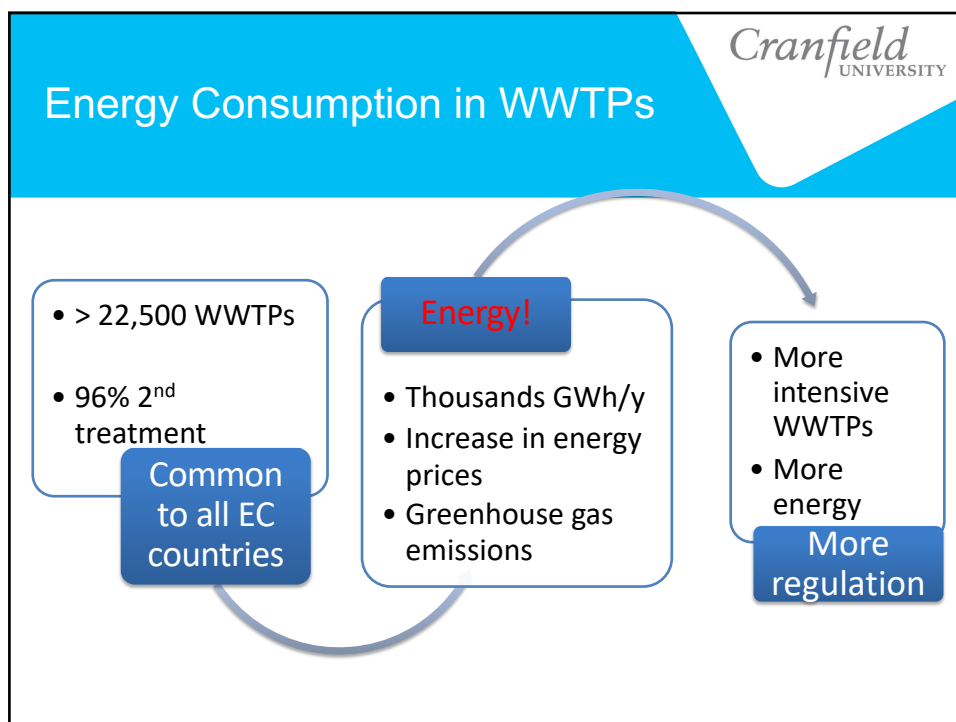


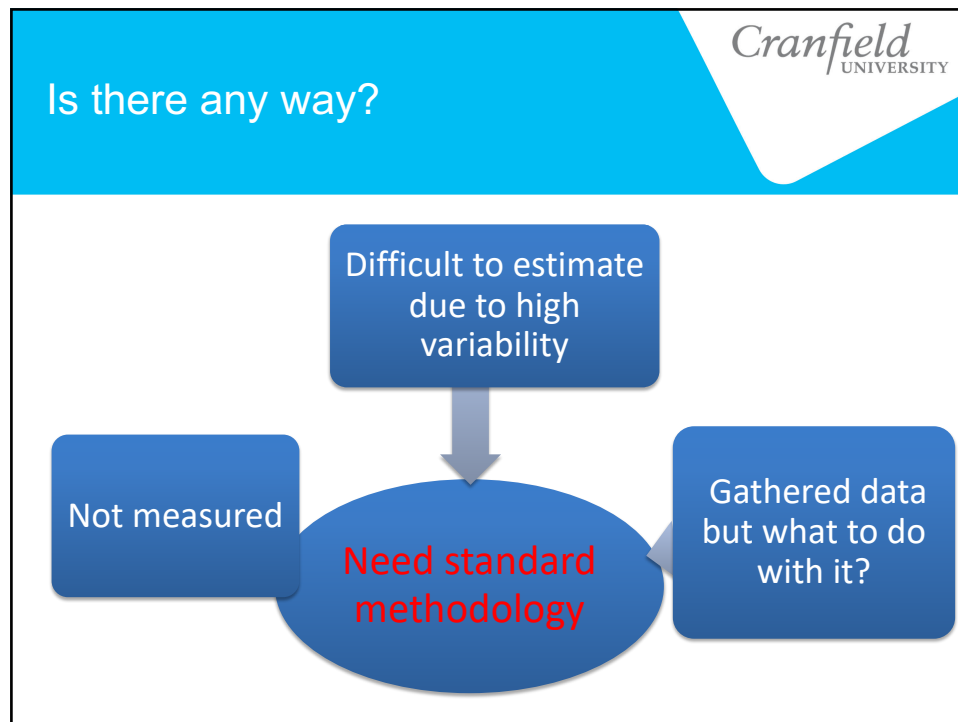
## Improving Energy Efficiency in Wastewater Treatment. Identification of Key Parameters and Key Performance Indicators

