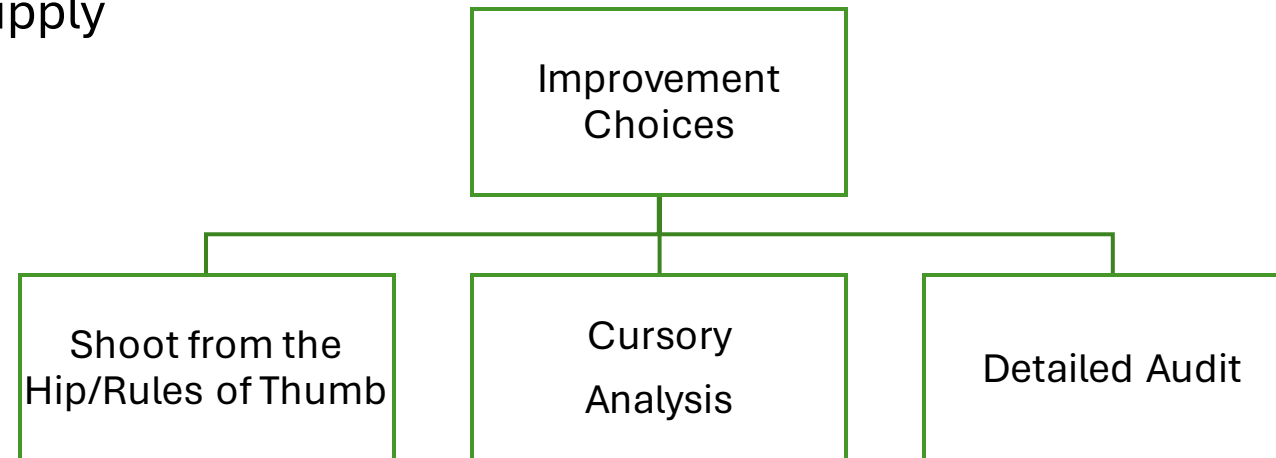
# What Drives the System?

- Demand Drives the System
- The Compressors are always operating in response.
- What drives Demand
  - The Process
  - The People who Design the Process



# “Optimizing” an Air System

- Optimizing an air system is ultimately an engineering problem.
- How you define the problem determines the answer.
- If demand drives the system, then demand likely should be analyzed along with the distribution system and with supply



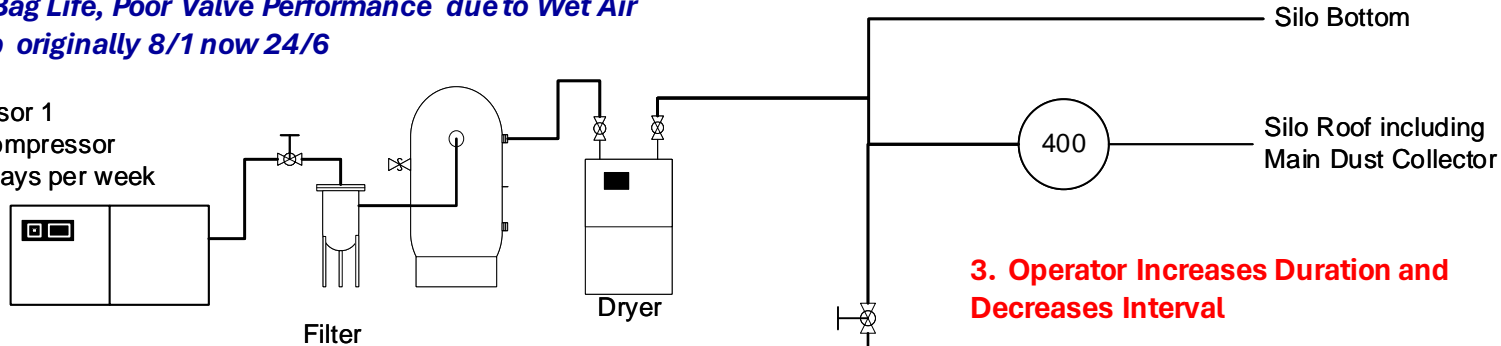
**Principle # 1. Analyze supply, distribution and demand**

# Case History #1

## Issues

- *Dusting due to Insufficient Pressure on Silo Roof*
- *Short Bag Life, Poor Valve Performance due to Wet Air*
- *125 hp originally 8/1 now 24/6*

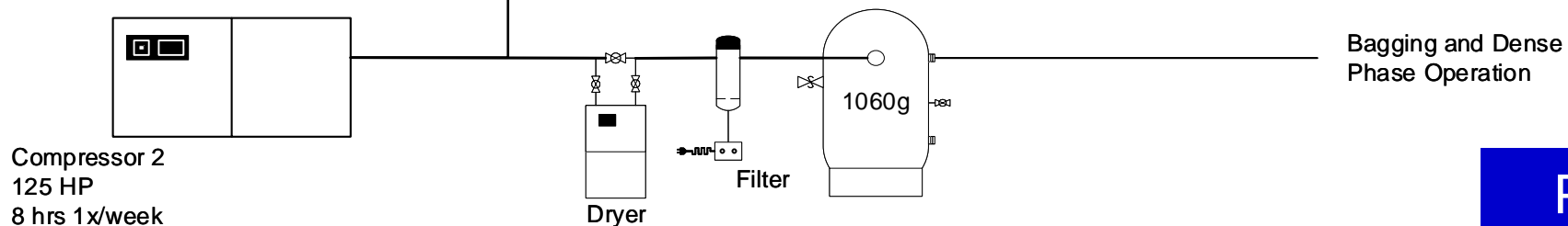
Compressor 1  
 75 HP Compressor  
 24hrs 6 days per week



**3. Operator Increases Duration and Decreases Interval**

**1. Compressor Fails – Emergency Connection to Dense Phase Required**

**2. Connection Made Upstream of Dryer**



	Compressor	
	Company	CAC
Project Cost	50000	60000
Savings	-10800	32000
Simple Return on Investment	Never	53%
Productivity Gains	Some	All

**Principle # 2. You can't overpay for competence**

# The Value of Independence

- How Likely are Brand Specific Auditors going to recommend a competitor's machine?  
There are cases where an OEM doesn't have an offering.
  - 100 HP, oil free screw compressor – FS Elliot
  - 300 HP, two stage flooded screw compressor – Atlas Copco



## ECO-Scroll 4-15kW | +

4-15 kw OIL-FREE AIR COMPRESSOR  
Environmentally friendly and highly reliable, the Eco Scroll comes with a user-friendly control interface with...

[VIEW DETAILS](#)



## ECO-Turbo Series 185-250kW | +

185-250kW AIR COOLED/WATER COOLED CENTRIFUGAL AIR COMPRESSOR With the ECO-Turbo, expert experience in centrifugal design and manufacturing for the highest...

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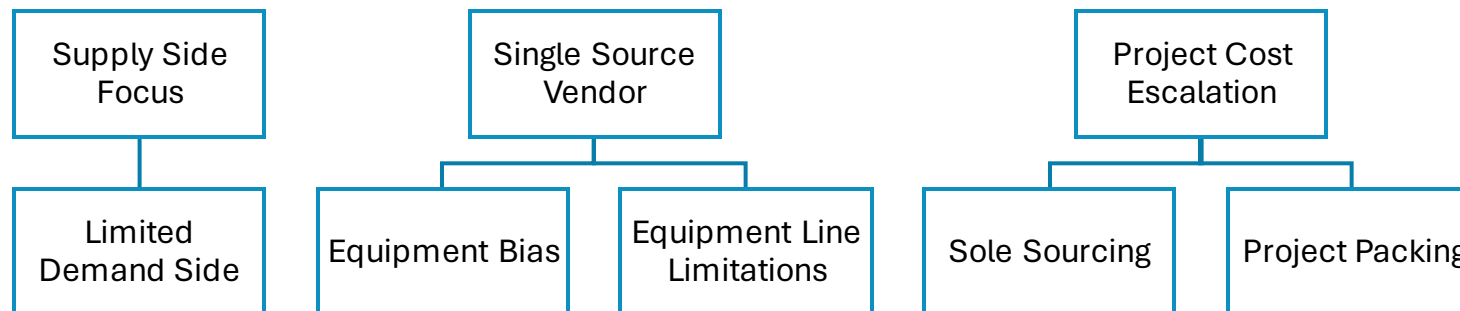


## OL Series 5-15HP | +

OL Series is the ideal reciprocating oil-less air compressor for applications where critical air quality is required such as food..

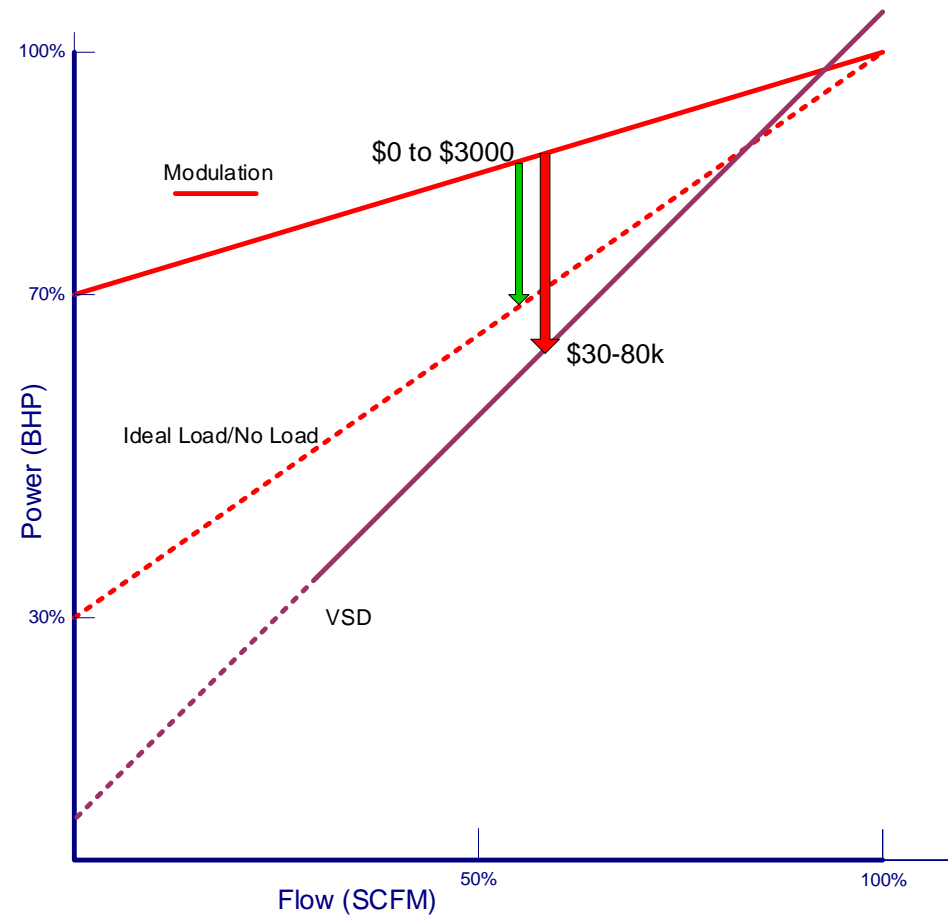
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# Is there a Conflict of Interest?



