

Often Overlooked but Never Underused, Compressed Air – an Introduction

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Learning Objectives

1. **Why compressed air should be considered as part of your commissioning portfolio**
2. **Understanding the basic compressed air system and its inefficiencies**
3. **Observations from the field**
4. **Opportunities for efficiency that *positively* impact the bottom line and make a case for commissioning**

Compressed Air

- Widely used in manufacturing facilities
- Is an expensive form of energy
- Absolutely critical to production
 - Owners need ***dry, reliable*** air at the ***right pressure***
 - Production shutdowns and equipment failure cost money, which businesses cannot afford

Compressed Air Systems

- Tend to be poorly designed
- Don't always provide clean, dry, reliable air
- Are not well understood by plant personnel and maintenance staff
- Are poorly maintained
- Are inherently expensive to operate
 - Even more so due to poor operation

CA can benefit from Cx/RCx

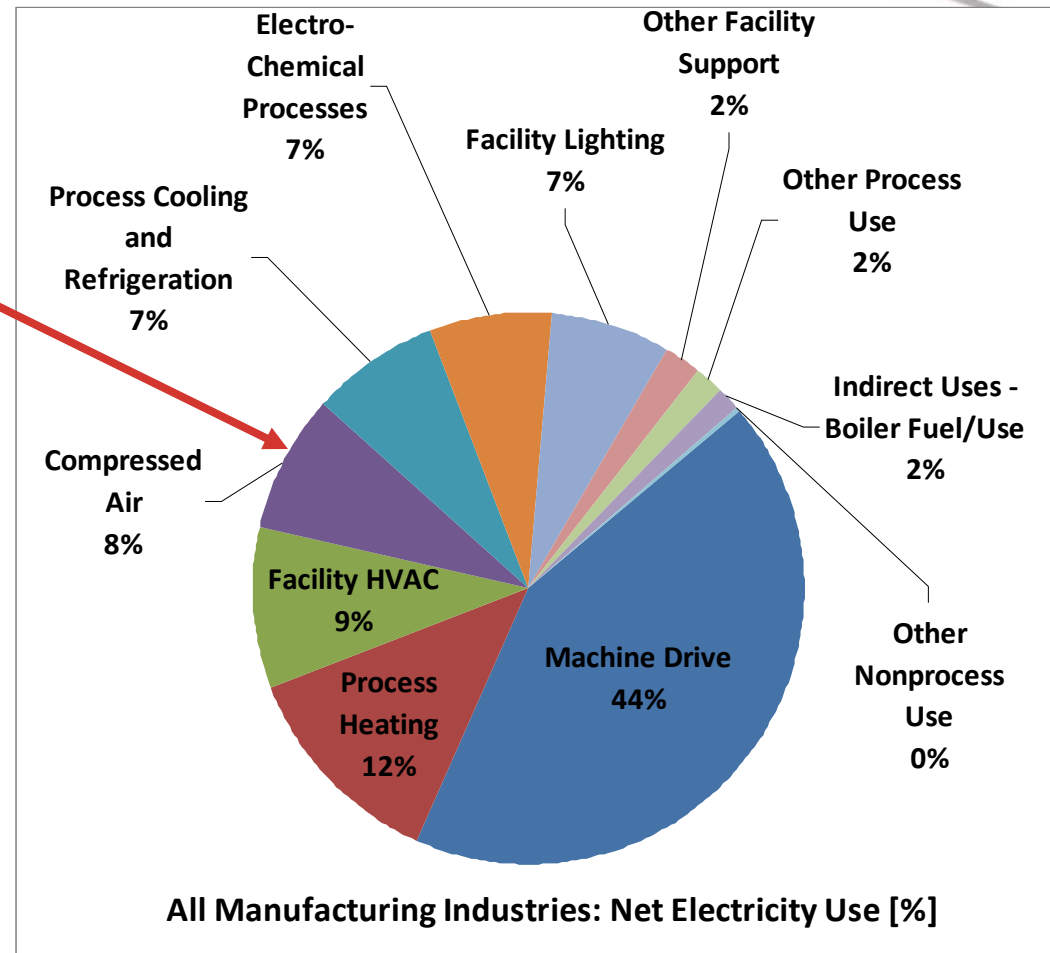
- **Significant benefits of Cx/RCx**
 - Improves design and performance
 - Provides ***clean, dry*** and ***reliable*** air
 - Decreases energy costs
 - Avoids unnecessary expenditures
 - Has value to the owner and staff
- **CA systems beginning to be Cx/RCx**
 - Programs offered by utilities
 - Largely untapped market

Air is Free, Right?

