



# **CO-GENERATION ANNUAL REPORT**

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YEAR OF EVALUATION 2017

*17<sup>th</sup> April 2018*

# Co-generation Annual Report

## Year of Evaluation 2017

### ***Introduction:***

The Energy Efficiency and Cogeneration Regulations S.L.545.16 (“the Regulations”) transpose into national law Directive 2012/27/EU on energy efficiency.

Regulation 24 (3) of the Regulations sets the requirements for an annual report on the amount of electricity and heat production from cogeneration. The Report is prepared, in accordance with the methodology prescribed by the Regulations and in line with Commission Delegated Regulation (EU) 2015/2402<sup>1</sup> applicable for the reporting of data related to the year 2016 and onwards. The report also includes data on primary energy savings achieved by the use of cogeneration, in accordance with the EU harmonised methodology described by the Commission Delegated Regulation (EU) 2015/2402.

### ***Method:***

The First Schedule and Second Schedule to the Energy Efficiency and Cogeneration Regulations prescribe an EU harmonised calculation methodology whereas default parameters and relevant reference values for the separate production of equivalent amounts of electricity and heat were sourced from the Commission Delegated Regulation (EU) 2015/2402.

### ***Existing Co-Generation Plants licensed and operating during 2017:***

During the year 2017, there were five CHP (Combined Heat & Power) or cogeneration plants licensed by the Regulator for Energy and Water Services and in operation. Also following the indications from Energy and Water Agency, the heat recovered from the DPS3 power plant at the Delimara Power Station and used for the production of fresh water, has been considered and reported as produced by cogeneration process:

1. Wastserv Ltd Sant Antnin CHP – application GEN/APP/CHP/01/10, licensed on 01-Oct-2011 and consisting of two reciprocating engines of 1.021MWe and 716kWe respectively.
2. Wasteserv Ltd Maghtab CHP – application GEN/APP/CHP/09/12, licensed on the 18-Oct-2012 and consisting of a reciprocating engine of 190kWe.

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<sup>1</sup> Commission Delegated Regulation (EU) 2015/2402 of 12 October 2015 reviewing harmonised efficiency reference values for separate production of electricity and heat in application of Directive 2012/27/EU of the European Parliament and of the Council and repealing Commission Implementing Decision 2011/877/EU

3. Neptune's WPSC CHP – application reference GEN/APP/CHP/01/15, licensed on the 23-Sep-2015 and consisting of a reciprocating engine of 49kWe.
4. Water Services Corporation- Ta' Barkat Sewage Treatment Plant – application reference GEN/APP/CHP/05/11, licensed on the 10/6/2015 and consisting of 3 reciprocating engines with a total capacity 1.11MWe.
5. Delimara Power Station- D3 plant combine cycle diesel engine consisting of 8 internal combustion engines changed from heavy fuel oil and gasoil fuel to natural gas during this reported period with a total capacity of 139MWe (capacity does not include the Steam Turbine Generator) in operation as from December 2012, having a heat recovery system which makes use of heat generated by the internal combustion engines to produce fresh water. In line with Figure1 in Commission Decision (2008/952/EC)<sup>2</sup> the thermal component being utilised for the Fresh Water Generation (FWG) has been taken as heat produced by cogeneration process.
6. Wasteserv Ltd - Malta North MBT CHP – new inclusion, application GEN/APP/CHP/01/16, licensed on the 03-Feb-2017 and consisting of a reciprocating engines for a total of 1.523MWe.

The Wasteserv Ltd Maghtab CHP described above does not qualify as a cogeneration unit in terms of the methodology described in the Energy Efficiency and Cogeneration Regulations since the heat generated by this unit is not being utilised but dissipated into the environment. The plant is effectively only generating electricity. Hence the Maghtab plant is not considered further in this report.

The new Wasteserv Ltd - Malta North MBT CHP has for the year reported not recorded its thermal energy usage, and as per Wasteserv Ltd correspondence (12-March-2018), system will be upgraded to record the thermal energy usage by end of April 2018. Hence for the year being reported, this plant is not being included as co-generation plant.

### ***Assumptions:***

- For the CHP plant at **Wasteserv Malta Ltd Sant Antnin Waste Treatment Plant**, data was provided by the operator; Wasteserv Malta Ltd. During the year

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<sup>2</sup> Commission Decision of 19 November 2008 establishing detailed guidelines for the implementation and application of Annex II to Directive 2004/8/EC of the European Parliament and of the Council

under review and as reported by the operator only one of the co-generation units was operative.

