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OPTIMIZING HVAC SOLUTIONS FOR LOW ENERGY BUILDINGS

近零能耗建筑中的暖通空调系统优化解决方案

John Woollett

OPTIMIZING HVAC SOLUTIONS FOR LOW ENERGY BUILDINGS
近零能耗建筑中的暖通空调系统优化解决方案

Important for Europe and critical for China

对欧洲及中国至关重要

(Average 5 years less life expectancy /person in China).

（中国人均使用寿命低于5年）

The HVAC community; Our part in the solution.

暖通空调领域： 我们的解决方案

1.Filtration.

过滤

2. Low Temperature Heating and Hight Temperature Cooling (LTHHTC).

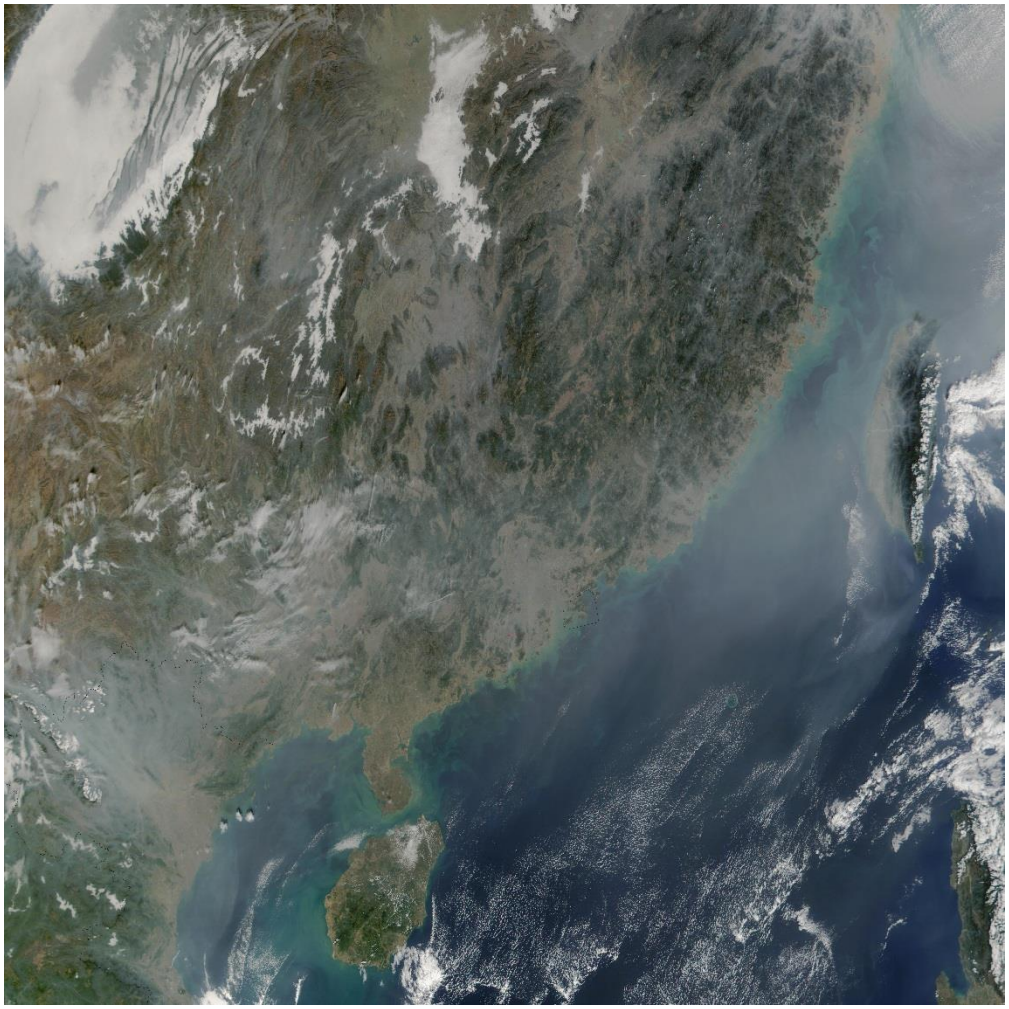
