20th AfWA International Congress and Exhibition 2020
Breaking new grounds to accelerate access to water and sanitation for all in Africa

IMPROVING DRINKING WATER AFFORDABILITY AND ACCESSIBILITY THROUGH ENERGY EFFICIENCY IMPROVEMENT-LESSONS AND EXPERIENCES FROM NWSC-KAMPALA

23rd – 24th February 2020, Kampala, Uganda

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INTRODUCTION

CONTEXT

- **SDG 6:**

“*Target 6.1: Achieve Universal and equitable access to safe and affordable drinking water for all*’’ (https://sdgcompass.org/)

- **Water-Energy Nexus: Symbiotic relationship**

“Water is needed to generate energy and energy is needed to deliver water for human use and treat waste water before return to the environment” (https://www.energy.gov/sites)

- **Energy Efficiency and Climate Change**

“*Energy Efficiency lowers emissions*. *Energy consumption and related emissions would be 60% higher than they are and consumers would be paying $800 billion more per year in absence of investments in energy efficiency improvement*’’ (https://www.triplepundit.com/)

DEFINITION OF KEY TERMS

- ACCESSIBILITY:

Safe water within 1 km of the dwelling or 30 minutes round trip(WHO)

- AFFORDABILITY:

Defined by affordability index- compares the water bill of a household to its disposable income (http://www.ciheam.org/)

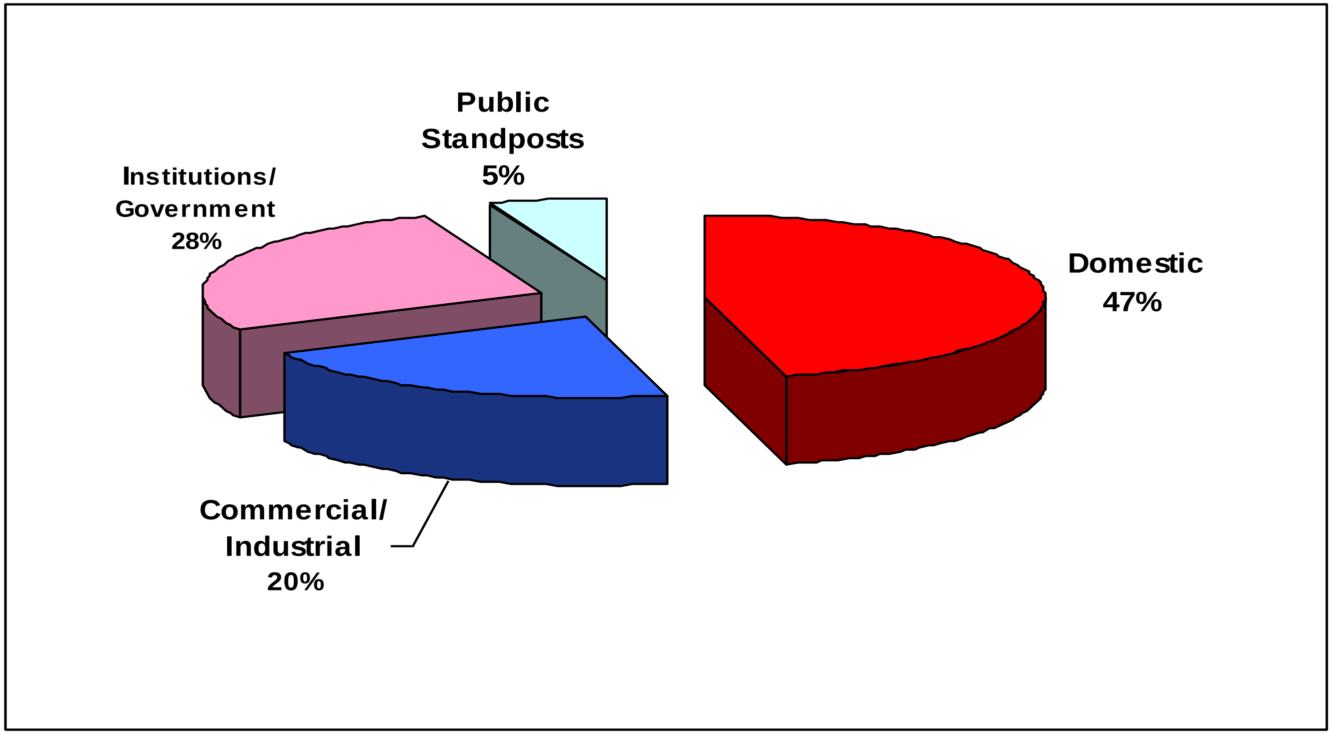
- DRINKING WATER:

Safe water that does not represent any significant risk to health over a lifetime of consumption (WHO)

- ENERGY EFFICIENCY: Lowering demand through technological changes (its different from conservation-which is behavioral based) (Katte Zerrener, 2020, https://www.triplepundit.com/)

NWSC'S JOURNEY TO ENERGY EFFICIENCY

- Foot Print: 256 towns todate (up from 23 towns in 2013)



INDEXATION OF TARIFF: ENERGY IS A FACTOR

- The tariff remained unchanged from 1994 to 2002
- As a result, the tariff was eroded by almost 45%
- In order to maintain the real value of the tariffs, NWSC adopted an indexation policy starting 2002.
- Tariffs are indexed against;
- Domestic inflation
- Foreign inflation
- Exchange rate changes
- Electricity price changes

Indexation formula $T1 = T0 (a\Delta I + b\Delta FI\Delta FX + c\mathbf{\Delta K}$

PROBLEM STATEMENT

--Water is a social good/human

-Tariff not full cost recovery

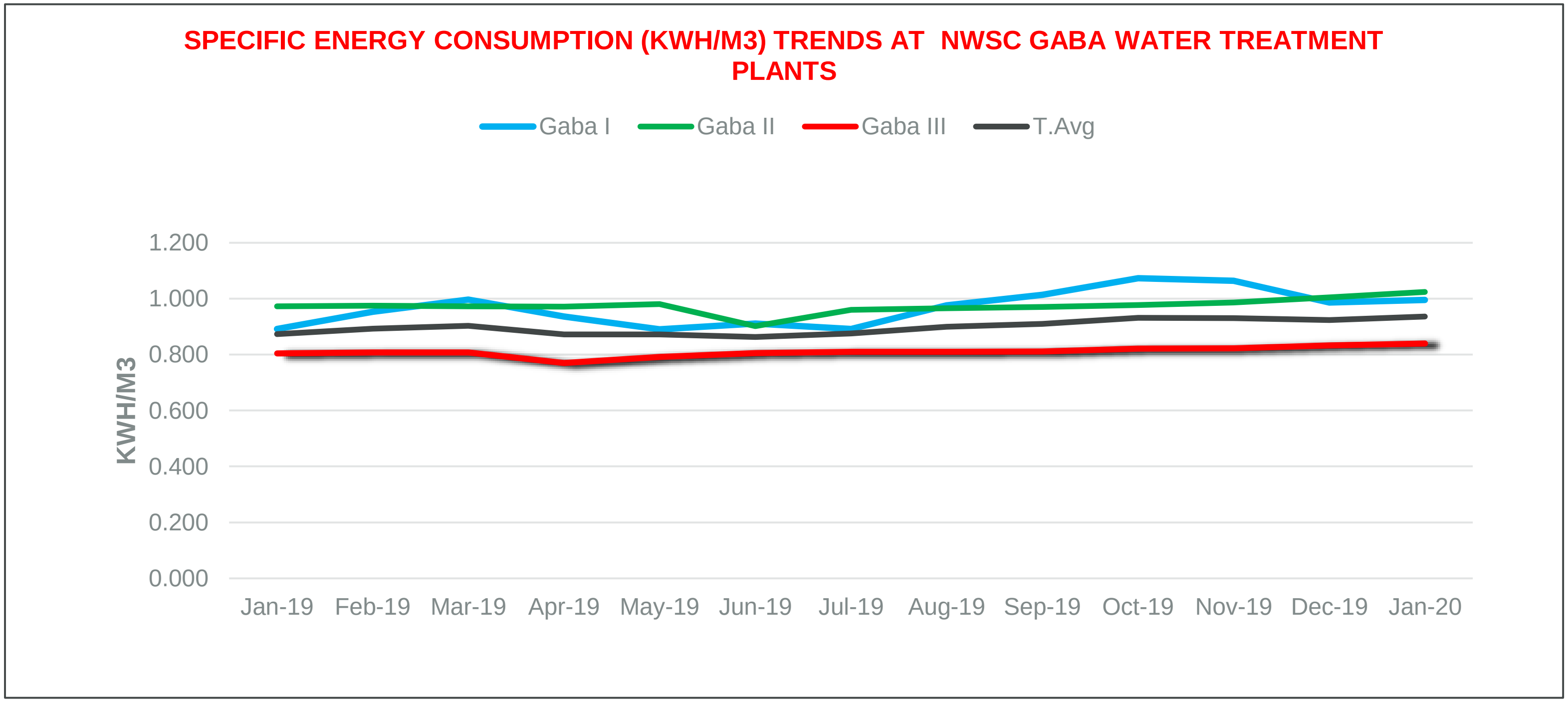
-Energy is expensive and impacts on the surplus/bottom line/ cash operating margin

