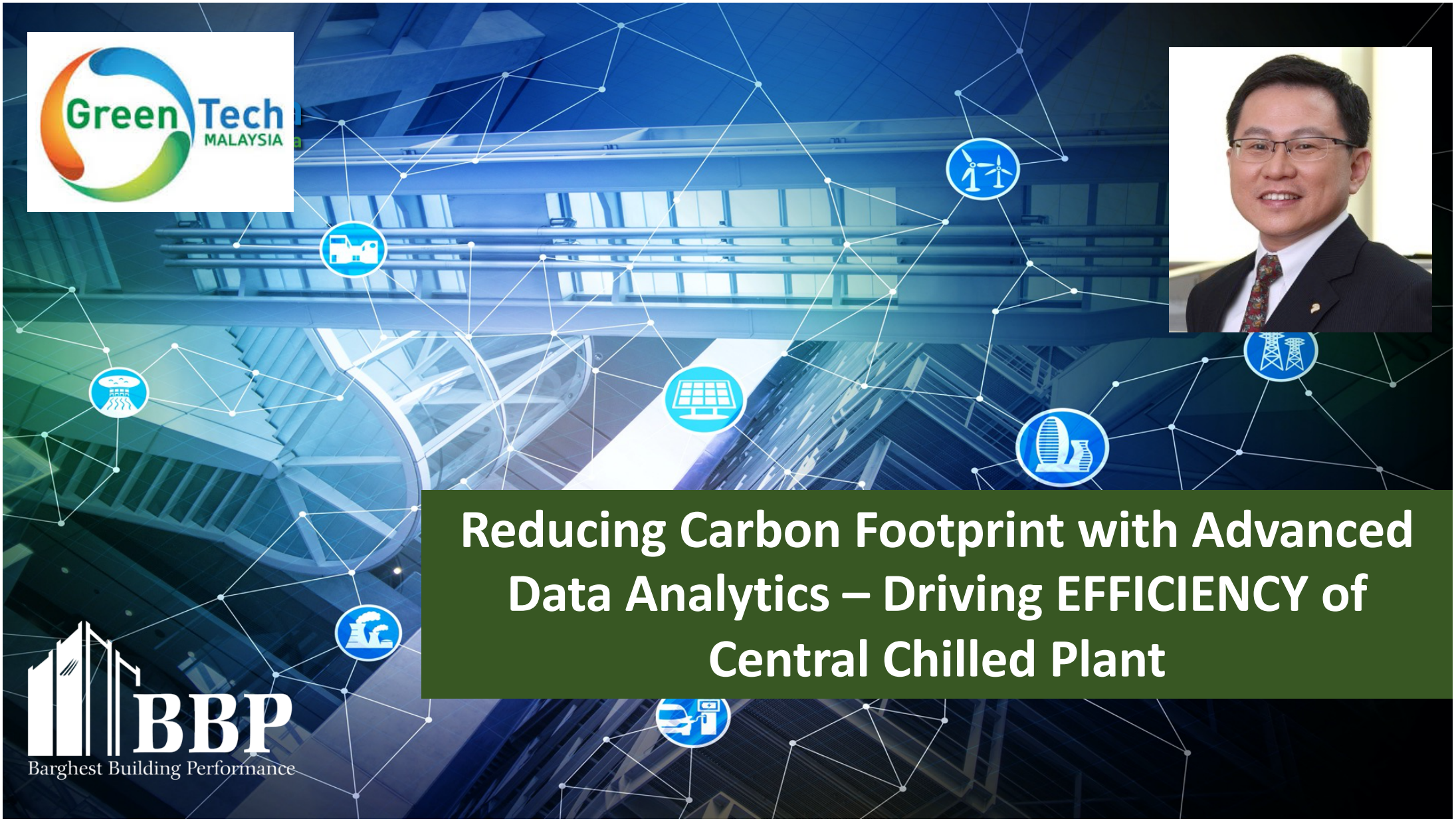
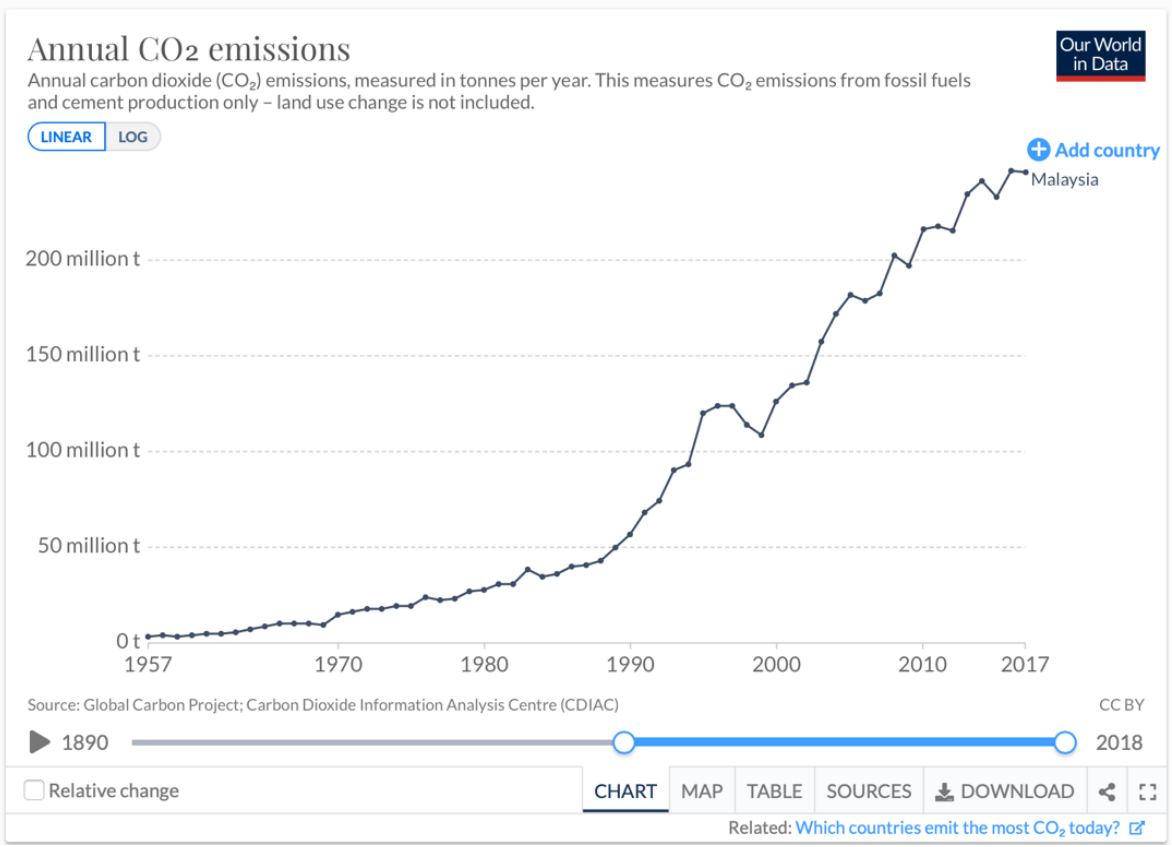

Green Tech
MALAYSIA
Reducing Carbon Footprint with Advanced Data Analytics – Driving EFFICIENCY of Central Chilled Plant
BBP
Barghest Building Performance

Lets take a look at DATA

The following graphs are extracted from Our World in Data website

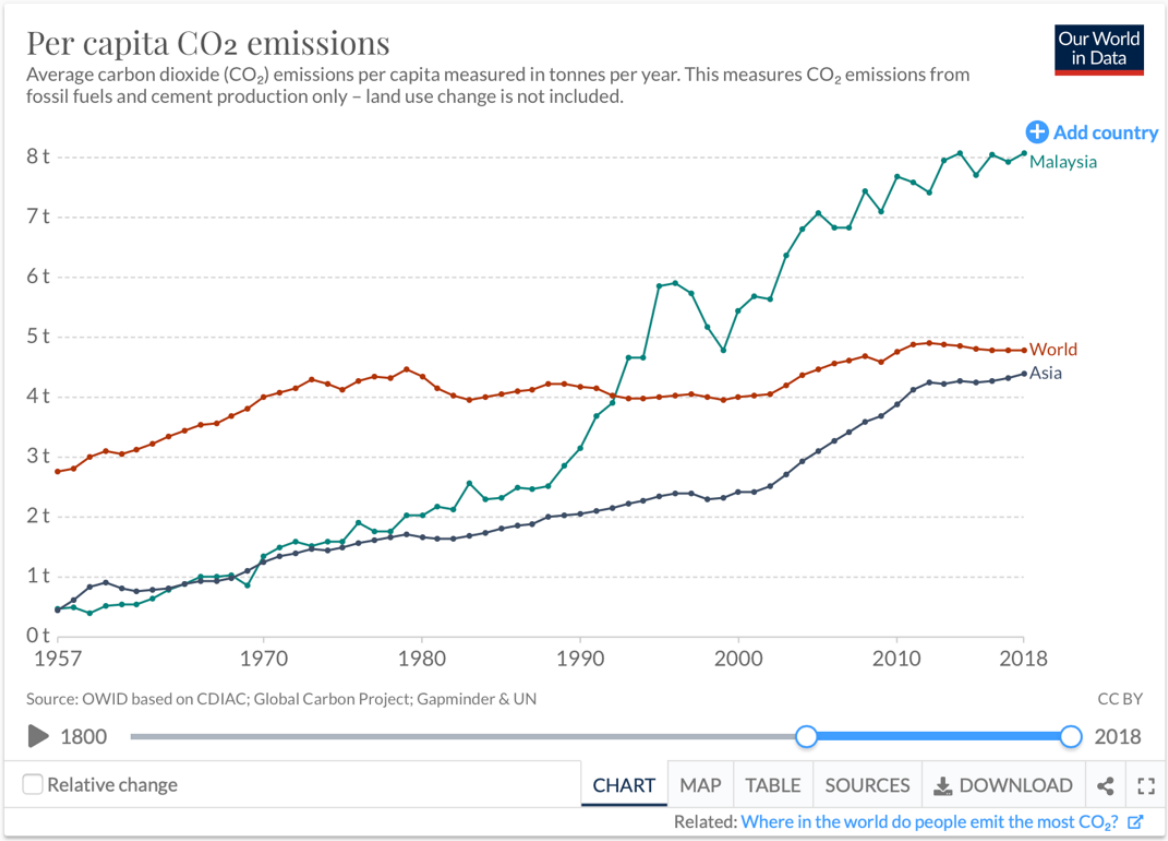
What are the country's **annual** CO_2 emissions?



