Industrial energy savings

Checklist

EECA

DECARBONISATION PATHWAY

The industrial energy savings checklist

This checklist is a practical guide to help industry establish energy efficient opportunities.

This checklist sets out of variety of opportunities with a wide range of costs (including many that are no-cost) which can be taken when embarking on a process towards decarbonisation.

It focuses on the following areas:

1. HVAC
2. Lighting
3. IT and office equipment
4. Motors and drive systems
5. Pumps
6. Fans
7. Steam generation
8. Compressed air

Before you start this guide, you can set the foundations by:

1. Putting in place an energy & carbon management plan with regular feedback from stakeholders and staff around how to improve your performance.
2. Assign energy management responsibilities to staff.
3. Maintain an updated action list of energy efficient opportunities.
4. Meet regularly and report on actions – provide the opportunity for staff feedback.
5. Start with a few simple actions from the low-cost list to see what savings you can make and then progress towards more complex actions as you feel comfortable.

HVAC			
ACTION	**SAVINGS**		
Clean evaporator and condenser coils	Up to 15% of existing HVAC energy use	Dirty coils in a split unit raise the condensing temperature and can lower the efficiency by up to 15%. Cooling capacity can also drop by up to 7%. Cleaning the coils only takes about an hour and improves the system's efficiency.	
Turn off the HVAC when not needed	10% - 70% of existing HVAC energy use	Heating and cooling unoccupied buildings wastes energy. Most split units have timers that can turn the HVAC on before staff arrive in the morning and off after business hours. Check that the timers are set to do this.	
Adjust temperature setpoints	2% - 10% of existing HVAC energy use	As well as being uncomfortable for the occupants, over-cooling a building during the summer or over-heating it during the winter results in excessive energy use.	
LIGHTING			
ACTION	**SAVINGS**		
Check and adjust light levels	Up to 50% of light circuit energy use	Light (lux) levels in many applications are typically much higher than required for the task. A basic lux survey and delamping (disconnecting individual lamps, usually fluorescent) to appropriate standard levels can save a large proportion of lighting energy use.	
Replace incandescent lamps with CFLs	80% of light circuit energy use	Incandescent lighting is highly inefficient and rarely used in non-residential applications, as the alternative compact fluorescent lamps (CFLs) have a number of advantages. For the same light output, CFLs use one-fifth of the power of an incandescent, and also last around eight times longer.	
Replace MR16 halogen lamps	30 - 80% of light circuit energy use	Halogen downlighting and spotlighting is common in architectural and display applications, but is one of the least efficient lighting types available. These can be replaced with high-efficiency halogens (30% more efficient), CFL downlights or LEDs (80% more efficient) for the same light output	
Modernise fluorescent lighting	40 - 60% of light circuit energy use	Due to a combination of age and design, most installed fluorescent light systems (lamp, reflector and electrical ballast) have room for substantial improvement in efficiency. These aspects of the lighting system can be improved by a professional redesign and refit with high-efficiency T5 fluorescent fittings.	
Replace high-bay warehouse lighting	45 - 70% of light circuit energy use	High-bay HID lighting - metal halide, mercury vapour and high pressure sodium – is commonly used in large indoor areas such as warehouses and retail outlets. Recent improvements in technology offer a range of improved-efficiency replacement options, with the most promising being T5 fluorescent high-bay light fittings for most applications.	
Investigate daylight-based lighting control	20 - 60% of light circuit energy use	Where skylights or large windows are present, indoor lighting is often still left on when natural light is sufficient. Automated dimming or switching systems can be used to reduce or eliminate the artificial lighting load, and are also recommended for outdoor lighting circuits.	

