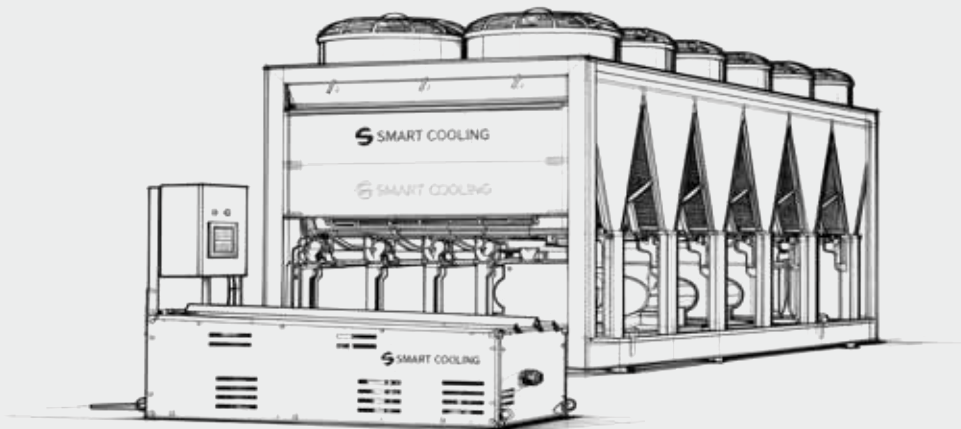


31 July 2019

TEST REPORT

045



**SMART COOLING™** PRO10 SYSTEM

# Double Tree by Hilton

Test Participants:

Project name: **DUBAI AL BARSHA HOTEL** Location: **Dubai, UAE**

Carrier UTS Engineer: **Iftikhar Amin**

Hilton al Barsha Hotel Engineer: **Jethi Thoma**

Gerab Energy Systems Engineer: **Ali Soufan**

Swiss Integrated Energy Technologies: **Luca Gallarate**

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## Introduction:

**Type of structure:** Multistory hotel building.

**Cooling units:** Air cooled water chiller **Carrier 30XA 1002** (2 units).

**Cooling capacity per manufacturer:** 1000 kW

**Electricity consumption per manufacturer:** 344 kW

**Chiller booster:** *Smart Cooling™ PRO 10*, adiabatic technology with condenser protection.

Chillers were retrofitted with the intelligent adiabatic *Smart Cooling™* system to reduce electricity consumption and increase COP.

System description (full original text preserved):

- Combines adiabatic evaporative **pre-cooling + condenser protection + mechanical air filtration**
- **Mounted externally** in front of condensers
- **Initiates adiabatic cooling** before mechanical cooling
- Applies fine mist of processed water **to reduce condensation temperature**.

**Smart Cooling™ ensures 100% condenser protection from direct contact with water.**

## Main components:

*Smart Cooling*™ comprises the following key components: protective membranes, water treatment and recirculation systems, high-pressure water pump, control unit, high-pressure nozzle panels, fasteners, and fixings.

- **Protective membranes** cover the condenser surface, preventing direct water contact.
- **Water system** purifies and sterilizes water to prevent mineral buildup and bacteria.
- **Pump** provides 70 bar pressure.
- **Control unit** regulates operation via real-time data (temperature, humidity, chiller parameters).
- **Nozzles** spray 5–40 µm droplets.
- A set of **fasteners and fixings** ensure the compatibility of the equipment with the chiller.