Source : https://ourworldindata.org

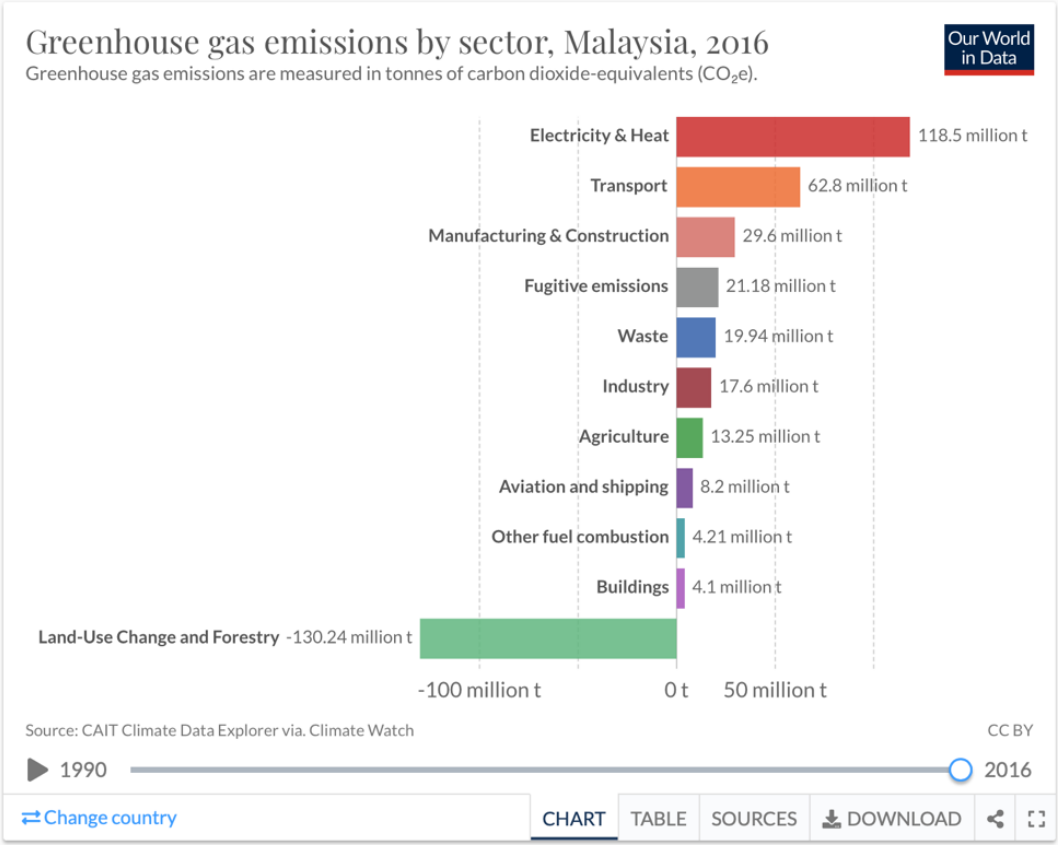
Per capita: how much CO_2 does the average person emit?

Source : https://ourworldindata.org



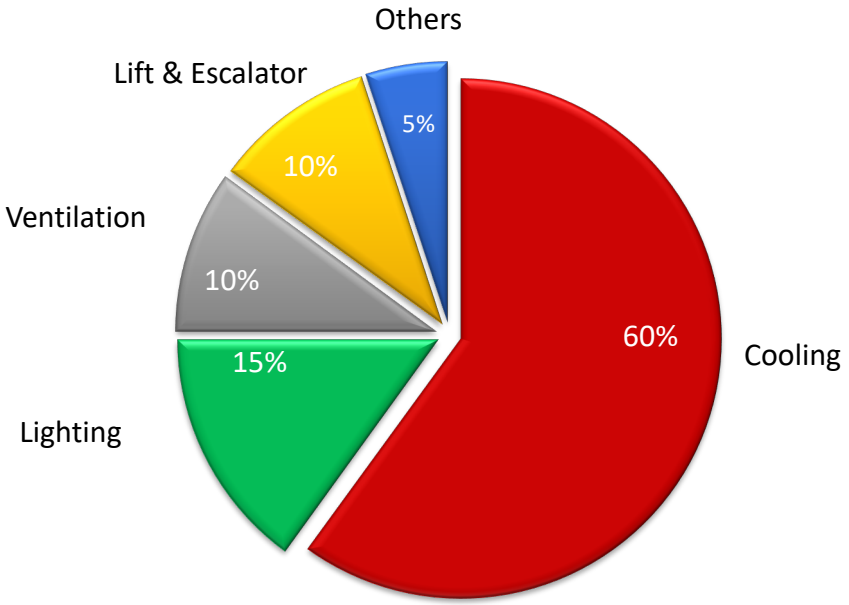
Where do emissions come from?

Source : https://ourworldindata.org

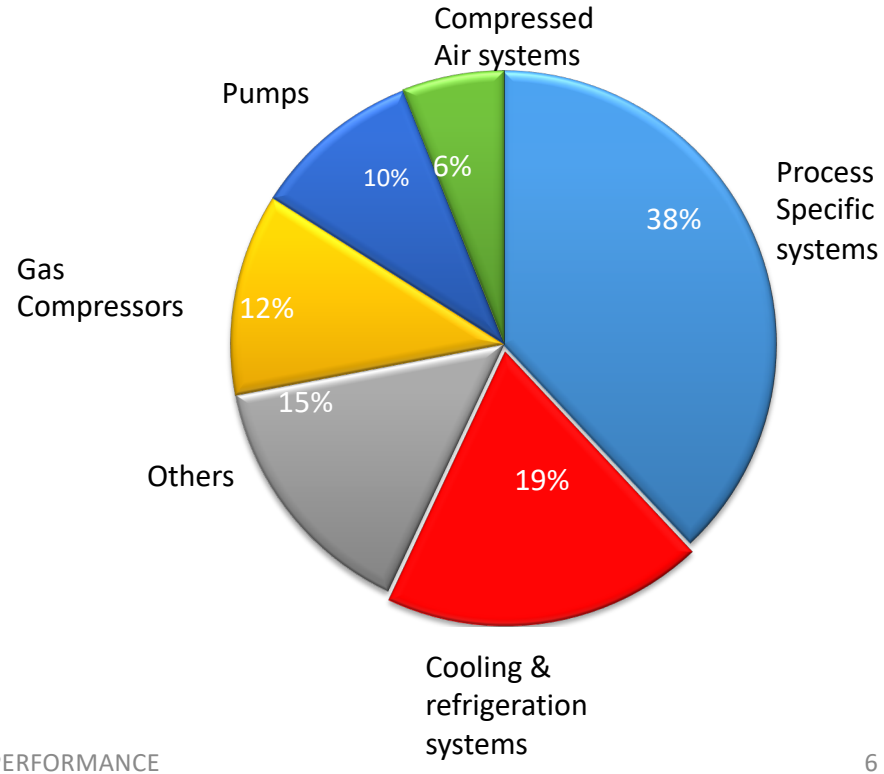


Climate Control is a major user of electricity

Air-conditioning represents 60% of commercial buildings' electricity consumption

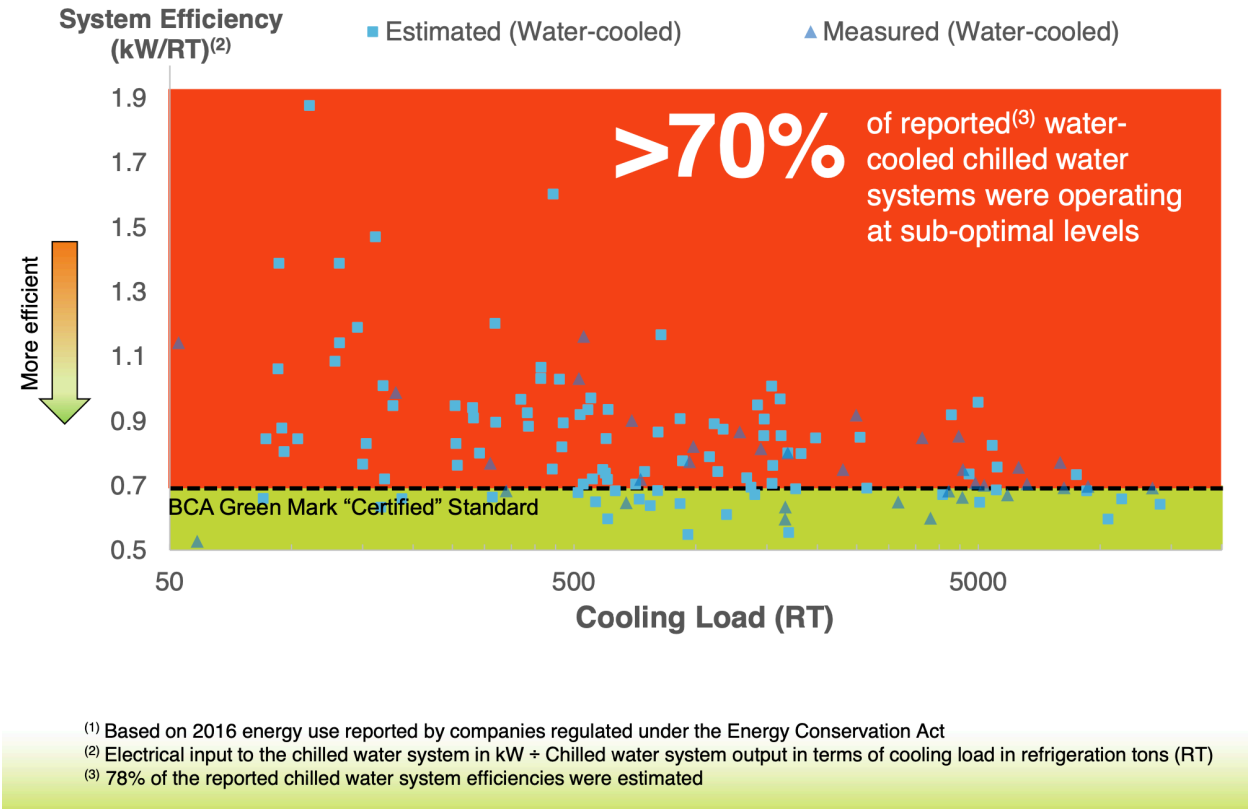


Cooling and refrigeration systems are second largest user of electricity in the industrial space