*Cranfield*  
UNIVERSITY



Pablo Campo-Moreno  
Cranfield Water Science Institute  
ecoSTP16, 28 June 2016  
[www.cranfield.ac.uk](http://www.cranfield.ac.uk)





*Cranfield*  
UNIVERSITY

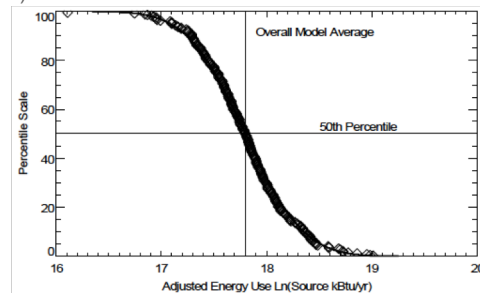
## International and National Standards

- **Lack** of normative documents specific for energy in WTTTPs
- Horizontal Standards:
  - EN ISO 50001 Energy management system
  - EN 16231 Energy efficiency benchmarking methodology
  - EN16247-1 Energy Audits- Part 1: General requirements
- National Standards:
  - UNI - CEI/TR 11428 Energy management - Energy audits

## Awwa Research Foundation Energy Benchmarking in WWTPs

*Cranfield*  
UNIVERSITY

$$\begin{aligned} \ln(E_s) = & 15.8741 \\ & + 0.8944 \times \ln(\text{influent average Mgal/d}) \\ & + 0.4510 \times \ln(\text{influent BOD mg/L}) \\ & - 0.1943 \times \ln(\text{effluent BOD mg/L}) \\ & - 0.4280 \times \ln(\text{influent average/influent design}) \\ & - 0.3256 \times (\text{Trickling filter? Yes-1, No-0}) \\ & + 0.1774 \times (\text{Nutrient removal? Yes-1, No-0}) \end{aligned}$$

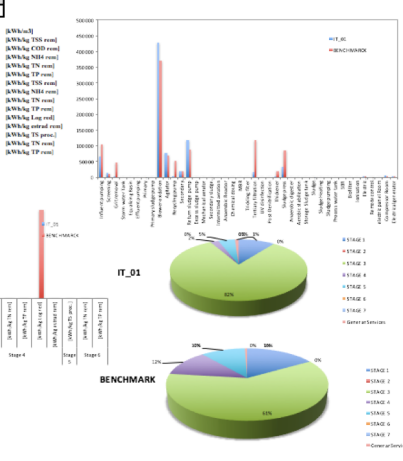


## Key Performance Indicators

*Cranfield*  
UNIVERSITY

- A key performance indicator (KPI) is a metric used to evaluate factors that determine the treatment efficacy at **each operation unit**.
- KPIs relate energy usage (kWh) with removal balances of pollutants (Flow, TSS, COD, NH<sub>4</sub>, N, P and Pathogens).
- Selected KPIs have to be monitored on a regular basis by on-line sensors or sample collection.

SELECT YOUR WWTP	PI [Size]	Flow-rate [m <sup>3</sup> /y]	DESIGNATED & TYPE classification	rate classification
IT 01	20000	1491363	10K-S-30K	2207718
ENERGY CONSUMPTION		AWB-DE	KPI <sub>0</sub>	

[illegible]

**Cranfield**  
UNIVERSITY

	WWTP	IT_01
Stage 1	[kW/h/m <sup>3</sup> ]	0.054
Stage 2	[kW/h/kg TSS rem]	
Stage 3	[kW/h/kg COD rem]	1.02
	[kW/h/kg NH4 rem]	13.73
	[kW/h/kg TN rem]	17.2
	[kW/h/kg TP rem]	16.96
Stage 4	[kW/h/TSS TSS rem]	2.72
	[kW/h/kg NH4 rem]	
	[kW/h/kg TN rem]	
	[kW/h/kg TP rem]	
	[kW/h/kg Log red]	0.1
	[kW/h/kg estrad rem]	
Stage 5	[kW/h/kg TSS proc.]	0.14
Stage 6	[kW/h/kg TN rem]	
	[kW/h/kg TP rem]	
ENERGY CLASS		13.36
A 0 - 9.9		
B 5 - 9.9 kWh/w KPI		
C 10 - 14.9 kWh/w KPI		C
D 15 - 19.9 kWh/w KPI		-
E 20 - 24.9 kWh/w KPI		-
F 25 - 29.9 kWh/w KPI		-
G 30 - 50 kWh/w KPI		-

- 4

Thank you!  
Questions?

For more information please visit  
[www.enerwater.eu](http://www.enerwater.eu)

ENERWATER Workshop June 28<sup>th</sup> at 17:30

[www.cranfield.ac.uk](http://www.cranfield.ac.uk)