2015 POWER SMART FORUM
GETTING TO ZERO: INNOVATING FOR THE FUTURE

Zeroing in on Compressed Air

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Why Compressed Air?

Convenient
Easily stored

Used inappropriately
Consumer of electricity

Opportunity for savings

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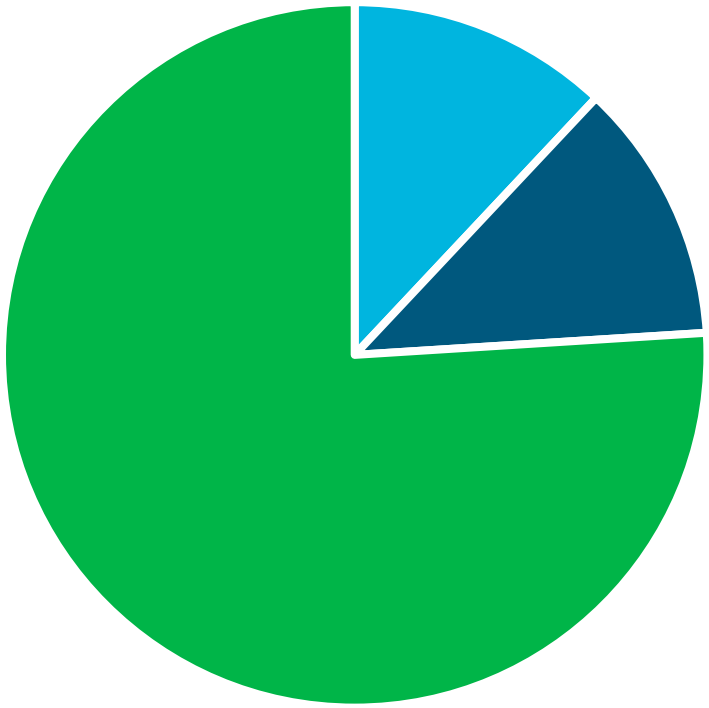
The Cost of Compressed Air

Did you know?
The cost of electricity to run a 200hp air compressor for 15 years can total **$1,000,000!** That is approximately $70,000 per year.



Electricity is 76% of compressed air costs

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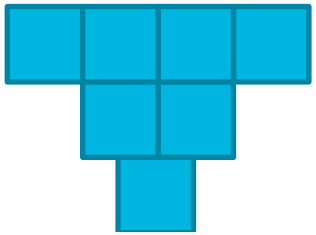
Single Stage Air Compression

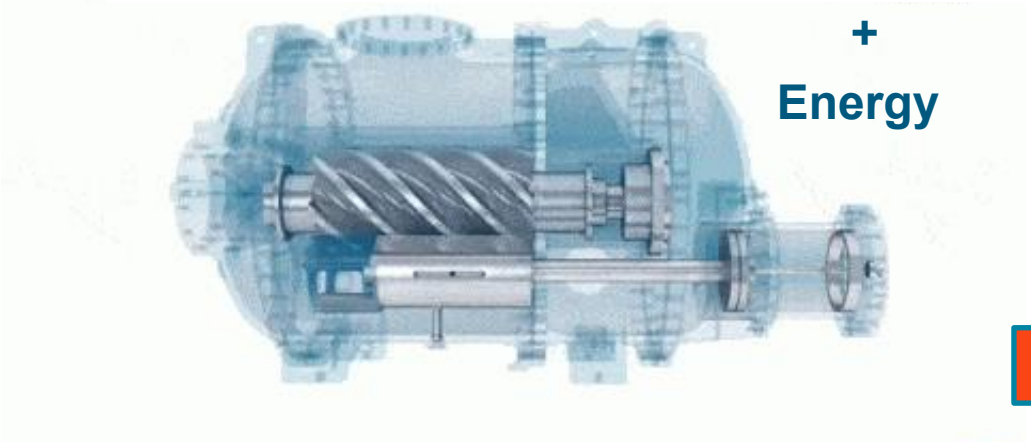


7 volumes of air at atmospheric pressure

Air compressor

+

Energy



1 volume of air at 7x atmospheric pressure

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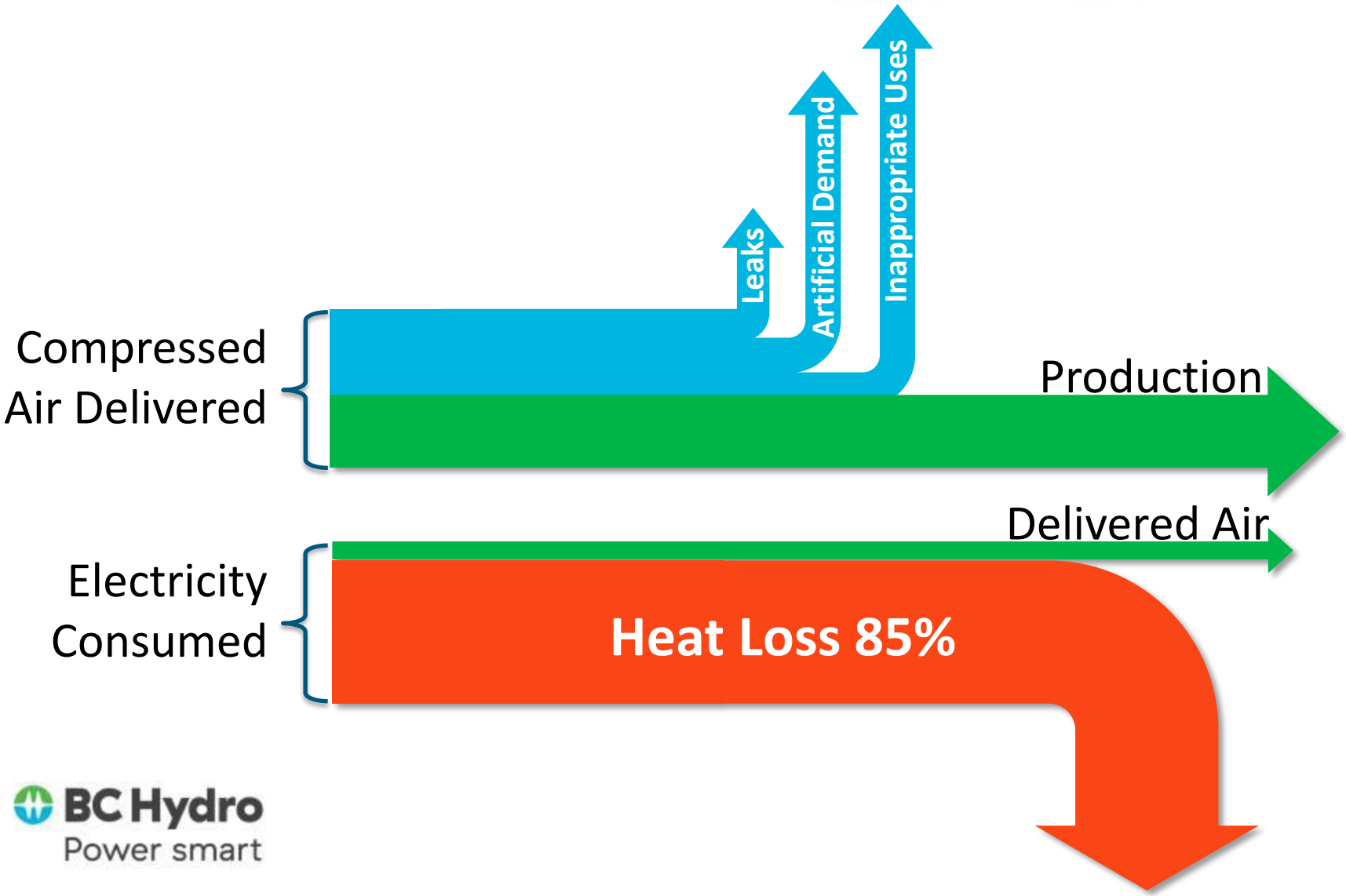
Compressed Air Efficiency