Source: NEA – Energy Use Reports and Energy Efficiency Improvement Plans 2014

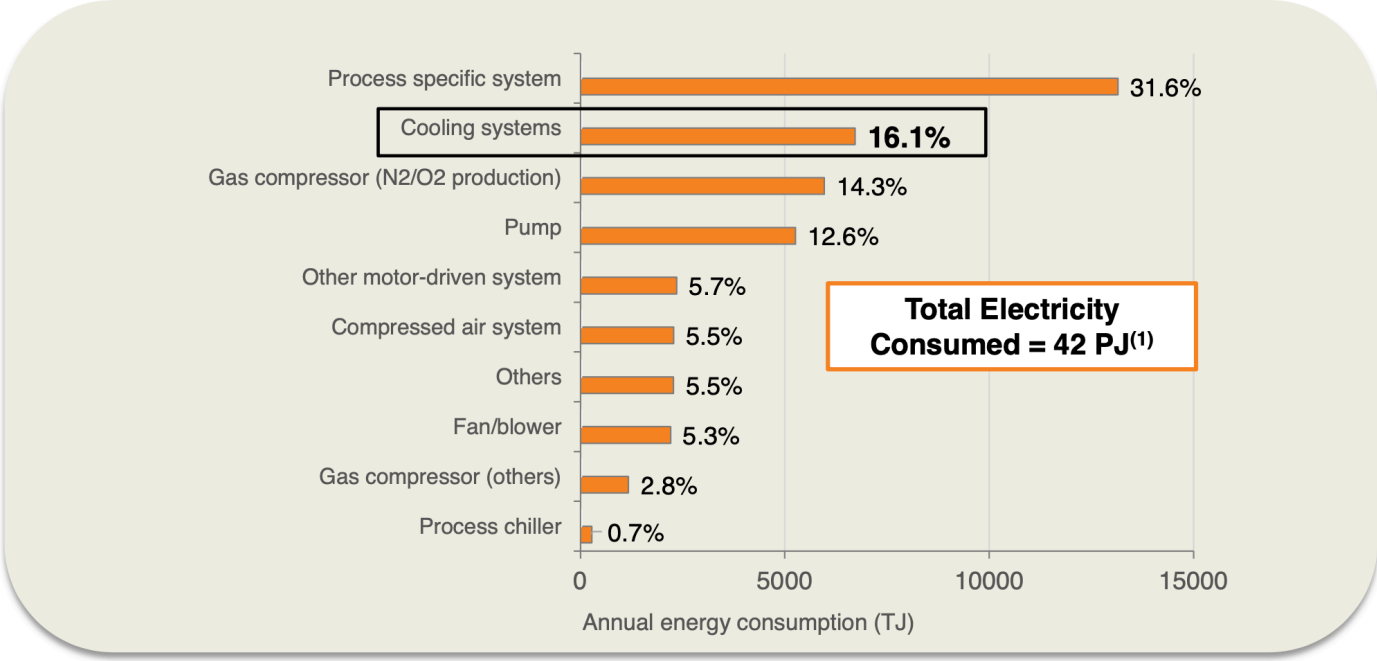
Current Efficiency Levels of Water-cooled Systems in Industrial Facilities



(1) Based on 2016 energy use reported by companies regulated under the Energy Conservation Act
(2) Electrical input to the chilled water system in kW ÷ Chilled water system output in terms of cooling load in refrigeration tons (RT)
(3) 78% of the reported chilled water system efficiencies were estimated