- CA systems are one of the largest users of electricity in an industrial facility
- A 100 hp compressor can reach **\$50,000** in electricity cost annually*
- Compressed air systems account for **1.5 billion** per year in energy costs**

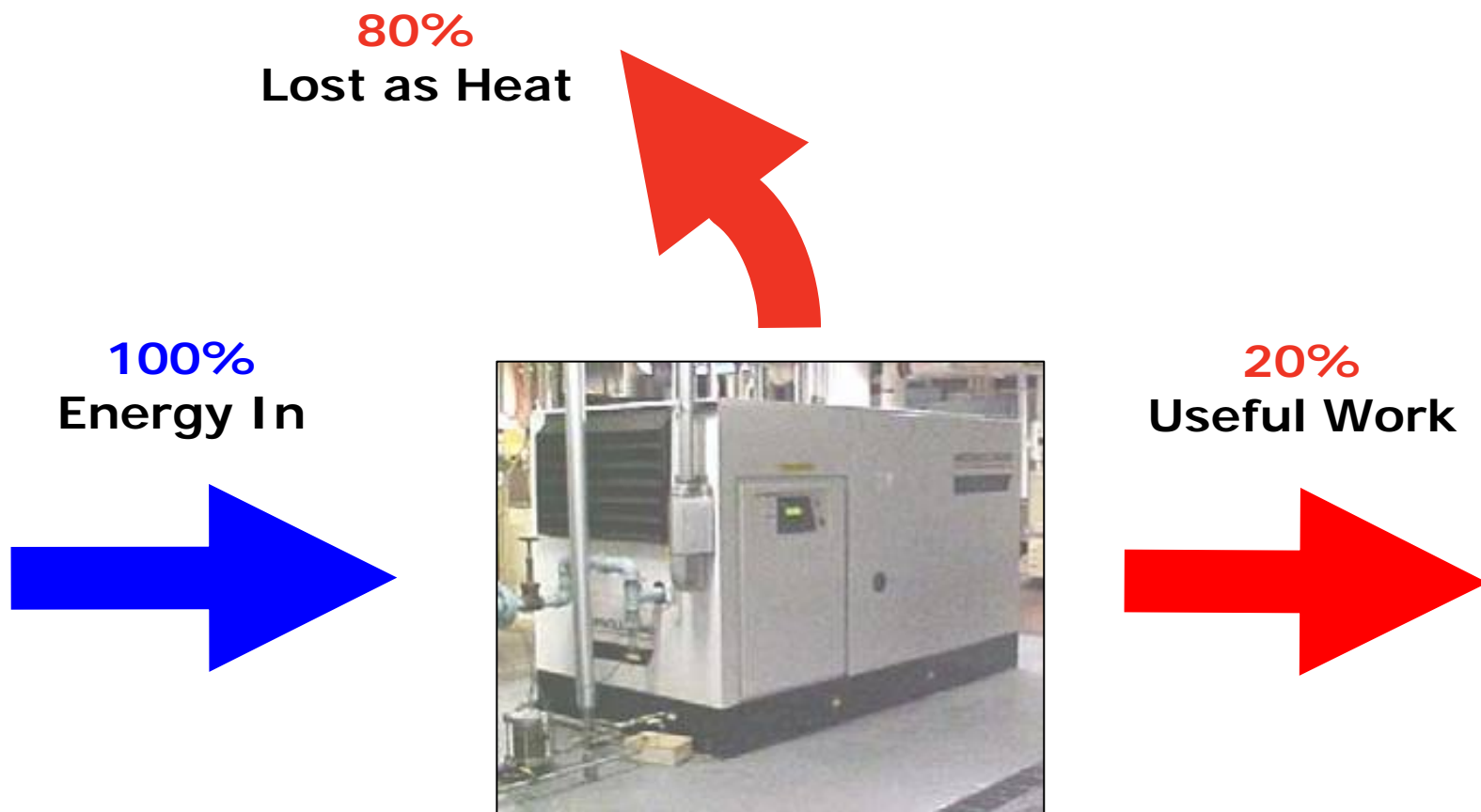
*Compressed Air Challenge