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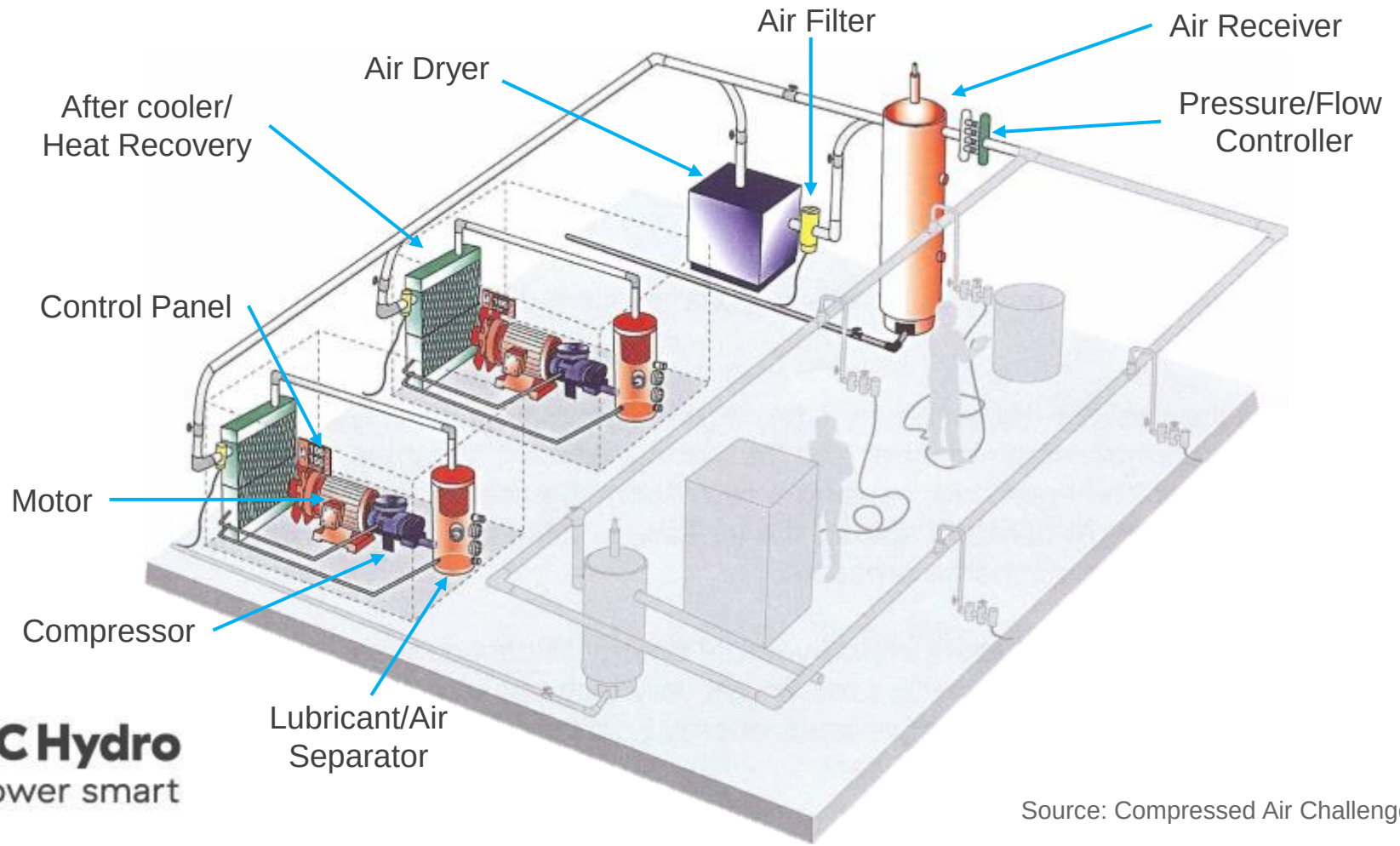
Compressed Air System – Supply Side

The supply side typically consists of:

Air intake, compressor, motor, after cooler, controls, and treatment equipment and accessories.