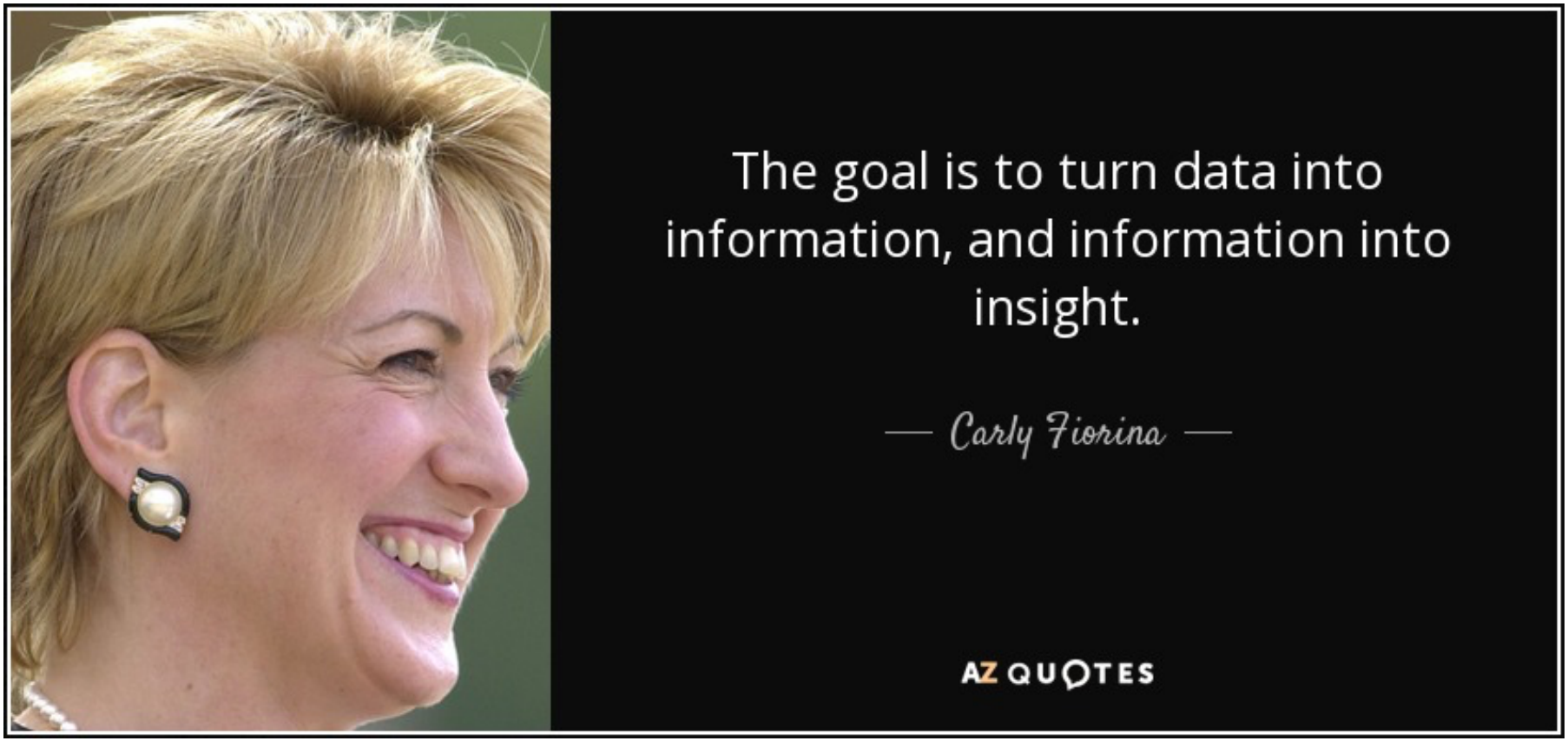
Source: NEA Singapore

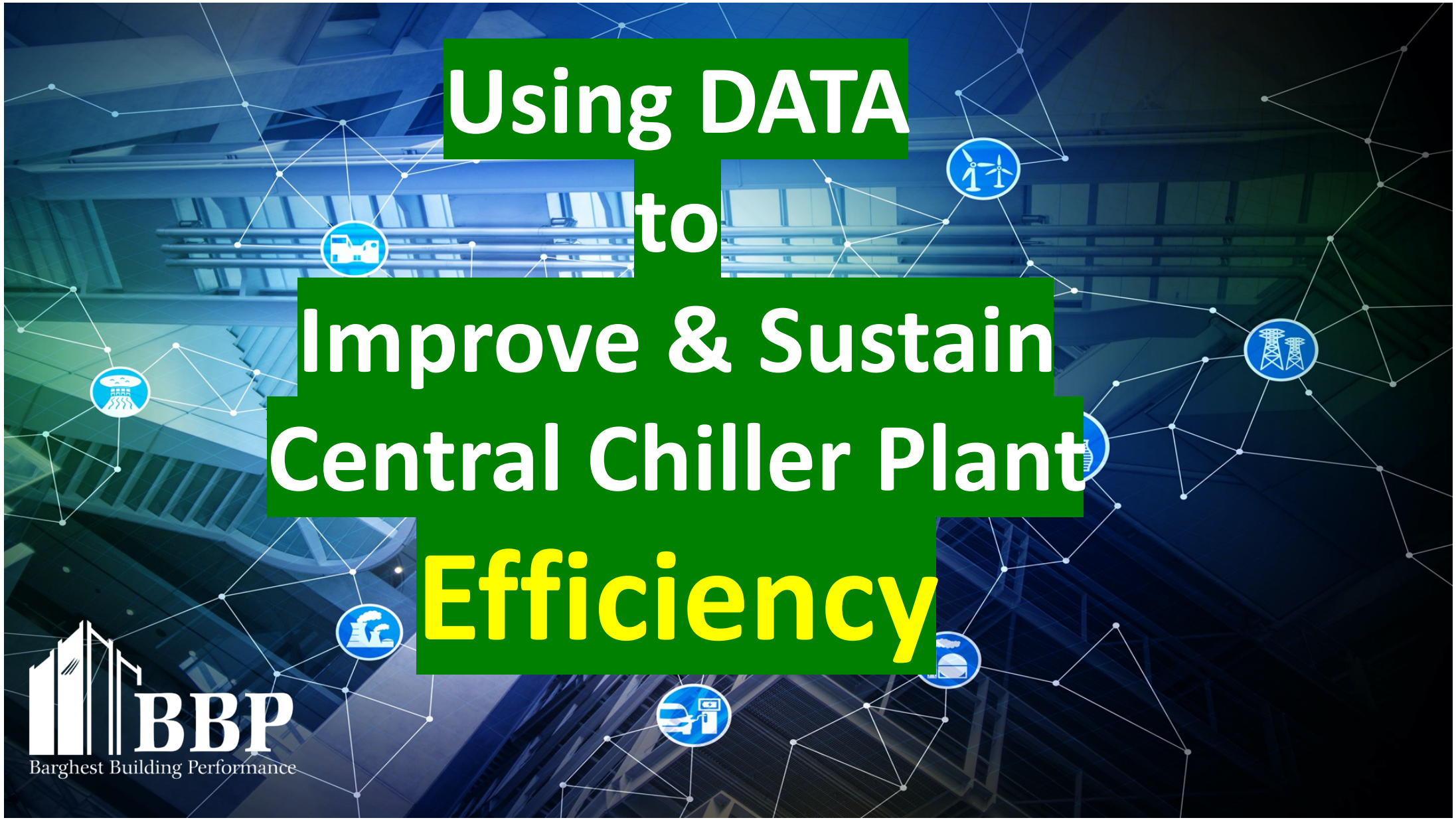
Electricity Users in the Industrial Sector



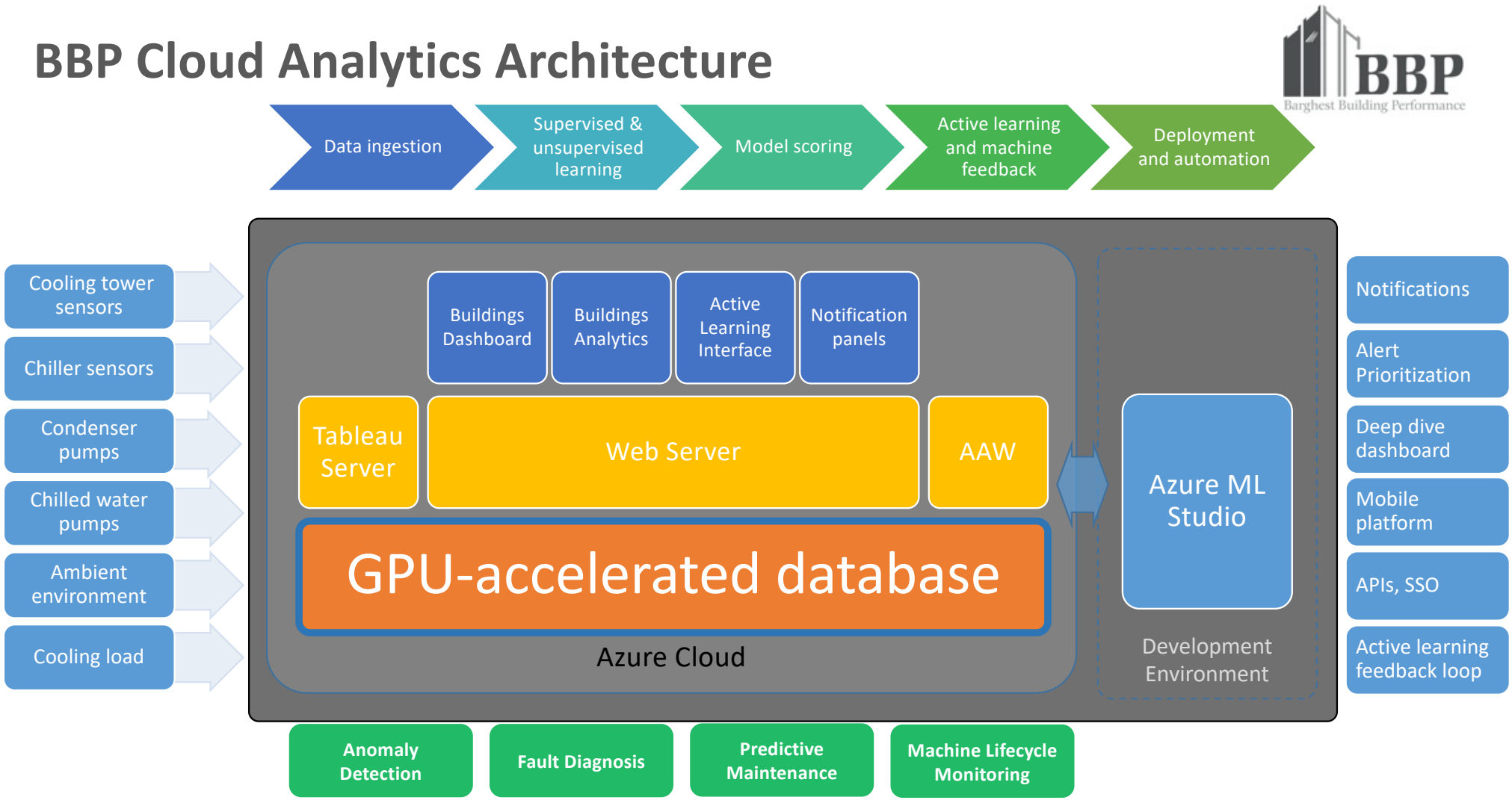
(1) Based on 2016 energy use reported by companies regulated under the Energy Conservation Act

Source: NEA – Energy Use Reports and Energy Efficiency Improvement Plans 2020


The goal is to turn data into information, and information into insight.
— Carly Fiorina —
AZ QUOTES


Using DATA
to
Improve & Sustain
Central Chiller Plant
Efficiency
BBP
Barghest Building Performance

BBP Cloud Analytics Architecture



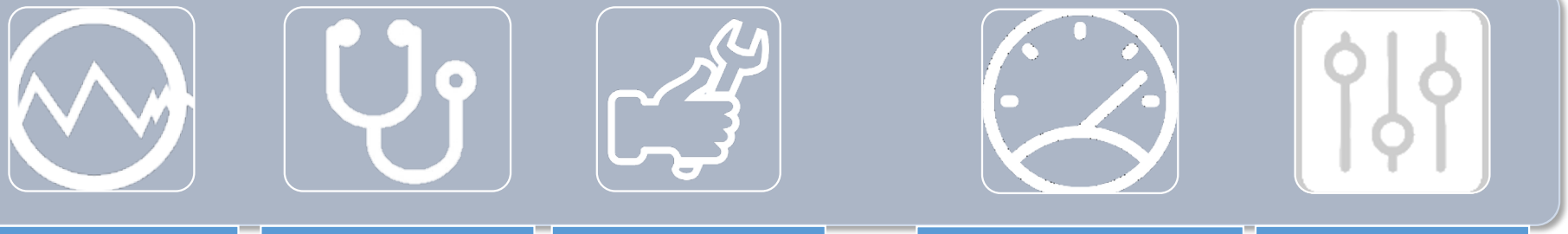
AI Based Energy Management Platform

Address maintenance issues

Improve equipment lifecycle

Improved productivity

Improved energy savings



Anomalies Detection

- Outlier detection algorithm to detect anomalies in signals using machine learning approach