低温加热，高温冷却

3. Demand Controlled Ventilation (DCV).

需求控制通风

THE BIGGER PICTURE

从太空拍摄地球

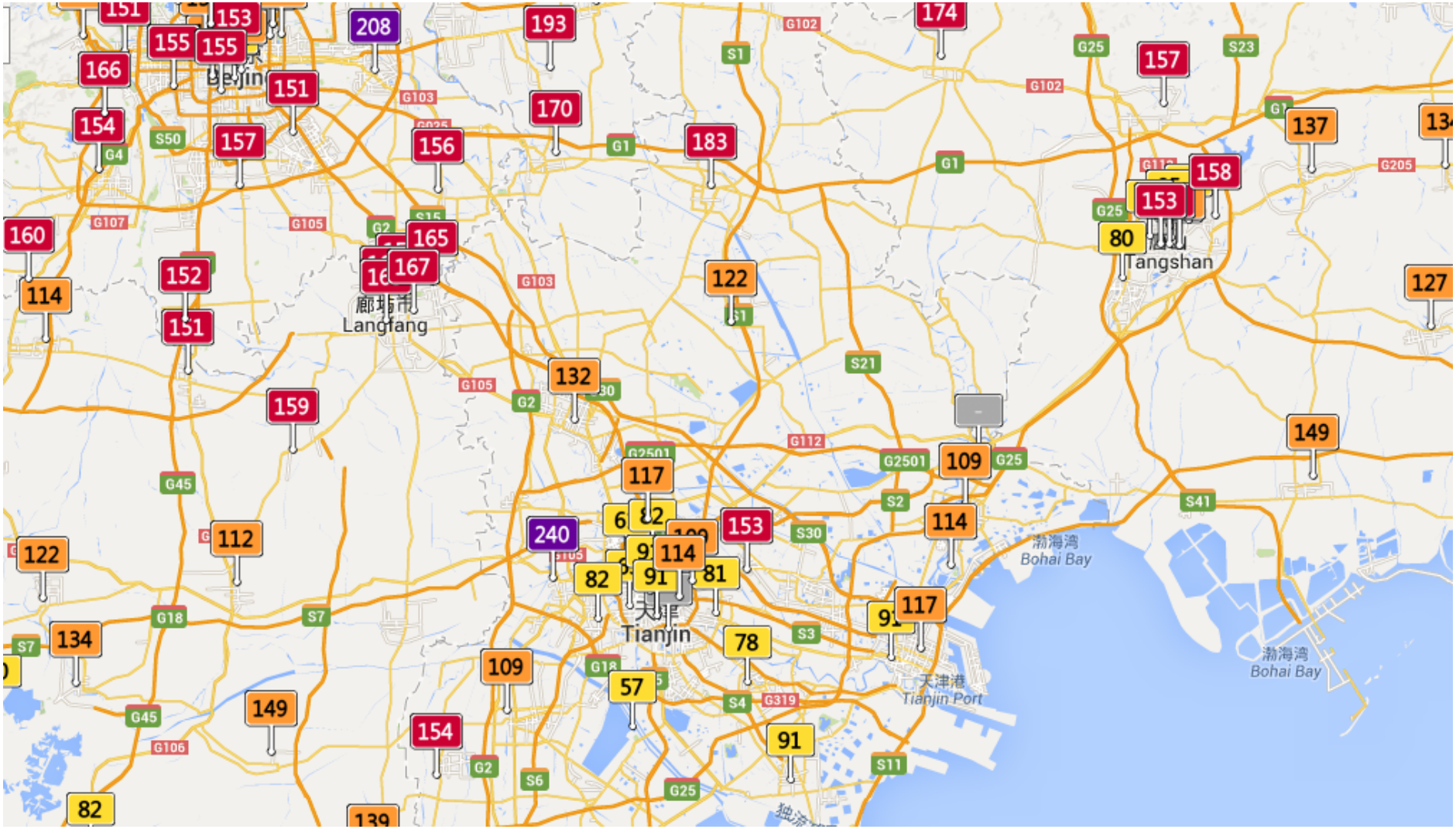


HOW WE FEEL
我们的人体感受

THE REGIONAL PICTURE
地区监测

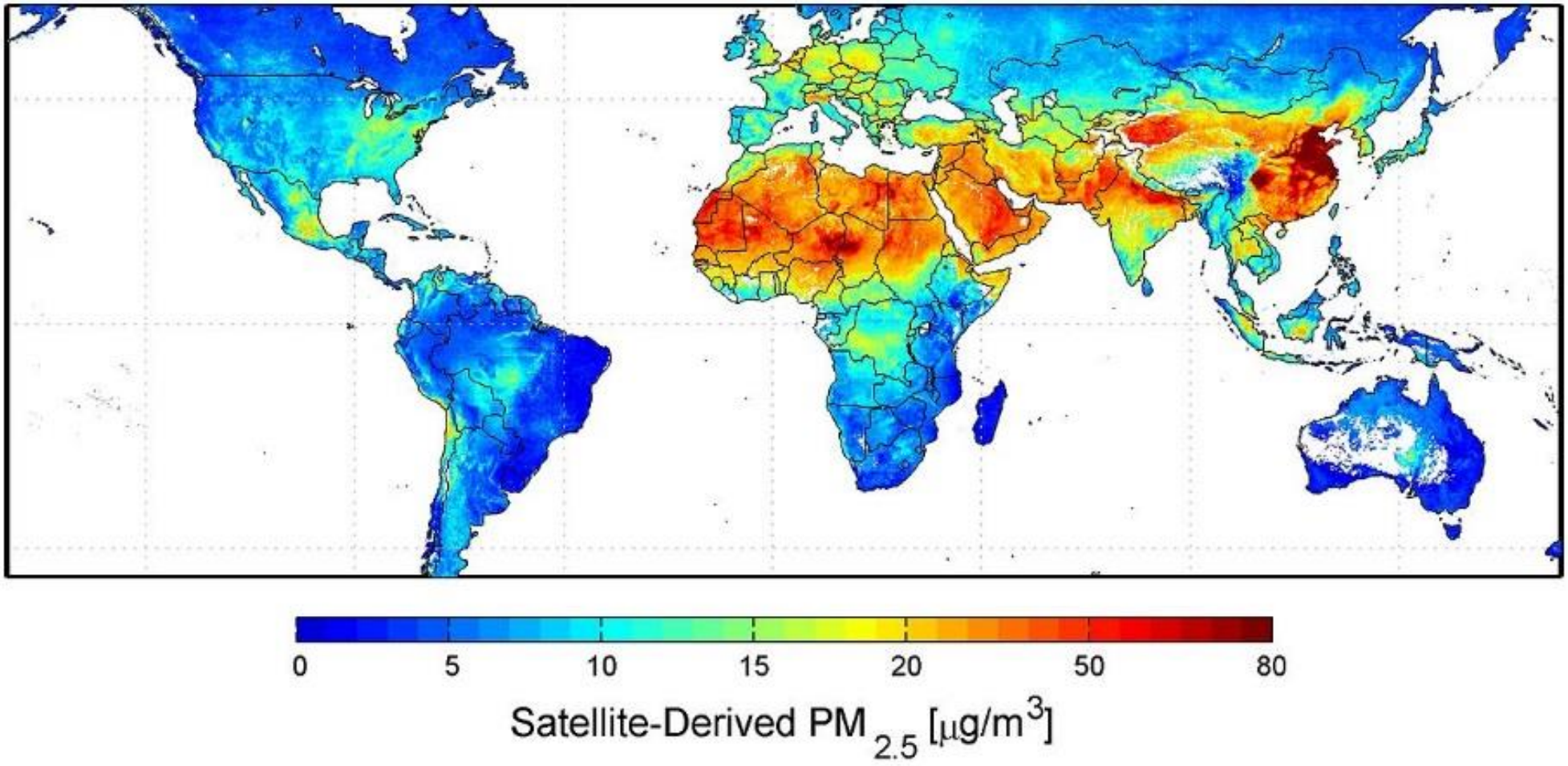
VISIBILITY

能见度



GLOBAL INTENSITY OF PM 2,5

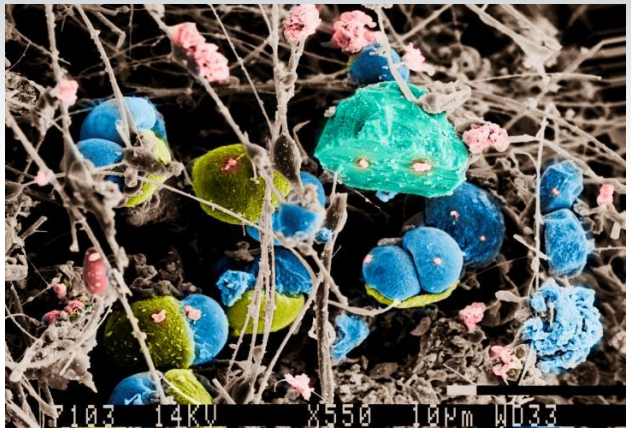
全球PM2.5 强度分布

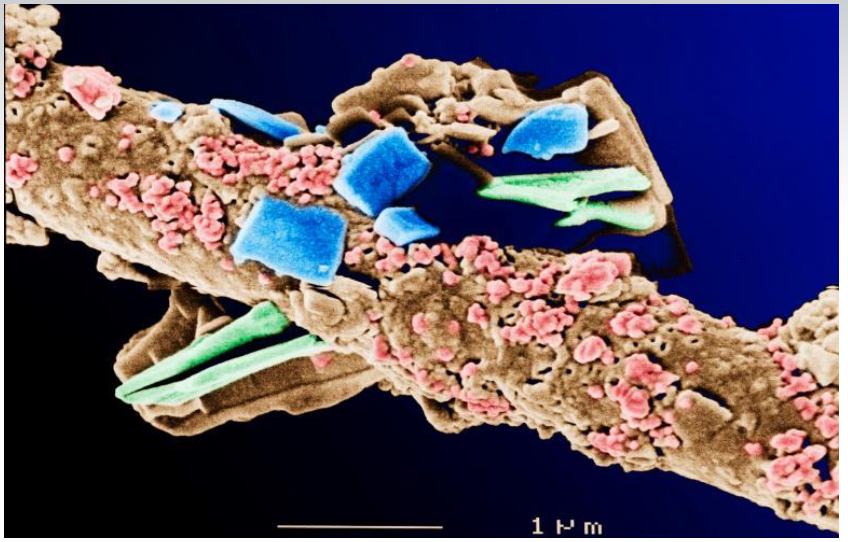


OUR NEEDS
我们的需求

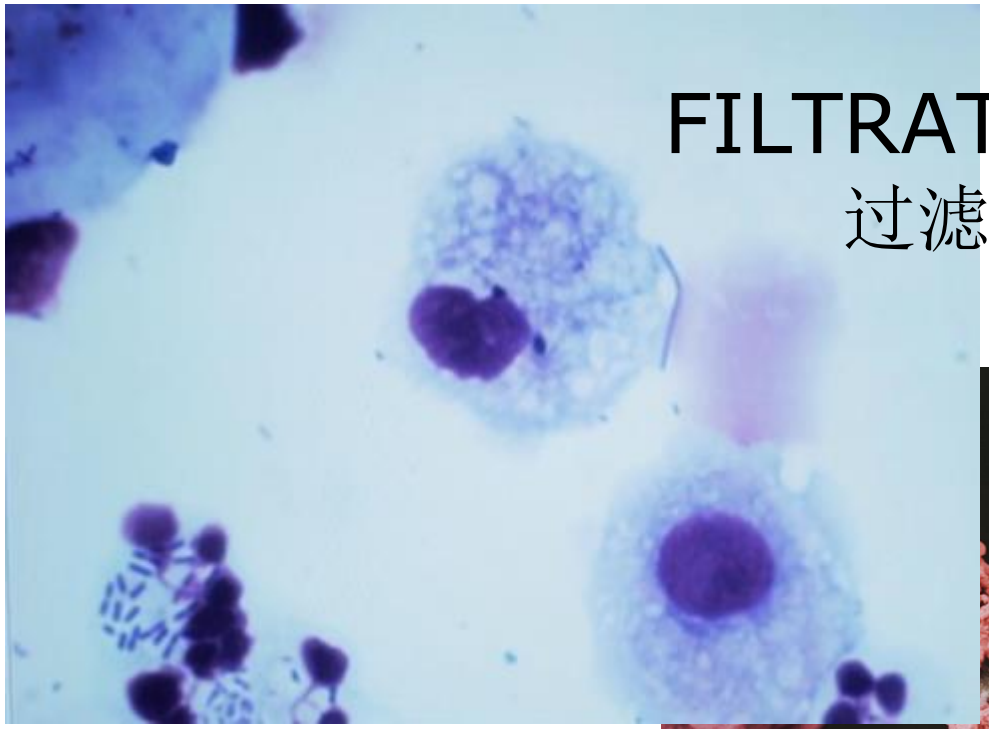
Daily：
每日所需：

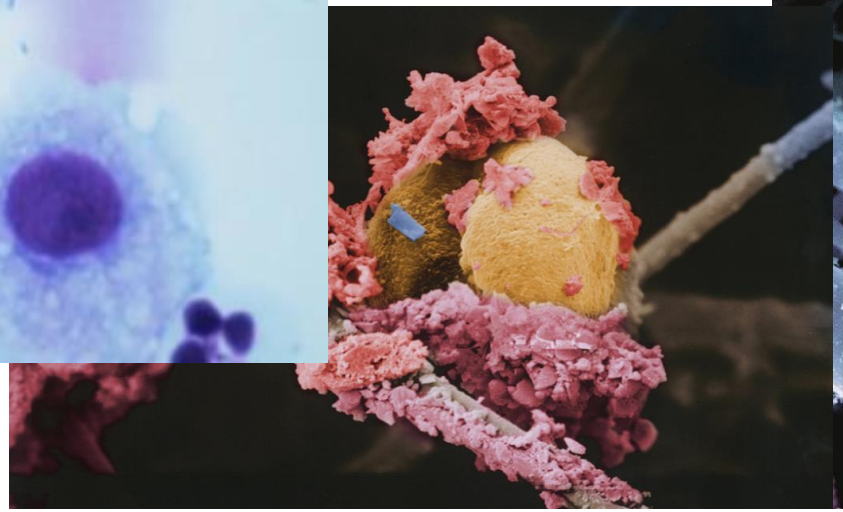
- 1kg food.
- 1kg 食物
- 2 kg water.
- 2kg 水
- 25 kg air.
- 25kg 空气

