CO2冷库解决方案

CO2 Solution for Distribution Center

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我们的使命 OUR MISSION

做商用冷冻行业的领跑者。为减少食品浪费不懈努力，为食品安全保驾护航。

We lead the commercial refrigeration business. Our relentless effort contributes to reduce food waste and protect food safety.

以创新的技术、优异的质量、卓越的服务、严谨合规的商业道德和高效的管理，致力为客户提供节能环保，更佳全生命周期成本的整体解决方案。

Through innovative technologies, distinguished quality and services, strict business ethics, and efficient management, we are committed to provide our customers with energy efficient, environmental friendly, and better lifecycle cost solutions.

环境友好 致力保护蔚蓝星球

ENVIRONMENT FRIENDLY TO PROTECT THE BLUE PLANET

蒙特利尔协议 1987
Montreal Protocol

ODP

为避免氟氯碳化物对地球臭氧层继续造成恶化及损害，蒙特利尔议定书中对CFC-11, CFC-12, CFC-113, CFC-114, CFC-115等五项氟氯碳化物 (HCFCs) 及三项海龙的生产做了严格的管制规定并制定逐步淘汰计划

In order to prevent the CFCs in industrial products from continuing to cause deterioration and damage to the Earth's ozone layer, the 1985 Convention for the Vienna Convention for the Protection of the Ozone Layer was signed to state a series of stepped limits on CFC use, production and phase out plan

京都议定书 1997
Kyoto Protocol

GWP

1997年12月在日本京都由联合国气候变化框架公约参加国三次会议制定。其目标是“将大气中的温室气体含量稳定在一个适当的水平，进而防止剧烈的气候改变对人类造成伤害”

It was established in December 1997 in Kyoto, Japan, by the third meeting of the United Nations Framework Convention on Climate Change. The goal is to “stabilize the greenhouse gas content in the atmosphere at an appropriate level to prevent severe climate change from harming humans”

基加利修正案 2016
Kigali Amendment

GWP

2019年1月1日，“蒙特利尔议定书”基加利修正案生效。 根据基加利修正案，各国承诺在未来30年内将氢氟碳化合物 (HFCs)的使用减少80%以上

On January 1, 2019 the Kigali Amendment to the Montreal Protocol came into force. Under the Kigali Amendment countries promised to reduce the use of hydrofluorocarbons (HFCs) by more than 80% over the next 30 years

环境保护大国担当

CHINA'S ENVIRONMENTAL PROTECTION PERSEVERANCE

2017年9月12日《蒙特利尔议定书》缔结30周年纪念大会
Commemorative meeting of the 30th anniversary of the Montreal Protocol

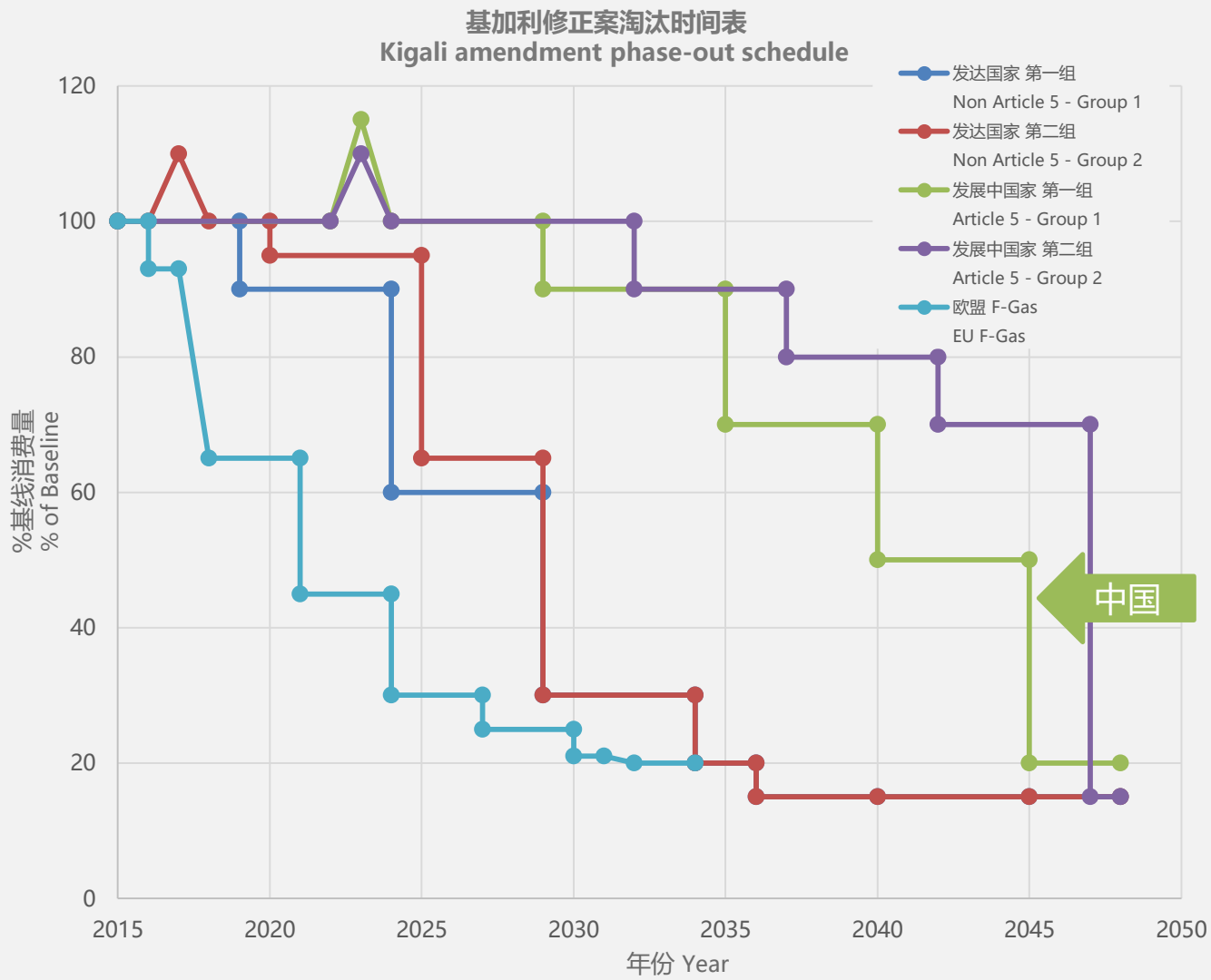
“我国要加快基加利修正案的批约进程，为修正案的实施做好充分的准备工作，并且要推动绿色低碳替代技术开发应用，大力发展臭氧层友好、气候友好、符合节能安全要求的替代技术。”