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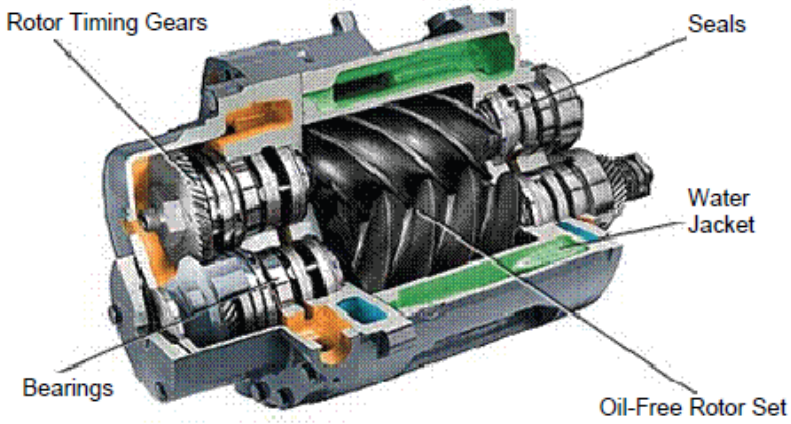
Source: Compressed Air Challenge

Common Compressors

- Rotary
  - 5 to 900 HP
- Reciprocating
  - 1 to 30 HP



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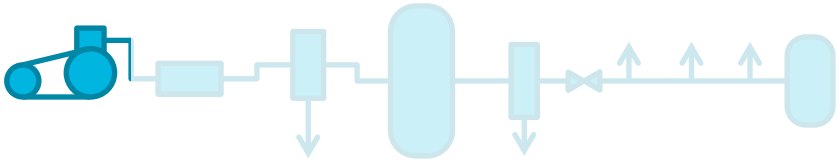

Types of Compressor Controls

Load/Unload	Modulating	Variable Speed	Start/Stop
Continuous Operation	Restricts Inlet to Control Air Output	Adjusts Motor Speed to Control Output	Cycles On/Off to Control Output
Good Efficiency With Storage	Less Efficient at Part Load	Very Efficient at Part Load	Most Efficient for <30hp Compressors

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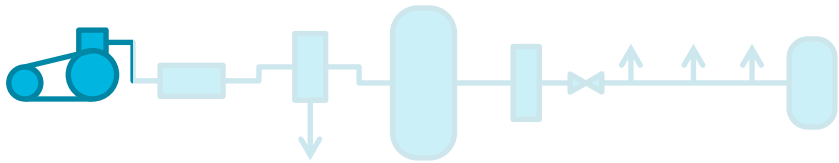

Compressor Controls Performance

Load	Modulating	Load/Unload 1 gal/cfm Receiver	Load/Unload 10 gal/cfm Receiver	Variable Speed Drive
100%	$21,680	$21,680	$21,680	$22,110
75%	$20,050	$20,810	$17,610	$16,250
65%	$19,400	$19,940	$16,690	$14,090
50%	$18,430	$18,640	$14,520	$10,840
25%	$16,800	$14,960	$10,080	$5,420
10%	$15,820	$9,970	$7,040	$2,170

Based on $0.06/kWh and 4,250hrs/year

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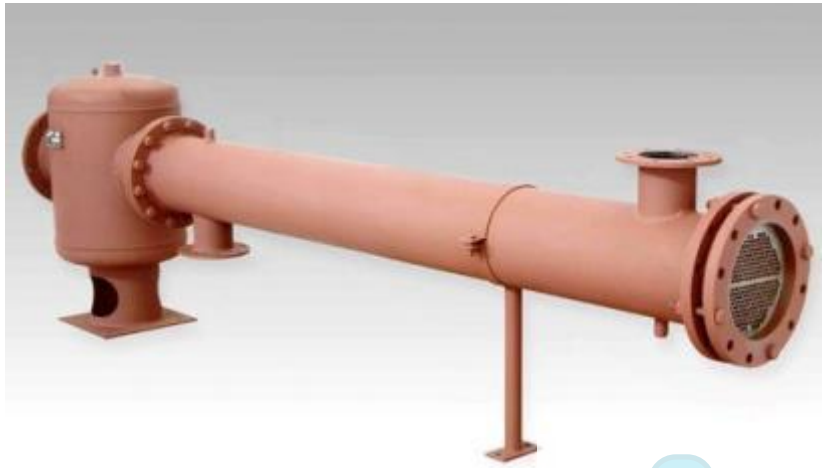
Air Compressor Coolers

- Approximately 80% of the total energy input for a compressor is converted to heat.
  - Intercoolers are used to remove heat between multiple stages of compression
  - After coolers are used to remove heat from both compressor lubricant and discharge air.
  - *Heat recovery through heat exchangers is also an opportunity for greater energy efficiency*.



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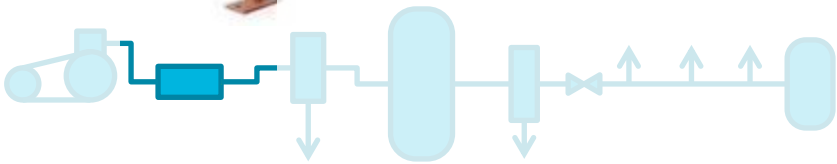

Air Dryers

- Since compressed air is warmer than ambient air, condensation is created.
- Air dryers serve to remove moisture, oil and contaminants
- Typical pressure drop across dryer: 3 to 5psi
- Important to consider when evaluating the efficiency of a system
- Air should only be dried to the level required by the facility
- Dryers should be selected based on required pressure dew point

Type	Dew Point	Power Requirement (kW/100cfm)
Refrigerant	35 to 39ºF	0.79
Desiccant (twin-tower)	-40ºF	2.0 to 4.0
Deliquescent (single-tower)	15 to 50ºF	0.2
Membrane	-40 to 40ºF	3.0 to 4.0