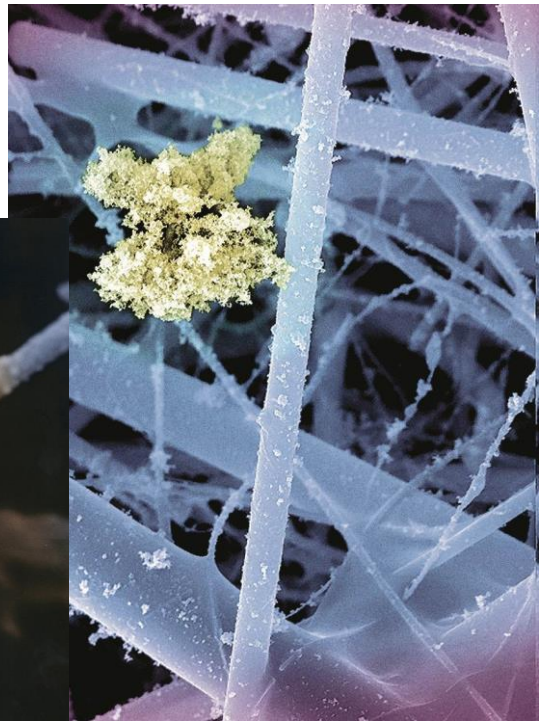




FILTRATION
过滤







TYPICAL HVAC ENERGY USE: PRESSURE DROP
典型空调系统耗能：压降

Based on balanced ventilation, with filter in inlet- and the outlet air, the Pressure Drop is distributed as (Pa):

Ducts (inlet- plus outlet air)	500	40%
Filters (inlet- plus outlet air)*	350	28%
Heat exchanger (inlet- plus outlet air)	240	19%
Cooling coils	60	5%
Heater	50	4%
Sound reduction (inlet- plus outlet air)	40	3%
Joint duct	10	1%
	1250 Pa	

Once in operation; the filter is the only thing in an HVAC system you can change at a reasonable cost.

一旦系统投入运行：暖通空调系统中唯一可以以合理价格进行更替的零部件便是过滤器

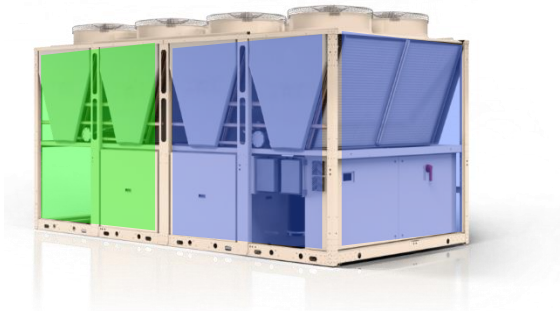
SYSTEM DESIGN
系统设计

VARIABLE TEMPERATURE SYSTEMS
变温系统

Why produce 100% cooling or heating, when it is not needed?
不需满负荷运行时，如何能够更加节能？

WATER BASED SYSTEMS
水冷系统

- Chillers
  冷水机组
- heat-pumps
  热泵
- free-cooling
  自由冷却



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TYPES OF APPLICATION
应用形式

AIR
通风

COMFORT
舒适性空调

HPAC

Focus: Energy Efficiency
关注聚焦：能效

WAYS TO EFFICIENCY
提高能效的途径

Method:
方法：

Understanding System
深入了解系统
Design
设计
Control
控制

Objective:
目标：

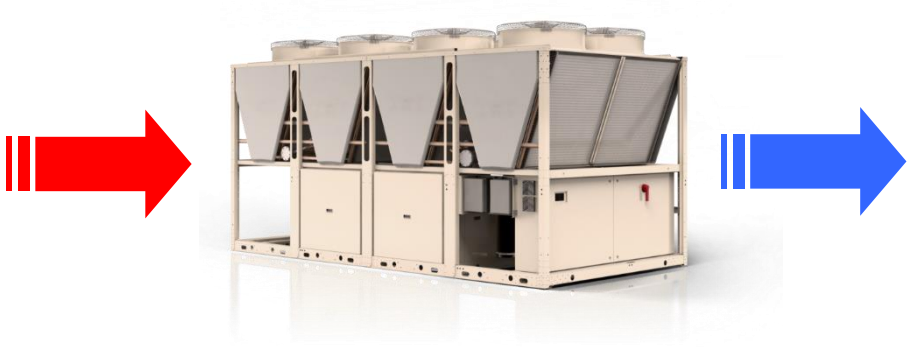
Energy Efficiency
Safe & Stable Systems
Payback (R.O.I)
安全、稳定、高效能系统的投资回收期

Focus: Energy Efficiency
关注聚焦：能效

WAYS TO EFFICIENCY
提高能效的途径

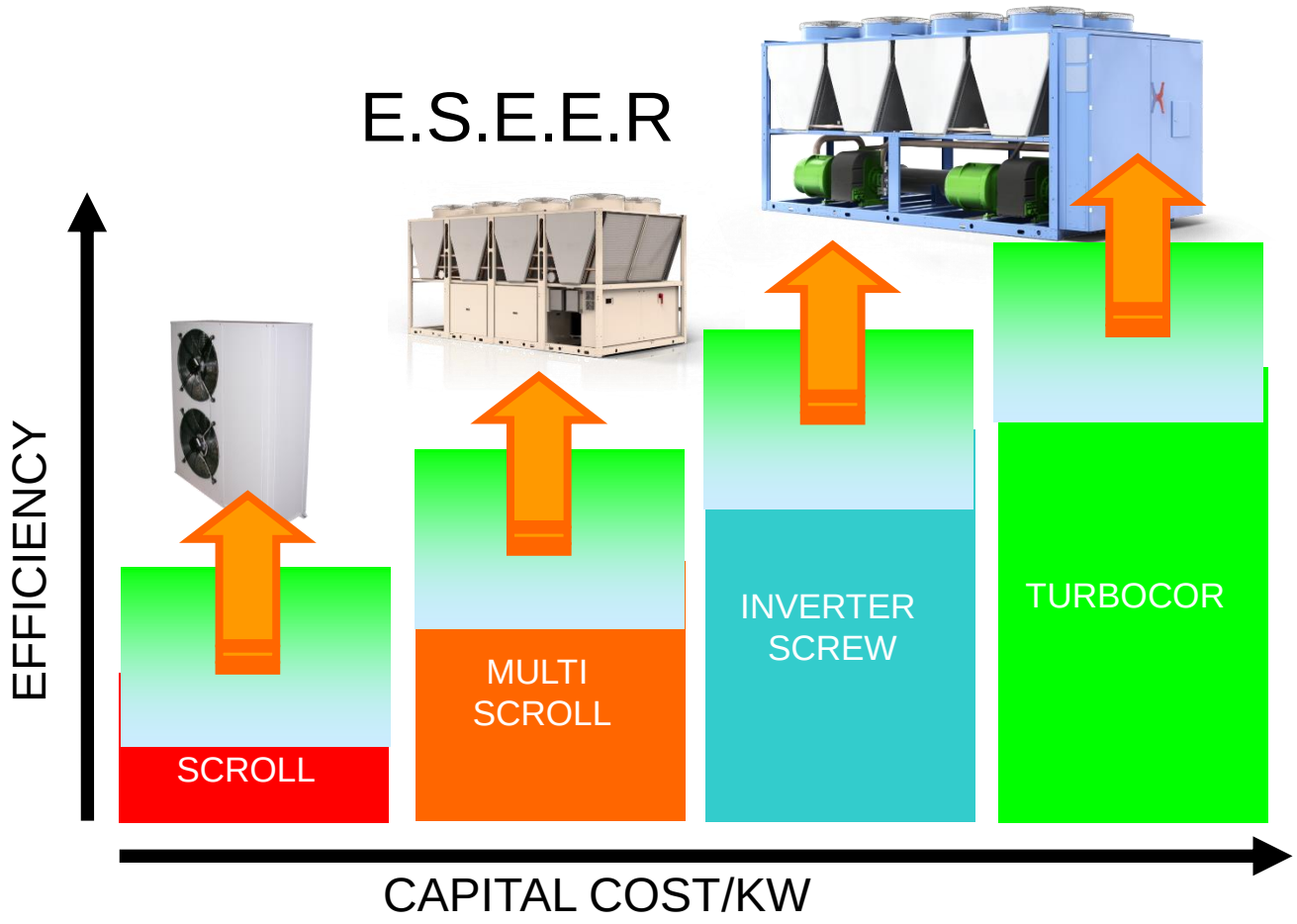
E.E.R energy efficiency ratio
E.E.R 能源效率比