- The **Neptunes WPSC CHP** report was prepared by their technical consultant and covers the period January 2017 to December 2017. The report notes the following:
  - Data is based on values measured or provided by the CHP control systems and other equipment installed on site.
  - Where measured data was not available, system data sheet values have been used for calculations, e.g. for the thermal energy output.
  - Net Calorific Values of the LPG fuel was provided by the fuel supplier.
  - Percentage of electricity exported to the grid is based on an estimate since the required metering by the Distribution System Operator was not yet installed.
  
- The **Water Services Corporation Tal-Barkat Wastewater Treatment Plant** consists of three reciprocating engines generators of 370kWe generating electricity and is mainly consumed on site by the wastewater treatment plant while thermal energy, tapped from the engines' oil coolers, water cooling and flue gas is being utilised to generate the biogas from the waste sludge. The plant is not equipped with any thermal metering and therefore the thermal energy used has to be estimated.
  
- In case of the reporting for the heat recovery at **Delimara Power Station from the DPS3**, it has to be noted that the main function of the plant is to generate electricity since the plant is one of the main electricity generators in Malta. The primary objective is to operate it in the most efficient way to transform the primary energy into electric energy. The plant is a combined cycle plant consisting of eight compression ignition reciprocating engines each coupled with an electricity generator with a heat recovery to generate steam from the flue gas to operate a combined cycle steam turbine driving a further electricity generator. The heat recovery being reported is the heat extracted from the reciprocating engines water cooling system all feeding into one common supply of heated water which in turn is connected to two fresh water generators. The primary fuel used was from more than one type and at a particular time only some of the eight reciprocating engines would be contributing to the supply of the heated water for the fresh water generators. Referring to Commission Decision (2008/952/EC), and in particular Figure 1, for the scope of this report only the component of the Useful Heat ( $H_{CHP}$ ) being utilised for the Fresh Water Generation is taken into account. In actual fact most of the thermal energy being generated from the D3 plant is utilised for the generation of steam to drive a steam turbine to generate electricity.

For the calculation of the PES the term “CHP Electricity Efficiency / Reference Electricity Efficiency” is unity given that the D3 plant is a centralised plant and one of the main generation plants in Malta hence is itself a reference plant. Therefore no gains usually attributed to the utilisation of decentralized plants such as reduction in energy losses in the distribution network may be claimed with respect to the DPS3 plant. The plant does not have any thermal metering and therefore the thermal energy has to be estimated.

## **Results:**

### **Wasteserv Ltd Sant Antnin CHP plant: (refer to Annex A)**

Electricity generated in period under review while in operation and when heat was utilised:

**127.4 MWh** mostly (94%) consumed on site in the waste treatment plant.

Thermal energy utilised in period:

**0.38 TJ** (105.55 MWh)

There were no Primary Energy Savings by this plant.

### **Neptunes' WPSC CHP: (refer to Annex B)**

Electricity generated in period:

**52.63 MWh** half of which, estimated consumed on site.

Thermal energy utilised in period:

**0.36 TJ** (101.1 MWh)

The **Primary Energy Savings**, calculated by the harmonised method defined in the regulations were:

**2.43 %**

### **Water Services Corporation Ta' Barkat CHP: (refer to Annex C)**

Electricity generated in period:

**4,322.0 MWh** mostly (98.9%) was consumed on site in the treatment plant.

Thermal energy utilised in period:

**19.56 TJ** (5,433.0 MWh)

The **Primary Energy Savings**, calculated using the harmonised method defined in the Regulations were:

**38.22 %**

**Delimara Power Station DPS3 Diesel Engine Combined Cycle power plant: (refer to Annex D)**

Heat utilised during the period under review:

**53.84 TJ** (14,956.0 MWh),

The **Primary Energy Savings**, calculated, based on the assumptions mentioned earlier, using the harmonised method defined in the Regulations were:

**3.27 %**

## Trend:

Year	2013		2014		2015	
Plant	Heat (kWh)	Electricity (kWh)	Heat (kWh)	Electricity (kWh)	Heat (kWh)	Electricity (kWh)
<b>Energy from waste</b>						
St Antnin	241,900.00	269,560.00	559,600.00	419,700.00	1,472,222.22	1,726,000.00
Ta' Barkat					5,139,373.00	4,066,894.00
Total energy displaced from waste	241,900.00	269,560.00	559,600.00	419,700.00	6,611,595.22	5,792,894.00
	511,460.00		979,300.00		12,404,489.22	
<b>Energy from fossil fuels</b>						
DPS3	47,106,000.00		51,229,900.00		37,760,000.00	
Neptune's					80,122.00	39,260.00
Total from fossil fuels	47,106,000.00	-	51,229,900.00	-	37,840,122.00	39,260.00
	47,106,000.00		51,229,900.00		37,879,382.00	
<b>Total energy from CHP</b>	<b>47,617,460.00</b>		<b>52,209,200.00</b>		<b>50,283,871.22</b>	