2019 INDUSTRIAL HV TARIFF VARIATION(ERA-UGANDA)

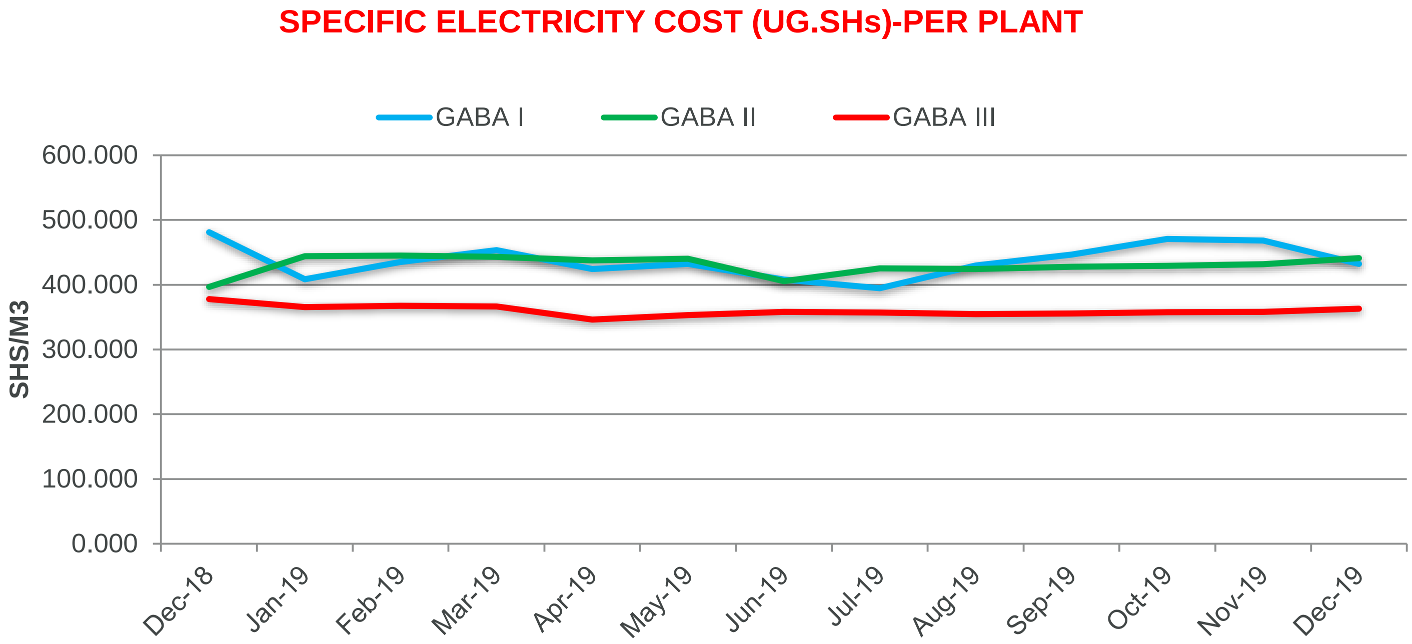
Month	Tariff charge per unit kWh (Ugx)		
	Shoulder	Peak	Off-peak
January-2019	389.1	503.6	254.2
February-2019	377.9	490.9	259.1
March-2019	377.9	490.9	259.1
April-2019	377.9	490.9	259.1
May-2019	375.1	487.2	241.7
June-2019	375.1	487.2	241.7
July-2019	375.1	487.2	241.7
August-2019	369.5	480.0	236.7
September-2019	369.5	480.0	236.7
October-2019	369.5	480.0	236.7
November-2019	367.6	477.5	236.3
December-2019	367.6	477.5	236.3
Average	374.3	486.1	244.9