# Automated Surveys

- What are Automated Surveys Designed to Do?



# The Implication - Corporate Perspective

Plant	North	South	East	West	Total
Current Cost (100k)	460,000	380,000	800,000	210,000	1,850,000
Potential Savings (%)	25%	32%	18%	35%	
• Potential Savings \$	115,000	121,600	144,000	73,500	454,100
Consultant 1	North	South	East	West	Total
Savings Captured	85%	85%	85%	85%	
Total Savings	97,750	103,360	122,400	62,475	385,985
Project Payback	2	2.5	1.8	2.2	
Project Cost	195,500	258,400	220,320	137,445	811,665
Overall ROI					2.1
Consultant 2-5	North	South	East	West	Total
Savings Captured	50%	85%	45%	35%	
Total Savings	57,500	103,360	64,800	25,725	251,385
Project Payback	2.5	3.5	4.2	2.6	
Project Cost	143,750	361,760	272,160	66,885	844,555
Overall ROI					3.4

Principle # 3. If outsourcing, use impartial, highly competent auditors. If using OEMs, create standards and processes that insures unbiased recommendations.

# What is the cost of a miss?

- If Demand drives the systems, what is the cost of a “miss”?
  - \$150/cfm/year = 74 €/m<sup>3</sup>/hr/year
  - Previous Example - \$16,000 per year
- Are the largest demand side opportunities “leaks”?
  - In some industries, yes. In most, no.

Demand Components SCFM	1st Shift		Savings	2nd Shift		3rd Shift	
	Current	Proposed		Curr	Prop	Curr	Prop
<b>Ready Mix System</b>							
Dust Collectors	251	123	128	251	123	0	0
Air Pads and Air Assist	260	168	92	131	89	0	0
Bag Cleaning	46	17	29	39	11	0	0
Miscellaneous	171	171	0	155	155	228	0
Leaks	122	40	82	122	40	122	0
<b>Totals</b>	<b>850</b>	<b>519</b>		<b>698</b>	<b>418</b>	<b>350</b>	<b>0</b>
<b>Grout System</b>							
Dust Collectors	19	12	7	8	0	0	0
Air Pads and Potential Blown Solenoid on Air Assist	116	20	96	116	0	116	0
Air Assist and Productive Load	23	73	(50)	0	0	0	0
Leaks	58	25	33	58	25	58	0
<b>Totals</b>	<b>216</b>	<b>130</b>		<b>182</b>	<b>25</b>	<b>174</b>	<b>0</b>

**P Principle # 4. Put the Cost of an Audit in Context with the cost of a “Miss”. Use ROI as the basis for the Project**

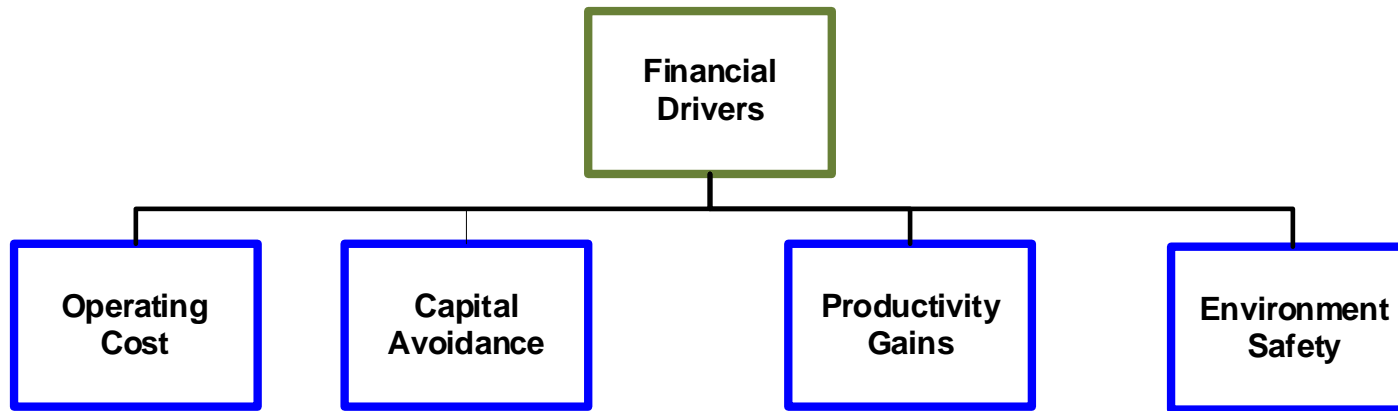
# Large Systems are Not Immune

- Consider the financial impact of ignoring demand reduction opportunities

<b>Application</b>	<b>Current</b>	<b>Proposed</b>	<b>Savings</b>
Supply Side Desiccant Dryers	1078	0	1078
Application A	1745	618	1127
Application B	150	25	125
Application C	291	50	241
Application D	249	175	74
Application E	135	140	-5
Application F	44	44	0
Application G	50	50	0
Application H	50	50	0
Application I	486	486	0
Application J	5	0	5
Miscellaneous	963	963	0
Application K	213	167	46
Application M	40	20	20
Application N	127	0	127
Safety/Fudge Factor	0	500	-500
Leaks	98	48	50
<b>Total</b>	<b>5723</b>	<b>3336</b>	<b>2388</b>
<b>Additional Energy</b>		<b>HP</b>	
Open Blowing Replacement	0	20	
Application D Motors	0	5	
Additional HP Load		25	

# Financial Drivers

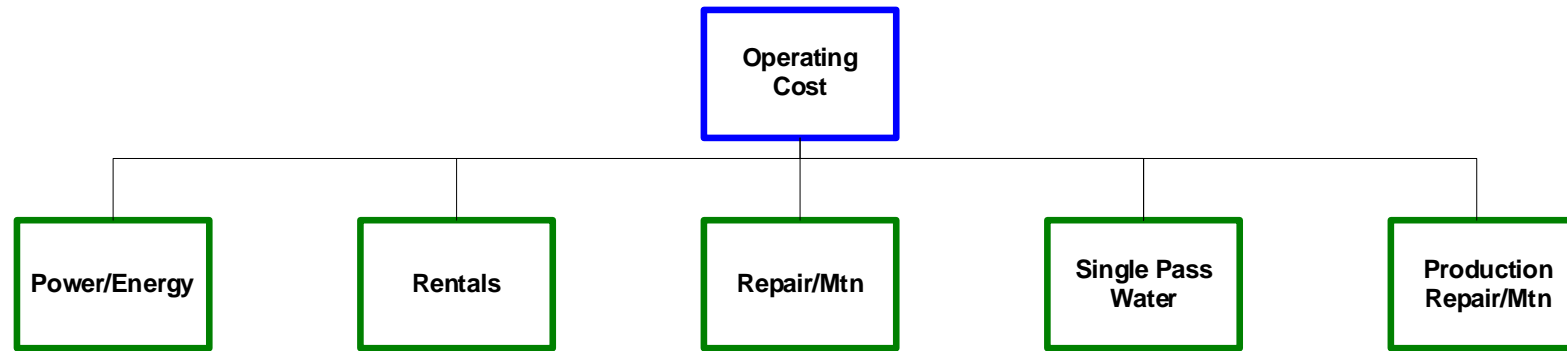
- What buckets of money can fund an ROI project?



- Cast as wide a net as possible. The greater the savings, the greater the improvement. Use Production's Money, not Maintenance and Engineering

**Principle # 5. Use Every Source of Savings to Fund the Project**

# Financial Drivers – Operating Costs



- Example: Producer of packaged dry-mixes, tile-setting products, exterior wall systems, related specialty products, and specialty
  - Current: 5 Compressors Running
  - Proposed 2 Compressors Running

<b>Financial Analysis - Current and Proposed Annual Cost of Operation</b>						
<b>Component</b>	<b>Hours</b>	<b>Current</b>		<b>Proposed</b>		<b>Annual \$ Savings</b>
		<b>KWD</b>	<b>Annual Kwh's</b>	<b>KWD</b>	<b>Annual Kwh's</b>	
<b>Electricity</b>						
Profile #1 - Weekday Operation	2,184	254.0	554,818	158.3	345,748	209,071
Profile #2 - 2nd Shift	1,976	228.5	451,538	122.9	242,902	208,636
Profile #3 - Third Shift (1 AM-5 AM)	832	175.3	145,852	0.2	0	145,852
Profile #4 - Weekend	3,744	0.0	0	0.0	0	0
<b>Totals</b>	<b>8,736</b>		<b>1,152,209</b>		<b>588,650</b>	<b>563,559</b>
Annual Operating Costs - Energy		290.5	\$92,177	67.5	\$47,092	\$45,085
Reduction in Mtn and Repair - Production Machinery			\$3,000			\$3,000
Repair and Maintenance - Supply			\$9,154		\$7,500	\$1,654
<b>Totals</b>			<b>\$104,331</b>		<b>\$54,592</b>	<b>\$49,739</b>

# Financial Drivers Rental Compressors

- Corporate Led Programs – Start Here
- Usually, the highest ROI projects along with productivity
- Everyone Learned to live with the Production Interruptions
  - Wet Air
  - Pressure Fluctuations

	Current	Proposed	Savings
Compressors Running	14	9	5
SCFM	8,828	4,004	4,824
	Current	Proposed	Savings
Power	849,760	517,190	332,570
Outside Mtn and Repair	100,000	85,000	15,000
Internal Mtn	0	0	0
Lubricant	29,358	12,943	16,415
Dryer Maintenance	25,000	25,000	0
Rental Compressors	288,000		288,000
Rental Dryers	108,000		108,000
Rental Diesel Compressors	148,220	37,055	111,165
Diesel Fuel	248,832		248,832
	1,797,170	677,188	1,119,982

