Save Energy and Money with Effective Compressed Air Systems

Kansas Environmental Conference

August 19, 2015

Resources

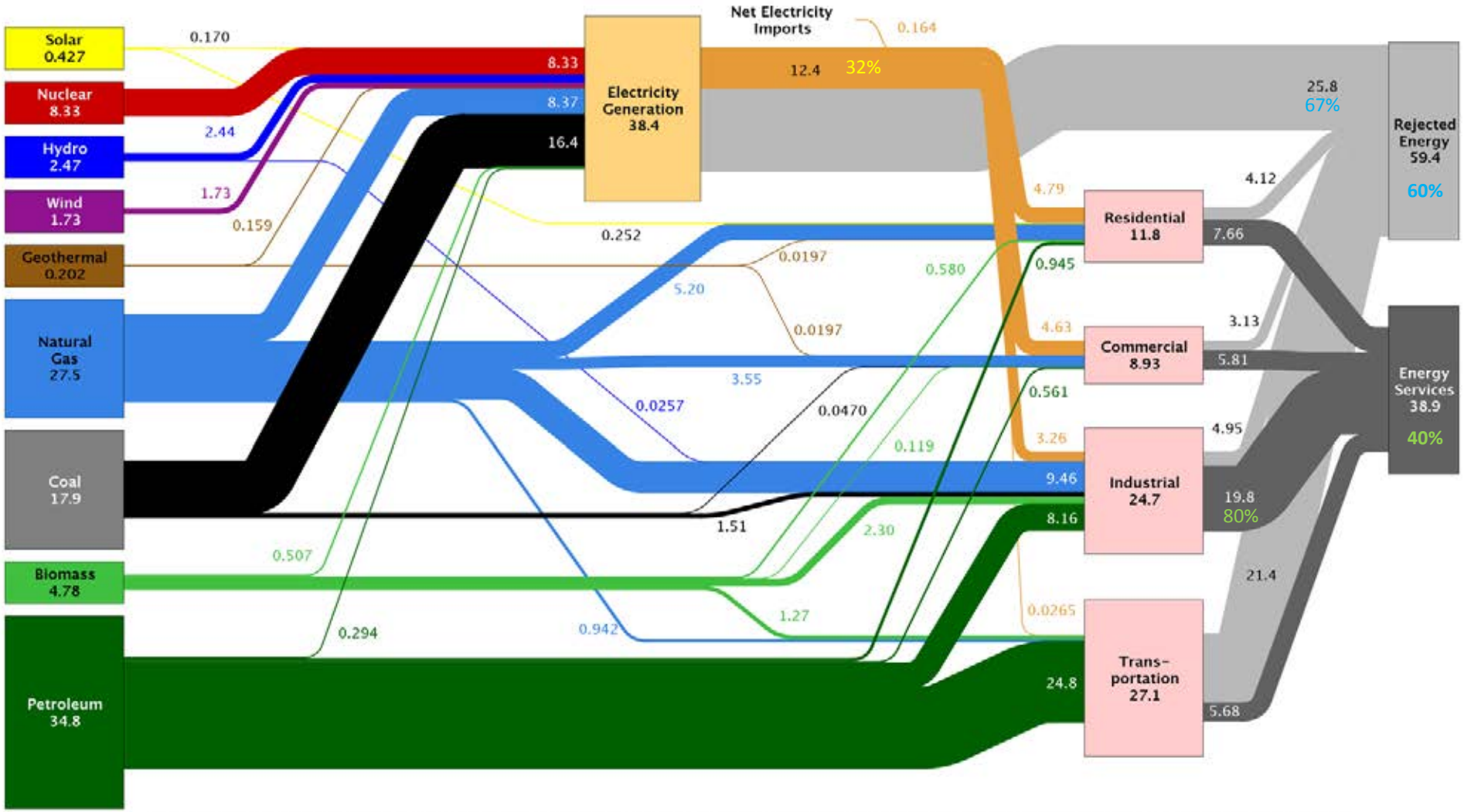
- Department of Energy
  - Tools
  - Fact sheets
  - Case studies
  - Training
- Compressed Air Challenge
  - Tools
  - Library
    - Improving Compressed Air System Performance: A Sourcebook for Industry
    - Fact sheets, case studies, newsletters, tip sheets, published articles
  - Training

Resources (cont.)