"China should speed up the ratification process of the Kigali amendment, fully prepare for the implementation of the amendment, and promote the development and application of green low-carbon alternative technologies, and vigorously develop the friendly, ozone-friendly and energy-saving safety requirements of the ozone layer. Alternative technology."

——摘自环保部部长在《蒙特利尔议定书》缔结30周年纪念大会上的讲话
Speech from the Minister of Environmental Protection at the 30th Anniversary of the Montreal Protocol

中国HCFC/HFC制冷剂淘汰计划

CHINA HCFC/HFC REFRIGERANT PHASE OUT PLAN



发达国家 第一组 基线
Non Article 5- Group 1

基线年： 2011-2013
Baseline year: 2011-2013

基线消费量： HFC平均消费量的GWP值 + 15%的HFCF基线消费量
Baseline: average HFC consumption of GWP + 15% of HCFC baseline

发达国家 第二组
Non Article 5- Group 2

基线年： 2011-2013
Baseline year: 2011-2013

基线消费量： HFC平均消费量的GWP值 + 25%的HFCF基线消费量
Baseline: average HFC consumption of GWP + 25% of HCFC baseline

第二组：白俄罗斯，俄罗斯。哈萨克斯坦，塔吉克斯坦，乌兹别克斯坦
Group 2: Belarus, Russia. Kazakhstan, Tajikistan, Uzbekistan

发展中国家 第一组
Article 5 – Group 1

基线年： 2020-2022
Baseline year: 2020-2022

基线消费量： HFC平均消费量（或生产量）的GWP值 + 65%的HFCF基线消费量
Baseline: average HFC consumption (or production) of GWP + 65% of HCFC baseline

发展中国家 第二组
Article 5 – Group 2

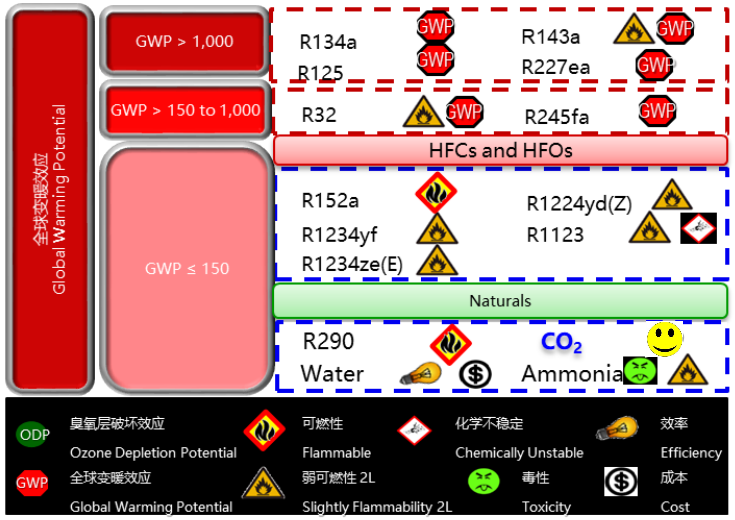
基线年： 2024-2026
Baseline year: 2024-2026

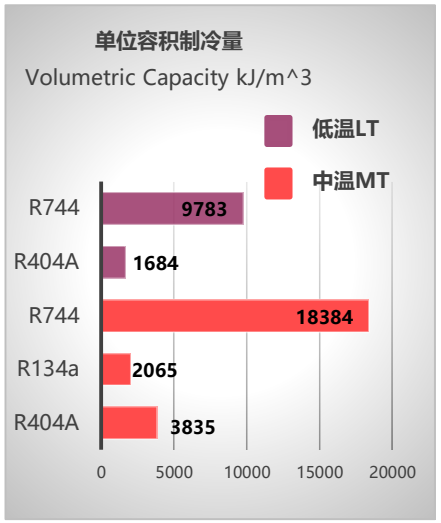
基线消费量： HFC平均消费量（或生产量） + 65%的HFCF基线消费量
Baseline: average HFC consumption (or production) of GWP + 65% of HCFC baseline