POWER OUT / POWER IN



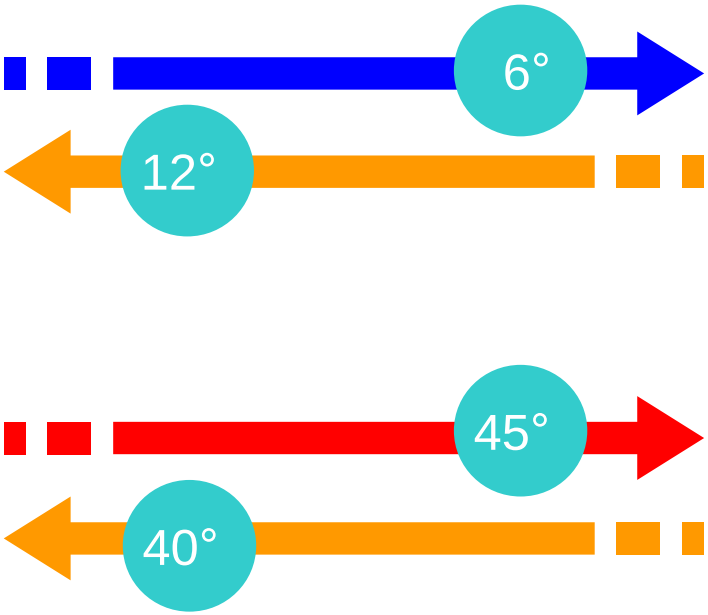
Focus: Energy Efficiency
关注聚焦：能效

WAYS TO EFFICIENCY
提高能效的途径



FIXED TEMPERATURE SYSTEMS
WATER BASED
水冷定温系统

SOURCE
源



USER
用户

FIXED TEMPERATURE SYSTEMS

WATER BASED

水冷定温系统

SOURCE
源

USER
用户

VALVE

100%

6°

12°

CHILLER

ON

OFF

100%

HEAT LOAD

0

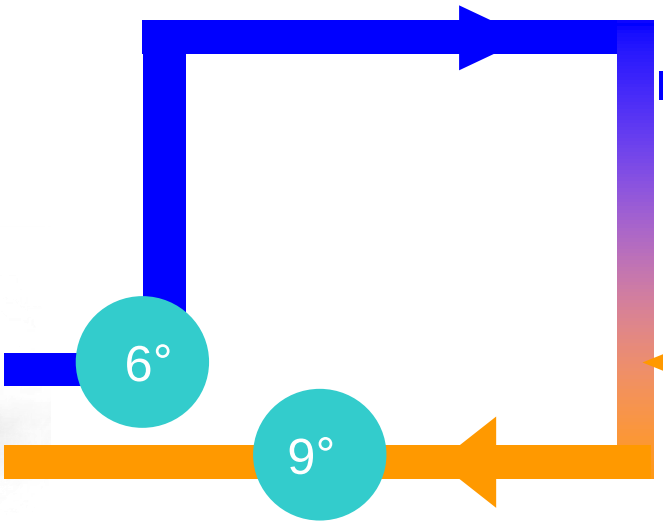
FIXED TEMPERATURE SYSTEMS

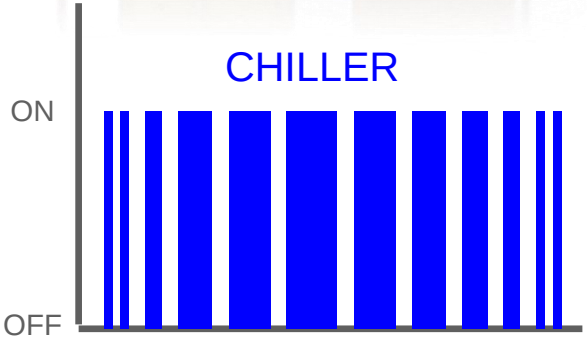
WATER BASED

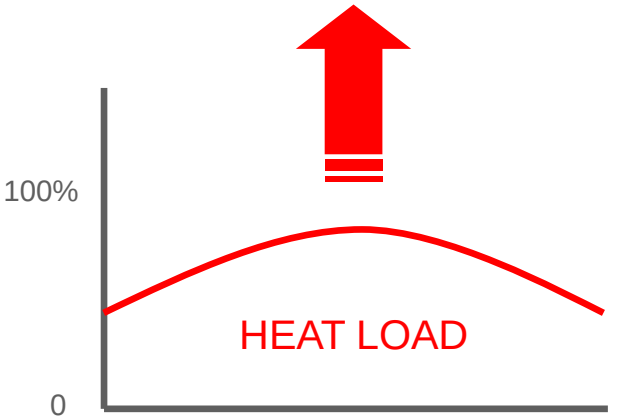
水冷定温系统

SOURCE
源

USER
用户







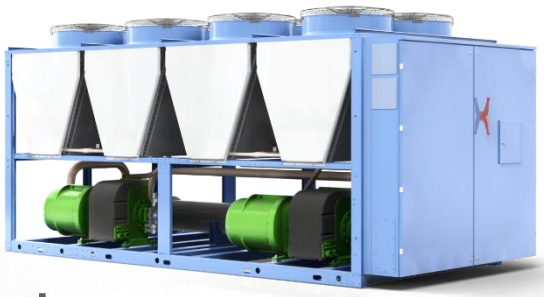
FIXED TEMPERATURE SYSTEMS
WATER BASED
水冷定温系统