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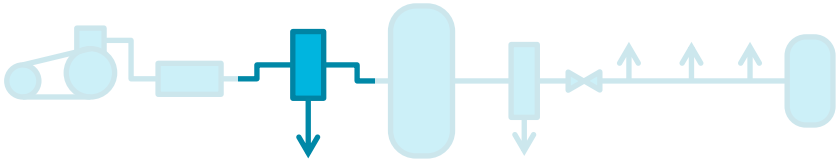
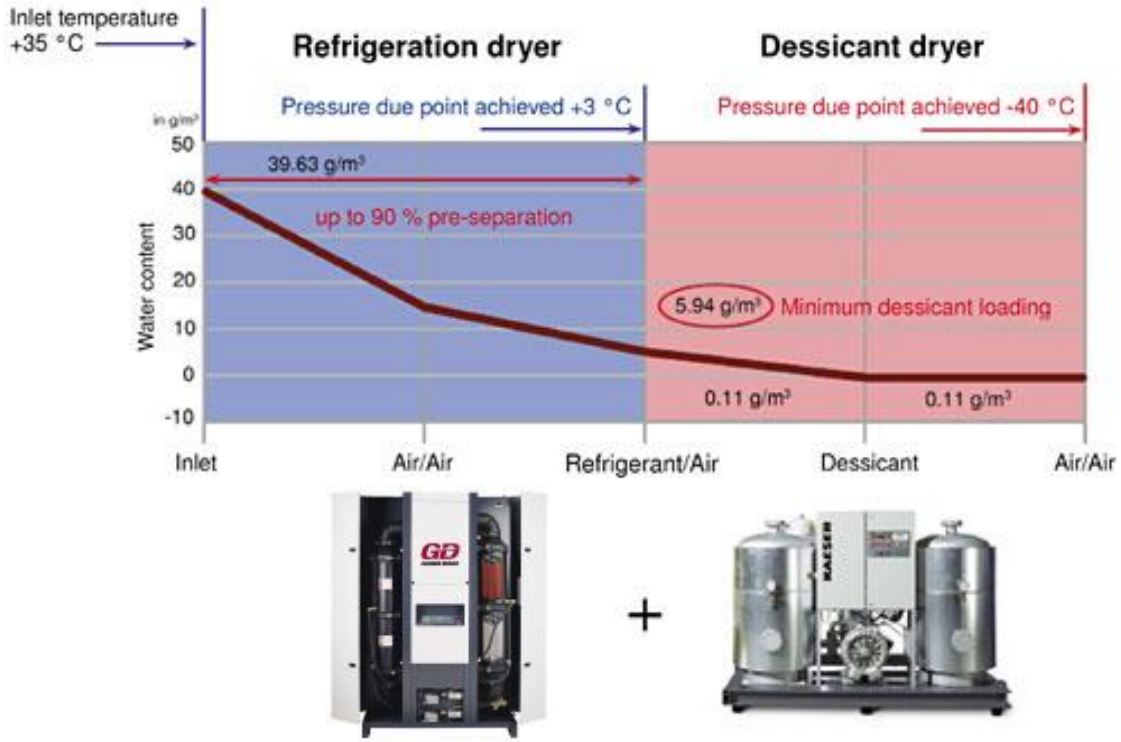


Source: Compressed Air Challenge

Efficient Air Drying

Refrigeration Dryer Specific Power: 0.79 kW/100cfm

Desiccant Dryer Specific Power: 2.0 to 4.0 kW/100cfm



Efficiency Measure:

- Cycle between Refrigerated and Desiccant Dryers based on Ambient Temperatures
- Combination of both dryers can achieve **savings of up to 67%**

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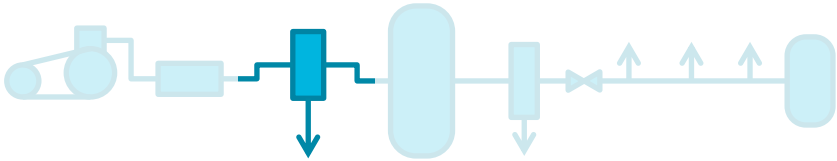
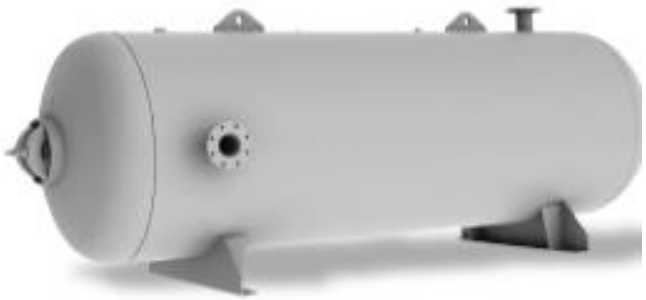


Source: www.kaeser.com

Air Storage Receivers

An adequate sized storage tank in the system helps to maintain air quality, air system stability, and overall system efficiency.



Facilities with **large fluctuations** in demand or **insufficient air pressure** should consider one or more receivers in the distribution system to **eliminate high operating pressure** through false demand.

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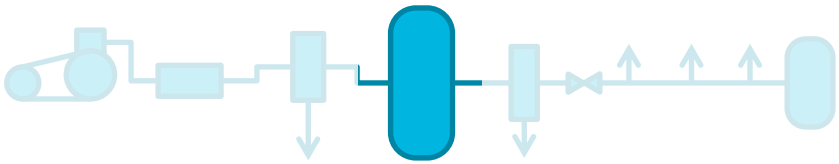
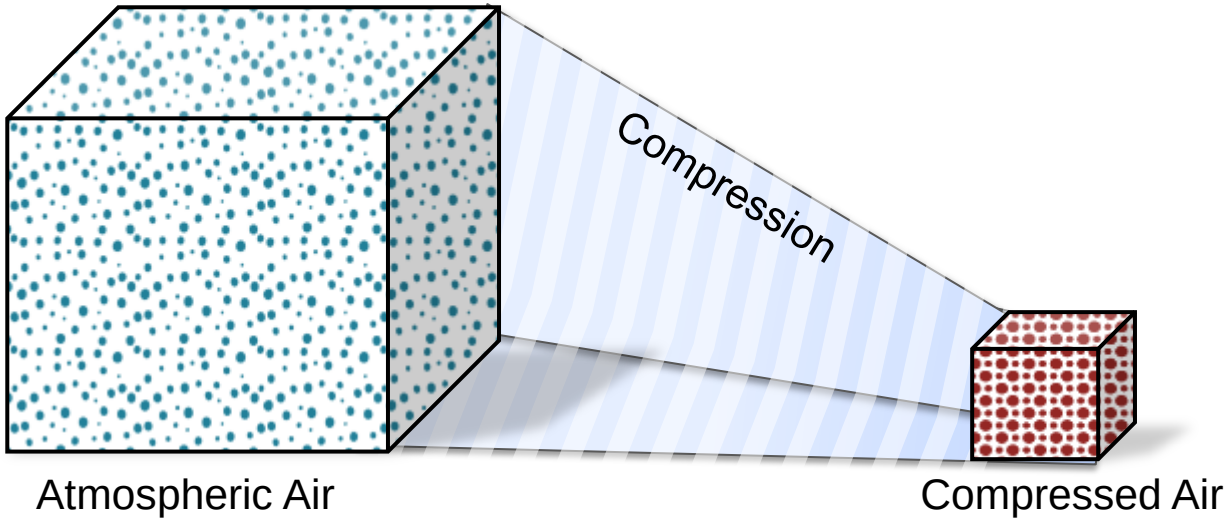