OBJECTIVES

- Specific energy consumption (kWh/m3)



- Specific energy cost (shs/m3)



ENERGY EFFICIENCY IMPROVEMENT APPROACH

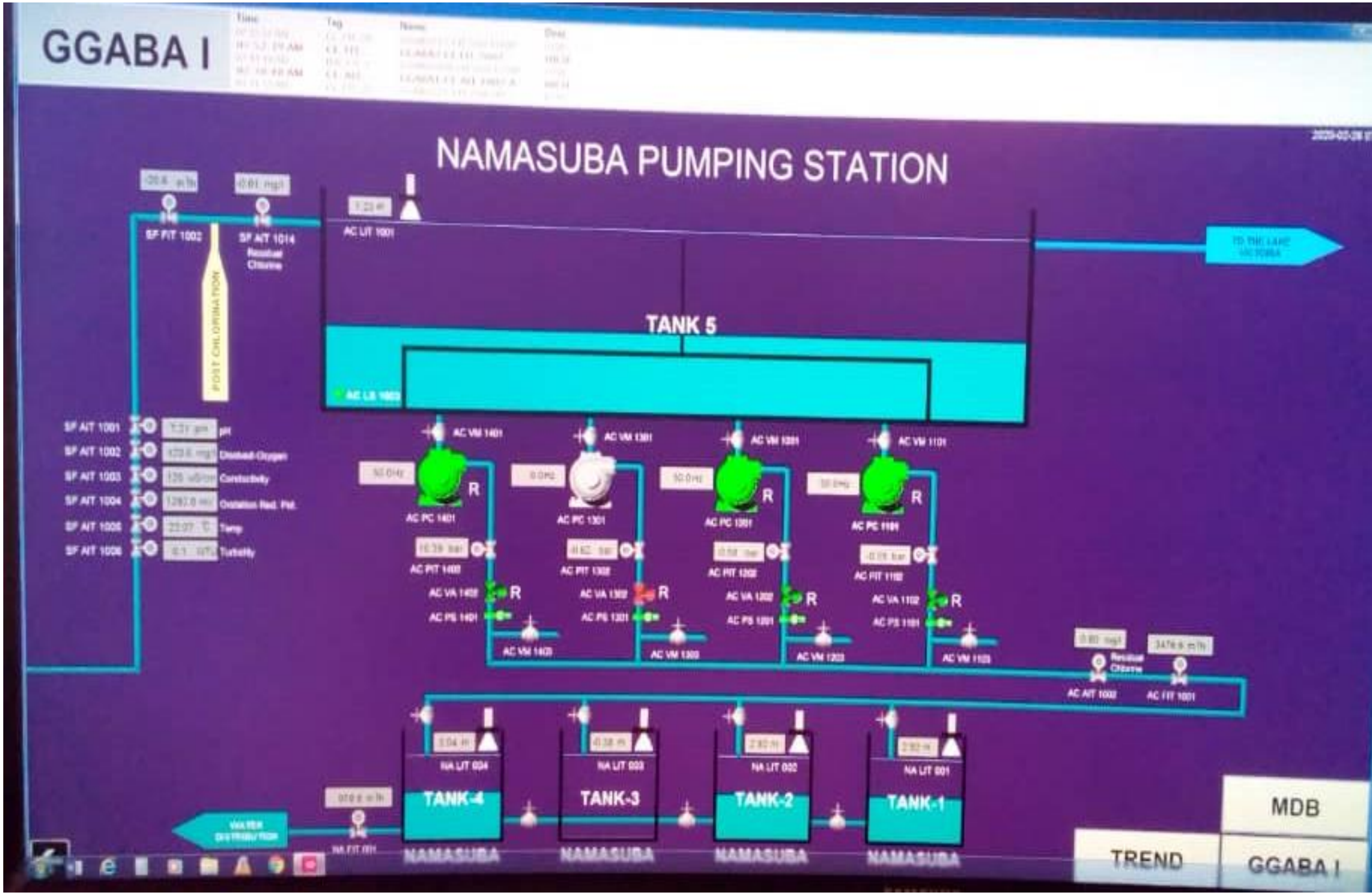
- Team: Stand alone energy management team/ mainstreamed team?