LIGHTING			
ACTION	**SAVINGS**		
Install occupancy-based lighting control	50 - 95% of light circuit energy use	Lights left on in unoccupied areas like toilets and storage rooms is a common occurrence. Ideally staff should turn lights off, but in practice the safest option is often to install occupancy sensors to automatically turn lights off in unoccupied rooms.	
Install timers on main lighting circuits	Up to 75% of light circuit energy use, depending on current practice	Leaving lights on in vacant buildings is a significant energy wastage. Timers can be used to automatically turn all lighting off during periods when normally vacant (e.g. night-time or weekends. A timed manual override will allow staff to use the building outside normal hours if necessary.	
IT & OFFICE EQUIPMENT			
ACTION	**SAVINGS**		
Check management of PCs and laptops	Up to $120 per device per annum	PCs and laptops left on overnight can contribute to major overall energy wastage. A simple out-of-hours survey will identify which machines are left on unnecessarily. Also, ensure 'power management' is enabled to put machines into sleep mode automatically when inactive (while most devices typically switch the display off automatically, they will continue to draw power unless specifically turned off or put into sleep mode).	
Check power management of printers and photocopiers	Around $100 per device per annum	Most modern photocopiers and printers come with inbuilt power management settings, but where these have not been activated or older machines are used, the idle energy wastage can be large. Check that these automatically enter 'power save' mode – and switch off completely outside work hours.	
MOTORS & DRIVE SYSTEMS			
ACTION	**SAVINGS**		
Install high-efficiency motors	Up to 5% of motor energy use	New MEPS (Minimum Energy Performance Standard) motors are typically 2% - 3% more efficient than older motors over a wide range of operating loads. MEPS replacements are typically up to 5% more efficient for rewound or lightly-loaded motors, and larger savings are possible when replacing motors in poor condition.	
Replace standard V-belts	Up to 5% of motor energy use	Standard V-belts have an efficiency of 93% - 98% depending on their age and tensioning. Cogged belts are generally 2% more efficient than standard V-belts, while synchronous belts typically have an efficiency of 98% and maintain this over their life.	
Regularly service gearboxes	Up to 5% of motor energy use	Gearboxes contain oil to lubricate their gears and reduce friction. Worn gearbox seals can leak oil, increasing friction and lowering efficiency. Prolonged operation with low oil levels can cause gearbox failure.	
Bypass soft starter units	3% of motor energy use	Motor soft starters typically have energy losses equivalent to 3% of the motor's power, dissipated as heat. Once a motor is running at full speed, the loss can be avoided by bypassing the soft starter using external contactors. Many new soft starters already have internal bypass contactors.	

PUMPS			
ACTION	**SAVINGS**		
Consider pump replacement	Up to 50% of pump energy use	Over time, system changes may mean the originally-specified pumps no longer run near best efficiency. A pump's maximum efficiency is often above 70%, but if improperly specified, can be as low as 30%. Improving pump efficiency can also reduce a pump's rate of wear and prolong its life.	
Investigate variable speed control on pumps	Up to 80% of pump energy use	For varying loads, such as pressurising domestic water or circulating heating/cooling water, variable speed control of pumps can greatly reduce energy consumption. A pump's power consumption is proportional to its speed cubed, so even small speed reductions can result in large energy savings.	
Trim pump impellers	Up to 20% of pump energy use	An oversized pump uses more energy than one correctly sized. The pump may have always been oversized, or the system's flow requirements have reduced since the pump's installation. Trimming a pump's impeller reduces its capacity and hence energy consumption. Ensure this is done in line with manufacturers' guidance.	
Isolate circulation loops when not required	5% – 20% of pump energy use	Unnecessarily circulating water increases the pumping power consumption and in heating or cooling systems, increases the thermal load. When not needed, circulation loops can be isolated either manually or automatically, using solenoid valves. If the circulation pump is controlled by VSD, isolating unneeded loops gives even greater savings.	
Install pressure switch control	Up to 90% of pump energy use	For pump systems with intermittent demand, pressure switch control turns the pump off when not required and eliminates the time the pump runs dead-headed. This system can be used in conjunction with a pressure accumulator, or bladder tank, to ensure the pump does not cycle too frequently.	
Install level control	5 - 75% of pump energy use	For dewatering or tank filling applications, pump level control ensures the pump only operates when necessary. The level control may be a simple float switch on a pump. More sophisticated methods include using variable speed pumps that maintain a level by matching inward and outward flows.	
FANS			
ACTION	**SAVINGS**		
Investigate variable speed drives (VSD)	10 - 80%	For varying loads, variable speed control of fans can greatly reduce their energy consumption. The fan's speed and output are varied using a VSD, and as a fan's power consumption is proportional to its speed cubed, small speed reductions can result in large energy savings.	
Isolate circuits when not required	5 - 20%	Moving air unnecessarily can significantly increase the load on a fan. When not needed, air extraction or supply ducts can be isolated by closing dampers, either manually or automatically. If the fan is controlled by VSD, reducing the fan system's airflow gives even greater saving.	

