TEST REPORT: Nr.55

Date: September 25 2020

CHILLER EFFICIENCY PERFORMANCE WITH INTELLIGENT ADIABATIC CHILLER-BOOSTING SYSTEM **SMART COOLING™** PRO10 FOR CARRIER 30XA1002 CHILLERS

Test Participants

Carrier Engineer: Mohammad Jebril

Ali & Sons Engineer: Righesh Mohanan

Gerab Energy Engineer: Ali Soufan

Swiss Integrated Energy Technologies: Luca Gallarate

Project Title: Audi Showroom

Location: Abu Dhabi, United Arab Emirates

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Introduction

Building Type: Audi Showroom, Abu Dhabi, United Arab Emirates

Cooling Unit: air cooled water chiller Carrier 30XA1002

Adiabatic Device: **Smart Cooling™** PRO 10

Chillers were retrofitted with the intelligent adiabatic **Smart Cooling™** system to reduce their electricity consumption and increase COP (Coefficient of Performance) efficiency.

The intelligent adiabatic **Smart Cooling™** system combines an adiabatic evaporative pre-cooling process and condenser protection with mechanical air filtration. The intelligent adiabatic **Smart Cooling™** system is mounted externally in front of the condensers of the cooling equipment. **Smart Cooling™** initiates the adiabatic process even before the mechanical cooling kicks in and the equipment receives a temperature-reducing fine mist of processed water that reduces the temperature of condensation within the cooling circuit.

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 are installed outside the condenser and cover its entire surface, preventing water mist from coming into direct contact with the condenser.

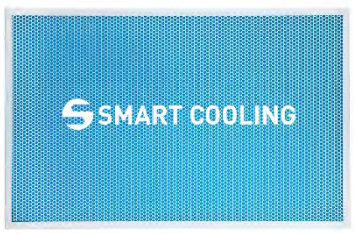
Water filtration, purification and sterilization: the system purifies water from minerals and sterilizes water to prevent bacterial occurrence.

A high-pressure pump provides water pressure of up to 70 bar while a water recirculation system reintroduces non-evaporated water into the water purification and pump system.

The control unit regulates the system according to real-time data sets such as chiller parameters, ambient air temperature and humidity to supply the adiabatic system with the appropriate amount of water.

A high-pressure nozzle provides water spray with 5- to 40-micron droplets.

A set of fasteners and fixings ensure the compatibility of the equipment with the chiller.



Measuring instruments

An RIF600 ultrasonic water flow meter was used to measure the effectiveness of the chiller.
An Eniscope Analytics energy monitoring equipment (BEST) was used to measure electricity consumption.

Equipment tested: **CARRIER 30XA1002 Air-cooled Water Chillers**

Chiller without **Smart Cooling™** system

Chiller with **Smart Cooling™** system

Testing procedures:

Test conducted on chiller No.1.

Testing time: 08/28/2020 - 09/05/2020 adiabatic system Smart Cooling™ switched ON.
Testing Time: 09/09/2020 –09/18/2020 adiabatic system Smart Cooling™ switched OFF.

Stage 1

A data logger is installed on the subject HVAC equipment to collect all applicable real-time energy consumption and unit performance information. Data is collected by using a temperature sensor, Eniscope analytics and BTU reader.

BTU Reader

Eniscope Device

Stage 2

The **Smart Cooling™** system is switched ON.