Energy management mainstreamed in O&M structure

- Management support
- Systems and Processes
- Technology
- Financing
- Partnerships

MATERIALS AND METHODS

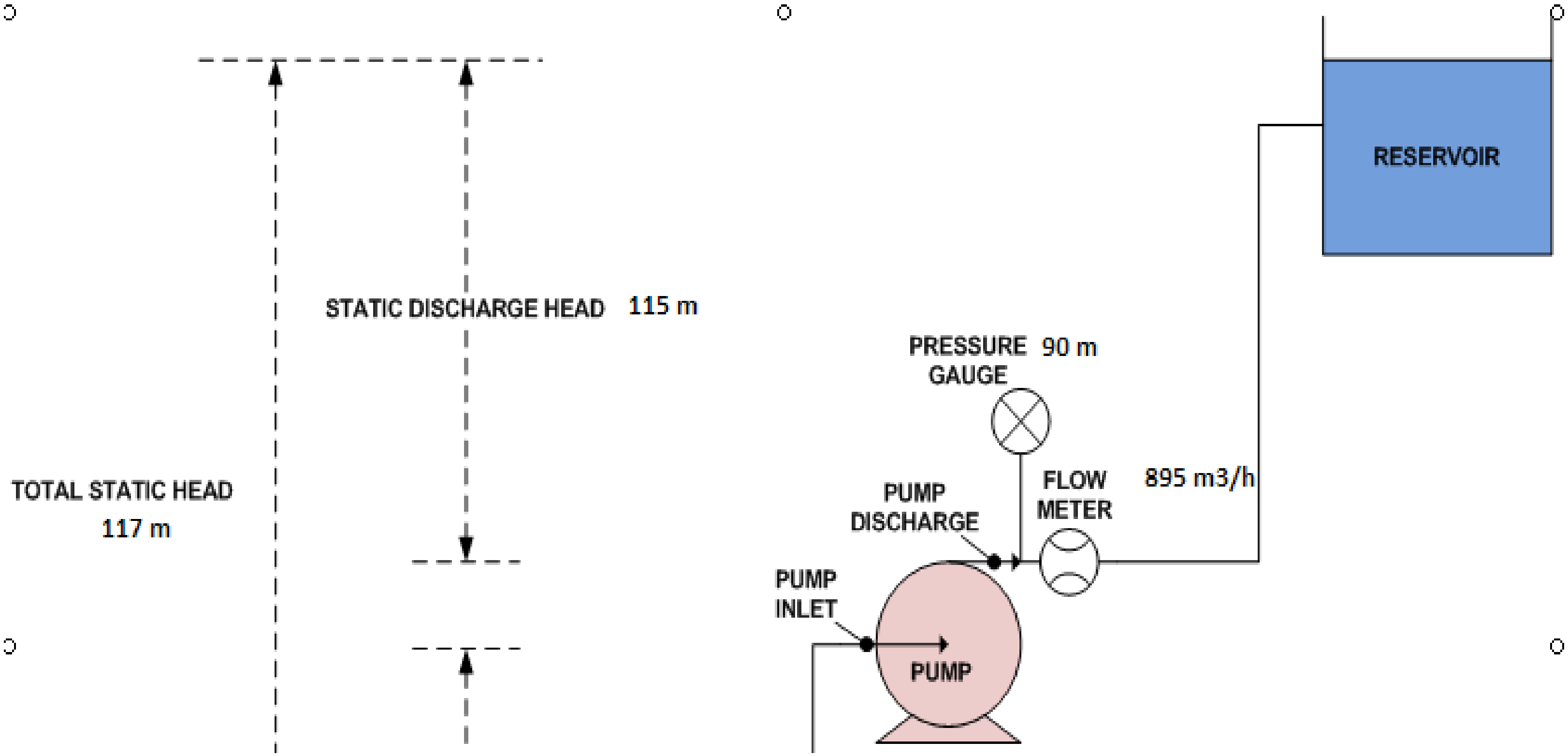
- Data Analysis: Track performance, Identify hot spots
- Energy Audits (Preliminary and Comprehensive):
- Pump Efficiency Tests: Strengthens evidence base for O&M decision making.
- O&M Practices: PPM, Overhauls, Pump Replacements
- Non-revenue water Management: Asset management practices to reduce product losses and increase revenue.
- **Automation: Process efficiency= energy efficiency= cost saving**