SOURCE
源

USER
用户

VALVE

50%



6°

9°

INVERTER COMPRESSOR

ON

OFF

100%

HEAT LOAD

0

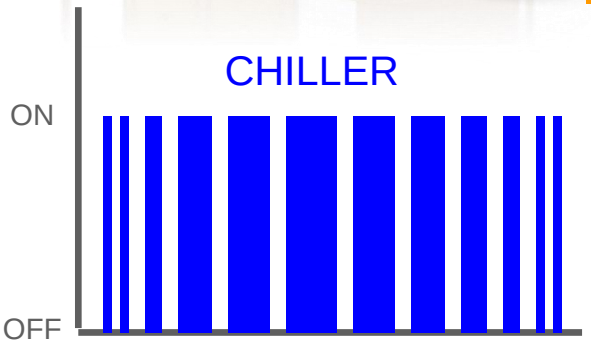
FIXED TEMPERATURE SYSTEMS

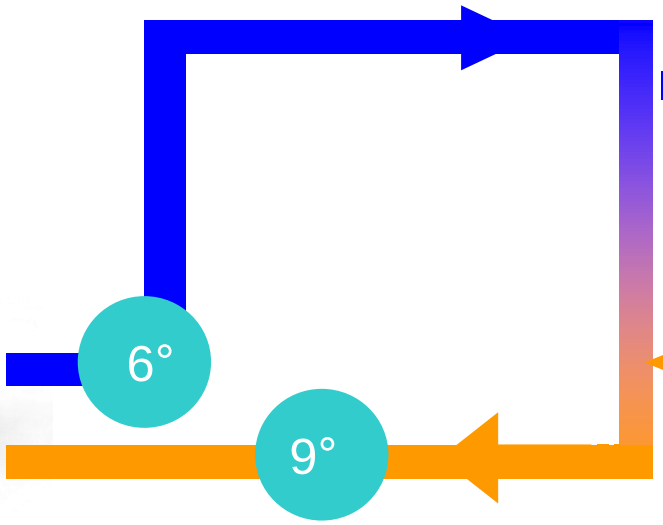
WATER BASED

水冷定温系统

SOURCE
源

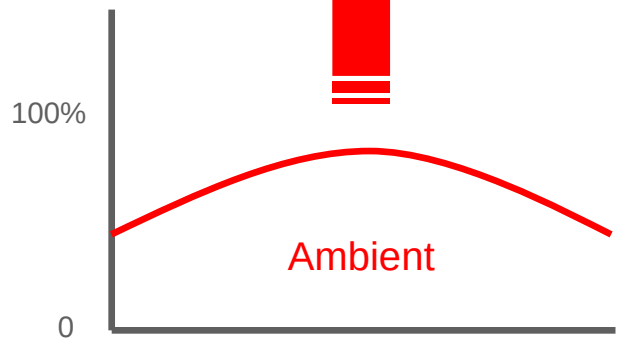
USER
用户





VALVE

50%



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FIXED TEMPERATURE SYSTEMS

WATER BASED

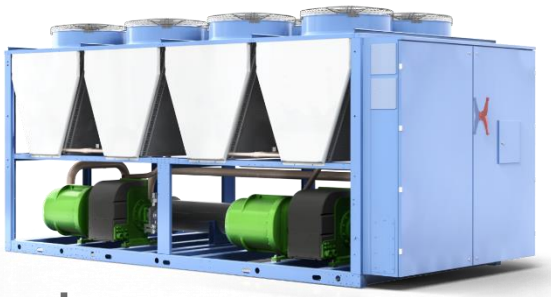
水冷定温系统

SOURCE
源

USER
用户

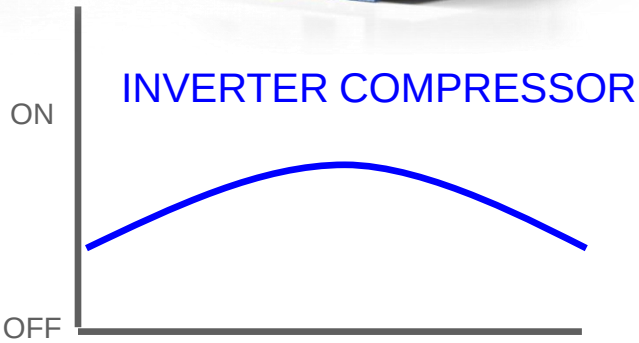
VALVE

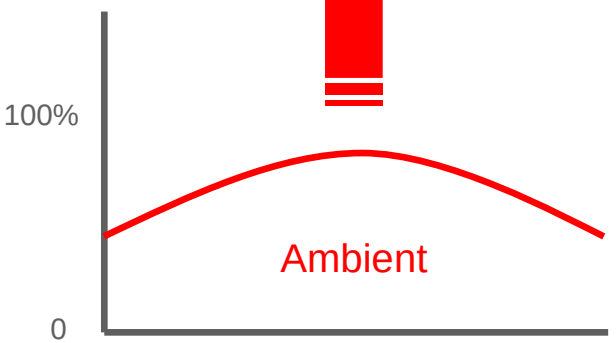
50%



6°

9°





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FIXED TEMPERATURE SYSTEMS

WATER BASED

水冷定温系统

SIMPLE OPERATION

CONTROL POINT

VALVE

50%

6°

9°

CHILLER

ON

OFF

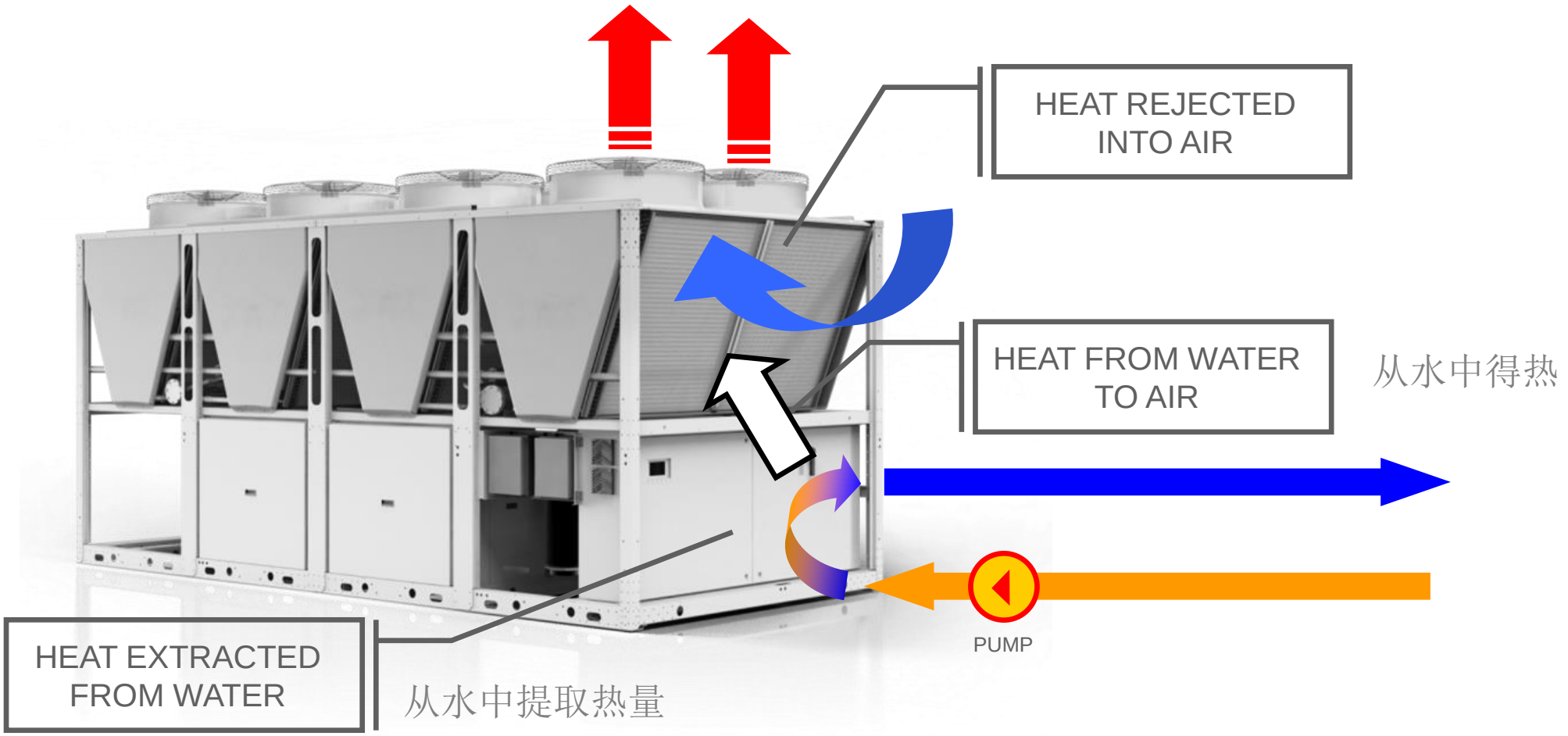
100%

INPUT VARIABLE

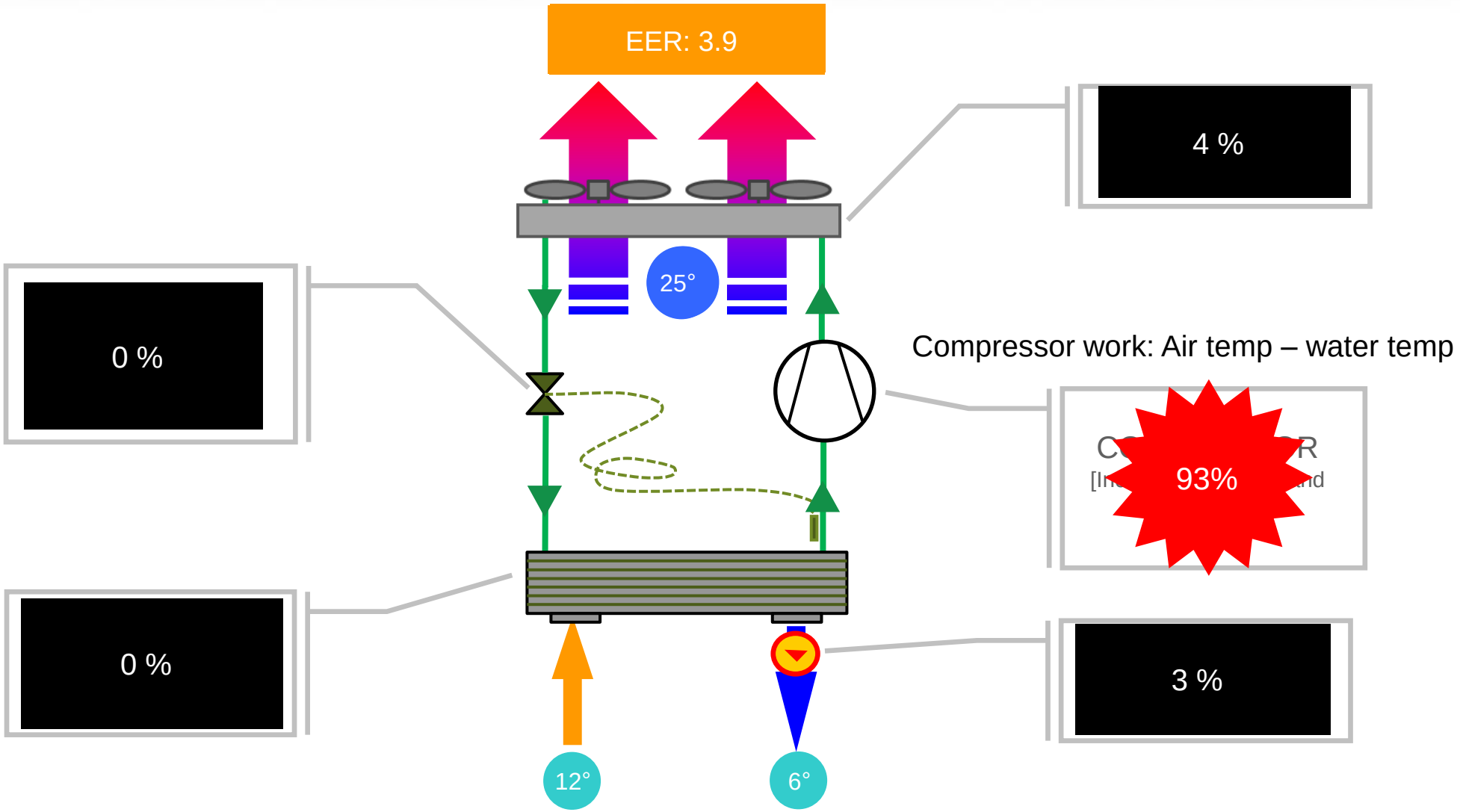
Ambient

0

HOW A CHILLER WORKS
冷水机组工作原理



HOW A CHILLER WORKS
冷水机组工作原理



VARIABLE OUTLET TEMPERATURE
可变出口温度

WHAT IS A VARIABLE TEMPERATURE SYSTEM?

什么是可变温度系统?