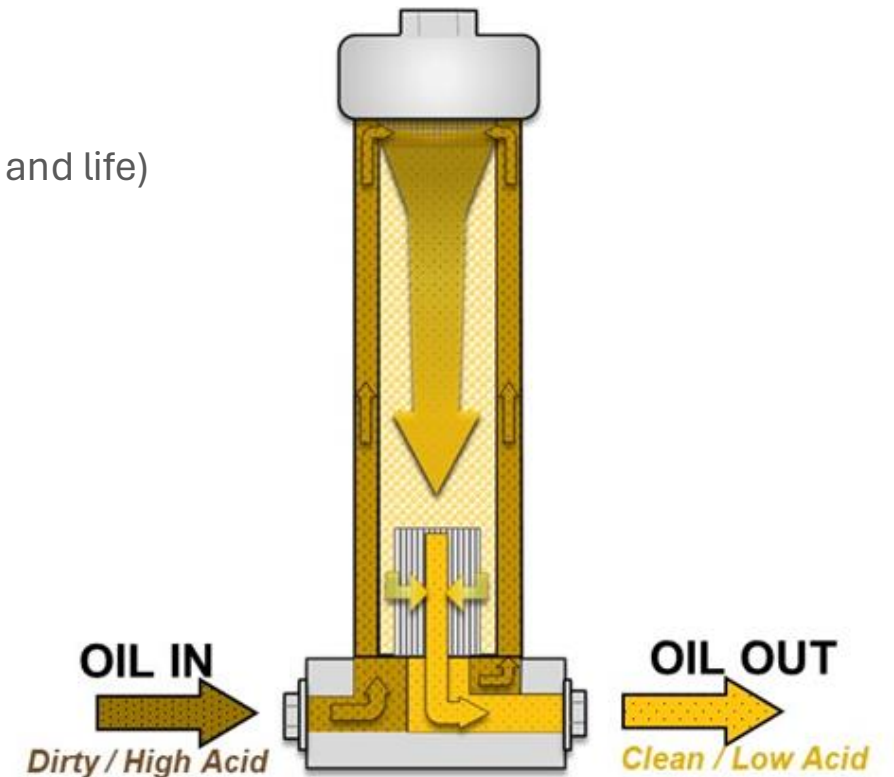


# Financial Drivers- Maintenance

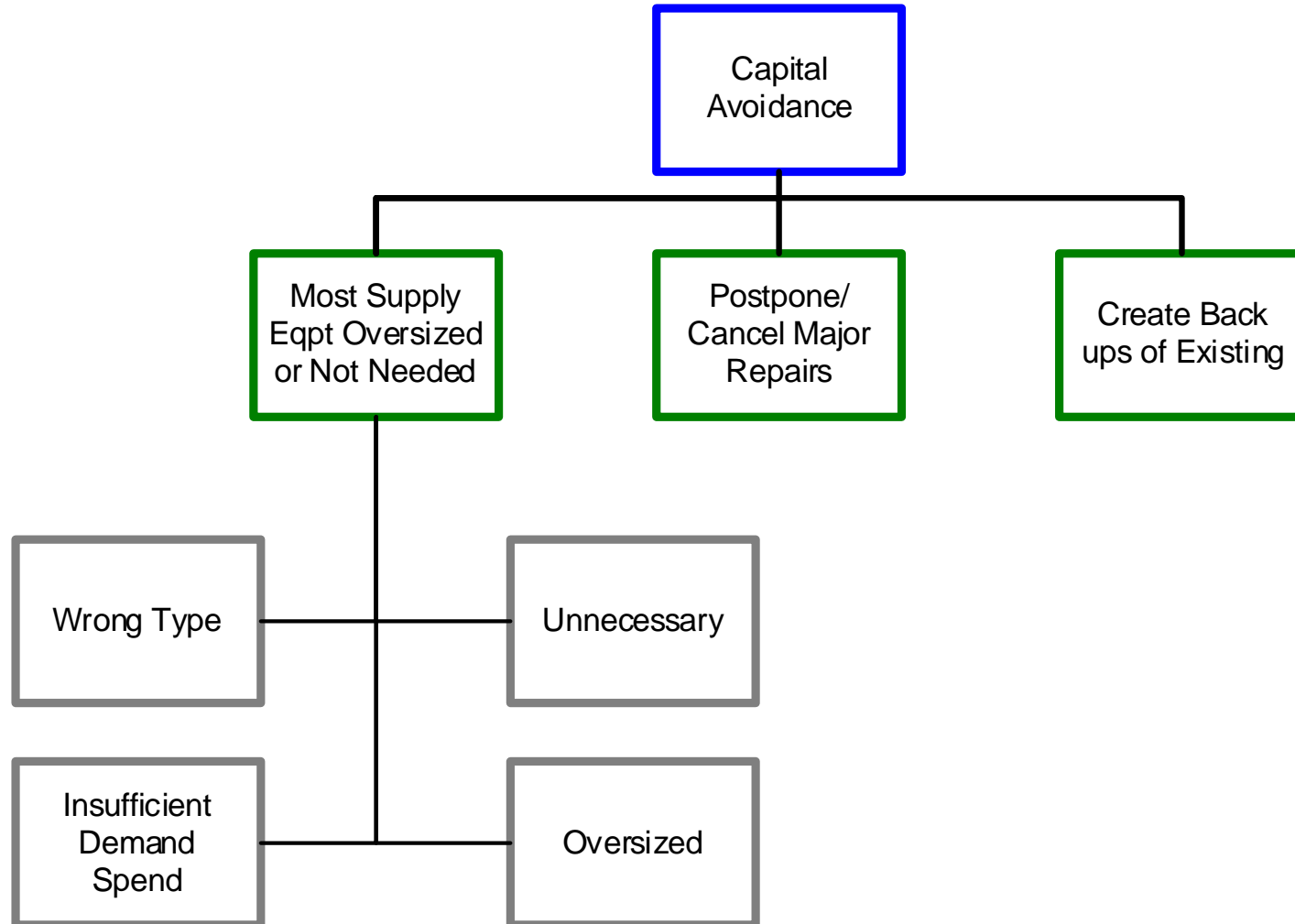
Less than Fully Informed Risk Aversion is not a good business strategy.

The biggest opportunities are:

- Condition Based Maintenance for Lubricant and Airends. Not Time Based
- Quality Non OEM Lubes (Risk/Reward)
  - High quality Lower Cost Lubes do Exist
  - 12,000-16,000 hours
- Oil Purification
  - Plants with 70,000 hours without changing lubricant
  - Reduced particulate to the airend bearings (Improved airend reliability and life)



# Financial Drivers – Capital Spending



# Capital Avoidance

- Demand Reduction while combining systems

**Current**

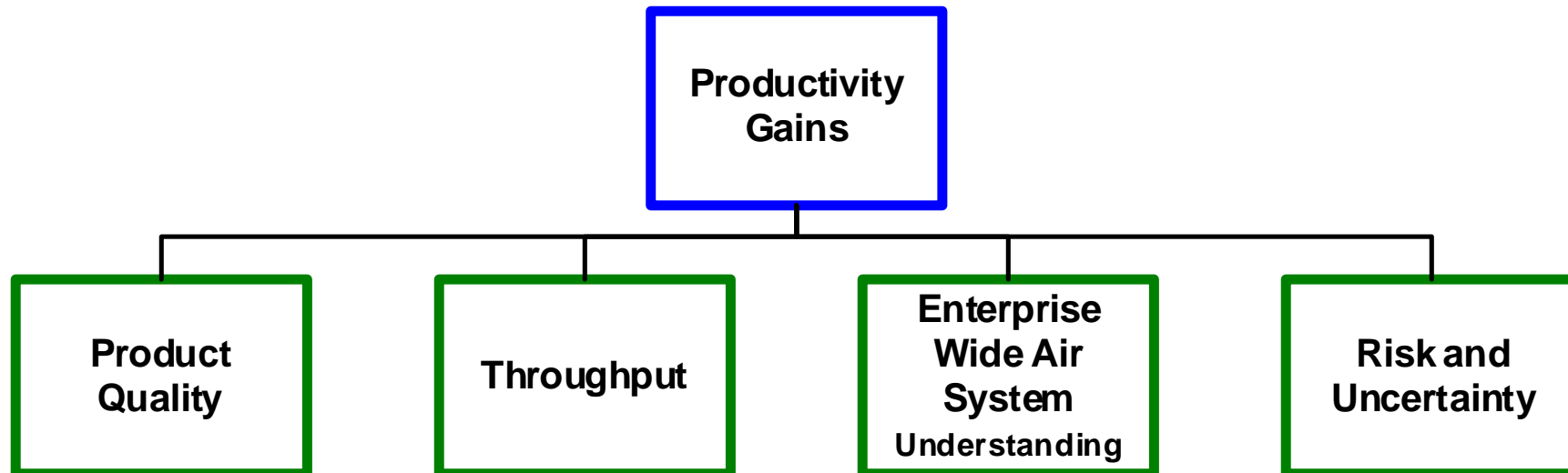
Comp. No.	Mfgr	Equip. #	Model #	Nominal Intake	Motor HP	FLA Amps	SCFM Capacity	% Loaded	SCFM Output	Average Amps	Average HP	Voltage	Power Factor	Average KW	Scfm /HP
<b>Profile #1 - Normal Operation - Average Demand</b>															
1	Gardner Denver 500 HP s	325J	EAY99E	2459	500	65.5	2,184	91.0%	1,987	65.4	556	4160	0.880	414	3.58
2	Gardner Denver 300 HP	425J	EAU99G	1481	350	42.0	1,315	0.0%	0	0.0	0	4160	0.880	0	
3	Gardner Denver 500 Hpsi	303J	EAY99E	2118	500	65.0	1,881	94.0%	1,768	57.6	490	4160	0.880	365	3.61
4	Gardner Denver 500 HP s	401J	EAYSVC	2118	600	70.0	1,913	85.0%	1,626	57.9	506	4160	0.905	377	3.21
5	Gardner Denver 500 HP s	401JA	EAYSVC	2118	600	70.0	1,913	90.0%	1,722	60.5	529	4160	0.905	394	3.26
6	Gardner Denver 350 HP s	400J	EBH0HB	1481	350	42.0	1,378	0.0%	0	0.0	0	4160	0.905	0	
7	Gardner Denver 40 HP sir	622J	EBH0HB	200	40	50.0	186	0.0%	0	0.0	0	460	0.820	0	
8	Gardner Denver 40 HP sir	415J	EBH0HB	200	40	50.0	186	60.0%	112	51.9	45	460	0.820	34	2.46
				12,175	2,980	Total	10,957	Total	7,215	293.2	2,125			1,585	3.40