GGABA I
NAMASUBA PUMPING STATION
TANK 5
TANK-4
TANK-3
TANK-2
TANK-1
NAMASUBA
NAMASUBA
NAMASUBA
NAMASUBA
POST CHLORINATION
MDB
TREND
GGABA I

Pump Hydraulic Efficiency η_{Pump} : 68.5%

System Friction Losses (Discharge Side) : -25.0 m of head = Pump Discharge Head - Static Discharge Head



Pump Efficiency Calculation Tool
- Inputs

SUSTAINABLE ENERGY AUTHORITY OF IRELAND

Pump / Pump Station	:	GUNHILL 2
Location	:	GABA 3 CWPS
MPRN	:	
Date	:	3/8/2019

ENTER DATA IN THESE CELLS ONLY

MOTOR

This section calculates the efficiency of the motor that drives the pump. You can enter the motor power from the nameplate data or from measurement (meter)

Rated Motor Power	:		kW	Enter from nameplate, if rated in Horsepower, use 1 HP = 0.746 kW
or				
Actual Motor Power Consumption	:		kW	From measurement (meter)
or				
Voltage	:	2946.0	V	From measurement (meter)
Current	:	74.0	A	From measurement (meter)
kVA	:	377.6	kVA	
Power factor (cos φ)	:	0.9		If VSD, then = 1 | Non-VSD Maximum = 0.83 | Non-VSD Typical Full Load = 0.78-0.81 | Non-VSD Typical Half Load = 0.70
and				
Motor Efficiency η_{Motor}	:	95%		From manufacturer's data sheets (try www search for motor type)

Measured efficiency percentages for some pumps			
Gabba 2		Gabba 3	
Muyenga 1	69.5%	Muyenga 1	57.1%
Muyenga 2	71.8%	Muyenga 4	82.5%
Muyenga 3	70%	Gunhill 1	50.9%
Muyenga 4	80%	Gunhill 2	75.9%
Muyenga 5	85.4%	Gunhill 3	65.1%
Raw water (pump 1)	58.1%	Raw water (pump 1)	78.1%
Raw water (pump 1)	63.4%	Raw water (pump 1)	73.1%
Raw water (pump 1)	60.4%	Raw water (pump 1)	72.3%

