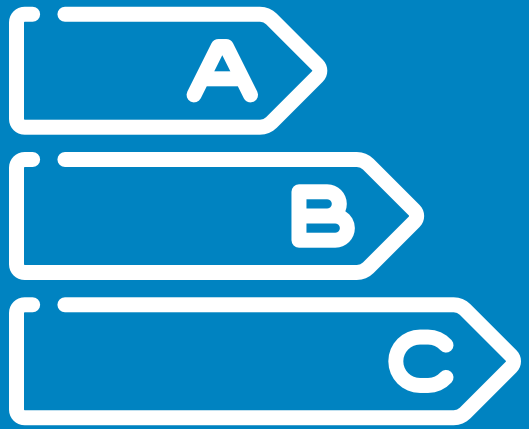

DAIKIN

HOW DAIKIN INVERTER SCREW SERIES CAN CONTRIBUTE TO ENERGY SAVINGS

Hubert Gatez
Daikin Europe NV

*The ways to **SYSTEMS EFFICIENCY***



HIGH EFFICIENCY CHILLERS

SMART SYSTEMS MANAGEMET

ENERGY RECOVERY

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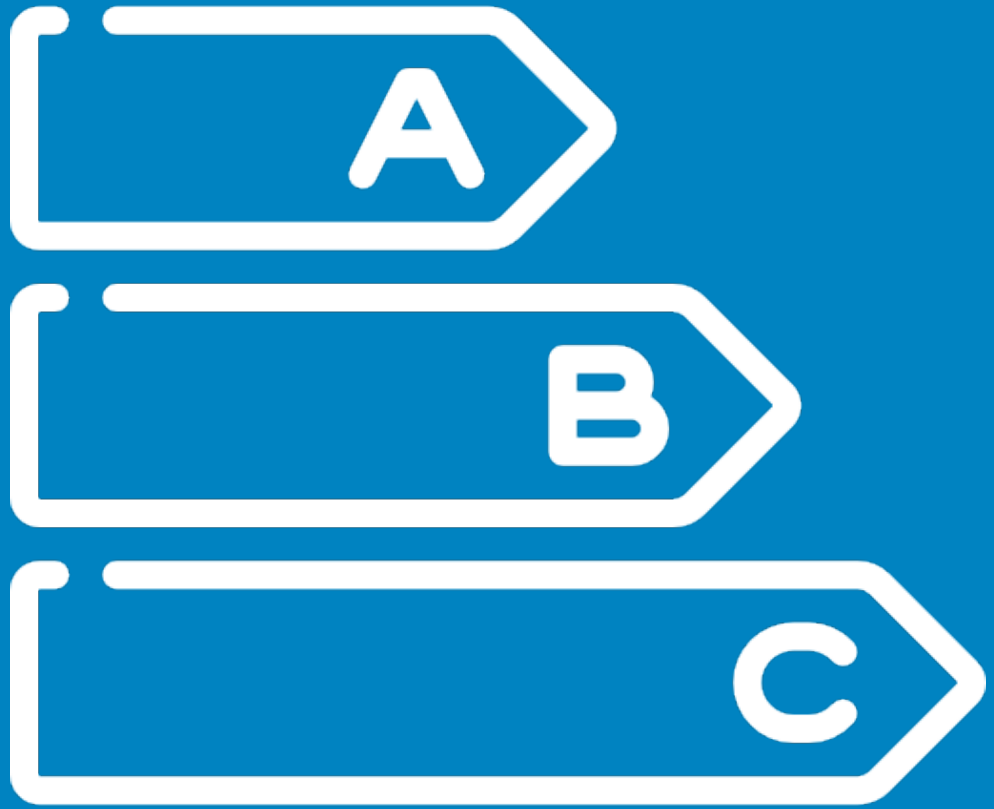
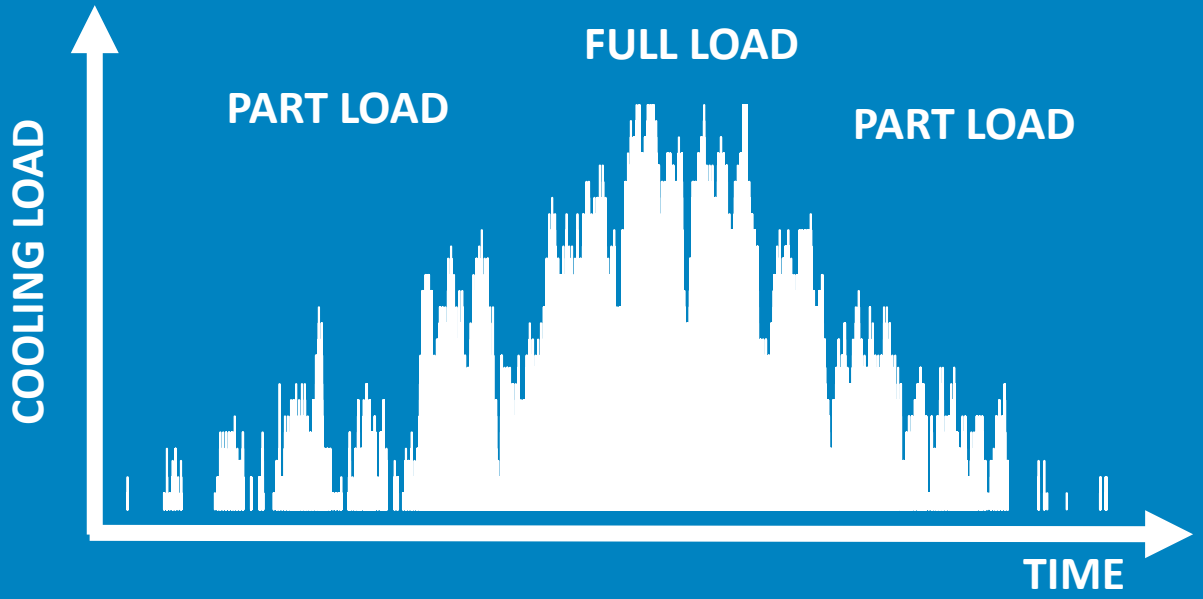


HIGH EFFICIENCY CHILLERS

HIGH EFFICIENCY CHILLERS



To be defined "EFFICIENT" a chiller must have HIGH PART LOAD EFFICIENCY

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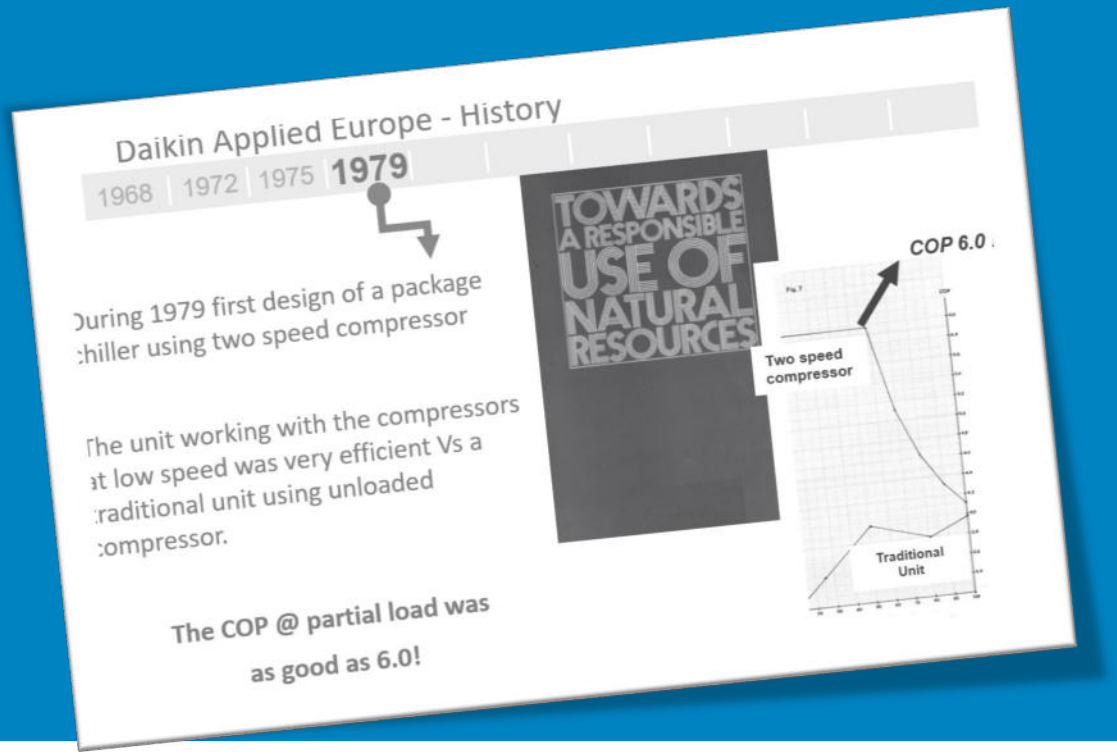
started promoting part load efficiency in 1979 !!



Introducing the first two speed reciprocating compressor

a lot has been done in the last 40 years…

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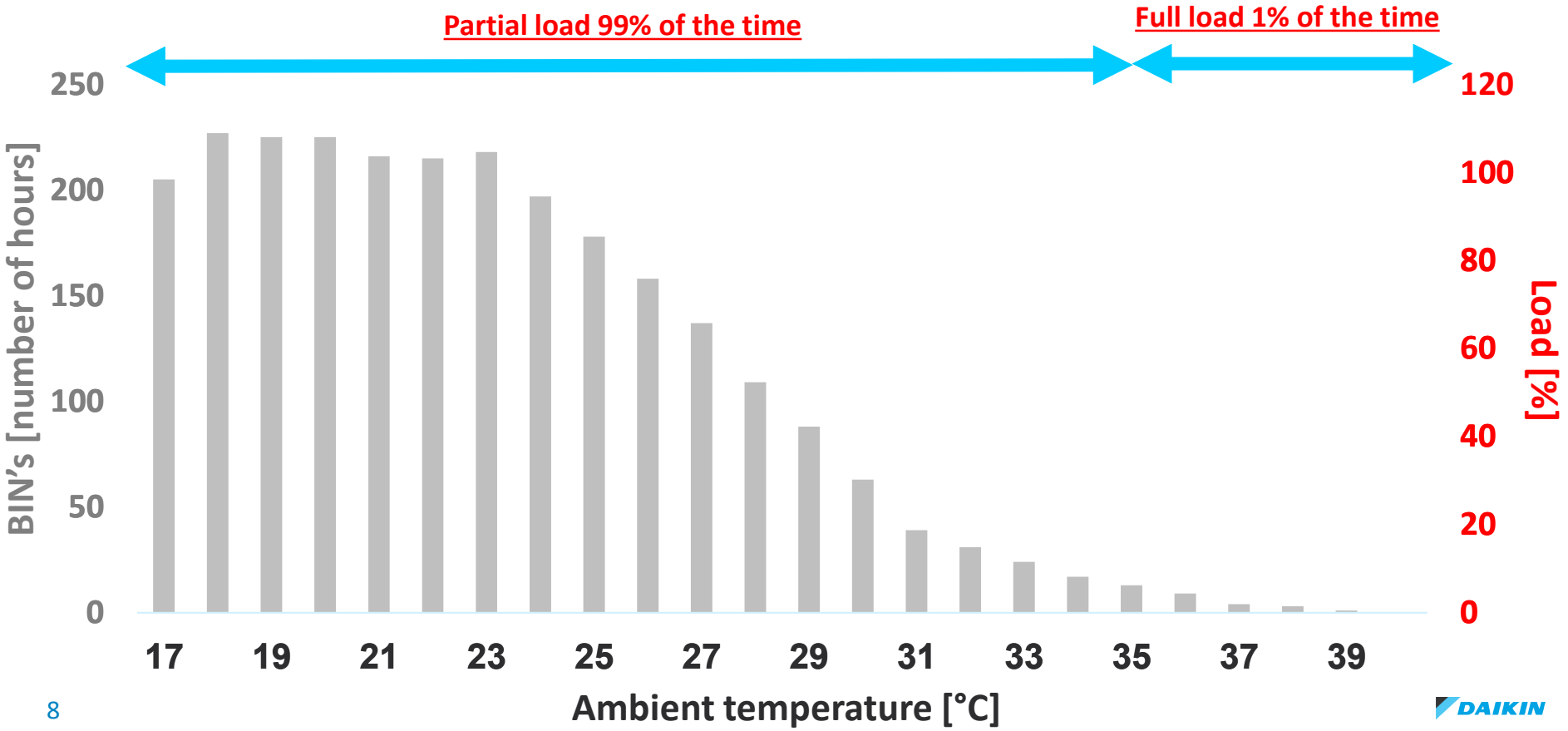
SEER is calculated over 2600 hours of chiller operation over the year.
Only 30 hours are considered as full load operation



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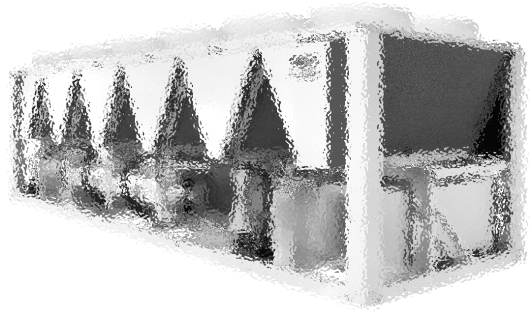
Starting from January 2018 only chillers compliant with minimum SEER requirements can be on the market

		TIER 1 (1st Jan 2018)		TIER 2 (1st Jan 2021)	
Chiller type	Capacity (kW)	ηs (%)	SEER	ηs (%)	SEER
Air Cooled	<400	149	3,80	161	4,10
Air Cooled	≥400	161	4,10	179	4,55
Water Cooled	<400	196	5,10	200	5,20
Water Cooled	≥400 and < 1500	227	5,88	252	6,50
Water Cooled	≥1500 and <2000	245	6,33	272	7,00

we can compare a fix speed compressor chiller recently launched from competition with ***DAIKIN TZ B***, inverter chiller launched in 2016



Competitor's fix speed chiller launched in 2018

capacity ≈ 800 kW

SEER 4,12

Minimum requirements 2018 → 4,10

Minimum requirements 2021 → 4,55

DAIKIN TZ B **inverter chiller launched in 2016**

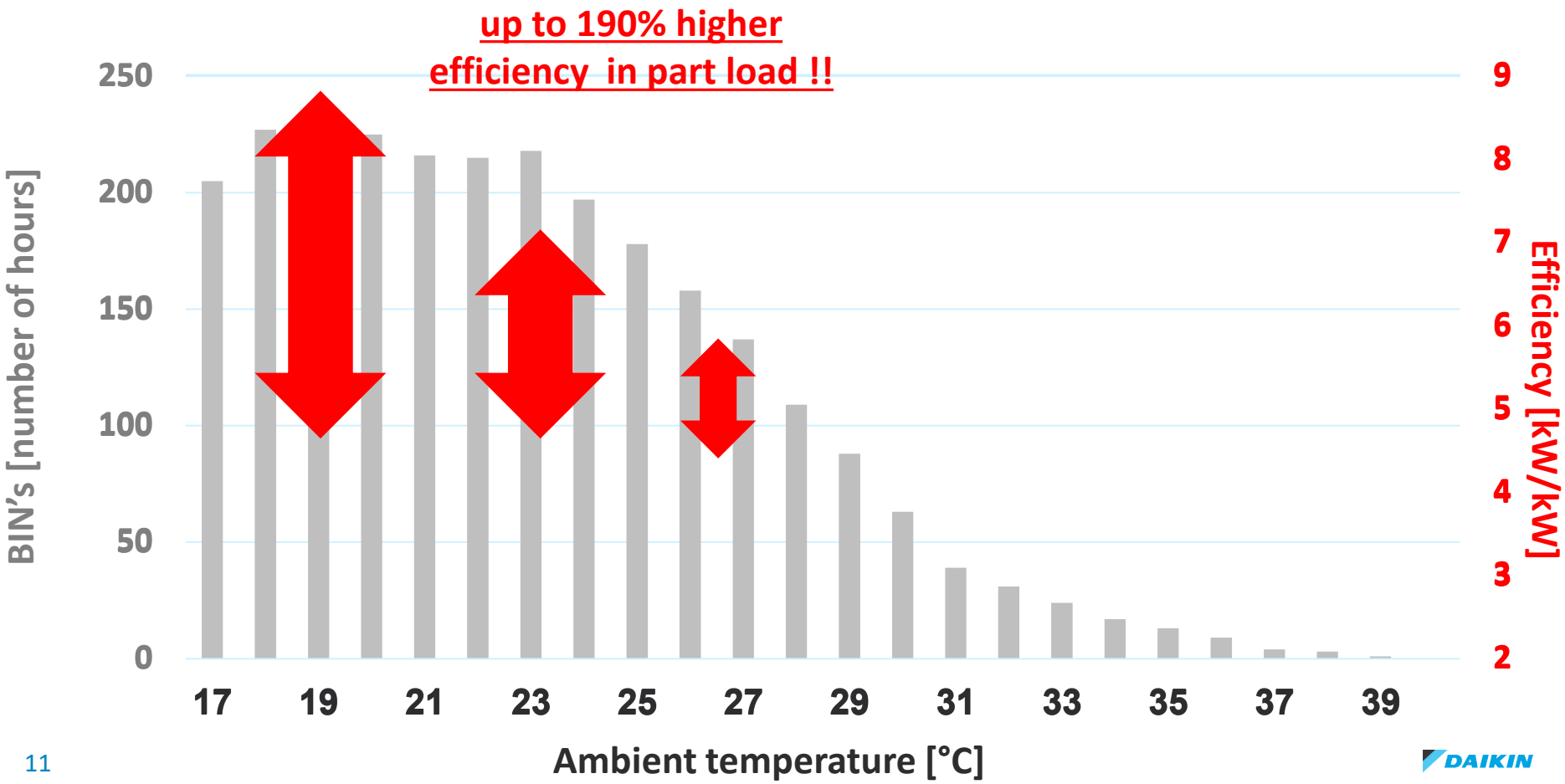
capacity ≈ 800 kW

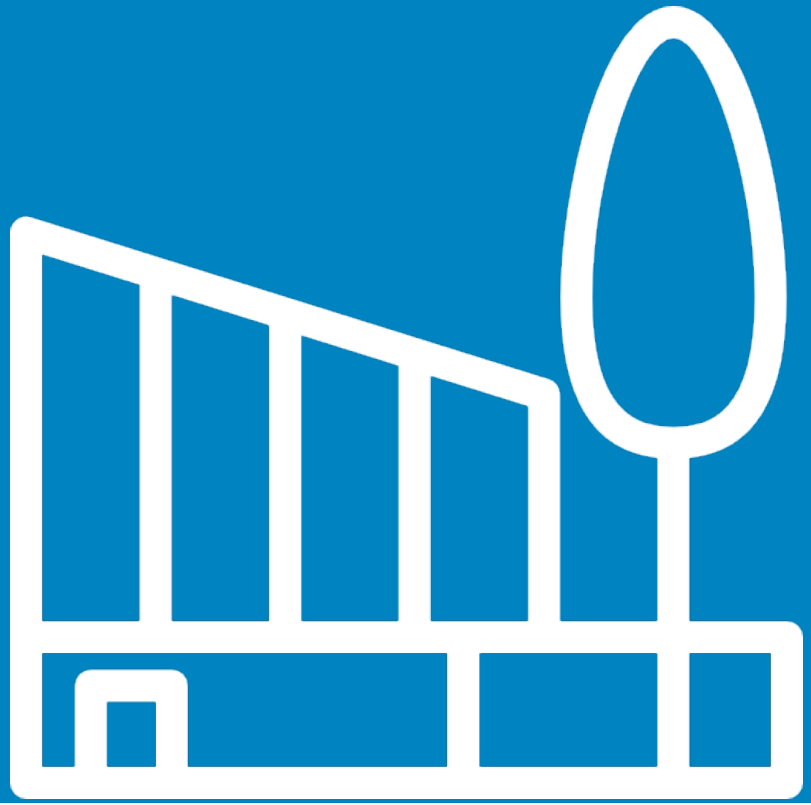
SEER 5,74

Minimum requirements 2018 → 4,10

Minimum requirements 2021 → 4,55

Looking at the two chillers efficiencies over the SEER profile….





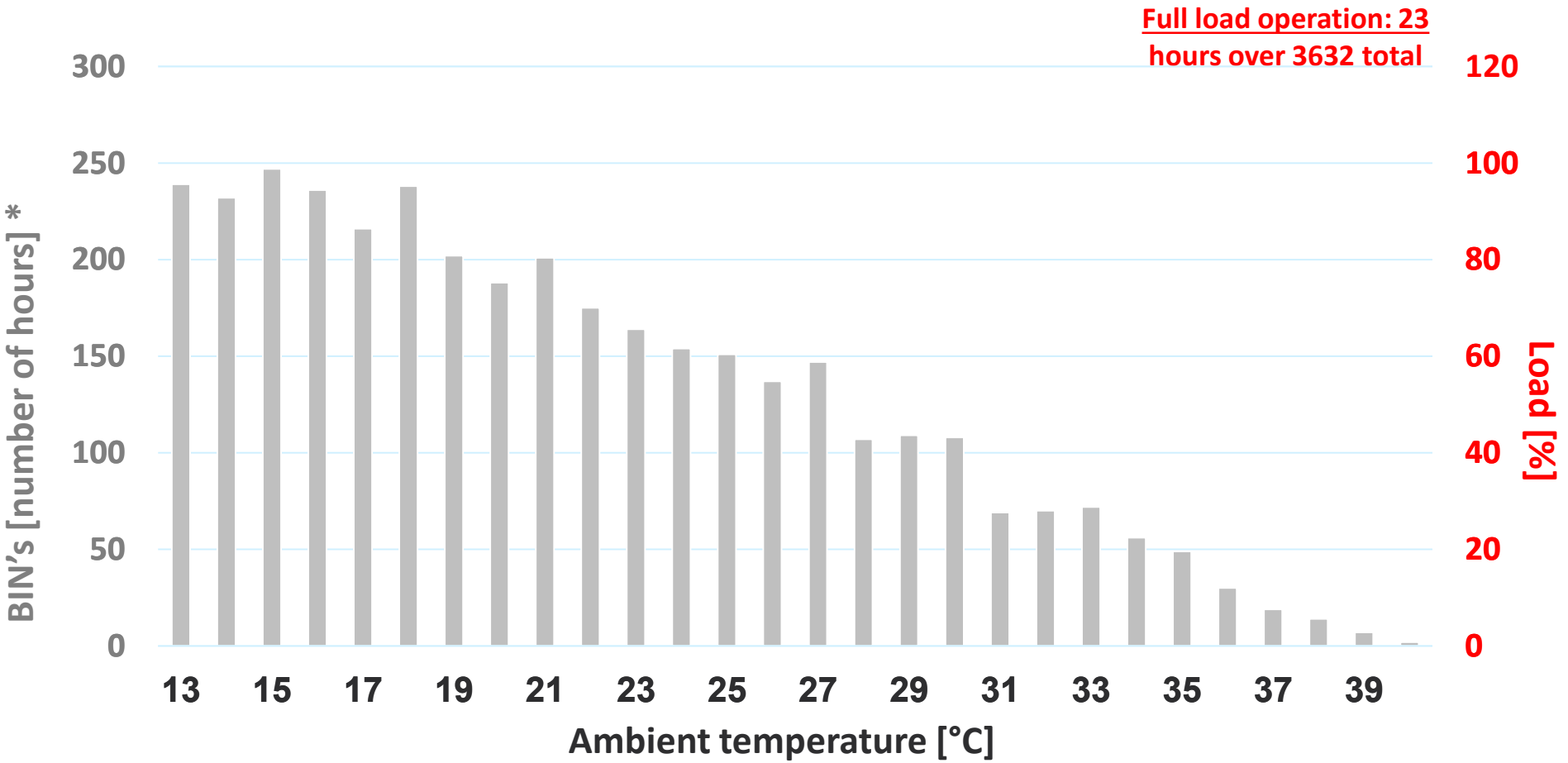
A new project:
Shopping Mall
Location: TEL AVIV

Design parameters:

- ✓ Design cooling capacity: 1,6 MW
- ✓ Requirement 3 chillers with 2 circuit each
- ✓ Ambient temperature: 38°C
- ✓ Chilled water temperature 7°C
- ✓ Chiller OFF @ ambient temperature 12°C

NEED TO EVALUATE THE LOAD PROFILE !!

Load profile evaluation



* Original Source Data (c) 2001 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), Inc.

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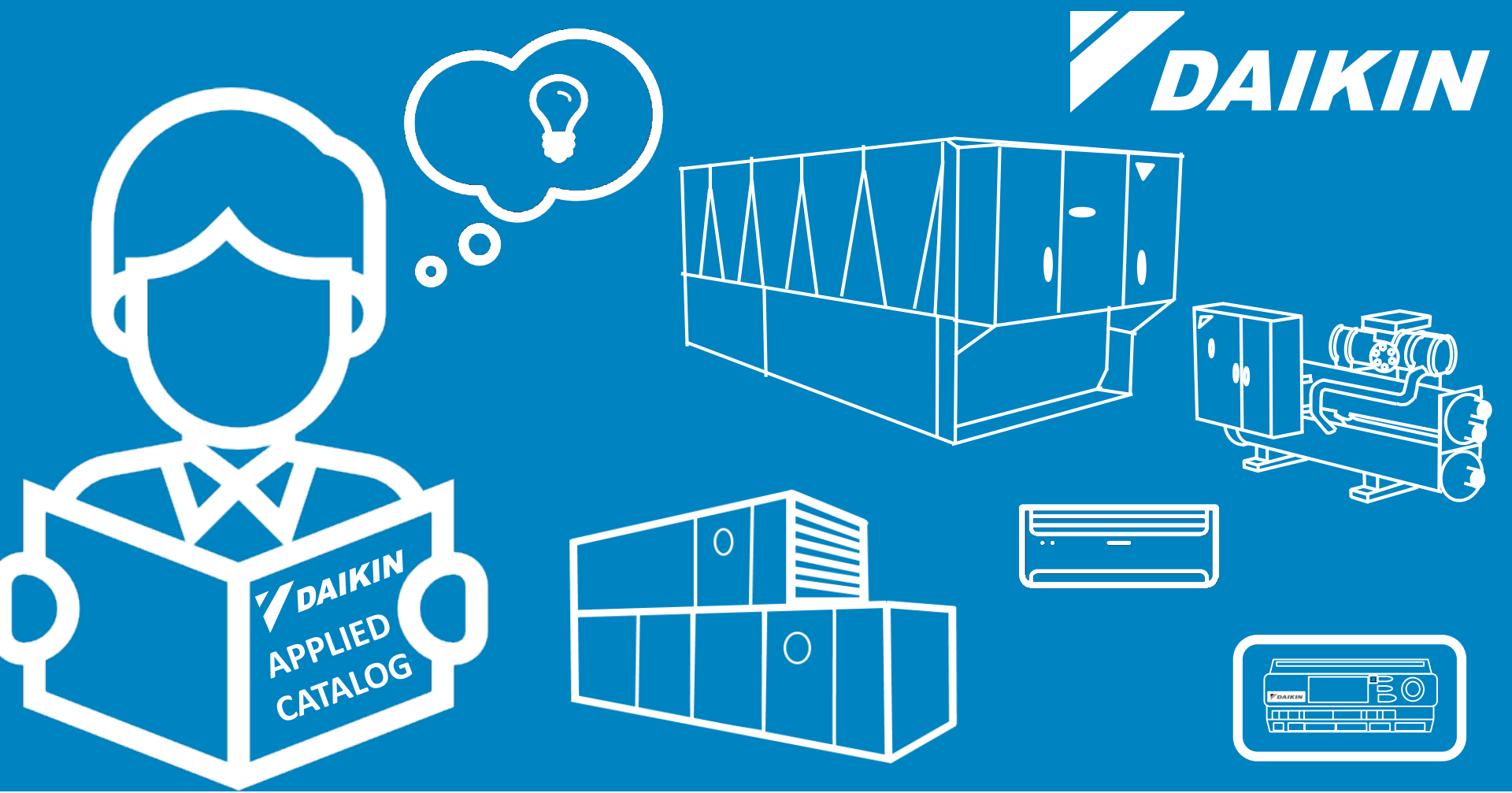
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APPLIED
CATALOG

DAIKIN TZ B – COOLING ONLY CHILLER - R134a/R1234ze

TZ CHILLER SERIES

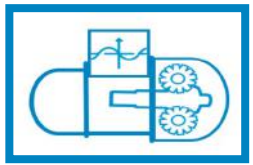
INVERTER +VVR

Features & Benefits

- ✓ designed for commercial and industrial
- ✓ capacity range **from 170 – up to 1150 kW***
- ✓ Single and dual circuit units
- ✓ Extensive list of options and accessories
- ✓ 50Hz & 60Hz versions available
- ✓ **BEST FULL LOAD AND PART LOAD EFFICIENCY**
- ✓ **3 efficiency levels**
- ✓ **3 sound configurations**

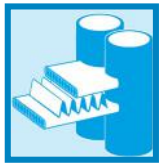
BEST AVAILABLE TECHNOLOGY IN ECO-DESIGN

OUTDOOR INSTALLATION



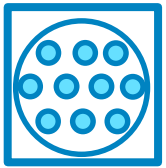
SINGLE SCREW COMPRESSOR with INTEGRATED REFRIGERANT COOLED VFD

VARIABLE VOLUME RATIO



MICROCHANNEL CONDESER

AXIAL FANS



DIRECT EXPANSION SHELL & TUBE EVAPORATOR

* conditions:
- OAT: 35°C
- EWT in/out= 12/7°C

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DAIKIN TZ B – COOLING ONLY CHILLER - R134a/R1234ze

TZ CHILLER SERIES

INVERTER + VVR

3 EFFICIENCY LEVES

Silver — avg. EER = 2,9* / avg. SEER = 4,5**

Gold — avg. EER =3,2* / avg. SEER = 5,0**

Platinum — avg. EER =3,5* / avg. SEER = 5,3**

Return of investment VS fix speed technology

COMPLIANT TO ECODESIGN TIER 2 of LOT21

EUROVENT CERTIFIED PERFORMANCE www.eurovent-certification.com

OUTDOOR INSTALLATION

SINGLE SCREW COMPRESSOR with INTEGRATED REFRIGERANT COOLED VFD

VARIABLE VOLUME RATIO

MICROCHANNEL CONDESER

AXIAL FANS

DIRECT EXPANSION SHELL & TUBE EVAPORATOR

* According EN14511

** According EN14825

*** Calculated on SEER profile

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DAIKIN TZ B – COOLING ONLY CHILLER - R134a/R1234ze

TZ CHILLER SERIES

INVERTER + VVR

3 SOUND CONFIGURATIONS

STANDARD SOUND

LOW SOUND (-6 dB* vs STANDARD SOUND)

REDUCED SOUND (-8 dB* vs STANDARD SOUND)

EUROVENT CERTIFIED PERFORMANCE
www.eurovent-certification.com

OUTDOOR INSTALLATION

SINGLE SCREW COMPRESSOR with INTEGRATED REFRIGERANT COOLED VFD

VARIABLE VOLUME RATIO

MICROCHANNEL CONDESER

AXIAL FANS

DIRECT EXPANSION SHELL & TUBE EVAPORATOR

* at Eurovent standard conditions

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For the project 3 EWAD570TZXSB2 are selected with following characteristics

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Technical Data Sheet

EWAD570TZ-XS B2

Performances calculated according to EN14511-3:2013

Cooling mode performances

Cooling capacity	555.0 kW	Evaporator water IN/OUT	12.00 °C / 7.00 °C
Power input	192.4 kW	Evaporator water flow	26.60 l/s
EER Cooling Efficiency	2.885 kW / kW	Evaporator pressure drops	40.0 kPa
ESEER	5.070 kW / kW	Ambient temperature	38.0 °C
IPLV.IP	6.290 kW / kW	Lw / Lp @ 1m	100 dB(A) / 79 dB(A)
SEER / ηs	5.04 / 198.6%	Evaporator fluid	Water
		Evaporator fouling factor	0.000 m2°C/W

SEER declared according to EN1825, fan coil application 12/7°C (inlet/outlet) water temperatures. Sound power level according to ISO 9614-1.

Unit information

Compressor type	Inverter Driven Single Screw	Refrigerant type	R134a
Capacity control	Stepless	Condenser type	Microchannel
Compressor N°	2	Condenser fans N°	12
Circuit N°	2	Condenser fans control	VFD
Refrigerant charge	80 kg	Altitude	0 MSL
		Evaporator type	Shell & Tubes

Actual refrigerant charge depends on the final unit construction, refer to unit nameplate.

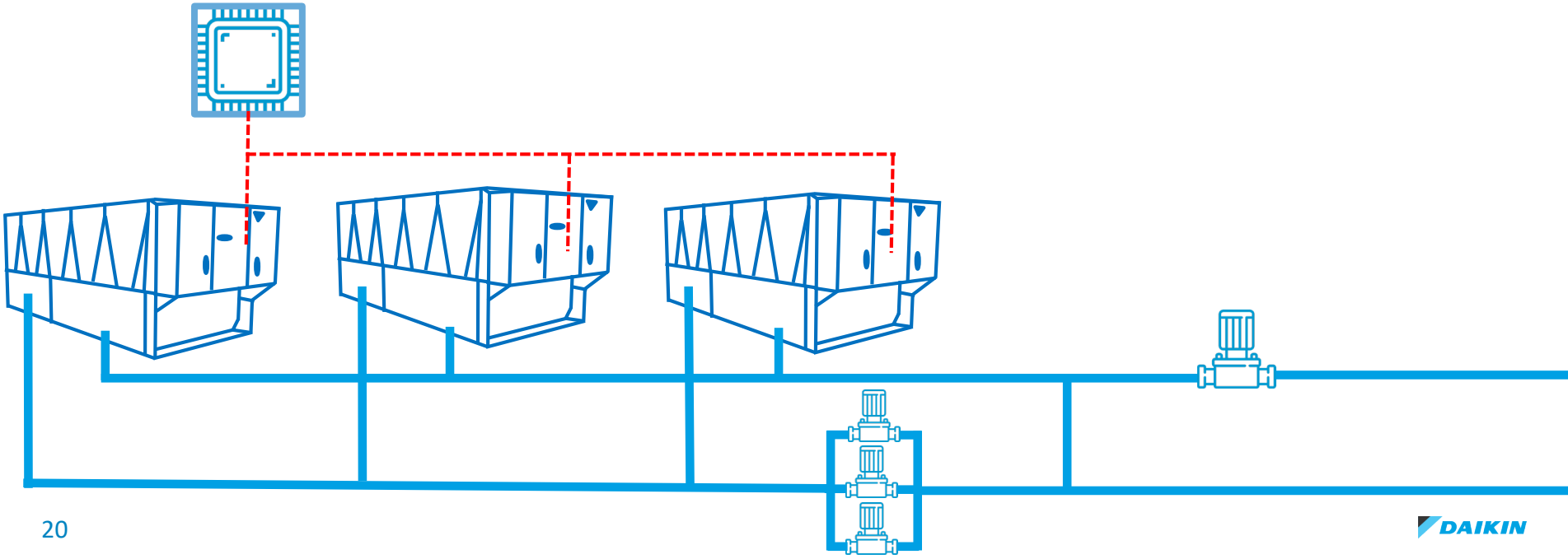
Electrical information

Power supply	400 V / 50.0 Hz / 3 Ph	Max. inrush current	0 A
Running current	329 A	Compressor starting method	Inverter
Max. Running current	385 A		
Max. current wires sizing	418 A		

Voltage tolerance ± 10%. Phase Voltage unbalance ± 3%. Electrical data referred to standard unit without options, refer to unit name plate data.

CONTROL STRATEGY

The designer decides to run the 3 DAIKIN chillers with a basic third part BMS control.
The logic will rotate the chiller to distribute the running hours and start the chillers in sequence together with the related pump.
When first chiller reach full capacity but more cooling energy is needed it starts the second and so on.



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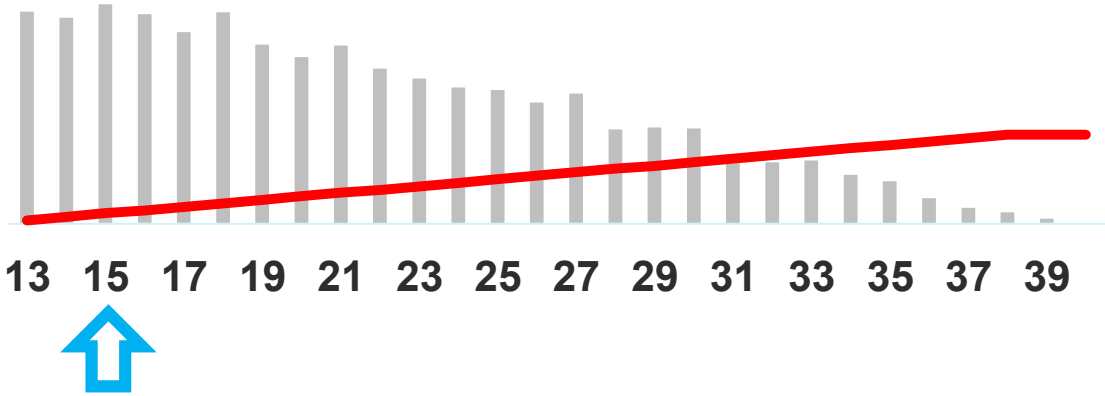

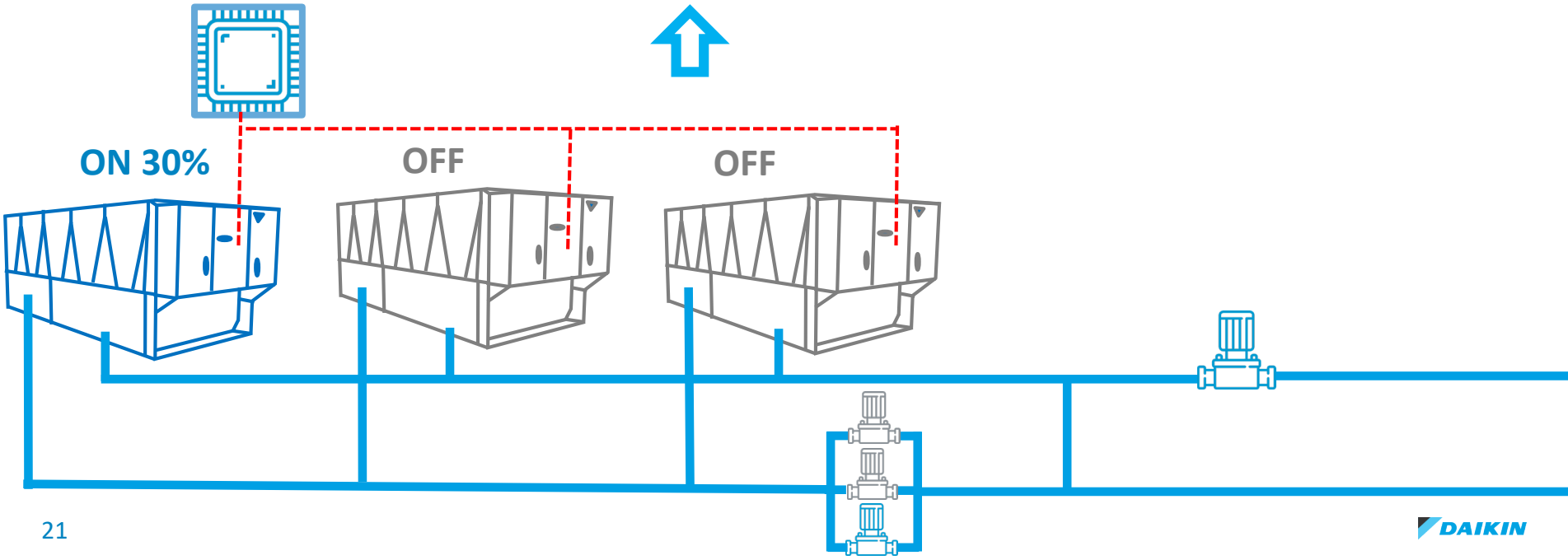

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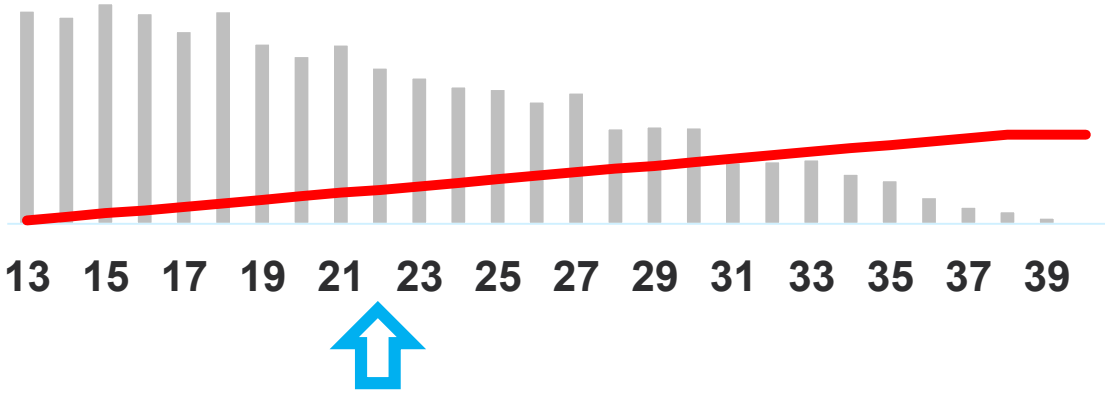

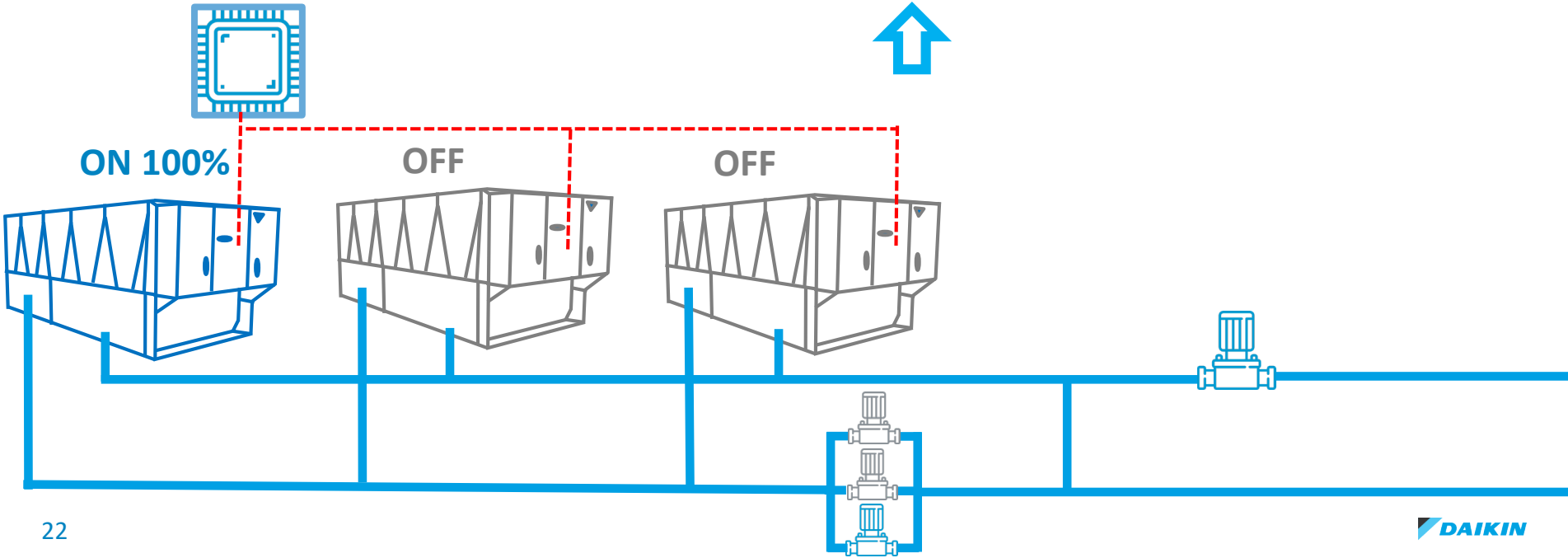

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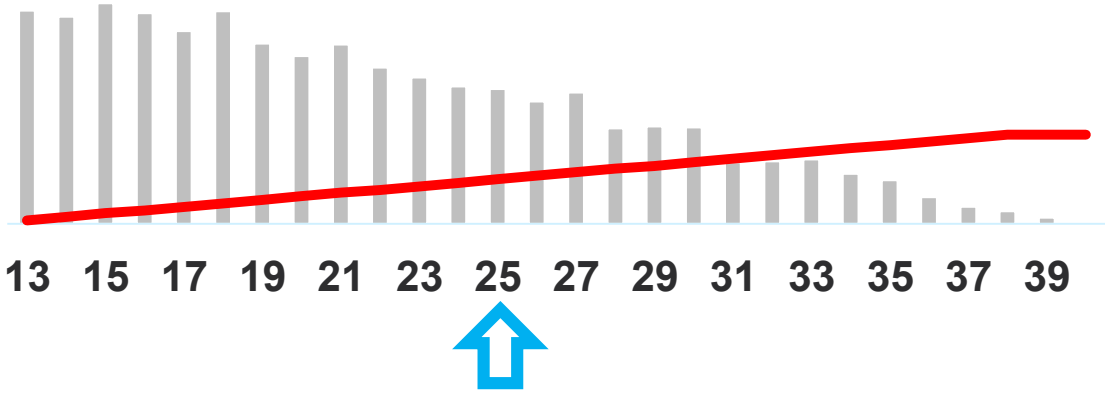

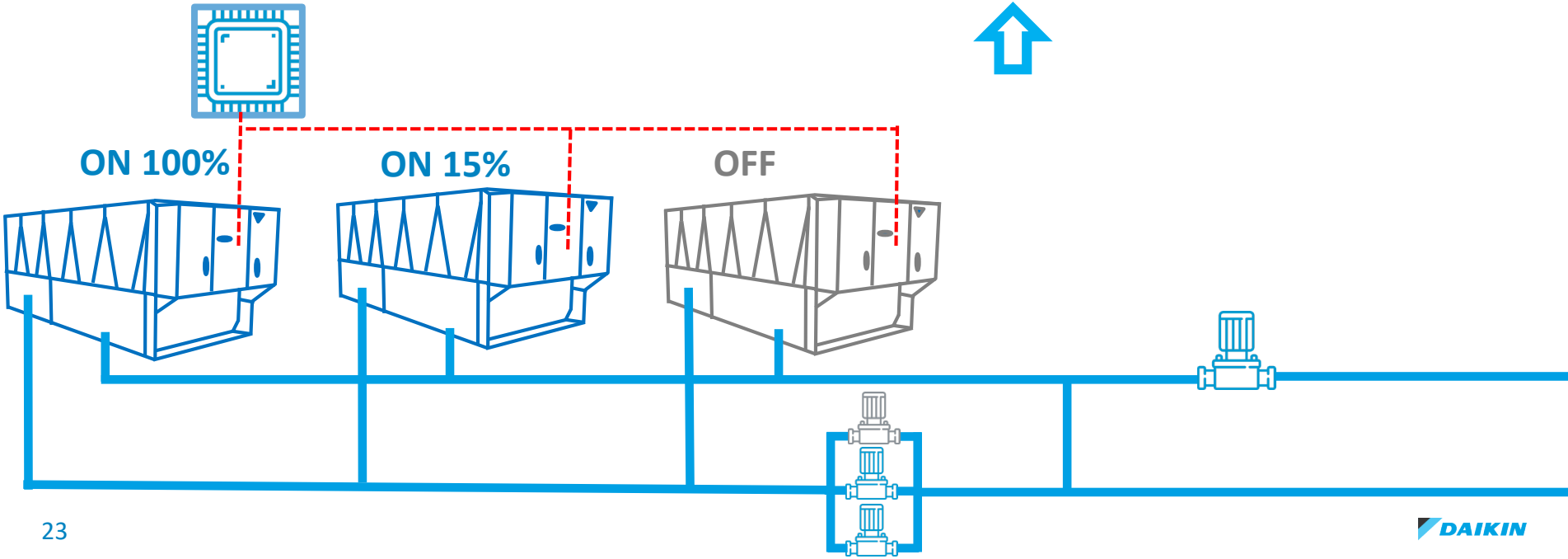

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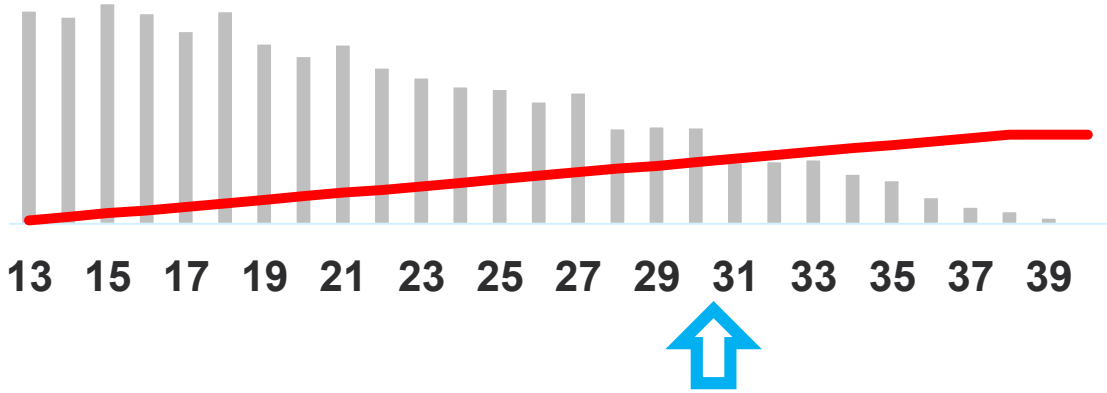

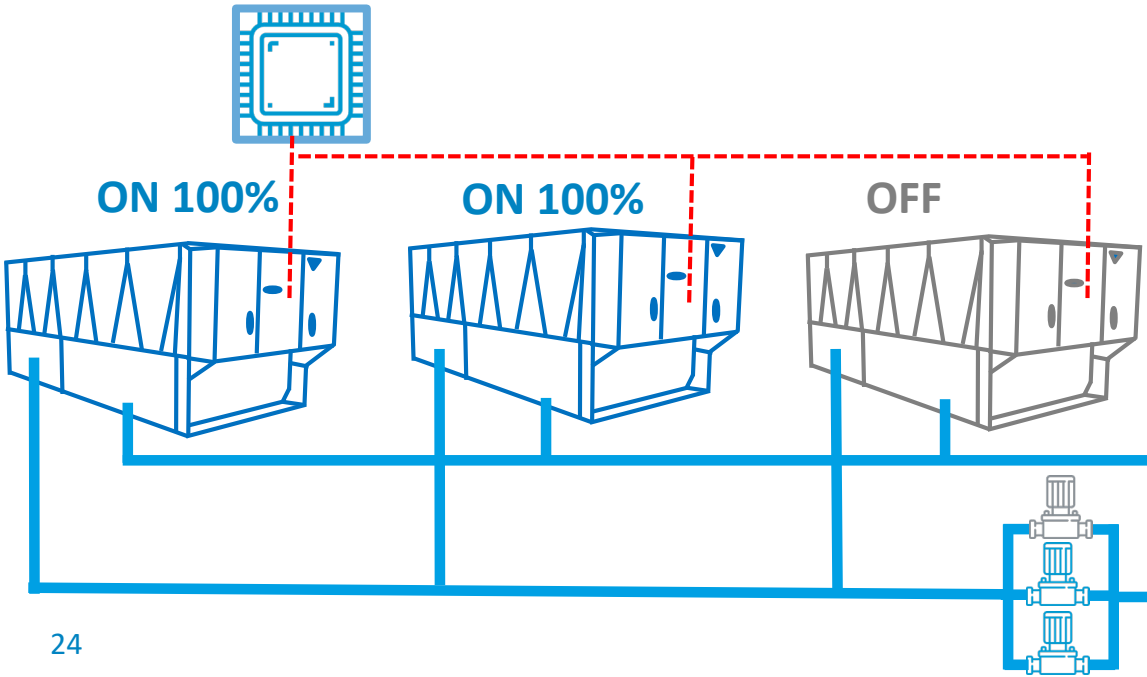

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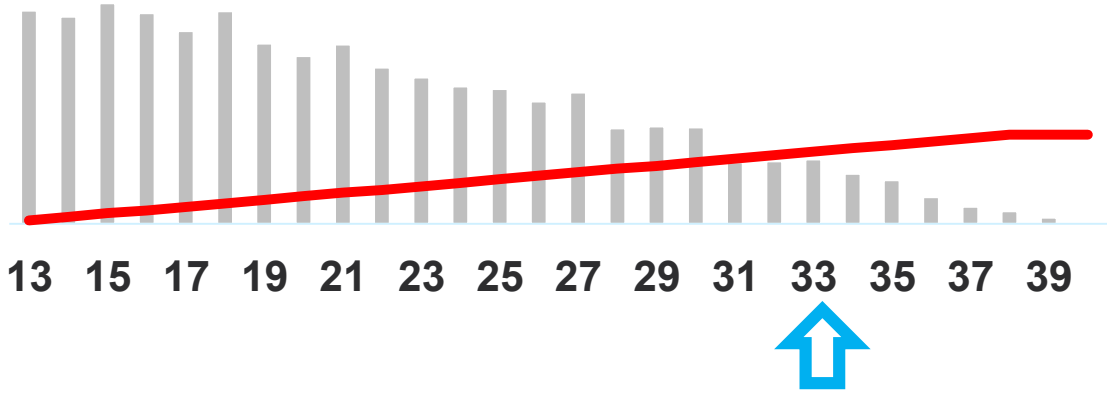

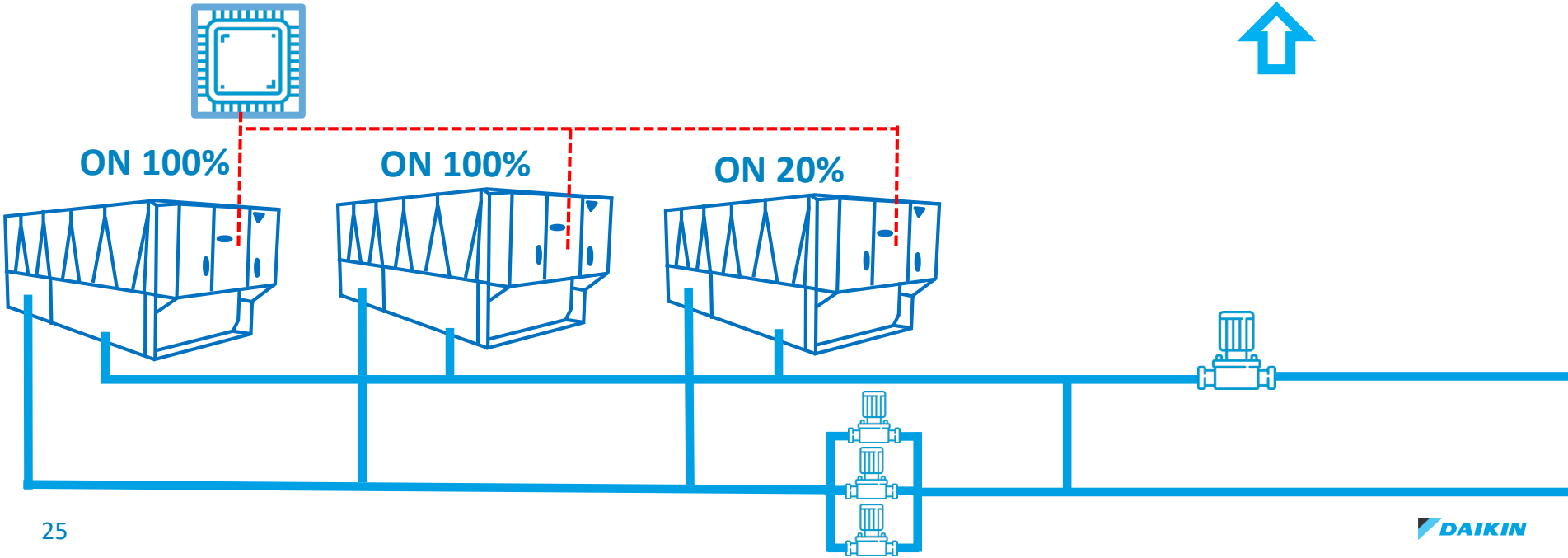

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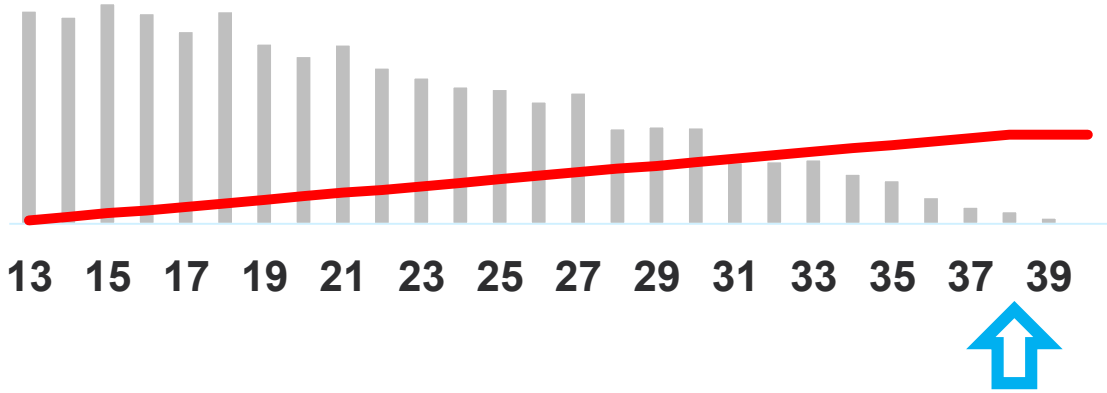
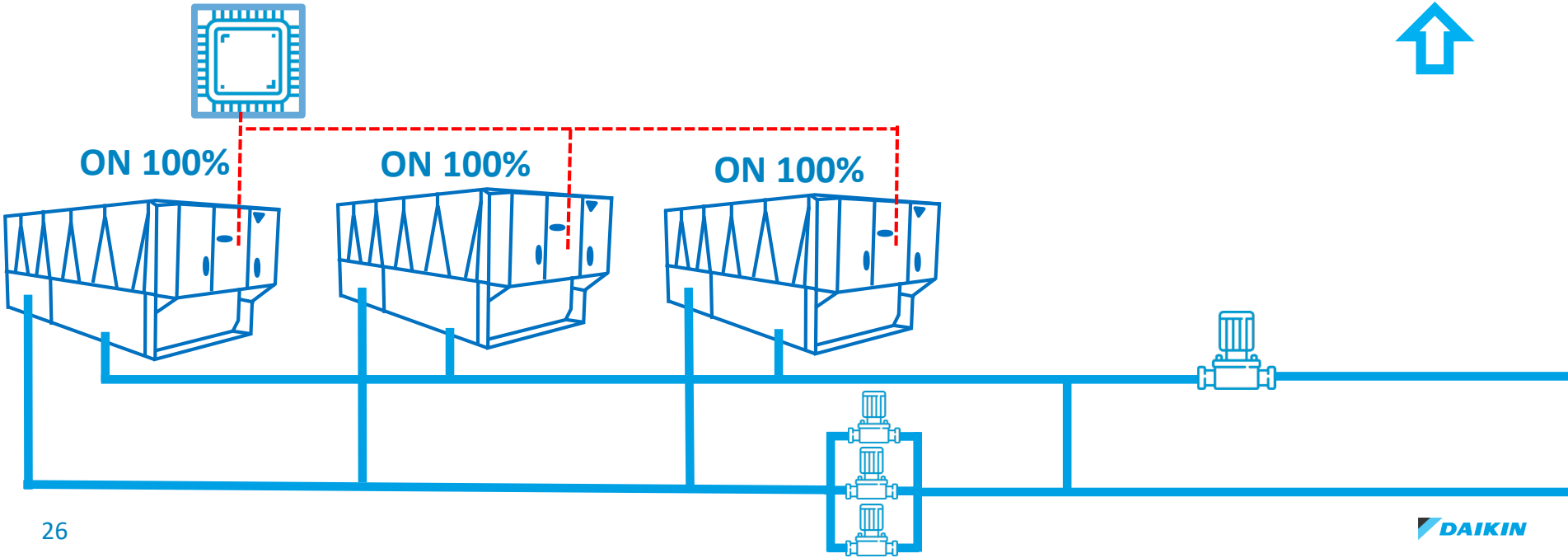
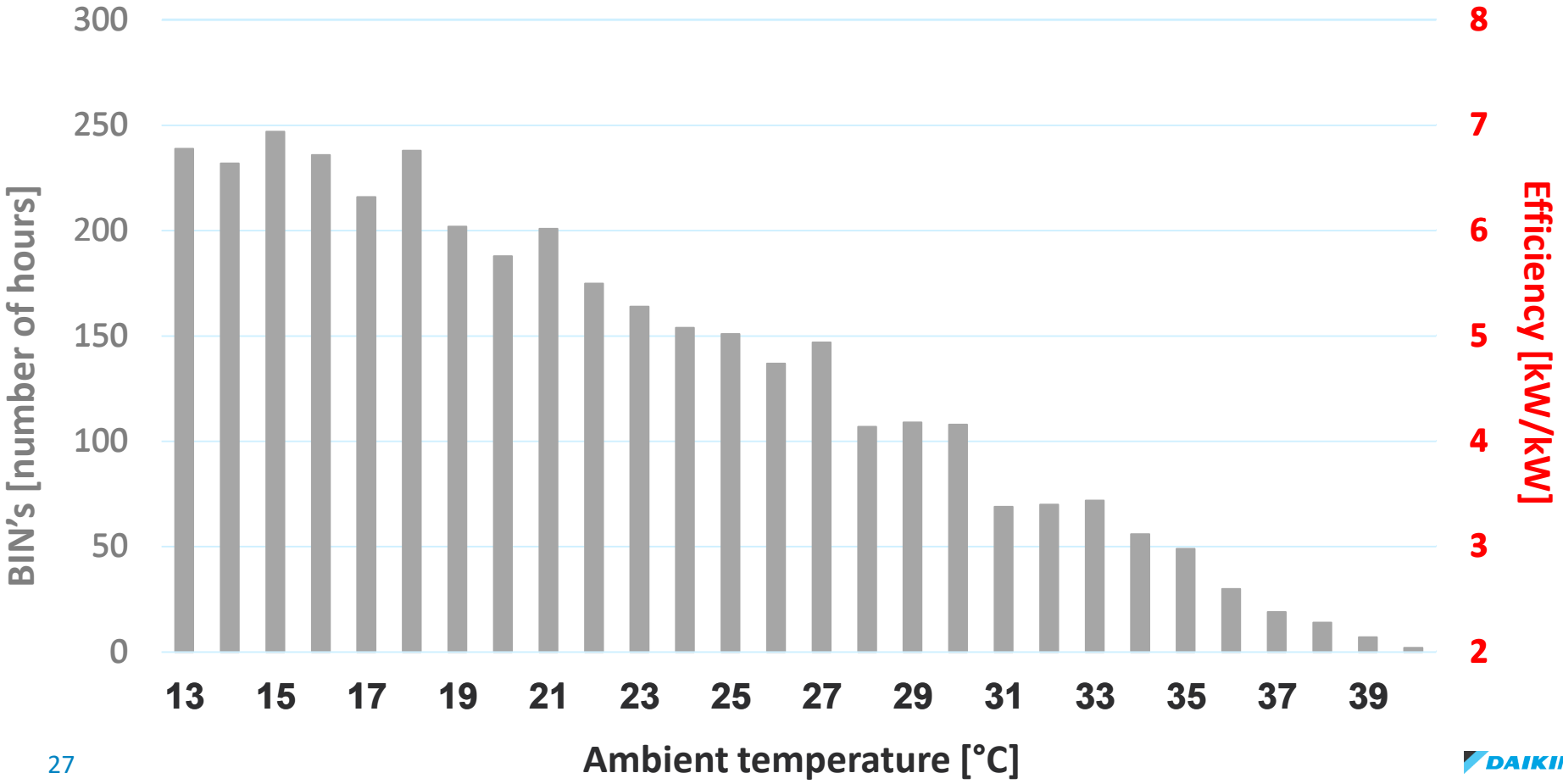




EFFICIENCY OVER THE YEAR

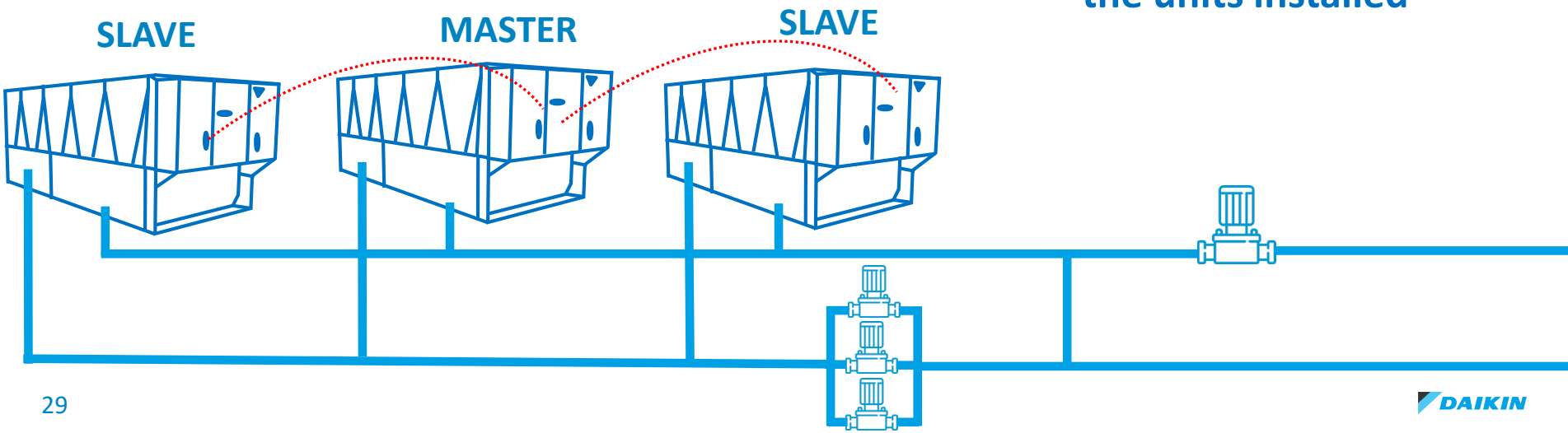


CAN WE DO SOMETHING BETTER??

CONTROL STRATEGY – DAIKIN MASTER/SLAVE (M/S)

With DAIKIN MASTER/SLAVE option there is no need of external controller or BMS. Is possible to connect 3 SLAVE to a single MASTER for a total of 4 units connected together.
M/S will not only balance the running hours of the chiller, also it will distribute the load among the chillers installed to improve the efficiency of the system.
Also the pumps are started with the related chiller

M/S can share the load among the units installed



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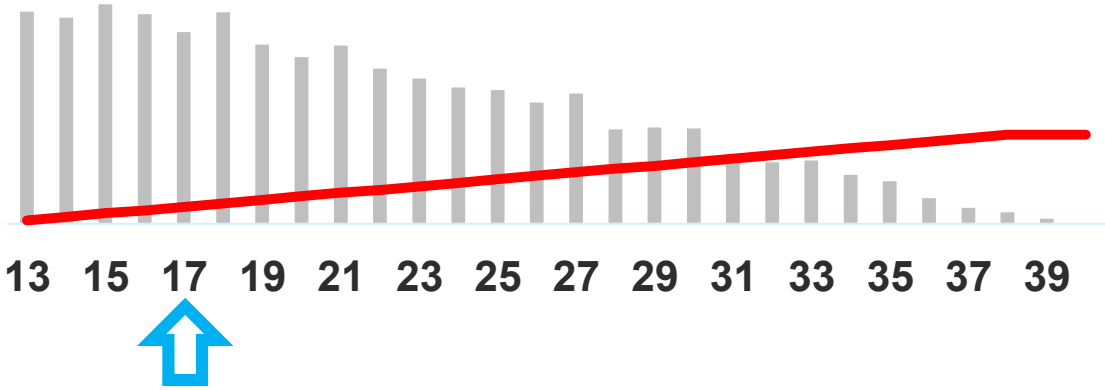

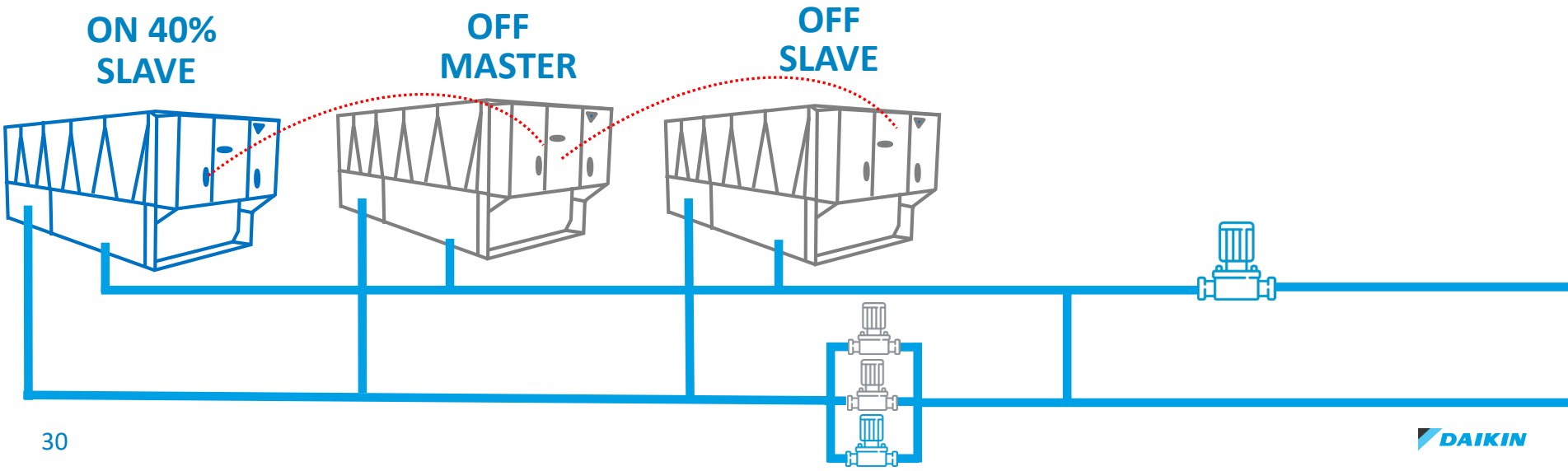

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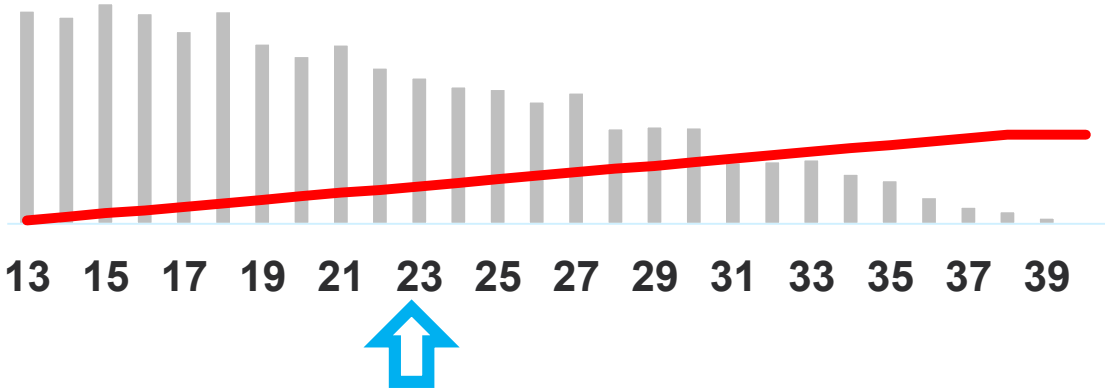

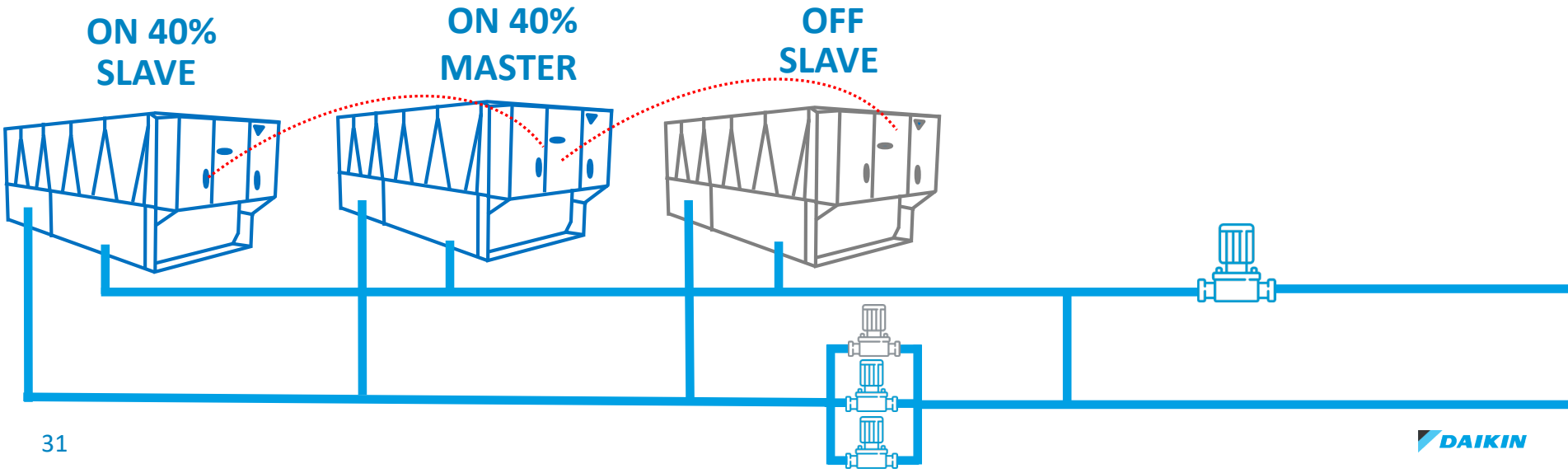

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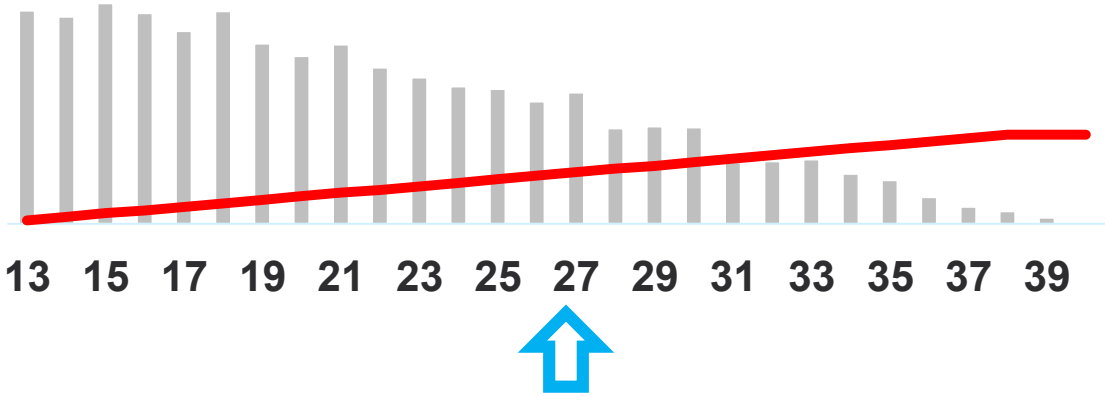

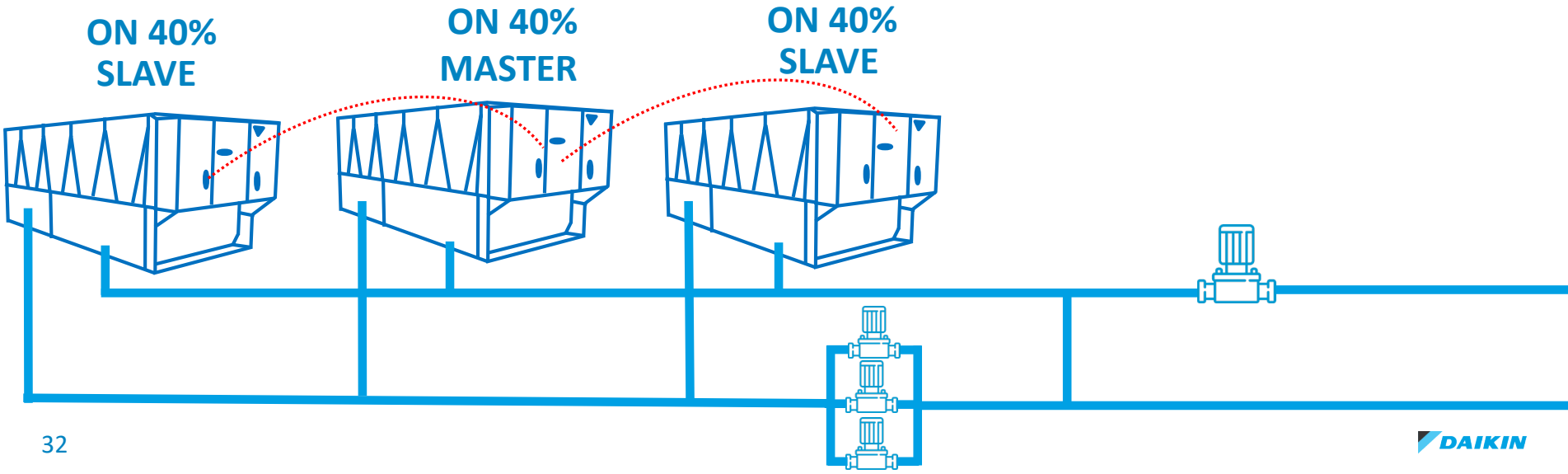

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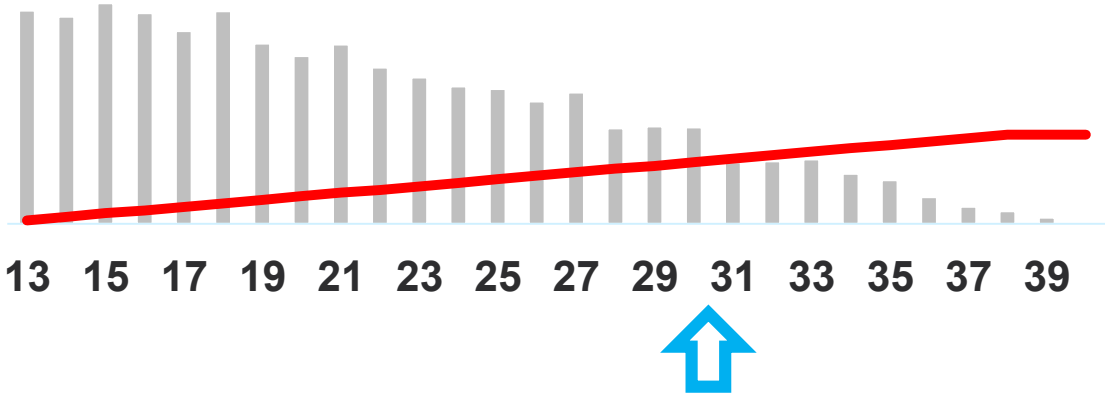

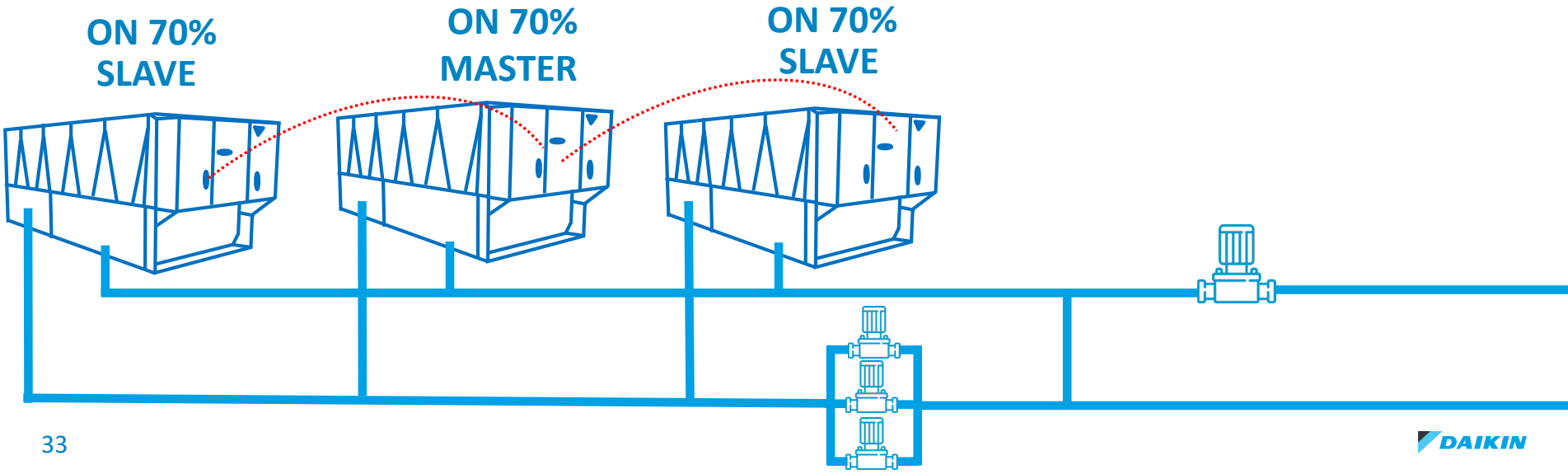

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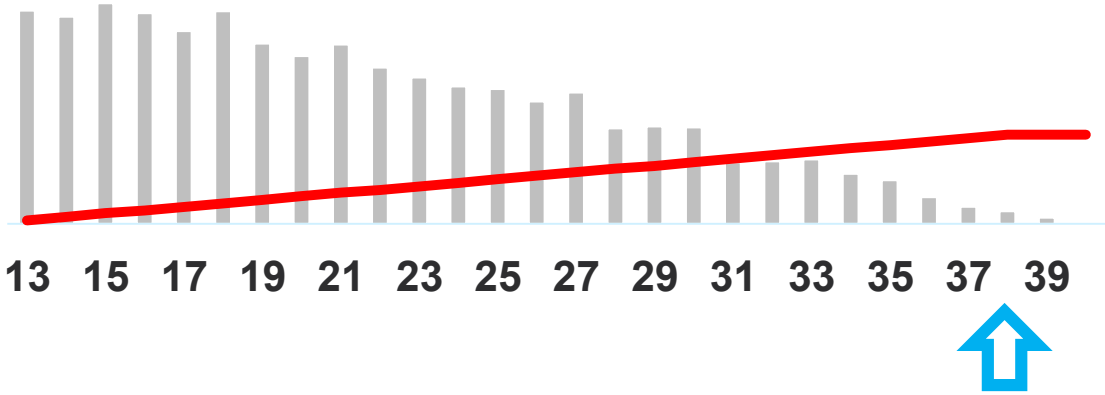
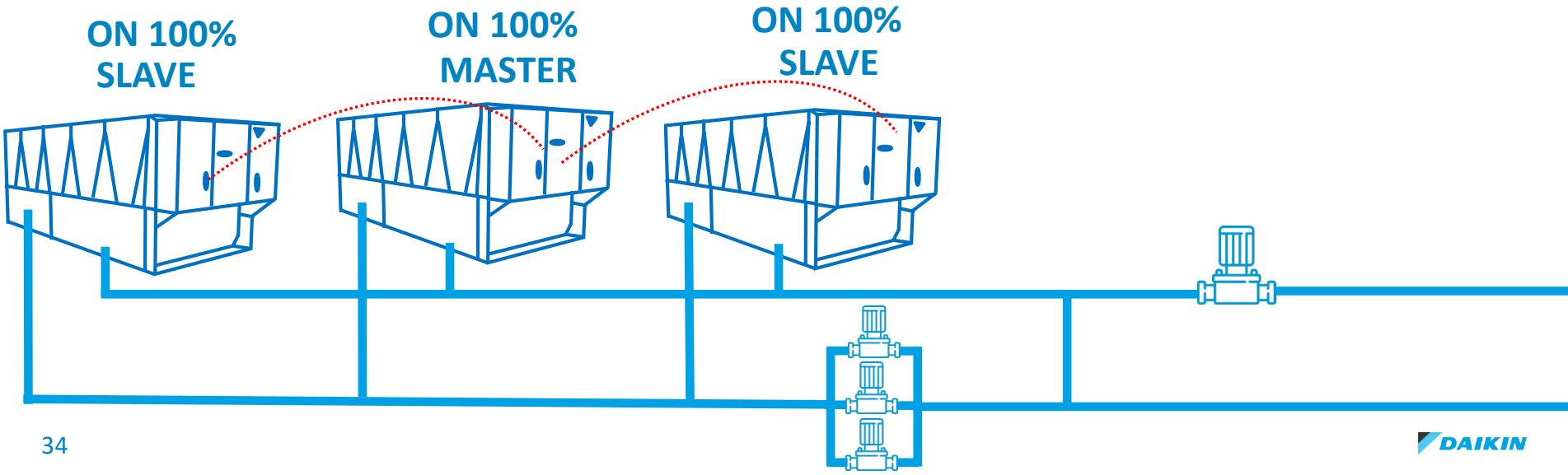
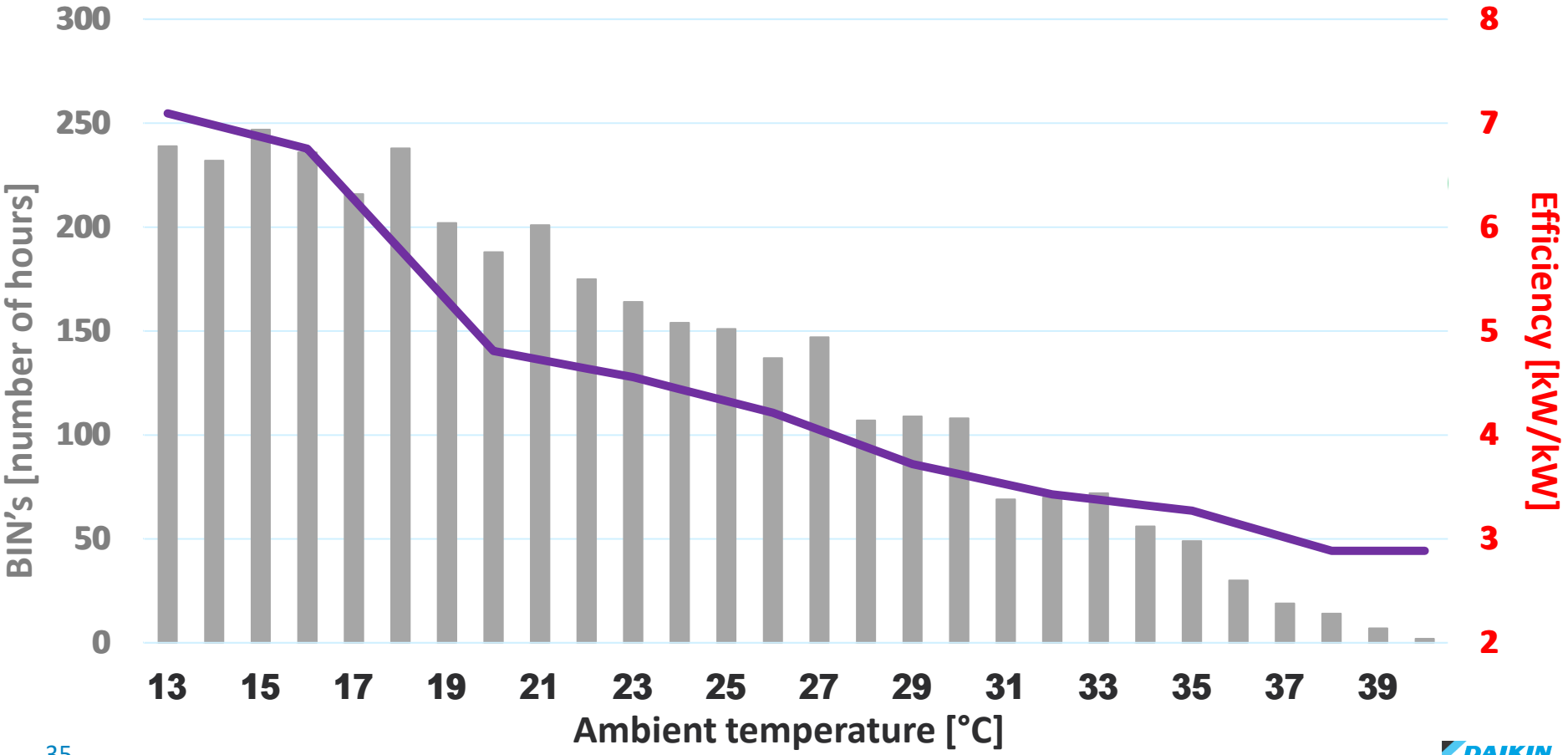


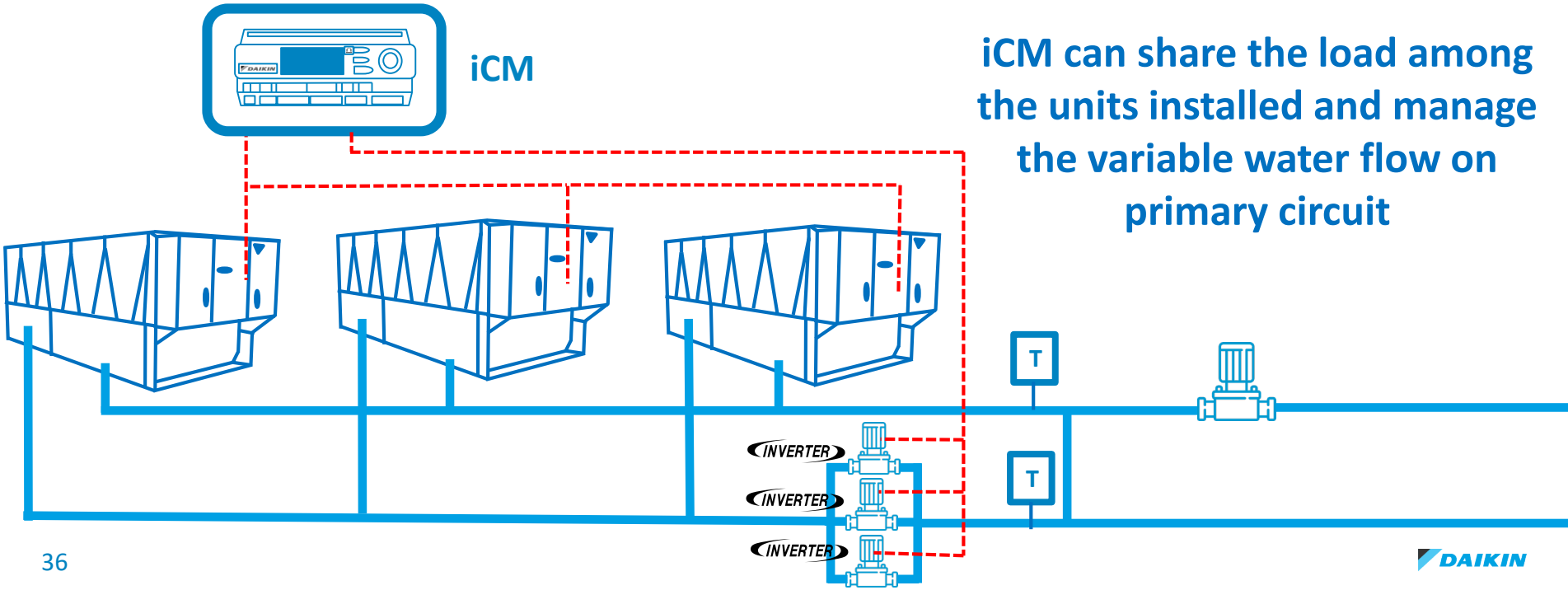


EFFICIENCY OVER THE YEAR with MASTER/SLAVE

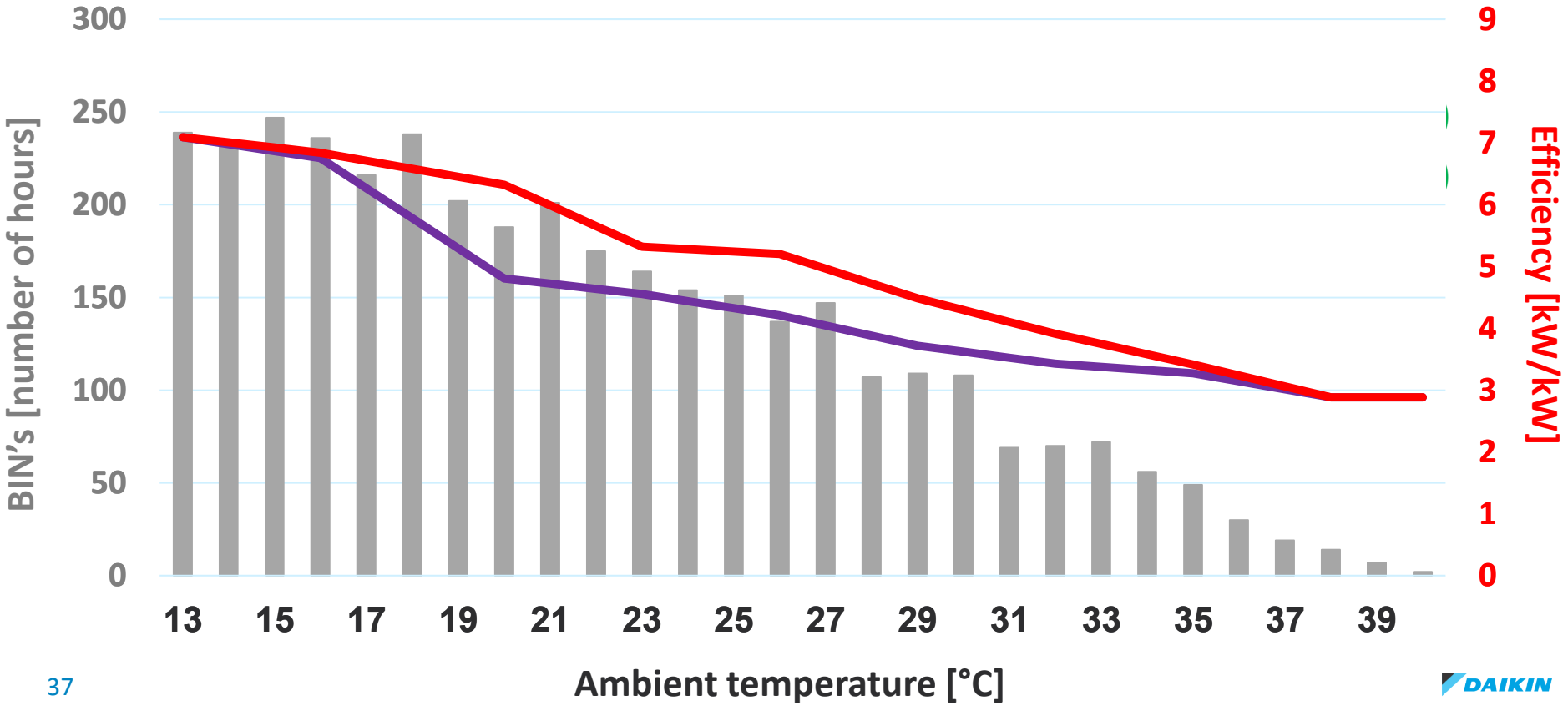


CONTROL STRATEGY – Intelligent Chiller Manager (iCM)

An additional controller fully customizable on client the specific application makes possible to further improve the efficiency of the cold production loop sequencing the chiller on best efficiency operation and modulating also the water flow on the primary circuit



EFFICIENCY OVER THE YEAR with iCM (variable flow on primary loop)



A new project:

Cooling laser machinery

+

Comfort Heating

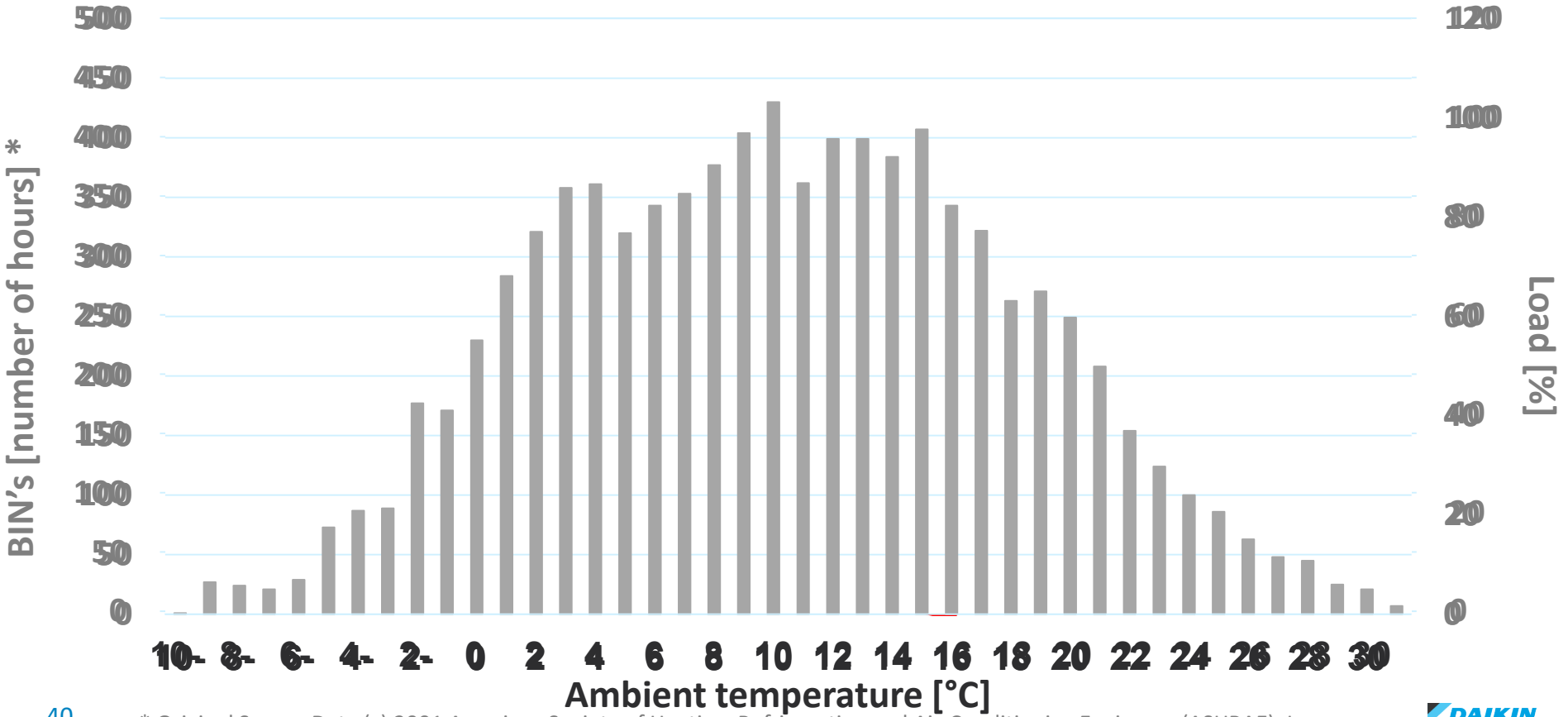
Location: Strasbourg

Design parameters:

- ✓ Design cooling capacity: 780 kW
- ✓ Design heating capacity: 860 kW
- ✓ Design ambient for cooling: 32°C
- ✓ Design ambient for heating: -10°C
- ✓ Set point cooling 10°C
- ✓ Set point heating 55°C

NEED TO EVALUATE THE LOAD PROFILE !!

Load profile evaluation



DAIKIN

DAIKIN VZ A – COOLING ONLY CHILLER - R134a/R1234ze

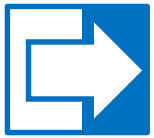
VZ CHILLER SERIES

INVERTER +VVR

Features & Benefits

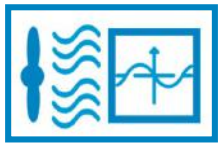
- ✓ Capacity range **from 450 – to 2100 kW***
- ✓ Single and dual circuit
- ✓ Compact design
- ✓ Condenser leaving water temperature up to 65°C
- ✓ Heat Pump version available
- ✓ Brine version available
- ✓ Total Heat Recovery
- ✓ Sound Proof Systems

…..and many other options and accessories


INDOOR INSTALLATION


SINGLE SCREW COMPRESSOR


VARIABLE VOLUME RATIO


AIR-COOLED VFD COMPRESSOR DRIVE


FLOODED SHELL & TUBE CONDENSER


FLOODED SHELL & TUBE EVAPORATORE

* conditions:
- CWT in/out = 30/35°C
- EWT in/out= 12/7°C

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DAIKIN VZ A – COOLING ONLY CHILLER - R134a/R1234ze

INVERTER +VVR

VZ CHILLER SERIES

3 EFFICIENCY LEVES

Silver — avg. EER = 5,2* / avg. SEER = 8,3**

Gold — avg. EER =5,5* / avg. SEER = 8,6**

Platinum — avg. EER =5,7* / avg. SEER = 8,9**

COMPLIANT TO ECODESIGN TIER 2 of LOT21

EUROVENT CERTIFIED PERFORMANCE www.eurovent-certification.com

INDOOR INSTALLATION

SINGLE SCREW COMPRESSOR

VARIABLE VOLUME RATIO

AIR-COOLED VFD COMPRESSOR DRIVE

FLOODED SHELL & TUBE CONDENSER

FLOODED SHELL & TUBE EVAPORATORE

* According EN14511

** According EN14825

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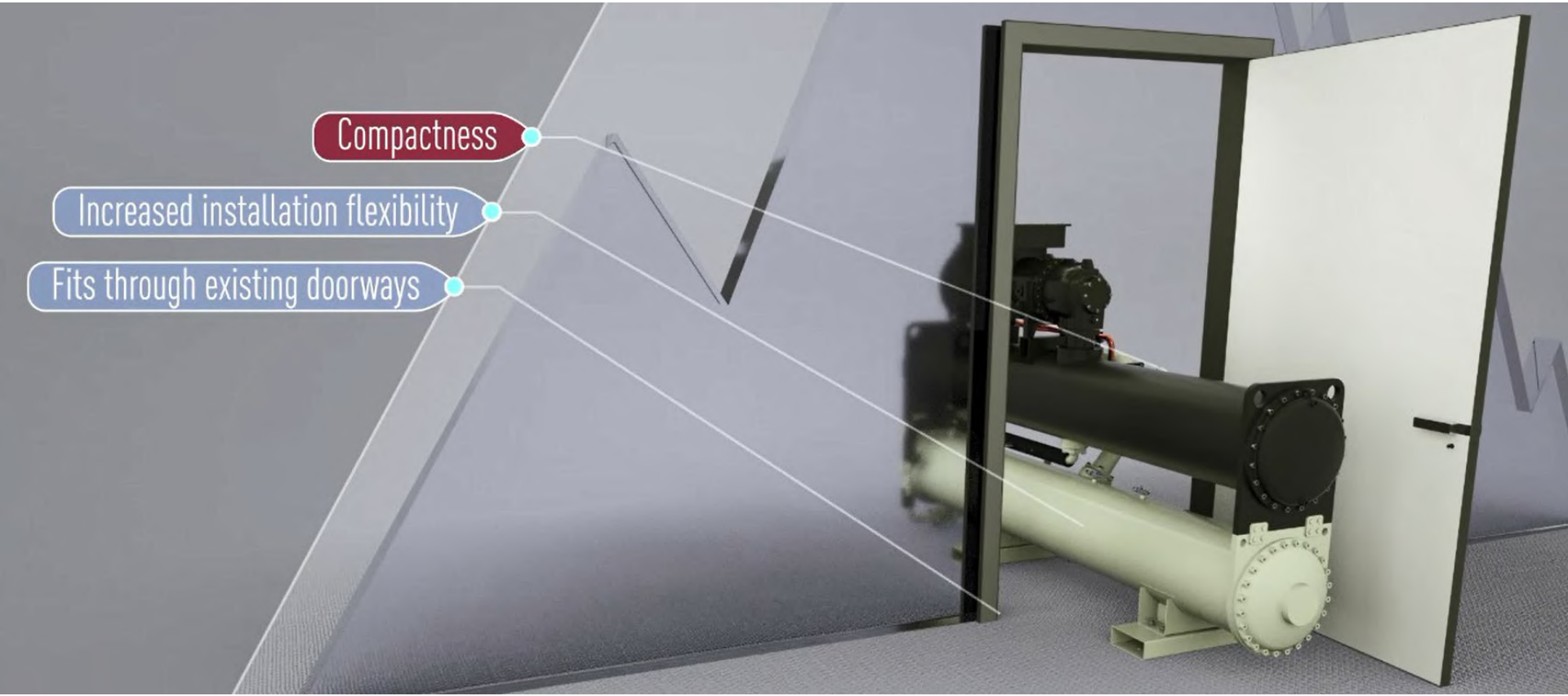
EWWD/H ~VZ – COOLING ONLY CHILLER

INVERTER +VVR

Features & Benefits



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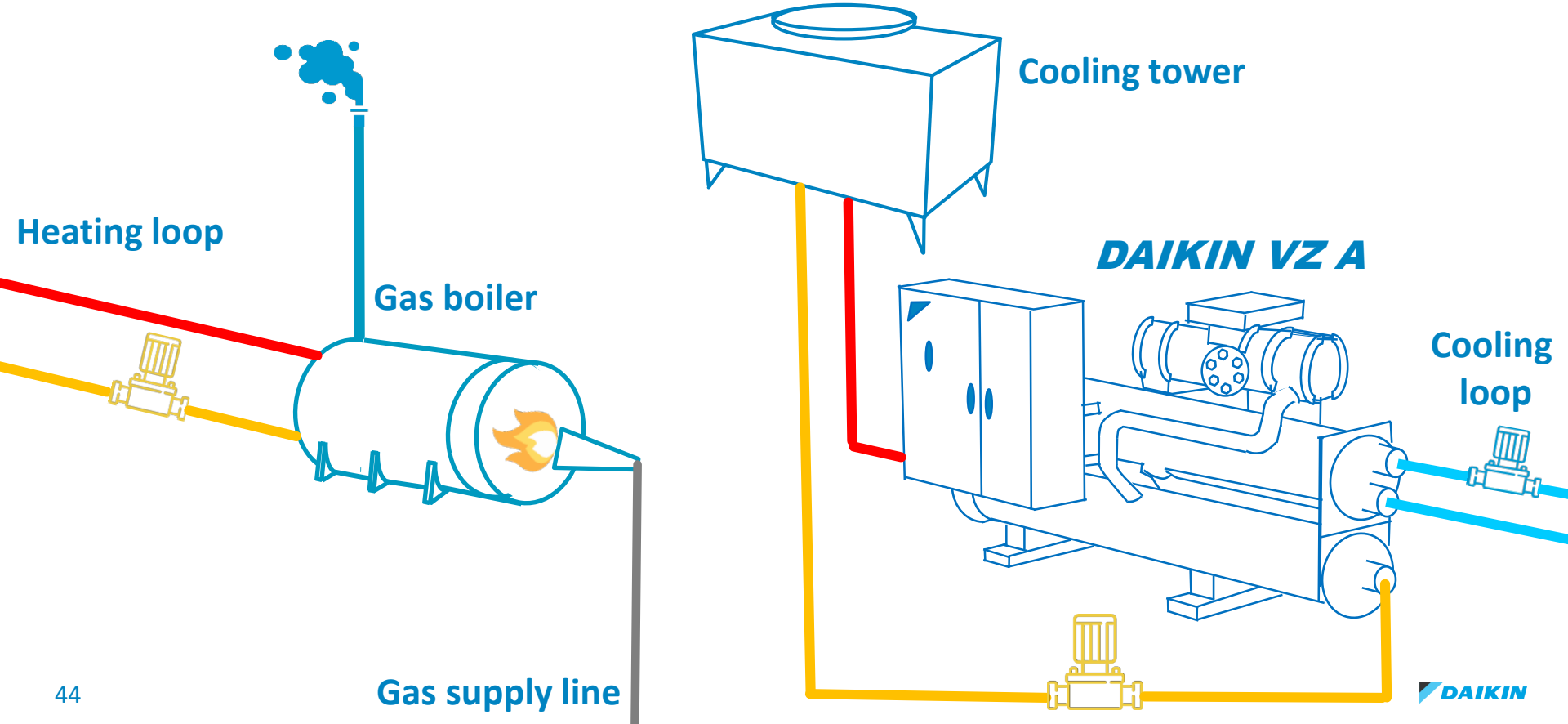
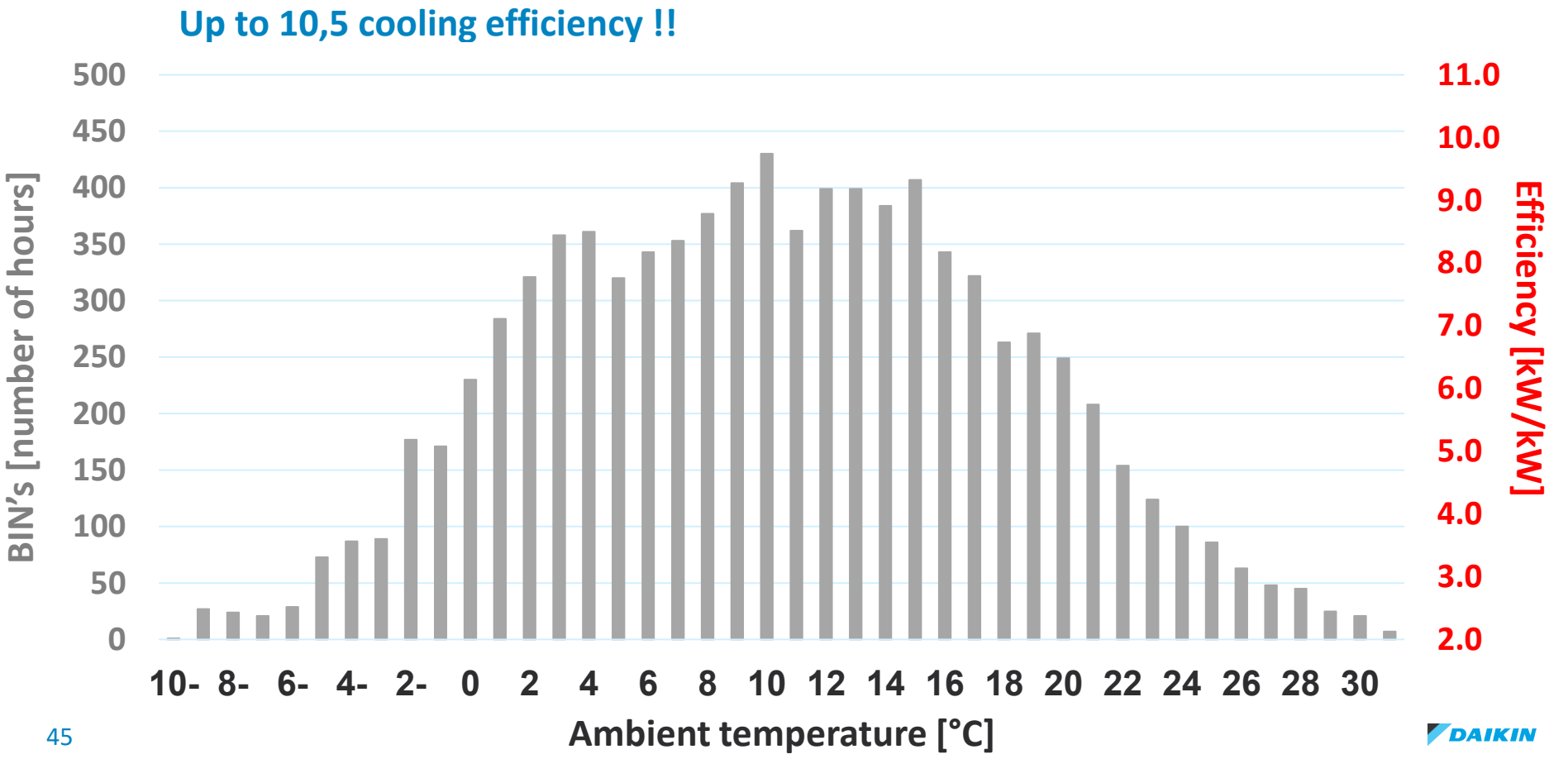
Solution: *DAIKIN VZ A* + with cooling tower for cooling load + Gas boiler for the comfort heating

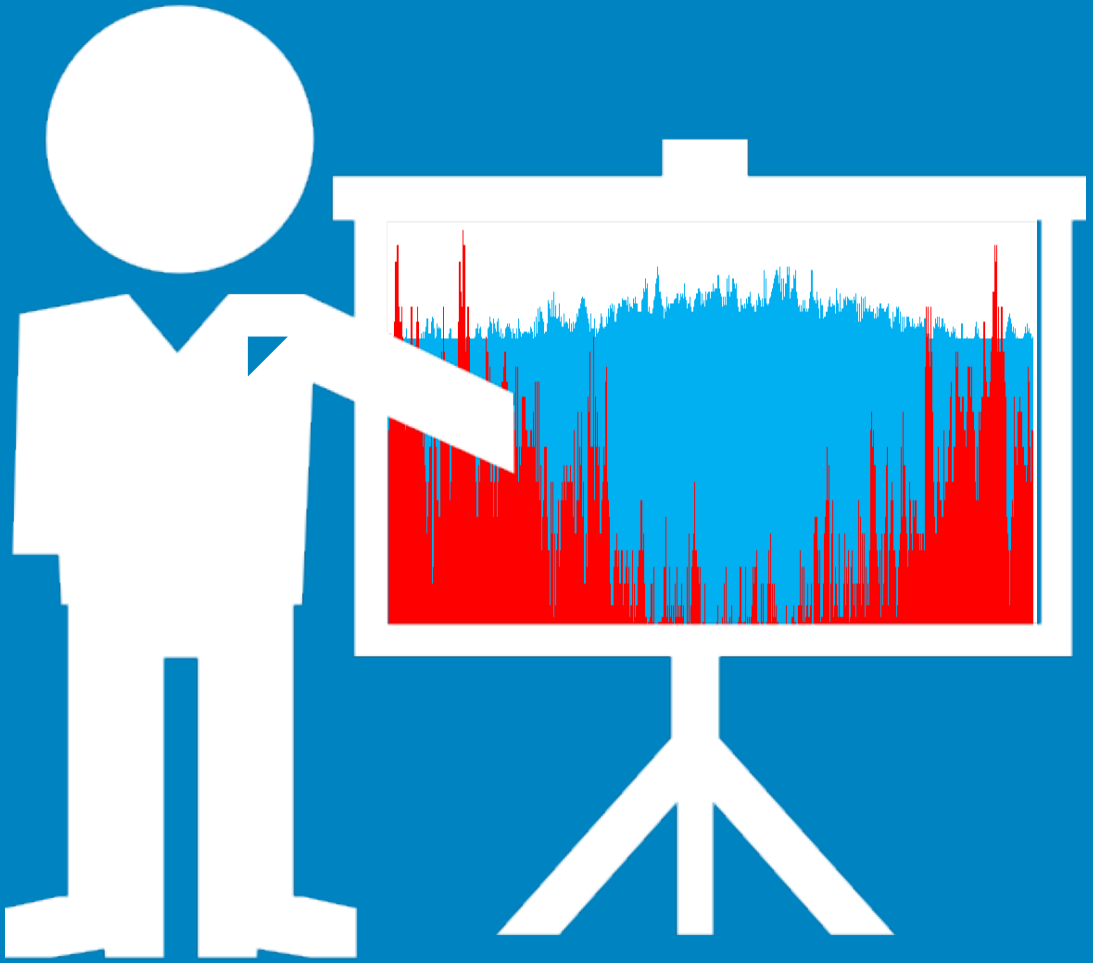


EFFICIENCY OVER THE YEAR with DAIKIN VZ A Cooling only

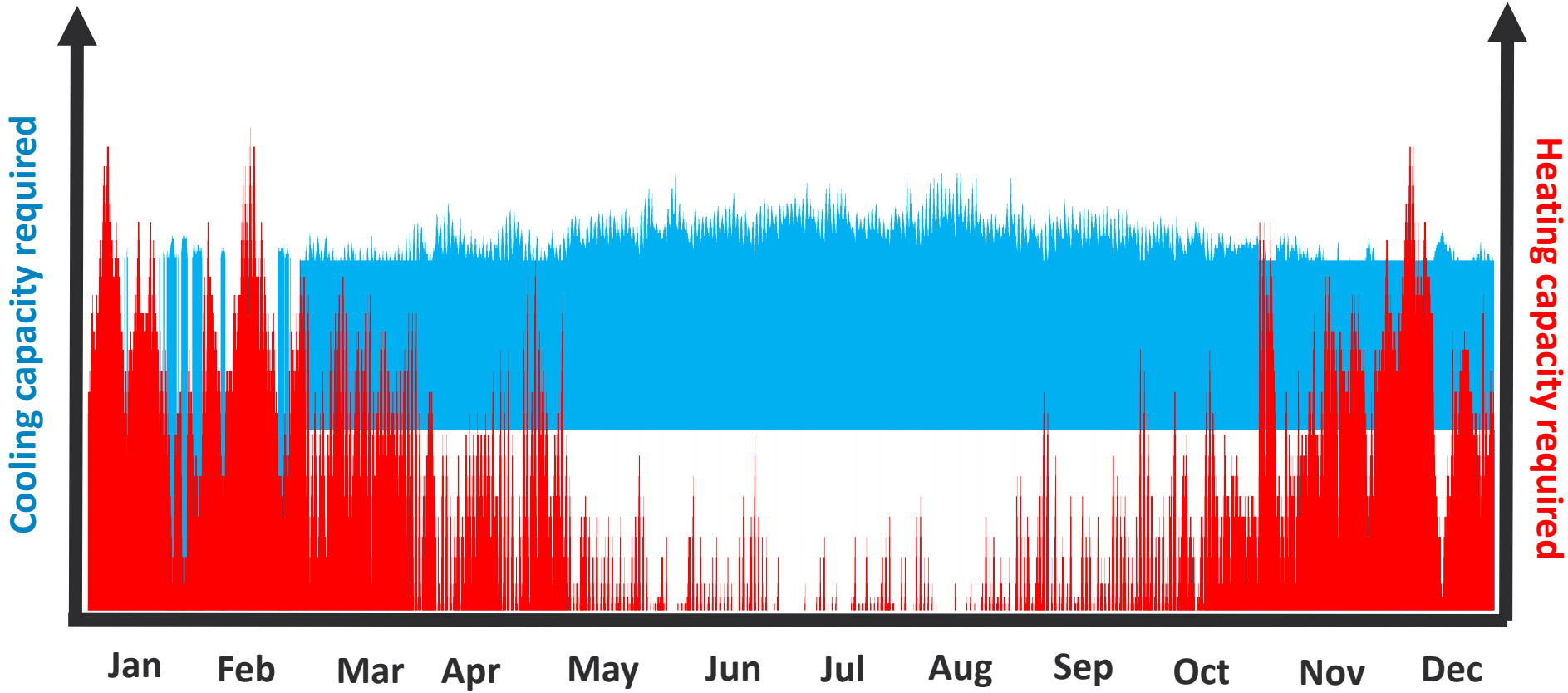


CAN WE DO SOMETHING BETTER??

Look at the load profile over the year….



There is always consistent cooling demand due to the cooling of the machinery. Thanks to this here is a lot a heat rejection that can be recovered



DAIKIN VZ A – COOLING ONLY CHILLER - R134a/R1234ze

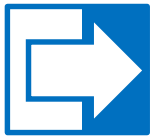
VZ CHILLER SERIES

INVERTER +VVR

Features & Benefits

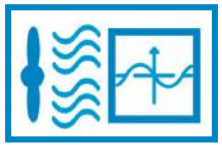
- ✓ Capacity range **from 450 – to 2100 kW***
- ✓ Single and dual circuit
- ✓ Compact design
- ✓ Condenser leaving water temperature up to 65°C
- ✓ Heat Pump version available
- ✓ Brine version available
- ✓ **Total Heat Recovery**
- ✓ Sound Proof Systems

…..and many other options and accessories


INDOOR INSTALLATION


SINGLE SCREW COMPRESSOR


VARIABLE VOLUME RATIO


AIR-COOLED VFD COMPRESSOR DRIVE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* conditions:
- CWT in/out = 30/35°C
- EWT in/out= 12/7°C

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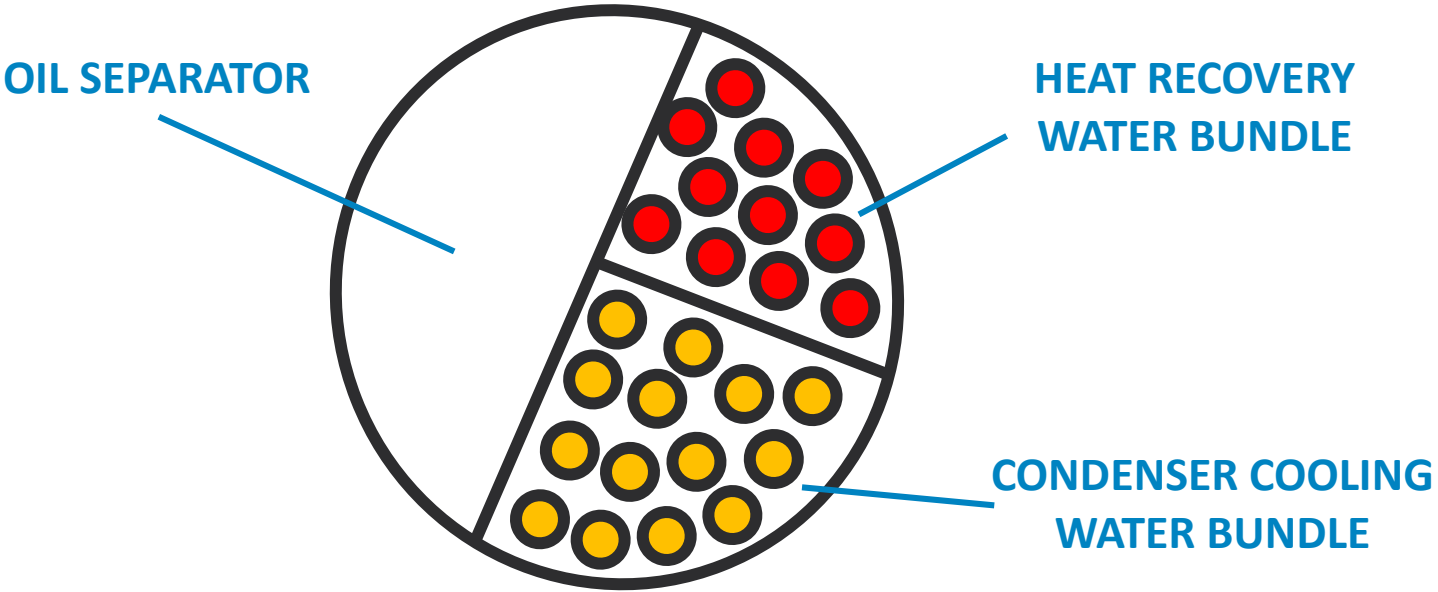
Total Heat Recovery

The condenser is provided with a two tube bundles, one for the condenser cooling water, one for the hear recovery circuit

UNIQUE SOLUTION



For the project 1 EWAD570TZXSB2 with THR is selected with following characteristics

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Technical Data Sheet

EWWD710VZXSA1+OP01

Cooling mode performances

Cooling capacity782.4 kW	IPLV.IP8.880 kW / kW
Power input165 kW	SEER / ηs8.96 / 350.4%
EER Cooling Efficiency4.700 kW / kW	
ESEER9.070 kW / kW	Lw / Lp @ 1m105 dB(A) / 86 dB(A)
Evaporator water IN/OUT15.00 °C / 10.00 °C	Condenser Water IN/OUT27.00 °C / 32.00 °C
Evaporator water flow36.90 l/s	Condenser Water flow44.61 l/s
Evaporator pressure drops73.0 kPa	Condenser pressure drop81.0 kPa
Evaporator fluidWater	Condenser fluidWater
Evaporator fouling factor0 m2°C/W	Condenser Fouling factor0.000 m2°C/W

SEER declared according to EN1825, fan coil application 12/7°C (inlet/outlet) water temperatures. Sound power level according to ISO 9614-1.

Heat recovery mode performances (total heat recovery)

Cooling capacity591.6 kW	Evaporator water IN/OUT15.00 °C / 10.00 °C
Heat recovery capacity863.0 kW	Evaporator water flow28.20 l/s
Power input234.0 kW	Evaporator pressure drops43.0 kPa
TEER (C.C. + H.C.) / P.I.6.300	HR water IN/OUT50.00 °C / 55.00 °C
	HR water flow39.30 l/s
	HR pressure drops65.0 kPa

Unit information

Compressor typeSingle Screw	Refrigerant charge110 kg
Capacity controlStepless	Refrigerant typeR134a
Compressor N°1	Condenser typeShell & Tubes
Circuit N°1	Evaporator typeFlooded S&T

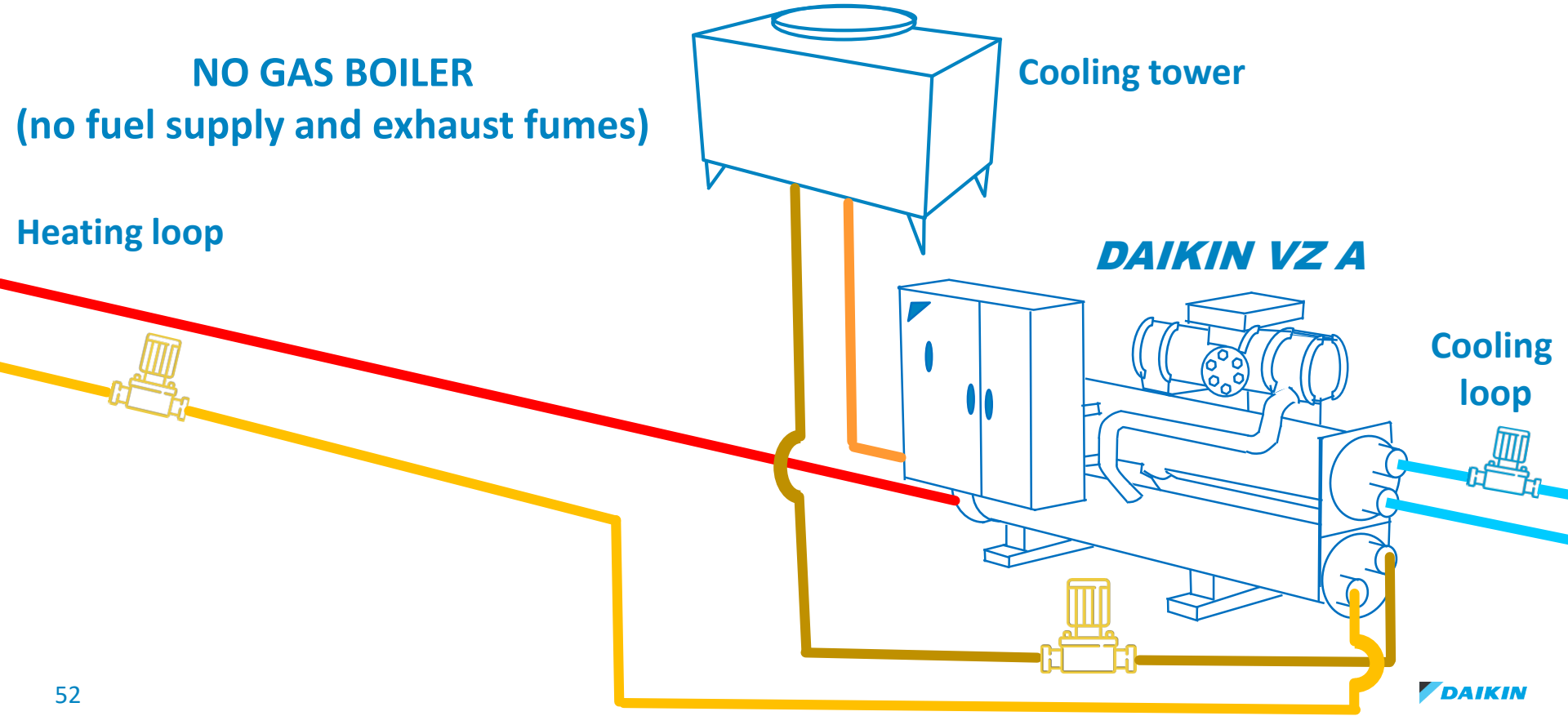
Actual refrigerant charge depends on the final unit construction, refer to unit nameplate.

Electrical information

Power supply400 V / 50.0 Hz / 3 Ph	Max. inrush current0 A
Running current224 A	Compressor starting methodVariable Frequency Drive
Max. Running current368 A	
Max. current wires sizing404 A	

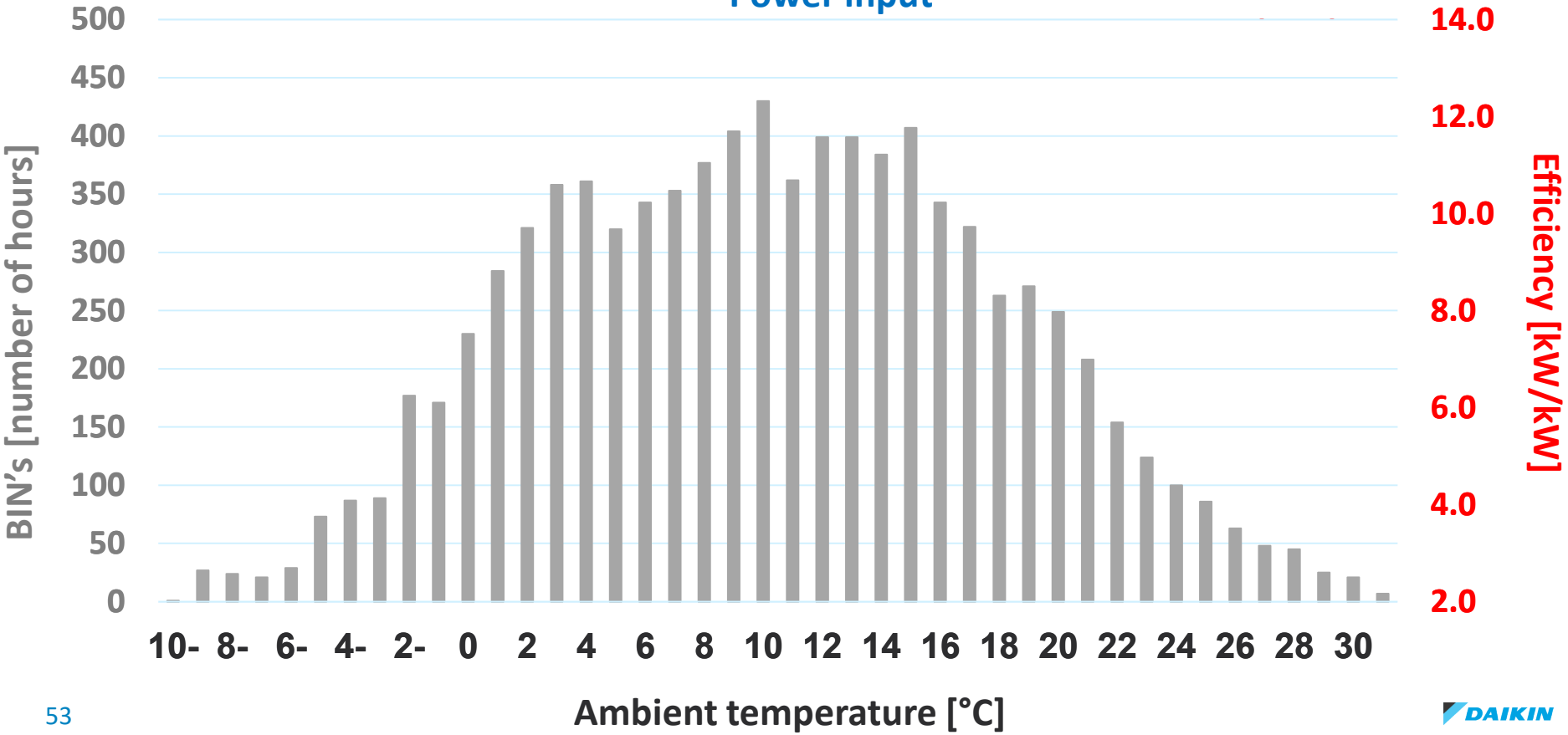
Solution: *DAIKIN VZ A with THR* + with cooling tower

NO GAS BOILER
(no fuel supply and exhaust fumes)



EFFICIENCY OVER THE YEAR with DAIKIN VZ A + THR

$$\text{Total Efficiency Ratio (TER)} = \frac{\text{Cooling capacity + Heating capacity}}{\text{Power input}}$$



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*The ways to **SYSTEMS EFFICIENCY***

HIGH EFFICIENCY CHILLERS

SMART SYSTEMS MANAGEMET

ENERGY RECOVERY

DAIKIN

THANK YOU