

Grab a clipboard and take this map along on your treasure hunt. Focus on uncovering operational and non-capital opportunities to save. When you find something, make notes about location; tools, materials, or expertise needed; or further research required. Feel free to add to or modify this list to suit your own needs.

Facility Name _____ Date _____ Team _____



Facility Management

- Review the plant's energy tracking system, billing records, production historians, or other sources of consumption data. Identify any spikes or unusual changes in energy use over the past year.
- Check the facility's energy action plan and reports from energy audits, assessments, and treasure hunts (if available) to see if earlier identified energy savings measures have been implemented.
- Inspect maintenance plans and records to identify areas to review during the treasure hunt. Routine or preventative maintenance on neglected equipment may yield energy savings.
- Review building management system (BMS) and/or building automation system (BAS) code, if applicable, to ensure that specific commands to reduce unneeded energy consumption (e.g., on/off times) remain active.
- Consider facility maintenance during daylight hours to reduce the need for lighting and HVAC during unoccupied periods.

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Production Equipment

Note: Because production equipment is unique to each manufacturing processes, these tips focus primarily on operating practices.

- Assess if process equipment is left on during non-production times and can be shut off.
- Evaluate if the start-up times currently used to bring process equipment to its operating conditions can be reduced or optimized. Consider whether a seasonal approach for startup and shutdown is appropriate.
- Review setpoints used on process equipment with operating manuals or equipment manufacturer specifications to see if changes can be made to save energy.
- Check ovens and other thermal processes for insulation damage, and radiant and convection heat losses.
- Inspect burners, temperature setpoints, and heat exchangers to ensure optimal operating conditions.



- Inventory motors used on process equipment and production lines and identify opportunities to install high-efficiency motors, variable frequency drives (VFDs), and/or opportunities to reduce motor size or the number of motors used.
- Check if conveyors and other transport equipment have automatic stop controls to avoid idle running.
- Check control systems to determine they have not been overridden, and evaluate the impact on energy use.
- Evaluate equipment capacity and runtimes to determine whether production schedules can be created to avoid operating under reduced production volume. For example, will running one piece of equipment at 80% capacity versus two at 40% capacity save more energy?

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3 Compressed Air

- Verify proper maintenance schedules are being followed, including:
 - Check filters are cleaned or replaced.
 - Check motors and compressors are properly lubricated.
 - Inspect fans and pumps where applicable.
 - Inspect drain traps periodically to ensure they are clean and not stuck in the open or closed position.
 - Inspect belts, where applicable.
- Check water cooling systems for water quality (pH and total dissolved solids), flow, operations and temperature.
 - Specify pressure regulators that close when failing.
- Review compressed air applications for excessive pressure, duration, or volume.
- Inspect, or consider installing, ultrasonic acoustic detector to identify leaks and the high-frequency hissing sounds associated with air leaks.
 - Track identified leaks to ensure they are repaired. Develop a leak program to assure leak detection and correction are ongoing.
- Confirm air is completely turned off to equipment no longer active (at solenoid valve).
- Assess, or consider implementing, a control strategy to ensure that only the right amount of compressed air, at the right time, is generated and used in the production system.
 - To determine proper control systems, assess compressed air requirements over time to establish a load profile.



- Evaluate if air pressure can be reduced to the lowest practical set point. Every 2-3 psi decrease in system pressure can reduce energy use of the compressors by 1%.
- Assess if pneumatic controls or tools can be replaced with electric systems.
- Identify opportunities for heat recovery of wasted heat from the compressors.
- Identify opportunities to replace compressors with a variable speed drive (VSD) compressor.
- Evaluate the potential to reduce header pressure during non-production time.
- Evaluate overall preventive and predictive maintenance of system.
- Confirm overall control system operations.
- Confirm operations of cooling towers with VFDs on pumps, two-speed fans, and overall sequence of operations.

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Motors

- Locate and identify all motors. Inventory conditions and specifications of each motor.
- Assess motor needs against actual use to determine if properly sized to meet the needs of its driven equipment. Replace wrong-sized motors with correct size and high-efficiency motors.
- Consider maintenance, repairs and upgrades to the motor systems, including economic costs and benefits using life-cycle costs.
 - If upgrades are pursued, monitor the upgraded system's performance to determine actual cost savings.
 - Consider purchasing energy-efficient motors in order to reduce the motor's life-cycle costs.
- Evaluate overall preventive and predictive maintenance of system.
- Confirm overall control system operations.
- Check shutdown practices for motors that are not in use to prevent idling. Consider automatic shutdown of motors.





