Regional Council Sewage and Water Treatment Energy Efficiency Guide

Report Prepared for NSW Treasury – Net Zero Regional Council Project

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Northmore Gordon is a climate change consulting firm specialising in energy efficiency, renewable energy and greenhouse gas management for the manufacturing and mining sectors. For further information, please visit our website at http://www.northmoregordon.com

Document information

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Contents

Glossary of Terms

EEOs – Energy Efficiency Opportunities

STP – Sewage Treatment Plant

WTP – Water Treatment Plant

LGCs – Large-scale Generation Certificates

STCs – Small-scale Technology Certificates

PV – Photovoltaic

UV – Ultraviolet

ESC – Energy Saving Certificate

CSF – Compressor System Factor

H_2S – Hydrogen Sulphide

PID - Proportional–Integral–Derivative

VSD – Variable Speed Drive

SCADA - Supervisory Control and Data Acquisition

DO – Dissolved Oxygen

I/O – Input-Output

DAF – Dissolved Air Floatation

RAS – Returned Activated Sludge

COD – Chemical Oxygen Demand

HRALs – High-Rate Anaerobic Lagoons

1 Introduction

1.1 Background

The Sustainable Councils program has been working with Councils to develop Net Zero targets for regional councils in NSW and help them develop plans and strategies for their journey to Net Zero. Working in collaboration with technical experts, Sewage Treatment Plants (STP) and Water Treatment Plants (WTP) have been identified as high energy users for Councils and in need of specific guidance within their Net Zero journey.

1.2 Objectives

Rather than each Council investigate, plan, procure and project manage the implementation of energy projects at STP's and WTP's, NSW Treasury engaged Northmore Gordon to prepare a Net Zero Guide with toolkit and business case template for STP's and WTP's which include:

1. Water and Sewage Treatment asset inventory for a sample set of regional Councils including, where possible: plant size (ML/day), population, treatment type, annual energy consumption, land and other constraints.
2. WTP and STP Net Zero Guide including
    a. A generic energy efficiency checklist for Councils with a range of associated upgrade costs, estimated energy & cost savings and paybacks.
    b. Energy Efficiency Opportunities (EEOs) Toolkit which is an interactive tool which enables councils to enter site specific details and assess the feasibility of 10 most common EEOs for STPs and WTPs.
    c. Waste to Energy assessment to Identify an STP size that a waste to energy project would be viable.
    d. Case studies of sewage reuse projects.
3. An online Tool that Councils can use to identify the optimal size solar array for a behind the meter, ground mounted system considering, costs to supply and install, LGC's vs STC, cents per kW for electricity, energy use profile, simple payback, 25 year operational and maintenance costs including inverter replacement, additional cost scenarios will include: flood prone land, acid sulphate soils, electrical meter upgrades and sub-station constraints
4. A Business Case Template that can be used in conjunction with the Tool above, so that Councils can get internal or external funding for the optimal array size.
5. An online tool that Councils can use for: identifying a mid-scale solar - in front of the meter – for Council sites, such as old landfill sites. Using the tool Council can test a range of sizes, costs, technical considerations for different scenarios.
6. Technical aspects for supply and install.

1.3 Northmore Gordon's approach

Northmore Gordon is a specialist Energy and Carbon Consultancy focused on reducing energy costs and decarbonising industry and commercial facilities. Northmore Gordon has drawn information from energy audits and energy efficiency opportunity assessments conducted for water and sewage treatment facilities in New South Wales and Victoria to create the high-level energy efficiency checklist. Northmore Gordon has used this expertise to develop the EEO toolkit spreadsheet, which enables the input of site specific details to assess the feasibility of 10 EEOs for WTPs and STPs, including waste to energy projects.

Northmore Gordon has also partnered with Beam Energy Labs to deliver the online Solar PV tool. Beam Energy Labs have developed an online assessment toolkit (Beam Solar), to model the energy and financial performance of on-site solar and battery storage projects.

1.4 How to use the suite of documents

The Net Zero Regional council STPs and WTPs guide consists of four key tools for the councils which will enable the selection and assessment of energy efficiency opportunities including solar PV, that will guide the councils in the journey towards Net Zero. The key tools are as follows.

1. **Regional Council Sewage and Water Treatment Plant Energy Efficiency Opportunity Checklist** – This spreadsheet provides indicative energy savings, cost savings and capex estimates for a range of EEOs. As majority of the opportunities are subject to site specific scenarios, the results are presented as a range. Therefore, it is recommended to use this spreadsheet as a starting point to gauge the potential EEOs and associated energy and cost savings.
2. **Regional Council Sewage and Water Treatment Plant Energy Efficiency Assessment Tool** – This spreadsheet is an interactive tool which allows the user to enter site specific details to assess 10 commonly found EEOs in STPs and WTPs. Additionally, this spreadsheet also includes a Waste to Energy feasibility assessment tool which enables the user to enter average daily wastewater inflow amount and the respective biological content in the incoming wastewater to estimate the potential size of the cogeneration plant that could be established at your STP.
3. **Regional Council Sewage and Water Treatment Plant Energy Efficiency Guide** – The EEO guide is this document which provides information and details on how to use each of the EEOs present in the EEO toolkit.
4. **Small and Large scale solar PV assessment tool** – This online tool will enable the councils to assess the potential solar PV capacity depending on various factors such as site’s current load profile, local weather conditions, land and roof availability etc. The tool can be accessed using the link here.

2 Energy Efficiency Opportunities

2.1 A Note on Energy Efficiency Incentives

Most of the opportunities presented in this tool and guide are eligible to be used to create environmental certificates, which may include:

- ACCUs (Australian Carbon Credit Units) - federal program for carbon offset projects
- LGCs (Large-scale Generation Certificates) – federal program for onsite generation
- ESCs (Energy Saving Certificates) – state program for energy efficiency projects

Some projects, depending on the scale, scheme chosen and the price of that certificate at the time, may be on their own worthwhile using in a certificate project. Waste to energy projects and improvements for some UV disinfection projects may be in this category. Others may become viable if done at scale (for example, replacing multiple high efficiency motors across a number of sites), and some may only be viable if combined into a single certificate project (so completing a number of the opportunities in this guide, and potentially others, at the same time and measuring the savings in one project).

Due to the complexity of each project and the impacts on what incentives can be achieved (equipment specifications, site and processing conditions, location, certificate price at the time of registration or trade) and the requirement to meet eligibility criteria in each case, further details about the specific opportunity would need to be considered to provide an estimate of value and feasibility.

Note that at the time of writing, opportunities which manage demand such as through load shifting are not able to create certificates, however this may change in the future.

2.2 Control Ultraviolet (UV) lamp intensity based on effluent flow rate and transmissivity

Opportunity 1: Control Ultraviolet (UV) lamp intensity based on effluent flow rate and transmissivity		
Baseline situation	UV systems used for disinfection of the effluent are sometimes operated at full power, regardless of the effluent flow or transmissivity. This could be a result of either lack of an operating dose control program, or sensors and wiper blades requiring repairs.	
Suggested improvement	It is recommended to implement / reinstate dose control mode for the UV system to control the lamp intensity based on effluent flow rate and transmissivity. This will ensure that only the required amount of dosage will be received while creating potentially significant energy savings.	
Estimated Cost ($)	**Electricity Savings (MWh p.a.)**	**Typical Payback (years)**
Up to $25,000[1]	**40 - 500[1] MWh p.a**	**Less than one year**
Key Assumptions	- Energy savings calculation assumes a 50% reduction in lamp intensity at off-peak hours.	

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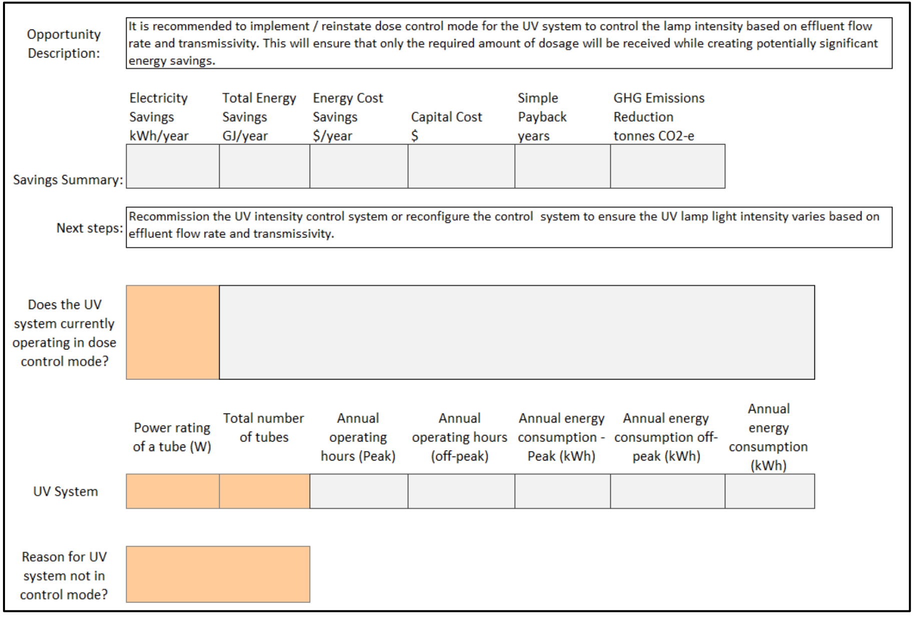
[1] Savings are subject to size of the site and the current energy usage by the UV disinfection system.

Opportunity 1: Control Ultraviolet (UV) lamp intensity based on effluent flow rate and transmissivity	
	• Energy savings calculation assumes a 25% reduction in lamp intensity at peak hours. • Energy consumption of UV lamps reduce linearly with the change of intensity.
Co-benefits	• Reduction in lamp intensity may prolong the useful life of the UV lamps. • Depending on the scale, this project may be eligible to create Energy Saving Certificates (ESCs) under the Energy Saving Scheme in NSW which would provide an added revenue which could improve project finances.
Risks	• Sensors that measure effluent flow and transmissivity may produce erroneous results and therefore ensure that they are maintained properly and tested for accuracy as per the guidelines. • It is important to incorporate sufficient safeguards to ensure effluent does not pass through untreated, as it could breach regulatory requirements. • If programming changes are made which enable lamps to be switched on and off, consideration should be given to the recommended frequency and total number of cycles based on manufacturer recommendations
How to use the toolkit	Figure 1 represents the toolkit interface of this EEO. Use the following steps to calculate energy & cost savings, estimated CAPEX and payback. • Select from the drop-down menu whether the UV system is currently operating in dose control mode. • If “No” is selected as the response, enter tube numbers and power rating on a tube. This will enable the calculation of annual energy consumption of the UV disinfection system. • Select the reason for the UV system for not operating in dose control mode from the drop-down menu. This will provide a more accurate capital cost estimate depending on the selection.