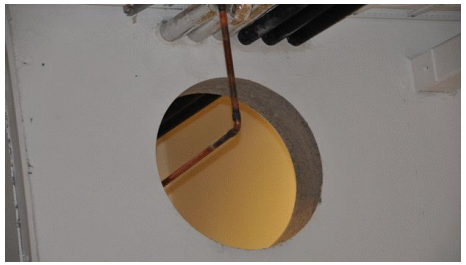
第二组：印度，沙特，巴基斯坦，科威特，巴林，伊朗，伊拉克，阿曼，卡塔尔，阿联酋
Group 2: India, Saudi Arabia, Pakistan, Kuwait, Bahrain, Iran, Iraq, Oman, Qatar, United Arab Emirates

自然工质 CO2

NATURAL REFRIGERANT CO2







❖ 绿色环保
Natural Refrigerant

- ❖ 全球变暖效应 GWP = 1
  Global Warming Potential (GWP = 1)
- ❖ 臭氧层破坏效应 ODP = 0
  Ozone Depletion Potential (ODP = 0)
- ❖ 天然物质 （工业生产流程的副产品）
  Natural (by-product of other industrial processes)
- ❖ 制取成本低，且广泛供应
  Cost effective and available worldwide

❖ 安全可靠
Safe and Reliable

- ❖ 制冷剂分类等级为A1，无毒，不可燃
  Classified A1, Non-flammable and Non-toxic
- ❖ 化学特性稳定，无腐蚀性
  Stable chemical properties， Non-corrosive

❖ 节能高效
High Efficiency

- ❖ 密度大，传热性能好
  High density and better heat transfer performance
- ❖ 单位容积制冷量分别比R404A/R134a 高 6/9 倍
  Volumetric capacity is 6/9 times higher than R404A/R134a.
- ❖ 粘度小，流动损失小
  Low viscosity and less pressure drop

❖ 系统紧凑
Small Footprint

- ❖ 机组占地小，节省机房空间
  Small footprint, saving space area
- ❖ 管路小，制冷剂充注量少
  Small pipe and less refrigerant charge amount
- ❖ 减少管路成本及安装时间
  Less cost on piping system and installation

开利冷冻品牌与CO2技术创新之路

CARRIER REFRIGERATION BRAND & CO2 INNOVATION

- 1877 林德发明并售出世界第一台制冷机
  The first Linde refrigeration machine sold.

- 1902 开利(Carrier) 创立
  Carrier founded

- 1961 Profroid工业成立
  PROFROID founded
  - 法国冷冻领域的领导者
    Leading manufacturer of Refrigeration Mechanical Systems

- 2002 研发CO2跨临界制冷机组
  Started developing a CO2 transcritical refrigeration system

- 2005 收购林德制冷
  Acquired Linde Refrigeration
  - 设立德国研发中心
    opens Lead Design Center in Germany

- 2006 上海研发中心成立
  Creation of SRDC

- 2007 创立GREEN&COOL品牌
  Creation of brand GREEN&COOL
  - 专注于CO2跨临界系统
    Only focused on Transcritical CO2

- 2009 德国第100台*CO2OLtec®*交付
  The opening of the 100th CO2OLtec® in Germany

- 2012 德国安装第1台*CO2OLheat®*
  1st CO2OLheat® space heating system is installed at EDEKA Meibohm, Germany

- 2012 中国首个安装CO2泵送系统门店
  The opening of 1st CO2 pump system in China

- 2016 本地化HybridCO_2OL机组投产
  CO2 localization

- 2019 中国第1台跨临界CO2系统交付
  1st Transcritical CO2 system delivered in China

开利CO2系统演进之路

CARRIER CO2 SYSTEM EVOLUTION

CO2复叠系统
- ❖ CO2仅限于低温侧，需要复叠换热器配合HFC中温制冷系统使用
- ❖ 在温暖气候下，比HFC具有更好的效率

Initial generation of CO2 cascade system
- ❖ CO2 limited to LT with cascade HX to HFC for MT
- ❖ Better efficiency vs HFC (warm climate)

HybridCO2OL

2000

- ➢ 冷量：中温 < 278kW, 低温 < 75kW
  Capacity: MT < 278 kW, LT < 75 kW
- ➢ 推荐使用地区：北方，中部，南方
  Area: All Climate

第一代CO2跨临界/双级增压系统
- ❖ 目标气候类型是温和气候和寒冷气候(全年平均温度 < 15°C)
- ❖ 相对于传统HFC系统或初代CO2复叠系统，能提供更好的节能收益

1st generation of CO2 Transcritical / Booster system
- ❖ Target Mild and Cold climate (annual average T° < 15°C)
- ❖ Provide energy gain vs conventional HFC or Hybrid systems

CO2OLtec

2004

- ➢ 冷量：中温 < 355kW, 低温 < 170kW
  Capacity: MT < 355 kW, LT < 170 kW
- ➢ 推荐使用地区：北方
  Area: Warm and Cold Climate

第二代CO2跨临界/双级增压系统+可调节式喷射器
- ❖ 目标气候类型是温带和热带气候, 废止了CO2赤道线
- ❖ 得益于喷射器，相对于CO2复叠系统，能提供更好的节能收益

2nd generation of CO2 Transcritical system
- ❖ Targeting Warm and Hot climates, to cancel the CO2 Equator
- ❖ Providing Energy gain vs Hybrid systems by using the ejector

CO2OLtecEvo

2014

- ➢ 冷量：中温 < 480kW, 低温 < 94kW
  Capacity: MT < 480kW, LT < 94kW
- ➢ 推荐使用地区：中部
  Area: Warm and Mild Climate