Hot Water and Steam Systems

- Review boiler setpoints. Locate the boiler's operating manual.
- Verify proper boiler preventive and predictive maintenance schedules are being followed. Ensure all boiler components are optimized.
- Measure the boiler's exhaust temperature to determine if combustion efficiency can be improved.
- Inspect the boiler's air-to-fuel ratio and ensure that it is correctly calibrated.
- Check and reduce excess air (O_2) to lowest level possible based on boiler's configuration.
- Inspect burners and fire-side heat exchangers and clean, calibrate, or adjust as needed.
- Inspect boiler fire tubes for excessive scale build-up.
- Check boiler water treatment system.
- Review hot water and steam demands to determine if boilers are oversized or if the number of boilers used can be reduced. If there are multiple boilers, optimize the number and sequence of boilers working to keep them as close as possible to nominal load, and optimum system efficiency.
- Review frequency of boiler blowdown, and assess the minimum required blowdown needed to maintain acceptable boiler water quality.
- Determine minimum header pressures required by the process, and lower boiler pressure and/or pressure-regulating valve to minimum requirements. Evaluate pressure setpoints based on seasonal approach.
- Establish daily boiler operation log and regular boiler preventive maintenance program to assure that boilers and control systems are operated to achieve optimum fuel efficiency.
- Clean heat exchangers. Verify heat exchanger actual pressure drop against the designed pressure drop, and actual heat transfer against the designed heat transfer.
- Inspect all steam traps and identify traps which are passing steam for repair or replacement.
- Check for ineffective, broken, and wet insulation in steam distribution systems. Use an IR/thermal camera, if one is available.
- Review steam trap maintenance practices. Establish a Steam Leak Management Program.
- Check for condensate leaks and measure condensate return percentage.

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- Evaluate if excess heat from condensate could be used for heat transfer and recovery.
- Confirm overall control system operations.



Pumps and Piping Systems

- Check system to eliminate unnecessary pressure drops from filters, dampers, valves, or poorly designed pipelines.
- Check piping insulation and replace or repair as needed.
- Check for unnecessary pumps.
- Check for primary and spare motors running simultaneously.
- Check if 3-way valves are being used and can be replaced by a VFD.
- Inspect piping to identify obstructions (especially water systems).
- Evaluate if the flow of the piping system matches the need of systems or is oversized.
- Look for multiple parallel pump systems with same number of pumps always in operation.
- Assess how many pumps are required to maintain proper pressure and flow.
- Confirm overall control system operations.



Fans

- Check for incorrect uses, such as centrifugal fans for low pressure and clean air applications.
- Check for pressure drop elimination (e.g., grades, dampers, poor design ductwork)
- Reduce exhaust flow to its minimum (e.g., ovens, rooms).
- Assess whether dampers can be removed and replaced with a VFD.
- Shut off unnecessary air curtains.
- Replace low-efficiency fans with high-efficiency fans.
- Confirm overall control system operation.

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Lighting

- Identify where lights have been left on in unoccupied spaces (e.g., common areas, storage rooms, restrooms, break rooms, outdoor areas).
- Identify and assess opportunities to use automated lighting controls:
 - Occupancy/motion sensors for low-traffic areas.
 - Timers or daylight sensors to dim or turn off exterior and parking lot lights during the day.
 - Dimming controls in locations where there is natural lighting (e.g., near windows).
- Confirm that installed lighting controls are operating as intended.
- Assess need to institute a regular cleaning plan for lamps/fixtures for maximum light output.
- Identify where reflectors can be practically added to existing lighting.
- Assess whether any areas are over-lit, compared to requirements or design levels; consider opportunities for de-lamping.
- Identify and de-energize and/or remove fixtures and ballasts that are not in use.
- Evaluate the opportunity to upgrade to more energy-efficient lighting options:
 - Replace all lights with LEDs.
 - Use LED Exit signs in place of incandescent or CFL models.

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Building Envelope

- Inspect doors and windows to identify gaps or cracks that can be repaired.
 - Note damaged or missing weather stripping.
- Note air leaks that should be sealed with caulking or other sealant.
- Inspect insulation and weather stripping levels and identify inadequacies to be addressed (including loading docks and garage doors).
- Assess opportunity to install vinyl curtains in loading areas.
- Note any doors left open to the outside and to any unheated or uncooled areas.
- Assess the opportunity to install solar film or other window coverings on east, west, or south exposures to reduce solar heat gain and heat loss.



- Assess the opportunity to install air lock doors for main entrances.
- Assess the opportunity to install a reflective (“cool”) roof covering in warm climates.