## Measuring instruments:

- RIF600 ultrasonic waterflow meter
- Enscope Analytics energy monitoring
- COP formula:  $\text{EI/kw} \div \text{cooling/kw} = \text{COP}$



*Chiller with Smart Cooling™ system*



*Chiller without Smart Cooling™ system*

- **Equipment tested:** Air-cooled water chillers, **CARRIER 30XA1002.**

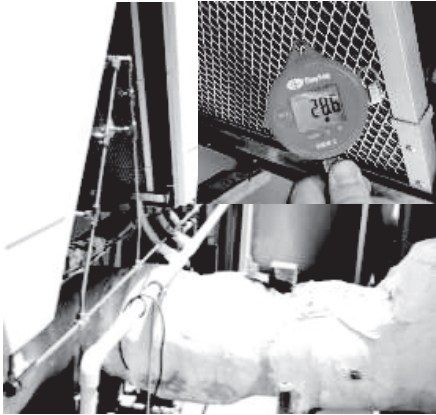
*Picture No.2*

Chiller equipped with chiller  
equipped with **Smart Cooling™**



## Testing procedures

A data logger was installed on the subject HVAC equipment to collect all applicable real-time electricity consumption and unit performance statistics. Data was collected by the Eniscope Analytics device.



*Temperature probe Nr.1  
Probe showing inflowing air  
temperature past the protective  
membrane: +28.6° Celsius.*



*Temperature probe Nr.2  
Probe showing inflowing air  
temperature before reaching  
the protective membrane: +43.0°  
Celsius.*

During the first 5 days (120 hours of use) of testing measured electricity consumption by the condenser without **Smart Cooling™**. During this period the chillers consumed **70,112 KW/h**. Water consumption was **0 m³** and the average temperature and relative humidity during the period were **36°C** and **34% RH**.

During the following 5 days (120 hours of use), with **Smart Cooling™** switched on and fully operational, data gathered shows the chiller consumed **53,386 KW/h**. Water consumption was **88 m³** and the average temperature and relative humidity during the period were **36°C** and **45% RH**.

After analyzing the monitoring, results show that energy savings gain delivered by **Smart Cooling™** during 5 operating days was **16,726 KW/h**.

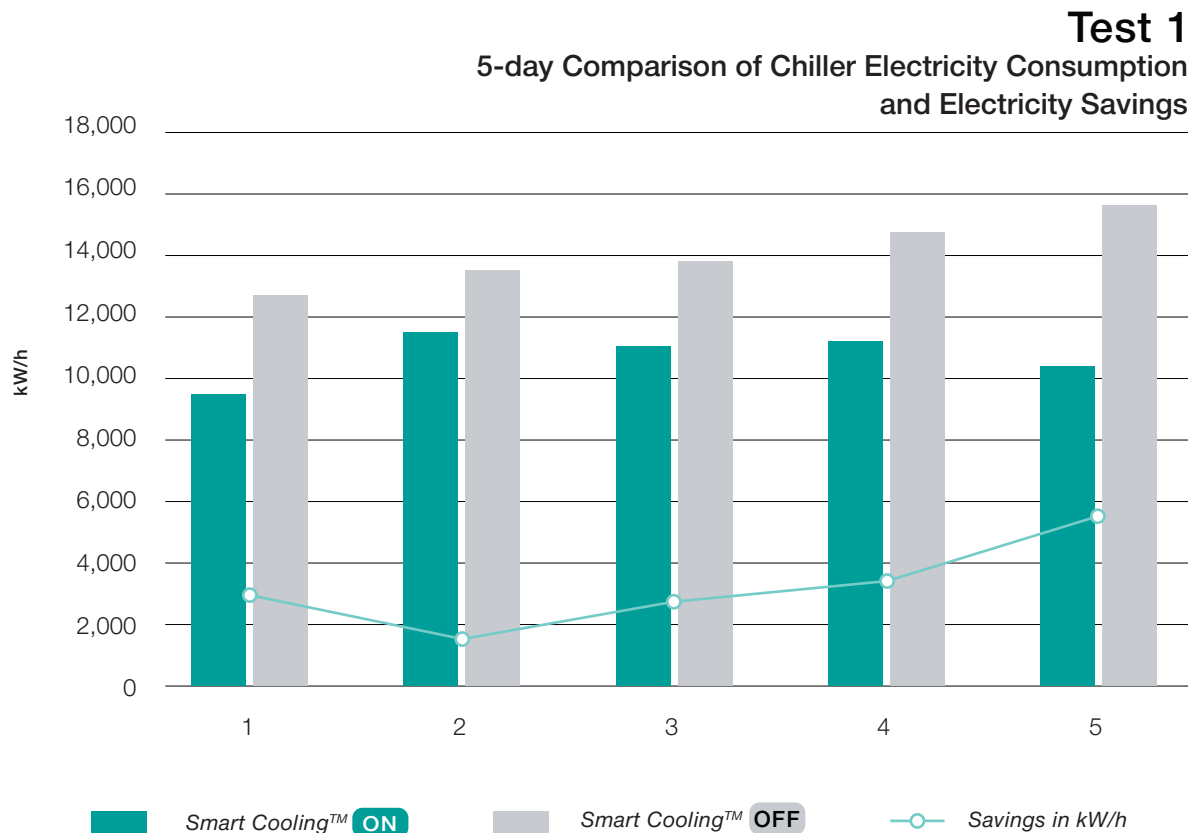
In the following pages, tables discriminate electricity consumption, air temperature and operating periods, before and after **Smart Cooling™**.