- My Energy University
  - Compressed air, seven modules
  - 84 other modules from audits to HVAC to lighting to procurement to waste heat recovery
- Design World webinar, December 11, 2014
- Kaeser webinar
- UE Systems
  - Equipment
  - Training
  - Resources – white papers, articles, blog, e-book

Estimated U.S. Energy Use in 2014: ~98.3 Quads

Lawrence Livermore National Laboratory



Source: LLNL 2015. Data is based on DOE/EIA-0035(2015-03), March, 2014. If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Distributed electricity represents only retail electricity sales and does not include self-generation. EIA reports consumption of renewable resources (i.e., hydro, wind, geothermal and solar) for electricity in BTU-equivalent values by assuming a typical fossil fuel plant "heat rate." The efficiency of electricity production is calculated as the total retail electricity delivered divided by the primary energy input into electricity generation. End use efficiency is estimated as 65% for the residential and commercial sectors 80% for the industrial sector, and 21% for the transportation sector. Totals may not equal sum of components due to independent rounding. LLNL-MI-410527

https://flowcharts.llnl.gov/

Why Compressors?

- Common to industry
  - Pneumatic tools, conveyors, hoists, pumps, machines
  - Aeration, filtration, dehydration, oxidation, fractionation
- Advantages:
  - Tools are usually smaller and lighter
  - Full range of speed and torque settings
  - Achieve required speed and torque quickly
  - No sparks and not much heat

Compressor Types

- Positive Displacement – a given quantity of air or gas is trapped in a compression chamber and the volume it occupies is mechanically reduced, causing a corresponding rise in pressure prior to discharge.
- Dynamic – impart velocity energy to continuously flowing air or gas by means of impellers rotating at very high speeds. The velocity energy is changed into static-pressure energy in the impeller and in discharge diffusers and volutes.

Selection Criteria

- Capacity
- Pressure
- Efficiency at full, partial, and no load
- Noise level
- Physical size
- Oil carry-over
- Vibration
- Maintenance

So what's the problem?

- Compressed air is very inefficient
  - Lot of energy required to compress air and treat it to desired temperature and dryness
  - Energy lost in distribution and normal pressure drop
  - Prone to misuse
  - 60-80% of compressed air energy is rejected as HEAT
  - Only about 10% of the power consumed by a compressed air system arrives at the point of use
  - Typically takes about 7.5-8 hp to produce 1 hp at point of use