Stage 3

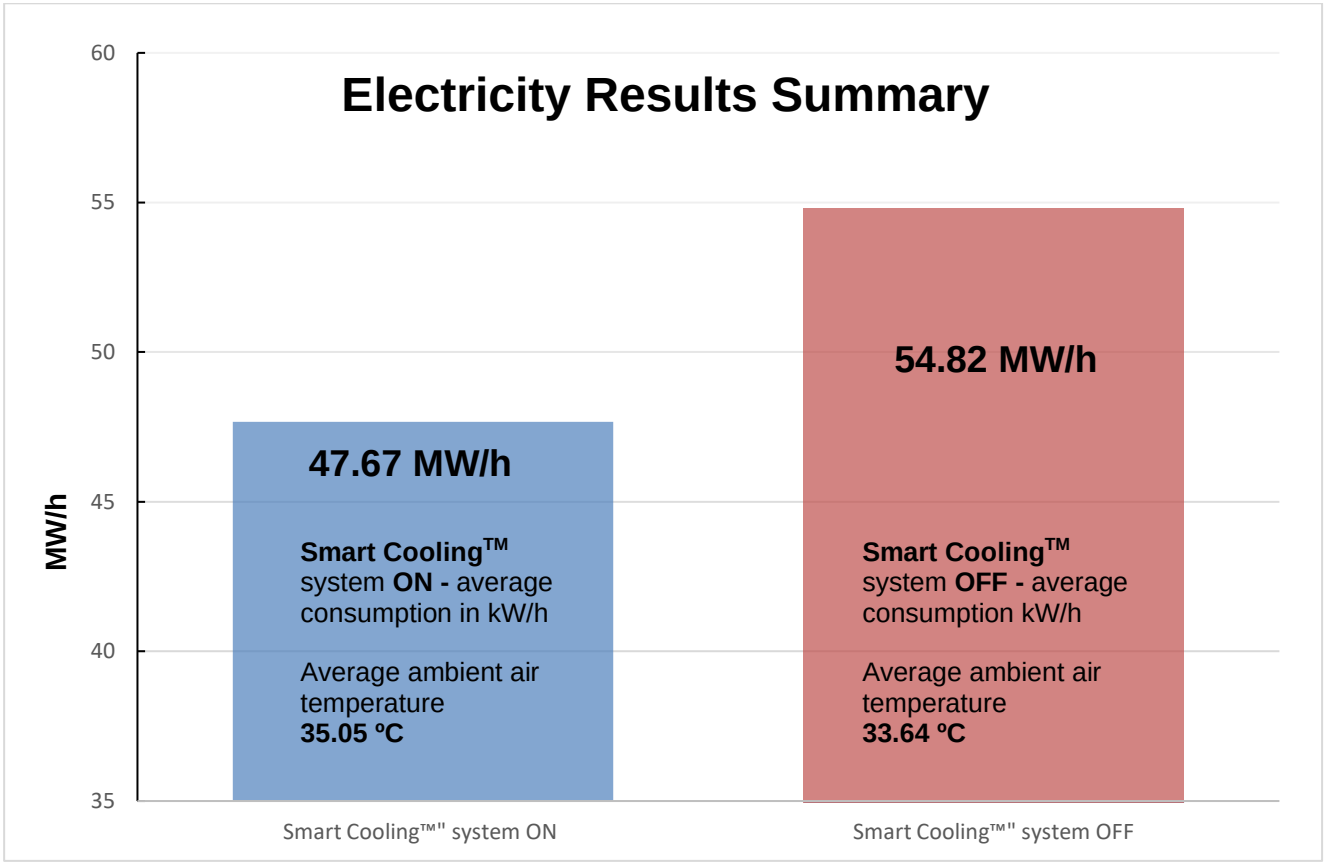
During the period between 08/27/2020 and 09/05/2020, the test measured electricity usage data by chiller nr.1 (chillers nr.2 and nr.3 were switched off) with the intelligent adiabatic **Smart Cooling™** system in operation. During this period, the chiller consumed **47.67 MW/h** of electricity and produced **161.55 MW/Q**, while water consumption was **99 m3** and the average temperature during the period was **35.05 C°.**