Plug Loads

Note: Some elements of this section may be relevant only to larger plants with attached office space. Please use judgement in determining which are applicable.

- Identify any new office equipment that will be needed soon; make plan to ensure they are ENERGY STAR certified where possible.
- Identify any equipment left on overnight (including those left in sleep/idle or screen saver mode).
- Ensure that power management settings are activated on office equipment such as computers, monitors, printers, and copiers.
- Ensure that any large-screen TV monitors are turned off during unoccupied times.
- Use networked printers, rather than personal printers in offices or workstations.
- Identify and discontinue the use of personal heaters and fans in offices or workstations (the use of such personal devices may indicate broader hot/cold issues that should be addressed at the system level).
- Identify where power strips can be used for easy disconnect from power source. Consider the use of advanced power strips.
- Assess plan for educating staff to unplug rechargeable devices once charged.
- Check if vending machines get turned off or put in sleep mode at the end of the day.
- Consider installing motion/occupancy-based vending machine controls.
- Look for opportunities to replace older vending machines with new ENERGY STAR-certified vending machines.

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HVAC

Note: Some elements of this section may be relevant only to larger plants with attached office space. Please use judgement in determining which are applicable.

- Identify and make plans to address instances of simultaneous heating and cooling.
- Ensure that thermostats and outside air temperature sensors are properly calibrated/maintained.
- Ensure that thermostats are set to appropriate temperatures based on season and local weather conditions.
- Confirm proper implementation of a temperature setback policy for heating/cooling when the building is unoccupied (including any special considerations for summer months).
- Perform testing and balancing of air and water systems.
- Ensure that thermostats are properly located to be representative of the room or zone for which the temperature is being controlled.
- Ensure that electronics are located away from thermostats.
- Ensure that space heaters are not being used in offices, break rooms, and other spaces.
- Identify where locking covers for thermostats and ventilation controls can be installed to prevent unauthorized adjustments.
- Ensure free airflow to and from registers.
- Ensure window shades are available to block excess heat gain; make plan to educate staff about when to use them.
- Identify where ceiling fans can be installed to move and de-stratify air layers. Ensure all existing ceiling fans are operating properly.
- Monitor make-up air ventilation; ensure the proper functioning of dampers to achieve outside air requirements.

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- Ensure that HVAC system components are being maintained regularly, including:
 - Replace filters on a regular schedule.
 - Inspect and clean evaporator and condenser coils.
 - Clean fan blades and adjust belts as needed.
 - Inspect water/steam pipes and ducts for leaks and/or inadequate insulation; address as needed.
 - Verify and calibrate operation of variable air volume (VAV) boxes, where applicable.
 - Evaluate furnace/boiler efficiency and clean/tune up as needed (including boiler water treatment and inspection of steam traps, as appropriate).
 - Check chiller and cooling tower components for fouling or corrosion; ensure proper water treatment is in place.
 - Check for unusual noise, vibration and/or decrease in performance of compressors/motors.
- Evaluate how chillers operate during the cold months and determine if chiller or pumps can be shut off.
- Identify and assess opportunities for installing VFDs for fan and pump motors, and VAV boxes in the ductwork – especially where variable loads are being served.
- Identify and assess opportunities for demand-controlled ventilation in areas with variable loads (e.g., meeting room, break room).
- Identify and assess opportunities to use occupancy sensors to control HVAC in offices or meeting rooms.
- Confirm overall control system operations.
- Confirm outside air requirements and needs, and adjust where appropriate.
- Identify and assess opportunities to replace standard v-belts with energy-efficient belts.
- Verify gas burner calibration, where appropriate.
- Verify proper preventive and predictive maintenance schedules are being followed. Ensure all components are optimized.
- Analyze and determine whether optimal startup and shutdown modes are being used.
- Determine whether economizer modes are being used.
- Confirm non-production modes are used, and schedules are being followed.

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Chillers

- Consider raising chilled water temperature to decrease the required temperature lift.
- Consider reducing condenser water temperature to decrease the required temperature lift.
- Verify proper chiller maintenance schedules are being followed.
 - Keep heat transfer surface clean.
 - Remove trapped air from the condenser.
- Consider replacing chilled water with naturally occurring cooling water when the outside temperature is low.
- Consider replacing absorption chillers with electric drive centrifugal chillers.
- Check water cooling systems for water quality (pH and total dissolved solids), flow, operations and temperature.
- Evaluate if air pressure can be reduced to the lowest practical set point.
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Treasure Map FOR MANUFACTURING PLANTS

ADDITIONAL NOTES:

