

azbil

HOW TO OPTIMIZE ACMV WATER DISTRIBUTION SYSTEM

Chiller Plant Optimization by **Azbil**

A large industrial chiller plant in a factory setting. The machine is a large, horizontal, cylindrical unit with a prominent circular access panel on the right side. It is surrounded by various pipes, valves, and electrical control boxes. The background shows a typical industrial environment with overhead lighting and structural elements.

65%

Total ACMV energy in a building
consumed by Chiller Plant



Optimization
of Chiller Plant



Key for
Sustainable Operation



Energy Efficiency

“Building Management System (BMS), standalone Energy Monitoring System (EMS) or local sequential controller has the capability to compute and display key indicators such as **water-side, air-side, total system efficiency** and calculated heat balance of the chilled water system.”



Intelligence

“Development of a digital twin of the project that represents the full asset virtually and includes geometric data, asset attributes, management data, asset performance and utilization data. (ii) **System Digital Twin** – detailed model based on operational data of individual systems to deep dive into its performance, conduct virtual stress tests and detailed analytics.”

Green Mark requires Energy Efficiency and Intelligence

BCA Green Mark Certification in Singapore

BCA: Building and Construction Authority in Singapore

Chiller Plant Optimization by Azbil

3 Chiller Plant Digital Twin

Chiller Plant Simulation by Digital Model in Cyber World to optimize entire chiller plant operation

2 Advanced Energy Saving Apps for Chiller Plant

Energy saving applications specially designed for chiller plant to further reduce energy consumption

1 Basic Chiller Plant Control

Controls and sequences of multiple chillers to improve overall performance of the plant operation

Chiller Plant Optimization by Azbil

3 Chiller Plant Digital Twin

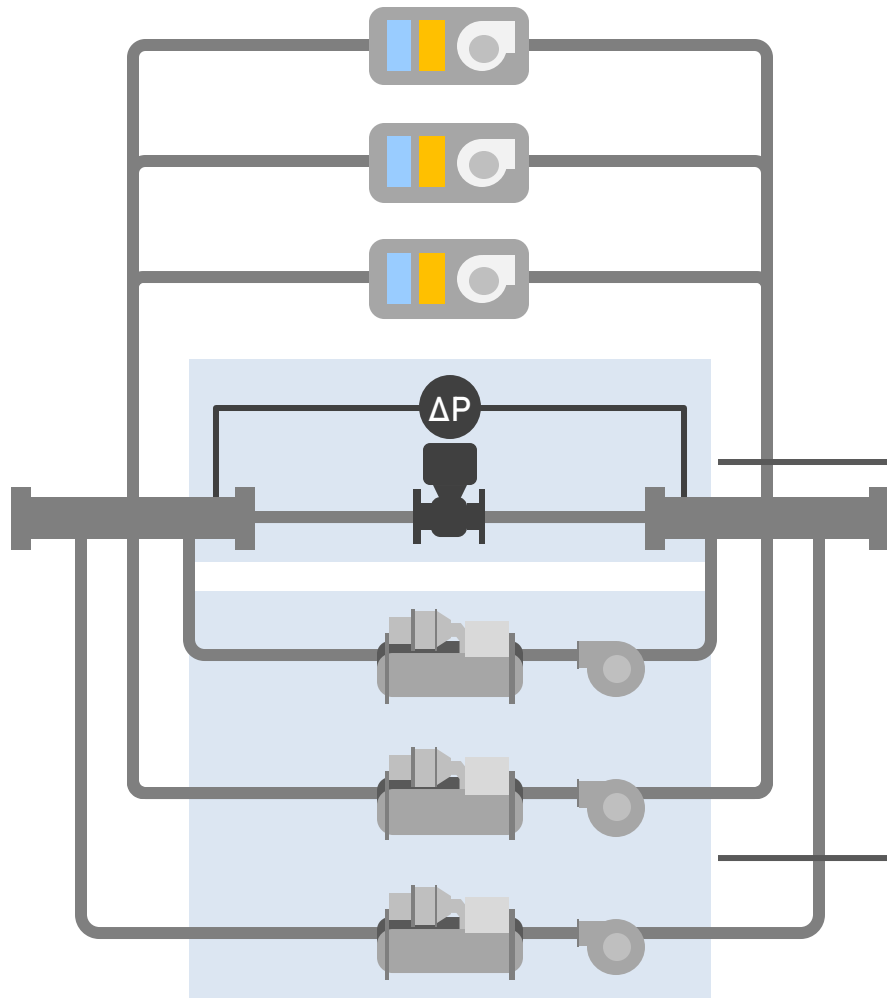
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Advanced Controller for Chiller Unit for Pump Unit



Operator Interface



Advanced Controller

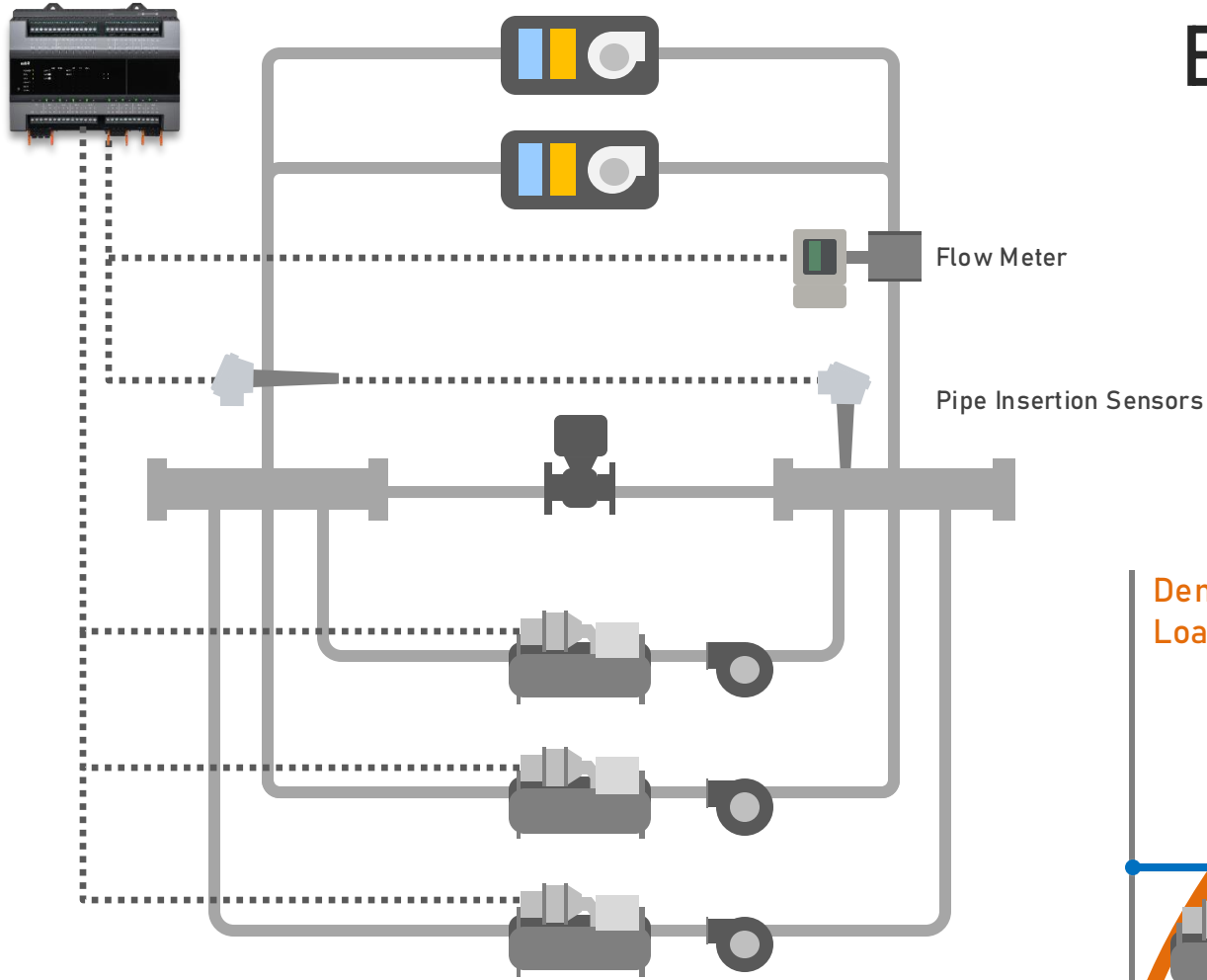
Controls Supply Water Pressure

Advanced Controller controls and maintains supply water pressure.

Controls Number of Chillers

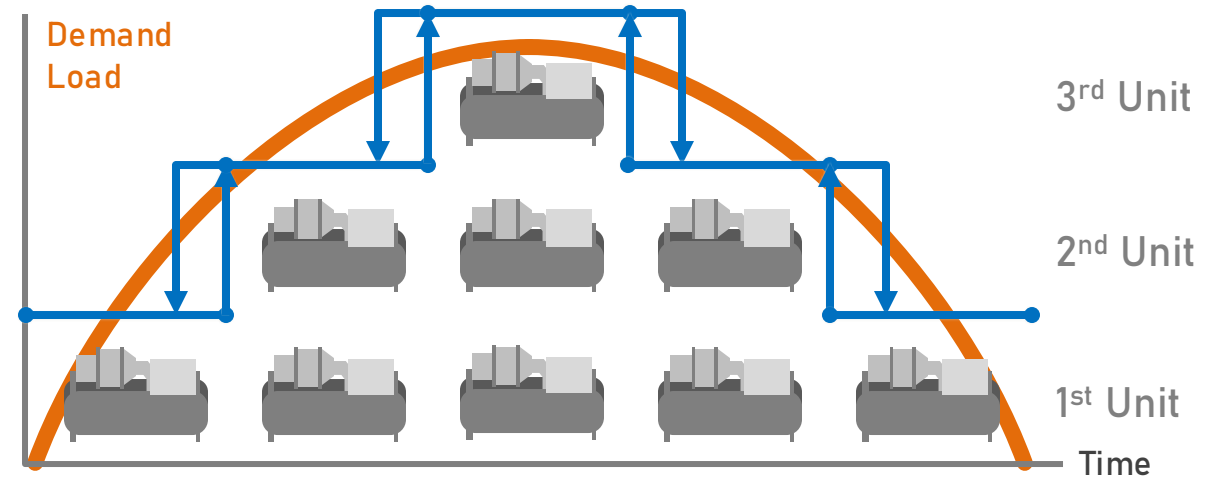
Advanced Controller controls the number of running chillers and maintains supply water temperature.

DDC Controller

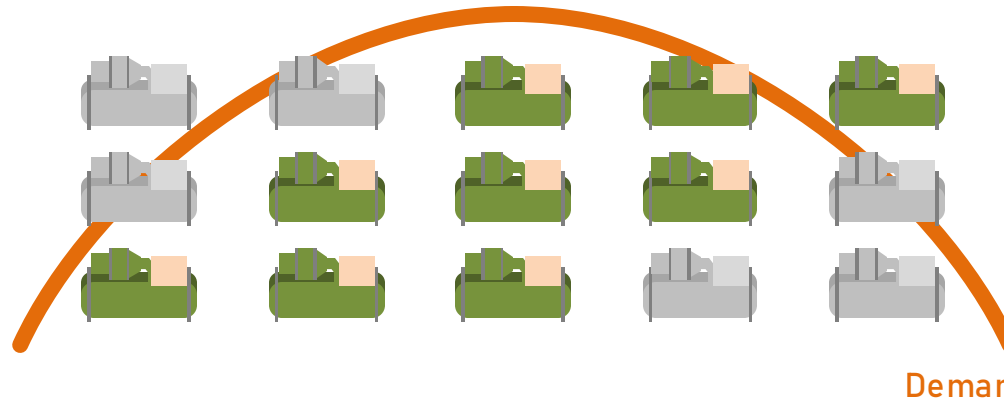


Basic Chiller Plant Control

controls the number of chillers
as demand load changes



Rotational Control

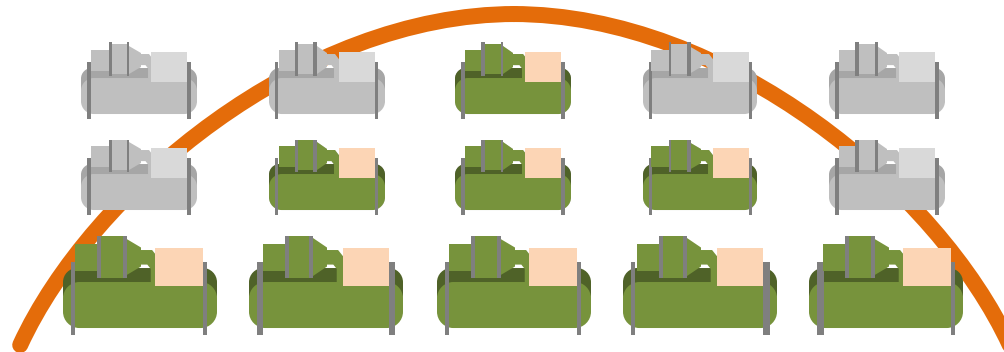


Equalize Chiller Runtime

When Chiller capacities are same

Demand Load

Sequential Control



ON/OFF Order is Fixed

When Chiller capacities differ

Rotational and Sequential

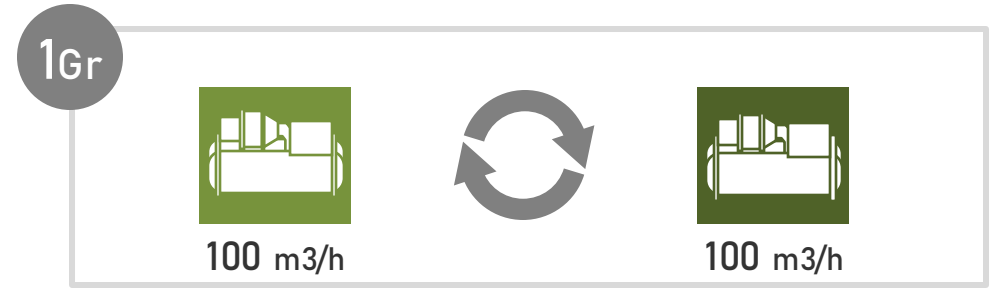
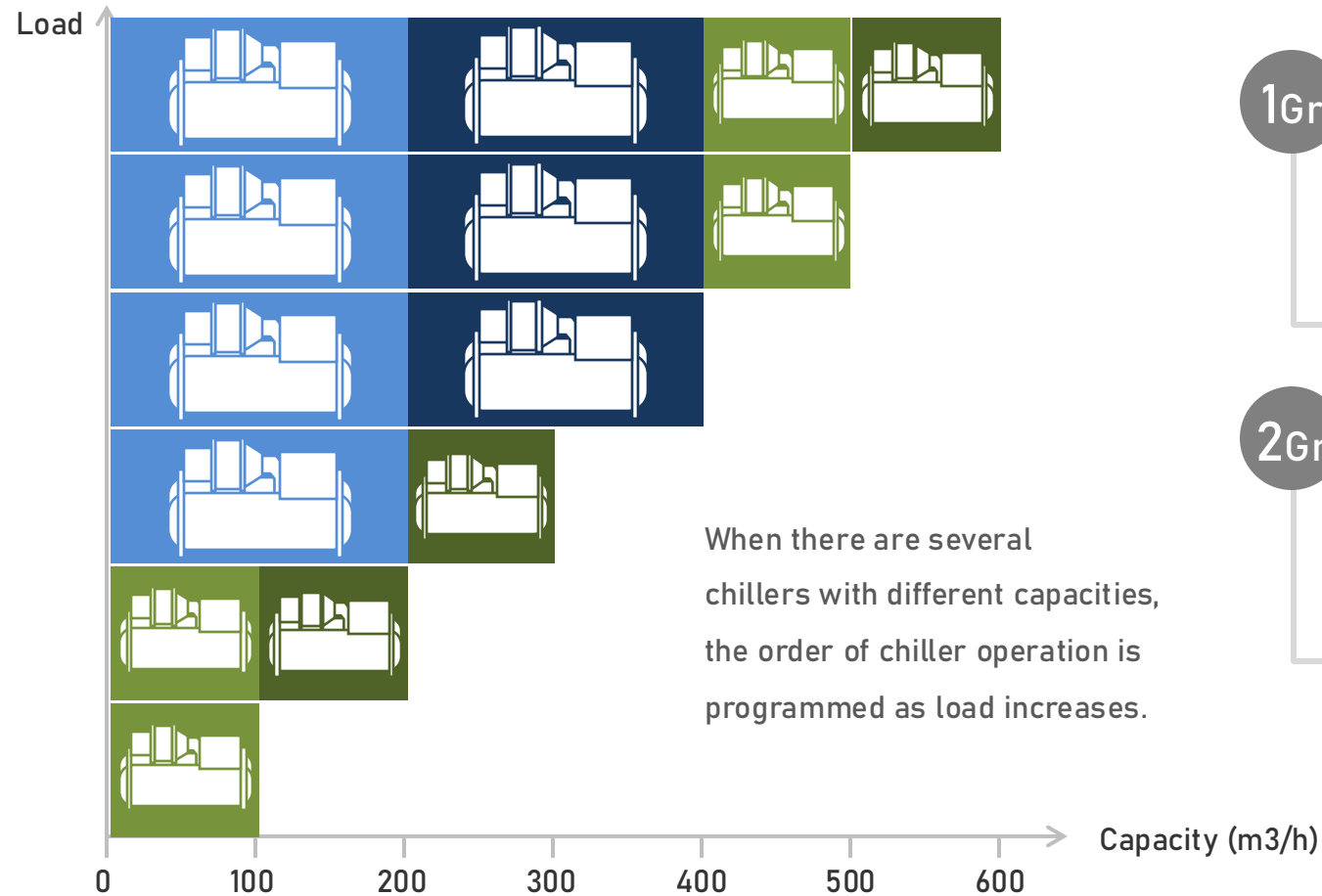
You can select either control as chiller plant design



ON



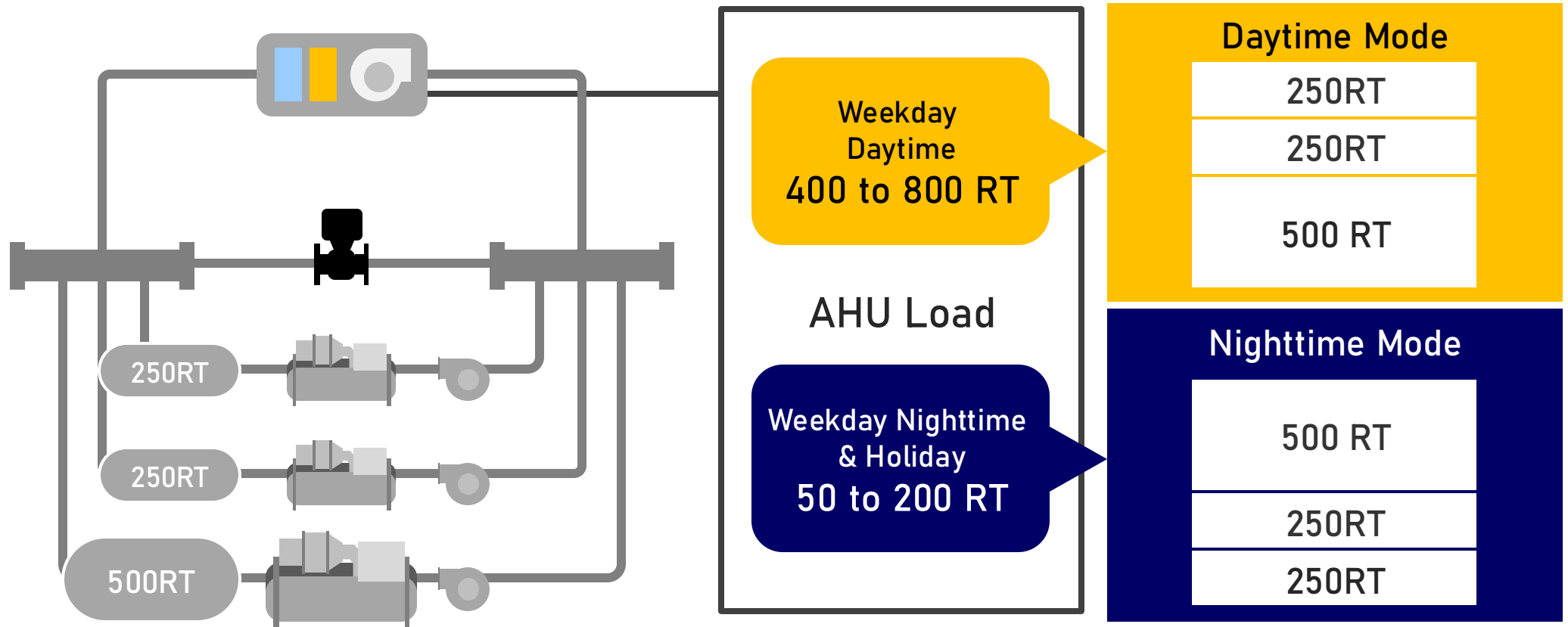
OFF



Chiller rotates within the group

Fine-tuned Programming

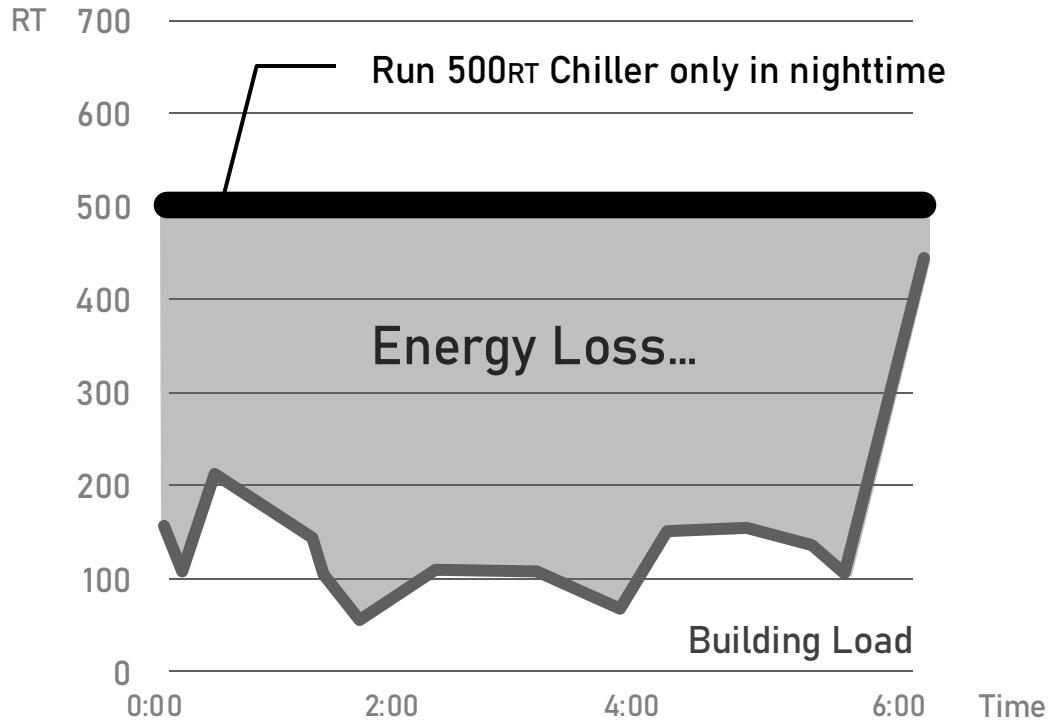
Fine-tuned running pattern for energy savings and continuous water supply



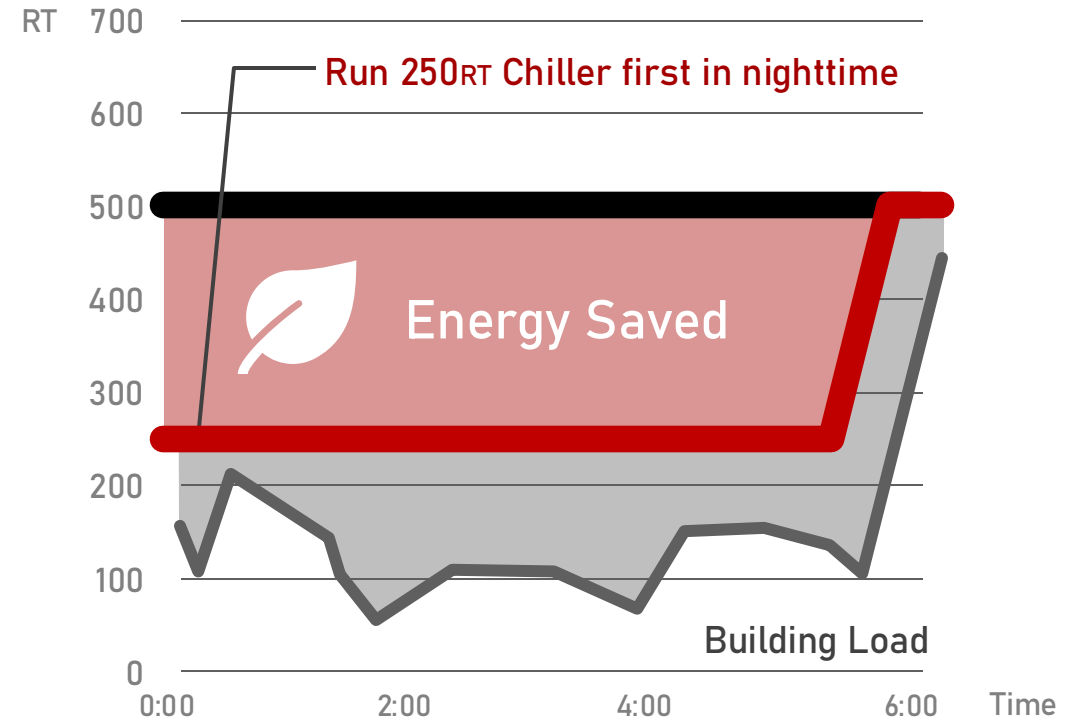
AHU load differs between daytime and nighttime

Azbil Control switches daytime and nighttime mode

Chiller Manufacturer: No Nighttime Mode

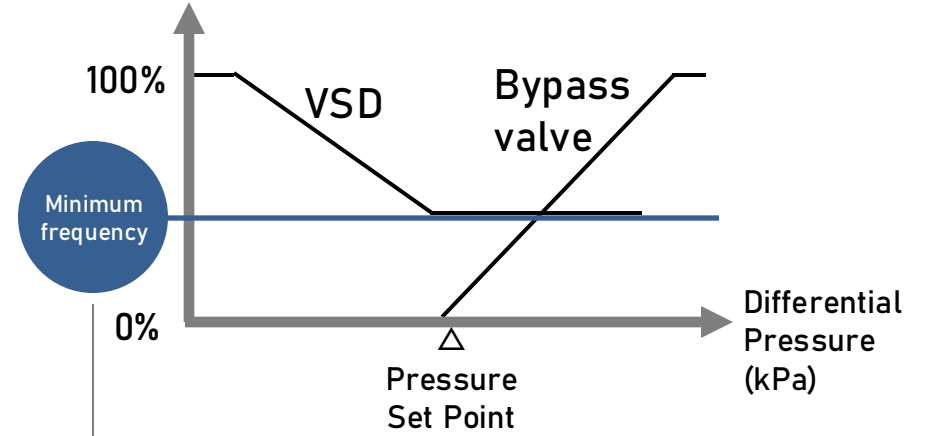
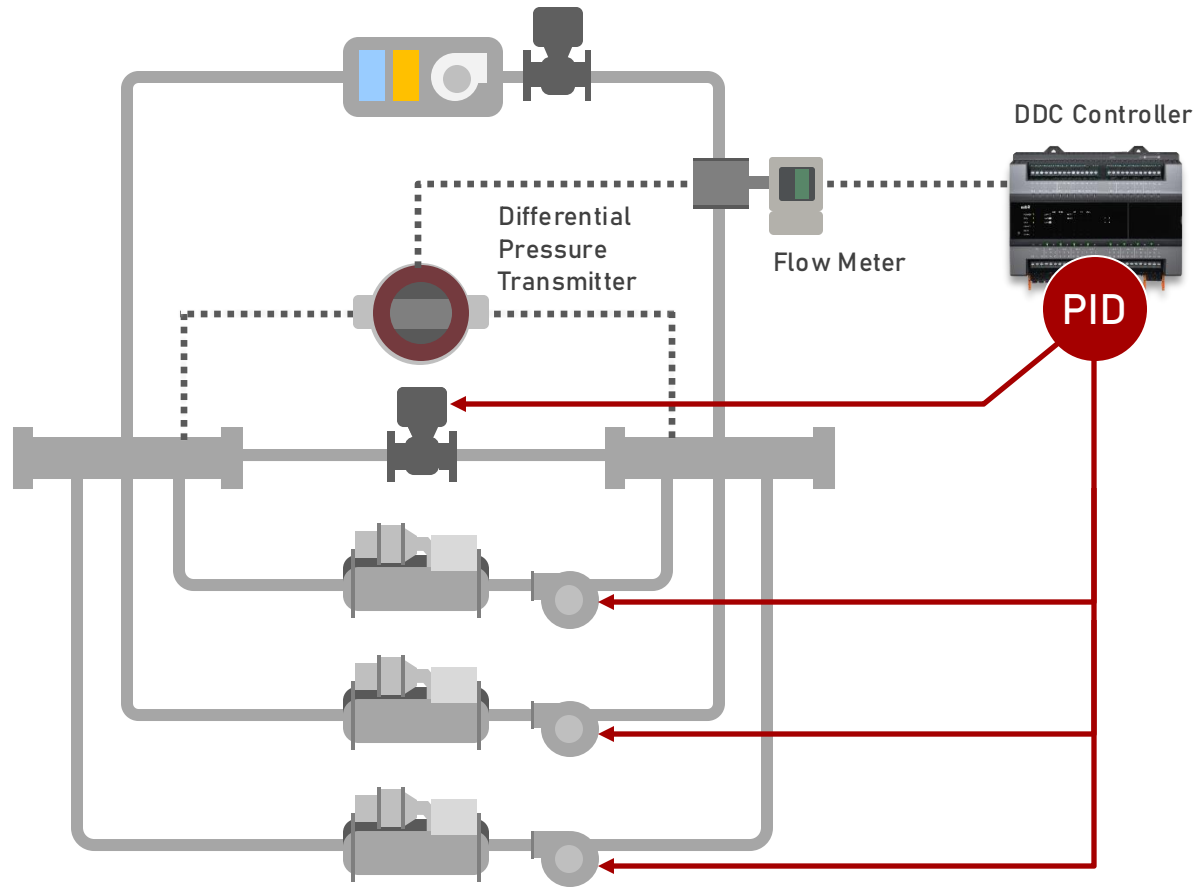


Azbil: switches to Nighttime Mode



Nighttime Mode Available

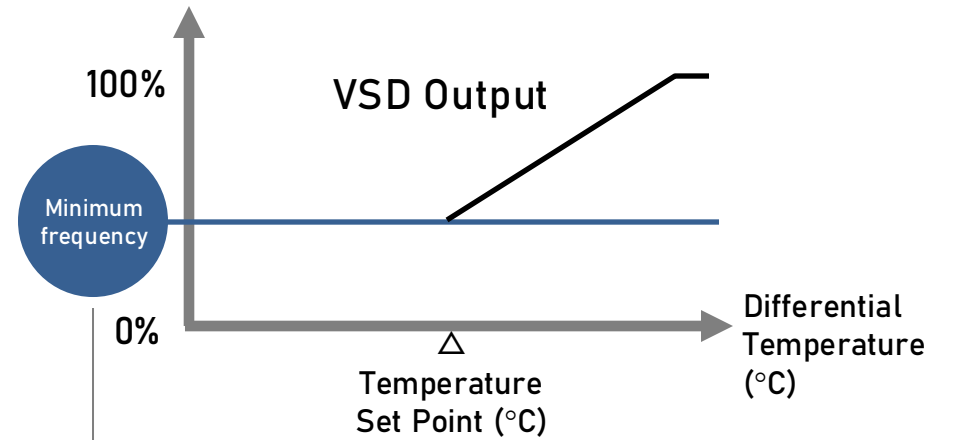
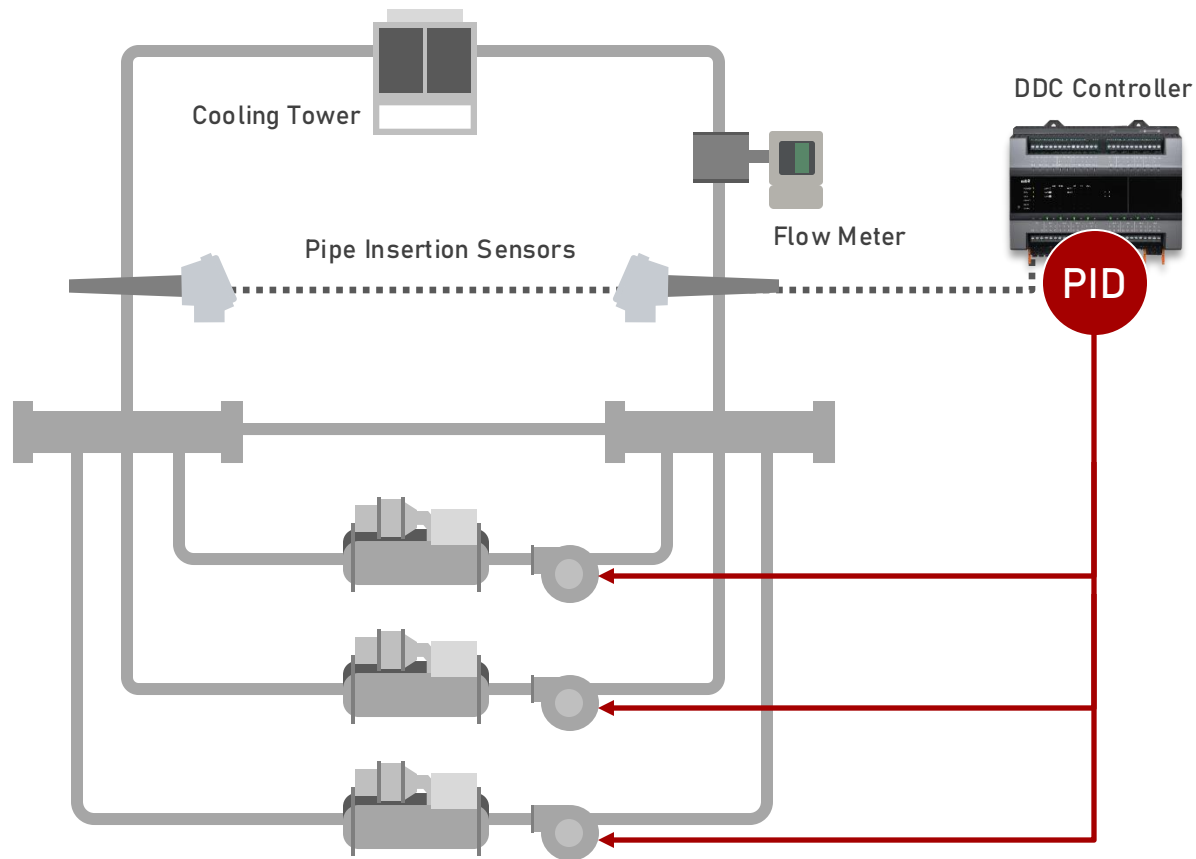
Azbil Control switches daytime and nighttime mode



When setting VSD's minimum frequency, chiller minimum flow must be taken into consideration.

VSD in Chilled Water Pump & Header Bypass Valve Control

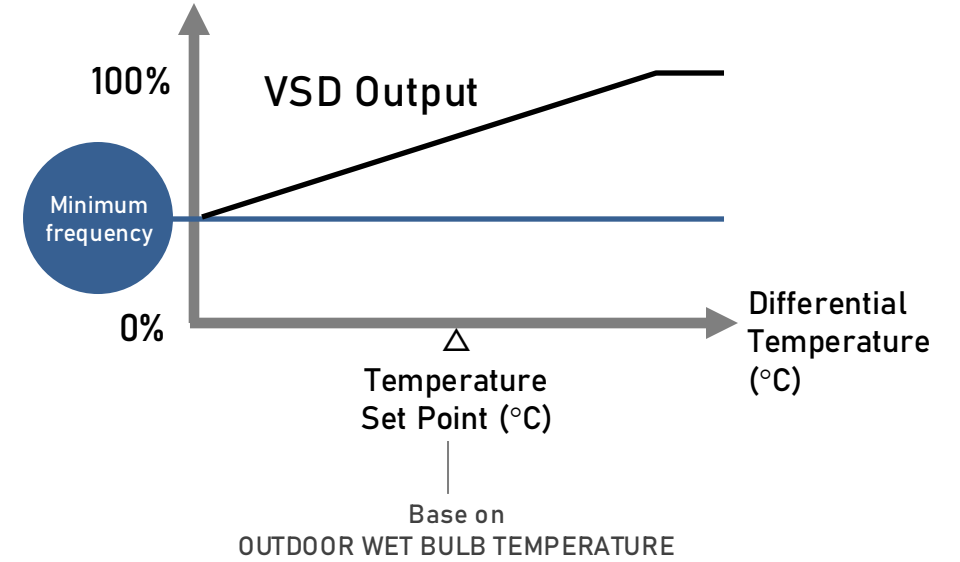
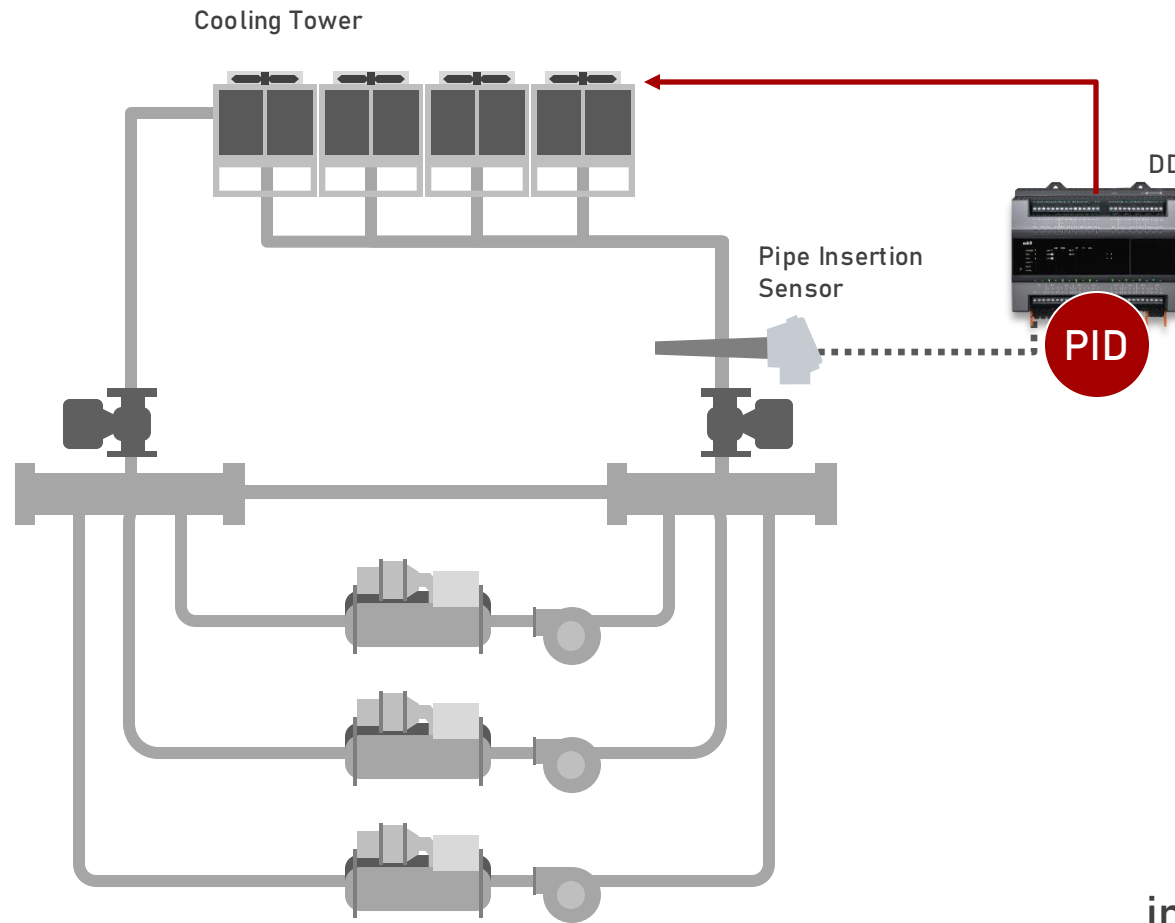
Maintain enough pressure to supply the chilled water to Air Handling Unit



When setting VSD's minimum frequency, chiller minimum flow must be taken into consideration.

VSD Control for Condenser Water Pump

Actual Case in Singapore; Azbil improves efficiency just with basic control



Nos of Cooling Tower is determined in order to minimize chiller kW + CT kW

VSD Control for Cooling Tower

Actual Case in Singapore; azbil improve efficiency even with basic control



Comparison of chiller efficiency at the same chiller plant

Azbil's Chiller Plant Control Improves Chiller Efficiency

Actual Case in Singapore; Azbil improves efficiency just with basic control

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If you are serious about pursuing **GREEN** buildings,

TOTAL SYSTEM EFFICIENCY

is required



Waterside Efficiency

Water-cooled Chiller Plant Efficiency



Airside Efficiency

Air Distribution System Efficiency

Advanced Control Makes Your Building Greener

Azbil Energy Saving Applications will make your building greener

Optimizing ΔT between Supply & Return Water for AHU and FCU

- AHU: Assuring ΔT by ACTIVAL+
- FCU: Chilled water (Hot water) return water temperature control

Optimizing Number of Pump Unit

- Secondary Pump Sequential Control

Reducing Secondary Pump Power Consumption

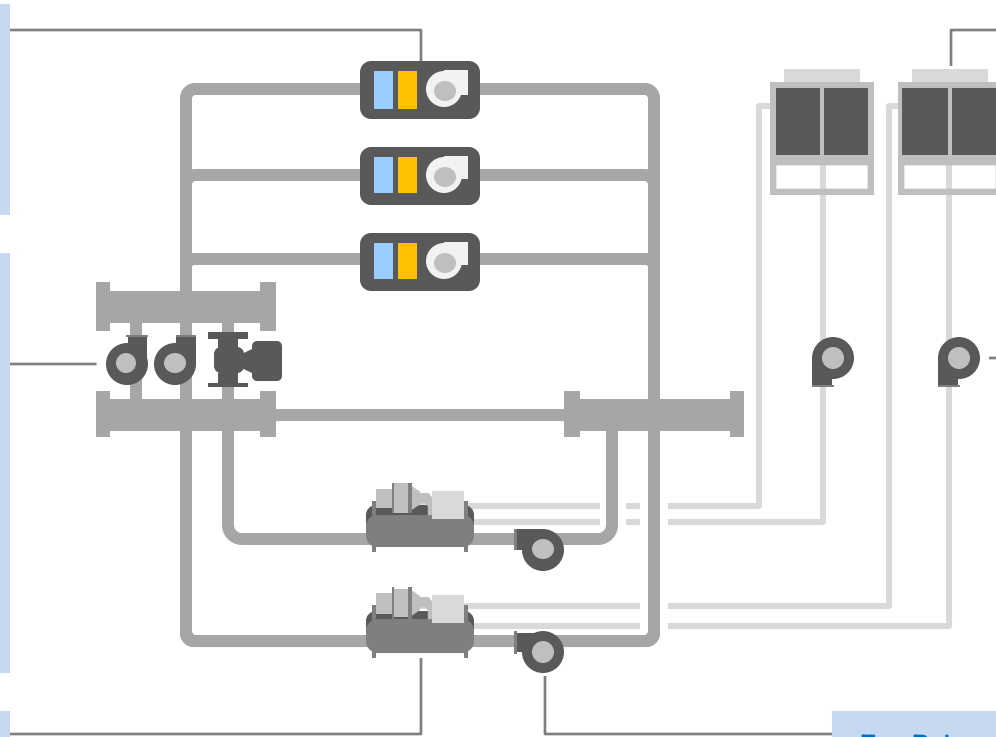
- Secondary Pump VVW Control
- Constant Discharge Pressure Control
- VVW by Estimated Terminal ΔP
- VVW by Terminal ΔP (Cascade) Control
- VVW by Terminal ΔP with ACTIVAL+
- VVW Control
- VVW Control by Flow Measurement

Optimizing Number of Chiller Units

- Sequential Control by Load Energy Flow Rate
- Chiller Suspension at Low Load
- Sequential Control for Minimum CO₂ Cost

Improving Chiller Efficiency

- VWT Control
Prediction from ACMV Load or Self-learning
- Reducing Condenser Water Temperature Auto
- Load Distribution Control for Multiple Pump System



For Cooling Tower Fan

- Cooling Tower Fan Sequential Control
- Cooling Tower Fan VSD Control

For Condenser Water Pump

- Condenser Water Pump VVW Control

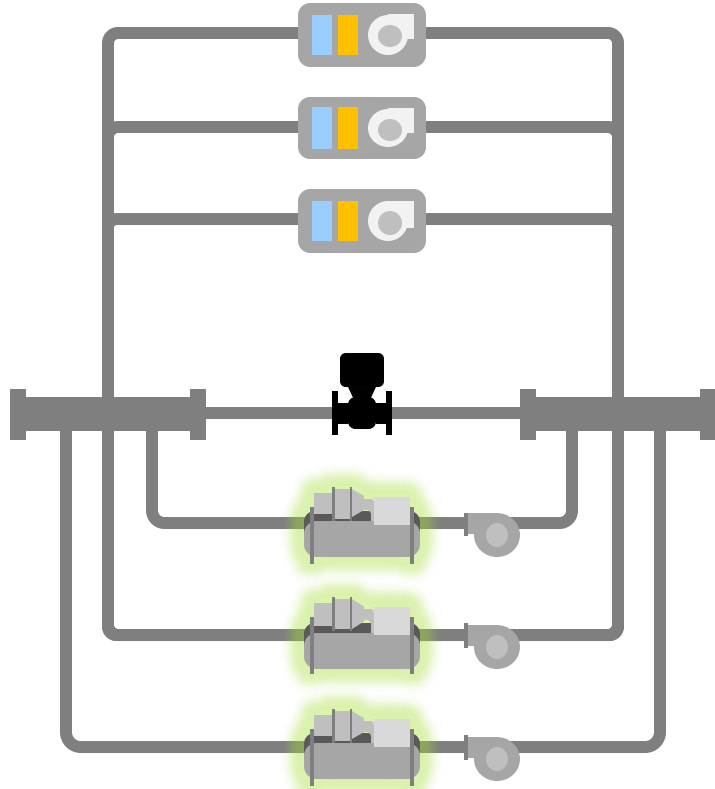
For Primary Pump

- Primary Pump VVW Control
1 Pump System / Fixed Pressure Setpoint
- Primary Pump VVW Control
1 Pump System / Variable Pressure Setpoint
- Primary Pump VVW Control
2 Pump Systems

Energy Saving Apps

Chiller Manufacturer

Waterside
Efficiency
Only



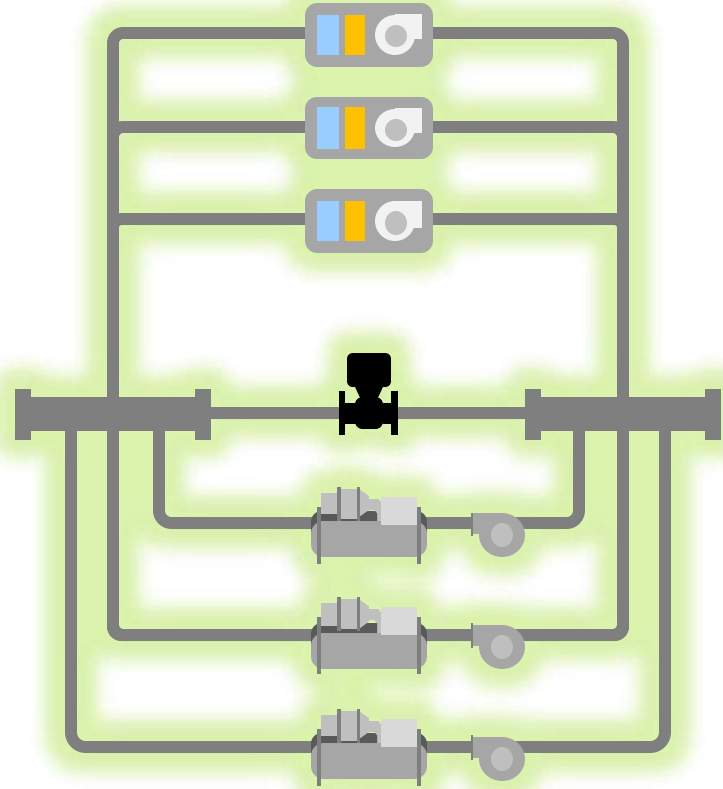
Only Considers
Chiller Efficiency



azbil



Airside
+
Waterside
Efficiency



Always Considers
TOTAL SYSTEM EFFICIENCY

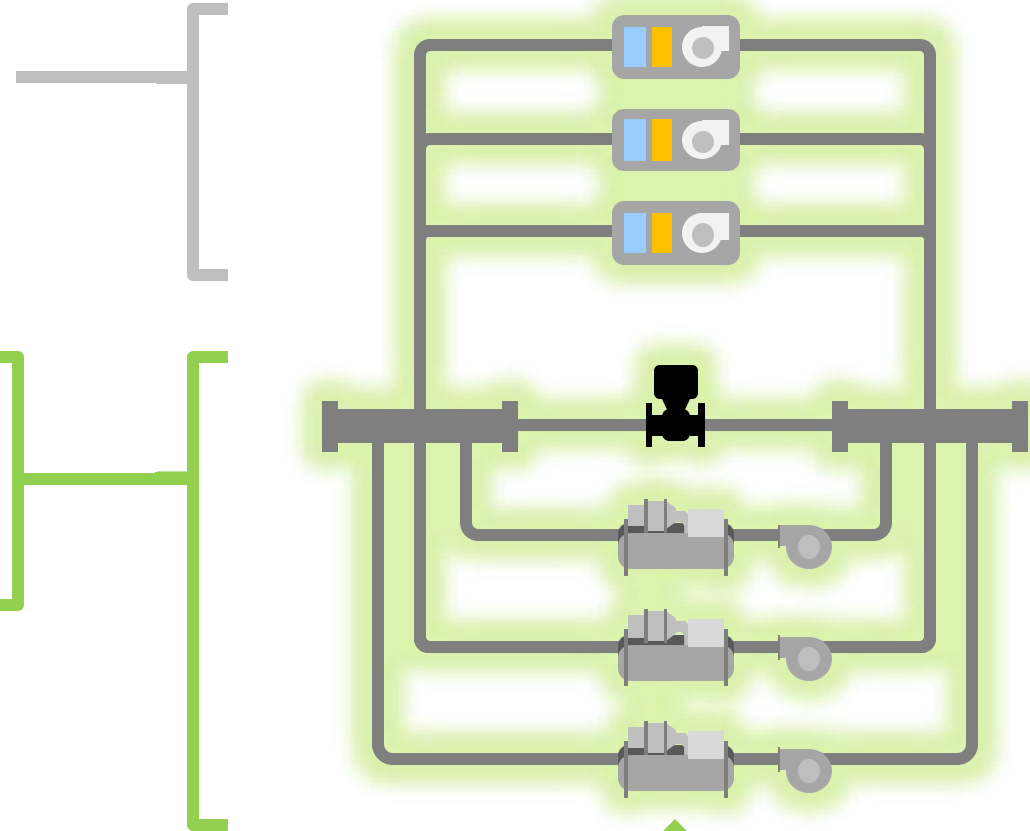
Azbil's Waterside Control
always considers airside environment

In this presentation, let us explain about

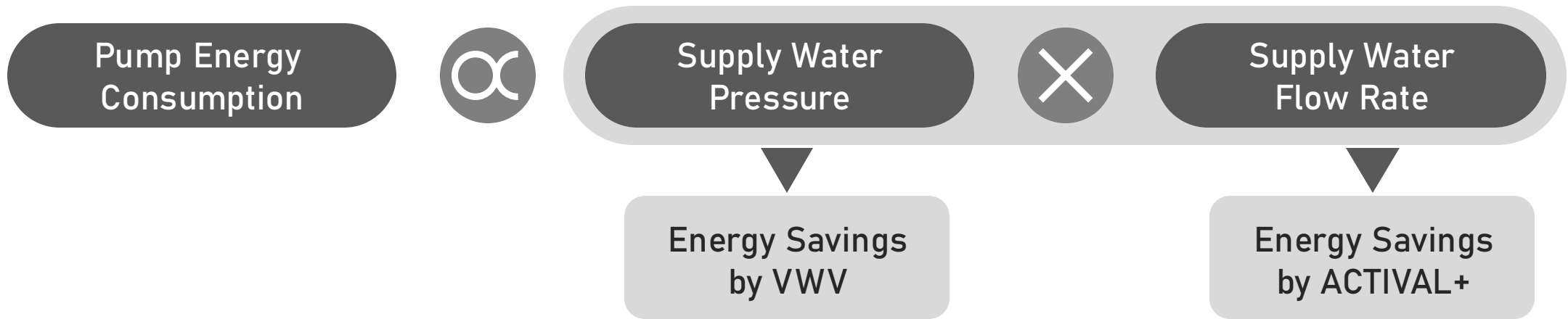


Waterside Efficiency

Water-cooled Chiller Plant Efficiency



Always Considers
TOTAL SYSTEM EFFICIENCY

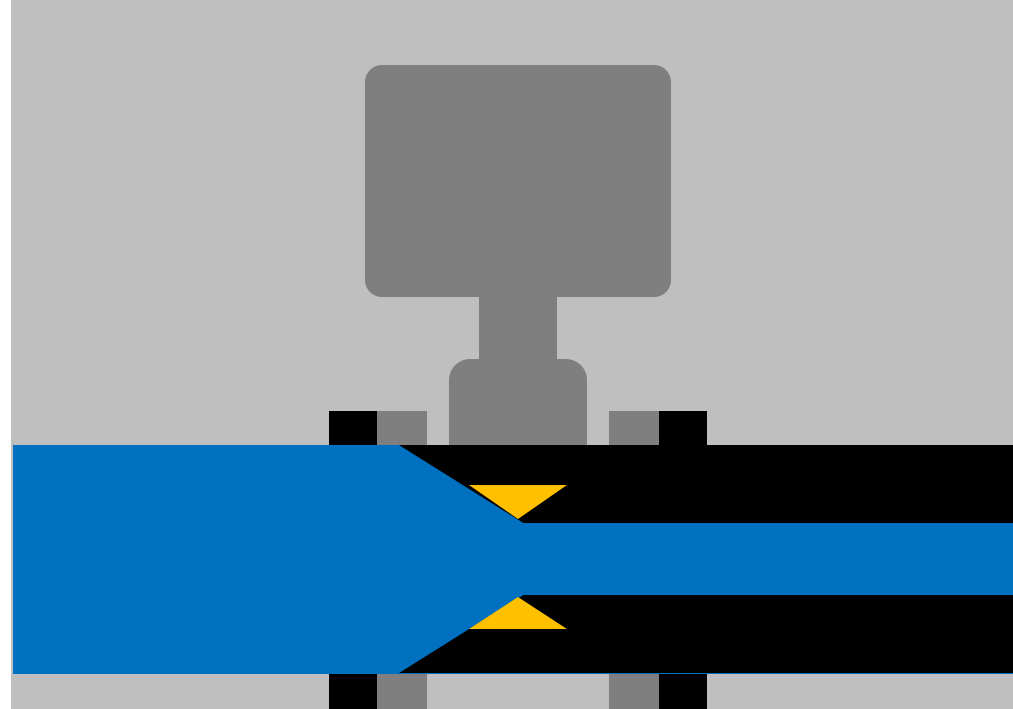


Controls not only Flow, But Also Pressure
ACTIVAL+ with Optimization Program

Variable Water Volume Control

Dynamic ΔP of Chilled and Hot Water Pressure

Conventional



Reduce water flow at the valve

Pressure Loss...

Waste Energy...

VWV Control w/ **ACTIVAL+**[™]

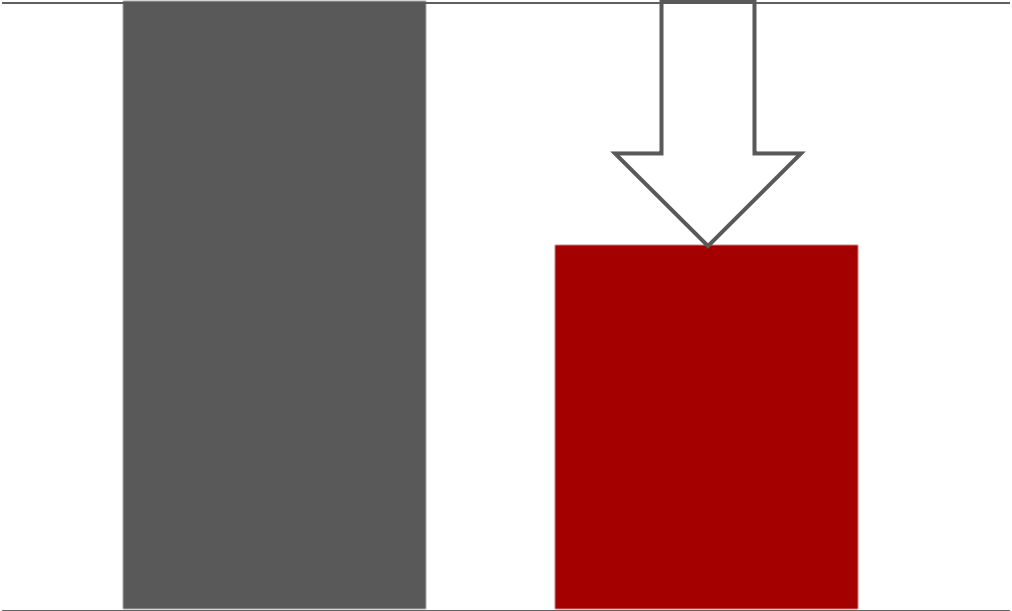


No water reduced at the valve

No Pressure Loss!

Save Energy!

Pump Power Consumption

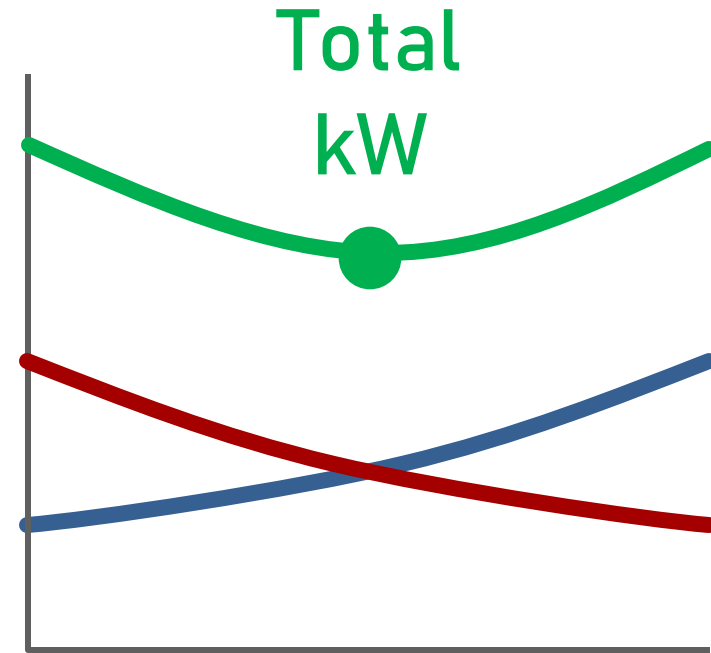
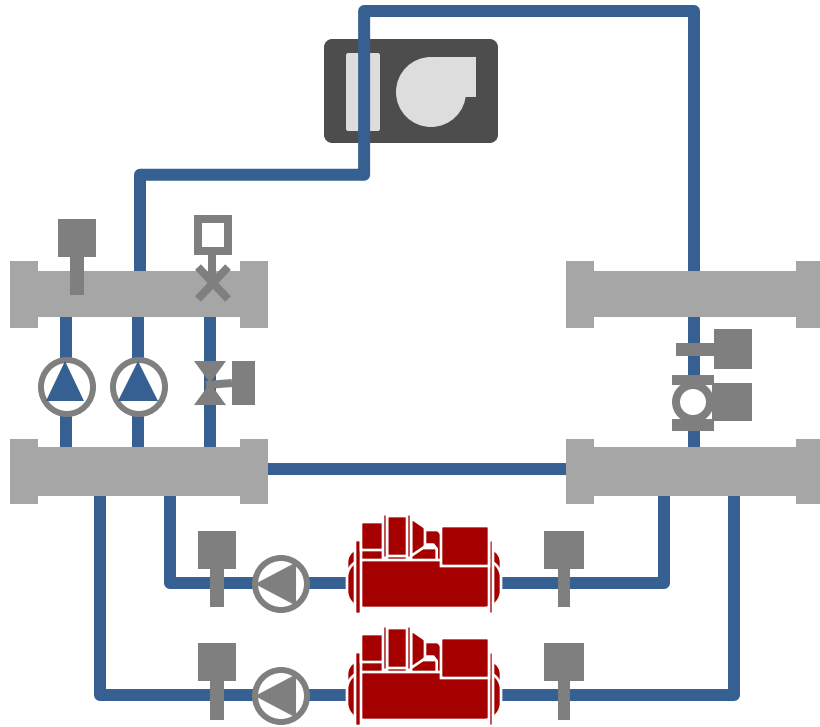


None

VWV
with
ACTIVAL+TM



-40%



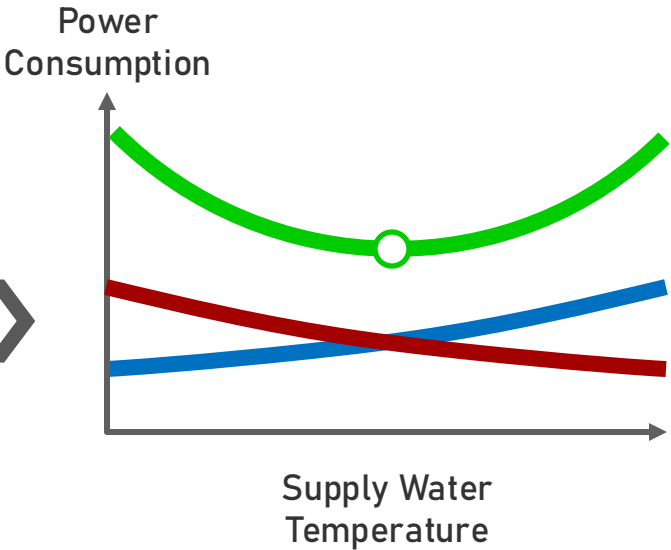
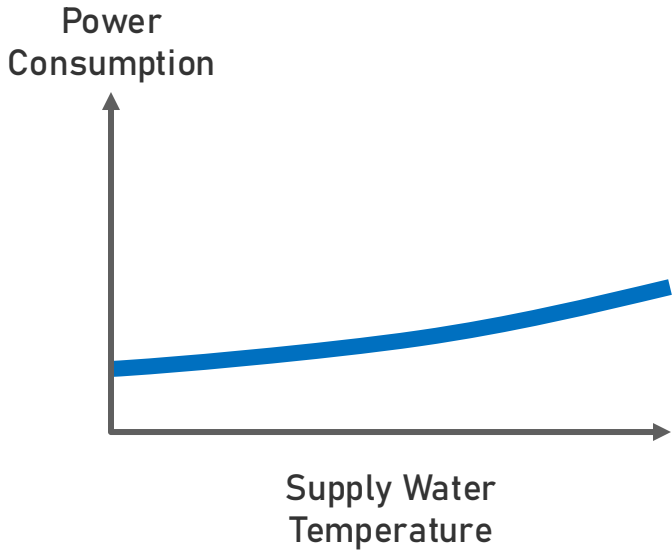
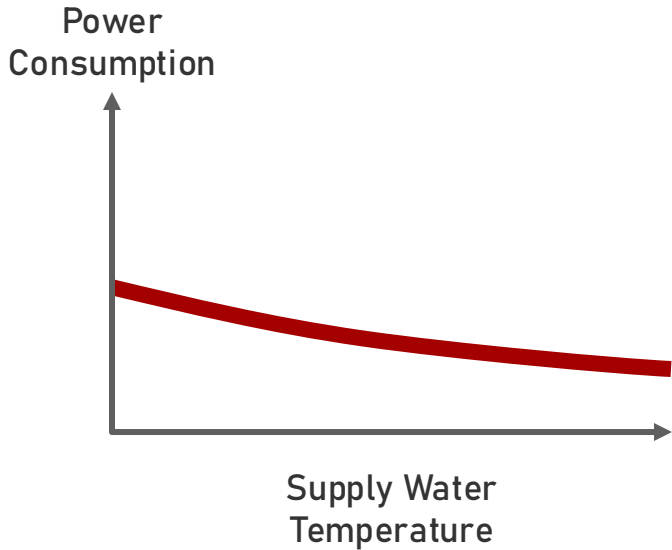
Variable Water Temperature Control

Chiller Discharge Water Temperature Optimization

Chiller Power Consumption

Water Distribution Power Consumption

Total Power Consumption



As supply water temperature increased,

Chiller Energy 

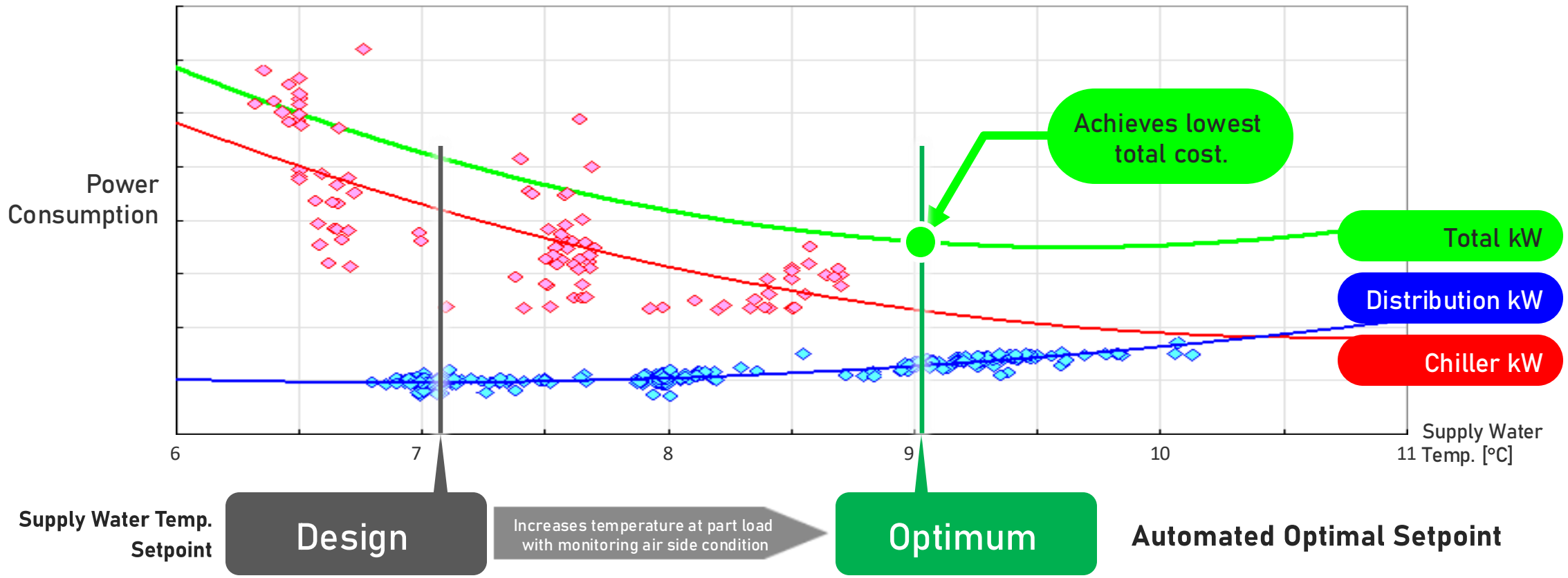
Water Distribution Energy 



TRADE-OFF



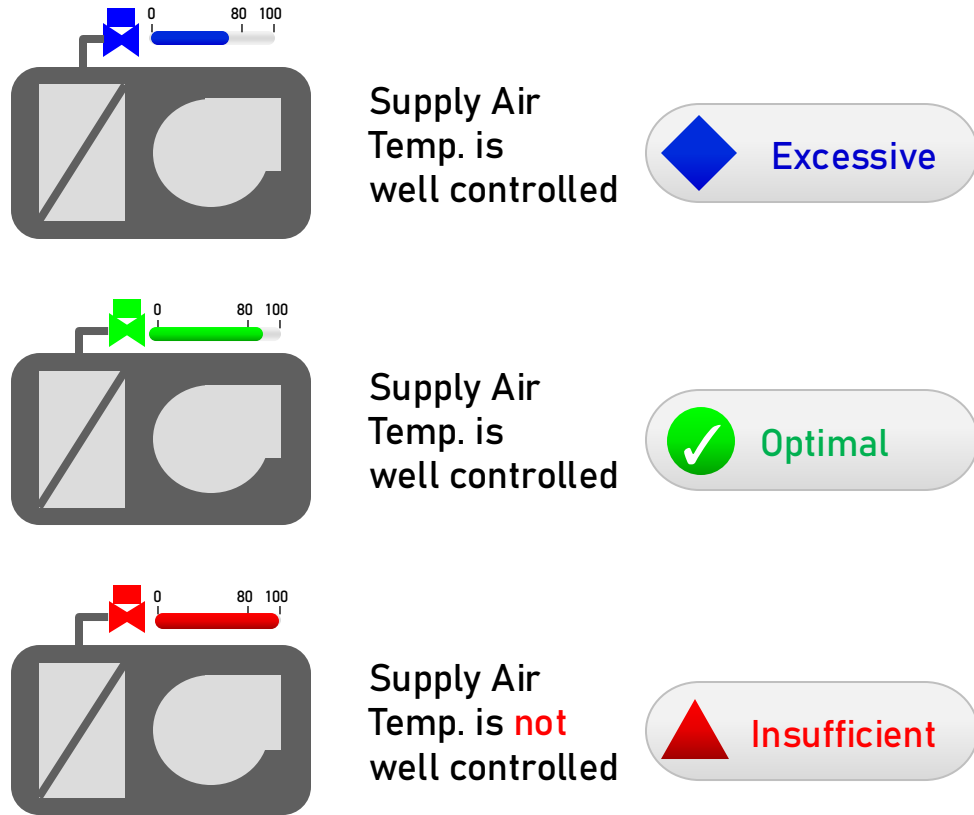
Need to find the most appropriate supply water temperature so that the power consumption becomes the least



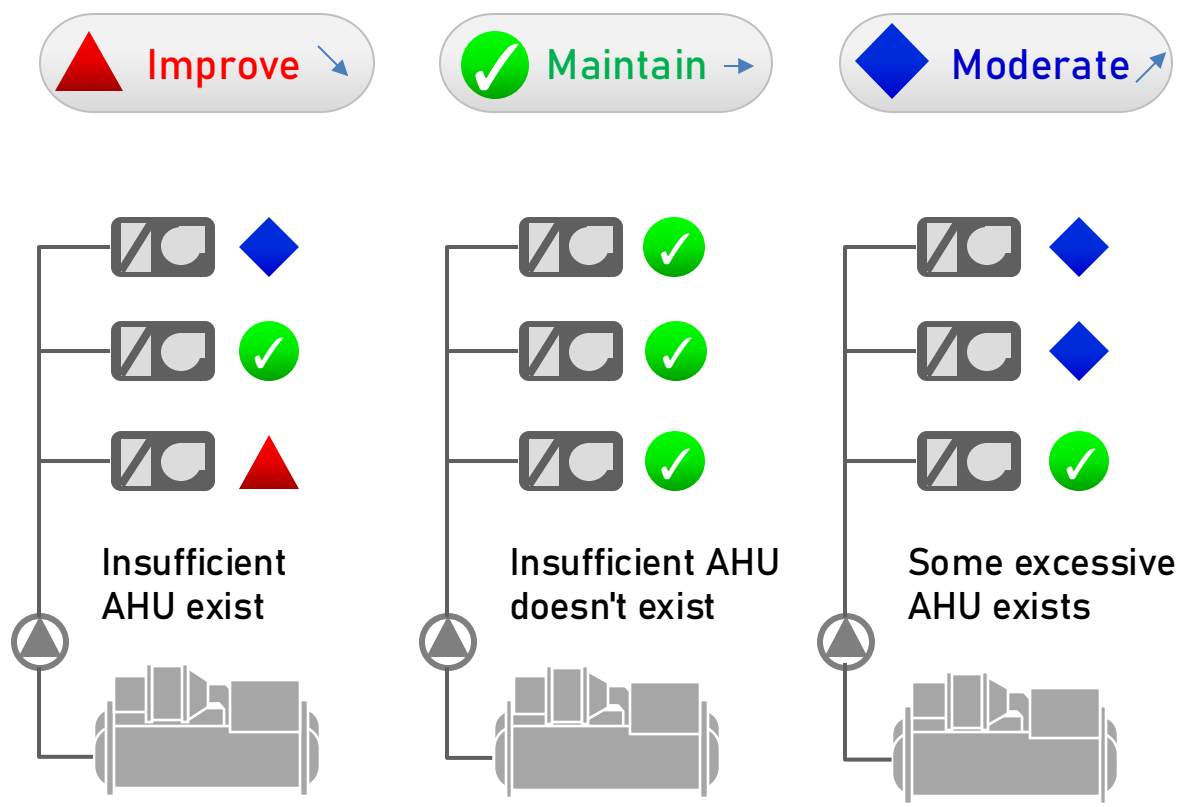
Find Optimal Supply Water Temperature

Best combination of chiller and distribution power consumption

Check the AHU Control Status

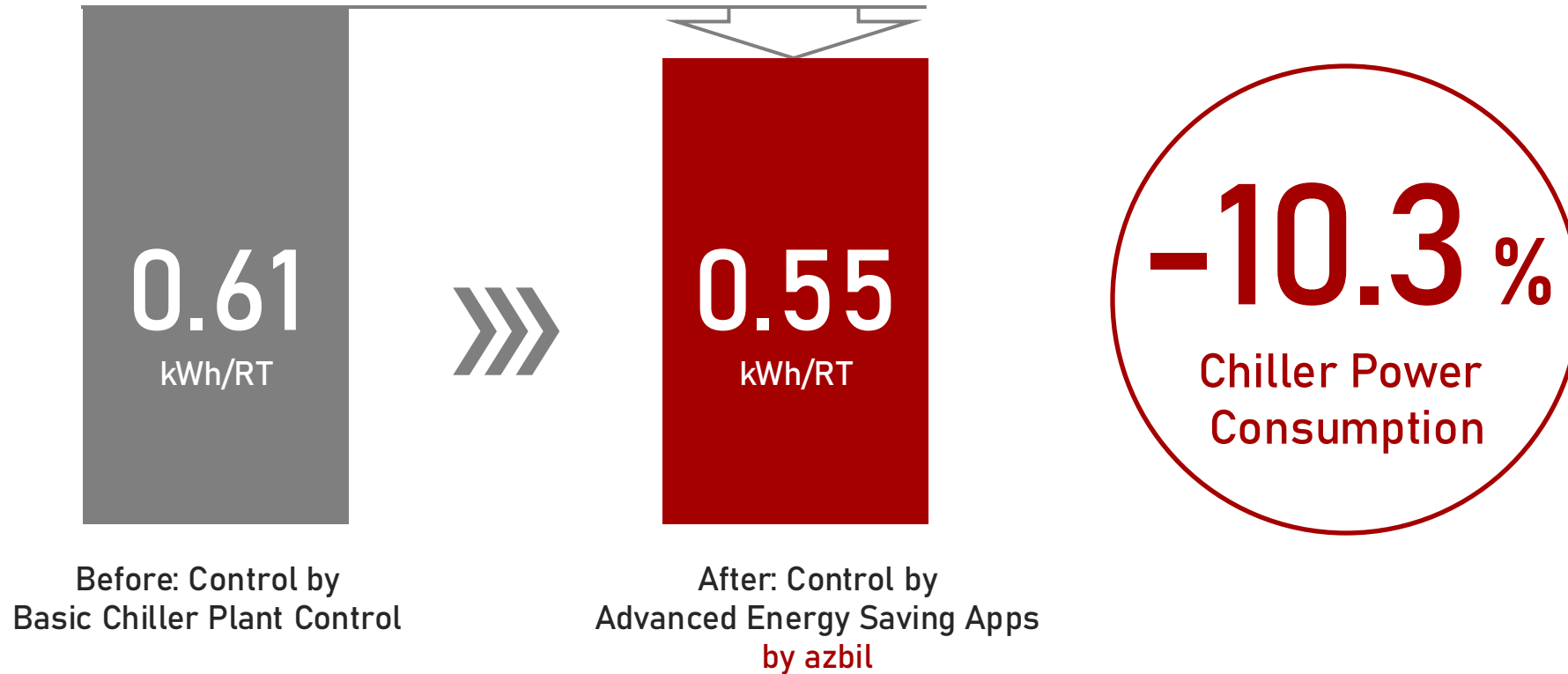


Change Supply Water Temp. SP



Change Supply Water Temperature Considering AHU Control Status.

Best balance of chiller plant and air side devices.



Comparison of chiller efficiency at the same chiller plant

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Actual Case in Singapore; Azbil improves efficiency

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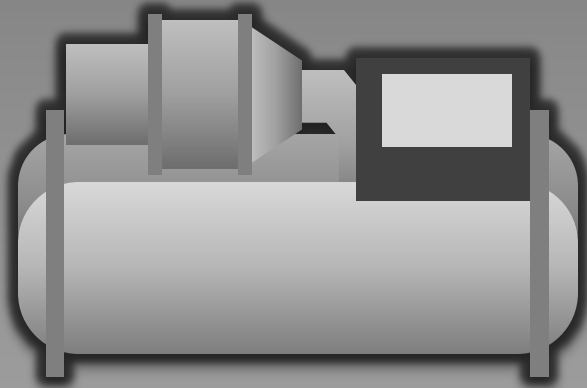
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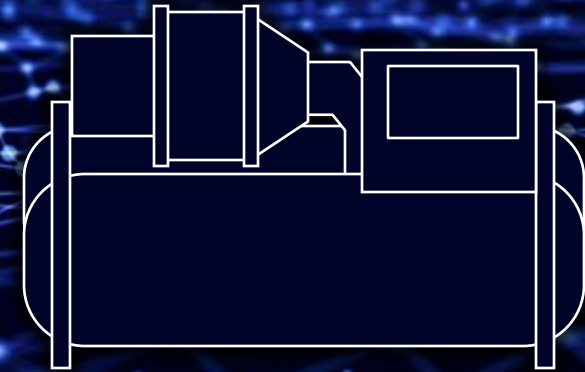
Chiller Plant

Real Chiller Plant in Physical World



CHILLER PLANT DIGITAL TWIN

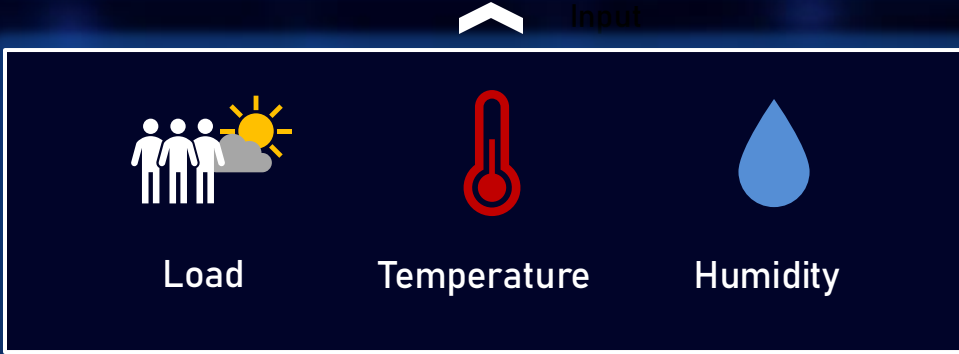
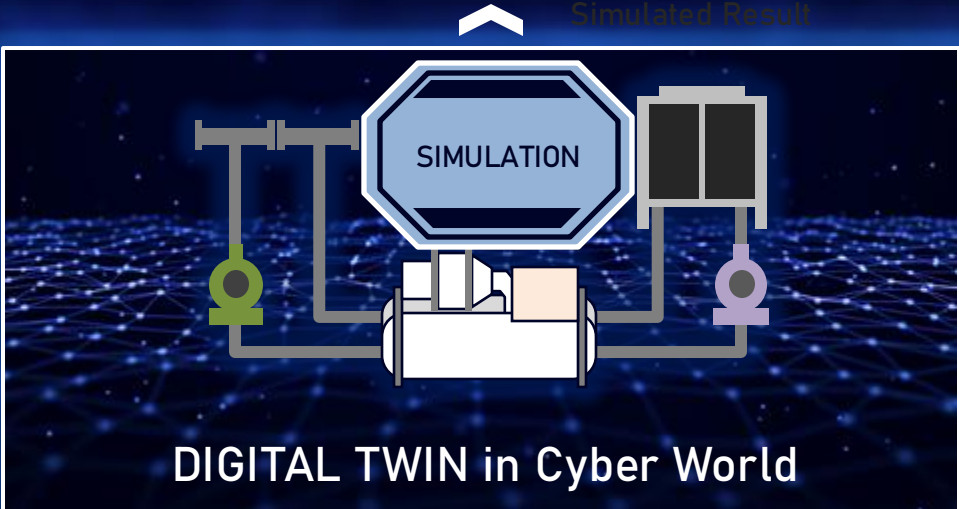
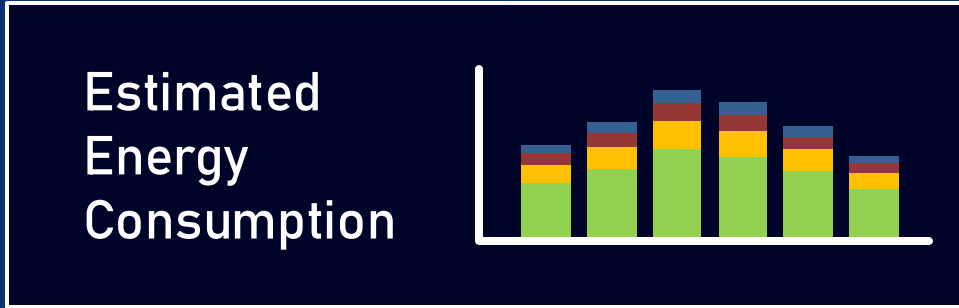
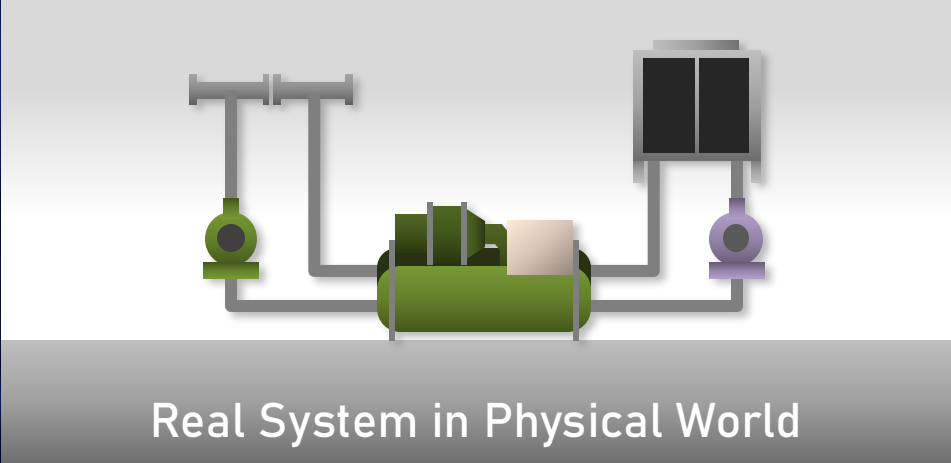
Digital Twin Model in Cyber World

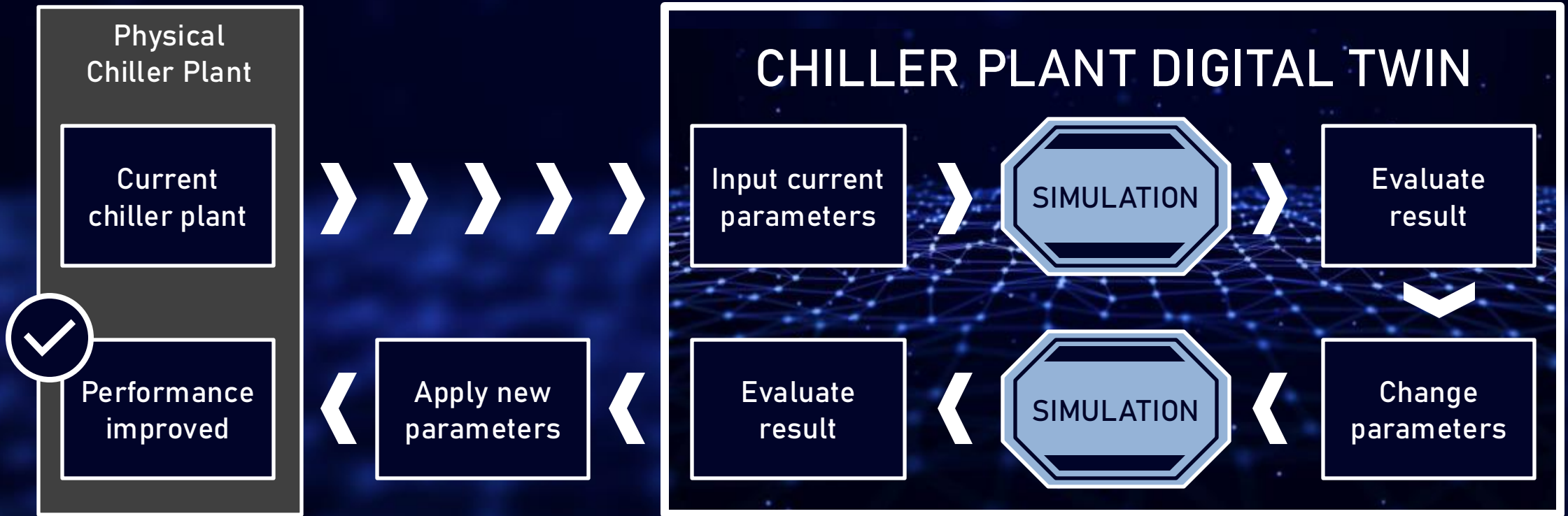


Metaverse of Chiller Plant

Creates the Digital Copy of chiller plant in the Cyber World by utilizing information in the Physical World

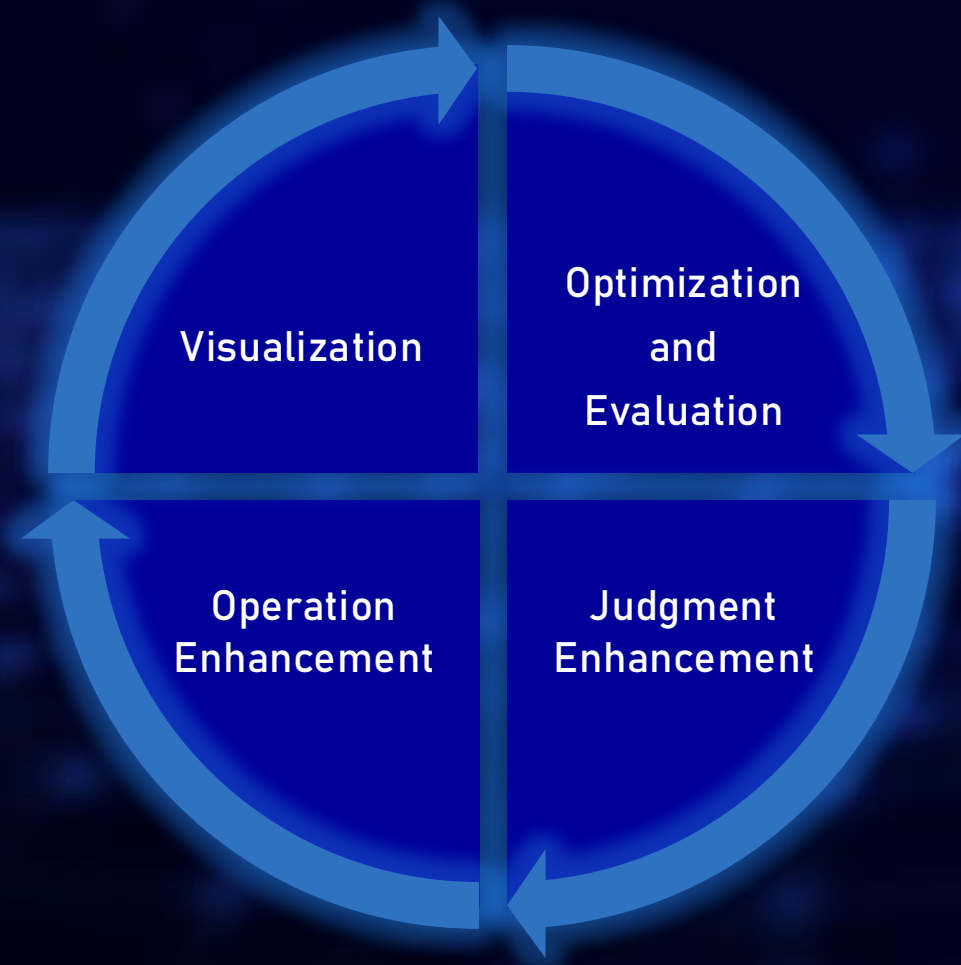
CHILLER PLANT DIGITAL TWIN





Improves Current Chiller Plant Performance

Chiller Plant Digital Twin improves your chiller plant performance without risks and costs



Visualization

Identify current usage status
with various Dash Boards

Optimization and Evaluation

Trial & Error in the cyber space
Energy optimization

Judgement Enhancement

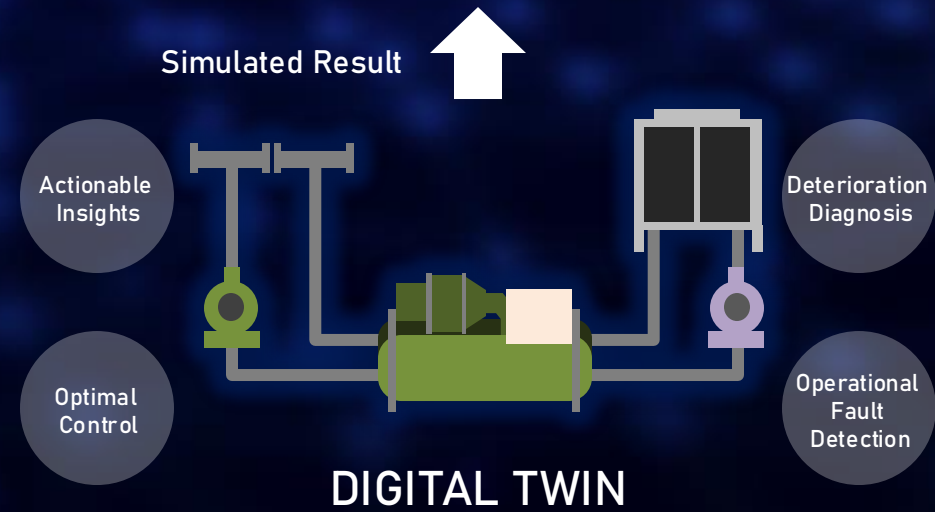
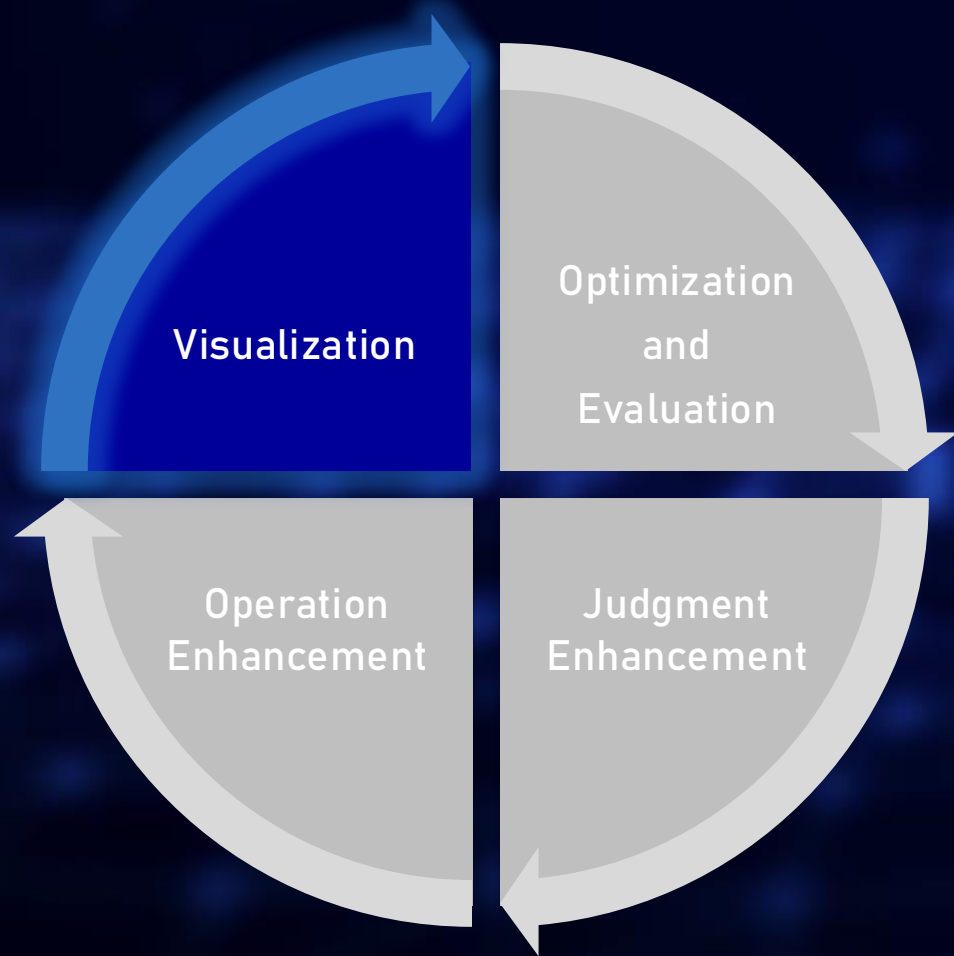
Operational fault detection
Comparison with ideal status

Operation Enhancement

Actionable insights
Operational Advice

Visualization

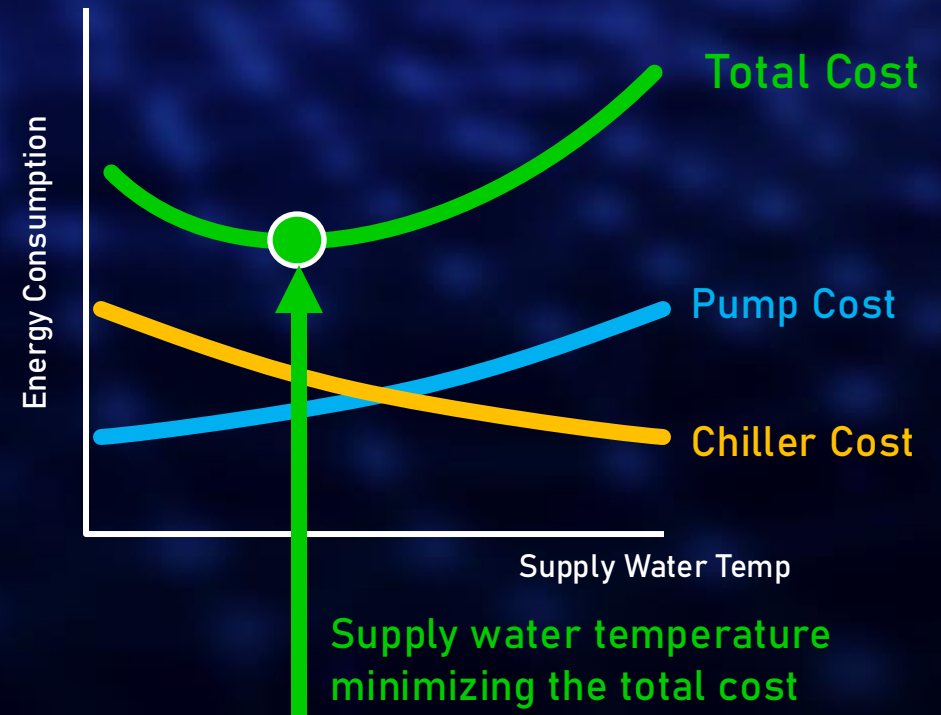
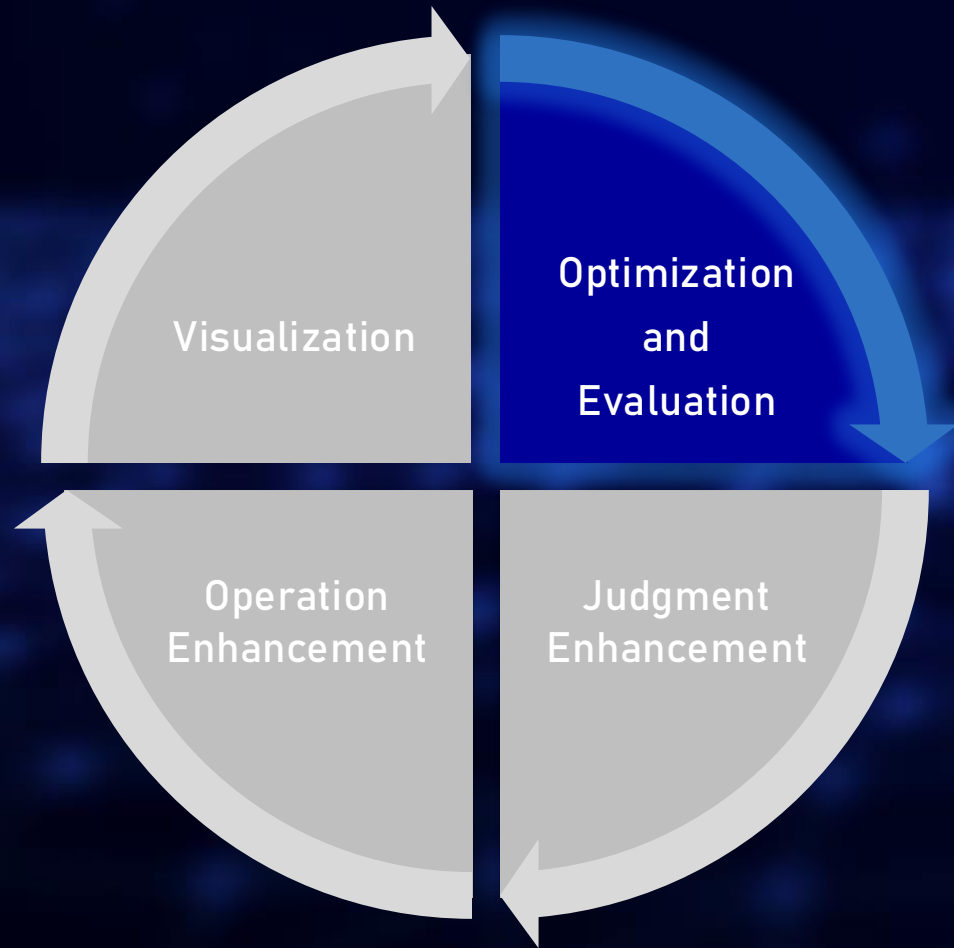
Identify current usage status with various Dash Boards

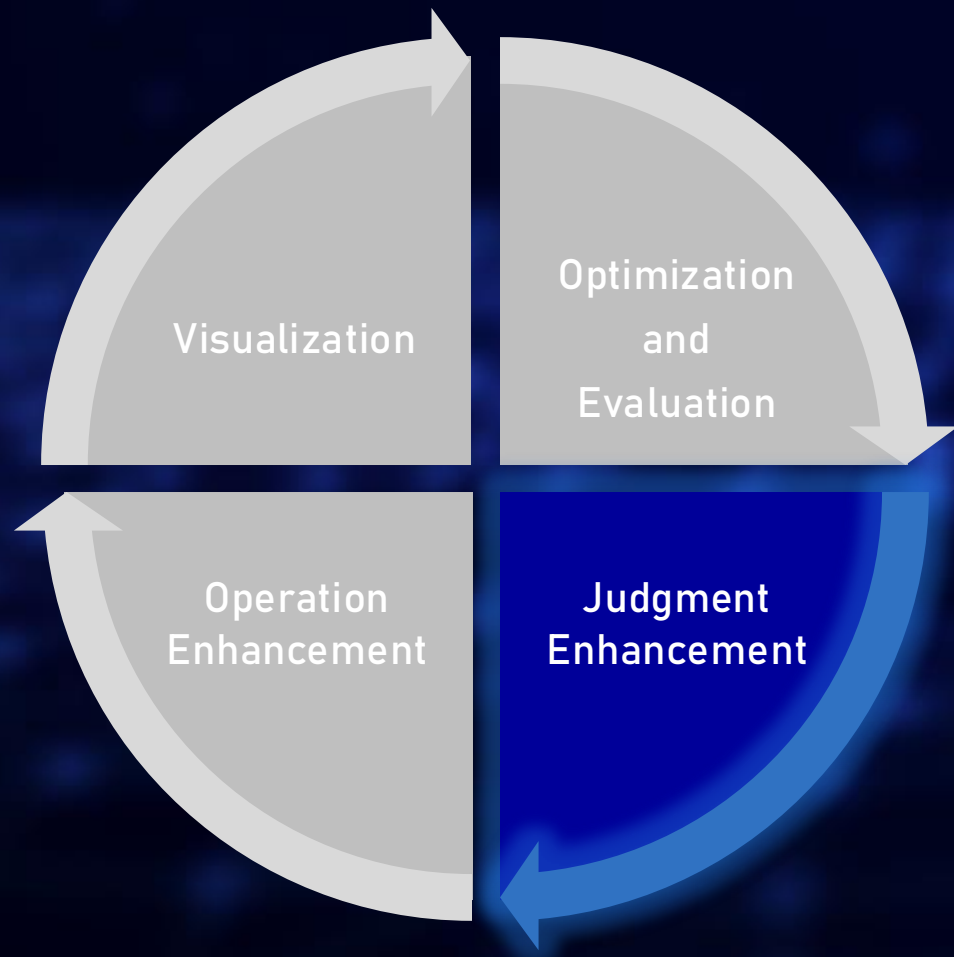


Optimization and Evaluation

Simulate energy consumption with no optimization measures in what-if scenarios

Compare with actual optimization result to show the effectiveness of optimization program



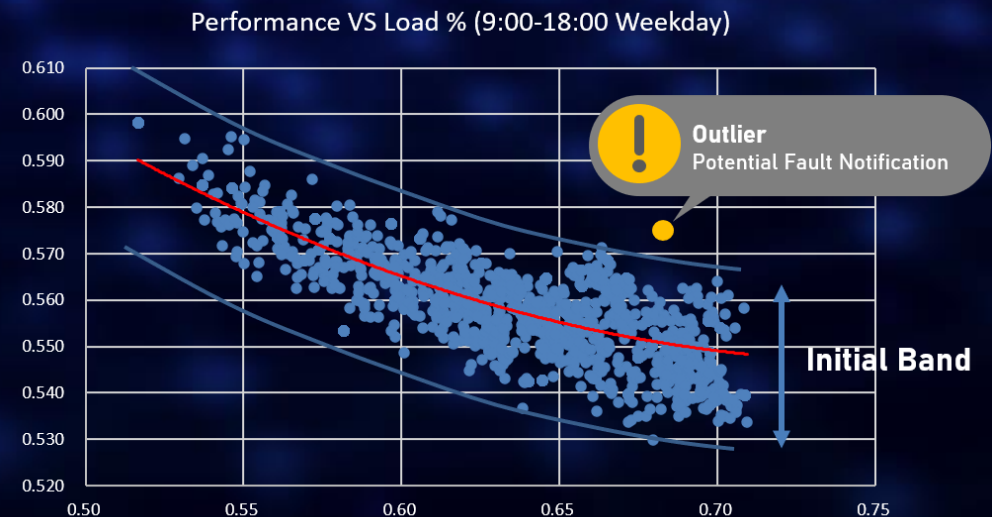


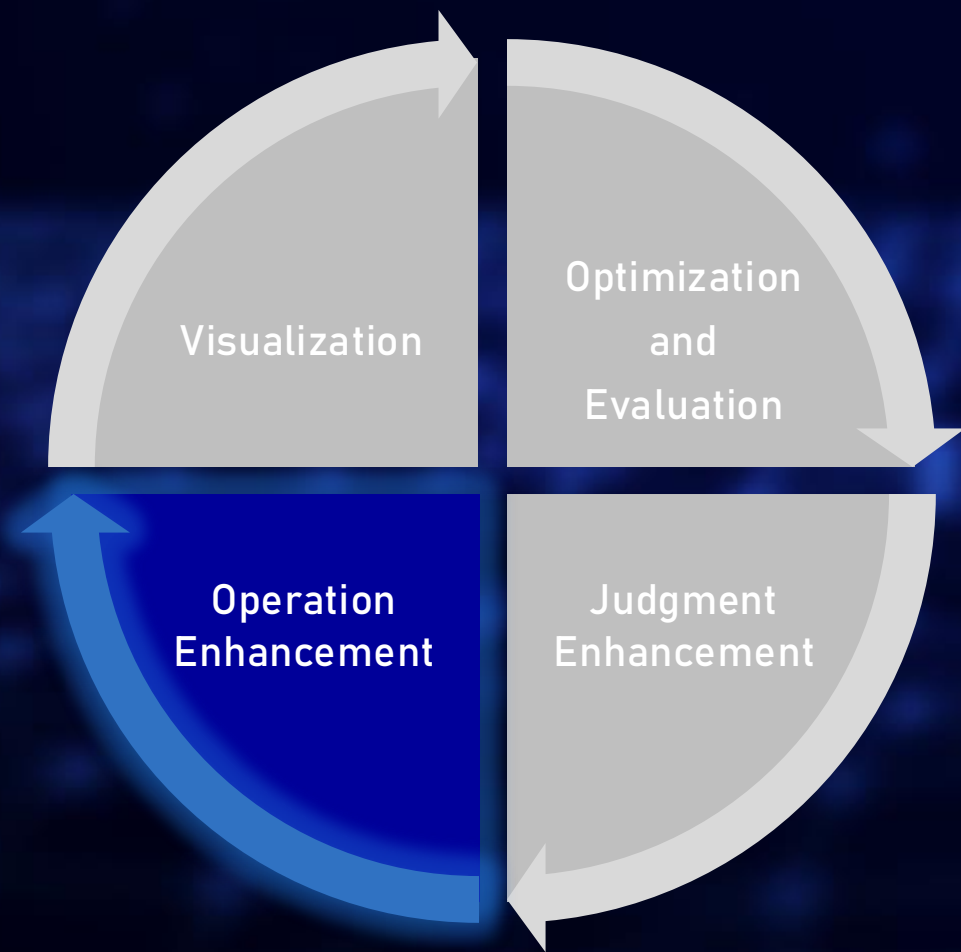
Judgement Enhancement

Operational fault detection + Root Cause Analysis
Comparison with ideal status

Provide steps to navigate operator for rectification
Show wastage amount if fault is not rectified

➔ Early Detection





Operation Enhancement

Built-in analytics automatically pick up Recommended Enhancement measures

Recommendation

Guide operator to improve operations by assessing actual equipment performance
Indicate saving amount of each measure

Deterioration Analysis

Compare original performance with current performance to verify the deterioration rate
Notify operator to provide recommendation of servicing equipment

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Thank you