Low cost improvements

Cost saving measures, productivity enhancements and optimisation opportunities for growers

Task	Detail	Complete?
Measure energy intensity	a. Calculate the energy required per kg crop produced. This will highlight opportunities of cost reduction by improved energy efficiency.	
	b. Get relevant energy bills or coal delivery tons and crop production output.	
	c. Use the energy calculation tool.	
	d. Refer to benchmarking for optimal energy intensity and cost saving opportunity.	
Basic energy saving maintenance	a. Conduct energy awareness training for staff to be efficient energy users.	
	b. Switch off equipment when not in use to either manual or programmed.	
	c. Check for leaking utilities (water/steam/air/CO_2).	
	d. Inspect all vents by ensuring seals are not damaged and sealed correctly.	
	e. Clean and inspect fans - ensure they are free from debris and spinning freely.	
	f. Clean greenhouse roof to optimise light transmission.	
	g. Ensure no broken glass or damaged cladding.	
	h. Check and clean temperature sensors – dry or dirty sensors are inaccurate.	
	i. Implement appropriate scheduling to regularly perform basic energy maintenance highlighted in this list.	
Boiler operations	a. Ensure boiler efficiency is known and being monitored.	
	b. Check your boiler is operating at the optimum efficacy according to OEM specifications.	
	c. Ensure the boilers are operated under strict boiler water quality controls.	

Task	Detail	Complete?
	d. Ensure boiler blow down and cycle rates have been optimised.	
	e. Ensure annual maintenance and cleaning has been undertaken.	
Ventilation	a. Reduce air exchange between greenhouse and outside to reduce heating/cooling loads. For example doors kept closed and installations of door strips.	
	b. Reduce fan speeds below 100% speed, if possible, fans should be over dimensioned, so that they do not need to run at 100% speed – a 20% reduction in fan speed results in a 50% reduction in energy. In general, pumps, fans, etc that can run at variable speeds save electricity and greatly improve controllability.	
Greenhouse temperature	a. Target optimal temperature setpoints remembering higher average temperature wears the plants out faster.	
	b. Consider implementing a "Dif" between day and Night set point temperatures.	
	c. Ensure temperature change is gradual – recommended 1°C per 45-60 minutes will avoid creating condensation on plants.	
	d. Check return water temperature, if its too high this indicates either the pipe temperature is too high and/or the flow rate is too high.	
	e. Use free heating or free cooling when outside air is closer to desired greenhouse conditions than what is currently inside the space.	
	f. Consider a second heating net, independent of the first. This allows much finer climatic control.	
	g. Review possibility of external temperature sensors to adjust boiler temperatures accordingly.	
	h. Review an optimal pipe temperature strategy, suiting the conditions to the desired output temperature.	
CO_2 enrichment	a. Apply CO_2 enrichment only when there is light. Aim for a higher CO_2 level when it is lighter. However, lower the CO_2 enrichment with increasing ventilation. A CO_2 control program can assist with this.	
	b. Target optimal CO_2 levels, 500-600ppm.m	
	c. Target best injection rate for ventilation type, For instance inject 60 kg/ha/hr when there is no ventilation and reduce it to 25 kg/ha/h when the vents are wide open.	
Humidity control	a. Humidity set point can be higher than 80% if there is an even temperature distribution in the greenhouse. It can also be set higher if controllability of the heating and venting system is better.	

Task	Detail	Complete?
	b. Prevent simultaneous heating and venting for humidity control - start with venting and let heating come in automatically if needed for temperature control.	
	c. Check the heating line and ventilation line, ensure there is no accidental cross over between heating and ventilation.	
Computer System	a. Check computer systems regularly and use graphs to inform adjustments. Things to look for include: • Difference between heating and venting setpoint • Minimum pipe temperature • P-band • Dead zones • Timing • Ramping • Purging • Boiler control • Strong fluctuations	
	b. Seek specialist training for climate control and computer control systems operation.	
Vent control	a. Review implementing a smarter venting strategy. At lower outside temperature and/or higher wind speeds, the vents do not need to open fully to be effective. At warm outside temperatures and low wind speed, vents must open far and fast to be effective. The common method to inform vent settings is using a P-band. The P-band should automatically adjust depending on the conditions.	
	b. Review vents on the leeward side and ensure they open first, it is recommended that only when those are open to 2/3 of their maximum extent, should the windward side vents be opened.	
	c. Ensure minimisation of temperature overshoot and oscillation above set point by employing modulating mixing valve control.	
	d. Ensure vents are correctly opening and closing and not getting caught or stuck in a fixed position.	