Year	2016		2017			
Plant	Heat (kWh)	Electricity (kWh)	Heat (kWh)	Electricity (kWh)		
<b>Energy from waste</b>						
St Antnin	472,222.22	587,200.00	105,555.56	127,400.00		
Ta' Barkat	6,478,323.00	5,389,757.00	5,433,064.00	4,322,013.00		
Total energy displaced from waste	6,950,545.22	5,976,957.00	5,538,619.56	4,449,413.00		
	12,927,502.22		9,988,032.56			
<b>Energy from fossil fuels</b>						
DPS3	17,690,000		14,956,000			
Neptune's	91,929.00	50,050.00	101,145.00	52,627.00		
Total from fossil fuels	17,781,929	50,050.00	15,057,145	52,627.00		
	17,831,979.00		15,109,772.00			
<b>Total energy from CHP</b>	<b>30,759,481.22</b>		<b>25,097,804.56</b>			

## Annex A – Workings for Wasteserv Ltd Sant Antnin CHP

Title: Sant Antnin recycling plant				
Type of CHP	Internal Combustion Engine 1.737MWe			
	Actual	Default as per Regulations	Units	Source of information
Year of evaluation	2017			
Average ambient temperature in year	19.30		°C	MET office
Cogeneration plant description	Reciprocating Engine at waste treatment plant			
Year of Manufacture	2007			WSM Ltd. ( 12-Mar-2018)
No of hours in operation in period	320		Hrs	WSM Ltd. ( 12-Mar-2018)
Type of fuel used	Biogas		55% CH <sub>4</sub> , 44% CO <sub>2</sub> , 200pp H <sub>2</sub> S	WSM Ltd. ( 12-Mar-2018)
NCV of fuel	27.5		MJ/kg	WSM Ltd. ( 12-Mar-2018)
Qty of fuel used in period	159,969.00		kg	WSM Ltd. ( 12-Mar-2018)
Primary energy input	1,219,444.45	all used while heat production	kWh	4.39TJ, WSM Ltd. ( 12-Mar-2018)
USED thermal energy in period	105,555.56	hot water 65°C 1.7bar	kWh	0.38TJ, WSM Ltd.( 21-Mar-2018)
Hours when thermal energy was USED	320		Hrs	WSM Ltd. ( 12-Mar-2018)
Electricity generated in period	127,400.00		kWh	WSM Ltd. ( 12-Mar-2018)
% of electricity exported	6.00%		%	WSM Ltd. ( 12-Mar-2018)
% of electricity consumed on site	94.00%		%	WSM Ltd. ( 12-Mar-2018)
Overall plant efficiency in period	19.00%	19%	%	WSM Ltd. ( 12-Mar-2018)
Power to heat ratio (fully utilised) plant	1.20			WSM Ltd. ( 12-Mar-2018)

## Annex A – Workings for Wasteserv Ltd Sant Antnin CHP (cont.)

<b>Electricity/ Thermal energy values</b>				
Electricity generated in year	127,400.00		kWh	
CHP thermal efficiency while heat is utilised	8.66%		%	
CHP electricity efficiency (electricity always generated during operation)	10.45%		%	
<b>Primary Electricity Savings from plant</b>				
Equivalent electricity generator efficiency				
Fuel and year of plant	Biogas 2007	42.00%	%	EU 2015/2402
Thermal Correction factor for elect. generation		-0.43%	%	
Correction factor - electricity exported	< 0.45kV	0.888		EU 2015/2402
Correction factor - electricity consumed on site	< 0.4kV	0.851		EU 2015/2402
Ref equiv. Elect. Efficiency		35.468%	%	EU 2015/2402
<b>Primary Thermal Savings from plant</b>				
Equivalent thermal equipment efficiency				
Fuel	Biogas 2007	70.00%	%	EU 2015/2402
Ref equiv. Thermal. Efficiency	hot water 65 °C	70.00%	%	
<b>PES</b>		-139.11%	%	Second Schedule of LN 196 of 2014
<b>PES (kWh)</b>		709,457.37	kWh	
Legend	Default values	Calculated	Entry	