PUMP OVERHAULS


5.0t
SPARK
LIGHT UP

ABOUT NRW

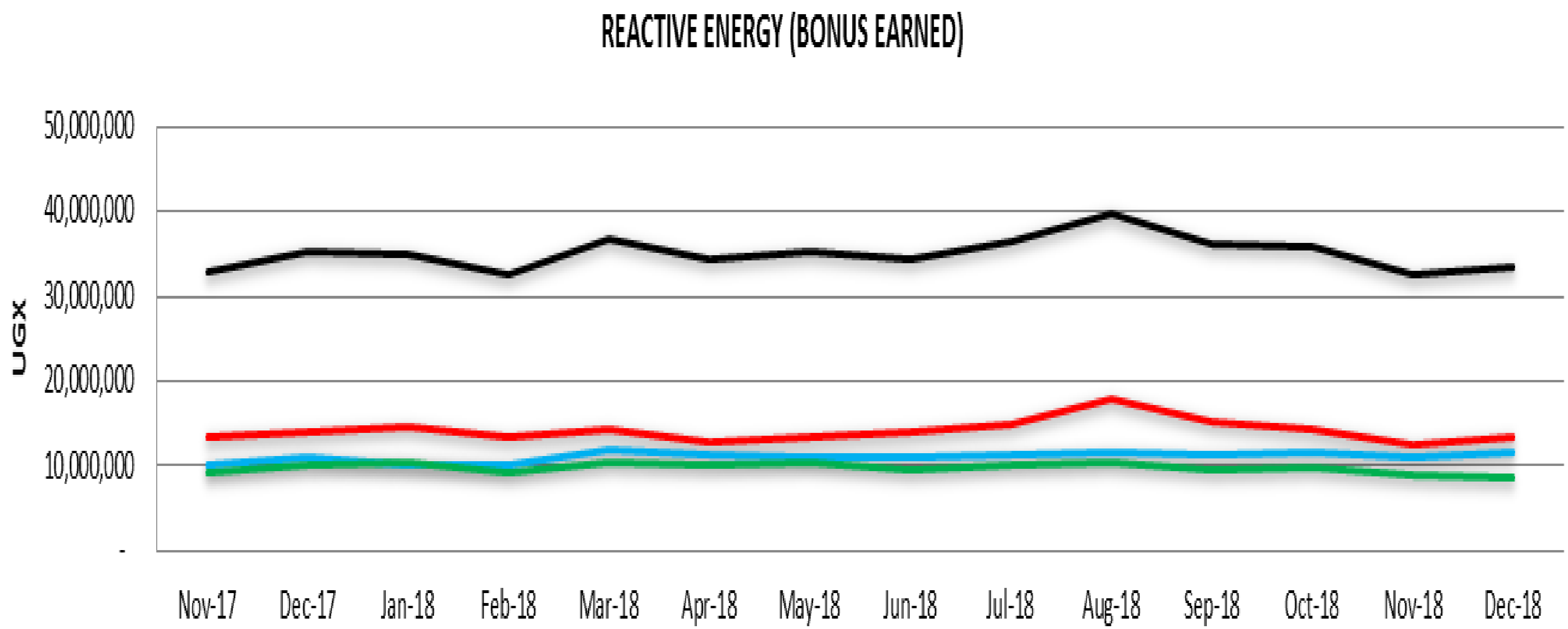
RESULTS AND DISCUSSION

- Reactive energy savings:

- Carbon footprint reduction (Demand side optimization). Mitigates climate change and reduces pressure on water supplies

