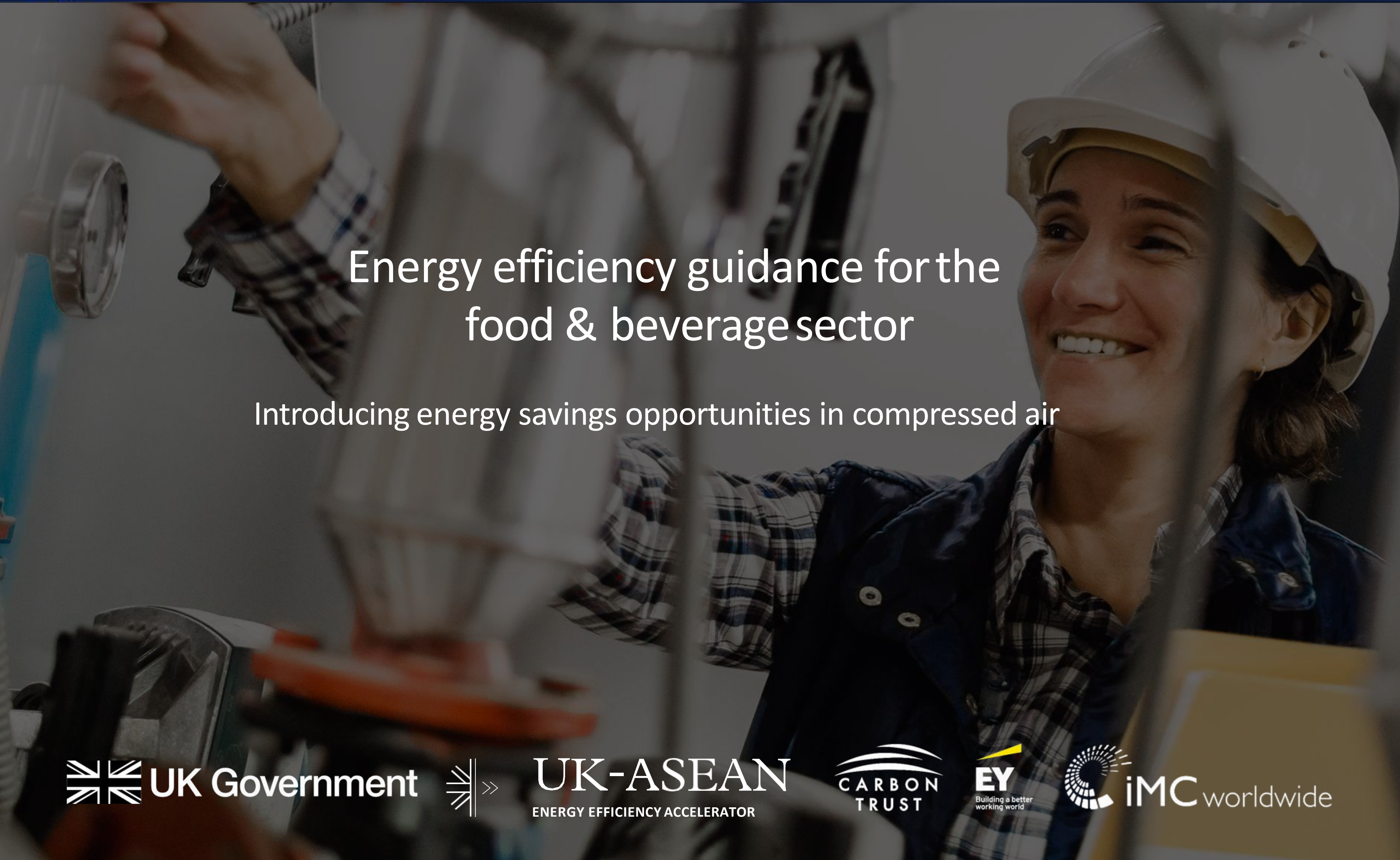
Department of Energy



Energy efficiency guidance for the food & beverage sector

Introducing energy savings opportunities in compressed air

UK Government

UK-ASEAN ENERGY EFFICIENCY ACCELERATOR

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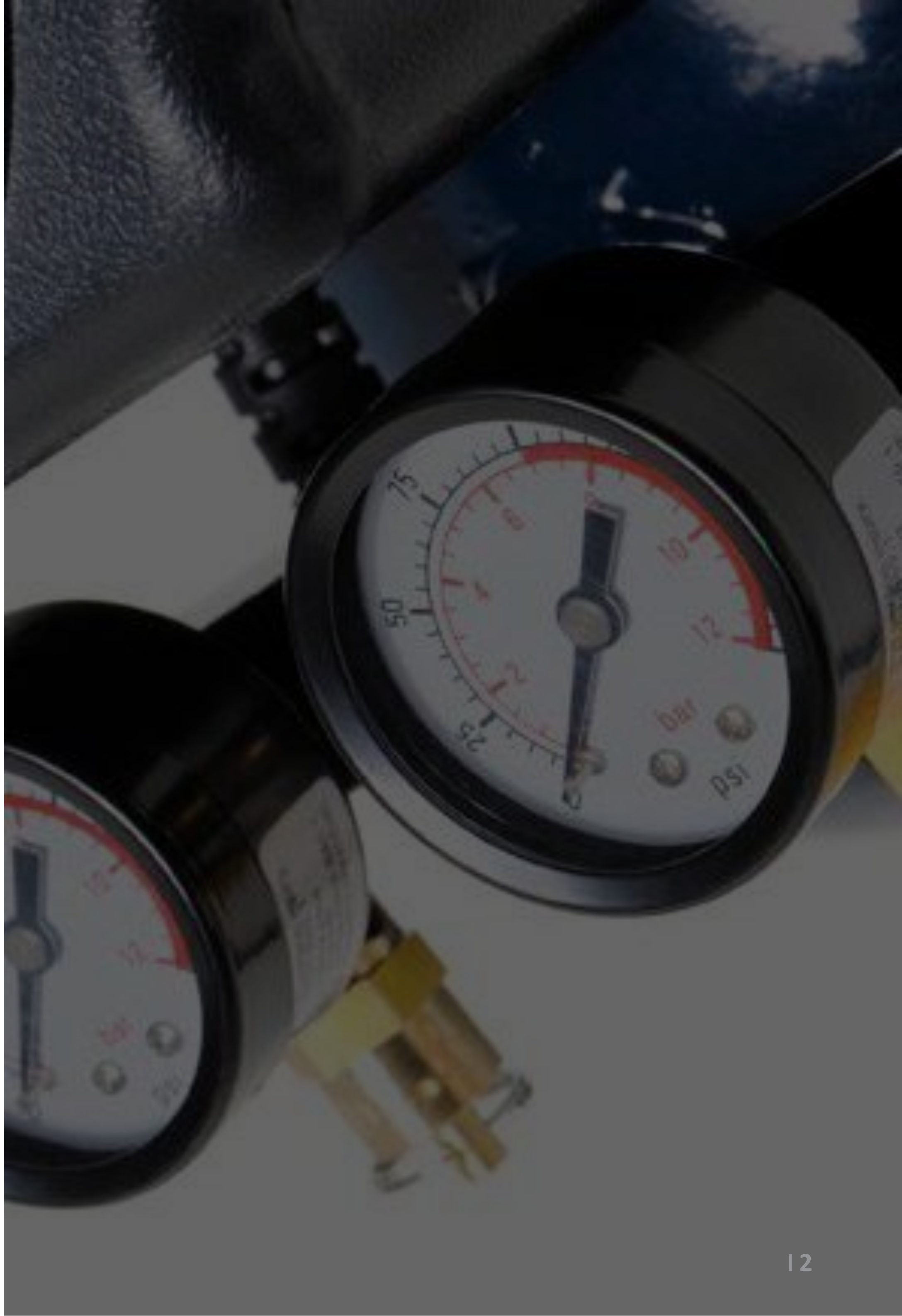
Compressed air

Compressed air is used as a power source for many food and beverage operations as it is a versatile, safe and flexible way to transmit energy. However, it is extremely costly to produce with as little as 8-10% of the energy supplied to the compressor being converted to usable energy at point of use.