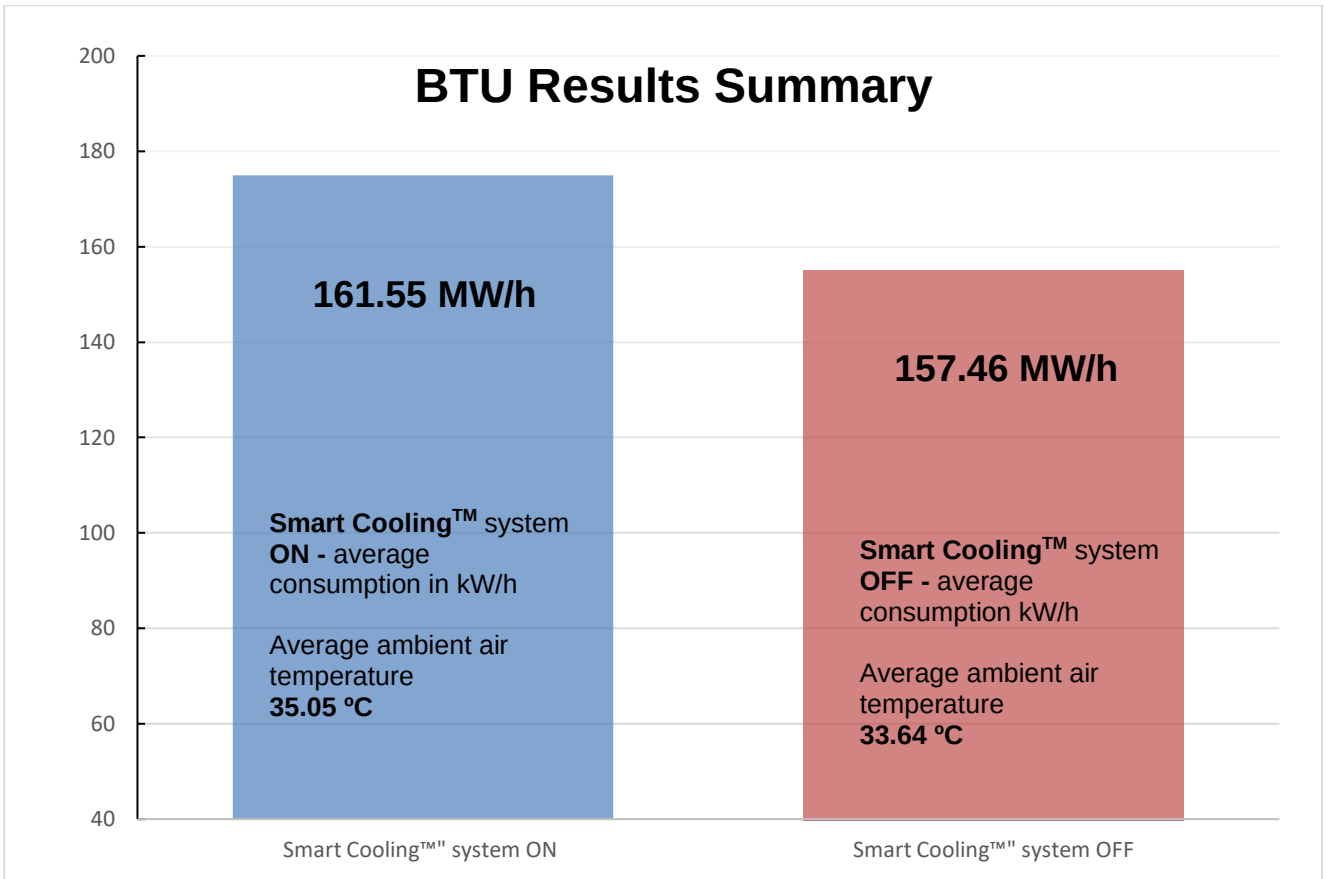
Stage 4

The **Smart Cooling™** system is switched OFF.

Step 5

During the period between 08/09/2020 and 09/18/20202 the test measured electricity usage data by chiller nr.1 (chillers nr.2 and nr.3 were switched off) with the intelligent adiabatic **Smart Cooling™** system **not** in operation. During this, period the chiller consumed **54.82 MW/h** of electricity and produced **157.46 MW/Q**, while water consumption was **0 m3** and the average temperature during the period was **33.64° C**


Electricity Results Summary
MW/h
60
55
50
45
40
35
47.67 MW/h
Smart Cooling™ system ON - average consumption in kW/h
Average ambient air temperature
35.05 ºC
54.82 MW/h
Smart Cooling™ system OFF - average consumption kW/h
Average ambient air temperature
33.64 ºC
Smart Cooling™" system ON
Smart Cooling™" system OFF


BTU Results Summary
200
180
160
140
120
100
80
60
40
161.55 MW/h
Smart Cooling™ system ON - average consumption in kW/h
Average ambient air temperature
35.05 ºC
157.46 MW/h
Smart Cooling™ system OFF - average consumption kW/h
Average ambient air temperature
33.64 ºC
Smart Cooling™" system ON
Smart Cooling™" system OFF

Post-analysis of data monitoring shows the electricity savings generated by the **Smart Cooling™** system in 10 operation days is **8.15 MW/h** of electricity and increased cooling load by **4.09 MW/Q.**