Air Filters

- The Air Filters protect the compressor from atmospheric airborne particles as well as protect end use devices
  - Use a filter that is recommended by the manufacturer for the compressor and required by the end use.
  - *High differential pressure across the filter will result in an increase in energy consumption. Hence a fine filter will consume more energy than a coarse filter.*



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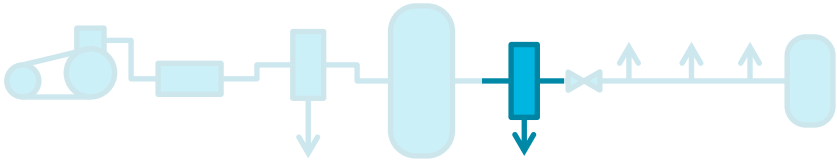

Supply Side Improvement Opportunities

Suggested Actions:

- Shut off compressors when not required
- Install or improve compressor controls
- Optimize air dryers and use dew point controls

Suggested Actions:

- Increase air storage to reduce compressor cycling and respond to peak air demands
- Use appropriate filters as per manufacturers specification

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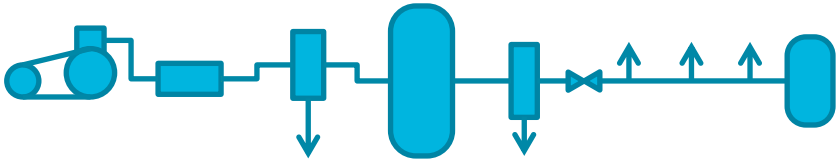
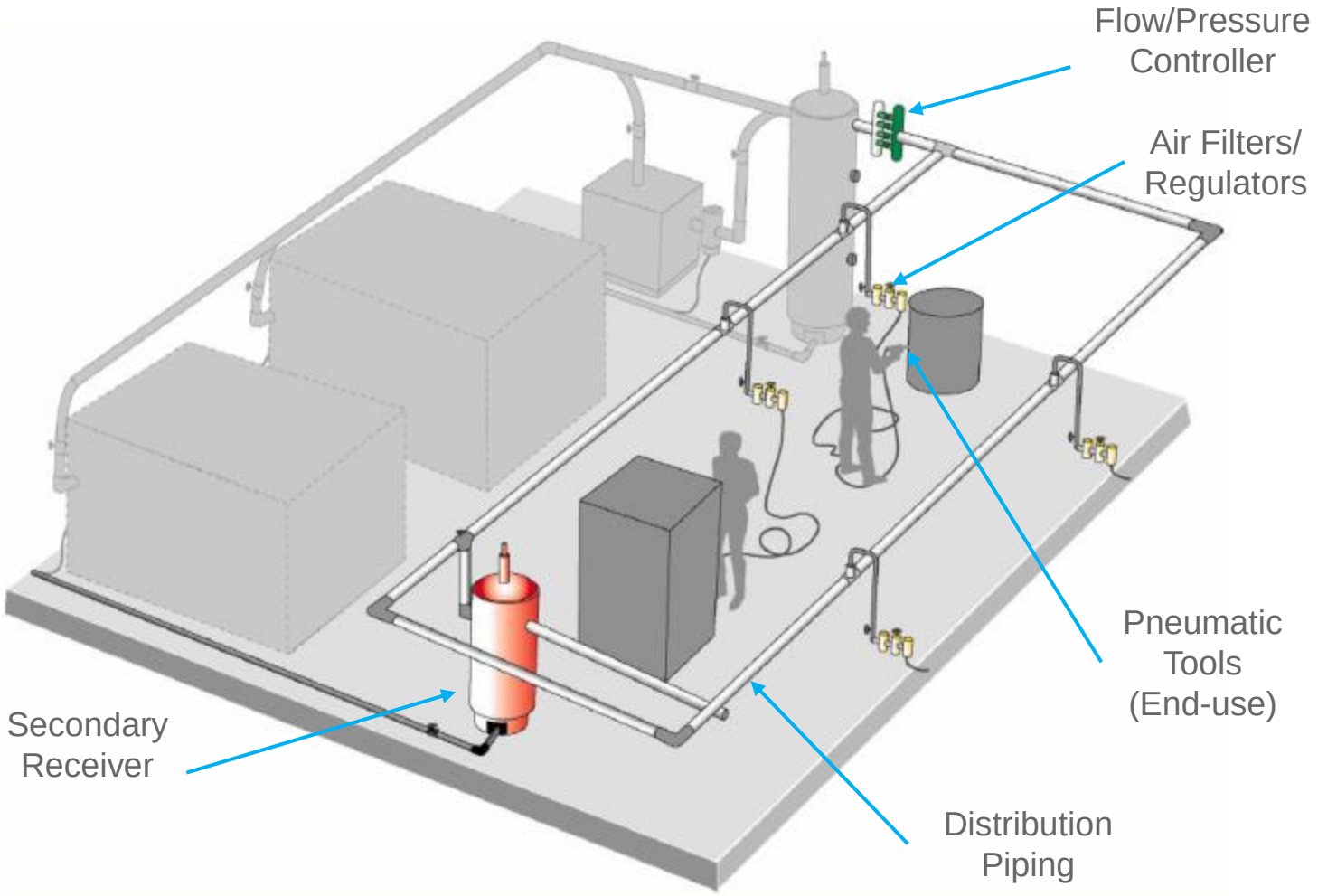


Compressed Air System – Demand Side

Demand side typically consists of:

Distribution piping, secondary storage, and end use equipment



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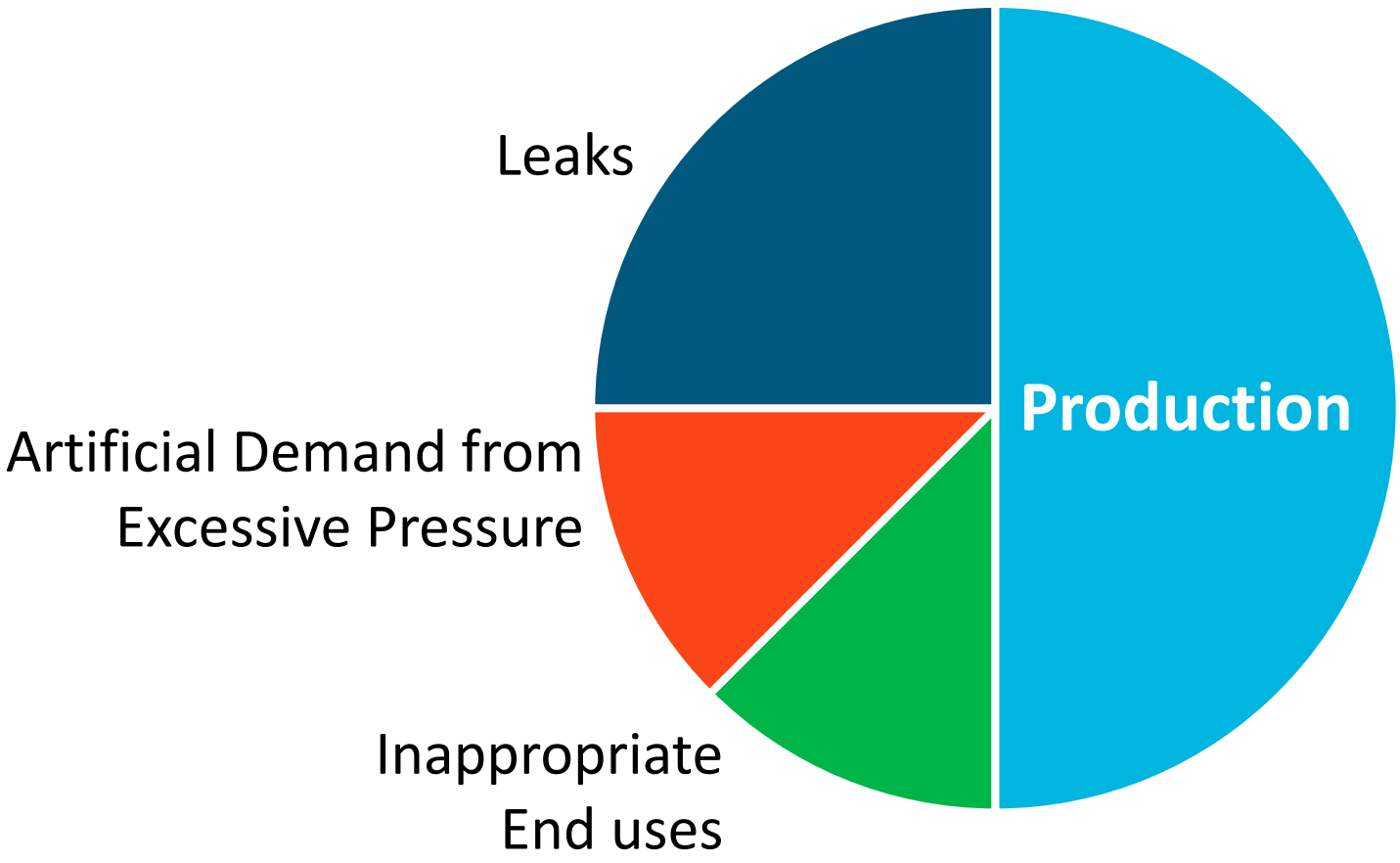
Typical Components of Demand



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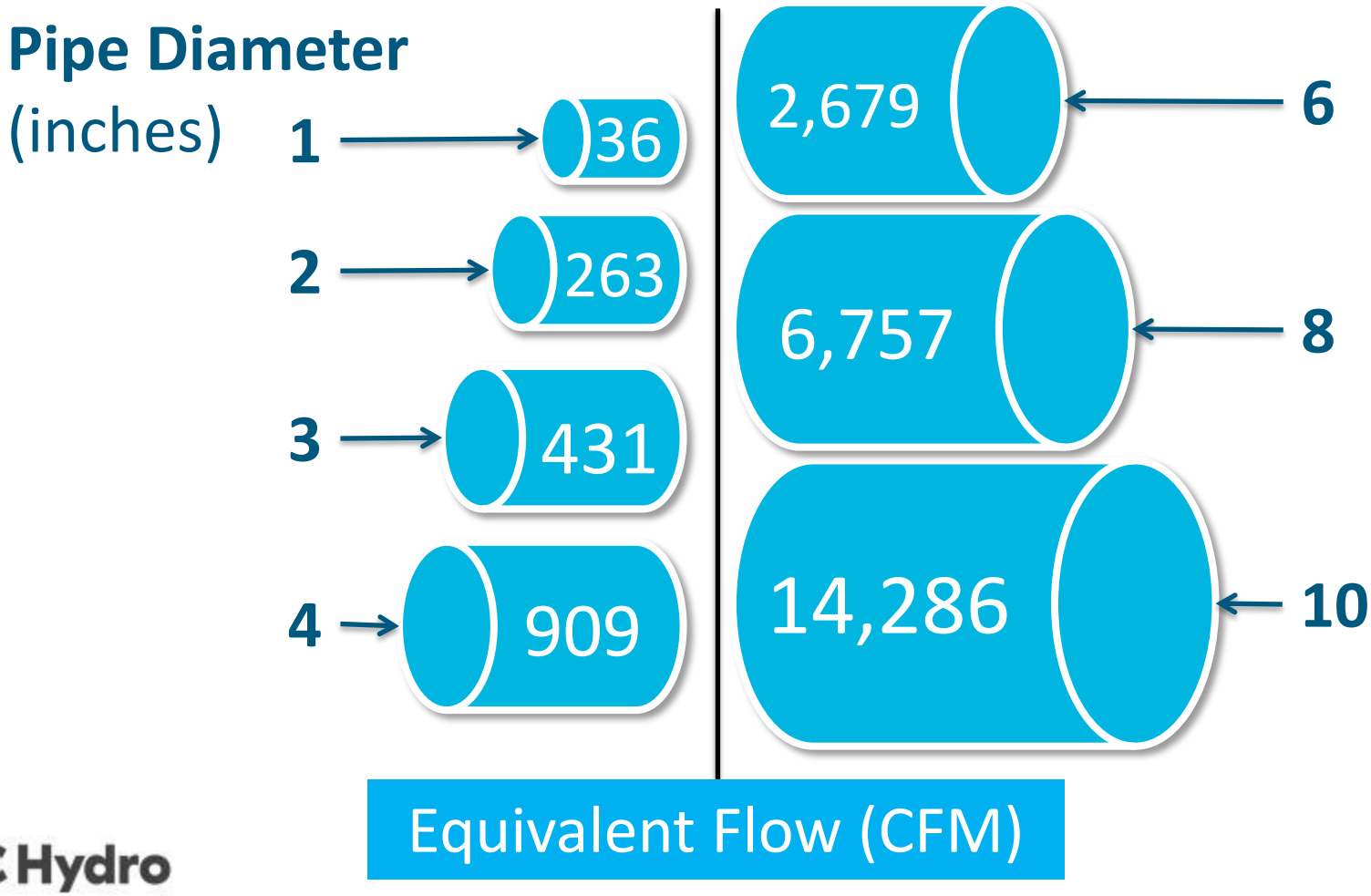
Distribution Piping