VARIABLE TEMP – AHU SYSTEM

可变温度空气处理系统

SOURCE

源

6° 9° 12°

VALVE

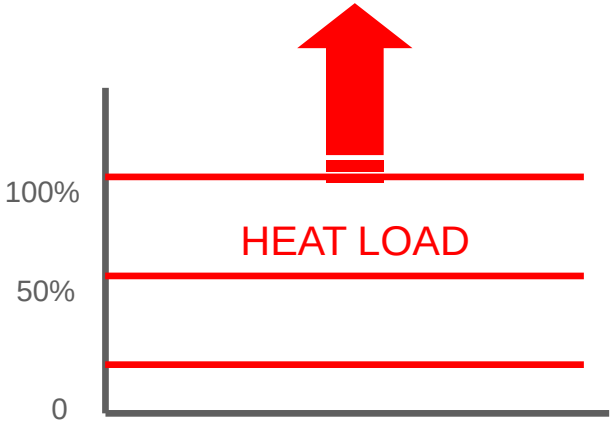
100%

PUMP

12° 14° 17°

USER

用户



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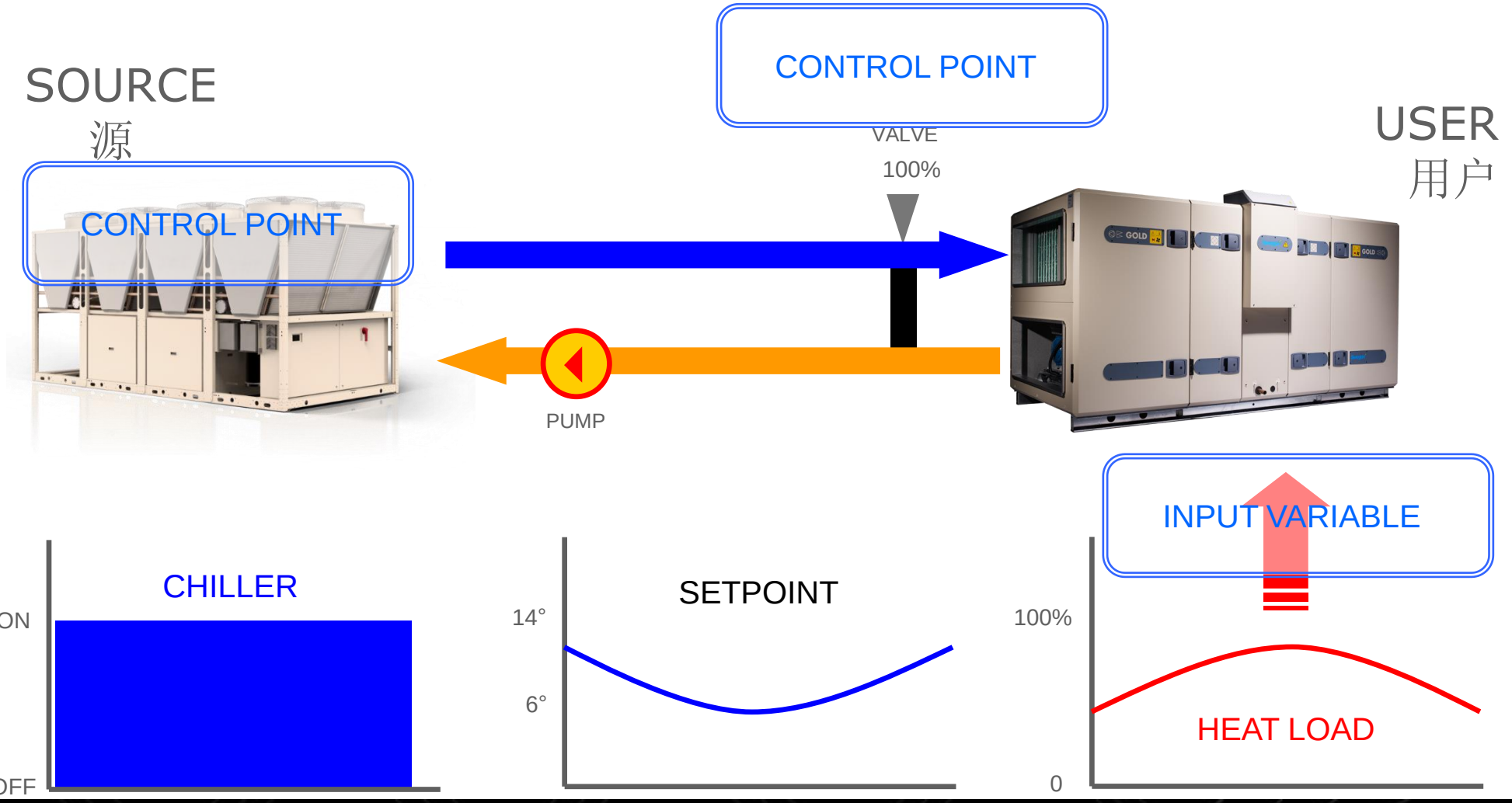
WHAT IS A VARIABLE TEMPERATURE SYSTEM?

什么是可变温度系统?

VARIABLE TEMP – AHU SYSTEM

可变温度空气处理系统



WHAT IS A VARIABLE TEMPERATURE SYSTEM?

什么是可变温度系统?

VARIABLE TEMP – AHU SYSTEM

可变温度空气处理系统

SOURCE

源

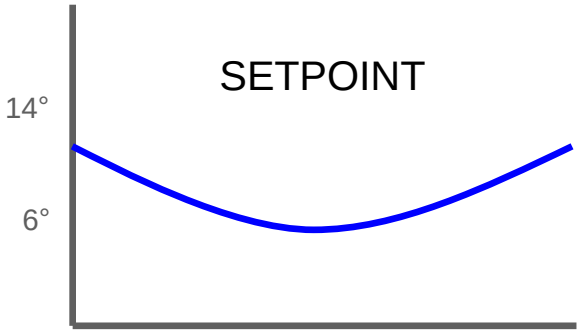
VALVE

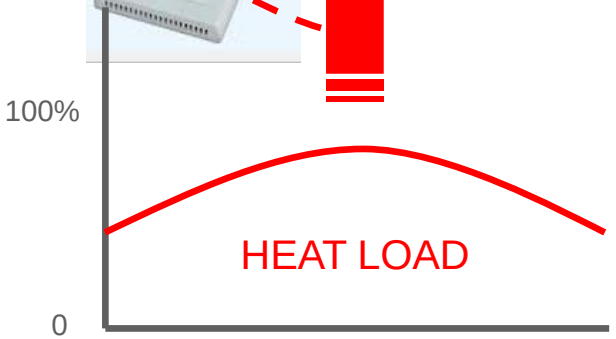
100%

PUMP

USER

用户





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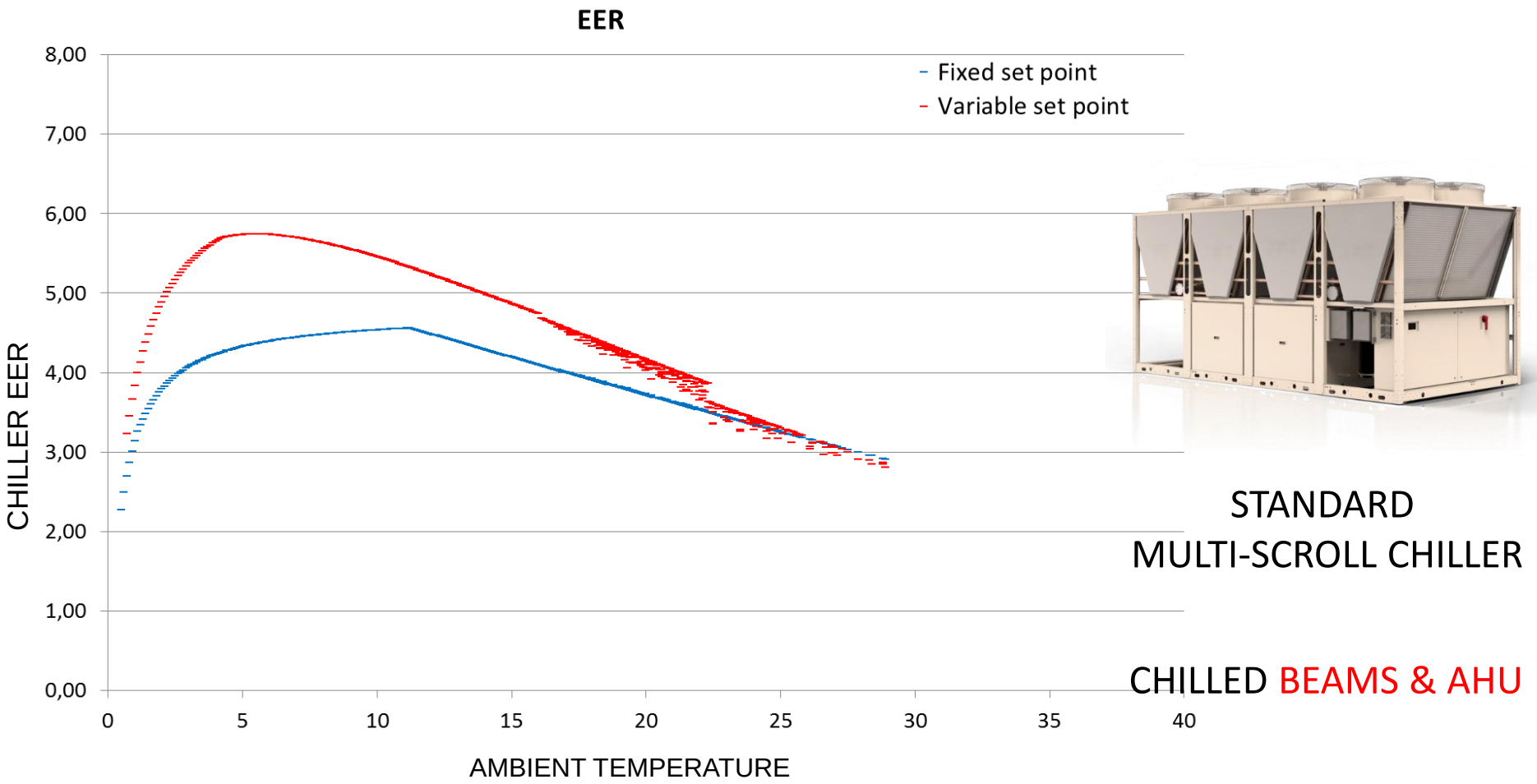
REAL EFFECTS ON PERFORMANE: E.E.R.
真实性能对比：E.E.R.