Opportunity 1: Control Ultraviolet (UV) lamp intensity based on effluent flow rate and transmissivity



Opportunity Description: It is recommended to implement / reinstate dose control mode for the UV system to control the lamp intensity based on effluent flow rate and transmissivity. This will ensure that only the required amount of dosage will be received while creating potentially significant energy savings.

	Electricity Savings kWh/year	Total Energy Savings GJ/year	Energy Cost Savings $/year	Capital Cost $	Simple Payback years	GHG Emissions Reduction tonnes CO2-e
Savings Summary:						

Next steps: Recommission the UV intensity control system or reconfigure the control system to ensure the UV lamp light intensity varies based on effluent flow rate and transmissivity.

Does the UV system currently operating in dose control mode?

	Power rating of a tube (W)	Total number of tubes	Annual operating hours (Peak)	Annual operating hours (off-peak)	Annual energy consumption - Peak (kWh)	Annual energy consumption off-peak (kWh)	Annual energy consumption (kWh)
UV System							

Reason for UV system not in control mode?

Figure 1: Optimisation of UV disinfection opportunity interface in the EEO toolkit.

2.3 Blower System Optimisation

Opportunity 2: Blower System Optimisation		
Baseline situation	Where multiple blowers operate in tandem, it is commonly observed that the trim blower undergoes rapid cycling resulting in efficiency losses. Moreover, there may be potential to optimise the overall blower system.	
Suggested improvement	It is recommended that STPs consider tuning the blower control system to avoid load/unload cycling of the trim blower. This is typically achieved by trimming the output of both blowers when achieving the required aeration rate. The reduction of rapid cycling would ensure the motors are operating close to the best efficiency point. Moreover, the toolkit combines the avoidance of rapid cycling with blower system optimisation which involves updating the control settings of the blowers to target operation at their best efficiency point.	
Estimated Cost ($)	**Electricity Savings (MWh p.a.)**	**Typical Payback (years)**
Subject to the respective site-specific inputs.		**Less than three years**
Key Assumptions	• Energy savings of up to 5% with proper blower staging and 10% with blower optimisation are based on project experience from similar facilities.[2] The actual energy savings from this opportunity is highly subjective of the existing operational patterns of each of the STPs/WTPs.	

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[2] https://www.environment.nsw.gov.au/research-and-publications/publications-search/energy-efficiency-opportunities-in-wastewater-treatment-facilities

Opportunity 2: Blower System Optimisation

Co-benefits

- Avoidance of rapid cycling of the trim blower would prolong the useful life of the equipment.

Risks

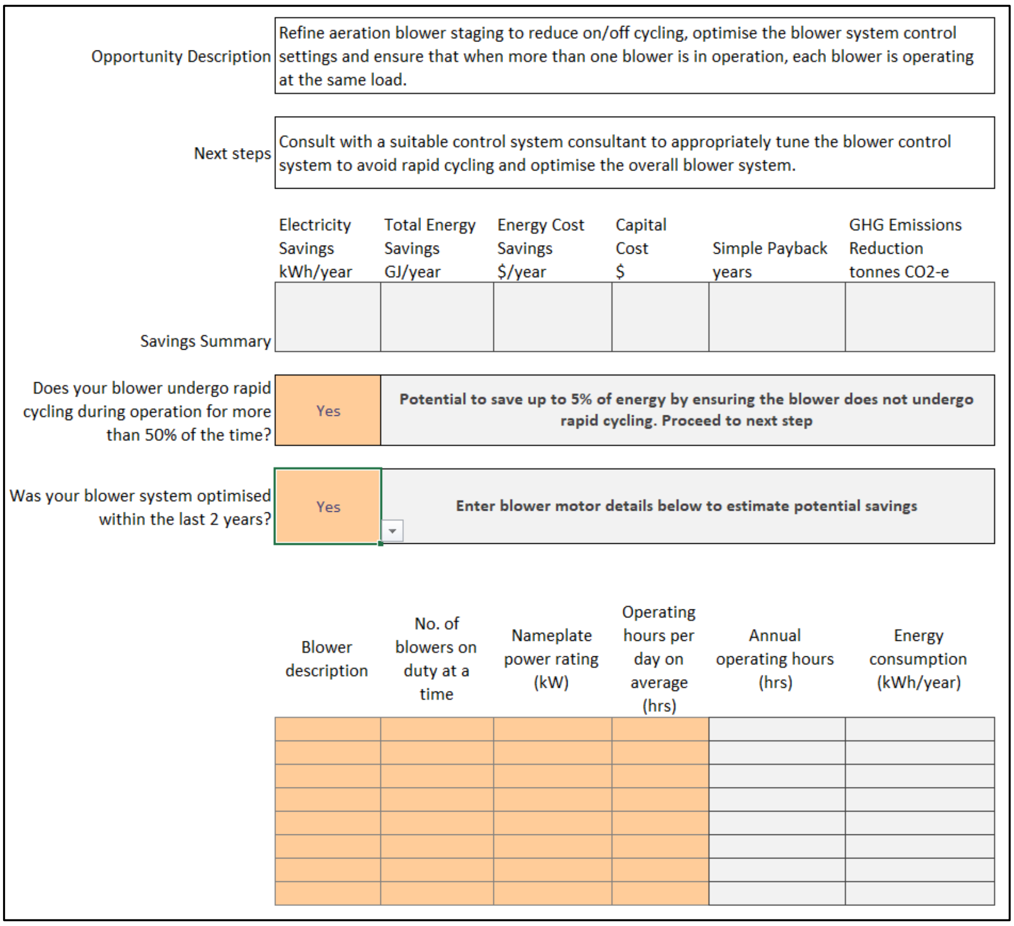
- Post-implementation verification should be undertaken to confirm that the blowers are operating efficiently and achieving the necessary process targets.

How to use the toolkit

Figure 2 represents the toolkit interface of this EEO. Use the following steps to calculate energy & cost savings, estimated CAPEX and payback.

- Enter the response to the two questions from the drop-down menu. This will assess the suitability and level of energy savings of this opportunity for your STP.
- Enter blower details such as count, power rating and daily operational hours.

Savings summary will provide estimated energy savings, cost savings, capital costs and payback.



Opportunity Description	Refine aeration blower staging to reduce on/off cycling, optimise the blower system control settings and ensure that when more than one blower is in operation, each blower is operating at the same load.
Next steps	Consult with a suitable control system consultant to appropriately tune the blower control system to avoid rapid cycling and optimise the overall blower system.

	Electricity Savings kWh/year	Total Energy Savings GJ/year	Energy Cost Savings $/year	Capital Cost $	Simple Payback years	GHG Emissions Reduction tonnes CO2-e
Savings Summary						

Does your blower undergo rapid cycling during operation for more than 50% of the time?	Yes	**Potential to save up to 5% of energy by ensuring the blower does not undergo rapid cycling. Proceed to next step**
Was your blower system optimised within the last 2 years?	Yes	**Enter blower motor details below to estimate potential savings**

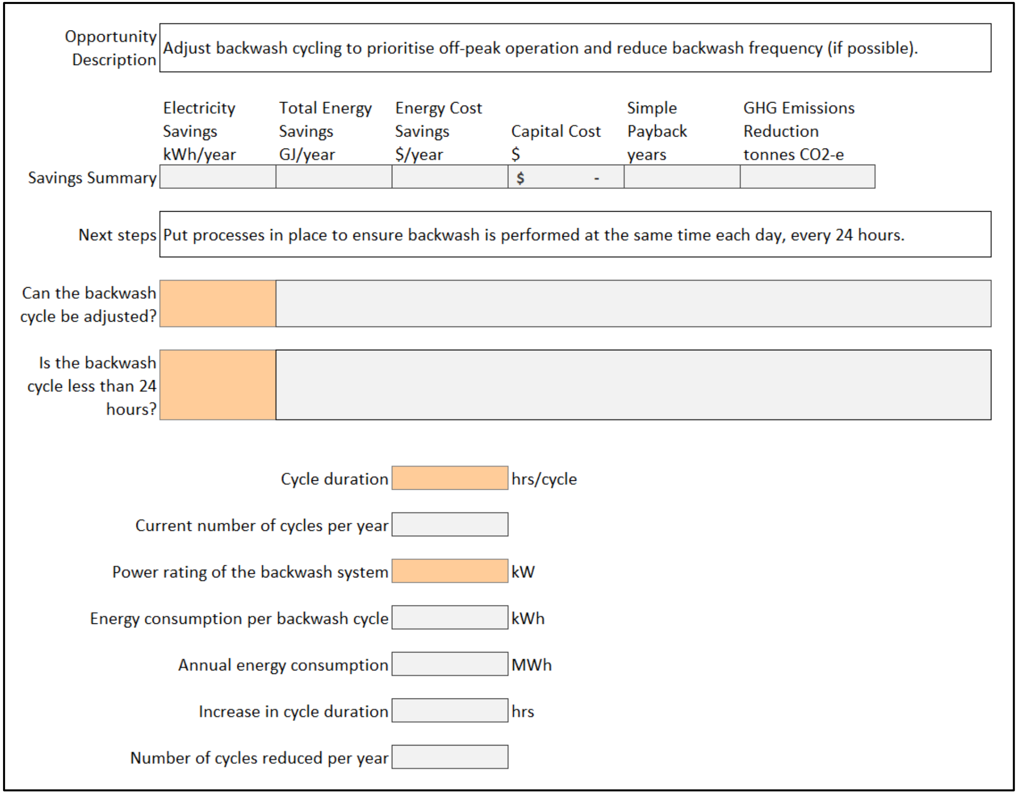
Blower description	No. of blowers on duty at a time	Nameplate power rating (kW)	Operating hours per day on average (hrs)	Annual operating hours (hrs)	Energy consumption (kWh/year)

Figure 2: Improve aeration blower staging opportunity interface in the EEO toolkit.