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Reduce System Pressure

Reducing system pressure may:

- improve overall system performance
- reduce leakage rates
- help with capacity problems
- Reduce stress on components

Did you know?
Every **2 psi** reduction in system pressure equals about **1% horsepower** savings.

10psi = 5% savings!

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Eliminate Inappropriate Uses

Suggested Actions:

-Walk through your plant and identify all compressed air uses and, if possible, flow & pressure requirements

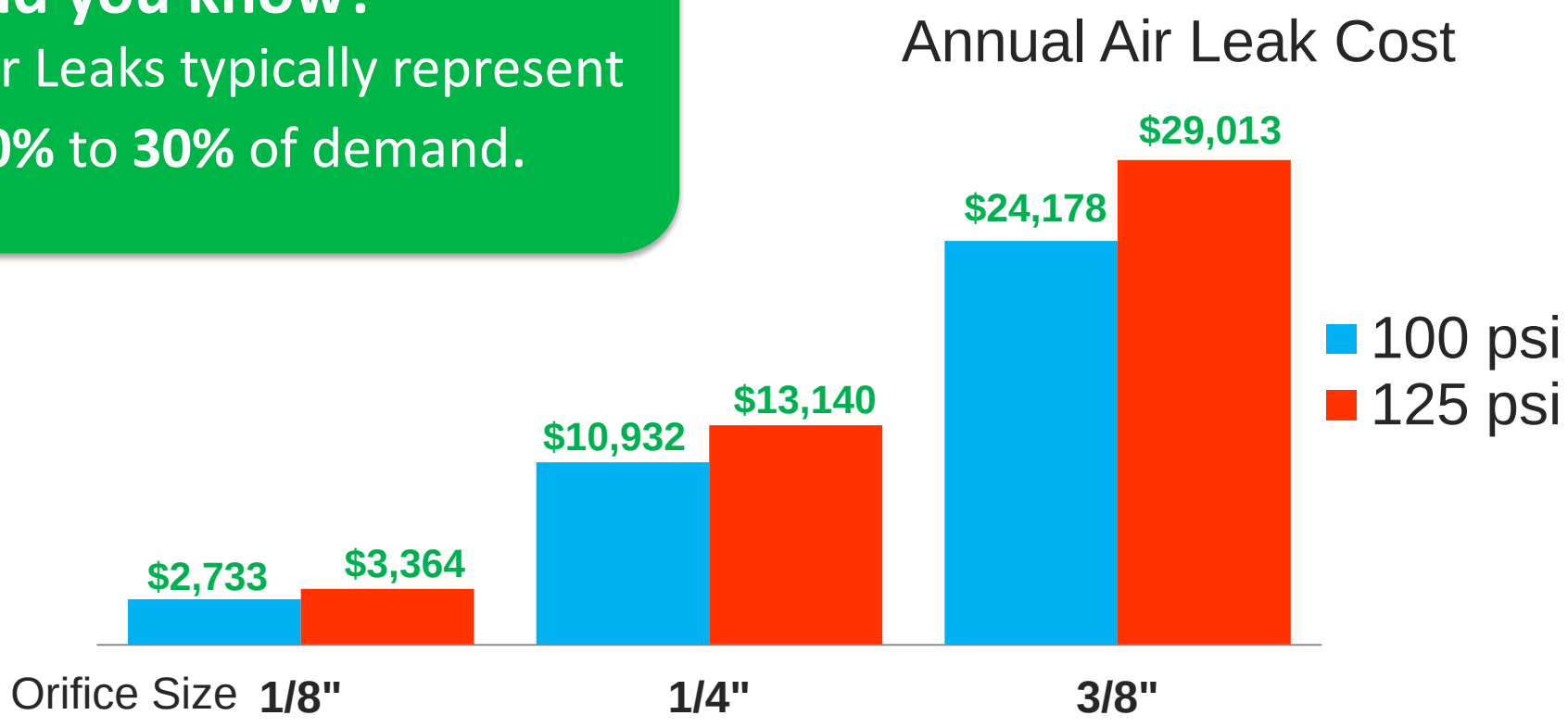
-Consult with a compressed air specialist to eliminate any inappropriate uses.

Inappropriate Application	Efficient Alternative
Open blowing for cleaning, drying, etc.	Low-pressure blowers, brooms, low flow nozzles
Air actuation	Electric actuation
Air motors (mixers, agitators, etc.)	Electric motors


EXAIR
Counter Cooler

Air Leaks

Did you know?
Air Leaks typically represent **20%** to **30%** of demand.



