Pneumatics/Compressed Air Systems

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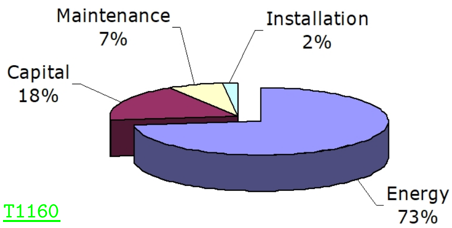
Training on
Energy Efficiency and Conservation
conducted by
Bangladesh Power Management Institute (BPMI)

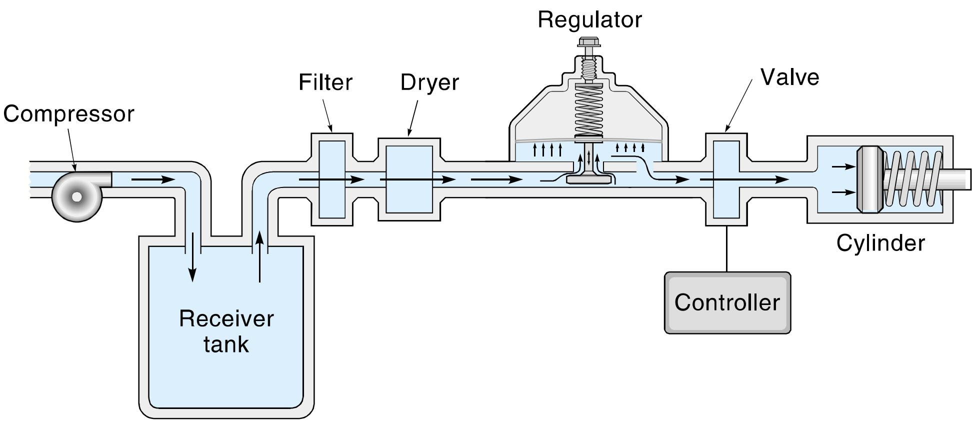
Overview

Compressed Air System (CAS)

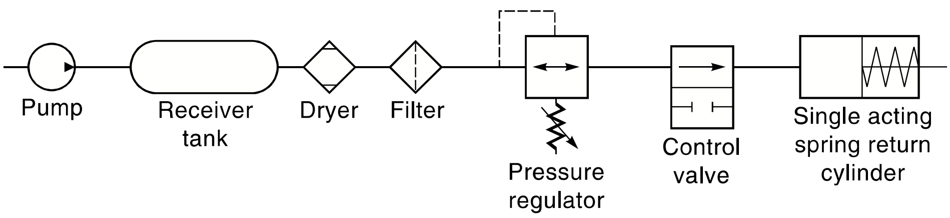
- Unique applications
- 10 x more expensive than electricity
- Leakages
- Pressure drops, poor pressure control
- Compressors not matched to demand
- Misconceptions about cost: Air is NOT free
- Heat recovery opportunities ignored



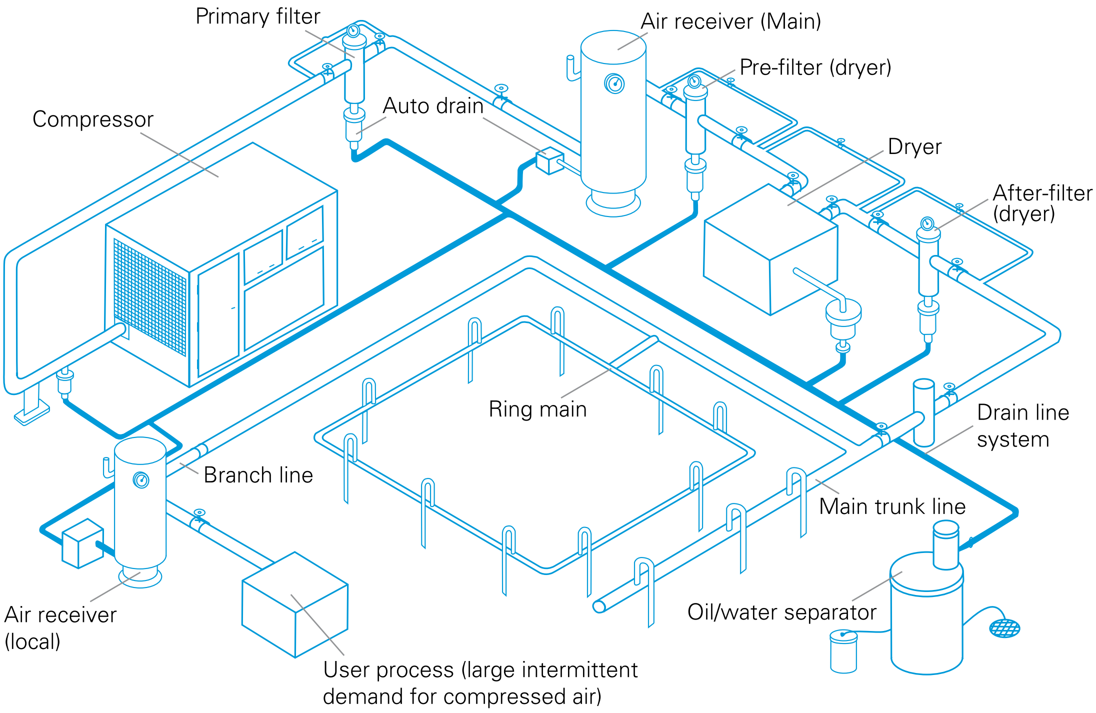
Components of CAS



(a) Diagram



(b) Symbolic diagram



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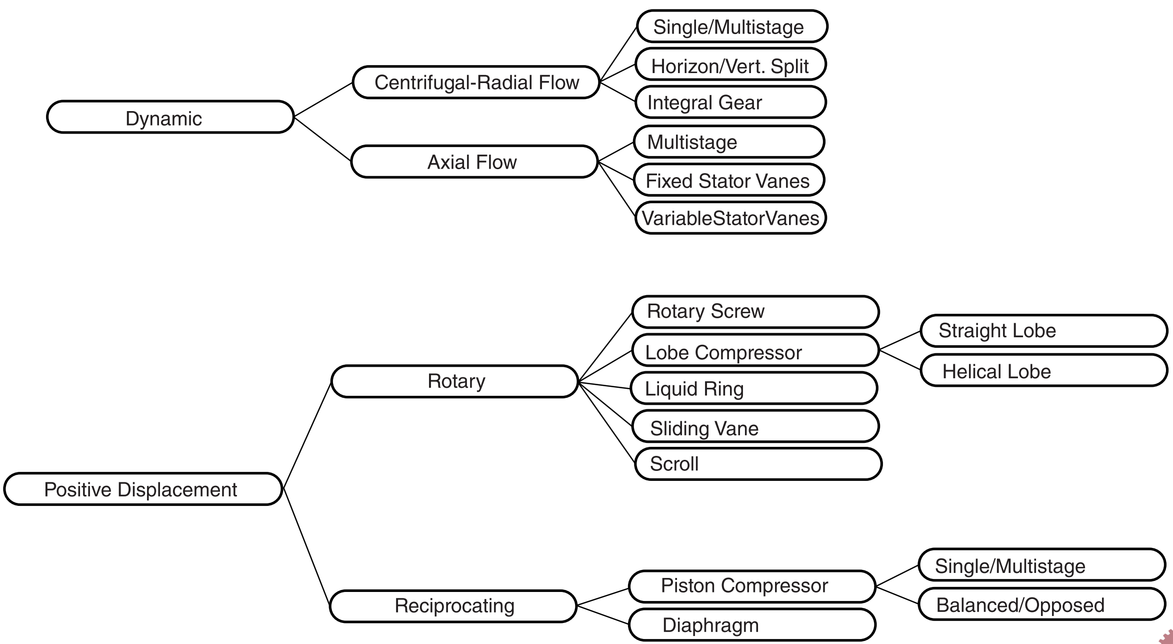
Compressor Classifications



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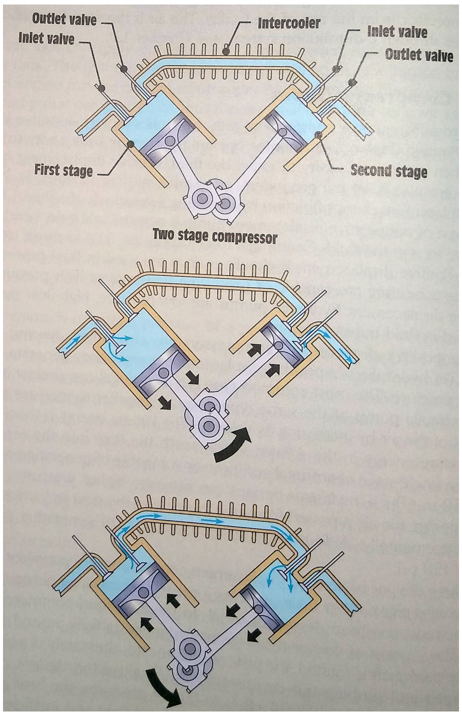
Reciprocating Compressor