## 5-day Periods On-Off Testing Measurement Outcomes

With *Smart Cooling*™, in a period of 5 days, the customer economized **16,726 kw/h** of electricity. Electricity supply charges were, at the time, **0.46 Emirati Dirham (AED)** per kw/h. Thus, total savings in electricity charges were of **7,693 AED**.

Water usage during the period was **88 m³** and water supply charges at the time were **10.5 AED** per m³.

In total, water supply expenses were of **924 AED**.



*Smart Cooling*™ granted total savings post running costs of **6,769 AED** in 5 days or **1,353 AED** per day. On average, *Smart Cooling*™ reduced electricity consumption by **3,345 kw/h** per day.

*Smart Cooling*™ engineers forecasted **17%** savings for a 14-hour period within a 24-hour operational period – initially evaluated as **755 kw/h** savings based on a **10°C** temperature drop.

However, the results measured during the system's operation show that *Smart Cooling*'s™ performance went well beyond predictions, delivering on average a **14°C** decrease and further boosting chiller efficiency.

# Test 1

Five-day electricity consumption comparison – 17 to 21 June with *Smart Cooling™ OFF* and 3 to 7 June with *Smart Cooling™ ON*

Date	Total chiller consumption in kWh with Smart Cooling™ OFF	Total chiller consumption in kWh with Smart Cooling™ ON	Savings in kWh	Savings in %	Chiller load with Smart Cooling™ OFF	Chiller load with Smart Cooling™ ON	Temperature with Smart Cooling™ OFF	Temperature with Smart Cooling™ ON
	17 June	3 June					17 June	3 June
17/06/2019								
00:00	526	292	236	45%			33.49	31.00
17/06/2019								
01:00	504	347	157	31%			33.24	30.44
17/06/2019								
02:00	496	302	193	39%			32.79	30.01
17/06/2019								
03:00	480	304	176	37%			32.59	29.87
17/06/2019								
04:00	480	366	112	23%			32.51	30.02
17/06/2019								
05:00	468	302	166	35%			32.26	29.87
17/06/2019								
06:00	443	304	139	31%			31.21	29.79
17/06/2019								
07:00	412	338	76	18%			32.13	30.99
17/06/2019								
08:00	469	366	104	22%			34.63	34.04
17/06/2019								
09:00	497	391	105	21%			36.81	34.78
17/06/2019								
10:00	469	394	104	21%			38.01	35.96
17/06/2019								
11:00	519	397	122	24%			41.79	38.24
17/06/2019					54%	57%		
12:00	572	379	193	34%			42.82	38.82
17/06/2019								
13:00	581	400	182	31%			39.74	36.75
17/06/2019								
14:00	569	427	142	25%			38.05	36.26
17/06/2019								
15:00	564	506	59	10%			37.39	35.12
17/06/2019								
16:00	565	470	95	17%			36.11	34.58
17/06/2019								
17:00	595	493	102	17%			35.42	34.00
17/06/2019								
18:00	606	483	123	20%			34.10	33.02
17/06/2019								
19:00	565	454	111	20%			33.54	32.46
17/06/2019								
20:00	543	440	103	19%			33.17	32.36
17/06/2019								
21:00	568	413	153	27%			32.79	32.29
17/06/2019								
22:00	495	451	45	9%			32.25	32.17
17/06/2019								
23:00	467	391	76	16%			32.05	32.36
Day Total	12483	9408	3075	25%				