STEAM GENERATION			
ACTION	**SAVINGS**		
Identify and repair steam leaks	Up to 30% of boiler energy use	Fixing steam leaks is often an easy, low- or no-cost way of reducing your steam system's operating costs and increasing energy efficiency. Fixing leaks also helps prevent damage to insulation on pipes and valves, and reduces the system's water and chemical use.	
Test and repair steam traps	1 – 20% of boiler energy use	An effective steam trap selection and maintenance programme is essential to maintain the steam system's efficiency and performance. Replacing failed steam traps often also reduces water and chemical use, for additional savings.	
Repair / upgrade / install insulation	1 - 20% of boiler energy use	All steam and condensate lines should be insulated to reduce heat loss and improve the quality of steam reaching the end users. Steam valves and fittings are often uninsulated, as solid cladding prevents easy access to them. In these cases, removable thermal jackets should be used to limit energy loss.	
Maximise condensate return	Up to 10% of boiler energy use	Recover condensate wherever economically practical. Steam that has delivered its energy by condensing still contains approx 15% of its original energy. Returning the condensate to the boiler feedwater tank reduces the boiler load, resulting in energy savings. Additional chemical and water savings often exceed the energy cost savings from returning condensate.	
Install economiser on boiler	5 - 10% of boiler energy use	Economisers increase energy efficiency by recovering heat from hot flue gases and using it to preheat boiler feedwater. This effectively increases the boiler's heat transfer area. Possible savings vary, but efficiency increases are typically 5% using a non-condensing economiser and 10% using a condensing economiser.	
Install automatic blowdown control	Up to 2% of boiler energy use	Boilers blow down (vent hot water) to control the level of total dissolved solids (TDS). Excess TDS fouls boilers and reduces efficiency. Manual blowdown wastes energy if it is too frequent, or causes fouling if too infrequent. Automatic controllers measure the TDS level and blow down at the optimum rate.	
Install blowdown heat recovery	Up to 2% of boiler energy use	When a boiler blows down, valuable heat energy is lost. Blowdown water is often above 150°C so is ideal for heat recovery. Most boiler blowdown heat-recovery applications preheat boiler feedwater, although offsetting other heat loads may be possible. The savings achievable depend on the boiler's blowdown rate.	
Conduct regular boiler combustion efficiency testing	2 - 10% of boiler energy use	Periodic testing of a boiler's efficiency, by measuring excess air levels and exhaust temperatures, is essential to ensure optimum operation. Too high an excess air level lowers efficiency and indicates burner adjustment is required, while too high an exhaust temperature indicates the boiler tubes are fouled and need cleaning.	
Install automatic air-fuel controls	Up to 3% of boiler energy use	On boilers with large burners, oxygen trim sensors can automatically adjust the burner's air-fuel ratio for maximum efficiency. By adjusting the boiler so the excess oxygen level is optimum, the minimum amount of excess air goes through the boiler	