## Annex B – Workings for Neptune’s WPSC CHP Plant

Title: Neptunes WPSC CHP plant				
Type of CHP	Internal Combustion Engine 49kWe			
	Actual	Default as per Regulations	Units	Source of information
Year of evaluation	2017			
Average ambient temperature in year	19.30		°C	MET office
Cogeneration plant description	Reciprocating Engine			
Year of Manufacture/ Licensing	2015			
No of hours in operation in period	1339		Hrs	Altern report 01-Feb-2018
Type of fuel used	LPG		95% Propane, 5% Butane	Altern report 01-Feb-2018
NCV of fuel	20,765.00	Propane 20,400, Butane 27,700	Kcal/m <sup>3</sup>	Altern report 01-Feb-2018
Qty of fuel used in period	6.90		m <sup>3</sup> /h	Altern report 01-Feb-2018
Primary energy input	223,077.40	all used while heat production	kWh	Altern report 01-Feb-2018 (166.6kWh/h)
USED thermal energy in period	101,145.00	hot water 32°C 2bar	kWh	Altern report 01-Feb-2018
Hours when thermal energy was USED	1339		Hrs	Altern report 01-Feb-2018
Electricity generated in period	52,627.00	1 year: Jan'17 - Dec'17	kWh	Altern report 01-Feb-2018
% of electricity exported	50.00%		%	Altern report 01-Feb-2018
% of electricity consumed on site	50.00%		%	Altern report 01-Feb-2018
Overall plant efficiency in period	69.00%	69%	%	Altern report 01-Feb-2018
Power to heat ratio (fully utilised) plant	0.52			Altern report 01-Feb-2018

## Annex B – Workings for Neptune’s WPSC CHP Plant (cont.)

<b>Electricity/ Thermal energy values</b>				
Electricity generated in year	52,627.00		kWh	
CHP thermal efficiency while heat is utilised	45.34%		%	
CHP electricity efficiency (electricity always generated during operation)	23.59%		%	
<b>Primary Electricity Savings from plant</b>				
Equivalent electricity generator efficiency				
Fuel and year of plant	LPG 2015	52.50%	%	EU 2015/2402
Thermal Correction factor for elect. generation		-0.43%	%	EU 2015/2402
Correction factor - electricity exported	< 0.45kV	0.888		EU 2015/2402
Correction factor - electricity consumed on site	< 0.45kV	0.851		EU 2015/2402
Ref equiv. Elect. Efficiency		45.275%	%	EU 2015/2402
<b>Primary Thermal Savings from plant</b>				
Equivalent thermal equipment efficiency				
Fuel	LPG 2015	90.00%	%	EU 2015/2402
Ref equiv. Thermal. Efficiency	hot water 32 °C	90.00%	%	
<b>PES</b>		2.43%	%	Second Schedule of LN 196 of 2014
<b>PES (kWh)</b>		5,544.82	kWh	
Legend	Default values			
	Calculated			
	Entry			

## Annex C – Workings for WSC tal-Barkat CHP

Title: Wastewater Treatment plant Ta'Barkat				
Type of CHP Internal Combustion Engine 1.11MWe				
	Actual	Default as per Regulations	Units	Source of information
Year of evaluation	2017			
Average ambient temperature in year	19.30		°C	MET office
Cogeneration plant description	Reciprocating Engine at wastewater treatment plant			
Year of Manufacture	2010			
No of hours in operation in period	12,376.00	Cumulative of 3 machines	Hrs	Plant in operation as CHP for 5967 hours during 2017
Type of fuel used	Biogas			
NCV of fuel	>5kWh/Nm <sup>3</sup>			WSC (12-Feb-2018)
Qty of fuel used in period	NA			
Primary energy input	12,338,872.00	all used while heat production	kWh	997kWh/hr WSC (24-Jan-2017)
USED thermal energy in period	5,433,064.00	hot water 80°C 3bar	kWh	WSC (12-Mar-2016 method)
Hours when thermal energy was USED	12,376.00		Hrs	WSC (12-Feb-2018)
Electricity generated in period	4,322,013.00		kWh	WSC (12-Feb-2018)
% of electricity exported	1.06%		%	Enemalta Plc PO9ENE048
% of electricity consumed on site	98.94%		%	
Overall plant efficiency in period	81.10%		%	WSC (12-Feb-2018)
Power to heat ratio (fully utilised) plant	0.84			WSC (12-Feb-2018)