第三代CO2跨临界/双级增压系统+可调节喷射器+半满液蒸发器
- ❖ 全气候类型
- ❖ 行业领先的效率，配备满液蒸发器、喷射器、泵
- ❖ 更好的节能收益

3rd generation of CO2 Transcritical system
- ❖ Targeting all climates (Cold, Mild and Warm)
- ❖ BIC efficiency with flooded evaporator + Ejector + pump
- ❖ Providing Energy gain

PowerCO2OL

CO2OLtecEvo

2016

- ➢ 冷量：中温 < 1.3MW, 低温 < 550kW
  Capacity: MT < 1.3MW, LT < 550kW
- ➢ 推荐使用区域：北方，中部，南方
  Area: All Climate

开利CO2系统市场领先地位

CARRIER CO2 SYSTEM LEADING THE MARKET

2018年底, 全球市场选择CO2作为制冷剂: (来源于SHECCO)

By the end of 2018, global market uses CO2: (source from SHECCO)

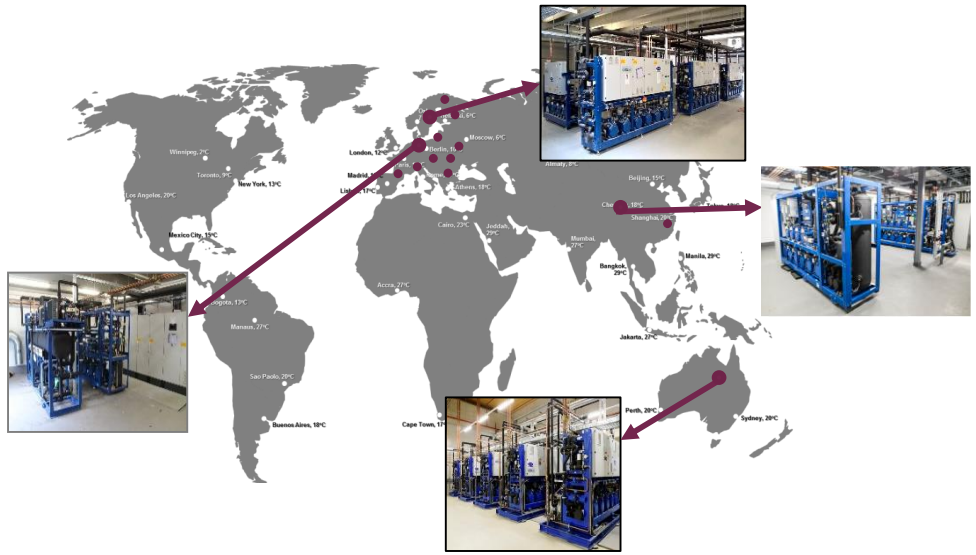
- 全球范围内的应用数量: *> 20000*
  Application quantity among the world: > 20000
- Carrier和Green & Cool的市场份额: *50%*
  Carrier / G&C share in the market:: 50%
- CO2跨临界相对于其他CO2系统,订单趋势: *> 75%*
  CO2 TC vs others, order trend: > 75%

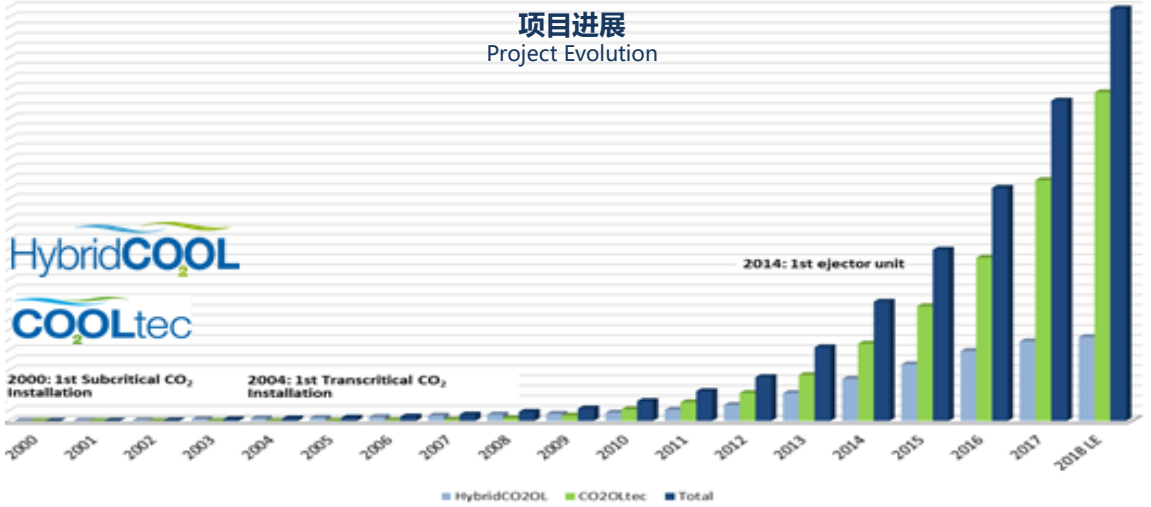
600+
专利
Patents

10,000+
欧洲项目
Installations in Europe

20+
中国项目
Installations in China

20+ years
行业经验
设计，制造，安装及售后
experiences
in design, production,
installations and after services

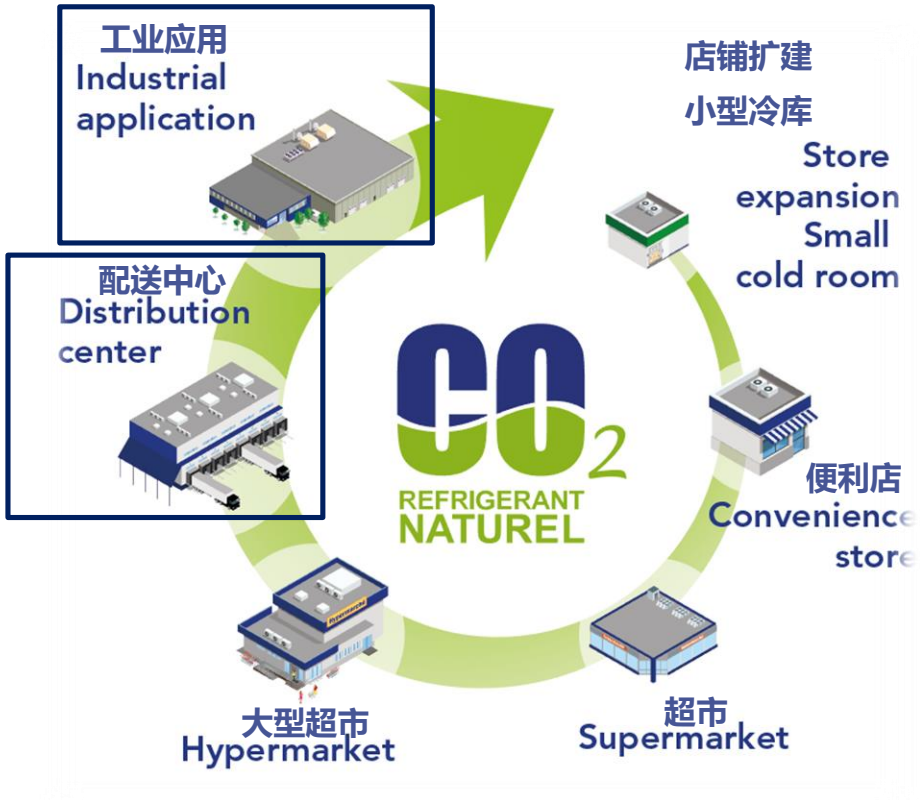


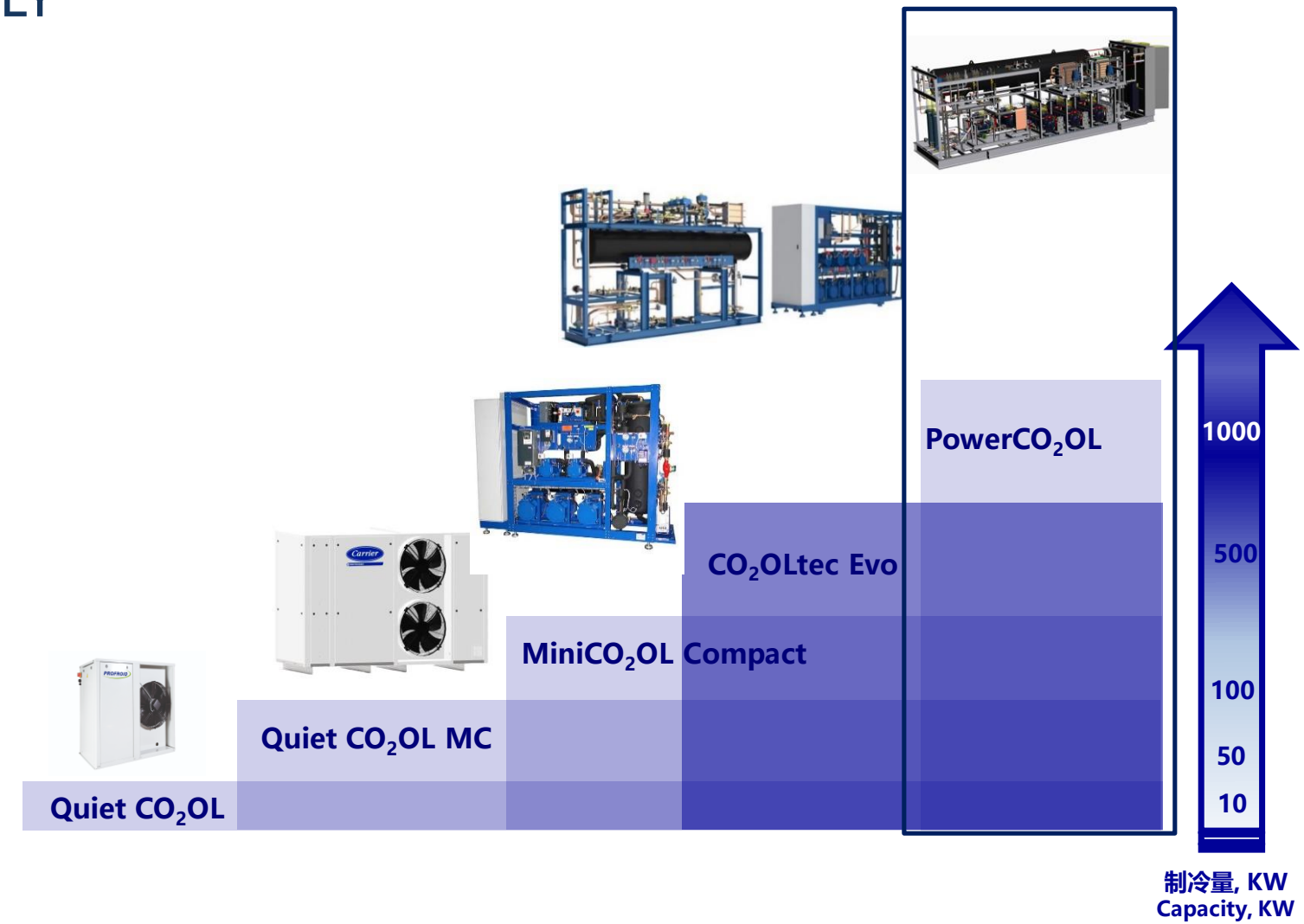


[1]2018年11月状态，包含亚临界和跨临界，包含所有品牌
[1]Status as of end November 2018. Transcritical & subcritical, all brands

开利CO2产品全系列解决方案

CARRIER CO2 PRODUCT FAMILY





PowerCO$_2$OL应用范围

PowerCO$_2$OL CAPACITY RANGE