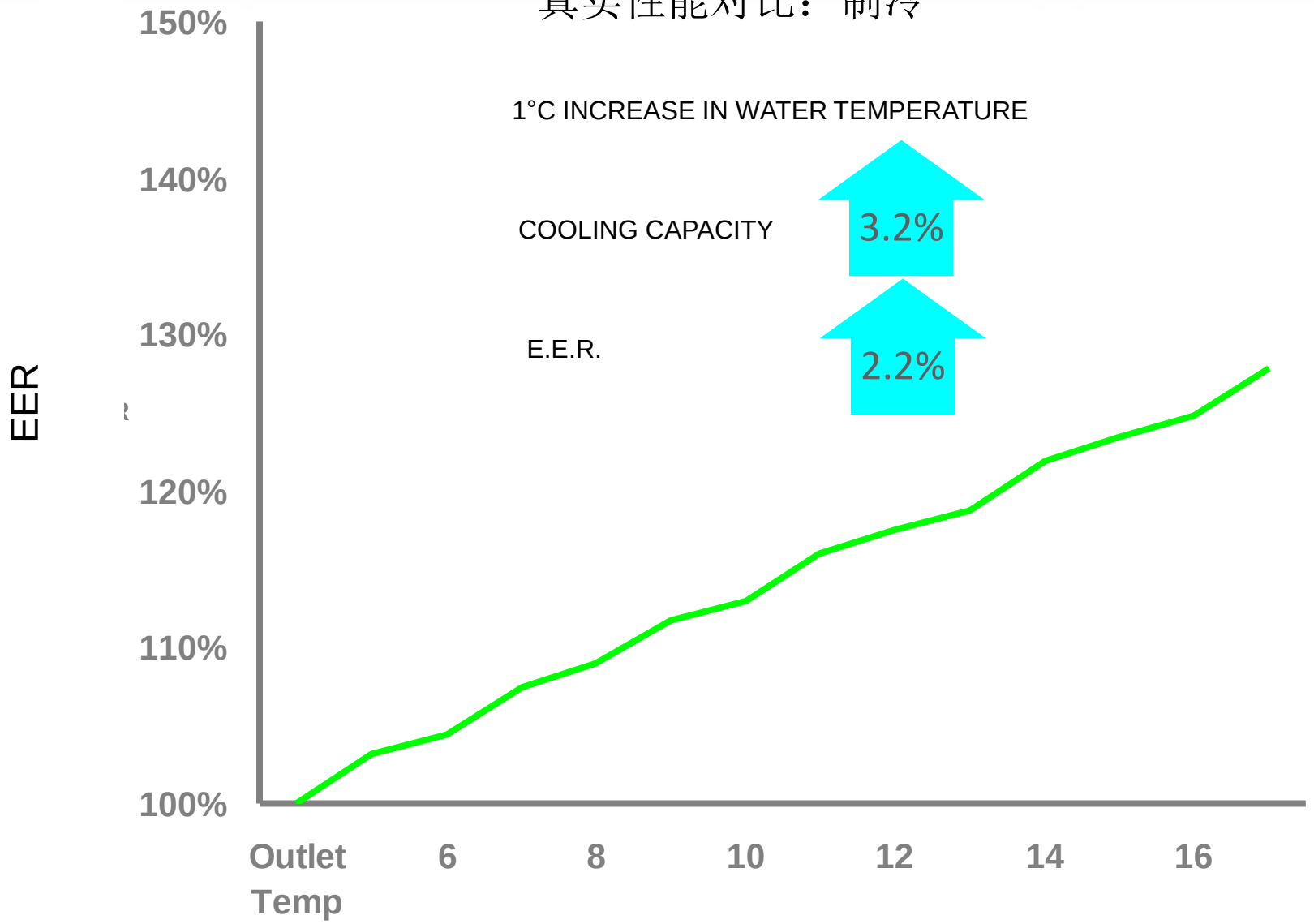


STANDARD
MULTI-SCROLL CHILLER

CHILLED BEAMS & AHU

REAL EFFECT ON PERFORMANCE: COOLING

真实性能对比：制冷



REAL EFFECT ON PERFORMANCE: APPLICATION
真实性能对比：应用

FAN COIL UNIT:
6° WATER TEMP

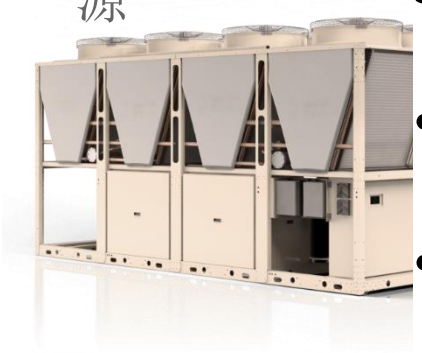
CHILLER NOT AT PEAK EFFICIENCY
非峰值运行的冷水机组能效
LATENT COOLING REDUCES EFFECT OF AVAILABLE SENSIBLE COOLING
潜冷降低显冷制冷效果

ACTIVE CHILLED BEAM:
14° WATER TEMP

CHILLER ALREADY AT PEAK EFFICIENCY
峰值段运行的冷水机组能效
NO LATENT COOLING – ALL AVAILABLE COOLING USED
无潜冷运行-所有制得冷量均用于制冷

ADVANCED SETPOINT CONTROL – COMBINED SYSTEMS
设定值先行控制 —— 组合系统

SOURCE
源



USER
用户

SYSTEM REQUIREMENTS
系统要求

- Intelligence at the AHU
  智能处理末端
- Control of chiller / heatpump setpoints.
  冷水机、热泵的设定值控制
- Feedback of water and air temperature.
  水、空气的反馈温度
- Control of flow rates (inverter pumps).
  流量控制

MIXED WATER FI
EXCHANGER TO
CIRCU..

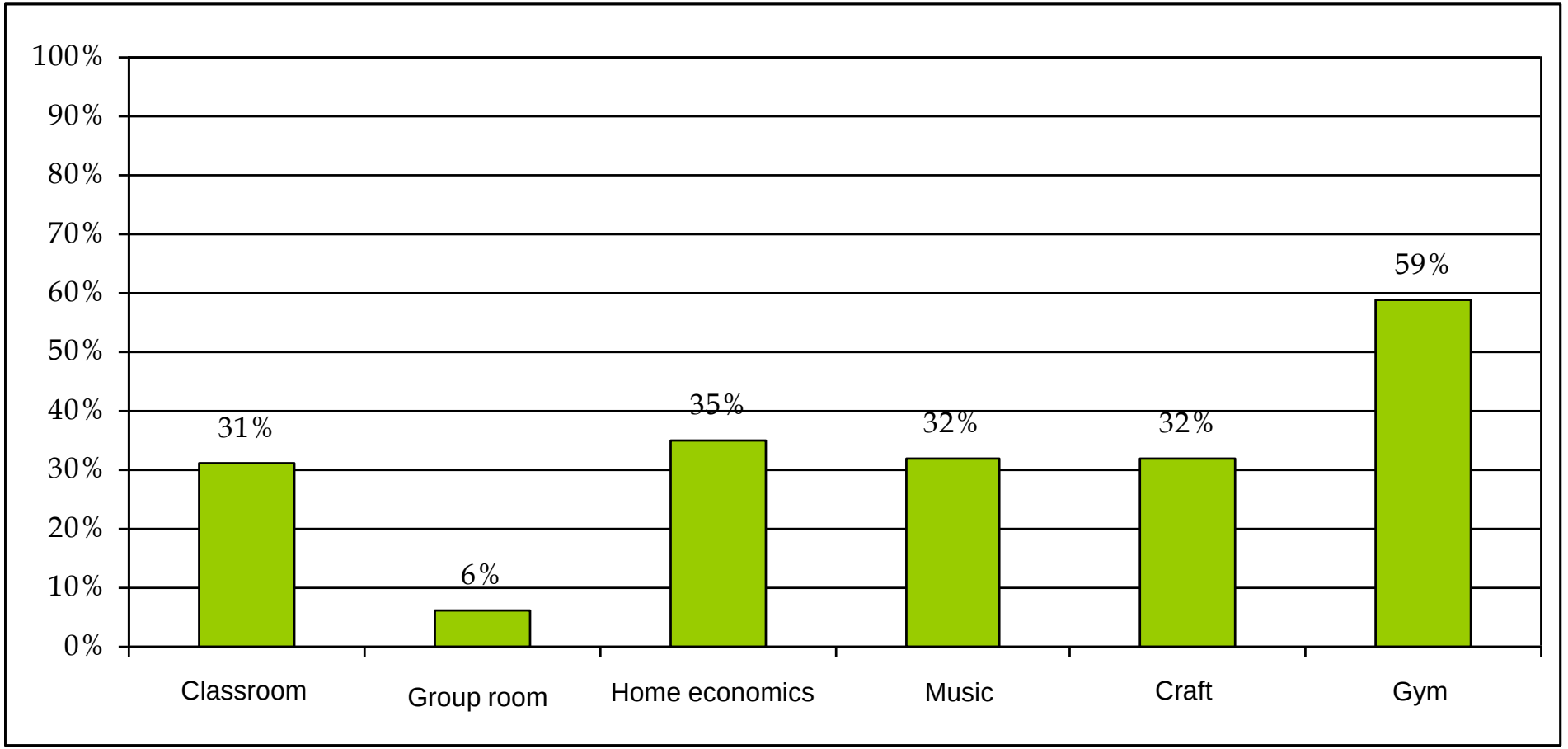
DEMAND CONTROL VENTILATION
需求控制通风

Providing ventilation based on feedback from the conditions and people in the room.