### Annex C – Workings for WSC tal-Barkat CHP (cont.)

<b>Electricity/ Thermal energy values</b>				
Electricity generated in year	4,322,013.00		kWh	
CHP thermal efficiency while heat is utilised	44.03%		%	
CHP electricity efficiency (electricity always generated during operation)	35.03%		%	
<b>Primary Electricity Savings from plant</b>				
Equivalent electricity generator efficiency				
Fuel and year of plant	Biogas 2010	42.00%	%	EU 2015/2402
Thermal Correction factor for elect. generation		-0.43%	%	
Correction factor - electricity exported	< 0.45kV	0.888		EU 2015/2402
Correction factor - electricity consumed on site	< 0.45kV	0.851		EU 2015/2402
Ref equiv. Elect. Efficiency		35.391%	%	EU 2015/2402
<b>Primary Thermal Savings from plant</b>				
Equivalent thermal equipment efficiency				
Fuel	Biogas 2010	70.00%	%	EU 2015/2402
Ref equiv. Thermal. Efficiency	hot water 80°C	70.00%	%	
<b>PES</b>		38.22%	%	Second Schedule of LN 196 of 2014
<b>PES (kWh)</b>		7,634,689.06	kWh	
<b>Legend</b>	Default values			
	Calculated			
	Entry			

## Annex D – Workings for DPS3 Plant at Delimara

Title: Heat recovery from DPS D3 diesel engine combined cycle plant				
Internal Combustion Engines with water cooling heat recovery for heat utilisation 136MW				
Type of CHP	Actual	Default as per Regulations	Units	Source of information
Year of evaluation	2017			
Average ambient temperature in year	19.30		°C	MET office
Cogeneration plant description	Heat recovery from reciprocating engines cooling water in a combined cycle plant			
Year of Manufacture/ Licensing	2012			REWS
No of hours in operation in period	26572		Hrs	Not provided for heat recovery related to FWG, however plant was in operation for 26,572 hrs
Type of fuel used	HFO/Gasoil/NG			D3 Power Generation Ltd (14-Feb-2018)
NCV of fuel	40.599 / 43.037		HFO/Gasoil GJ/T	Enemalta Plc 1-Mar-2018
Qty of fuel used in period	8,457mT of HFO & 885mT of Gasoil & 3,160,000GJ of NG		T or J for NG	D3 Power Generation Ltd (14-Feb-2018)

**Annex D – Workings for DPS3 Plant at Delimara (cont.)**

Primary energy input	983,731,603.14	491,078,816.29	kWh	Calculated from details by D3 Power Generation Ltd (1-Mar-2018), Second figure is CHP_fuel estimated since only 49.92% of the time was the plant providing heat
USED thermal energy in period	14,956,000	Part used only in heat recovery for Fresh Water Generator	kWh	D3 Power Generation Ltd (9-Feb-2018)
Hours when thermal energy was USED	13,265		Hrs	Not provided for heat recovery related to FWG, however plant was in operation for 26,572 hrs and from P/H ratios and known total electricity output and thermal output, the percentage of time in co-gen mode is calculated to be 49.92%

**Annex D – Workings for DPS3 Plant at Delimara (cont.)**

Electricity generated in period	409,220,000.00	204,298,960	kWh	Electricity generation not considered for PES. "nd figure CHP electricity estimated from calculations related to P/H as compared to total electricity, showing that only 49.92% of the time was utilising heat.
% of electricity exported	Not relevant		%	This is one of the main national generators. Not relevant to PES
% of electricity consumed on site	Not relevant		%	This is one of the main national generators. Not relevant to PES
Overall plant efficiency as CHP in period	45%		%	Calculated from details by D3 Power Generation Ltd (14-Feb-2018)
Power to heat ratio (fully utilised) plant	13.66			Calculated from details by D3 Power Generation Ltd (1-Mar-2018)

### Annex D – Workings for DPS3 Plant at Delimara (cont.)

<b>Electricity/ Thermal energy values</b>				
If Overall plant Efficiency < 75%				
Electricity generated in year	Not relevant		kWh	
CHP thermal efficiency while heat is utilised	N/A	3.05%	%	Thermal component relevant to FWG process
CHP electricity efficiency (electricity always generated during operation)	Not relevant		%	This is one of the main national generators. Not relevant to PES
<b>Primary Thermal Savings from plant</b>				
Equivalent thermal equipment efficiency				
Fuel	Natural Gas	90.00%	%	EU 2015/2402
Ref equiv. Thermal. Efficiency		90.00%	%	EU 2015/2402
PES		3.27%	%	Second Schedule LN 196 of 2014, not considering PES for electricity.
PES (kWh)		16,617,777.78	kWh	
Legend	Default values	Calculated	Entry	