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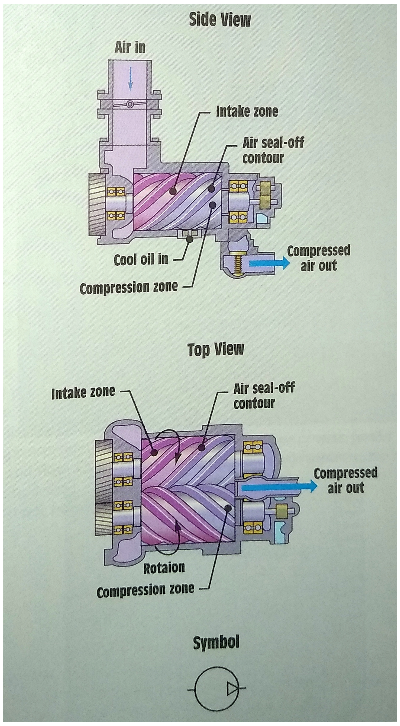
Pneumatic/Compressed-Air Systems (CAS)

Screw Compressor



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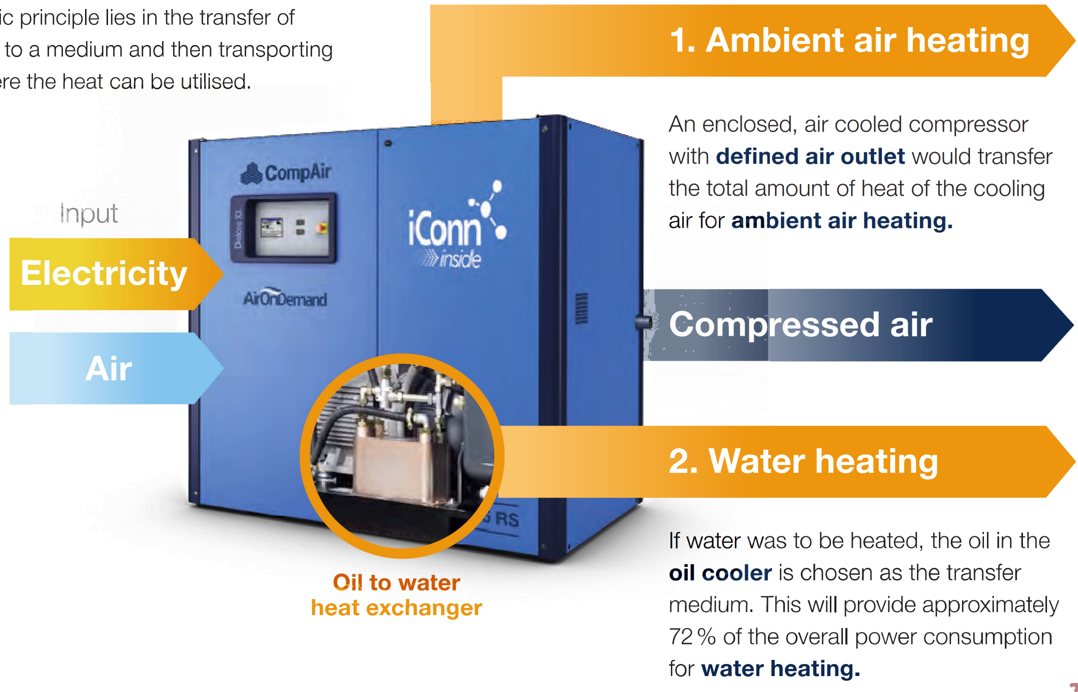
Energy Conversion in CAS System

The basic principle lies in the transfer of the heat to a medium and then transporting it to where the heat can be utilised.