以室内人员活动情况及环境工况作为反馈条件提供送风

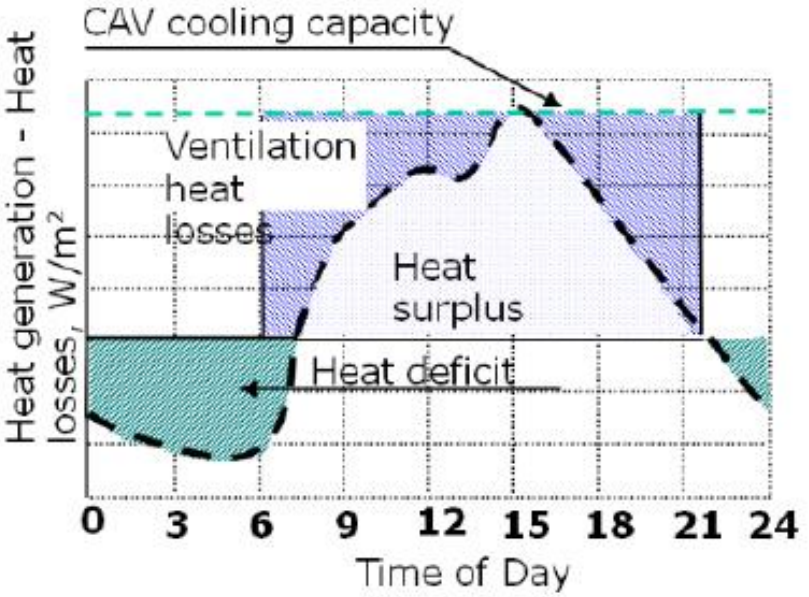
Occupancy % during the school day

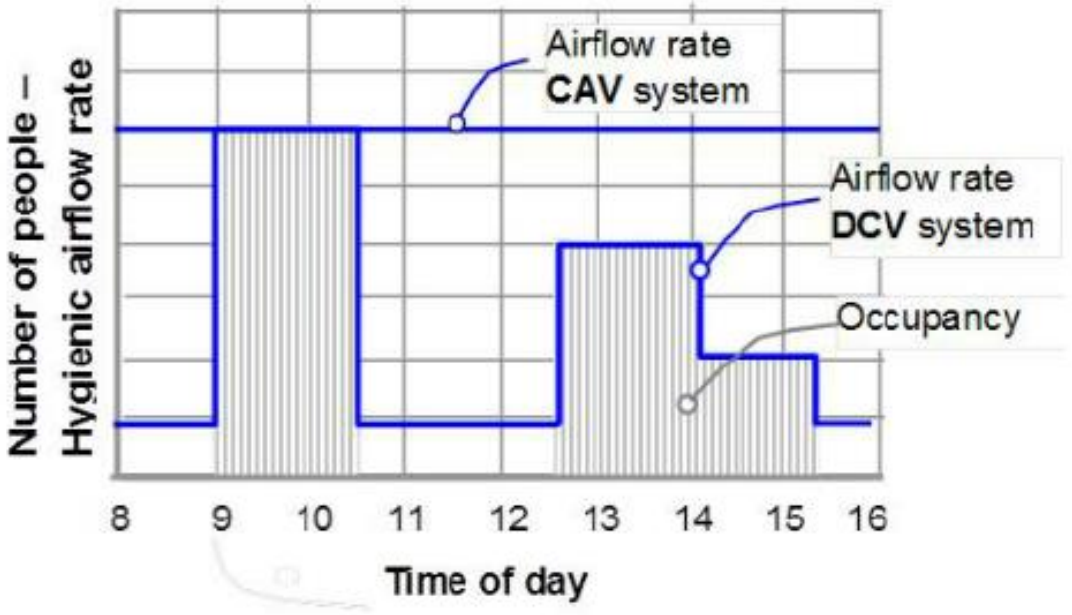
学校上课日人员使用情况 %



DEFINITION OF DCV
需求控制通风定义

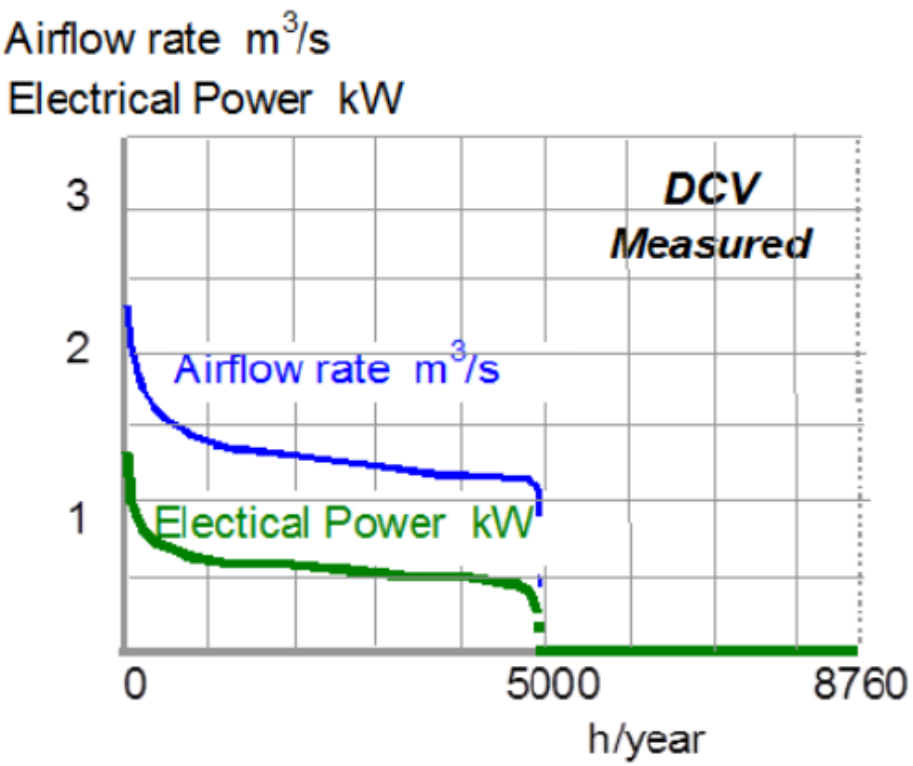
Provide the exact amount of clean air at the required temperature at the right time in the right place.
在合适的时间，合适的地点，按照要求温度，精确控量提供清洁空气

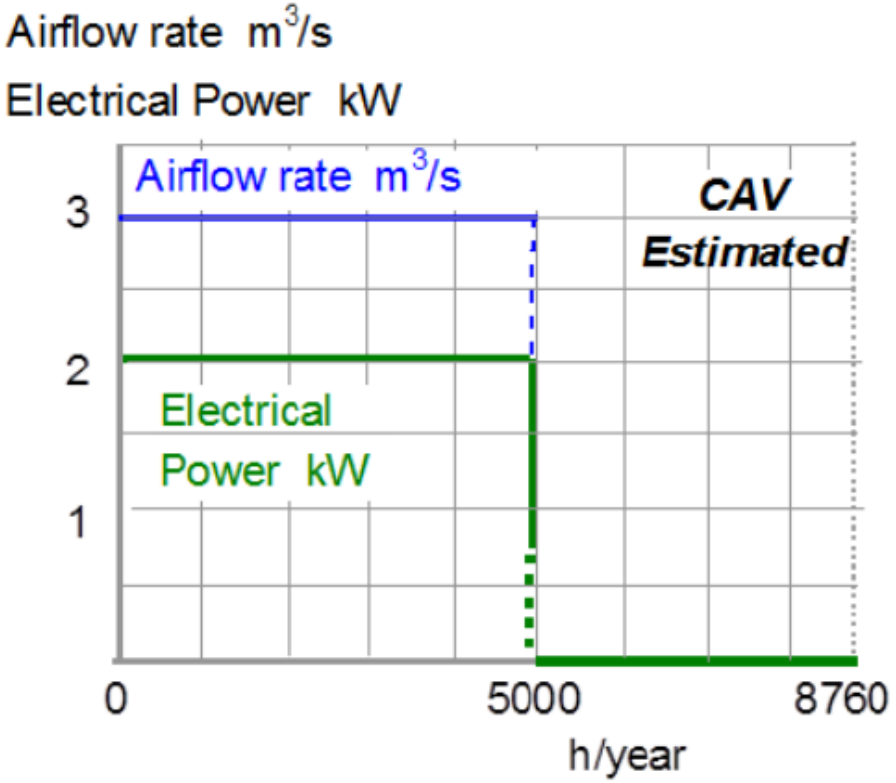




Source:Maripuu, Chalmers

DCV FIELD MEASUREMENTS
需求控制通风的现场测试





Source:Maripuu, Chalmers

OPTIMIZING HVAC SOLUTIONS FOR LOW ENERGY BUILDINGS
低能耗建筑的空调优化方案

Filtration is important.
过滤系统至关重要

Advanced setpoint control is import; heating/cooling and ventilation.
设定点的优选控制非常重要：供热、供冷以及通风

How we look at our buildings HVAC systems from the complete building as a system (infiltration, glass, solar, occupancy).
从建筑整体角度审视空调系统（包括渗透、玻璃、日照、人员使用）

Solutions for the future? What do we want?
未来的解决方案？我们的需求？

Reduced energy demand.
降低能源需求

Reduced pollution.
减少污染

Increased health in buildings and outside.
增强建筑室内外的健康舒适性

DO WE REALLY WANT OR NEED THIS?
我们的未来该是怎样的？