Machine Diagnostics

- Root cause analysis
- False Alarm Detection

Condition-based Lifecycle Management

- Failure monitoring and prediction
- Schedule timely maintenance when necessary

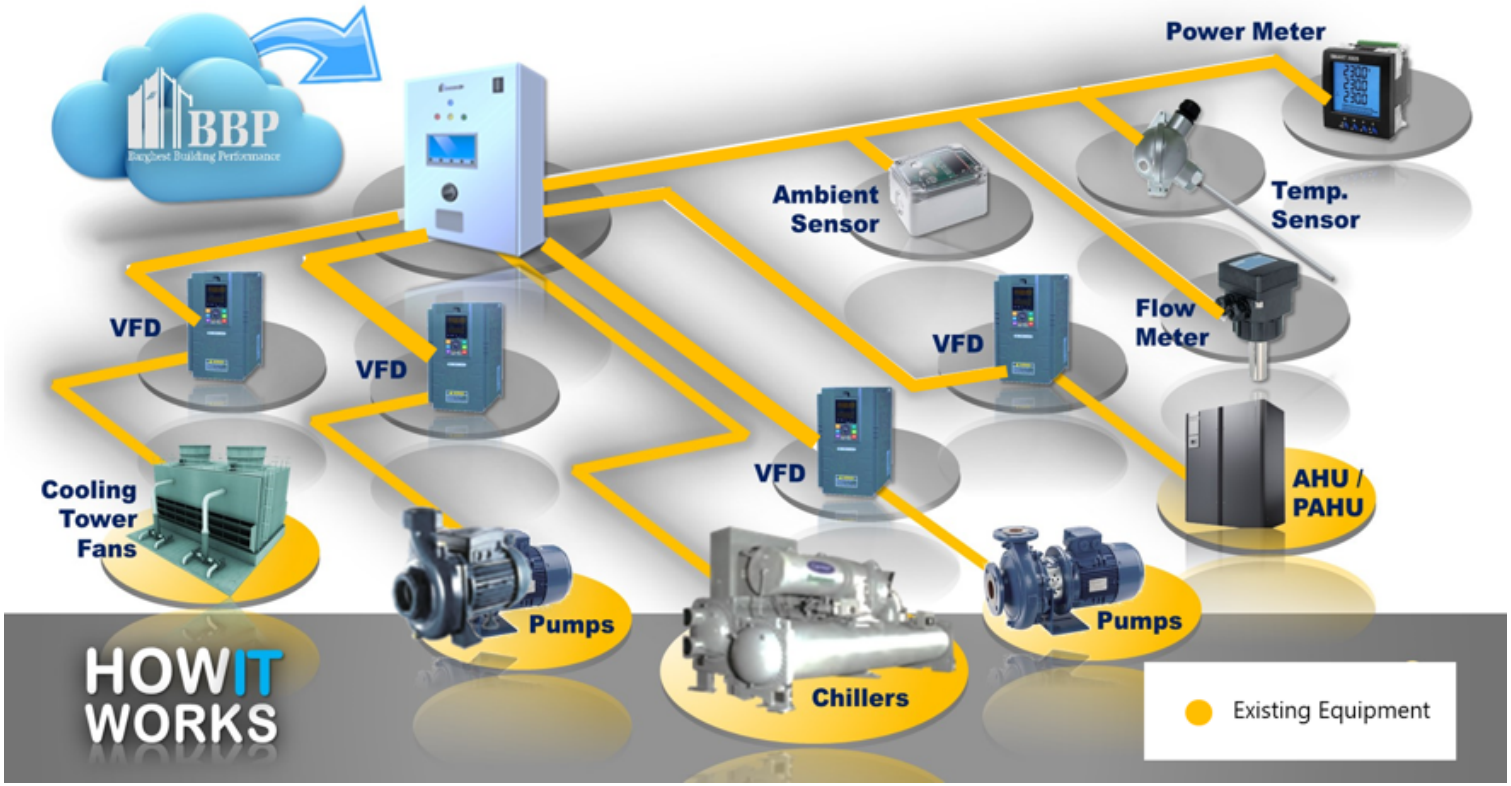
Energy Optimization

- Machine characterization
- New setpoints recommendation and active controls
- Compensate and adapt to changing conditions
- Account for long-term deterioration of machine conditions

Edge Control

- On-site control based on optimal energy efficiency levels

Holistic optimization using sensors, controls, programming, software & asset management



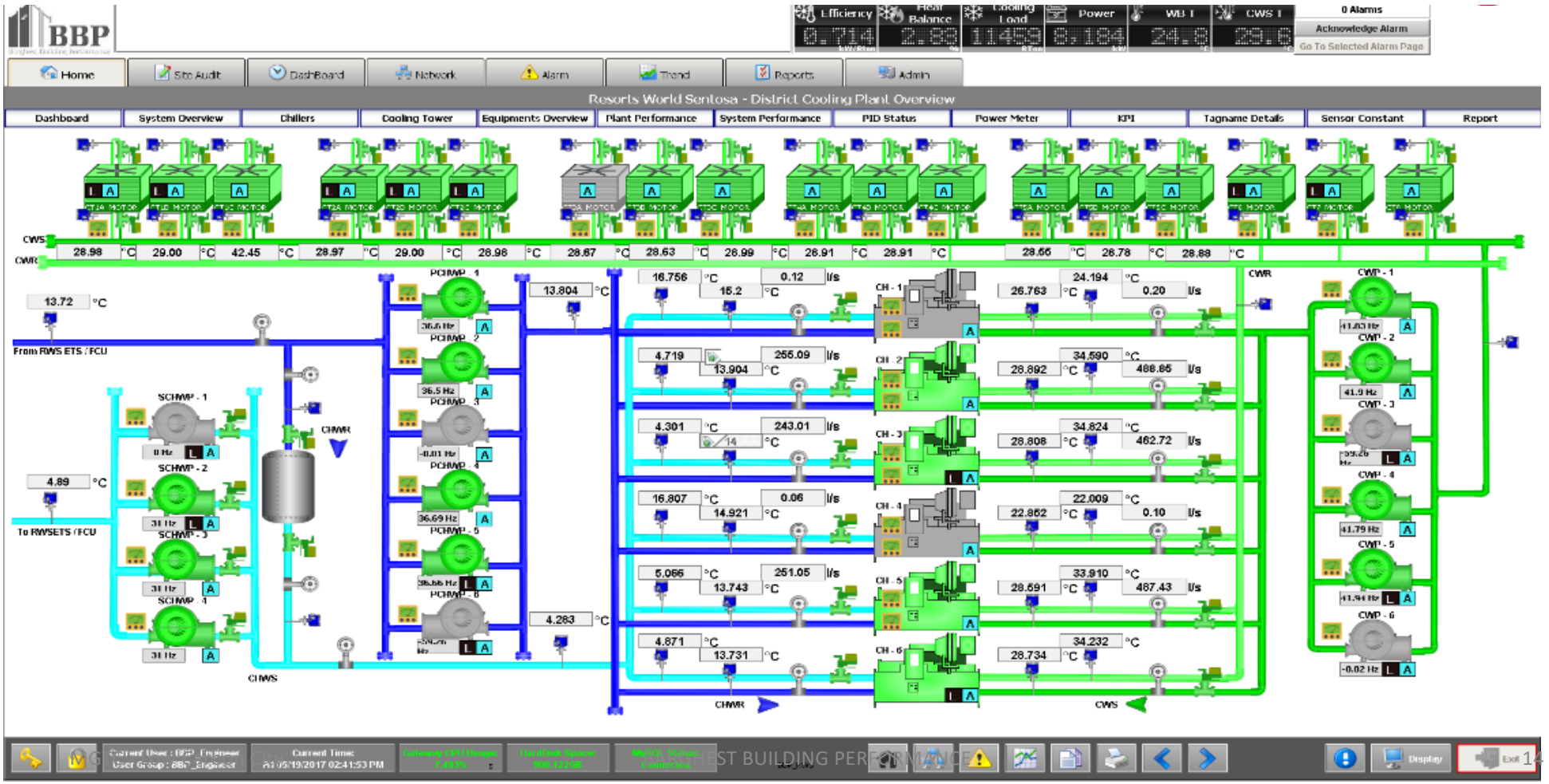
How It Works

Holistic chiller plant control logic – not just single component

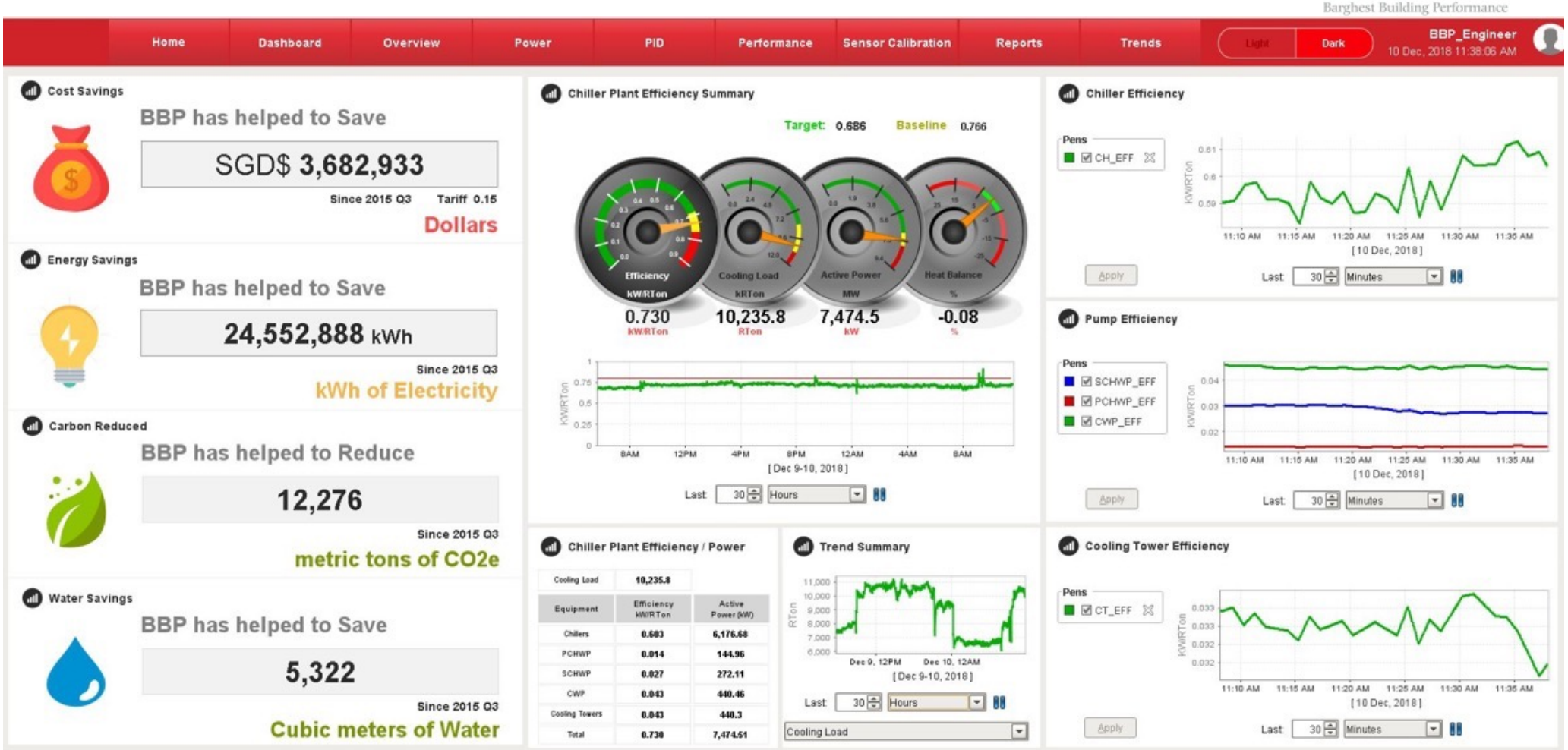
Fail-safe redundancies

Full customization to match operating requirements
Complete **reporting and monitoring for** better O&M