**Proposed**

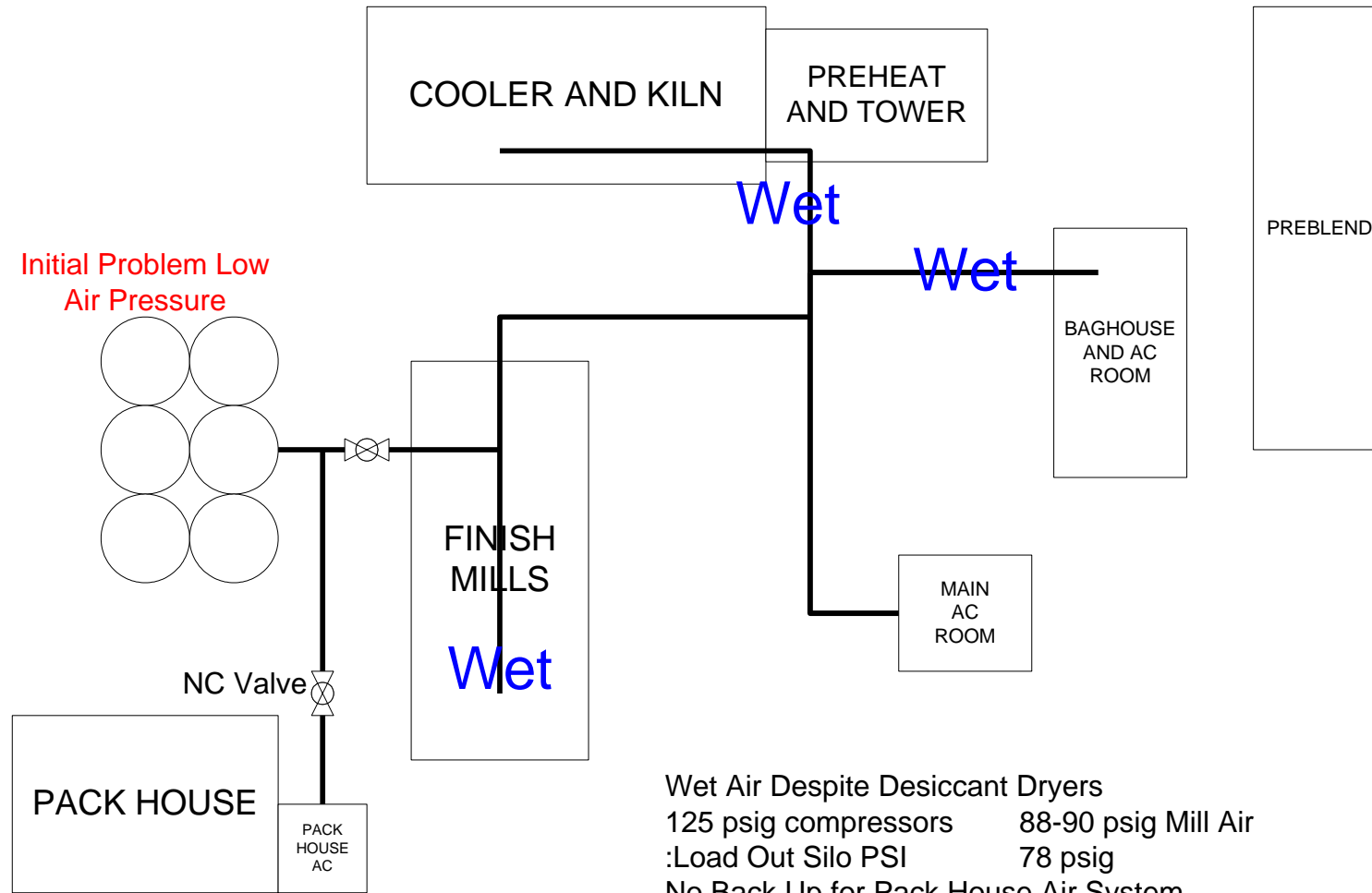
<b>Profile #1 - Normal Operation - Average Demand</b>															
1	Gardner Denver 500 HP single-stage AH#1			2,459	500	66	2,184	97.1%	2,121	68	578	4,160	0.88	431	3.67
2	Gardner Denver 300 HP single-stage AH#2			1,481	350	42	1,315	0.0%	0	0	0	4,160	0.88	0	
3	Gardner Denver 500 Hpsingle-stage AH#2			2,118	500	65	1,881	100.0%	1,881	60	511	4,160	0.88	381	3.68
4	Gardner Denver 500 HP single-stage AH#3			2,118	600	70	1,913	0.0%	0	0	0	4,160	0.91	0	
5	Gardner Denver 500 HP single-stage AH#3			2,118	400	70	1,913	0.0%	0	0	0	4,160	0.89	0	
6	Gardner Denver 350 HP single-stage			1,481	350	42	1,378	0.0%	0	0	0	4,160	0.89	0	
7	Gardner Denver 40 HP single-stage 4th floo FM			200	400	50	186	0.0%	0	0	0	460	0.89	0	
8	Gardner Denver 40 HP single-stage			200	40	50	186	0.0%	0	0	0	460	0.89	0	
9				0	0	0	0	0.0%	0	0	0	460	0.89	0	
				0	0	0	0	0.0%	0	0	0	0	0.85	0	
				12,175	3,140	Total	10,957	Total	4,002	128	1,089			813	3.67

# Financial Drivers - Productivity

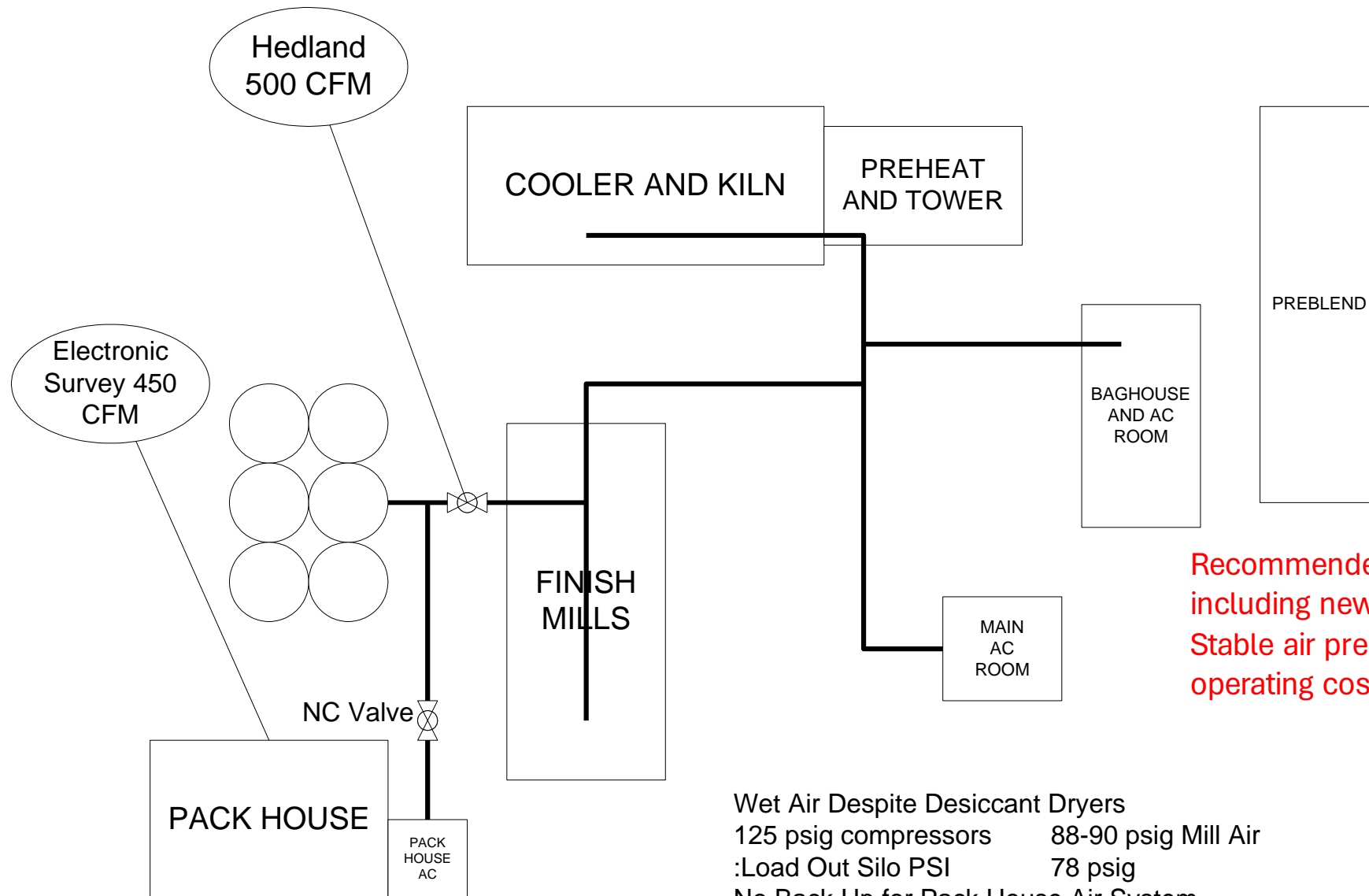
- Disproportionate Return on Investment
  - Air Pressure or Air Quality Creating Throughput or Scrap