Date	Total chiller consumption in kWh with Smart Cooling™ OFF	Total chiller consumption in kWh with Smart Cooling™ ON	Savings in kWh	Savings in %	Chiller load with Smart Cooling™ OFF	Chiller load with Smart Cooling™ ON	Temperature with Smart Cooling™ OFF	Temperature with Smart Cooling™ ON
	18 June	4 June					18 June	4 June
18/06/2019								
00:00	526	429	97	18%			32.28	32.62
01:00	512	447	65	13%			32.13	31.53
02:00	508	394	113	22%			31.88	30.42
03:00	500	418	82	16%			31.40	30.72
04:00	491	456	35	7%			30.63	31.32
05:00	481	447	35	7%			30.00	31.04
06:00	488	450	36	7%			29.70	31.46
07:00	512	462	50	10%			30.87	32.40
08:00	516	470	46	9%			31.97	34.87
09:00	540	477	62	12%			33.81	37.52
10:00	587	486	121	21%			36.96	41.48
11:00	598	492	103	17%			39.52	46.57
12:00	584	473	111	19%	88%	77%	42.07	45.03
13:00	590	470	120	20%			39.12	40.57
14:00	610	475	135	22%			37.86	37.73
15:00	654	514	40	6%			36.57	37.77
16:00	655	514	41	6%			35.74	37.29
17:00	653	568	85	13%			35.22	36.56
18:00	636	539	97	15%			34.16	36.03
19:00	624	523	101	16%			33.73	36.63
20:00	632	524	108	17%			34.29	36.89
21:00	610	511	99	16%			34.25	37.63
22:00	621	479	42	6%			33.83	37.69
23:00	509	475	34	7%			33.60	37.61
Day Total	13533	11673	1860	14%				

Date	Total chiller consumption in kWh with Smart Cooling™ OFF 19 June	Total chiller consumption in kWh with Smart Cooling™ ON 5 June	Savings in kWh	Savings in %	Chiller load with Smart Cooling™ OFF	Chiller load with Smart Cooling™ ON	Temperature with Smart Cooling™ OFF 19 June	Temperature with Smart Cooling™ ON 5 June
19/06/2019								
00:00	561	428	133	24%			33.86	37.42
19/06/2019								
01:00	586	425	161	27%			34.43	36.76
19/06/2019								
02:00	558	427	131	24%			34.69	36.12
19/06/2019								
03:00	528	434	96	18%			34.52	35.29
19/06/2019								
04:00	510	468	42	8%			34.24	34.85
19/06/2019								
05:00	500	446	54	11%			33.93	34.53
19/06/2019								
06:00	500	446	52	10%			33.65	34.61
19/06/2019								
07:00	519	457	62	12%			33.84	35.68
19/06/2019								
08:00	575	472	104	18%			34.27	36.73
19/06/2019								
09:00	556	474	83	15%			35.35	36.76
19/06/2019								
10:00	577	467	110	19%			37.23	41.86
19/06/2019								
11:00	597	482	115	19%			41.03	46.33
19/06/2019					65%	85%		
12:00	635	388	247	39%			42.99	45.59
19/06/2019								
13:00	644	414	230	36%			49.22	49.39
19/06/2019								
14:00	621	429	193	31%			37.99	39.16
19/06/2019								
15:00	634	560	74	12%			36.52	37.80
19/06/2019								
16:00	635	526	107	17%			35.46	36.60
19/06/2019								
17:00	637	525	112	18%			34.55	36.05
19/06/2019								
18:00	636	531	106	17%			33.70	35.35
19/06/2019								
19:00	589	517	72	12%			32.99	34.74
19/06/2019								
20:00	576	451	126	22%			32.92	34.95
19/06/2019								
21:00	571	383	189	33%			32.89	35.40
19/06/2019								
22:00	524	377	148	28%			32.51	35.69
19/06/2019								
23:00	493	405	89	18%			32.25	35.43
Total of day	13769	10933	2836	21%				