STEAM GENERATION			
ACTION	**SAVINGS**		
Clean boiler at regular intervals	Up to 10% of boiler energy use	Boiler tubes are fouled on the fire-side by soot from burning fuel, and on the water-side by deposits from feedwater impurities. Fouling decreases the heat transfer from the combustion gasses to the water, increasing the exhaust temperature and reducing efficiency. Regular fire-and water-side cleaning ensures good heat transfer is maintained.	
Reduce boiler pressure setpoint	1 - 2% of boiler energy use	Steam boilers are often set to produce steam at about 9 bar.g, even though the steam accumulator typically stores steam at a lower pressure (about 3 - 4 bar.g), for use in the moulding machines at an even lower pressure (often 2 - 3.5 bar.g). Reducing the steam pressure to about 6 bar.g will slightly improve boiler efficiency, but check with your boiler contractor to make sure this change is properly monitored.	
Install flue gas isolation dampers	2 - 10% of boiler energy use	For a hot non-firing boiler, natural convection can cause air to flow through the boiler and out of the flue, removing heat from the system. A flue-gas isolation damper that closes when the boiler is not firing reduces natural convection heat losses, lowering the standby losses.	
Consider more automation for moulders to reduce steam consumption	10 - 20% of boiler energy use	Modern moulding machines have more automation to more tightly control steam consumption during the moulding process. For example, pressure feedback can limit the amount of steam used instead of a timer-controlled valve. Discuss with the moulding machine manufacturer, or a specialist machinery contractor, or consider a new moulding machine.	
COMPRESSED AIR			
ACTION	**SAVINGS**		
Identify and repair compressed air leaks	20 – 50% of compressed air energy use	Compressed air leaks commonly account for 20% to 50% of total compressed air consumption. Air leaks are costly because they consume compressed air continuously, even if no production is occurring. Fixing leaks is often as simple as tightening a loose connector, and as a result can provide an extremely attractive payback period.	
Identify and remedy compressed air misuses	5 – 50% of compressed air energy use	Compressed air systems are only about 12.5% efficient, with each unit of work requiring eight units of electricity. Unregulated, unnecessary use of air can almost always be replaced with more efficient technologies. Remedying misuse saves energy and can delay the need to purchase additional compressor capacity.	
Reduce compressor pressure setpoint	Up to 14% of compressed air energy use	Compressed air devices are often designed to operate at 6.0 bar, though many sites supply air at 7.0 bar. Assess the site's air pressure requirements; if no devices need air above 6.0 bar, then reduce the air pressure setpoint. A 1.0 bar pressure reduction reduces energy use by 7%.	
Reduce distribution pressure drop	Up to 14% of compressed air energy use	Excessive pressure drops can result from installing too much equipment on an undersized compressed air line. To get enough pressure at the machines, the system pressure is then increased, which lowers efficiency. Increasing the line size reduces pressure losses, maintains efficiency, and results in a more stable pressure.	

COMPRESSED AIR			
ACTION	**SAVINGS**		
Improve capacity control	5 – 30% of compressed air energy use	Air compressors with good turn-down efficiency, such as a variable speed or variable displacement compressors, can use up to 30% less energy than other capacity control methods.	
Improve intake design	2 - 10% of compressed air energy use	Poor air quality, high air temperatures and low inlet pressures reduce an air compressor's efficiency. Ensure there are no inlet restrictions - e.g. blocked filters - and that the compressor receives clean, cool air. A 3°C reduction in air temperature will typically reduce compressor energy consumption by 1%.	
Install heat recovery	50% of compressed air energy use	More than 60% of an air compressor's input energy is lost as heat. The heat of compression can be used directly for space heating or indirectly for heating water, for domestic use or as boiler feedwater. Many compressor manufacturers sell kits to recover the waste heat for water heating.	
Improve sequencing controls	0 - 20% of compressed air energy use	Advanced control systems can monitor a plant's pressure and flow requirements, allowing optimum control of installations with multiple air compressors. The control system reduces the time air compressors run unloaded, can eliminate over-pressurisation during times of low demand and will improve the system pressure stability.	