KAESER COMPRESSORS

Percent of Electricity Consumed by Compressed Air Systems

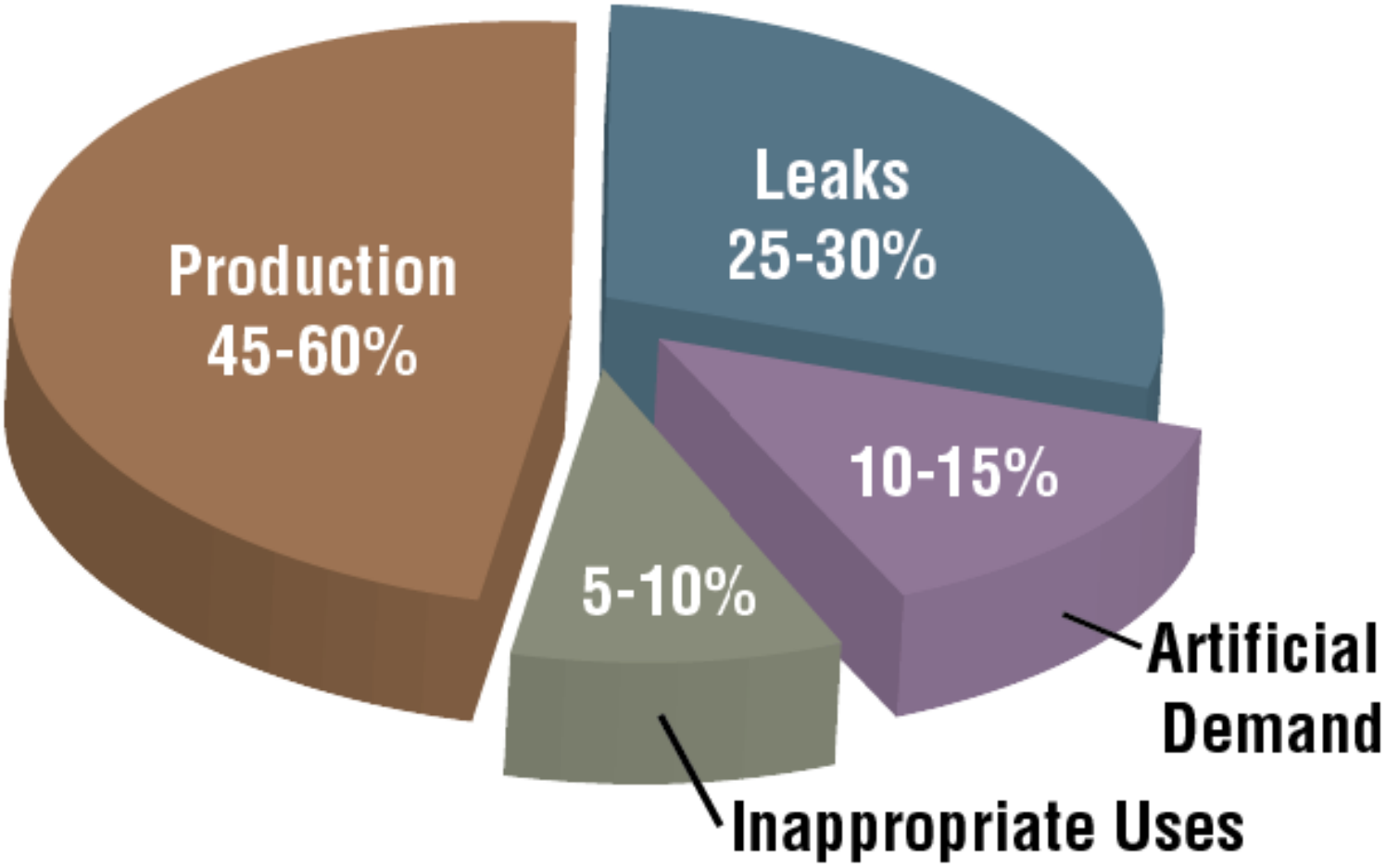
KAESER COMPRESSORS

If Compressed Air Systems Were Optimized

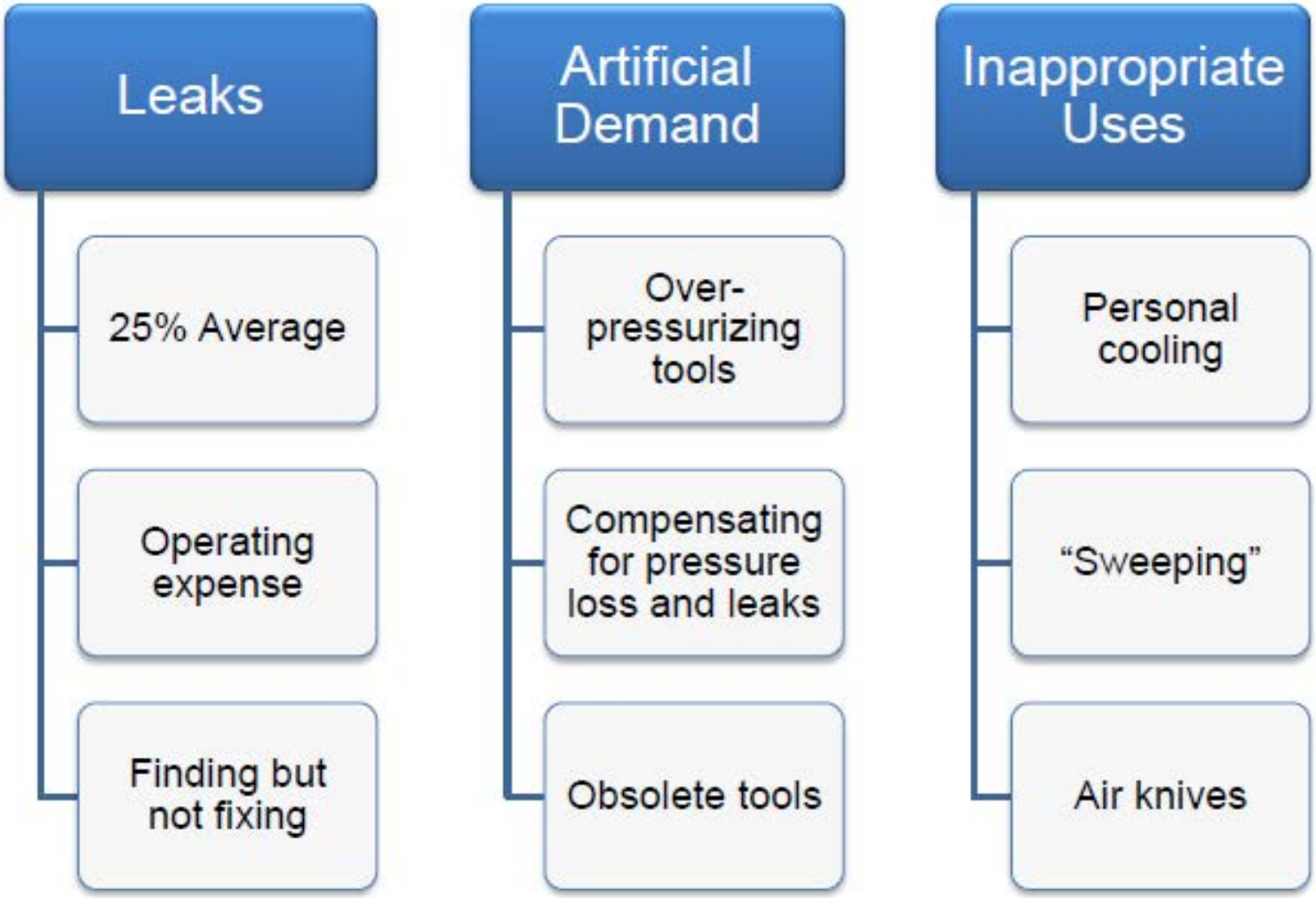
Inefficiencies

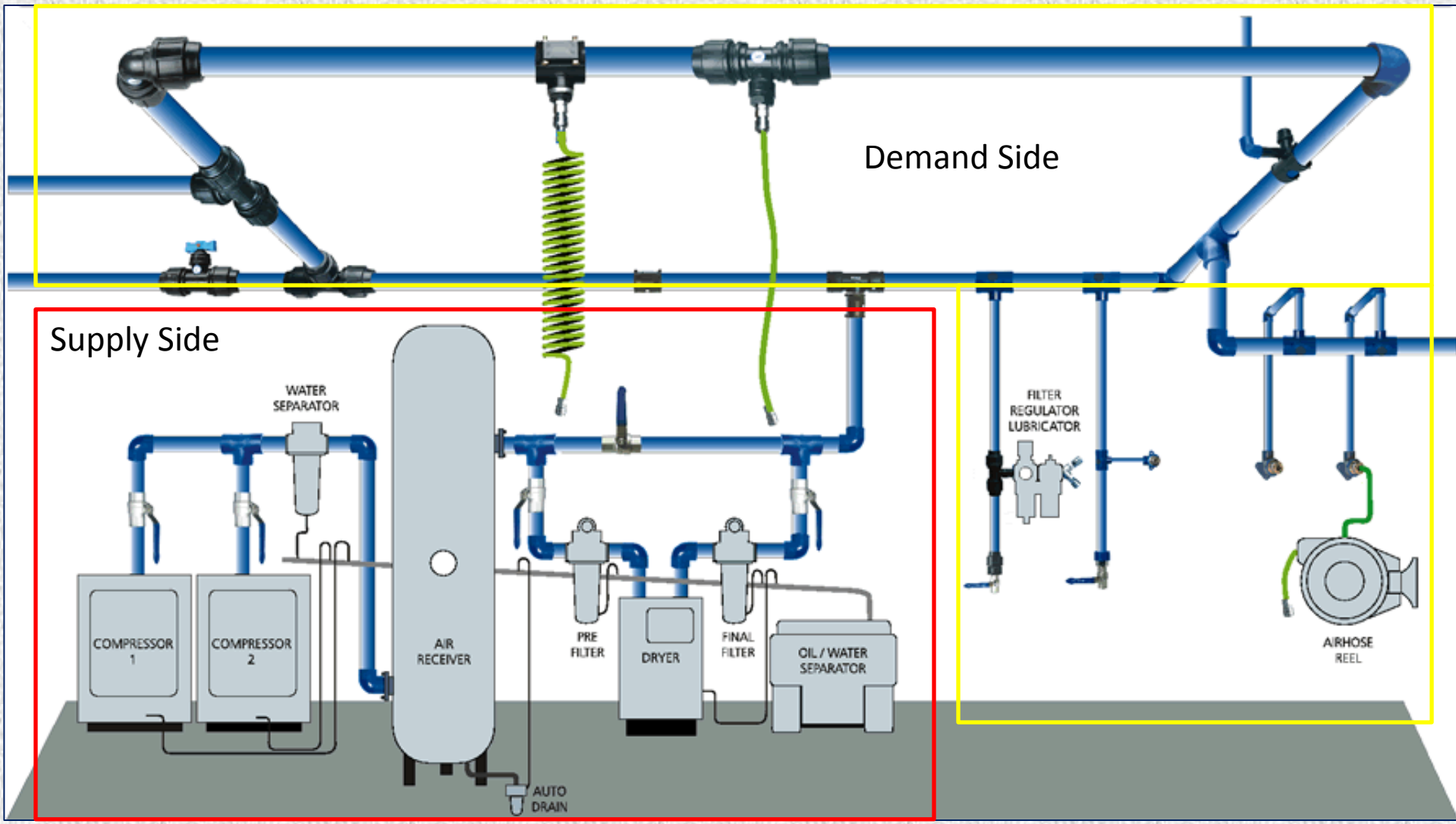
- Assumption that “more is better”
- Little or no thought to system efficiency
- No plan for increases or decreases in demand
- Emphasis on “first cost” over lifetime costs
- Lack of understanding of the complete system
- Modifying a system is perceived as a risk to production