Plant Level information



Site Level Dashboard



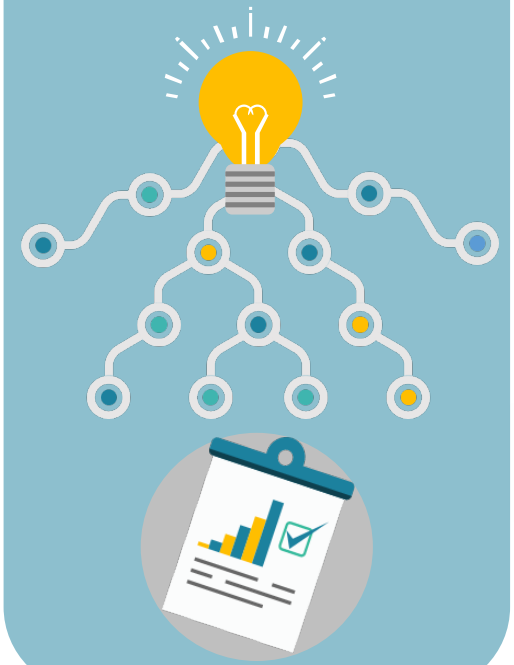
Customize Control Logic With Data Collection and Advanced Analytics

BBP
Barghest Building Performance

1 Vertically integrated data acquisition

2 Advanced analytics

3 Complex insight creation



4 Reprogramming control algorithm for lower energy

Setting 1

```
if lag_RH >= 70.24
AND lag_WB_T60 < 23.57
OR
if lag_RH < 70.24
AND lag_WB_T >= 25.94
AND lag_DB_T30 >= 31.93
```

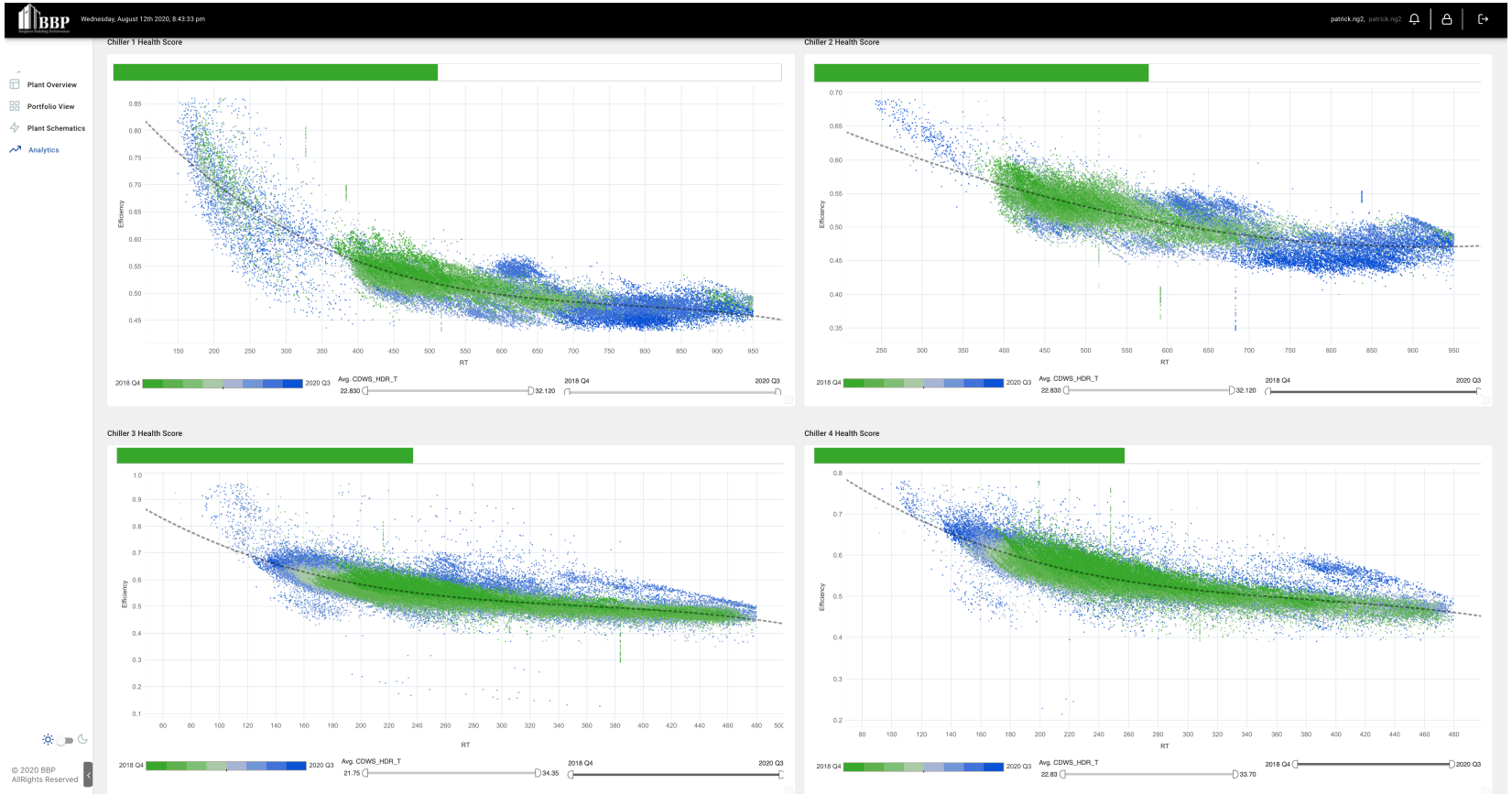
Setting 1.5

```
if lag_WB_T < 25.94
AND lag_RH < 70.24
AND lag_RH30 < 65.94
OR
if lag_WB_T < 25.94
AND lag_RH < 70.24
AND lag_RH30 >= 65.94
AND TOTAL_RT_CL < 1595.72
OR
if lag_WB_T >= 25.94
AND lag_RH < 70.24
AND lag_RH60 >= 77.96
AND lag_DB_T30 < 31.93
OR
if RH < 79.99
AND lag_RH >= 70.24
AND lag_WB_T30 < 24.81
AND lag_WB_T60 >= 23.56
```

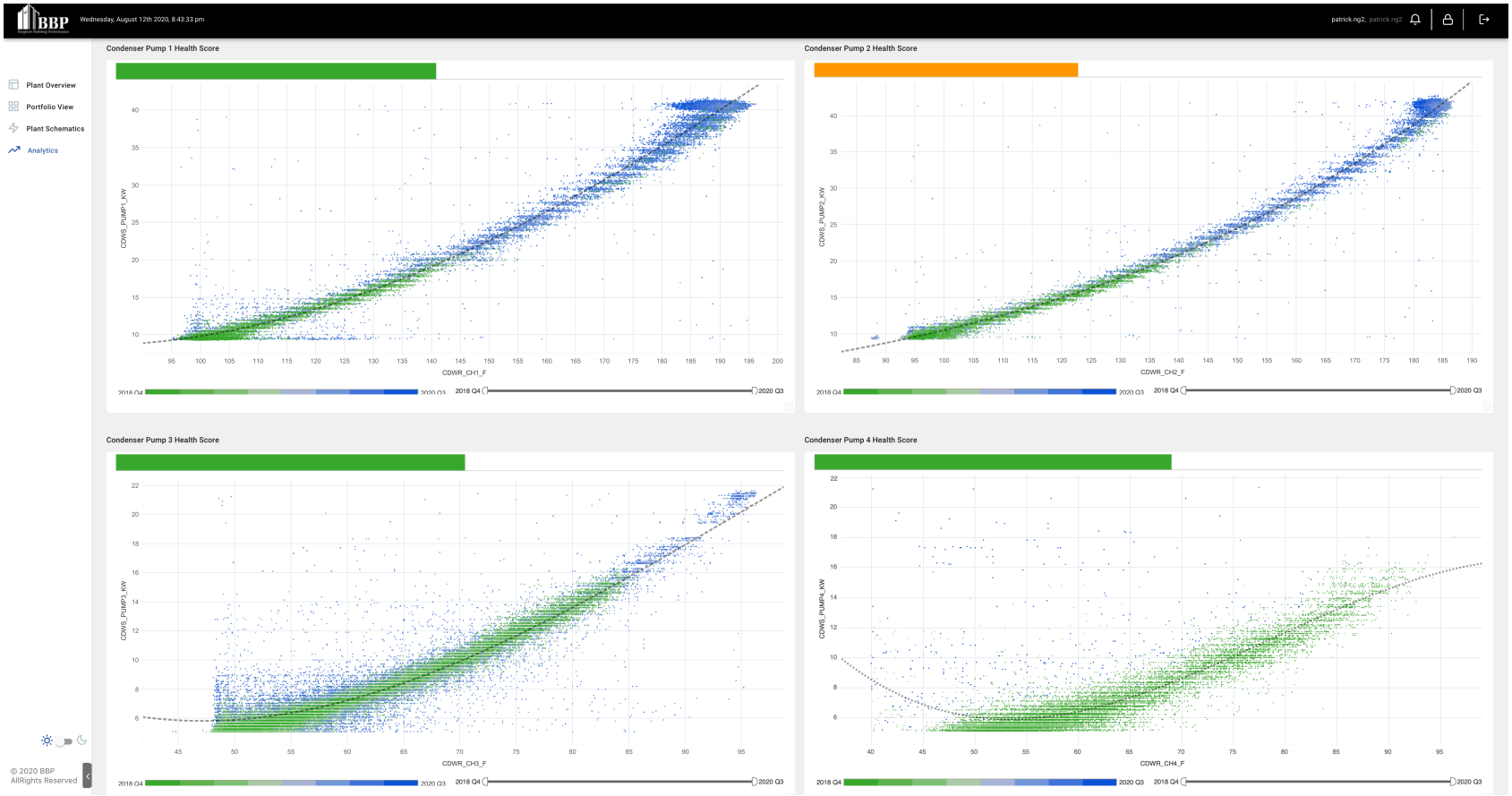
Setting 2

```
if lag_WB_T60 >= 23.56
AND lag_RH >= 70.24
AND RH >= 79.99
OR
if lag_WB_T60 >= 23.56
AND lag_RH >= 70.24
AND RH < 79.99
AND lag_WB_T30 >= 24.81
OR
if lag_WB_T < 25.94
AND lag_RH < 70.24
AND lag_RH30 >= 65.94
AND TOTAL_RT_CL >= 1595.72
OR
if lag_WB_T >= 25.94
AND lag_RH < 70.24
AND lag_RH60 < 77.96
AND lag_DB_T30 < 31.93
```