# Productivity Gains – Case History



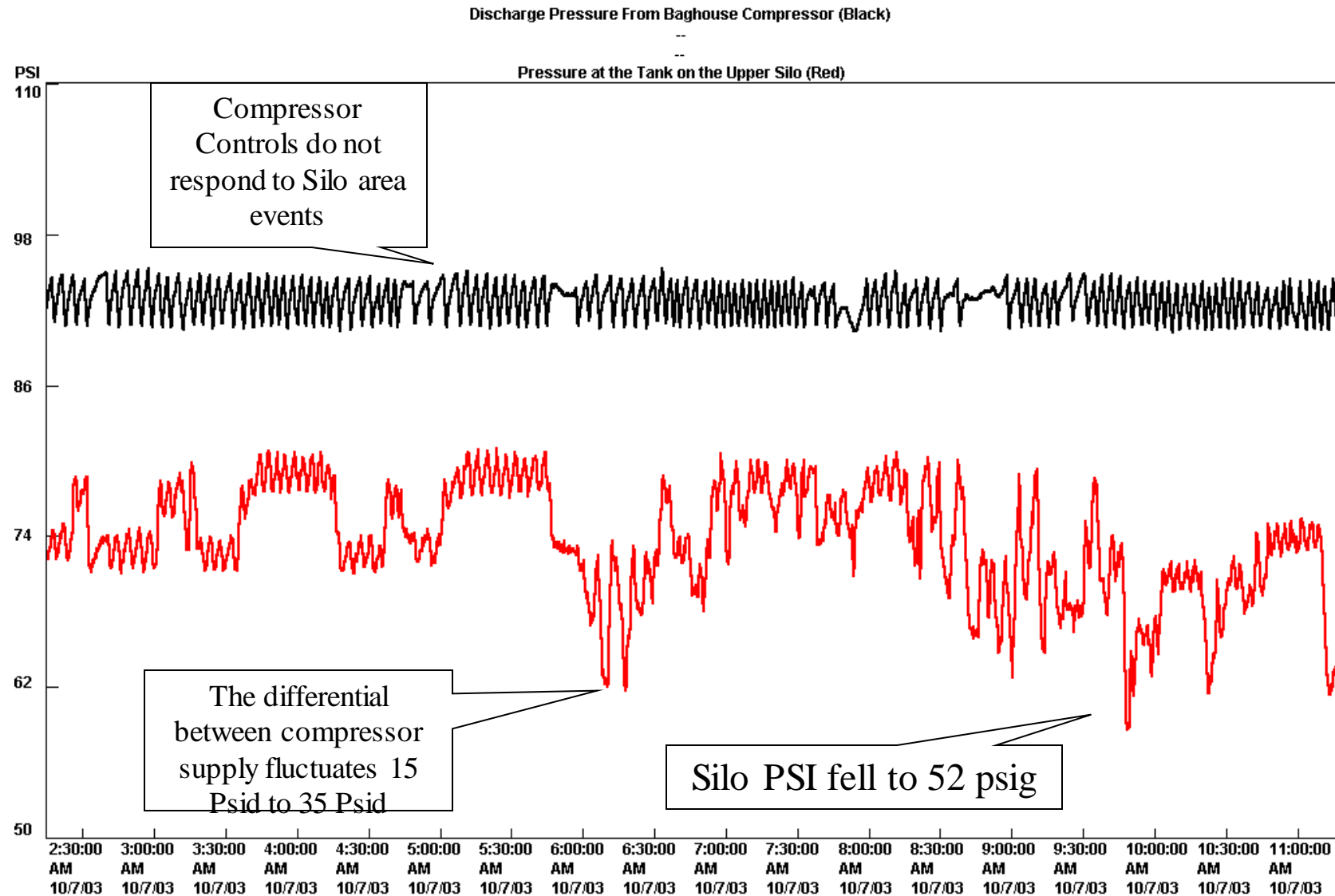
# Compressor Room Solutions



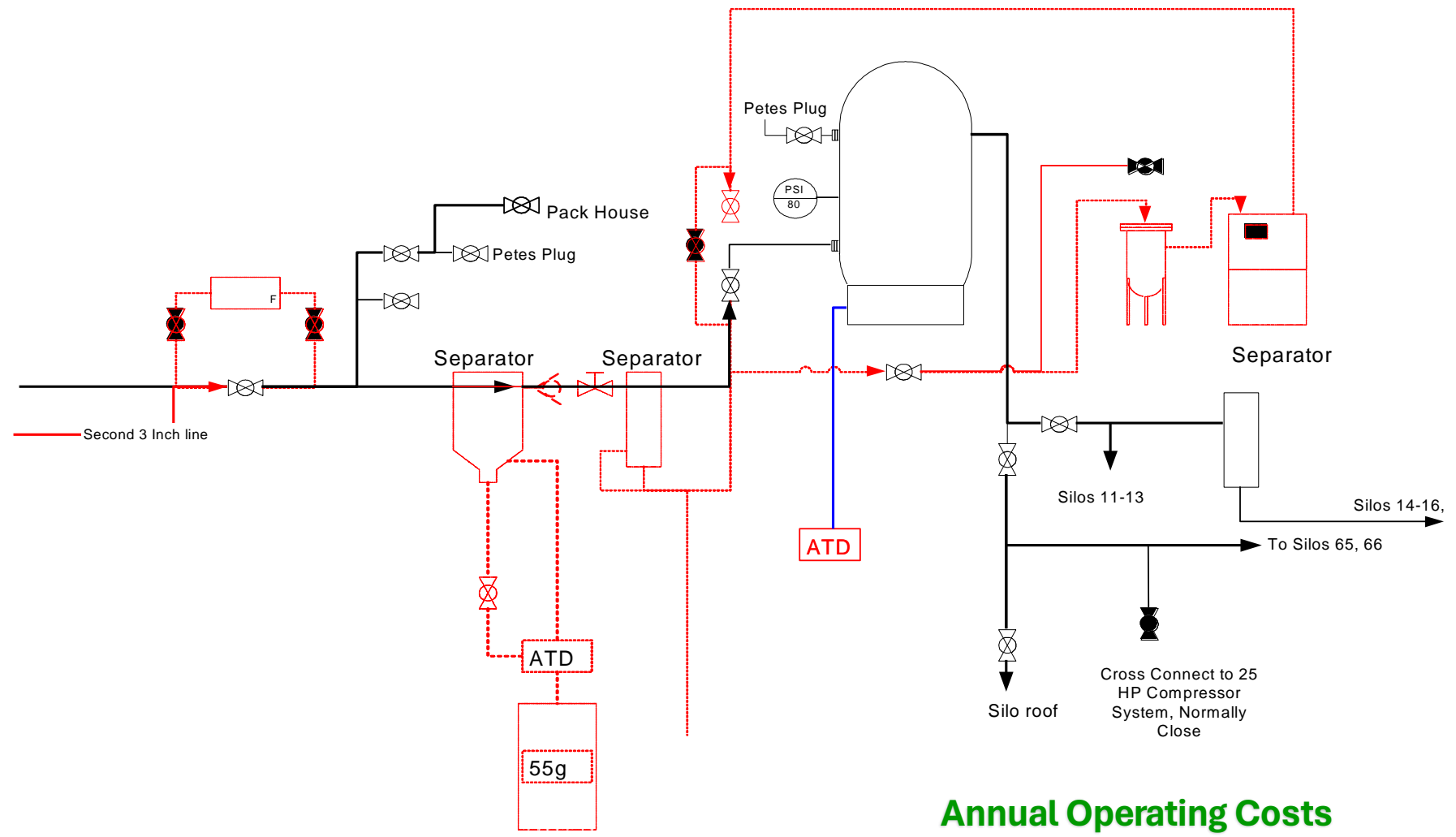
**Recommended: \$150,000 Project including new compressors**  
**Stable air pressure at an increase in operating costs of \$50-\$100k**

Wet Air Despite Desiccant Dryers  
 125 psig compressors      88-90 psig Mill Air  
 :Load Out Silo PSI      78 psig  
 No Back Up for Pack House Air System

# Data Driven Analysis



# Silo Entry Proposed

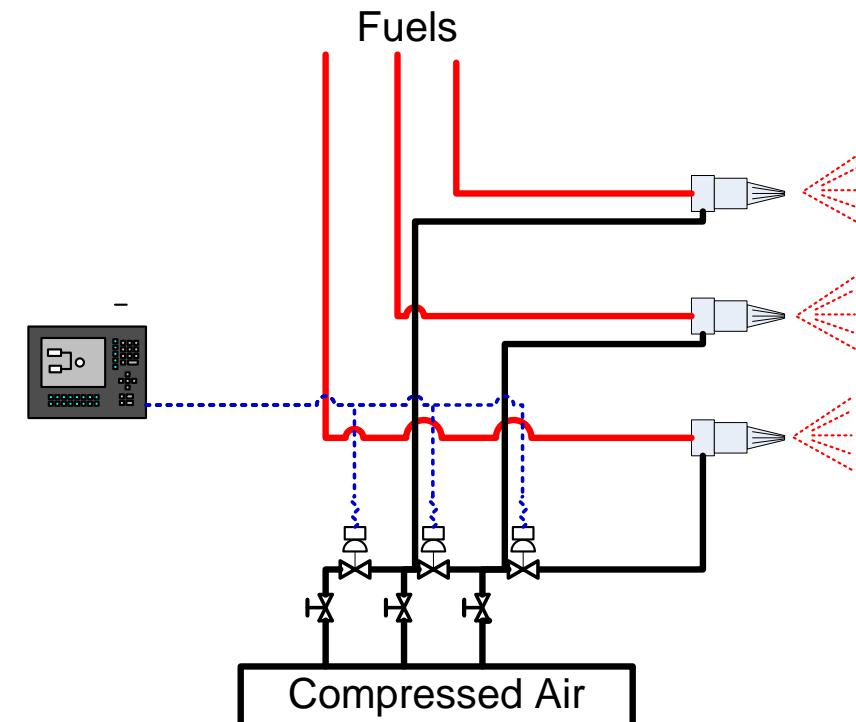


**Capital Costs**  
**\$150,000 vs. \$6,000**

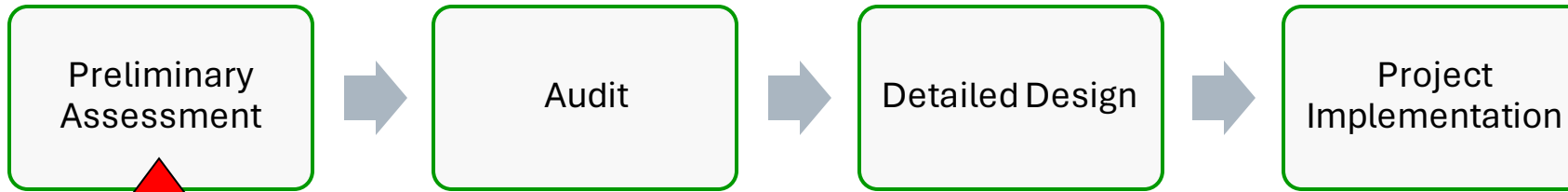
**Annual Operating Costs**  
**\$50,000 vs. \$0**