2.4 Backwash Cycle Optimisation

Opportunity 3: Backwash Cycle Optimisation		
Baseline situation	The filters undergo a backwash cycle, typically scheduled to operate once every 16 hours.	
Suggested improvement	If it is possible to extend the time between backwash cycles to once every 24 hours without impairing filter performance, then not only could the total energy consumption be reduced, but the cycles could be preferentially scheduled to off-peak hours, taking advantage of the tariff differential and avoiding the demand spikes that contribute to capacity charges. The filter flux monitoring would still be in place and able to call for an early backwash if required before the scheduled backwash time. Scheduling could also be adjusted to avoid backwashing at the same time as other intermittent processes, aiming to reduce peak demand and associated charges.	
Estimated Cost ($)	**Electricity Savings (MWh p.a.)**	**Typical Payback (years)**
≈ $5,000	**Subject to the respective site-specific inputs.**	**Less than one year**
Key Assumptions	• This opportunity is contingent on extending the time between backwashes to 24 hours not impairing filtration system performance. This assumption will need to be verified in a plant trial, monitoring individual filter tank level and flux over extended periods between backwash cycles.	
Co-benefits	• Energy cost savings through taking advantage of shoulder and off-peak rates. • There is potential energy savings from a long train of processes triggered by the backwash, which includes treatment of the backwash effluent. Therefore, there are additional energy savings beyond that related to the backwash pumps.	
Risks	• Conditions in Key Assumptions need to be met for this opportunity to be viable.	
How to use the toolkit	Figure 3 represents the toolkit interface of this EEO. Use the following steps to calculate energy & cost savings, estimated CAPEX and payback. • Enter the response to the two questions from the drop-down menu. This will assess the suitability of this opportunity for your WTP. • Enter the number of hours per cycle and the power rating of the equipment belonging to the backwash system. Savings summary will provide estimated energy savings, cost savings, capital costs and payback.	

Opportunity 3: Backwash Cycle Optimisation



Opportunity Description: Adjust backwash cycling to prioritise off-peak operation and reduce backwash frequency (if possible).

	Electricity Savings kWh/year	Total Energy Savings GJ/year	Energy Cost Savings $/year	Capital Cost $	Simple Payback years	GHG Emissions Reduction tonnes CO2-e
Savings Summary				$ -		

Next steps: Put processes in place to ensure backwash is performed at the same time each day, every 24 hours.

Can the backwash cycle be adjusted?

Is the backwash cycle less than 24 hours?

Cycle duration hrs/cycle

Current number of cycles per year

Power rating of the backwash system kW

Energy consumption per backwash cycle kWh

Annual energy consumption MWh

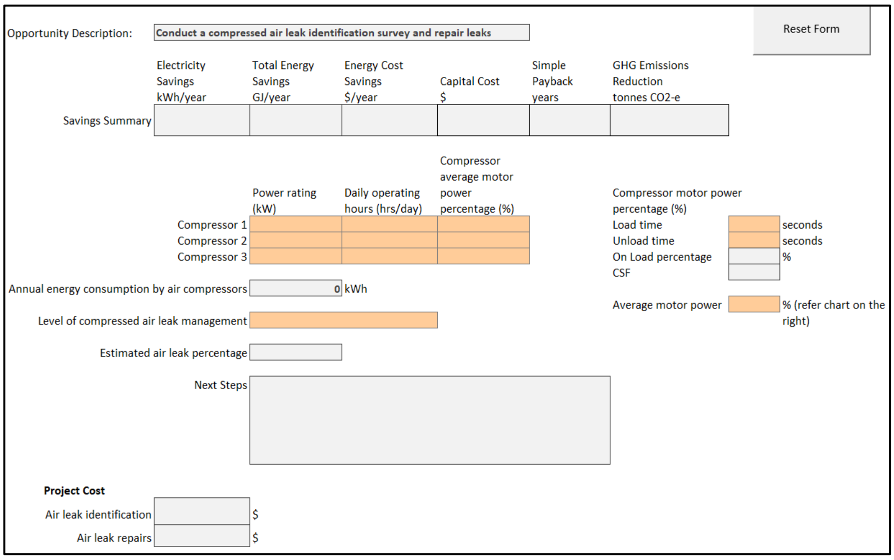
Increase in cycle duration hrs

Number of cycles reduced per year

Figure 3: Backwash optimisation opportunity interface in the EEO toolkit.

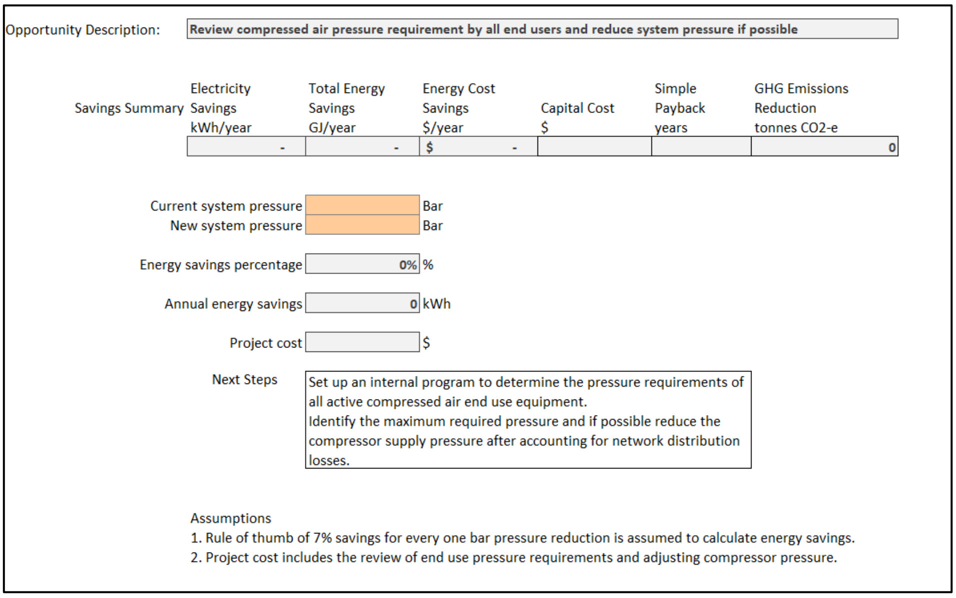
2.5 Compressed Air Leak Repair

Opportunity 4: Compressed Air Leak Repair		
Baseline situation	It is common for compressed air networks to leak unnoticed. Based on Northmore Gordon's experience with conducting air leak surveys and end use assessments, poorly maintained sites can have air leakage rates of up to 30% to 40%.	
Suggested improvement	Compressed air is highly energy intensive to produce and therefore air leaks represent a significant wastage in energy usage. Moreover, air leaks create pressure drops in the network, requiring the compressors to operate at much higher pressure set points than required, which further increases energy consumption. Therefore, it is recommended that STPs and WTPs consider conducting compressed air leak surveys to identify leaks in the network and repair the identified leaks.	
Estimated Cost ($)	**Electricity Savings (MWh p.a.)**	**Typical Payback (years)**
≈ $6,500	**10% to 30% of compressor total energy usage**	**Less than one year**
Key Assumptions	• Poorly maintained compressed air networks have air leaks of about 30% of overall site's air demand.	

Opportunity 4: Compressed Air Leak Repair	
	- Averagely maintained compressed air networks have air leaks of about 15% of overall site’s air demand. - Well maintained compressed air networks have air leaks of about 5% of overall site’s air demand. - A compressed air leak wastes about 2,000 kWh / year.
Co-benefits	- Further reduction in compressor energy consumption by reducing compressor pressure set point after repairing air leaks. - Reduce compressor run hours.
Risks	- Compressed air leaks tend to reappear after a certain time period. Therefore, leak repairs need to be a routine task.
How to use the toolkit	Figure 4 represents the toolkit interface of this EEO. Use the following steps to calculate energy & cost savings, estimated CAPEX and payback. - Enter the power rating of the air compressors and the respective annual operating hours. - The compressor motor power percentage can either be entered as an assumed value (of about 0.7 to 0.8) or could be calculated using measured load and unload times and CSF curves. A detailed description on how to use the CSF curve is present in the toolkit. - Select the level of air leaks from the drop down menu. Once all of the above steps are complete, the toolkit will calculate and show energy savings, cost savings, estimated capital cost and payback specific to your WTP or STP. The project cost value includes air leak identification using the ultrasonic leak detection method, and air leak repair by a contractor.  Opportunity Description: Conduct a compressed air leak identification survey and repair leaks Annual energy consumption by air compressors: 0 kWh Figure 4: Compressed air leak repair opportunity interface in the EEO toolkit.

2.6 Compressed Air Pressure Optimisation

Opportunity 5: Compressed Air Pressure Optimisation		
Baseline situation	It is commonly observed that compressed air pressure requirements are not regularly reviewed by industrial facilities, and Northmore Gordon has identified a number of sites where compressor supply pressure had not been changed even after the equipment with the highest pressure requirement was removed / changed.	
Suggested improvement	It is recommended that STPs and WTPs consider reviewing compressed air pressure requirements of all compressed air end users and investigate the possibility of reducing supply pressure after accounting for distribution pressure losses.	
Estimated Cost ($)	**Electricity Savings (MWh p.a.)**	**Typical Payback (years)**
$500	**7% energy savings from total compressor energy consumption for every 1 bar pressure reduction.**	**Immediate**
Key Assumptions	• To save energy through this opportunity, it should be identified that compressor set points are higher than what is required by compressed air end use equipment.	
Co-benefits	• Reduction in compressor supply pressure set point would subsequently reduce the number of air leaks on site as system pressure has a direct influence on the compressed air leaks.	
Risks	• Compressor set points may need to be increased back to the previous level if the equipment that required the highest pressure is replaced with a similar equipment or repaired.	
How to use the toolkit	Figure 5 represents the toolkit interface of this EEO. Use the following steps to calculate energy & cost savings, estimated CAPEX and payback. Review pressure requirements of all compressed air end users on site and if it is identified that compressor pressure is more than what is required, enter	

Opportunity 5: Compressed Air Pressure Optimisation	
	the current and new system pressure in the toolkit. Once the values are entered, the savings estimates will appear in the savings summary section.  Figure 5: Compressed air pressure optimisation opportunity interface in the EEO toolkit.

