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NEWENERGY

TRIBE

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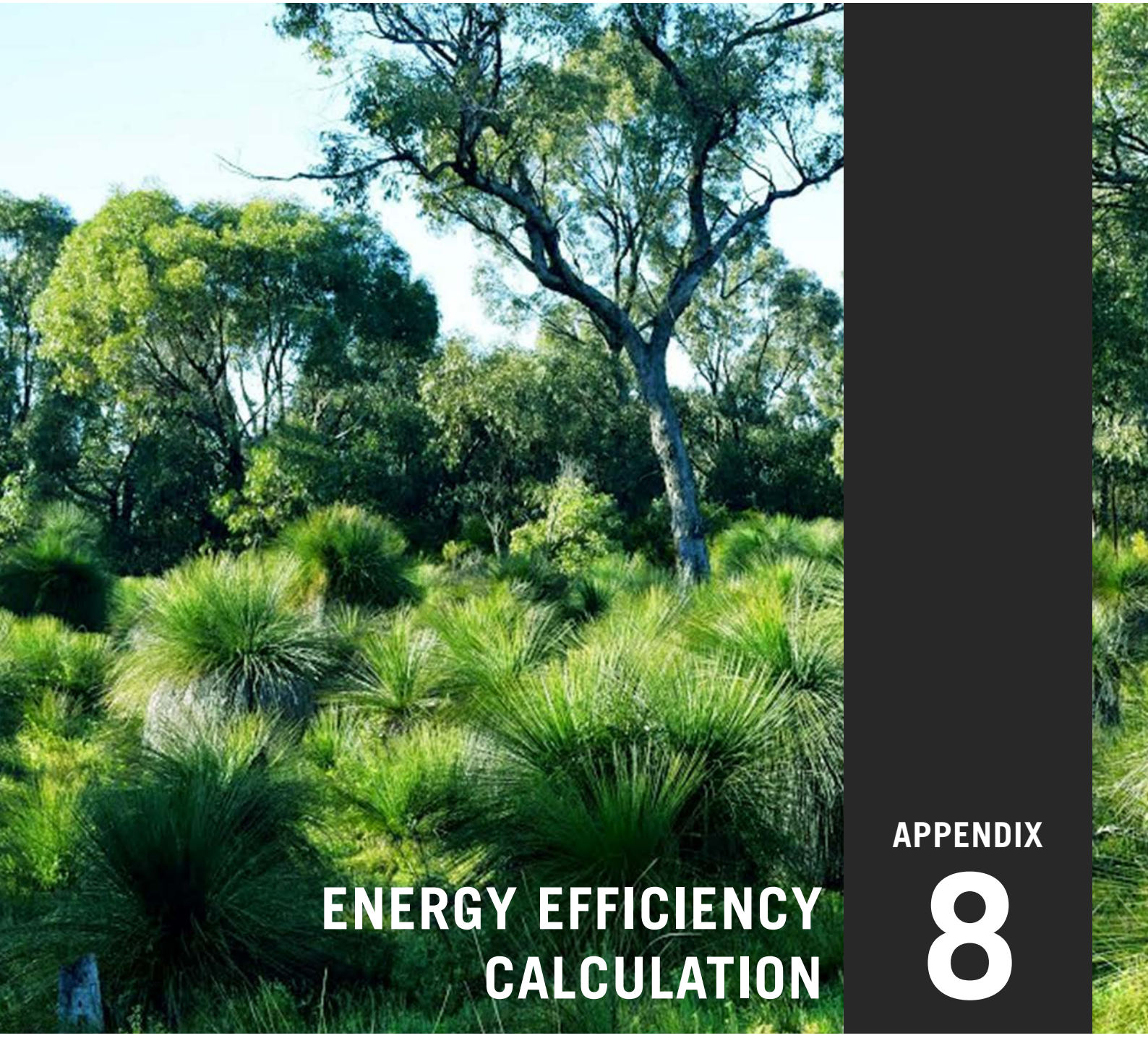