**Department of Energy



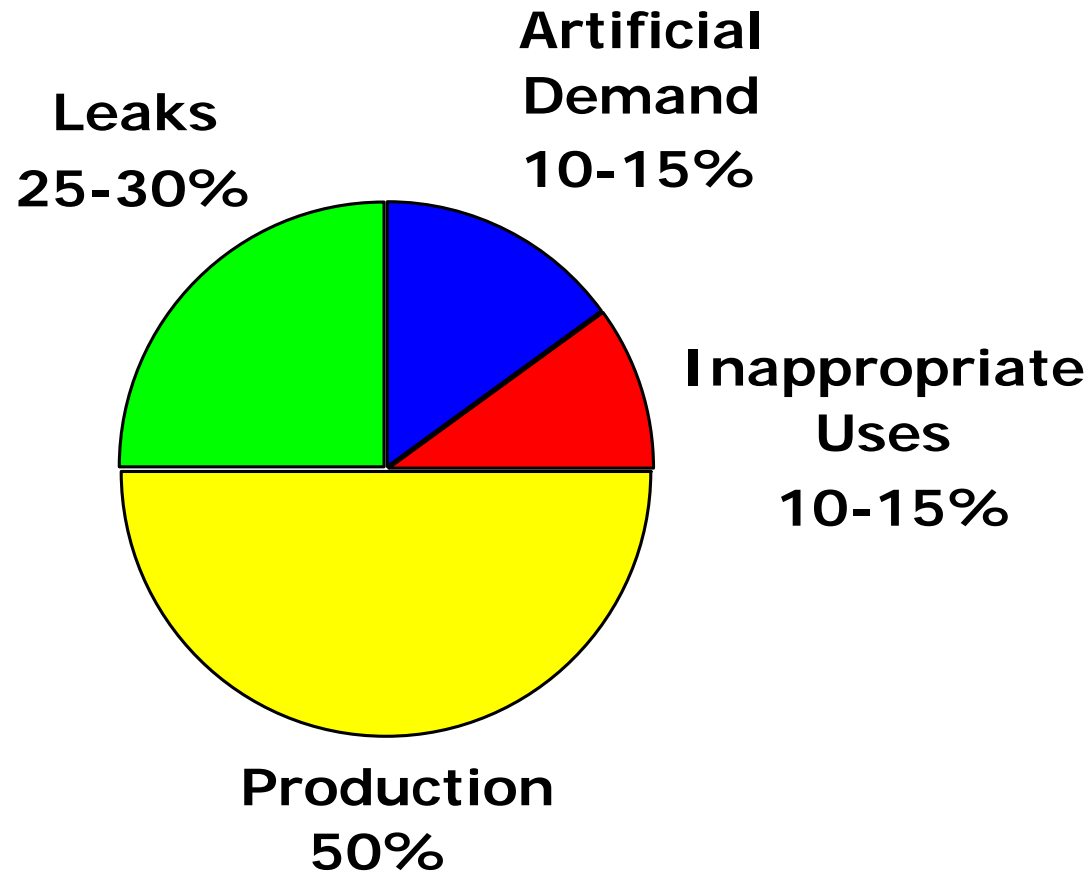
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What Makes Compressed Air So Expensive?



Where Does it All Go?

- **Of the total air produced**
 - Only 50% actually contributes to production
- **Of the total energy input to the compressor**
 - Only 10% reaches the production floor