# Productivity – Case History

- Productivity Gains can be larger than energy
  - Midwest Plant burns Waste fuels and waste materials
  - Air used for Atomization on the Alternative Fuels Burner

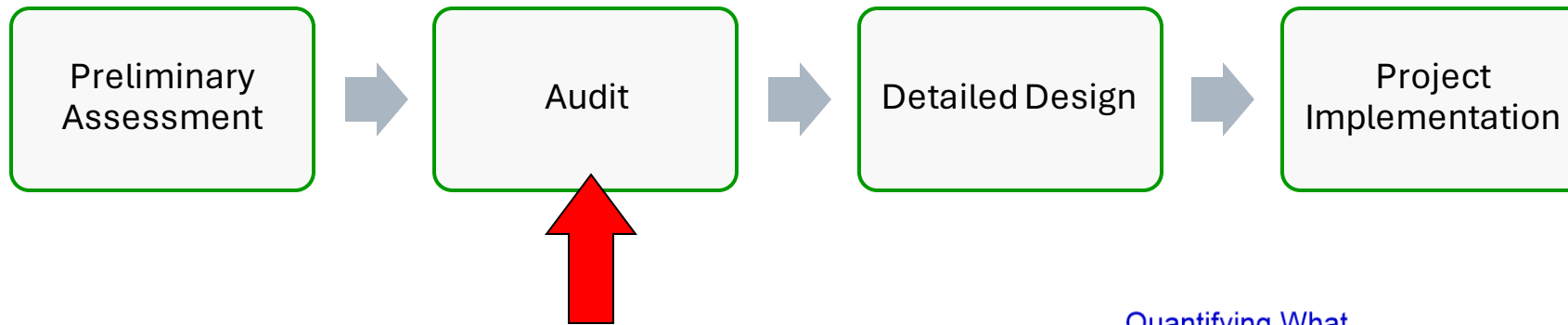


# The Improvement Process

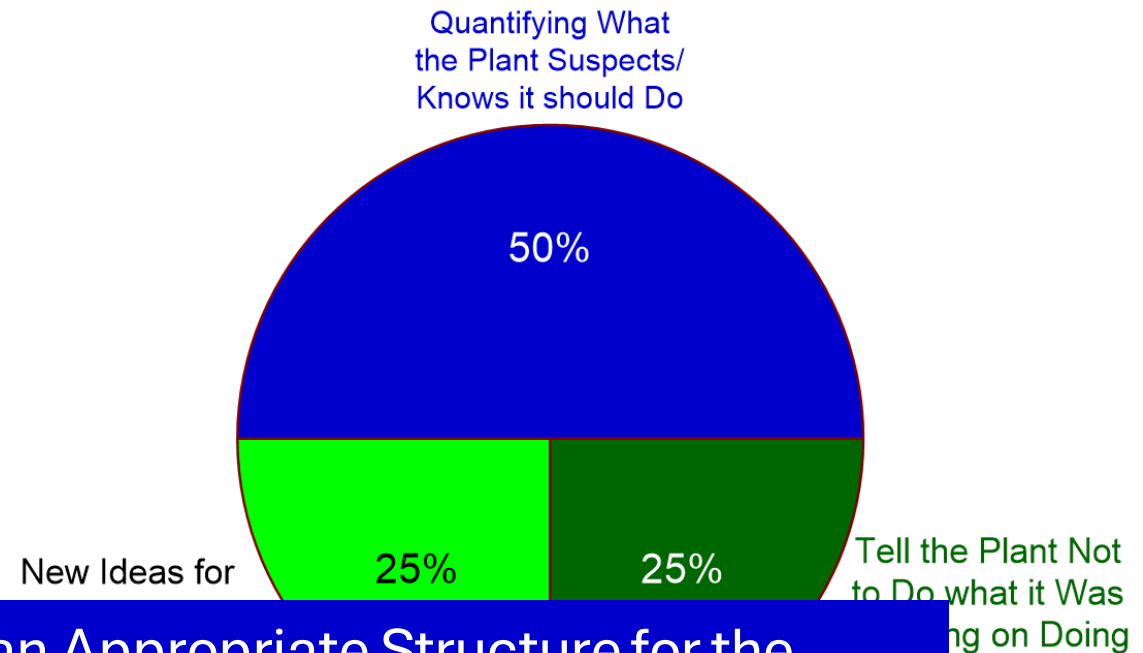


Country	of cement, tons per year?	total installed kw or HP? How many of these are oil free? b) How many compressors run for most of the time on a daily basis? What is the installed kw or HP for these compressors? How many of these are oil free? c) How many compressors are spare, what is their total kw or HP?	Estimated KW on line	Estimated kW/1M tons per year of cement	KWH	period of time (> Quarter of the year)? Are they diesel or electric? Review all plants and highlight any that show an opportunity that the conditional formatting did not net	compressors' screw elements? (highlight in green any plant that is 40000 or less hours)	problems that cause a throughput or product quality issue? (highlight any that conditional formatting didn't capture - Yes)	purchases of compressed air equipment in the next one to two years? (highlight any that the conditional formatting didn't capture)	what level of improving the
United States	2,200,000	a)42 high pressure compressors, 4 oil free b)33 run full time, about 3114 hp total, zero oil free	3114	2498	1135	21891576	Yes, both diesel and electric	24000	Yes, Lack of air pressure creates plug ups in dust collectors.	Yes
Côte d'Ivoire	2,000,000	a) 8+1, 483, 0 b)4, 262, 0 c)0, 0	262	131	2295120	no	No information on that issue	No quality issue, interconnection between air production is not good enough, then when pressure drop down equipment stops	yes, 2 screws unit or complete compressor	
India	3,000,000	A)21, 3438kw, All are oil injected, B)16, 2624 KW,NIL, C)5 at various application, 814 KW	2624	875	22966240	NO	AFTER FOUND ANY ABNORMALITY	MOISTURE IN PRESSURIZED AIR LINE	YES FOR SPARE(NEED SPARE BANKING AT PLANT)	
India	2,000,000	a) 4 Number Compressors installed, 3 Compressors - 160 KW & 1 with 75 KW capacity, none is oil free, b) 2 Compressors run - 1 - 160 KW and 1 - 75 KW for most of time, 2 are stand-by - 160 KW each.	395	198	3460200	No, Electric	Till date no screw has been replaced		No	
India	1,500,000	a) 94 Nos compressors ( 3 X 132 KW and 01x 30 KW ), No any oil free compressors b) for plant Running 02 compressors run ( 01 compressor 100 % and 2nd compressor 60 % ) 132 KW X02, no any oil free compressor	426	284	3731760	NO	NO CHANGED YET	WATER MOISTURE	NO	
India	1,500,000	(a) Three, 195 Kw, all (b) Two, 120 Kw, all (c) One, 75 Kw	390	260	3416400	No	Based on conditioning monitoring report.	No	No	
India	800,000	(a) Total 8 Nos, High pressure 4 Nos - installed power total 177 kw ( 2nos 55 kw, 1 no. 37 kw & 1 No. 30 kw), & Low pressure 4 Nos - installed total 300 kw, 75 kw with 1.1 S.F. motors. None of them is oil free (b) High pressure 2 Nos, High pressure one of 55 Kw & another of 37 kw / 30 Kw, and Low pressure 02 Nos, 75 kw with 1.1 S.F. motors None of them is oil free (c) High pressure 2 Nos, High pressure one of 55 Kw & another of 37 kw, & low pressure 02 Nos, 75 kw with 1.1 S.F. motors 8 compressors, 8x55kW, 0 oil free, 4 compressors most of the time, 4x55KW, 4 spare	177	221	1550520	no	8 to 10 years in HP, in LP never changed in last 20 years	no	yes, replacement of all LP compressors one by one in next 3 to 4 years, as existing model has become obsolete	
Cameroon	1,300,000	a) Number of compressors: 11 total kW: 1040 kW, oil free: none, b) number: 5 kW, 410 kW	220	169	1927200	no	no data available (very rarely)	None	1 compressor to be replaced this year (KW, 75) order process on-going?	
Germany	600,000	Ans for instrument system & packing we have 2 compressor 90 KW & 110 KW, for fly ash unloading we have 110kw 2 nos & 75 kw 3 nos, we use mostly 90 kw & 75 kw, all compressor are oil injected, 2 compressors	200	286	1752000	no	electric 20000h	non	non	
France	50,000	a) 3 compressors - total 85kW - 1 oil free b) 5 c) 8505 Hp + 45 Hp, b) 5 compressors, 375 Hp, c) no spare	85	#DIV/0!	744600	No	> 90000H	No	No	
Philippines	450,000	Total 6 Compressors are installed, 3 for Instrument Air (220 KW - 110, 55 & 55) and 3 for Dense phase conveying for flyash (260 KW - 110, 75 & 75), all are oil lubricated b) 1 compressor of 55 KW is running for instrument air and 2 compressors 75 KW each are running for dense phase conveying. c) We have two spare compressors (132 KW & 110 KW).	375	301	2635065	No	Not yet replaced	Yes	No	
India	1,000,000	a) 3 - 225 kw b)1, 75kw c)2, they work alternately 150 kw	220	220	1927200	No	We have not replaced screw yet, although 3 compressor's screw have been reconditioned	No	Not yet	
Cyprus	350,000	7 compressors are installed for a total installed of 1344 KW. They are all oil free. No spare. Compressors used for cement transport air (4 cement ball mills) and AC production for the plant.	150	429	1314000	no	20000 hrs	no	no	
France	300,000	a) Total 19 Compressors, installed KW:1520 & All are oil free b) 15 compressors, installed Kw-1510, all are oil free c) 4 compressors are spare with installed KW-418 Total: 3 -> 2 x 55kw + 1 x102kw	1344	4480	11773440	No	90000 hours	No	No	
Bangladesh	2,000,000	Total: 3 -> 2 x 55kw + 1 x102kw	3856	1928	3378560	No	Not yet replacement	Not yet facing such problems	we have plan to purchase 2 new compressor with installed KW-150	
Africa	435,000	a) 4 compressors are installed Total power 190 kw, b) 3 Compressors run for most of the time (145 kw total power)	215	494	1883400	NO	25 000 hours	Problem of humidity of air / air dryer	1 compressed air and 1 air dryer	
Morocco	500,000	a) 3 compressors run for most of the time (145 kw total power)	145	290	1270200	No	About 30 000 h	No problem related to air quality except the presence of water	Yes - A new compressor and screw replacement	
Kenya	1,600,000	a) 3 compressors run for most of the time (145 kw total power) b) 6 compressors run most of the time	685	428	6000600	No	40,000 hrs	No	Yes	