Opportunity Description: Review compressed air pressure requirement by all end users and reduce system pressure if possible

Savings Summary	Electricity Savings kWh/year	Total Energy Savings GJ/year	Energy Cost Savings $/year	Capital Cost $	Simple Payback years	GHG Emissions Reduction tonnes CO2-e
	-	-	$ -			0

Current system pressure		Bar
New system pressure		Bar
Energy savings percentage	0%	%
Annual energy savings	0	kWh
Project cost		$

Next Steps: Set up an internal program to determine the pressure requirements of all active compressed air end use equipment.
Identify the maximum required pressure and if possible reduce the compressor supply pressure after accounting for network distribution losses.

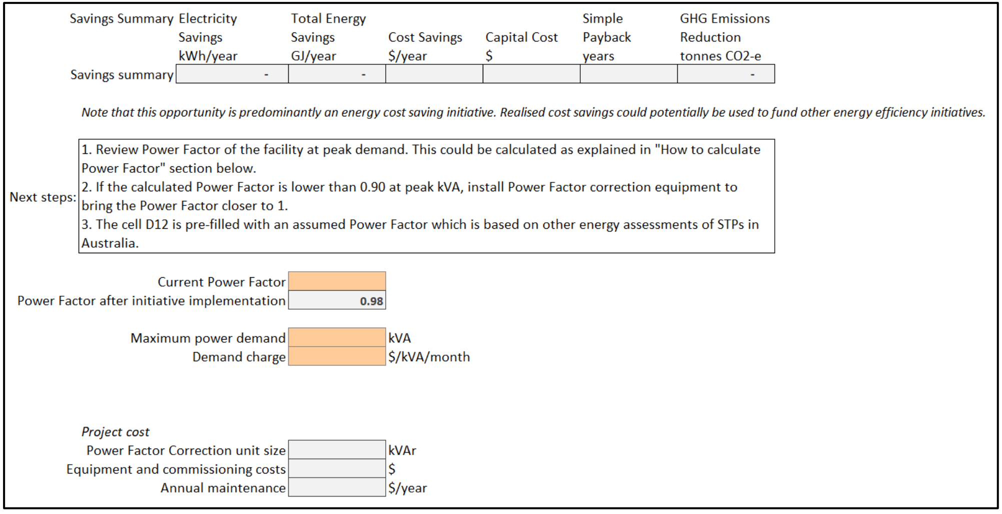
Assumptions
1. Rule of thumb of 7% savings for every one bar pressure reduction is assumed to calculate energy savings.
2. Project cost includes the review of end use pressure requirements and adjusting compressor pressure.

2.7 Review Power Factor and Install Power Factor Correction Units

Opportunity 6: Review Power Factor and Install Power Factor Correction Units	
Baseline situation	Network demand charge can be a significant cost component of a site’s electricity bills and is determined by the maximum network demand experienced during the billing cycle. The network demand is charged based on the apparent power (kVA) which is related to the Power Factor. When the Power Factor is lower than 1, the Apparent Power (kVA) will be higher than the Real Power (kW) indicating that what is being charged for the network demand is more than the actual sites demand. The effect of poor Power Factors will have varying consequences depending on the tariff structure. For example, a site may be on a twelve-month rolling demand charge, which means a single spike in demand could cause a long-term energy cost increase. Additionally, sites may be incurring a summer demand incentive charge, increasing the imperative to reduce total kVA particularly in these peak times.
Suggested improvement	Northmore Gordon has observed Power Factors of 0.75 – 0.9 in STPs and WTPs. Therefore, it is recommended to review the existing Power Factor at maximum demand, and if appropriate install Power Factor correction units to bring the Power Factor close to unity (about 0.98). This will reduce the

Opportunity 6: Review Power Factor and Install Power Factor Correction Units		
	monthly maximum kVA and may therefore provide cost savings, depending on the tariff structure.	
Estimated Cost ($)	**Electricity Savings (MWh p.a.)**	**Typical Payback (years)**
Subject to PF unit size.	**n/a**	**Less than 5 years.**
Key Assumptions	• This is only relevant for sites on a tariff structure which includes a demand charge. • Accurate determination of site's Power Factor would require interval data analysis. A conservative figure of about 0.85 could be used if access and analysis of interval data is not possible. • It is assumed that maximum demand entered in cell D15 will prevail throughout the year to estimate cost savings. To improve the accuracy, enter the annual average of the monthly maximum demand.	
Co-benefits	• Energy cost savings with quick paybacks that could be utilised for other energy efficiency and carbon abatement opportunities.	
Risks	• Depending on the chosen technology, the installed equipment may not resolve all power factor issues. For example, if there are a number of non-linear loads (such as variable speed drives), then there may be some amount of harmonic distortion which would not be resolved by static VAR generators (SVG), and would require the installation of active power filtering (APF) in addition to the SVG. This can be determined by analysing power quality at the site. • Some technology (such as capacitor banks) may also require ongoing annual service fees for maintenance and cleaning (estimated at approximately $700 per year)	
Next Steps	Figure 6 represents the toolkit interface of this EEO. Use the following steps to calculate energy & cost savings, estimated CAPEX and payback. • Enter the current Power Factor, maximum Network Demand and Network Demand charge of your STP/WTP. • The tool will calculate the required size of the Power Factor correction units (in kVAr) required to bring the Power Factor up to 0.98. Savings summary will provide estimated energy cost savings, capital costs and payback for this opportunity.	

Opportunity 6: Review Power Factor and Install Power Factor Correction Units



Savings Summary	Electricity Savings kWh/year	Total Energy Savings GJ/year	Cost Savings $/year	Capital Cost $	Simple Payback years	GHG Emissions Reduction tonnes CO2-e
Savings summary	-	-				-

Note that this opportunity is predominantly an energy cost saving initiative. Realised cost savings could potentially be used to fund other energy efficiency initiatives.

Next steps:

1. Review Power Factor of the facility at peak demand. This could be calculated as explained in "How to calculate Power Factor" section below.
2. If the calculated Power Factor is lower than 0.90 at peak kVA, install Power Factor correction equipment to bring the Power Factor closer to 1.
3. The cell D12 is pre-filled with an assumed Power Factor which is based on other energy assessments of STPs in Australia.

Current Power Factor		
Power Factor after initiative implementation	0.98	
Maximum power demand		kVA
Demand charge		$/kVA/month

Project cost

Power Factor Correction unit size		kVAr
Equipment and commissioning costs		$
Annual maintenance		$/year

Figure 6: Power Factor correction opportunity interface in the EEO toolkit.

2.8 Install VSDs on Odour Control Ventilation Fans

Opportunity 7: Install VSDs on Odour Control Ventilation Fans		
Baseline situation	It is commonly observed that odour control ventilation fans are set to operate at fixed speeds irrespective of H_2S levels or time of the day.	
Suggested improvement	It is recommended to install VSDs to configure fans to run at lower speeds when the levels of H_2S are lower, with a bottom limit set to ensure that the filters continue to function correctly, air change-over rates are maintained and that air escapes from the stack at an appropriate rate. Such an adjustment would require robust monitoring to ensure that air quality levels and scrubber operation are not impeded whilst the plant is occupied. An alternative to operating the fans on a PID-based control, is to designate a reduced load period overnight. For example, if the fans are reduced to 10% speed overnight (provided that H_2S limits are not exceeded, in which case an override scenario would enable) this would result in a reduction in power up to 29% for these hours, based on affinity laws.	
Estimated Cost ($)	**Electricity Savings (MWh p.a.)**	**Typical Payback (years)**
Subject to the respective site-specific inputs.	**40 – 60 MWh p.a**[3]	**Less than four years.**
Key Assumptions	• Energy savings through the motor speed reduction using the VSDs are calculated as per the pump affinity laws (refer to the technical details section further down in this table). Energy savings estimates represents a theoretical maximum amount which may be slightly higher than what could be achieved. • The PID-based control approach assumes that the STP/WTP has a SCADA system and CAPEX estimates do not include costs for the establishment of a SCADA system.	
Co-benefits	Reduced wear on the fan motors.	
Risks	• Ventilation fan motor speed cannot be lowered below the critical limit to ensure that filters continue to function correctly, air change-over rates are maintained and that air escapes from the stack at an appropriate rate. • Any changes to the odour control system may require some hygiene monitoring before and after the change to ensure appropriate environmental conditions are being maintained.	
How to use the toolkit	Figure 7 represents the toolkit interface of this EEO. Use the following steps to calculate energy & cost savings, estimated CAPEX and payback. • Enter motor details such as number of duty fans, power rating and operational hours per day. • If the existing motors are controlled by VSDs, insert the reduced motor speed. If not, enter 100%.	