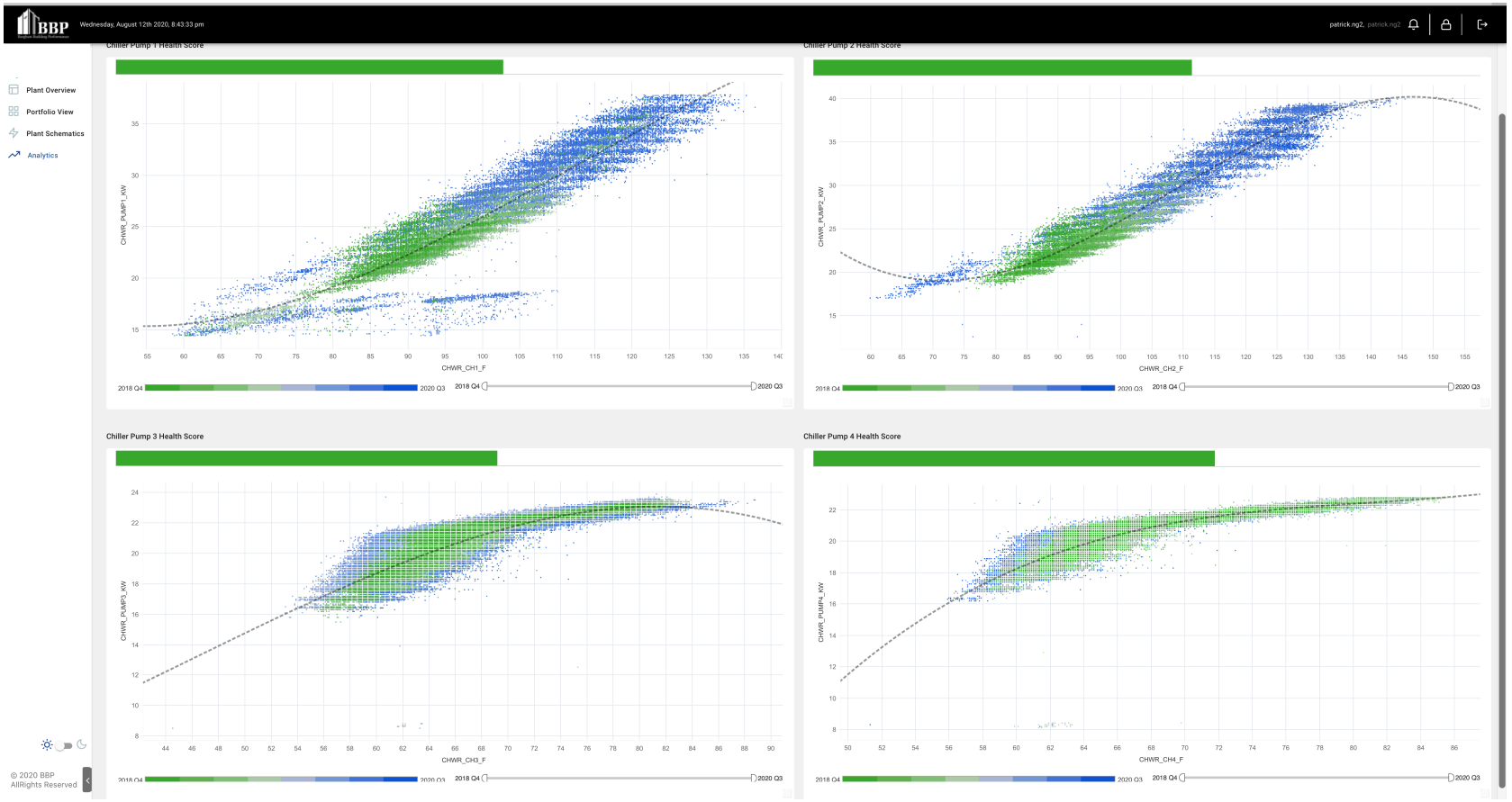
Chillers Health Scores



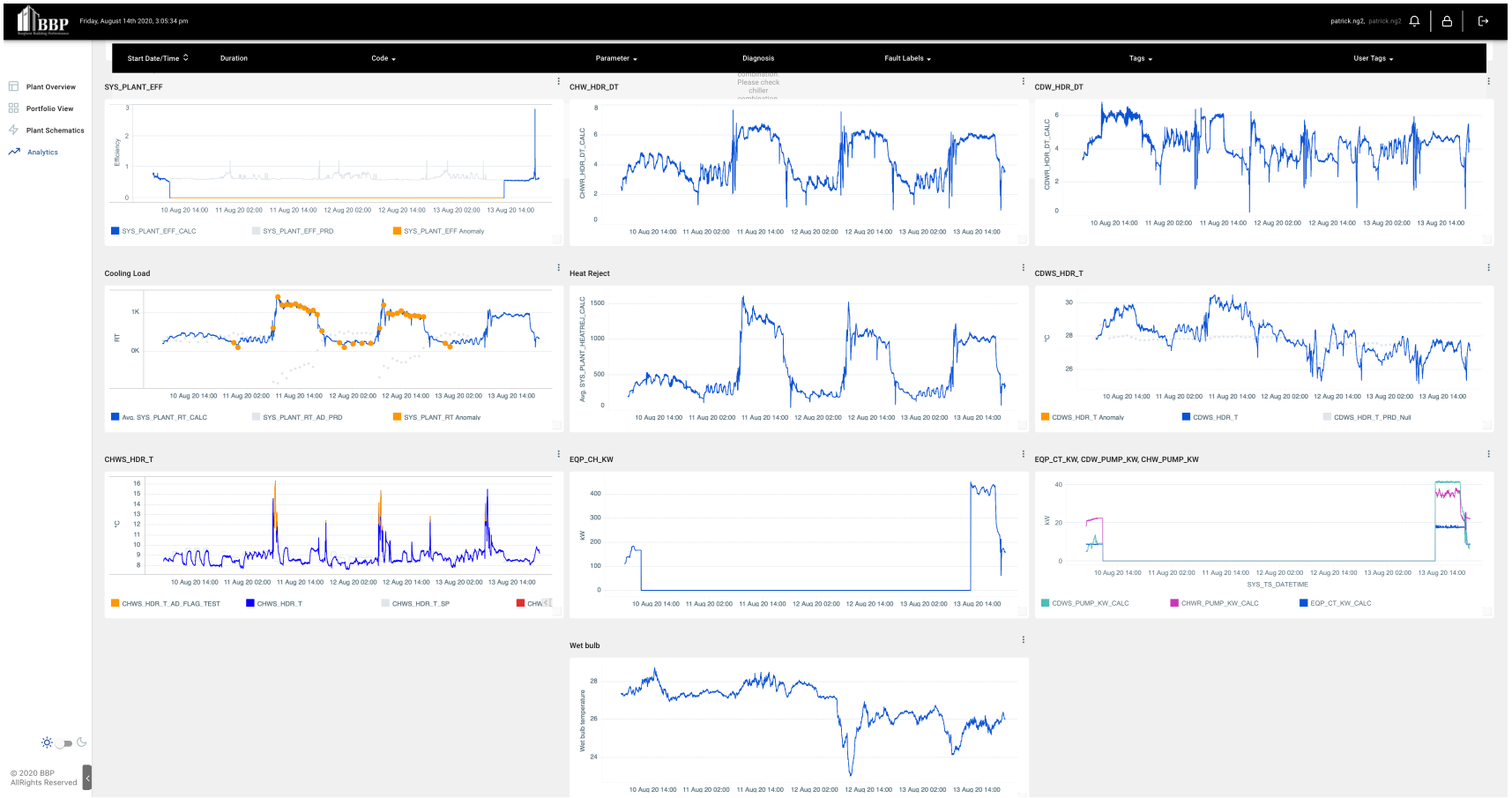
Condenser Water Pumps Health Score



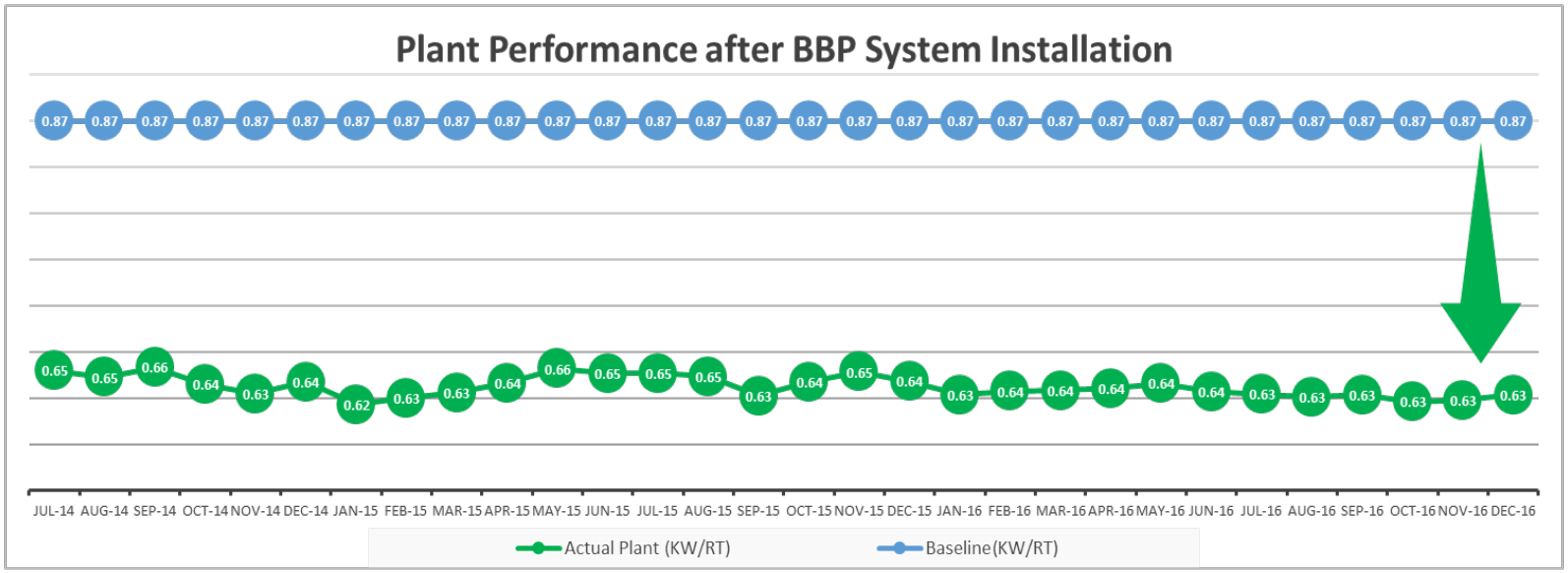
Chilled Water Pumps Health Score



System Efficiency and Anomaly Detections

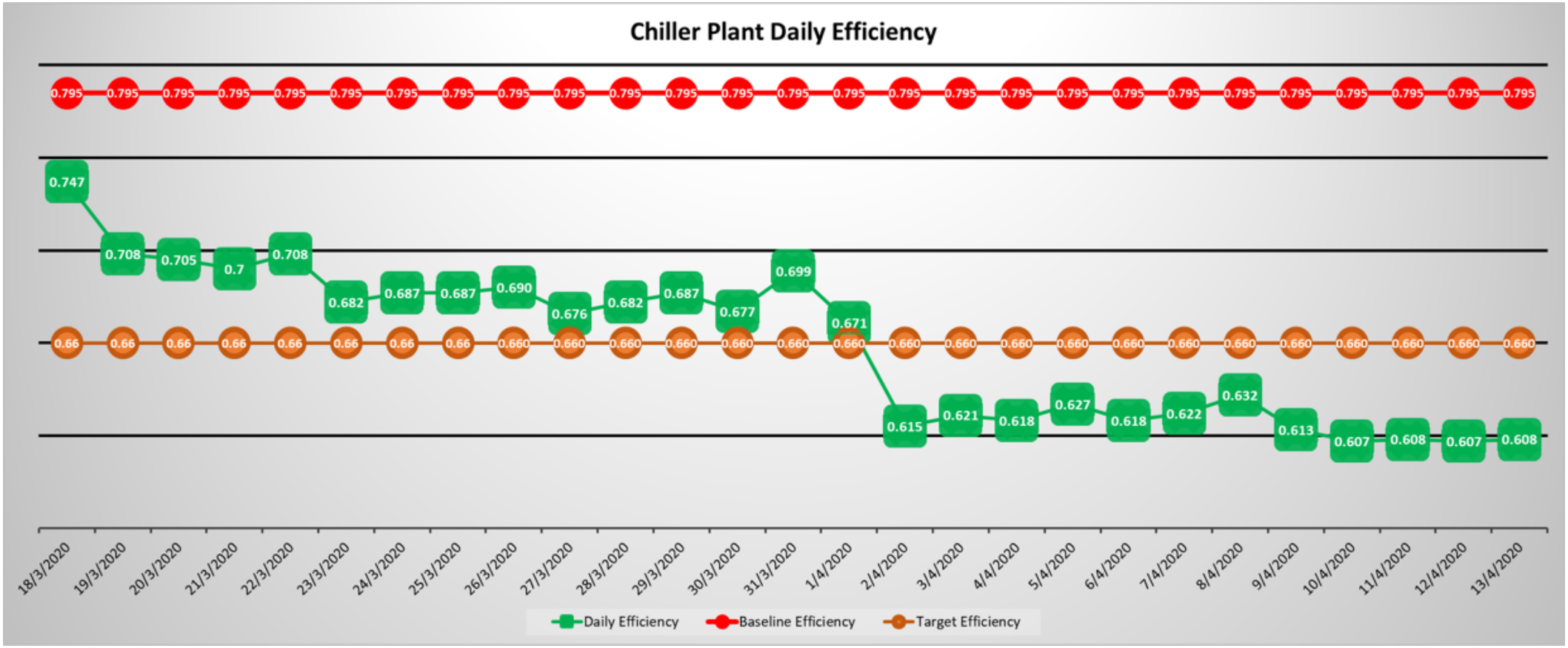


Industrial Building

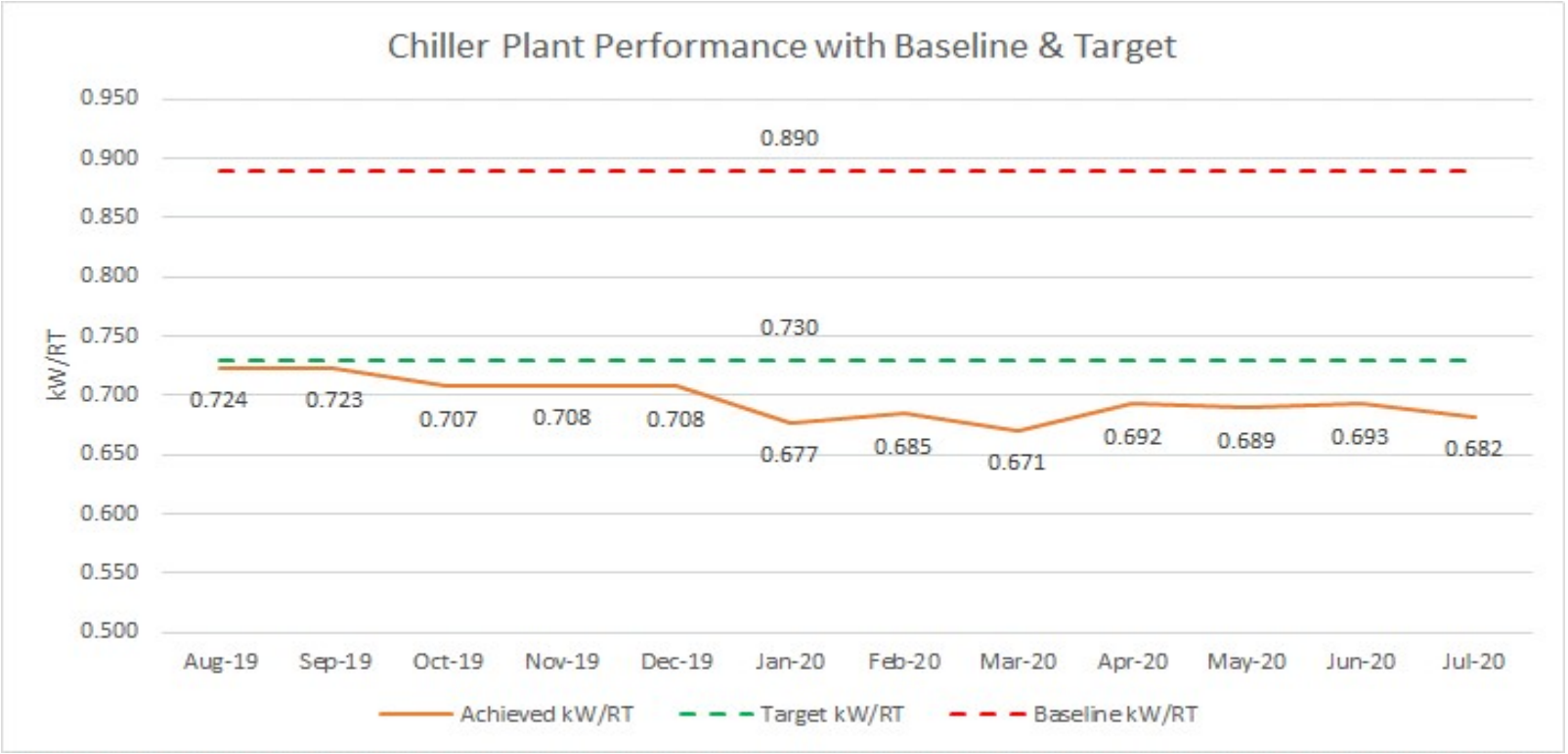


Results	▪ 27% improvement from baseline through optimisation ▪ Contributing to 3,500,000 kWh per Year ▪ 6 year of constant performance at Green Mark Platinum level without deterioration

Chiller Plant Daily Efficiency During MCO



5-Star Hotel – Chiller Plant Performance



Barghest Building Performance

Thank you for your attention

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