# The Improvement Process

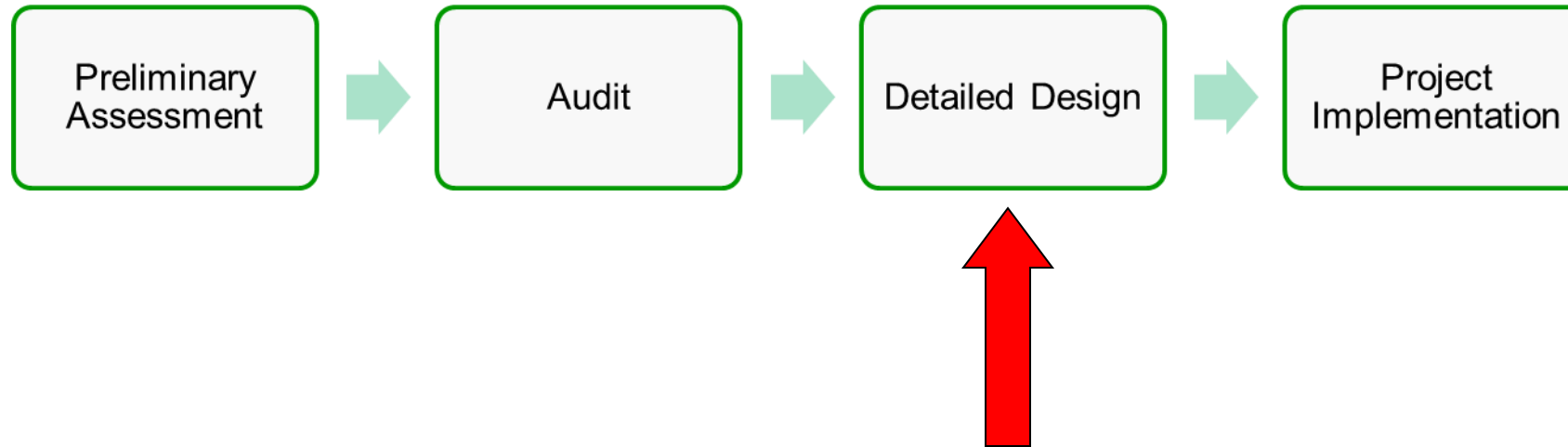


- The Audit is the Roadmap



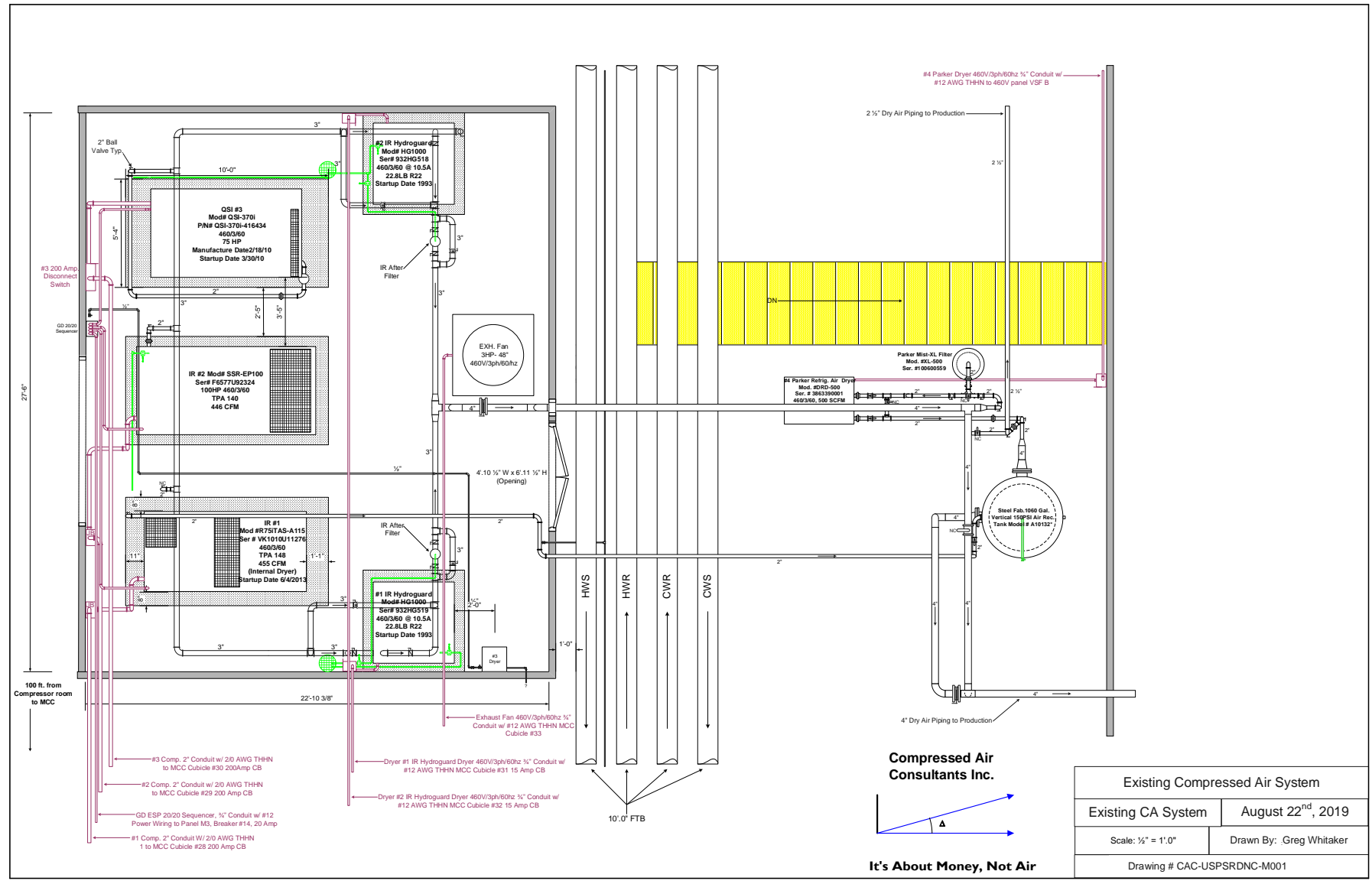
**Principle # 6. Create an Appropriate Structure for the Improvement Process**

# A Better Process - Design



- Detailed Design
  - Reduces the risk of cost over runs and missed deadlines
  - Purpose is to create bid documents that define internal or external scope of work to implement the project

# Existing Compressed Air System



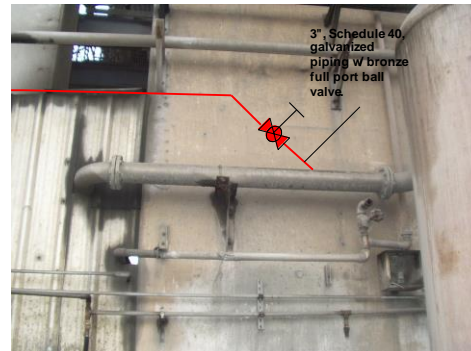
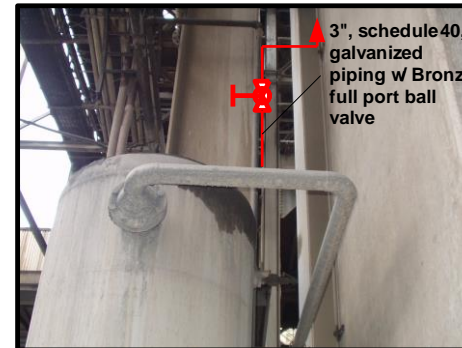
Existing Compressed Air System	
Existing CA System	August 22 <sup>nd</sup> , 2019
Scale: 1/2" = 1'-0"	Drawn By: Greg Whitaker
Drawing # CAC-USPSRDNC-M001	



# Mechanical Description

## **\*Install cross tie piping from the Downcomer to the Plant Air Systems (Action Item #14 and #15)**

The Downcomer air compressors will be shut down during the plant outage. The Downcomer wet header needs to be cross-tied to the wet header on Compressor C for the plant air system. This work must be completed during the scheduled Jan / Feb 2005 shutdown. Authorized plant personnel need to be contacted in order to lock and tag out the two (125 HP and 150 HP) Gardner Denver compressors supporting the Downcomer system. The drain on the wet receiver should be opened in order to depressurize the Downcomer piping system. Cut the



3" main wet header for the downcomer system directly downstream of the 1,060- receiver. Butt weld a 3" factory tee into the main downcomer main header. Install a 3", full port bronze ball valve. Close the new 3" ball valve once it has been installed.