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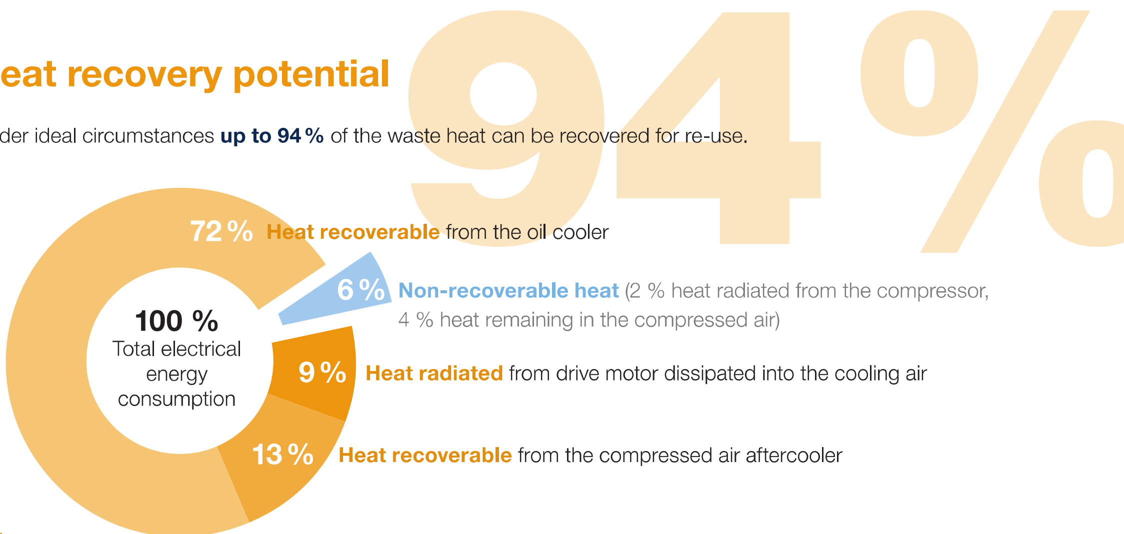
Heat recovery potential

Under ideal circumstances **up to 94 %** of the waste heat can be recovered for re-use.



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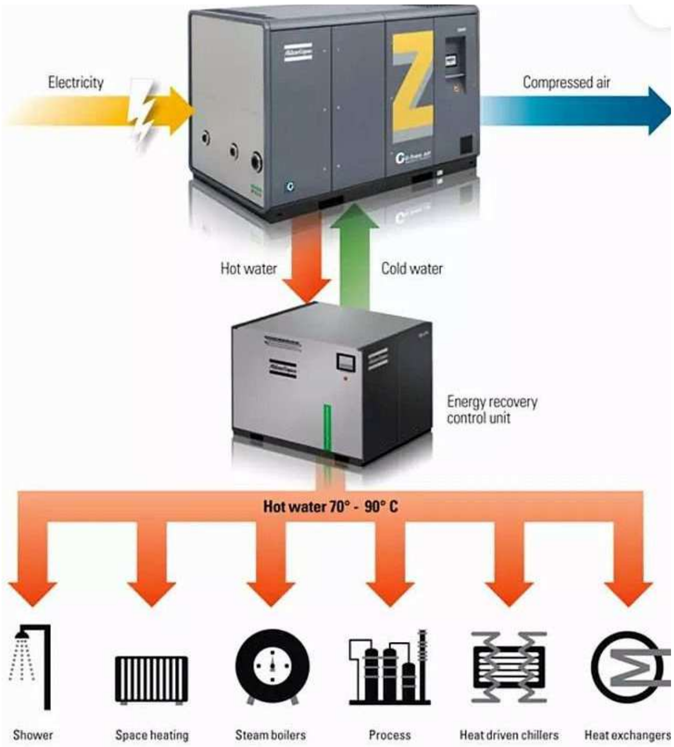
Typical Energy Recovery Applications