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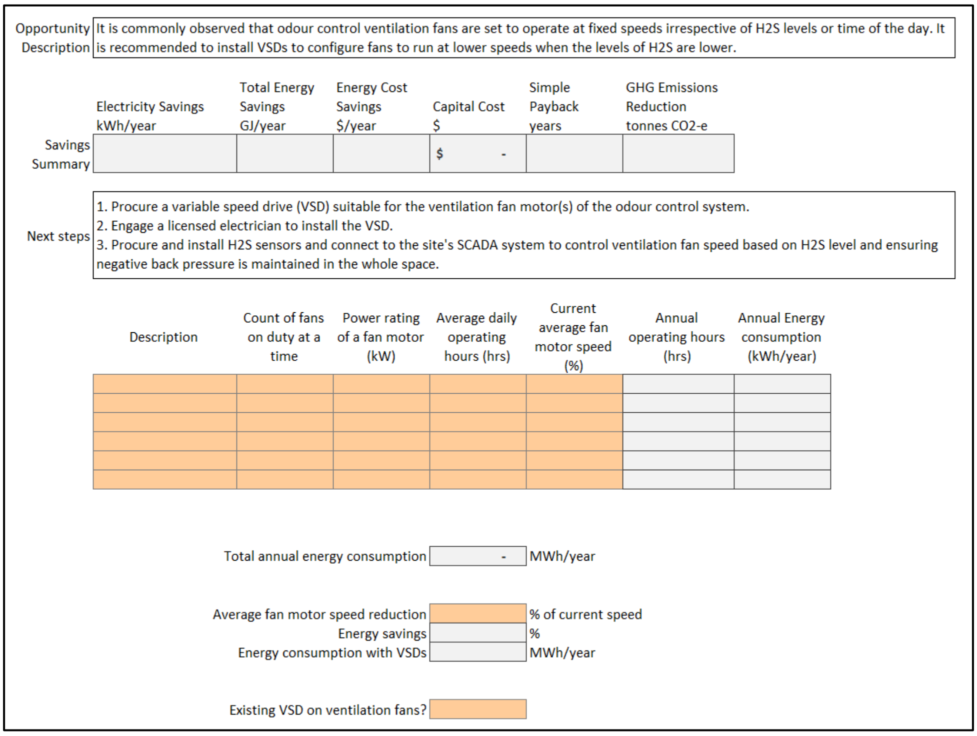
[3] Savings are subject to the size of the odour control system.

Opportunity 7: Install VSDs on Odour Control Ventilation Fans

- Select the average percentage of speed reduction that is achievable, from the dropdown menu.
- whether there are VSDs on the ventilation fan motors. Input to this cell will adjust the project capital cost accordingly.

Once all input cells are complete, the estimated energy savings, cost savings, capital cost and payback will be present in the savings summary. Click on “Reset Form” button if required to re-start the calculation or assess a different scenario.



Opportunity Description: It is commonly observed that odour control ventilation fans are set to operate at fixed speeds irrespective of H2S levels or time of the day. It is recommended to install VSDs to configure fans to run at lower speeds when the levels of H2S are lower.

	Electricity Savings kWh/year	Total Energy Savings GJ/year	Energy Cost Savings $/year	Capital Cost $	Simple Payback years	GHG Emissions Reduction tonnes CO2-e
Savings Summary				$ -		

Next steps:
1. Procure a variable speed drive (VSD) suitable for the ventilation fan motor(s) of the odour control system.
2. Engage a licensed electrician to install the VSD.
3. Procure and install H2S sensors and connect to the site's SCADA system to control ventilation fan speed based on H2S level and ensuring negative back pressure is maintained in the whole space.

Description	Count of fans on duty at a time	Power rating of a fan motor (kW)	Average daily operating hours (hrs)	Current average fan motor speed (%)	Annual operating hours (hrs)	Annual Energy consumption (kWh/year)

Total annual energy consumption: - MWh/year

Average fan motor speed reduction: % of current speed
Energy savings: %
Energy consumption with VSDs: MWh/year

Existing VSD on ventilation fans?

Figure 7: VSDs on ventilation fans opportunity interface in the EEO toolkit.

Technical details

Pump Affinity Laws - Affinity Laws describes the relationship between power, flow, impeller diameter, head, shaft speed of a motor. The laws apply to pumps and fans and explain to what extent a reduction in motor speed will result in a disproportionate reduction in power consumption.

Equation 1: Pump affinity laws

$$\frac{P1}{P2} = \left(\frac{n1}{n2}\right)^3$$

Where,

P1 = The current power (kW)
P2 = The new power (kW)
N1 = The current motor speed (rpm)
N2 = The reduced motor speed (rpm)

2.9 Install VSD on Surface Aerators

<table>
<tr><th colspan="3">Opportunity 8: Install VSD on Surface Aerators</th></tr>
<tr><td>Baseline situation</td><td colspan="2">Surface aerators in lagoons and aeration tanks are generally operated at a fixed speed to deliver a specified amount of oxygen. It is common for surface aerators to be sized to supply the maximum oxygen requirement. However, in operation, the oxygen requirement varies depending on inflow to the lagoon/tank.</td></tr>
<tr><td>Suggested improvement</td><td colspan="2">It is recommended that WTPs and STPs consider installing VSDs to reduce surface aerator speed when oxygen demand is low. The control of the VSDs can either be from Dissolved Oxygen (DO) sensors located throughout the lagoon/tank or from the inflow rate to the lagoon/tank.</td></tr>
<tr><td>Estimated Cost ($)</td><td>Electricity Savings (MWh p.a.)</td><td>Typical Payback (years)</td></tr>
<tr><td colspan="2">Subject to the respective site-specific inputs.</td><td>Less than four years.</td></tr>
<tr><td>Key Assumptions</td><td colspan="2">Energy savings are calculated as per the affinity laws. Therefore, savings estimate represents a theoretical maximum amount which may be slightly higher than what could be achieved.
The calculations use an average motor load factor of 0.8.
There is a SCADA system and necessary I/O boards at close proximity to the lagoons to enable network connection to either the DO sensors or inflow meters. If the site requires network upgrades, energy cost savings are unlikely to justify the additional CAPEX requirement.</td></tr>
<tr><td>Co-benefits</td><td colspan="2">Reduced wear on the aerator motors and therefore would prolong useful life of them.
Improved process control.</td></tr>
<tr><td>Risks</td><td colspan="2">For larger lagoons, it may not be practical to place DO sensors and obtain consistent DO level data due to the changing DO level in different sections of the lagoon. Therefore, in such cases, controlling VSD speed based on inflow may be more beneficial.</td></tr>
<tr><td>Additional notes</td><td colspan="2">Surface aerator technologies that are available in the market have different levels of energy efficiency. The energy efficiency is benchmarked based on the oxygen transfer rate measured in kg O_2 / kWh. Table 1 represents the range of oxygen transfer rates based on mechanical aerator type. It is recommended that STPs consider slow speed surface aerators to replace existing units when they reach end of life, as they have the highest oxygen transfer rate per unit of electricity, that is about 25% more efficient compared to high-speed turbine aerators.
Table 1: Oxygen transfer rate (kg O_2/kWh) based on mechanical aerator type.
<table>
<tr><th>Type of mechanical aerator</th><th>Oxygen transfer rate (kg O_2 / kWh)</th></tr>
<tr><td>Brush aerators</td><td>1.52 – 2.13</td></tr>
<tr><td>Slow speed surface aerators</td><td>1.82 – 2.13</td></tr>
</table></td></tr>
</table>

Opportunity 8: Install VSD on Surface Aerators

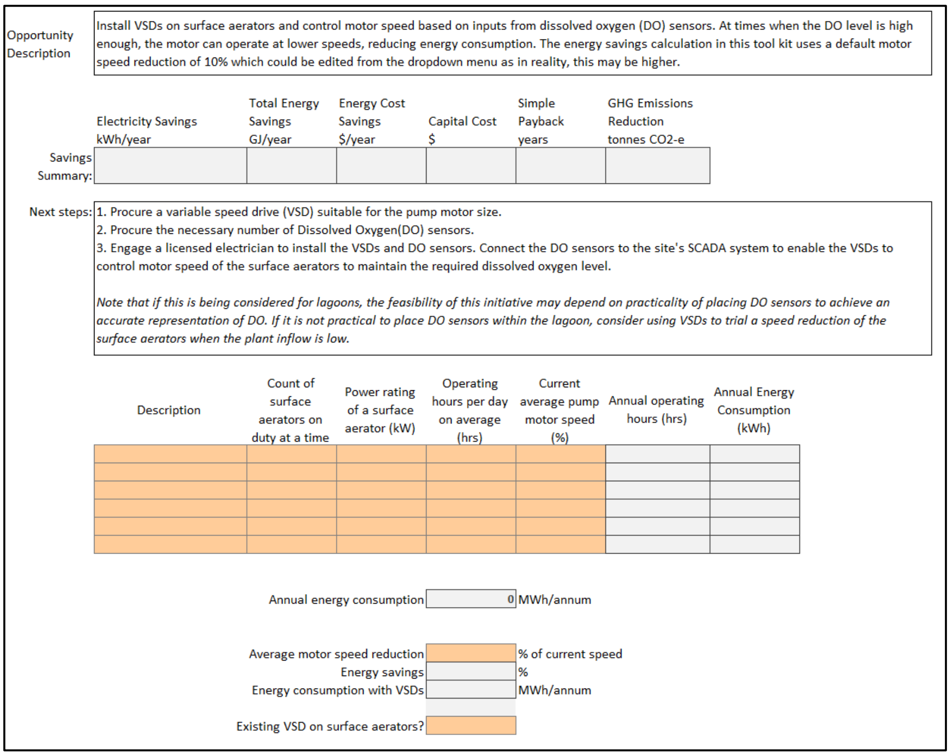
Vertical turbine (high speed surface) aerators	1.52 – 1.98
Induced surface aerators	0.61 – 0.91
Submerged turbine (turbine mixer & compressor)	0.91 – 1.52

How to use the toolkit

Figure 8 represents the toolkit interface of this EEO. Use the following steps to calculate energy & cost savings, estimated CAPEX and payback.

- Enter the motor ratings, count of the active surface aerators and the respective daily operational hours.
- Select the average speed reduction from the drop-down menu. Use 10% as a conservative estimate.
- Enter whether surface aerators are already connected to VSDs. This will adjust the project capital cost accordingly.

Upon completion of the relevant cells, the savings summary will provide the estimated energy savings, cost savings, capital costs and payback.



Opportunity Description: Install VSDs on surface aerators and control motor speed based on inputs from dissolved oxygen (DO) sensors. At times when the DO level is high enough, the motor can operate at lower speeds, reducing energy consumption. The energy savings calculation in this tool kit uses a default motor speed reduction of 10% which could be edited from the dropdown menu as in reality, this may be higher.

	Electricity Savings kWh/year	Total Energy Savings GJ/year	Energy Cost Savings $/year	Capital Cost $	Simple Payback years	GHG Emissions Reduction tonnes CO2-e
Savings Summary:						

Next steps:
1. Procure a variable speed drive (VSD) suitable for the pump motor size.
2. Procure the necessary number of Dissolved Oxygen(DO) sensors.
3. Engage a licensed electrician to install the VSDs and DO sensors. Connect the DO sensors to the site's SCADA system to enable the VSDs to control motor speed of the surface aerators to maintain the required dissolved oxygen level.