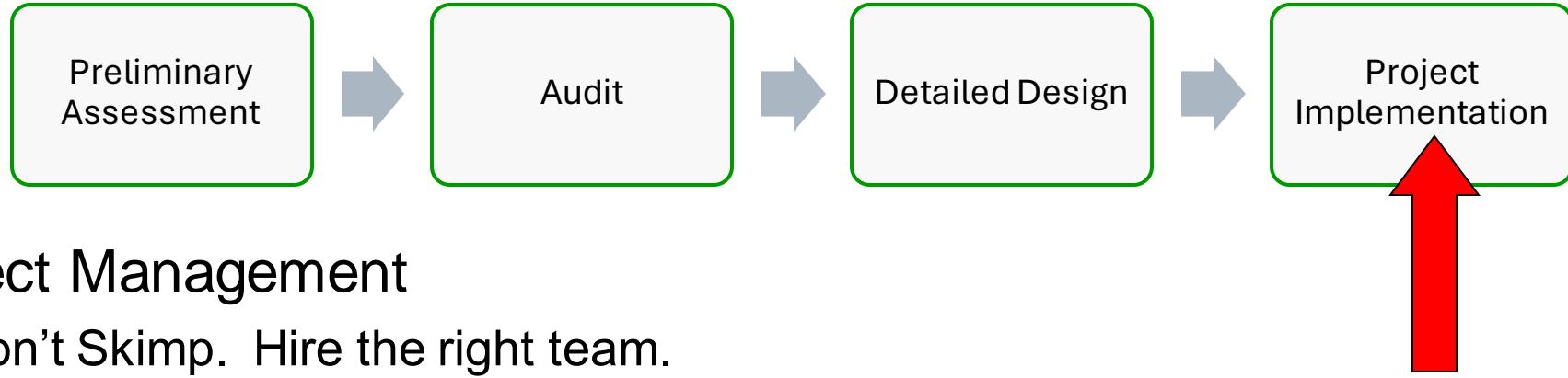
A 3" full port ball valve will also have to be installed on the wet header downstream of Compressor C. The 3" valve will also have to be installed during the plant shutdown. Before work can

start, the 500 HP Compressor C will have to be shut down and electrically locked out. The isolation valves as outlined in the adjacent picture must also be locked out. Saddle a 3" section of galvanized piping at a 45-degree angle to the wet header for Compressor B. Install a 3", full port bronze ball valve. Close the new 3" ball valve once it has been installed.



These valves must be locked out before Welding in new 3" isolation for Downcomer spill

# The Process



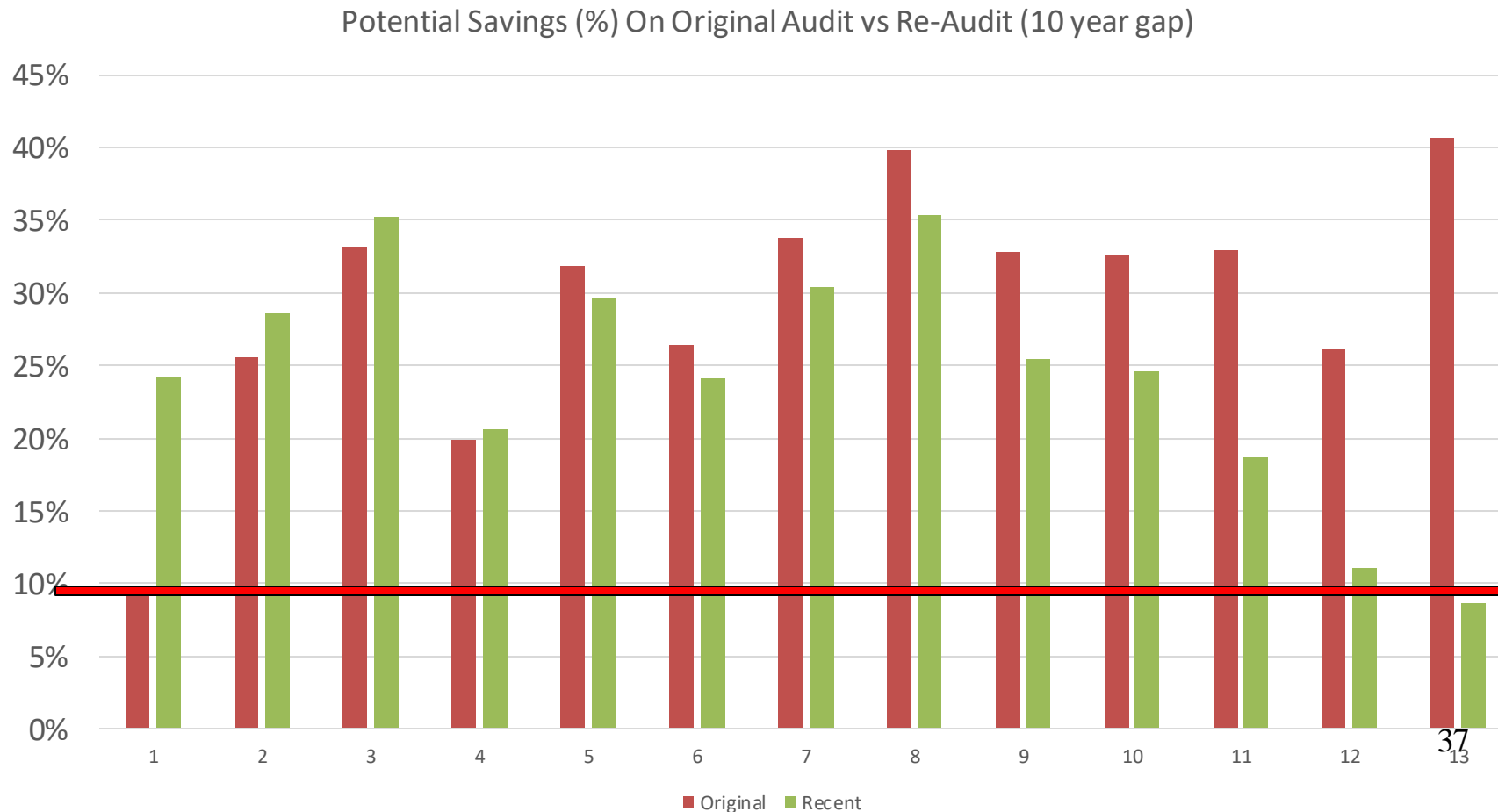
# That Process was Inadequate

- Originally Running on 11 Compressors + 1 Portable
- After implementation, running on 5-7
- Three Years Later, Running on 10 Compressors

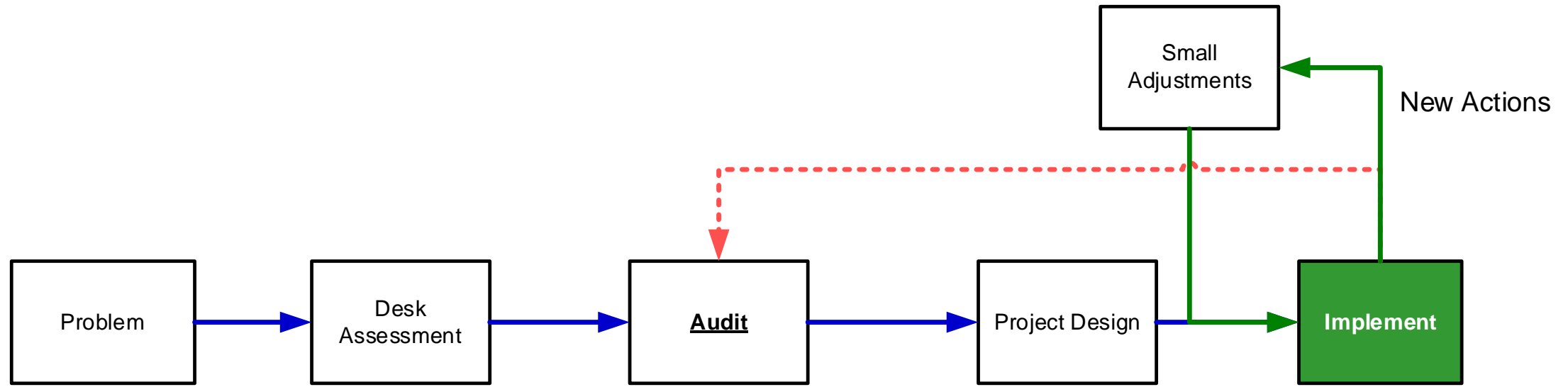
<b>Compressor Allocation Summary - Proposed 1st shift</b>							
	Summer			Spring/Fall			
	%	Average		%	Average		%
<u>Compressor</u>	<u>Capacity</u>	<u>HP</u>	<u>Output</u>	<u>Capacity</u>	<u>HP</u>	<u>Output</u>	<u>Capa</u>
Compressor A - 250 hp	100%	264	1,053	0%	0	0	100
Compressor B - 350 hp	0%	0	0	100%	340	1420	0%
Compressor C - 500 hp	100%	558	2,282	100%	558	2461	100
Compressor D - 250 hp	100%	264	1,053	0%	0	0	0%
Pack House Compressor 75 HP	100%	82	292	100%	82	315	100
Air Cannon Comp. 1 25 HP	0%	28	0	30%	20	30	100
Air Cannon Comp. 2 25 HP	0%	28	0	100%	28	99	0%
Downcomer Comp.1 150 HP	100%	175	695	100%	180	750	100
Downcomer Comp. 2 150 HP	0%	0	0	0%	0	0	0%
New Baghouse Comp. 1 60 HP	0%	0	0	0%	73	0	82%
New Baghouse Comp. 2 60 HP	0%	0	0	100%	75	296	0%
6 Desiccant Air Dryers	0%	0	0	0%	0	0	0%
* Based on Scfm delivered to the system							
<b>Total</b>		<b>1,399</b>	<b>5,375</b>		<b>1,356</b>	<b>5,370</b>	
<b>Scfm/HP*</b>			<b>3.84</b>			<b>3.96</b>	
<b>HP Savings</b>		<b>643</b>			<b>686</b>		
<b>Excess Capacity</b>			<b>2,743</b>			<b>3,388</b>	

# That Process Wasn't Adequate

- Partial Implementation, Didn't Sustain the Savings Stream or Both
  - Average \$56,000/year loss



# Optimization - Sustainment



- Step 1
  - Execution of **Complete** Project to Capture all Savings with Monitoring and Verification
  - Outsource to reduce performance and installation risk

# Optimization Sustaining the Savings

## 1. Quicker Feedback and Course Correction

- Require Realtime KPIs in the future



# Optimization Sustaining the Savings

## 2. Convert “Tribal Knowledge” to Paper/Electrons

- A. System Design Considerations - (Records)
- B. Training operators on Supply and Demand as Needed
- C. Reminders

## 3. Compressed Air Team

- A. Production, Process, Maintenance Engineering
- B. The goal is cultural change, not X meetings per year



**Air, your most Expensive Energy. Even a little adjustment can cost plenty (\$5000 per year)**

# Summary

1. Analyze supply, distribution and demand
2. You can't overpay for competence
3. If outsourcing, use impartial, highly competent auditors. If using OEMs, create standards and process that insures unbiased recommendations
4. Put the Cost of an Audit in Context with the cost of a “Miss”. Use ROI as the basis for the Project
5. Use Every Source of Savings to Fund the Project
6. Create an Appropriate Structure for the Improvement Process including post project

***It's About Money, Not About Air***