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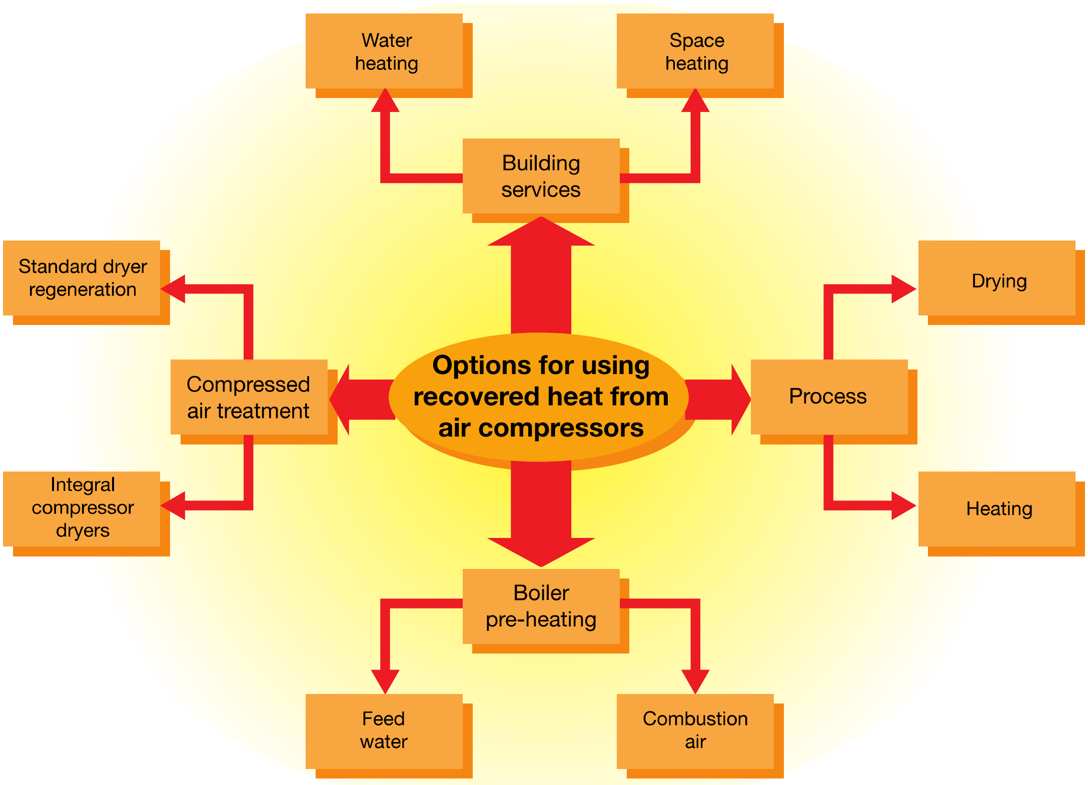

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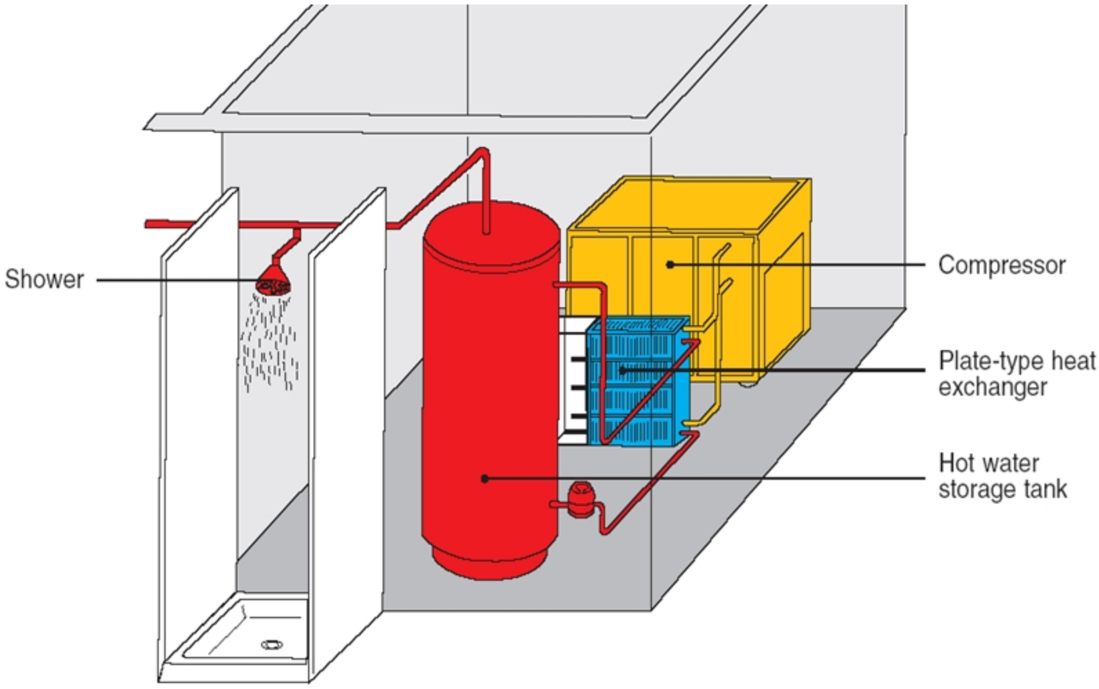