Note that if this is being considered for lagoons, the feasibility of this initiative may depend on practicality of placing DO sensors to achieve an accurate representation of DO. If it is not practical to place DO sensors within the lagoon, consider using VSDs to trial a speed reduction of the surface aerators when the plant inflow is low.

Description	Count of surface aerators on duty at a time	Power rating of a surface aerator (kW)	Operating hours per day on average (hrs)	Current average pump motor speed (%)	Annual operating hours (hrs)	Annual Energy Consumption (kWh)

Annual energy consumption 0 MWh/annum

Average motor speed reduction % of current speed
Energy savings %
Energy consumption with VSDs MWh/annum

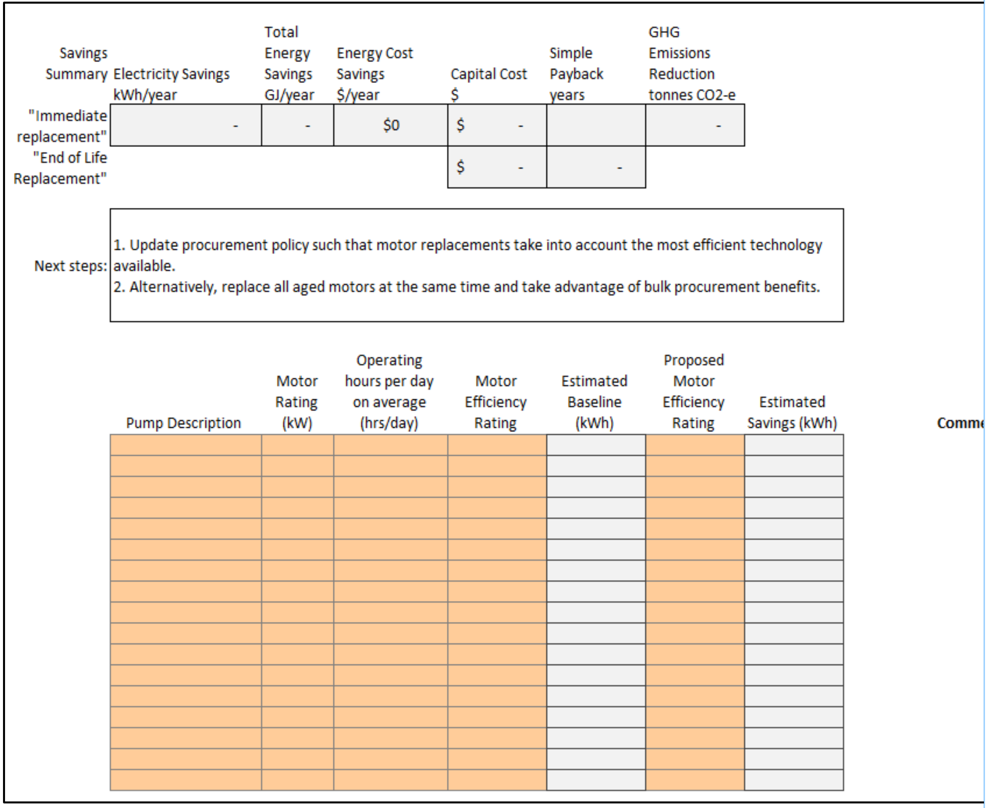
Existing VSD on surface aerators?

Figure 8: VSDs on surface aerators opportunity interface in the EEO toolkit.

2.10 Improve Motor Efficiency - Replace motors with high efficiency motors at the end of life

Opportunity 9: Improve Motor Efficiency - Replace motors with high efficiency motors at the end of life		
Baseline situation	STPs and WTPs use a significant number of motors and it is commonly observed that the majority of the older motors on site are of lower efficiency class (No IE class or IE1).	
Suggested improvement	It is recommended that STPs and WTPs consider replacing motors with a higher efficiency class (IE3 or IE4) when they reach end of life. Immediate replacement prior to end of life is unlikely to be justifiable as energy savings are in the range of 1% to 10%, depending on motor size. Note that the replacement of high efficiency motors may be eligible to create deemed ESCs under the NSW Energy Saver program, which may further reduce the payback for this activity. Contact an accredited certificate provider (ACP) for further information.	
Estimated Cost ($)	**Electricity Savings (MWh p.a.)**	**Typical Payback (years)**
Subject to motor size.	**1% to 10% - Subject to motor size.**	**Less than 5 years for end-of-life replacements.**
Key Assumptions	• Lower the motor rating, higher the efficiency gain. For example, upgrading an IE1 class 1.1kW motor to IE3 would result in energy savings of about 10% whereas the same for a 37kW motor is about 3%.	
Co-benefits	• High efficiency class motors generally have comparatively higher useful lives.	
Risks	• High efficiency class motors are physically larger than standard motors and therefore consider space restrictions prior deciding to upgrade to high efficiency class motors.	
How to use the toolkit	Figure 9 represents the toolkit interface of this EEO. Use the following steps to calculate energy & cost savings, estimated CAPEX and payback. • Enter the motor rating and the respective IE class of the motors requiring replacements. • The IE class of the current motor can be obtained from the motor nameplate. • Select the efficiency of the higher efficiency class replacement motor. The comments section will display whether it is viable to upgrade the relevant motor and savings summary will provide estimated energy savings, cost savings, capital costs and payback.	

Opportunity 9: Improve Motor Efficiency - Replace motors with high efficiency motors at the end of life



Savings Summary	Electricity Savings kWh/year	Total Energy Savings GJ/year	Energy Cost Savings $/year	Capital Cost $	Simple Payback years	GHG Emissions Reduction tonnes CO2-e
"Immediate replacement"	-	-	$0	$ -		-
"End of Life Replacement"				$ -	-	

Next steps: 1. Update procurement policy such that motor replacements take into account the most efficient technology available.
2. Alternatively, replace all aged motors at the same time and take advantage of bulk procurement benefits.

Pump Description	Motor Rating (kW)	Operating hours per day on average (hrs/day)	Motor Efficiency Rating	Estimated Baseline (kWh)	Proposed Motor Efficiency Rating	Estimated Savings (kWh)	Comme

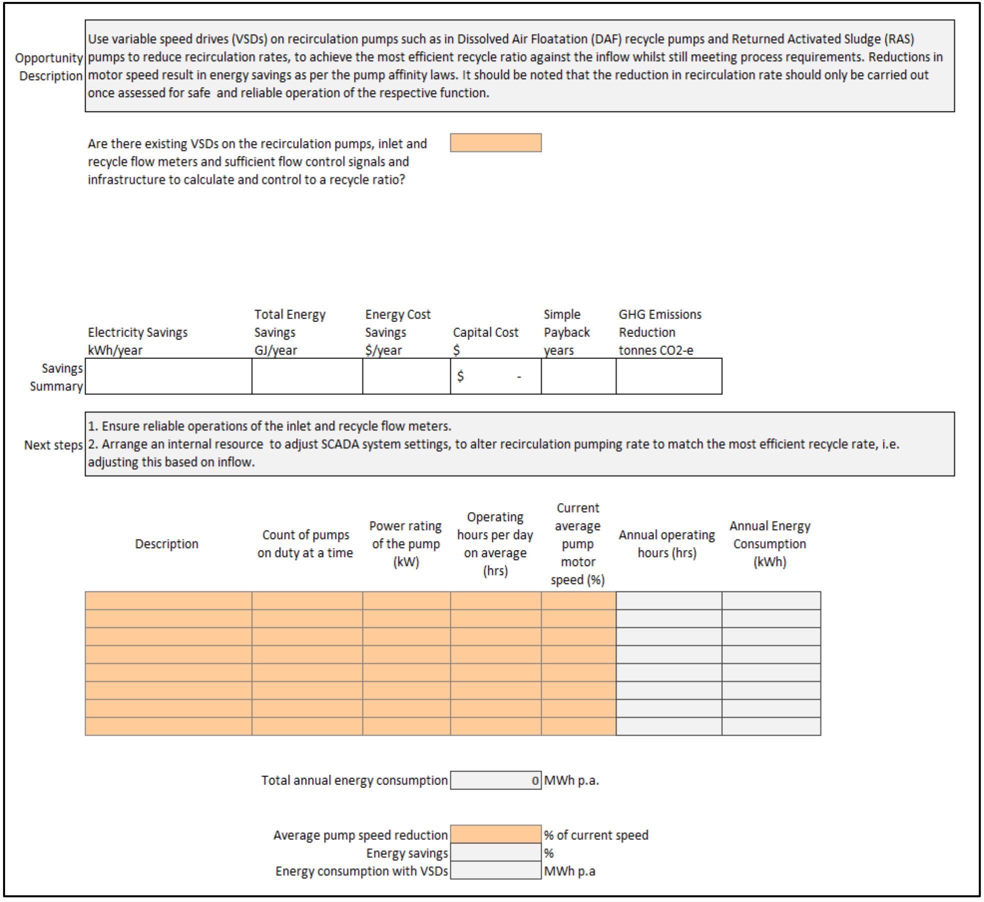
Figure 9: High efficiency motors opportunity interface in the EEO toolkit.