❖ **PowerCO$_2$OL 范围**
Capacity Range

250kW 500kW 1000kW


单独蒸发温度
Single evaporating temperature


双蒸发温度 (Booster双级增压)
Dual evaporating temperature (Booster)


单独低蒸发温度
Single low evaporating temperature

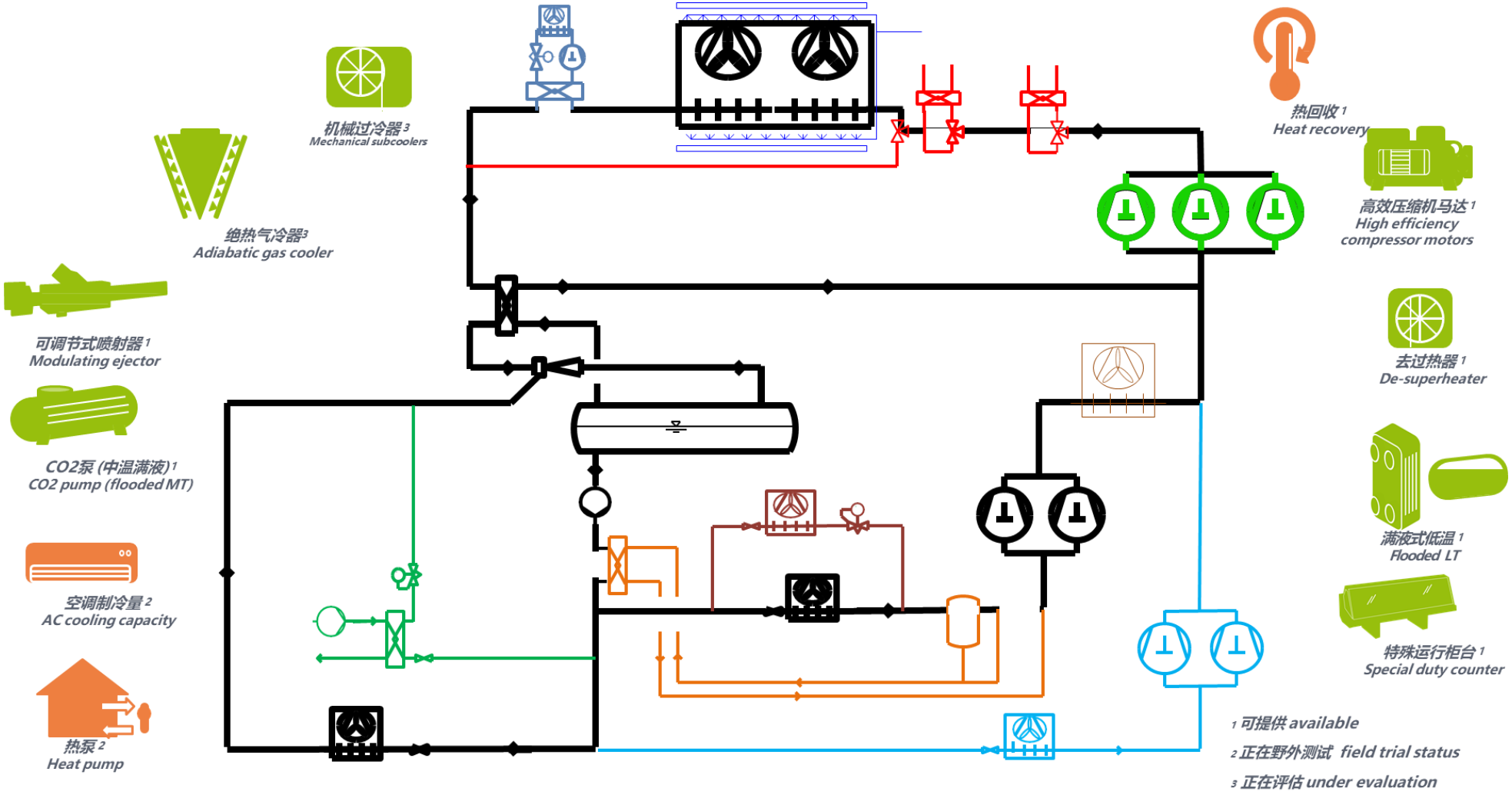
中温 (MT) -8°C/32°C (89 bar)
低温 (LT) -32°C (0°C)