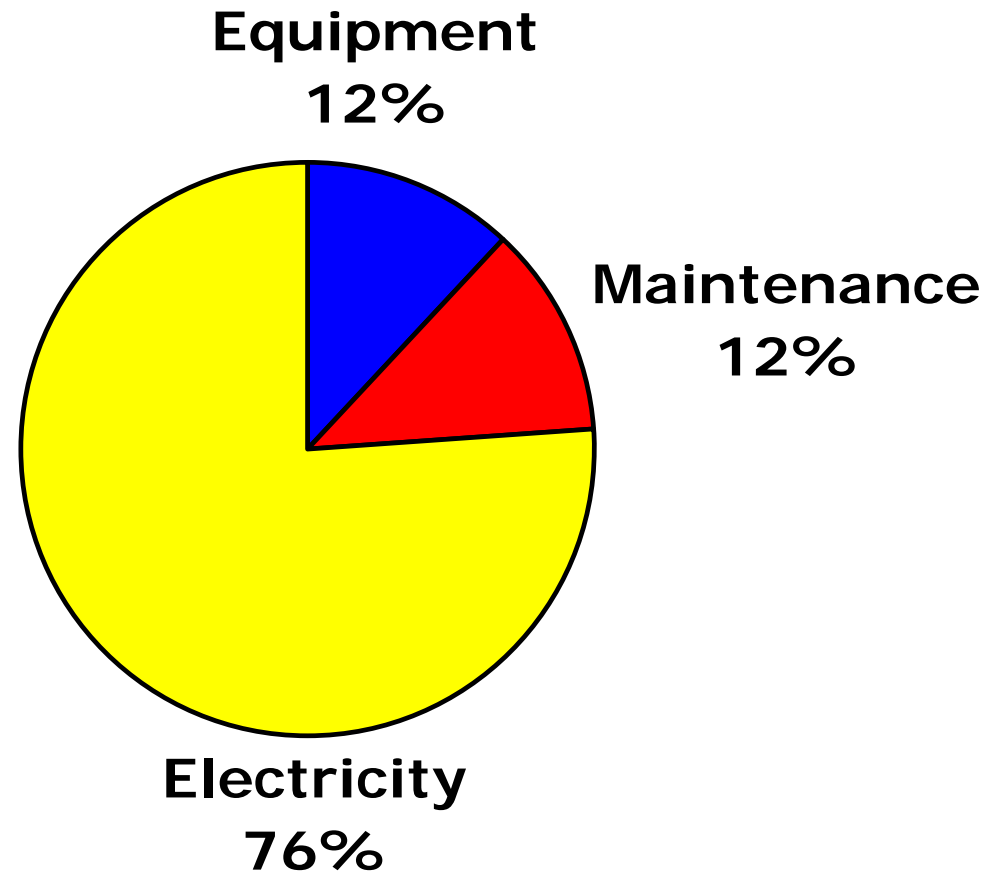


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Breakdown of Cost for a CA System

- **Typical CA Plant Operating Cost Factors**

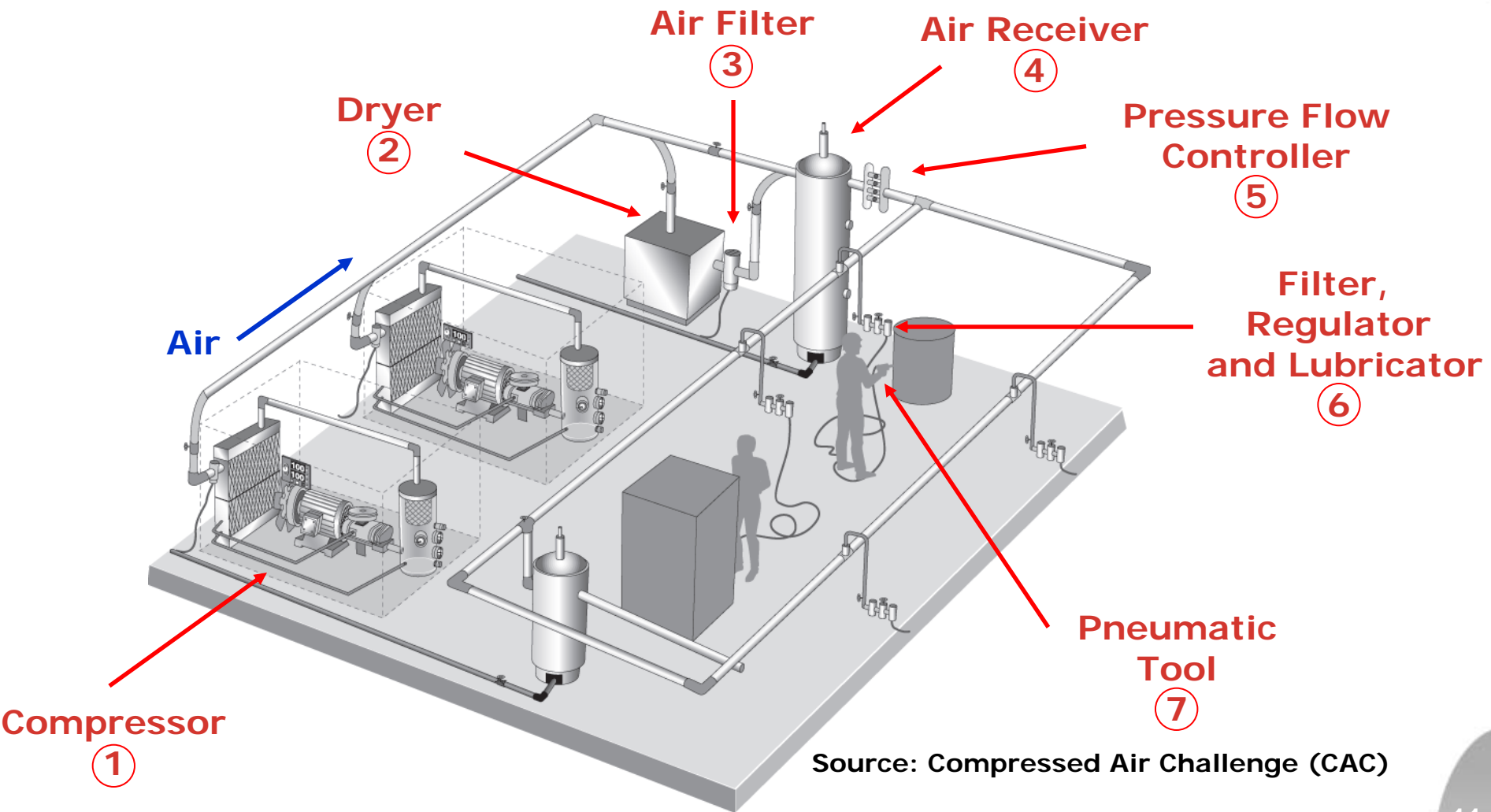
- Electricity use drives costs
- Accounts for 75% of total cost
- Major opportunity for energy savings