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Compressed Air Leak Audit

Plant wide walkthrough and review of the compressed air system

Determine location and size of leaks in the system

Log leaks on a tracking spreadsheet

Calculate air consumption and cost of leaks

Prioritize maintenance schedule

27-Oct-14

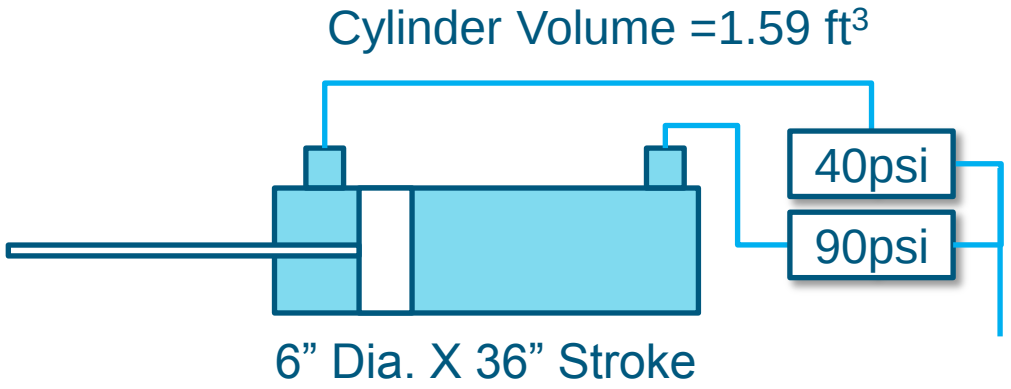
	Air Leaks Repaired		Cost Avoidance			CO_2	NO	
	CFM	Cost	Identified	Repaired	% Complete	Identified	Identified	I
	0.0	$0.00	$4,794.88	$0.00	0%	72250	156	

Record Number	Group Name	Location Name	Type of Gas	Pressure at Leak	dB Reading	Problem Description	Hours Per Day	D
S101	Wash	Extractor	Air	100	73	Valve Leak, far left	24	
S102	Wash	Extractor	Air	100	67	Valve leak far right, when activated	1	
S103	Wash	Extractor	Air	100	40	Valve leak second on left, when ativated	24	
S104	Wash	Dryer	Air	75	25	Drain on filter bowl	24	
S105	Wash	Milnor Dryer	Air	100	27	Compression fitting on 3/8 poly line	24	
S106	Wash	Milnor Dryer	Air	100	67	Right cabinet bottom valve, when activated	1	
S107	Wash	Milnor Dryer	Air	100	70	Left cabinet bottom valve, when activated	1	
S108	Wash	Sheet folder	Air	75	67	Regulator inside cabinet	24	
S109	Main area	Thermopatch	Air	100	37	Hole in air line	24	
S110	Main Area	Thermopatch	Air	100	34	Inside press	24	

Dual Pressurization

Did you know?

Some applications require high force in only **one direction** and minimal force on the return.



Compression Ratio:
@90psi = 7.12
@40psi = 3.72

Air used by cylinder
Up = 4.2 ft^3
Down = 2.2 ft^3

Air saved:
= 24%

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Proven Energy Efficiency Measures

Supply Side (25-35% Savings)	Demand Side (65-75% Savings)
Improve Controls (Sequencer)	Identifying and repairing air leaks
Reduce system pressure	Regular maintenance
Regular maintenance	Eliminate inappropriate air usage
Energy Efficient Compressors/Dryers	Minimize unregulated users
Compressor heat recovery potential	Look for alternative forms of power

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Self Serve Incentive Program

1. Talk to your vendor 

2. Submit an application 

3. Receive Incentive 

Audit Details

Name of Vendor : Tree Hugger Wood Products
Auditing Period : 7/7/2015 To 7/14/2015
Report Date : 7/27/2015
SIP File Number : 16000

Executive Summary

General comments:

In July 7th the above referenced facility was data logged for compressor power, plant pressure and flow. After review of the data, VSWP consumes a total of 381,500 Kwhrs/year in the compressor room alone. Energy savings can be achieved through up-grading of equipment, control stragety and re-

Table 1: Proposed Energy Conservation Measures (ECMs)

ECM #	Description	Demand Reduction [kW]	Energy Savings [kWh/yr]	Project Cost [$]
1	Reduce System Pressure	3	19,000	$ 13,500
2	Efficient Compressed Air Dryers	2	15,000	$ 62,000
3	Efficient Compressors	23	159,000	
4				
5				
6				
	Total :	28	193,000	$ 75,500
			Total Non-Electric Savings :	$ -

Proposed Compressor System Description

ompressor ID	Function	Manufacturer / Model	Rated Motor Power [HP]	Rated Flow [acfm]	Rated Pressure [psig]	Control / Type
#1	Primary	Gardner Denver VS40 (54HP)	54	243	100	VFD

Proposed Air Dryer System Description

anufacturer / Model	Rated Package Power [kW]	Rated Flow [acfm]	Rated Pressure [psig]	Type
rdner Denver RES246	1.4	246	120	Refrigerated - Cycling

8.0 Conclusions and Recommendations

t

dy as we have uncovered energy saving opportunities for the customer. In doing king to reduce maintenance costs that are associated with older equipment. e to purchase the new compressor, dryer and receiver tank. Then put a plan th Skeans) for the installation of all the equipment. Incremental costs are installation of equipment, new electrical supply or up-grade, re-working the g "wet tank", installing the dryer with by-pass and installing a new "dry tank" ting maybe required to re-capture the heat generated from the compressor.

made during analysis

lated by way of pump down and calculated at various time throughout the essors. Formula used: CFM (Free air) = V (Volume in Cubic Feet) x (P1 - P2) x 1.25 ge at lower pressures) / T (time in minutes between P1 & P2) X 14.7. V=39cuft x x 14.7 = 4000/60 = 60cfm estimated. Open blowing in the plant could be present and further demand side analysis could be used. The VFD compressor will accomodate these adjustments to the system.

Provide any additional recommendations for the customer to consider

No loss tank drains are recommended at all low points in the system to remove condensate. A condensate management system is also recommended to remove the oil from the condensate before draining to sewer. New bylaws are in place for condensate management systems. Add a drain the the existing "wet tank" drain will come with new tank and all related compressor room equipment. No condensate system has been added to this study. Contact Skeans for more information.

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Q & A

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Thank You!

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