❖ PowerCO$_2$OL 设计要点
PowerCO2OL Enablers

- ❖ 大排量6缸压缩机，趋向于100 m3/h排量
  Large 6 cylinder compressors - trend to 100 m3/h displacement
- ❖ 自主研发PLC可编程控制器
  In-house developed PLC based controller
- ❖ 创新型储液罐设计
  Innovative receiver design
- ❖ 紧凑的模块化框架设计
  Compact modular frame design

PowerCO$_2$OL解决方案

PowerCO$_2$OL SOLUTIONS PORTFOLIO

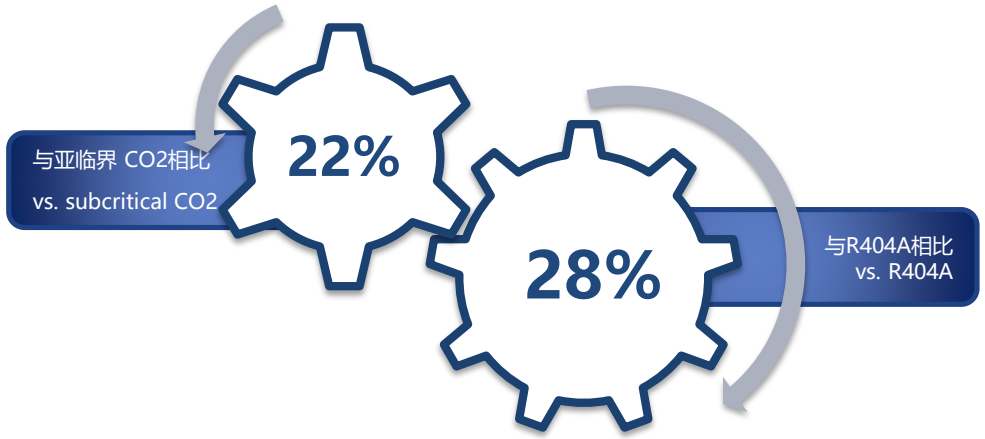


PowerCO$_2$OL节能效果对比

PowerCO$_2$OL ENERGY-SAVING COMPARISON

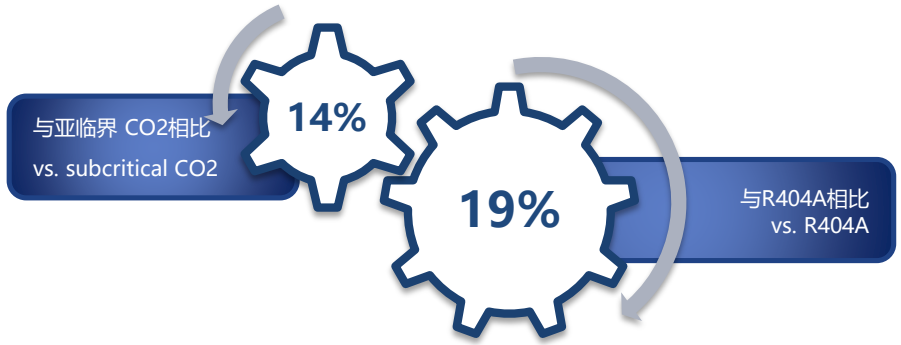
❖ **平均温度 10~15°C**

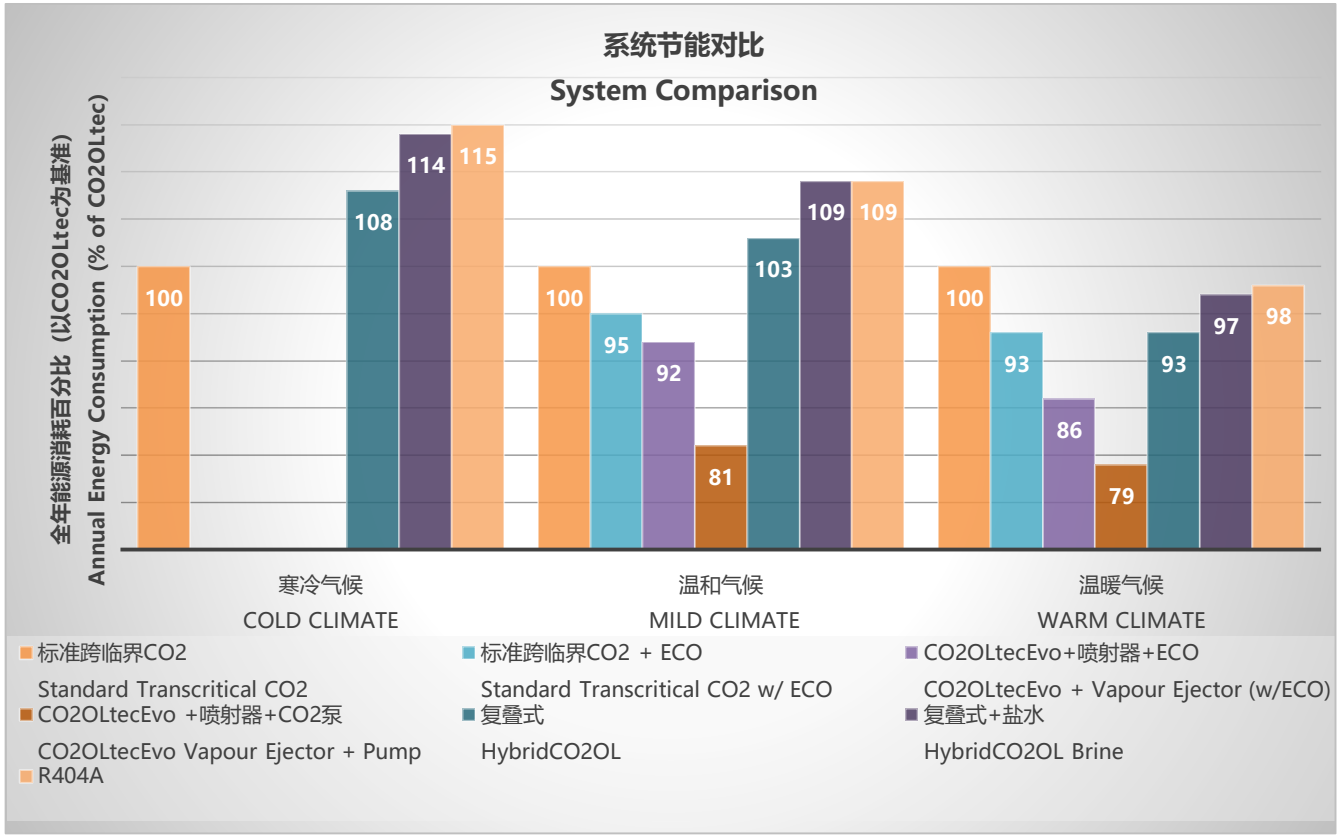
Average Temperature 10~15°C



❖ **平均温度 > 15°C**

Average Temperature > 15°C