Date	Total chiller consumption in kWh with Smart Cooling™ OFF	Total chiller consumption in kWh with Smart Cooling™ ON	Savings in kWh	Savings in %	Chiller load with Smart Cooling™ OFF	Chiller load with Smart Cooling™ ON	Temperature with Smart Cooling™ OFF	Temperature with Smart Cooling™ ON
	20 June	6 June					20 June	6 June
20/06/2019								
00:00	537	377	160	30%			32.44	35.13
20/06/2019								
01:00	527	363	173	33%			32.29	34.91
20/06/2019								
02:00	518	347	169	33%			32.04	34.61
20/06/2019								
03:00	504	337	167	33%			31.83	33.84
20/06/2019								
04:00	490	424	67	14%			30.97	33.77
20/06/2019								
05:00	495	400	95	19%			30.49	33.79
20/06/2019								
06:00	497	399	98	20%			30.58	32.43
20/06/2019								
07:00	488	411	74	15%			31.85	33.89
20/06/2019								
08:00	530	451	79	15%			33.56	35.83
20/06/2019								
09:00	613	516	97	16%			35.50	38.44
20/06/2019								
10:00	613	508	105	17%			38.41	41.69
20/06/2019								
11:00	647	507	141	22%			43.42	47.04
20/06/2019					88%	79%		
12:00	712	509	203	29%			45.52	45.52
20/06/2019								
13:00	731	512	219	30%			43.53	39.53
20/06/2019								
14:00	709	501	209	29%			38.16	38.01
20/06/2019								
15:00	693	556	137	20%			36.75	36.37
20/06/2019								
16:00	690	568	122	18%			35.89	35.29
20/06/2019								
17:00	688	554	132	19%			35.57	34.63
20/06/2019								
18:00	674	527	148	22%			34.91	33.86
20/06/2019								
19:00	691	510	181	26%			34.15	33.71
20/06/2019								
20:00	733	517	216	30%			33.65	33.71
20/06/2019								
21:00	728	475	253	36%			33.71	33.97
20/06/2019								
22:00	625	423	202	32%			33.65	34.26
20/06/2019								
23:00	580	410	170	29%			33.21	34.15
Day Total	14787	11091	3696	25%				

Date	Total chiller consumption in kWh with Smart Cooling™ OFF	Total chiller consumption in kWh with Smart Cooling™ ON	Savings in kWh	Savings in %	Chiller load with Smart Cooling™ OFF	Chiller load with Smart Cooling™ ON	Temperature with Smart Cooling™ OFF	Temperature with Smart Cooling™ ON
	21 June	7 June					21 June	7 June
21/06/2019								
00:00	658	433	224	34%			33.22	33.76
21/06/2019								
01:00	609	400	209	34%			33.27	33.29
21/06/2019								
02:00	607	405	201	33%			33.36	32.99
21/06/2019								
03:00	602	351	251	42%			32.96	32.49
21/06/2019								
04:00	670	424	245	37%			33.03	32.77
21/06/2019								
05:00	599	380	218	36%			33.61	32.12
21/06/2019								
06:00	568	391	178	31%			33.76	31.66
21/06/2019								
07:00	578	378	200	35%			34.51	33.10
21/06/2019								
08:00	601	449	152	25%			35.73	35.08
21/06/2019								
09:00	628	492	135	22%			37.63	38.14
21/06/2019								
10:00	729	423	307	42%			40.30	39.04
21/06/2019								
11:00	722	464	258	36%	74%	68%	41.61	41.30
21/06/2019								
12:00	763	467	316	40%			41.64	41.52
21/06/2019								
13:00	760	459	321	41%			38.43	38.99
21/06/2019								
14:00	768	494	275	36%			36.67	36.35
21/06/2019								
15:00	716	482	233	33%			35.55	36.68
21/06/2019								
16:00	758	475	283	37%			34.96	35.90
21/06/2019								
17:00	626	480	136	22%			34.57	35.29
21/06/2019								
18:00	632	444	188	30%			34.27	34.26
21/06/2019								
19:00	635	432	203	32%			34.02	34.30
21/06/2019								
20:00	730	426	304	42%			34.05	35.04
21/06/2019								
21:00	620	419	201	32%			33.96	35.29
21/06/2019								
22:00	502	347	155	31%			33.81	35.01
21/06/2019								
23:00	499	354	145	29%			33.69	34.69
Day Total	15619	10280	6339	34%				
PERIOD TOTAL	70112	53386	16726	24%				