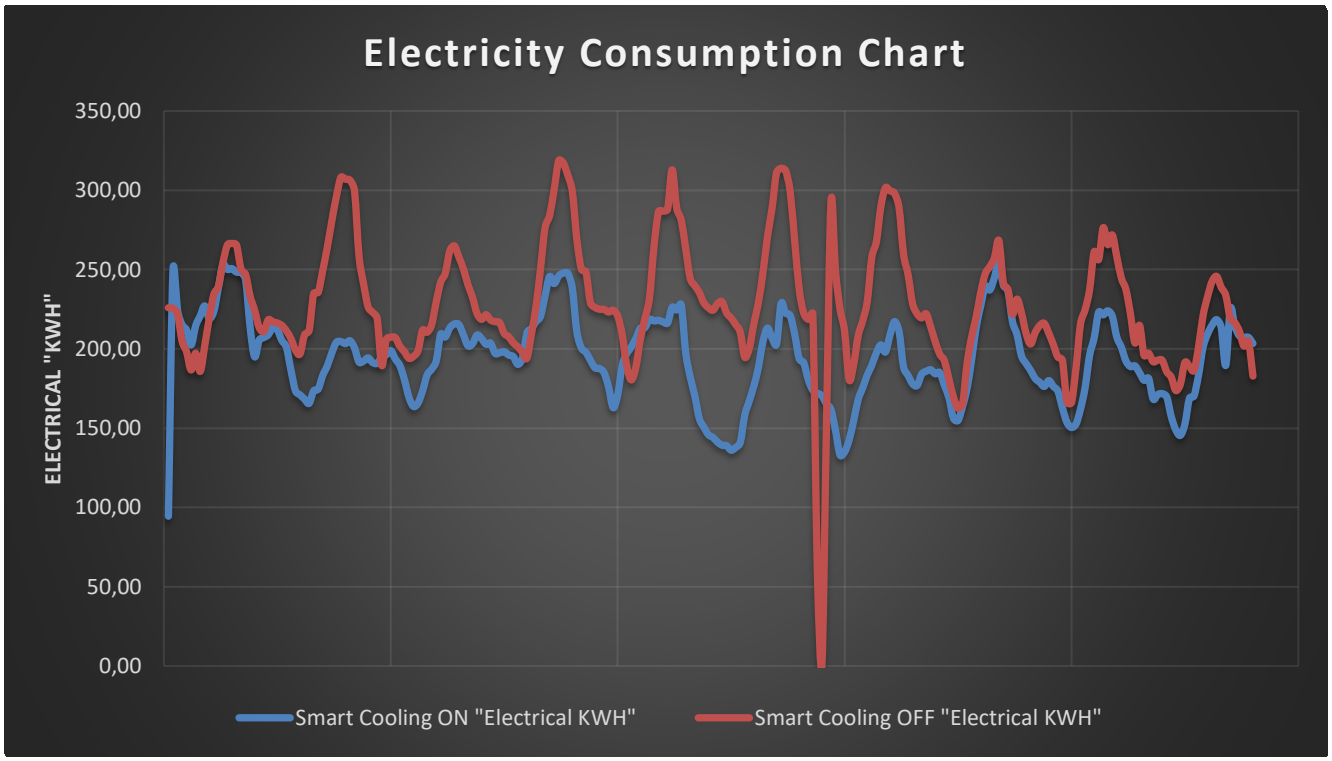
Within these 10 days, the customer saved **8150 kw/h of electricity**. At an electricity rate of AED 0.45 per kw/h, the total savings amount to AED 3,667.5.