2.11 Use VSDs to Optimise Recirculation Pumps

Opportunity 10: Use VSDs to Optimise Recirculation Pumps		
Baseline situation	Recirculation pumps such as those used for Dissolved Air Floatation (DAF) and Returned Activated Sludge (RAS) generally operate at fixed speeds irrespective of plant throughput.	
Suggested improvement	Use variable speed drives (VSDs) on recirculation pumps such as in Dissolved Air Floatation (DAF) recycle pumps and Returned Activated Sludge (RAS) pumps to reduce recirculation rates, to achieve the most efficient recycle ratio against the inflow whilst still meeting process requirements. Reductions in motor speed result in energy savings as per the pump affinity laws. It should be noted that the reduction in recirculation rate should only be carried out once assessed for safe and reliable operation of the respective function.	
Estimated Cost ($)	**Electricity Savings (MWh p.a.)**	**Typical Payback (years)**
Subject to the respective site-specific inputs.		**Less than four years.**

Opportunity 10: Use VSDs to Optimise Recirculation Pumps	
Key Assumptions	• Control of VSDs based on plant throughput requires a PID-based control approach. Therefore, it is assumed that the STP/WTP has a SCADA system and CAPEX estimates do not include costs for the establishment of a SCADA system. • Reliable flowmeter data is required for this initiative to work without affecting the process. • Energy savings are calculated as per the affinity laws. Therefore, savings estimate represents a theoretical maximum amount which may be slightly higher than what could be achieved.
Co-benefits	• Reduced wear on the recirculation motors and therefore would prolong useful life of them. • Improved process control.
Risks	• As this opportunity requires throughput measurements, proper maintenance of relevant equipment is vital for consistent operation • There may be no ability to implement this without programming changes, the costs of which may be disproportionate to the savings opportunity.
How to use the toolkit	Figure 10 represents the toolkit interface of this EEO. Use the following steps to calculate energy & cost savings, estimated CAPEX and payback. • Enter the motor ratings, number of duty pumps and the respective daily operational hours. • Select the average speed reduction from the drop-down menu. Use 10% for as a conservative estimate. • Enter whether the recirculation pumps are already connected to VSDs. This will adjust the project capital cost accordingly. Upon completion of the relevant cells, the savings summary will provide the estimated energy savings, cost savings, capital costs and payback.

Opportunity 10: Use VSDs to Optimise Recirculation Pumps



Opportunity Description: Use variable speed drives (VSDs) on recirculation pumps such as in Dissolved Air Floatation (DAF) recycle pumps and Returned Activated Sludge (RAS) pumps to reduce recirculation rates, to achieve the most efficient recycle ratio against the inflow whilst still meeting process requirements. Reductions in motor speed result in energy savings as per the pump affinity laws. It should be noted that the reduction in recirculation rate should only be carried out once assessed for safe and reliable operation of the respective function.

Are there existing VSDs on the recirculation pumps, inlet and recycle flow meters and sufficient flow control signals and infrastructure to calculate and control to a recycle ratio?

	Electricity Savings kWh/year	Total Energy Savings GJ/year	Energy Cost Savings $/year	Capital Cost $	Simple Payback years	GHG Emissions Reduction tonnes CO2-e
Savings Summary				$ -		

Next steps:
1. Ensure reliable operations of the inlet and recycle flow meters.
2. Arrange an internal resource to adjust SCADA system settings, to alter recirculation pumping rate to match the most efficient recycle rate, i.e. adjusting this based on inflow.

Description	Count of pumps on duty at a time	Power rating of the pump (kW)	Operating hours per day on average (hrs)	Current average pump motor speed (%)	Annual operating hours (hrs)	Annual Energy Consumption (kWh)

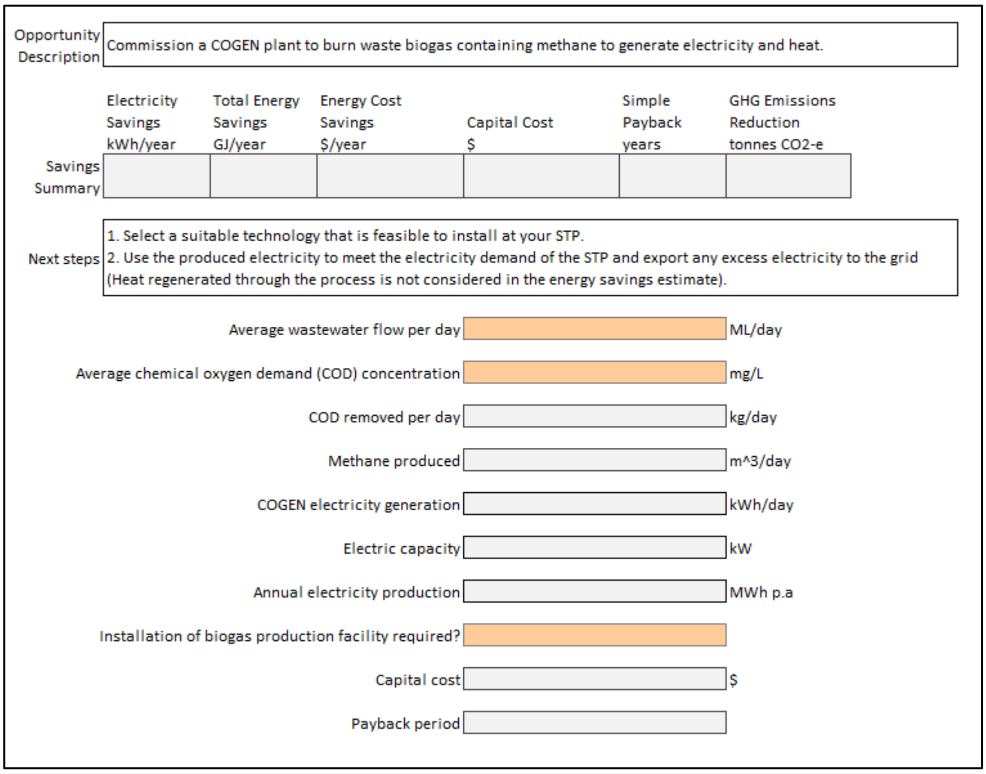
Total annual energy consumption 0 MWh p.a.

Average pump speed reduction % of current speed
Energy savings %
Energy consumption with VSDs MWh p.a

Figure 10: VSDs on recirculation pumps opportunity interface in the EEO toolkit.

2.12 Waste to Energy Feasibility Assessment

Opportunity 11: Waste to Energy Feasibility Assessment	
Description	STPs have the capacity to convert the received waste to energy through anaerobic digestion to produce biogas. A combined heat and power cogeneration plant (CHP) can be installed to burn the captured biogas to produce electricity and heat. The electricity produced can be used to offset grid consumption and the excess can be exported back to the grid. Northmore Gordon included a Waste to Energy calculation in the toolkit to assess the minimum threshold below which it does not make economic sense.
Key Assumptions	• Chemical Oxygen Demand (COD) removal rate is 85% • 0.25 m^3 of methane is produced per kg COD removed (That is approximately 70% of the maximum theoretical value) • The efficiency of a Cogen engine is about 30 – 35% • Feed in tariff to the grid is 0.05 $/kWh • The calculator does not account for the technology maintenance and operation costs

Opportunity 11: Waste to Energy Feasibility Assessment	
	• The calculator does not account for savings from thermal energy produced and therefore represents a conservative scenario • The total capital cost of the Cogen engine and its installation is generally between 1.5 to 3 times the cost of the Cogen engine and varies linearly with the plant size
Pros	• Renewable energy generation and onsite usage would either reduce or eliminate grid electricity usage. This can represent a significant CO_2 emissions abatement. • The project may also be eligible to create environmental certificates such as LGCs, ACCUs or ESCs, which would further improve the business case and reduce the payback period. For further information on how this might apply and the potential benefits, seek guidance from an accredited certificate provider.
Cons (and technical risks)	• The practicality of this opportunity may be subjected to site specific details such as the amount of biogas that could be produced, existing infrastructure to capture biogas and land availability.
Next Steps	Figure 11 represents the toolkit interface of this EEO. Use the following steps to calculate energy & cost savings, estimated CAPEX and payback. • Enter the average wastewater volume treated per day and chemical oxygen demand (COD) concentration (mg/L) of the wastewater. • Select whether the facility requires to commission an anaerobic digester to produce biogas. If an anaerobic digester is required, the capital cost of the project will be significantly higher. Savings summary will provide estimated energy savings, cost savings, capital costs and payback.  Opportunity Description: Commission a COGEN plant to burn waste biogas containing methane to generate electricity and heat. Savings Summary: Electricity Savings kWh/year; Total Energy Savings GJ/year; Energy Cost Savings $/year; Capital Cost $; Simple Payback years; GHG Emissions Reduction tonnes CO2-e Next steps: 1. Select a suitable technology that is feasible to install at your STP. 2. Use the produced electricity to meet the electricity demand of the STP and export any excess electricity to the grid (Heat regenerated through the process is not considered in the energy savings estimate). Average wastewater flow per day: ML/day Average chemical oxygen demand (COD) concentration: mg/L COD removed per day: kg/day Methane produced: m^3/day COGEN electricity generation: kWh/day Electric capacity: kW Annual electricity production: MWh p.a Installation of biogas production facility required? Capital cost: $ Payback period Figure 11: Waste to Energy opportunity interface in the EEO toolkit.

3 Case Studies for Sewage Reuse

01 Base situation

A STP located in western suburbs of Melbourne Victoria has a designed capacity of 5.7 ML/day. The plant takes sewage water from domestic and industrial sources and treats it through two High Rate Anaerobic Lagoons (HRALs) (for industrial waste) followed by a Sequenced Batch Reactor aeration, settling and decanting process.

What was done

A biogas fired 360 kW Cogeneration plant was commissioned to utilise the biogas generated through the anerobic digesters which was previously flared off.

Results

Using the biogas generated through the high strength organic waste, electricity has been generated which has reduced the STP's grid electricity consumption, which has reduced energy its costs and carbon footprint. This project has the further potential to utilise the thermal energy produced to offset other heating processes in the local community.

02 Base situation

A STP located in the City of Gold Coast has a designed capacity of 17.5 ML/day. The plant produces biogas through its existing biodigesters.

What was done

The biogas was dried and treated to remove contaminants and used to power a 550kW Cogeneration system.

Results

The electricity production was used to offset grid consumption and the generated heat was used to ensure that the digester system operates at optimal efficiency. The Cogeneration system produces approximately 4,000 MWh of renewable electricity annually while driving down STP's energy costs significantly.[4]

03 Base situation

A Water Recycling Plant (WRP) located in the South Eastern suburbs of Melbourne has two anaerobic digesters that operates a biological process where organic matter is converted to biogas.

What was done

The WRP commissioned a 360kW Cogeneration system to produce electricity and heat. The system included two Activated Carbon biogas scrubbing systems to remove harmful gases like H2S prior to being used in the engine.

Results

The electricity produced from the Cogeneration system reduced on site grid consumption by 40% and has been a key tool in WRP's strategy to minimise carbon emissions and achieve Net Zero.[5]

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[4] https://www.evoet.com.au/projects/coombabah-wastewater-treatment-plant/

[5] https://www.evoet.com.au/projects/mt-martha-water-recycling-plant/

04 Base situation

A Water Reclamation Plant located in Western Suburbs of Melbourne treats wastewater from predominantly domestic sources. The biosolids generated from the process was transported in closed trucks to large drying bays to get dried with help of wind and sun.