## Test 2: 30-day Summary

Test No.2 was carried out for the period of 30 days, between 31 May and 30 June 2019. During this period, the chillers' electricity consumption was calculated with *Smart Cooling*™ turned ON.

The **Carrier 30XA 1002** chillers operated with the *Smart Cooling*™ unit **ON** for consecutive 20 days, during when the total energy consumption of the chillers' MW/h was measured.

### Measured consumption with *Smart Cooling*™ **ON**

*Smart Cooling*™ equipment was **ON** for 20 days with an average hotel occupancy of **72%**. In 20 days, total chiller consumption was of **221.41 MW/h**, an average of **11.07 MW/h** per day.

- Formula:  $(221.41 \text{ MW/h} \div 20 \text{ days}) = 11.07 \text{ MW/h}$  on a 24-hour average.

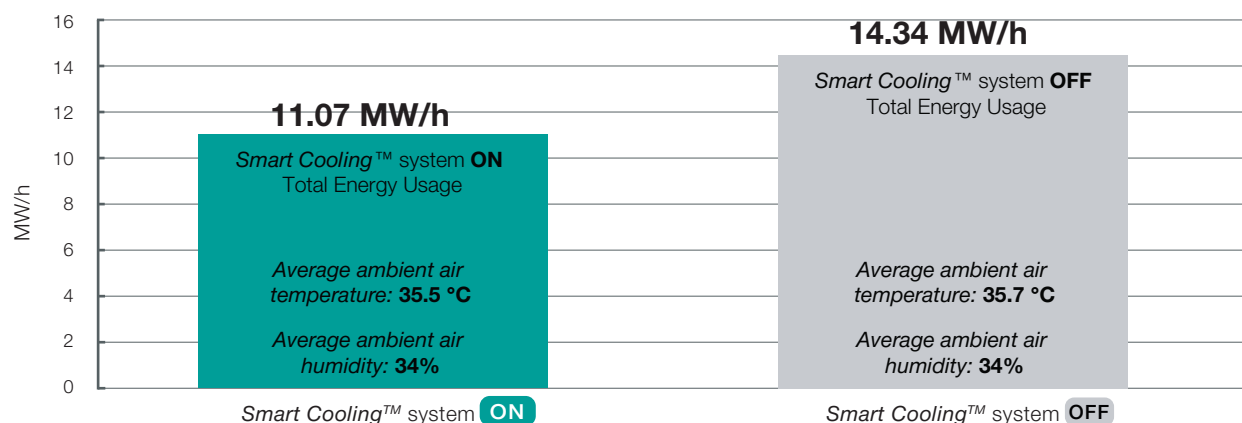
### Measured consumption with *Smart Cooling*™ **OFF**

*Smart Cooling*™ equipment was **OFF** for 9 days with an average hotel occupancy of **82%**. In 9 days, total chiller consumption was of **129.06 MW/h**, an average of **14.34 MW/h** per day.