Energy savings opportunities compressed air:

The energy costs of operating a compressor over its lifetime far outweighs the initial capital expenditure. It is therefore important that every effort is made to reduce compressed air use and maximise system efficiency. Carbon Trust studies have shown that savings of 30% or more are available from most compressed air system.



Is compressed air required?

In many cases it is possible to use electrical instead of pneumatic tools. Substituting electric tools for compressed air hand tools can reduce demand by between 10-20%.

The use of pneumatic cylinders in automatic processes for linear and turning movements has a ten times higher energy consumption level than electric or hydraulic drives.

Cut down on unnecessary compressed air usage

Compressed air is often used inappropriately, e.g. to clean down machinery. In many cases, using a vacuum cleaner or air blown from a fan is a far cheaper alternative.

Compressed air is often used to create vacuum for various lifting/ picking requirements when using a dedicated vacuum pump will use 70% less power.

Use appropriate control

The use of a central controller will ensure the most appropriate mix of compressors are used to meet the required demand. If a compressor is not being used then it will be automatically switched off. An idling compressor can still use up to 40% of its full load.

Meet peak demand using a variable speed drive compressor (VSD)

Fixed speed compressors are at their most efficient when running at full load. It is therefore more efficient to use a variable speed compressor to meet variable demand as they operate more efficiently at part load.

Investigate bringing in compressor air from outside

Cooler air is denser and reduces the load on the compressor. Providing cooler intake air from outside can produce substantial savings.

> *For every 4°C drop in the temperature of the intake air, efficiency improves by 1%.*

Re-using waste heat

Up to 90% of heat generated by a compressor can be used to heat water or air. Consider whether the heat generated can be reused to:

- Provide hot water
- Preheat boiler feed water
- Provide process heat for drying, etc.

Minimise generation pressure

Systematically review the distribution system to identify and remove any significant pressure drops.

Distribution pipework should be of an adequate bore and laid out as a ring main.

The maximum pressure drop from air receiver to most end use should be <0.5 bar.

> *Reducing the system pressure by 1 bar will decrease energy consumption by 8 %.*

If one application requires a higher pressure then consider installing a smaller, local generator rather than increasing the pressure of the whole system.

Reduce system losses and leaks

Compressed air losses of 30%-40% are not uncommon in the food and drinks sector.

Leak detection should be carried out as part of the weekly maintenance schedule.

Listening for leaks during quieter moments is very effective. In noisy environments an ultra-sonic leak detector can be used.

Ensure no loss condensate valves are used rather than timed or manual types.

Fit solenoid valves to automatically isolate equipment from the ring main when switched off.

Isolate pipe runs no longer in use.

Don’t over treat

Treating compressed air is expensive and can add as much as 20% to generations costs.

Only treat the air to the standard required.

> *Treatment cost increase 3% for every treatment class attained.*

Refrigerated dryers are the most efficient treatment method up to a dew point of 3°C.

Desiccant dryers are typically used to achieve dew points down to Class 1 standard dew point (-70°C).

Control of the regeneration cycle should be by dew point rather than timed with heat of compression used where the desired dew point allows.

Checklist and tips for efficient operation of compressed air systems

This checklist summarises the key criteria and characteristics of energy efficient compressed air systems. If you are unable to indicate "YES" to all questions, it is likely that the efficiency of your system could be improved, saving you money and reducing your carbon emissions.