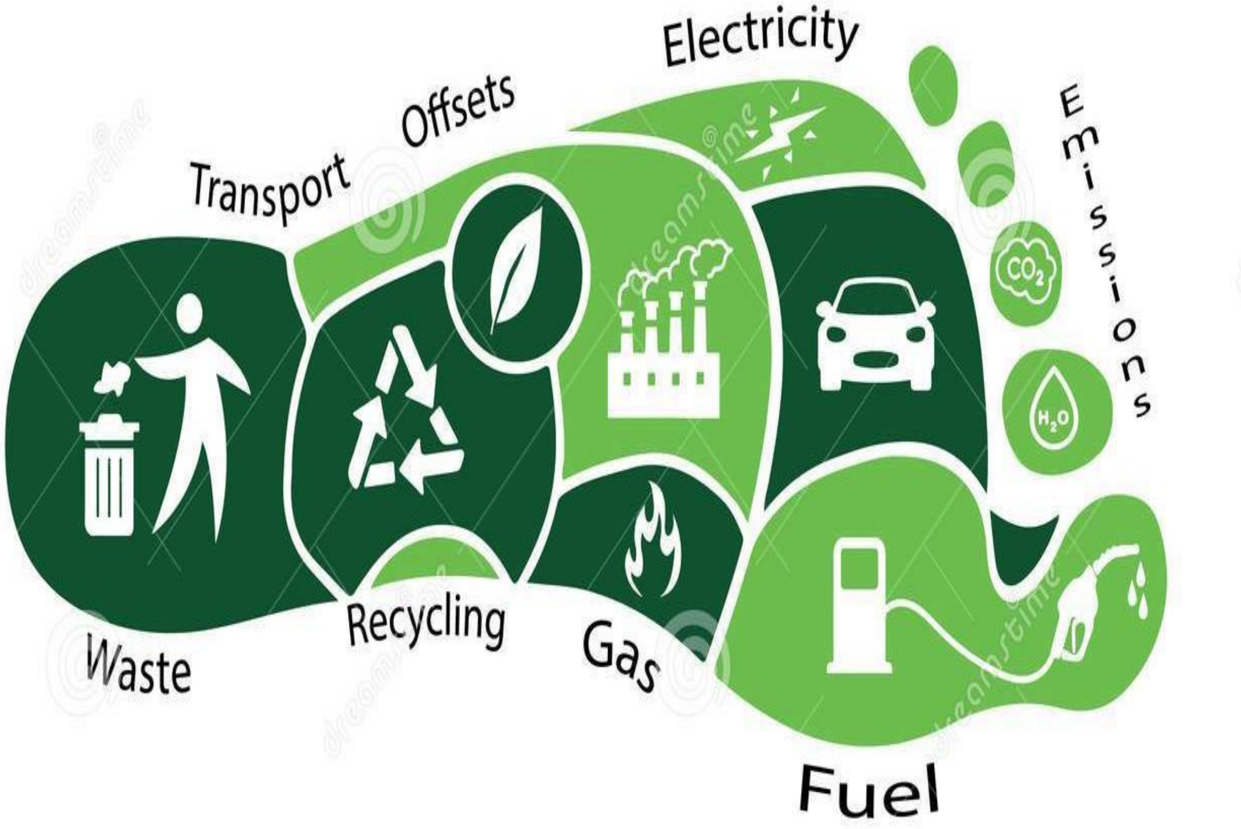
- Sustainability- enhances commercial viability of the organization

- Improved asset management practices



	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18
Gaba I	10,121,700	11,013,000	10,000,962	9,996,714	11,899,327	11,369,975	11,122,792	10,914,730	11,443,300	11,572,820	11,249,230	11,527,920	11,006,962	11,598,042
Gaba II	9,304,598	10,168,598	10,297,212	9,344,241	10,488,345	10,150,878	10,445,466	9,655,626	10,105,926	10,390,783	9,559,660	9,877,372	8,826,176	8,594,391
Gaba III	13,327,176	13,969,999	14,496,225	13,277,692	14,420,494	12,945,689	13,547,946	13,898,587	14,935,844	17,805,457	15,206,364	14,437,732	12,667,720	13,376,844
TOTAL	32,753,474	35,151,597	34,794,399	32,618,647	36,808,166	34,466,542	35,116,204	34,468,943	36,485,070	39,769,060	36,015,254	35,843,024	32,500,858	33,569,277

CARBON FOOT PRINT



CONCLUSIONS

- Energy is needed to make water available at points of use.
- Energy is a cost in the water accessibility equation
- Inefficient use of energy increases this cost and is a cost driver to safe water access ultimately making the water unaffordable.
- Utilities need to save money to remain commercially viable and be able to invest in safe water extension.
- Cost containment through energy efficiency optimization has been one of NWSC's strategies to remain commercially viable while supplying a social good to the country.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