- Formula:  $(129.06 \text{ MW/h} \div 9 \text{ days}) = 14.34 \text{ MW/h}$  on a 24-hour average.

### Test Nr. 2 summary:

After a 30-day, 24-hour comparison test of average electricity consumption of a **Carrier 30XA1002**, we ascertained that average savings were of **2 to 3 MM/h**, contingent on the hotel's occupancy rate. Total 30-day water consumption, including *Smart Cooling*™ maintenance was **375 m³**.



## Test 2

30-day overview with Smart Cooling™ turned **ON** and **OFF**

Smart Cooling™ Water and Electricity Consumption Readings								
Date	Previous water consumption in m³	Current water consumption in m³	Total Consumed	Total kWh consumed	OCCP %	Smart Cooling™ operational notes	Average ambient air temperature	Highest ambient air temperature
31/05/2019	0	36	7916.56	8.77	47.08	On - final adjustments performed	34	43
01/06/2019	36	50	3079.44	8.25	47.08	on	34	40
02/06/2019	50	60	2199.6	8.43	47.08	on	34	43
03/06/2019	60	78	3959.28	8.41	54.04	on	33	39
04/06/2019	78	95	3739.32	11.67	57.94	on	36	46
05/06/2019	95	112	3739.32	10.93	76.32	on	37	46
06/06/2019	112	130	3959.28	11.59	83.29	on	37	47
07/06/2019	130	148	3959.28	10.28	77.44	on	35	41
08/06/2019	148	162	3079.44	9.92	85.02	on	35	45
09/06/2019	162	175	2859.48	10.43	77.16	on	35	43
10/06/2019	175	184	1979.64	11.36	81.62	on - after 14:00, one Smart Cooling™ circuit not operating	33	41
11/06/2019	184	197	2859.48	12.2	82.73	on - after 14:00, one Smart Cooling™ circuit not operating	35	42
12/06/2019	197	212	3299.4	12.27	85.07	on	37	44
13/06/2019	212	226	3519.36	12.13	93.31	on	37	44
14/06/2019	226	241	2859.48	12.45	85.86	on	36	44
15/06/2019	241	254	2859.48	12.54	77.16	on	35	43
16/06/2019	254	265	2419.56	12.54	85.35	on	35	42
17/06/2019	265	274	1979.64	12.48	84.96	At 17:00, Smart Cooling™ turned off	34	43
18/06/2019	274	274	0	13.53	85.35	off	34	43
19/06/2019	274	274	0	13.77	85.24	off	35	43
20/06/2019	274	274	0	14.71	85.02	off	35	45
21/06/2019	274	274	0	15.62	74.37	off	35	42
22/06/2019	274	285	2419.56	16.01	74.09	Off (cleaning process)	37	44
23/06/2019	285	294	1979.64	15.36	75.55	Off (cleaning process)	37	43
24/06/2019	294	294	0	13.58	83.84	off	36	44
25/06/2019	294	294	0	12.96	83.29	off	35	43
26/06/2019	294	294	0	13.52	85.91	off	37	42
27/06/2019	294	309	3299.4	12.82	85.79	On, after 15:00	37	44
28/06/2019	309	332	5059.08	12.58	79.67	on	37	44
29/06/2019	332	355	5059.08	12.03	71.03	on	38	46
30/06/2019	355	375	4399.2	11.83	75.32	on	37	47

## ROI Summary:

### Calculated savings:

- Daily electricity savings =  $2.5 \text{ Mw/h} \times 0.45 \text{ AED (energy supply rate)} = \text{AED } 1,125.$
- Monthly electricity savings =  $\text{AED } 1,125 \times 30 \text{ days} = \text{AED } 33,750.$