What was done

A Biosolid drying facility was commissioned to achieve 90% de-watered pelletised biosolids that is suitable for farm fertiliser that can be safely handled, easily transported and reused immediately after processing.

Results

This initiative enables the organisation to meet the commitment to a no-waste sewage system. Moreover, 30% of the carbon emissions from heavy truck movements have reduced as a direct result of this initiative.[6]

05 Base situation

A Water Recycling Plant located in South Eastern suburbs of Melbourne predominantly treats domestic wastewater.

What was done

In the year 2020, two 550kW biogas and natural gas Cogeneration systems were commissioned along with several other innovative upgrades to increase plant capacity by 50%.

Results

The combined system is capable of producing up to 9,000 MWh/year while generating significant energy cost savings. This project has been identified as one of the key initiatives in the Net Zero pathway of the water authority.[7]

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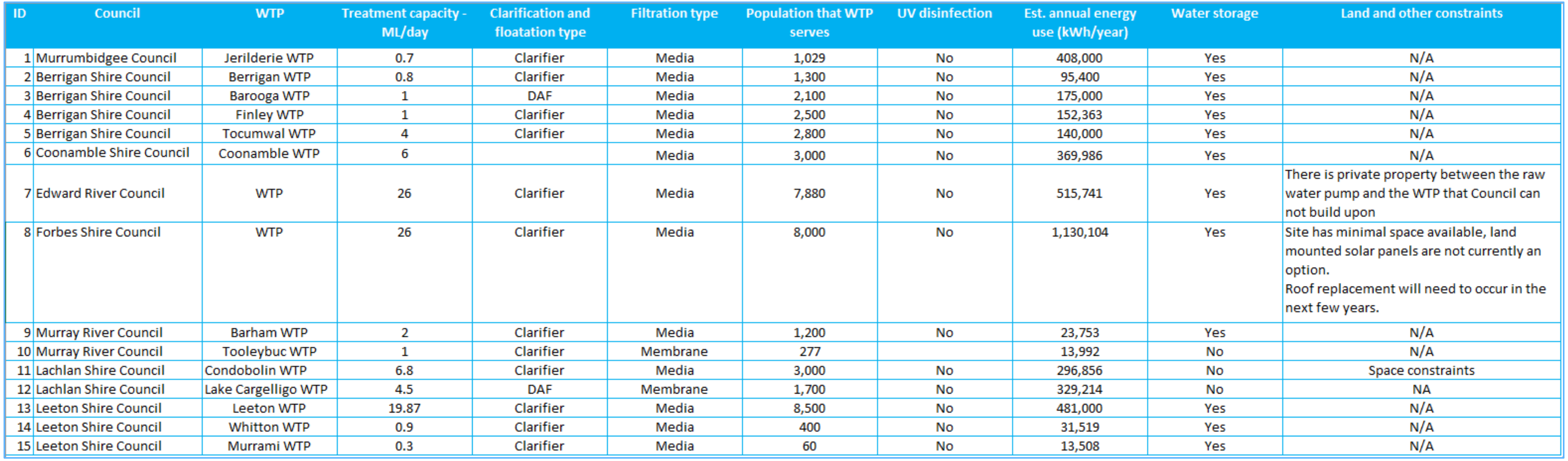
[6] https://plenarygroup.com/news-and-media/news/2014/biosolids-plant-wins-premiers-sustainability-award

[7] https://ancr.com.au/boneo_water_recycling_plant.pdf

4 Appendix - Asset Inventory

Northmore Gordon, with the assistance of NSW Treasury, issued data requests and questionnaires to a select set of regional councils to gather details such as plant size (ML/day), population, treatment type, annual energy consumption, land availability and other constraints. This data was then summarised to create the Asset Inventory which enables prioritisation of opportunities and a more targeted assistance to councils. Table 2 and Table 3 represents the Asset Inventories created for the 12 council's WTPs and STPs.

Table 2: Asset Inventory – WTPs



ID	Council	WTP	Treatment capacity - ML/day	Clarification and floatation type	Filtration type	Population that WTP serves	UV disinfection	Est. annual energy use (kWh/year)	Water storage	Land and other constraints
1	Murrumbidgee Council	Jerilderie WTP	0.7	Clarifier	Media	1,029	No	408,000	Yes	N/A
2	Berrigan Shire Council	Berrigan WTP	0.8	Clarifier	Media	1,300	No	95,400	Yes	N/A
3	Berrigan Shire Council	Barooga WTP	1	DAF	Media	2,100	No	175,000	Yes	N/A
4	Berrigan Shire Council	Finley WTP	1	Clarifier	Media	2,500	No	152,363	Yes	N/A
5	Berrigan Shire Council	Tocumwal WTP	4	Clarifier	Media	2,800	No	140,000	Yes	N/A
6	Coonamble Shire Council	Coonamble WTP	6		Media	3,000	No	369,986	Yes	N/A
7	Edward River Council	WTP	26	Clarifier	Media	7,880	No	515,741	Yes	There is private property between the raw water pump and the WTP that Council can not build upon
8	Forbes Shire Council	WTP	26	Clarifier	Media	8,000	No	1,130,104	Yes	Site has minimal space available, land mounted solar panels are not currently an option. Roof replacement will need to occur in the next few years.
9	Murray River Council	Barham WTP	2	Clarifier	Media	1,200	No	23,753	Yes	N/A
10	Murray River Council	Tooleybuc WTP	1	Clarifier	Membrane	277		13,992	No	N/A
11	Lachlan Shire Council	Condobolin WTP	6.8	Clarifier	Media	3,000	No	296,856	No	Space constraints
12	Lachlan Shire Council	Lake Cargelligo WTP	4.5	DAF	Membrane	1,700	No	329,214	No	NA
13	Leeton Shire Council	Leeton WTP	19.87	Clarifier	Media	8,500	No	481,000	Yes	N/A
14	Leeton Shire Council	Whitton WTP	0.9	Clarifier	Media	400	No	31,519	Yes	N/A
15	Leeton Shire Council	Murrami WTP	0.3	Clarifier	Media	60	No	13,508	Yes	N/A

Table 3: Asset Inventory – STPs

ID	Council	STP	Treatment capacity - ML/day	Type of STP	Sub-type	Population that STP serves	Est. annual energy use (kWh/year)	Level of treatment	Reverse Osmosis (RO)	Ultrafiltration (UF)	Ultraviolet Disinfection (UV)	Compressed air	Dissolved Air Floatation (DAF)	Centrifuges (dewatering)	Odour control system with forced ventilation (fans)	Presence of significant Raw Sewage Pumps, Interstage Pumps, or Effluent Pumps	Land and other constraints
1	Forbes Shire	STP	20	Type 3 - Extended Aeration Act.	Type 3 - Sub type 3.3	10,000	461,791	Tertiary	No	No	Yes	No	No	No	No	Yes	N/A
2	Edward River Council	STP	4	Type 4 - Tricking filters	Type 4 - Sub type 4.1	7,880	361,424	Primary	No	No	No	Yes	No	No	No	Yes	Asset is at the end of its life and is due for replacement
3	Berrigan Shire Council	McCulloughs Rd STP	N/A	Type 2 - PST + Act. Slude + An. Dig	Type 2 - NA	2,800	82,967	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4	Berrigan Shire	Finley STP	N/A	Type 2 - PST + Act.	Type 2 - NA	2,500	27,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5	Berrigan Shire Council	Berrigan STP	N/A	Type 2 - PST + Act. Slude + An. Dig	Type 2 - NA	1,300	17,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6	Berrigan Shire Council	Barooga STP	N/A	Type 6 - Rotating Biological	Type 6 - NA	2,100	1,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7	Blayney Shire Council	Blayney STP	0.7 - 1.3	Type 3 - Extended Aeration Act.	Type 3 - Sub type 3.3	4,000	171,000	Tertiary	No	No	Yes	No	No	No	Yes	Yes	N/A
8	Murray River Council	Barham STP	0.6	Type 4 - Tricking filters	Type 4 - Sub type 4.1	1,200	30,141	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9	Murray River Council	Moulamein STP	0.5	Type 5 - Lagoons	N/A	484	21,323	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10	Coonamble Shire Council	Coonamble STP	1	Type 4 - Tricking filters	Type 4 - Sub type 4.1	3,000	143,038	Tertiary	No	No	No	No	No	No	No	No	N/A
11	Coonamble Shire Council	Gulargambone STP - Pasveer Channel	0.2	Type 3 - Extended Aeration Act. Sludge	Type 3 - Sub type 3.2	500	27,034	Tertiary	No	No	No	No	No	No	No	No	
12	Murrumbidgee Council	STP	0.4	Type 2 - PST + Act. Slude + An. Dig	Type 4 - Sub type 4.2	1,029	133,000	Primary, Secondary & Tertiary	No	No	No	No	No	No	No	Yes	N/A
13	Leeton Shire Council	Leeton STP	11.5	Type 3 - Extended Aeration Act.	Type 3 - Sub type 3.3	6,500	253,000	Tertiary	No	No	No	No	No	No	No	Yes	N/A
14	Leeton Shire Council	Leeton STP		Type 4 - Tricking filters	Type 4 - Sub type 4.1												
15	Leeton Shire Council	Yanco STP	0.5	Type 3 - Extended Aeration Act.	Type 3 - Sub type 3.3	370	18,795	Tertiary	No	No	No	No	No	No	No	Yes	N/A
16	Lachlan Shire Council	Condobolin STP	4400 EP	Type 2 - PST + Act. Slude + An. Dig	Type 2 - NA	3,000	N/A	Secondary	No	No	No	No	No	No	No	No	NA
17	Lachlan Shire Council	Condobolin STP		Type 4 - Tricking filters	Type 4 - Sub type 4.2												
17	Lachlan Shire Council	Lake Cargelligo STP	2000 EP	Type 2 - PST + Act. Slude + An. Dig	Type 2 - NA	1,400	77476	Secondary	No	No	No	No	No	No	No	No	NA