U.S. Department of Energy Estimates that Half of All Compressed Air is Wasted



Components of Waste





http://www.airenergy.com.au/application-examples/schmatic-diagram/

Air Compressor Leaks – Demand Side

- Impact of compressed air leaks
  - Drop in system pressure
  - Rapid compressor cycling (leading to reduced life)
  - Increased production and maintenance costs

Three Methods of Leak Detection

Method	Advantages	Disadvantages
Listen and Feel	• Simple • Quickly identifies large leaks • No special tools required	• Only effective for large leaks • Requires direct physical contact • Must be able to hear above the plant equipment • Will not work for most leaks • Gives no information on volume of leak
Soapy Water	• Reliable • Simple • No special tools required	• Time consuming • Requires direct physical contact • Gives no information on volume of leak
Ultrasonic	• Versatile • Can detect leaks as small as a pinhole • Fast and accurate • Does not require plant downtime • Does not require physical contact	• Requires special equipment

How Much Does a Leak Cost?

- Costs shown here are for a *single* leak
- Compressor efficiency can be found on CAGI data sheet for that model
- The cfm flow through leak varies with air pressure, size and shape of orifice

Actual cost of a single leak based on 8,760 operating hours and 10 cents/kWh

1/16"	$865
1/4"	$13,867
3/8"	$31,200
1/2"	$55,333

This small hole (1/4" diameter) costs you approx. **$1,155** every month

Annual Cost of a Leak =
Leakage rate (cfm) x kW/cfm x operating hours x $/kWh

Case Studies

- Schwan's Global Supply (Tony's Pizza)
  - 46 leaks, $23,060/year
- CST Storage (2011)
  - 17 leaks, $10,400/year
- CST Storage (2012)
  - 13 leaks, $34,700/year (one argon leak at $30,300/year)

Questions?

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Jacquelyn Sommers – The Coleman Company

Compressed Air Audit

- Coleman has 8 air compressors
- The compressed air uses 6,900,200 KWh/yr and $544,300/yr

This air compressor has an air dryer that was added to it at the beginning of June. The air dryers can decrease operating costs for the air compressors by eliminating moisture and contaminates from the compressed air.

- Compressed air audit on the air compressors and blowmolds.

- Ultrasonic leak detector from UE Systems

Ultraprobe 9000 ultrasonic leak detector from UE Systems

- Tentative Findings:
  - 85 leaks
  - 521,100 KWh
  - $40,500
- Challenging Part
- Fun Part

Questions?

Jacquelyn Sommers

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Thank you for your time!