APPENDIX

8

ENERGY EFFICIENCY CALCULATION

APPENDIX 8: Energy Efficiency Calculation

Project: Rockingham
Project Nr.: YE-3324
Name: Rem
Date: 08.09.2017
Revision: 0

Calculation of approximate R1 figure

	Plant Capacity		Unit	LPN_0MW
	Nominal plant throughput		t/y	300'000
	Design LHV		GJ/t	9.78
	Xno/Xmcr			1.000
	Number of boilers		u	1
	Description of Performance Guarantees		**Unit**	
	Net power output			
	Gross Power produced for export at point LPN = Maximum Thermal Loading, Fouled Boiler		MWe	31.40
	Net Power produced for export at point LPN = Maximum Thermal Loading, Fouled Boiler		MWe	28.20
	Plant electrical consumption at nominal throughput (+ transformer losses)		MWe	3.2
	CHP power output			
	Heat Export at point LPN		MWth	0.00
	Additives and Consumables			
	Maximum fuel consumption for one cold start-up of one furnace (at LHV of gas oil of 42.65 MJ/kg)		kg	26'700
	Maximum fuel consumption for one normal stop of one furnace (at LHV of gas oil of 42.65 MJ/kg)		kg	12'900

According to the Guidelines on the interpretation of the R1 Energy efficiency formula for Incineration facilities dedicated for the processing of municipal solid waste according to Annex II of Directive 2008/98/EC on waste

The plant is designed to meet an expected efficiency performance value of approximately 0.778

[Ep - (Ef + Ei)] / [0,97 * (Ew + Ef)] > 0.65

The definition and expected values for the different parameters are provided below and are calculated on an annual

Parameter	Definition	Equivalence Factor	Unit	Expected Value Electricity Only
1)Ep	**Ep** means annual energy produced as heat or electricity. It is calculated with energy in the form of electricity being multiplied by 2.6 and heat produced for commercial use multiplied by 1.1 **Ep** = (Epe + Eph) with:		GJ/year	**2'233'670**
Epe	**Epe** = total **generated** electricity = power output at generator outlet **at nominal load** after 8'000 hours [of operation MW] x 8000 [h/y] x 0.95 x 3.6 [GJ/MWh] 0.95 is a correction factor that accounts for boiler continuous blow-down and for potential turbine lower efficiency with load variations, ambient Temperature variations, fouling of the ACC	**x 2.6**	GJ/year	**2'233'670**
Eph Nota:	**Eph** = total exported heat **Transport losses, inefficient use by third parties and transformation of heat into electricity by third parties** Ep is the energy produced by the incineration facility. The fact that energy is used inefficiently by third parties shall not be taken into account and shall have no effect on the R1 energy efficiency formula. The same applies in the case of energy losses due to transport of heat energy. **Backflows and return flows of generated energies** Backflows from external sources shall be deducted from Ep as they directly lower the rate of energy recovery from waste.	**x 1.1**	GJ/year	-
2)Ef Nota:	**Ef** means annual energy input to the system from fuels contributing to the production of steam **Ef** = 50% of heat input used in start-up/auxiliary burners = 50% x LHV oil/gas x number of boilers x (4.5 x guaranteed oil/gas usage for cold start-up per boiler + 6 x guaranteed oil/gas usage for shutdown per boiler) [GJ/y] 50% is an accepted ratio for the part of the heat usage through the burners that produces steam 4.5 accounts for 3 cold start-ups and 3 warm start-ups per year, assuming oil/gas consumption for warm start-up being half of a cold start-up LHV of gas oil of 42.65 MJ/kg is assumed No equivalence factor applies for fuels (fuel-oil, gas ...), i.e. the actor is 1	**x 1.0**	GJ/year	**4'213**
3)Ew	**Ew** means annual energy contained in the treated waste calculated using the lower net calorific value of the waste **Ew** = **Nominal** plant throughput [t/y] x design LHV [GJ/t]		GJ/year	**2'932'800**
4)Ei	**Ei** means annual energy imported excluding Ew and Ef **Ei** = Eie + Eih with:		GJ/year	**12'262**
Eie Nota:	**Eie** = Electricity import = (Guaranteed Plant electrical consumption [MW] x 150 h/annum + 0.5 MW x 760 h/annum) x 3.6 [GJ/MWh] 150 h/annum accounts for electricity import during unplanned turbine shutdown + the annual time required for start-ups 500 kW x 760 h/annum accounts for electricity import for maintenance during total plant shutdown and when no incineration takes place	**x 2.6**	GJ/year	**8'050**
Eih Nota:	**Eih =** External heat consumed for process purposes (SCR...) + 50% x total oil/gas usage start-ups and shutdwons The consumption at the burner during start-up and shut down periods is roughly 50%without steam being produced (Ei) and 50 % with steam production (Ef)	**x 1.1** **x 1.0**	GJ/year	**4'213**
0.97	**0.97** is a factor accounting for energy losses due to bottom ash and radiation.			**0.97**
R1 - Efficiency Performance	**[Ep - (Ef + Ei)] / [0,97 * (Ew + Ef)]**	**Approximate**		**0.778**