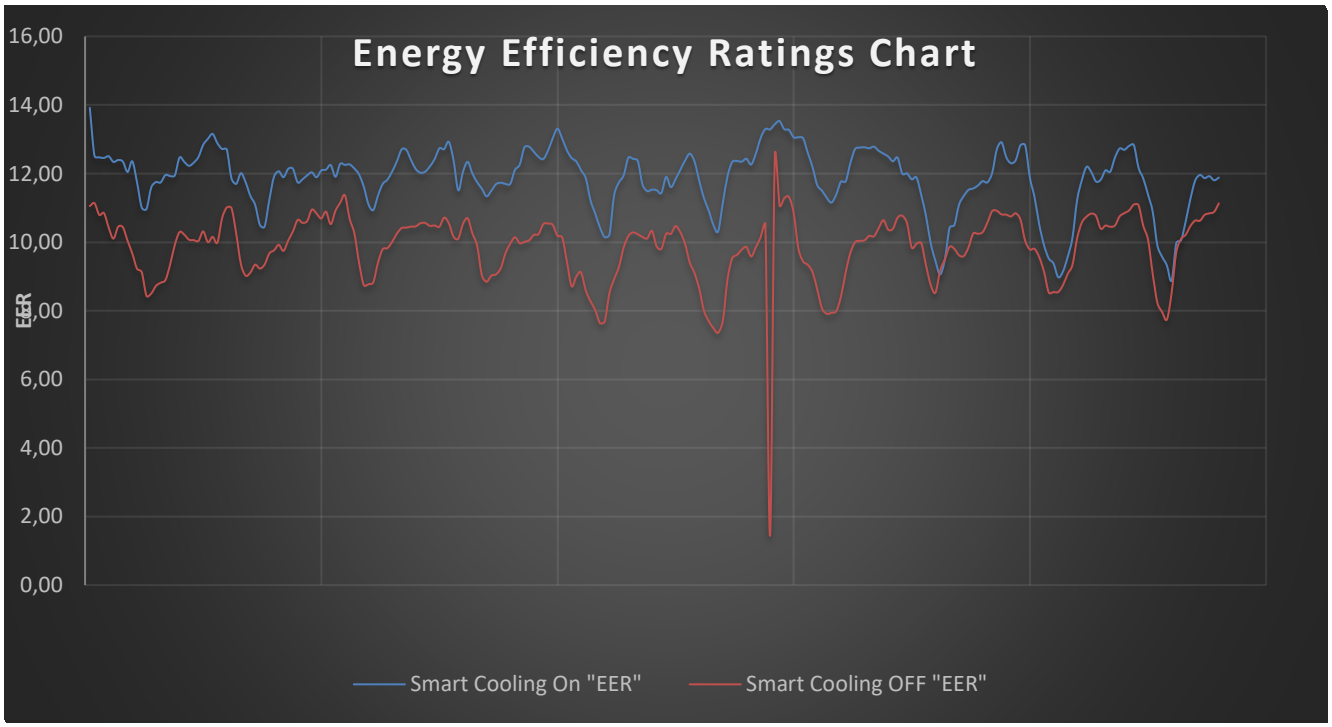
To achieve this result, 54 m3 of water were used, with water expenses of AED 10 per m3. In total AED 540 were spent on water.

Total savings after running costs were AED 3127.5 per 10 days or AED 366.7 per day or, on average, 815 kw/h per day for one operational chiller.

Testing Summary:

Smart Cooling™ Test Report in Chiller 1 Ali & Sons Audi Showroom, Abu Dhabi		
Status of **Smart Cooling™**	**ON**	**OFF**
Operating Date	27/08/2020 - 05/09/2020	09/09/2020 - 18/09/2020
Average Ambient Temperature "°C"	35.05	33.64
Average Flow "m³/h"	173.25	173.75
Total Electricity Consumption "MWH"	46.67	54.82
Average Electricity Consumption "KWH"	194.47	228.43
Average electricity consumption "KWH" at 100% load, 35 °C ambient temperature and exiting water temperature 6 °C	315.00	315.00
Chiller load %	61.74%	72.52%
Total Cooling Capacity "MWH"	161.55	157.46
Average Cooling Capacity "KWH"	673.11	656.07
Average EER	11.86	9.83
Electricity Consumption %	↘ 17.47%	
Cooling Capacity %	↗ 2.53%	
Energy Efficiency Rating (EER) %	↗ 20.59%	





Conclusion

Test results show that the intelligent adiabatic equipment **Smart Cooling™** increased chiller performance by, on average, 20.59% during 24 operational hours.

Ali Soufan

September 25 2020

Annex

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RIF600 | Clamp-on Ultrasonic Meter Calibration Report

Pipe diameter	DN80		Date	15/12/2018
Ambient temperature	29°C			
Standard Device before test	Normal		Model:	RIF600W
Standard Devide 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	0,759	-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	
	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 JJG 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		Date	15/12/2018
Temperatura ambiente	29°C			
Dispositivo standard prima del test	Normale		Model:	RIF600W
Dispositivo standard dop il test	Normale			
Risultato del test	Qualified			
Liquido	Acqua			
Accuratezza	1%			
Potenza dei segnali	UP:	90		
	DOWN:	90		
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	101,47	25,0	0,300	102,27	102,10	0,739	0,759	-0,147	0,147
	101,47		25,0	0,300	102,07		0,591			
	101,42		25,0	0,300	101,97		0,542			
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	26,36		25,0	0,300	26,56		0,759			
	26,39		25,0	0,300	26,58		0,720			

Verification Based on JJG 1030-2007 < Ultrasonic flowmeter verification procedures >
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