Opportunities for Energy Efficiency?

- **Department of Energy**
 - Estimates that **20 to 50%** of the energy used by a compressor can be **saved** with energy efficiency improvements
- **Savings potential**
 - \$10 K to \$25 K for a 100 hp compressor
 - \$300 M to \$750 M (nationally)

A "Typical" Compressed Air System



Source: Compressed Air Challenge (CAC)

Observations from the Field

- Plant personnel use air as if it's free; lack of understanding
- Compressor(s) operates at a pressure that is higher than needed
- Leak surveys and repairs are rarely ever performed
- Controls don't work or poor schemes
- Poor system design
- High pressure drops
- Maintenance and operational issues
- Moisture in the lines
- Compressors operating on nights and weekends – when not needed

Energy Cost Saving Opportunities

- **Typical opportunities include:**
 - Low flow nozzles
 - Pressure reduction
 - Leak reduction
 - Controls
 - Receiver capacity
 - Distribution system design
- **Savings generally range from 20-50%**
- **Immediate to 3 year simple payback possible**

Low/No Cost Opportunities for Savings

- **Leak Surveys**
 - Identify and repair leaks regularly
 - Implement a program
 - Maintained savings of **20% - 30%** is typical
 - May potentially allow for compressors to be turned off



Low/No Cost Opportunities for Savings

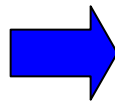
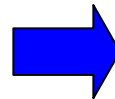
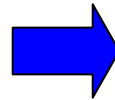
- **Operating Pressure**
 - Usually set at 100-110 psi
 - Most facilities have never attempted to lower the pressure
 - Higher pressures are needed due to poor distribution systems
- **Major automobile plant**
 - Heavy air user (over 1 M square feet)
 - Decided to lower pressure on their own
 - Previously used 84 psi
 - Now uses 74 psi (lowest observed)
 - o Saves \$180k/yr
- **Savings**
 - Typically 1% energy savings for every 2 psi reduced



Low/No Cost Opportunities for Savings

Eliminate inappropriate use of compressed air:

- Personal cooling
- Open pipe blow-off
- Cleaning
- Etc.



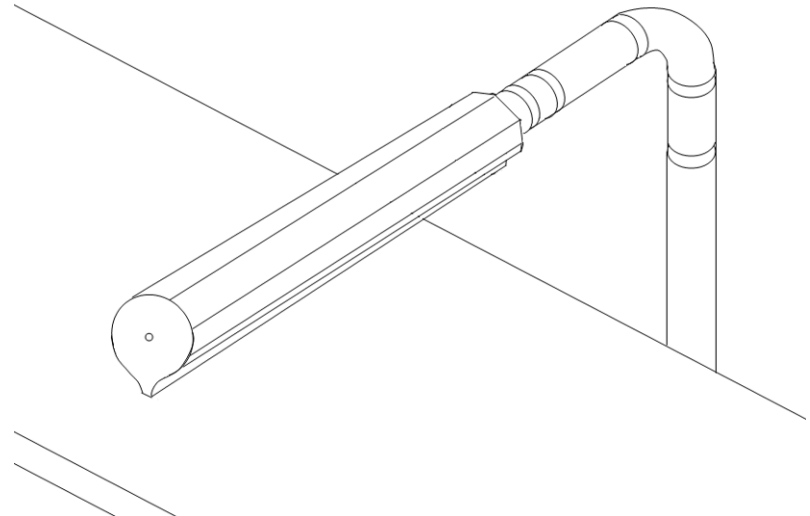
For energy savings use:

- Electric fan
- Electric blower, or engineered nozzles
- Shop vacuums

~ 8 HP of electrical energy = 1 HP of work with CA

From the Field – Air Nozzles

- **Facility**
 - Used pipes w/ holes for blowing (ex. see right)
 - Always kept air running despite no product on line
- **Recommended**
 - Engineered nozzles and air knives + solenoid valves and sensors
- **Economics**
 - Investment: \$12,500
 - Savings: \$13,400
 - Simple Payback: < 1 year



Capital Cost Improvements

- **Improve controls**
 - Ensures compressors operate fully loaded + properly sequenced
 - 10% potential savings
- **Provide adequate storage**
 - Typical range 3-4 gal/cfm
 - Will reduce operation of trim compressor
- **VFD compressor for trim**
 - Best part load performance
- **Heat Recovery**
 - 80% of compressor input energy available as heat
 - Can be used for space heating

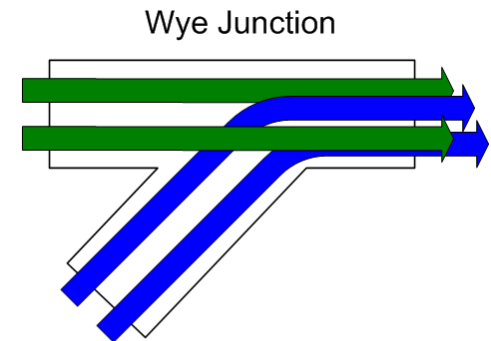
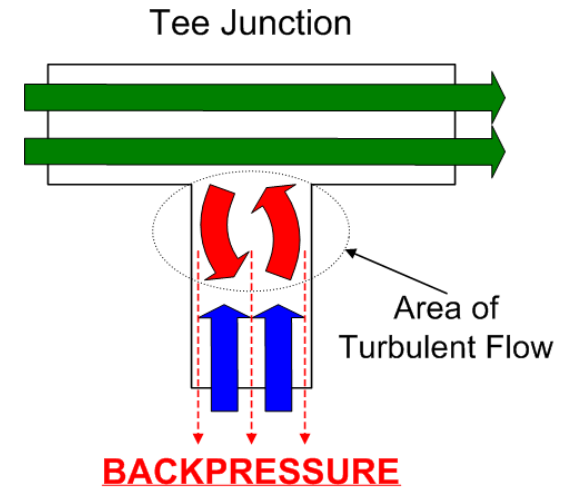
From the Field - Controls

- **Facility**
 - Compressor
 - o Equipped with energy efficient spiral valve controls
 - Control was observed to not be functioning
 - o Operated in modulation mode only
- **Recommended**
 - Repair control
- **Economics**
 - Investment: \$800
 - Savings: \$20,000
 - Immediate Payback



Help the CA System Breathe Easier

- **Reduce pressure drops**
 - Correctly size pipes, use Y instead T connections
 - Don't over-filter air
- **Compressor inlet air**
 - Compressors like cool, dry, clean air
- **Maintain the compressor**
 - Change filters, etc.
- **Reduce moisture in the lines**
 - Check dryer, drains, filters and pipe connections
 - Drain the system regularly



Conclusion

- There are many opportunities to increase the efficiency of compressed air systems
 - Good fit for Cx/RCx
- Should be considered for inclusion as part of a Cx/RCx portfolio
- Relatively untapped market for Cx/RCx
- Valuable service to the owner

Additional Resources

- **Contact your local utility**
 - May have a compressed air RCx program
 - o ComEd, www.comed.com
- **Compressed air information sources**
 - The Compressed Air Challenge
 - o <http://www.compressedairchallenge.org>
 - DOE Compressed Air Best Practices
 - o http://www1.eere.energy.gov/industry/bestpractices/compressed_air.html
- **Compressed air software**
 - AIRMaster+
 - o Can be found on DOE CA Best Practices site

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Thank you!

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