### Operation costs:

- Monthly water consumption =  $375 \text{ m}^3 \times 10 \text{ AED (water supply rate)} = \text{AED } 3,750.$
- Biochemical materials and maintenance costs = **AED 600.**
- Total operational costs = **AED 4,350.**
- Monthly net savings =  $\text{AED } 33,750 - \text{AED } 4,350 = \text{AED } 29,400.$

### Equipment costs:

- 2 Smart Cooling™ devices = **AED 210,000 (Inc. VAT)**

### Return on Investment (ROI):

- 2 Smart Cooling™ devices =  $210,000 / (29,400 \times 8) = \text{10.7 Months}$

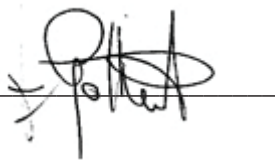
#### ROI Calculation Notes:

*There are effectively eight operating months comprising heat season and four months with negligible savings, which were not considered for the purposes of this ROI calculation.*

As per the readings above, measured savings range from **2 to 3 MW/h** per day. For estimation purposes, we have based the ROI calculation on average savings of **2.5 MW/h.**

ROI calculation is contingent on a building's cooling requirements and external air temperature).

Luca Gallarate  
31 July 2019



## Annex:



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### RIF600 | Clamp-on Ultrasonic Meter Calibration Report

Pipe diameter	DN80	Date	15/12/2018
Ambient temperature	29°C	Model	RIF600W
Standard Device before test	Normal		
Standard Device After Test	Normal		
Test result	Qualified		
Measured Medium	Water		
Accuracy	1%		
Signal Strength	UP: 90 DOWN: 90		
Standard device name	Static volumetric method/standard Meter Method Water Flow/Standard Device		
Standard device accuracy	0,20%		

Test	Standard Meter flow		Temperature	Pressure	Tested Meter Flow		Basic Error	Repeatability	
Point	m3/h		°C	Mpa	m3/h		%	%	
Point 1	101,52	101,47	25,0	0,300	102,27	102,10	0,739	-0,147	0,147
	101,47		25,0	0,300	102,07		0,591		
	101,42		25,0	0,300	101,97		0,542		
Point 2	71,27	71,27	25,0	0,300	71,75	71,75	0,673	-0,146	0,147
	71,19		25,0	0,300	71,65		0,646		
	71,34		25,0	0,300	71,86		0,729		
Point 3	26,32	26,36	25,0	0,300	26,51	26,55	0,722	-0,132	
	26,36		25,0	0,300	26,56		0,759		
	26,39		25,0	0,300	26,58		0,720		

Verification Based on JIG 1030-2007 < Ultrasonic flowmeter verification procedures >  
Scale Factor=1





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## RIF600 | Test Report misuratore di portata ad ultrasuoni clamp on

Diametro tubazione DN80  
Temperatura ambiente 29°C  
Dispositivo standard prima del test Normale  
Dispositivo standard dop il test Normale  
Risultato del test Qualified  
Liquido Acqua  
Accuratezza 1%  
Potenza dei segnali UP: 90  
DOWN: 90

Date 15/12/2018

Model: RIF600W

Tipo di dispositivo standard Metodo volumetrico statico/Misuratore di portata volumetrico  
Accuratezza del dispositivo standa 0,20%

Test	Misuratore standard	Temperatura	Pressione	Misuratore testato	errore base	Ripetibilità
Punti	m3/h	°C	Mpa	m3/h	%	%
Punto 1	101,52	25,0	0,300	102,27	0,739	-0,147
	101,47	25,0	0,300	102,07	0,591	
	101,42	25,0	0,300	101,97	0,542	
Punto 2	71,27	25,0	0,300	71,75	0,673	-0,146
	71,19	25,0	0,300	71,85	0,646	
	71,34	25,0	0,300	71,86	0,729	
Punto 3	26,32	25,0	0,300	26,51	0,722	-0,132
	26,36	25,0	0,300	26,56	0,759	
	26,39	25,0	0,300	26,58	0,720	

Verification Based on JIG 1030-2007 < Ultrasonic flowmeter verification procedures >  
Scale Factor=1