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Heat recovery for shower water heating

Compressed Air - survey results

- 600 compressors in 8 countries
- Average size 300 kW (10 - 5500 kW)
- Leaks were 20% ave
- Savings potential was 30% ave
- 90% - pressure too high
- 80% - over capacity
- 70% - air treatment problems
- 20% - undersized pipes

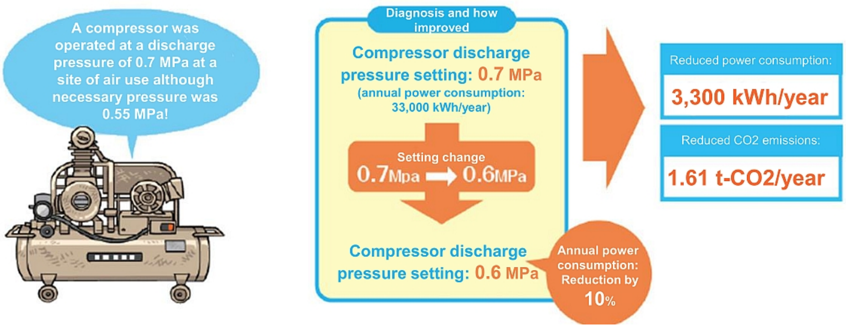
Plenty of opportunities to save energy / costs

Compressed-Air Systems: Inefficiencies

- Leakage
- High pressure drops
- Unsuitable applications
- Poor pressure control
- Compressors not matched to demand
- Frequent start-ups and unloaded running
- Heat recovery opportunities ignored
- Unsuitable air treatment

- Rule of thumb - 6 m/s max
- Large radius elbows
- Smooth internal walls
- Ring main design
- Adequate receiver volume
- Receivers especially for pulsating loads
- Operate at the minimum pressure required for plant to operate correctly
- 1 bar pressure reduction gives 6-9% of cost reduction
- Adjust pressure difference for pressure switches to 0.5 bar max
- Consider electronic sequence controller and pressure transducer for multi-compressor sites

- Leak reduction is very low-cost opportunity
- 20% savings of total running cost is often achievable
- Air Leakage - typical culprits
  - Leaking hoses, couplings
  - Condensate drains, valves
  - Pipes, joints and flanges
  - Pressure regulators
  - Lack of interlocked isolation valves on machines
  - Air tools left connected when not in use



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Energy saving opportunities for a typical industrial CA system

	Potential savings[2]	Investment[3]
Management Actions		
Raise the awareness of all users to the proper use of compressed air	10-15%	Low
Develop and implement a maintenance programme for the whole system	5-8%	Low
Install metering and implement monitoring	5-10%	Medium
Use only trained and competent personnel for installation, servicing and system upgrades	5-10%	Low
Develop and implement a purchasing policy	3-5%	Low
Technical Actions		
Implement a leak reporting and repair programme	20-40%	Low
Do not pressurise the system during non-productive periods	2-10%	Low
Fit dryer controls (refrigerant and desiccant)	5-20%	Medium
Install compressor drive and system control measures	5-15%	Medium
Install heat recovery measures where appropriate	Up to 75%	Medium

[1] Operating at 7 bar(g) (700kPa(g)) with an output of 500 litres/s
[2] The percentage figures given are indicative, are not cumulative and will vary with each system
[3] Low = less than £2,000; Medium = £2,000—£10,000

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Inappropriate uses of compressed air and alternatives

Inappropriate use of compressed air	Alternative
Ventilation	Fans, blowers
Liquid agitation	Mechanical stirrer or blower
Cleaning down workbenches, floors and personnel	Brushes, vacuum cleaner
Rejecting products off a process line	Mechanical arm
Transporting powder at low pressure	Blower

Annual cost of air leaks

Hole diameter (mm)	Air leakage at 7 bar(g) (700kPa(g))		Power to air leaks[2] (kW)	Cost of leak[3] (£/year)	
	litres/s	cfm[1]		48 hours/week	120 hours/week
0.50	0.20	0.42	0.06	7.2	18
1.5	1.8	3.8	0.54	65	160
3.0	7.1	15	2.1	250	630
6.0	28	59	8.4	1,000	2,500

[1] Cubic feet per minute
[2] Based on 300W/litre
T1347 [3] Based on £0.05/kWh

Thanks a Lot