Checklist and tips

Ref	Best practice criteria	Response	Feedback
1	**Do you control your compressors using a centralised sequence control?**	[yes]/[no]	An electronic group control system is able to select the most suitable mix of compressors to meet demand. These will also ensure complete compressor shutdown when not required. The resulting improved control can provide savings of 15% or more with a payback of 1-2 years.
2	**Do you meet peak demand using a variable speed drive (VSD)?**	[yes]/[no]	Best practice is to have a fixed speed compressor meet the base load demand with a VSD compressor to match the peak demand. While typically 25% more expensive than a fixed speed compressor this additional cost will be more than paid back over the lifetime of the compressor. Typically integrating a VSD drive into a system will achieve project savings of 15% and a payback of 3-4 years.
3	**Is the air being drawn by the compressors as cool and clean as possible?**	[yes]/[no]	The temperature of air drawn by the compressors has a significant influence on the energy consumed. The cooler the air drawn, the more efficient the compression process so ducting cool air directly to the compressor is best practice. Typically a 4°C rise in inlet air temperature results in a 1% increase in energy consumption. Ensure filter changes are included in the maintenance schedules. Obstructed air filters can increase energy use by 4%. Payback is < 1 year.
4	**Can the waste exhaust heat from the compressor be recovered and usefully used?**	[yes]/[no]	Compressed air requires cooling before entering the distribution system. This is achieved using either air or water. The resultant heat can be relatively easily recovered and used to provide space heating, hot water, preheating boiler water, process heat, etc. Typically up to 80% of the electrical energy supplied to a compressor can be recovered as heat. Usefully utilising this heat to provide hot water for washing or drying, etc. will payback in < 1year.
5	**Has every effort been made to minimise the system pressure?**	[yes]/[no]	Minimising the air pressure required by the end-use devices can result in excellent energy savings. Reducing the pressure by 1 bar will decrease energy consumption by ~8%. Review the distribution system removing unnecessary filter, valves, etc. Ensure pipe work size is adequate and resolve pipe restrictions. Ensure the distribution system is a ring main and the air receiver correctly sized. These actions will payback in < 1 year.
6	**If using desiccant dryers is the regeneration cycle timed?**	[yes]/[no]	Switching to dew point control offers much more precise control and can significantly reduce the number of tower change overs required to maintain high quality dry air. It is not uncommon for cycle times to extend by over 50% giving a typical project saving 10% and payback of < 1 year for a retrofit controller. Depending on the dew point classification required consider installing a heat of compression dryer (HOC) with annual run costs 70% lower than other desiccant dryer systems.
7	**Is the compressed air being treated to the minimal standard required?**	[yes]/[no]	The treatment of compressed is energy intensive and air should only be treated to the minimum classified level required according to ISO 8573. Air treated to treatment Class 4 increases energy consumption by 3% while achieving Class 1 will increase it to 15-21%. Simply reducing the treatment level by one Class will save 3% with immediate payback.

Checklist and tips

Ref	Best practice criteria	Response	Feedback
8	**Does your system use no loss condensate drain valves?**	[yes]/[no]	Compressed air systems produce large volumes of water that needs to be removed from the system. To prevent unnecessary and costly air loss from manual or timed valves fit electronic 'no loss' drain valves. These will provide a 3% saving on annual compressed air costs and a typical project payback of 3 years.
9	**Is there a formal program of monthly leak detection and repair?**	[yes]/[no]	Compressed air losses of 30%-40% are not uncommon in the food and drinks sector. Leak detection should be formalised and carried out as part of the monthly maintenance schedule. Where compressed air is used for cleaning alternatives should be found. Production areas and processes should be isolated from the system when not in use and redundant areas disconnected. Savings of 20-30% from leak deduction is not uncommon.
10	**Do you use compressed air to create a vacuum?**	[yes]/[no]	As up to 90% of the energy used to generate compressed air is typically lost as heat it is an expensive and inefficient process so should only be used if required. Compressed air is often used to create a vacuum for pick and place applications when a dedicated vacuum pump will generate the same volume of vacuum using 70% less power and payback in < 2 years. The use of pneumatic cylinder typically has 10 times higher energy consumption than either electric or hydraulic drives.