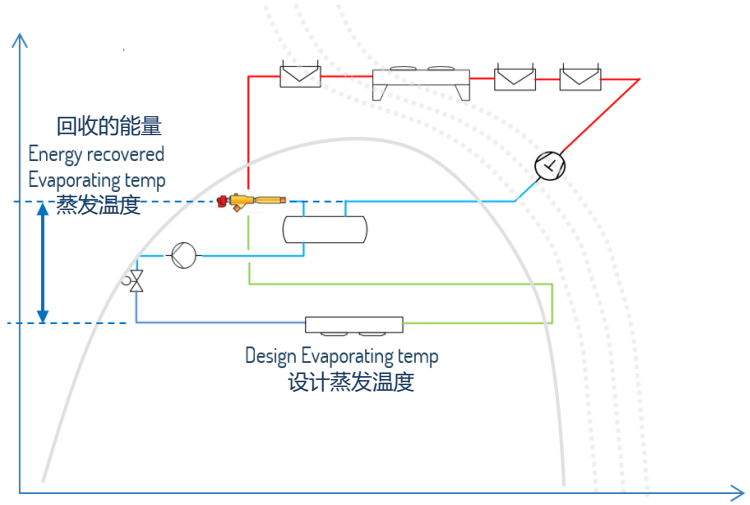


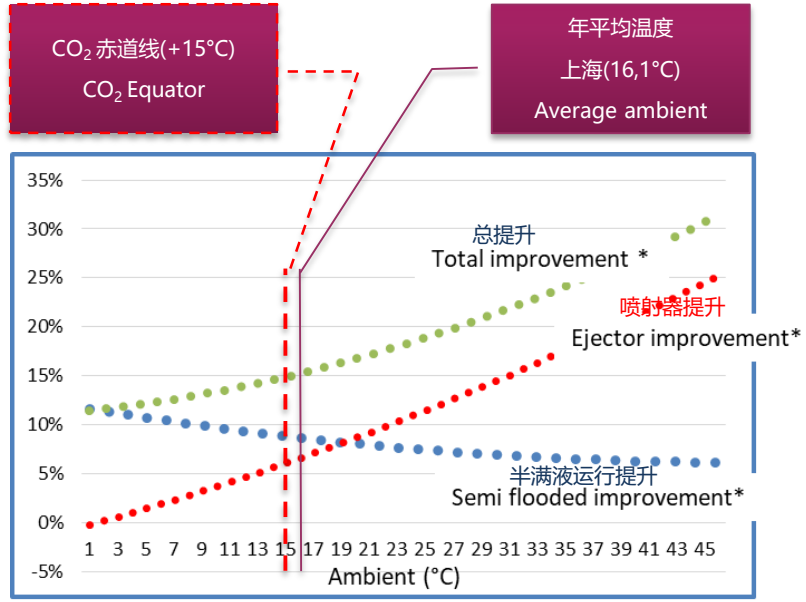
- *工程明细：94m长中温展示柜，38m长低温展示柜，228m3容量的中温冷库，55m3容量的低温冷库。中温展示柜带玻璃门，EC风机LED照明，（开利e*cube节能控制器模块）*
- *Projection based on 94m MT cabinets, 38m LT cabinets, 228m³ MT coldroom, 55m³ LT coldroom. MT cabinets /w glass doors, EC fans, LED lighting.. (Carrier e*cube).*
- *环境温度曲线: 温暖气候类型 = 相当于塞维利亚，雅典，巴塞罗那和马德里等地的平均值*
- *Temperature profiles: Warm Climate = Average Seville, Athens, Barcelona & Madrid (17°C avg); Mild Climate = Berlin (10°C avg); Cold Climate = Average Oslo, Stockholm, Helsinki (7°C avg)*
- *HybridCO2OL = CO2 LT + R134a MT*

PowerCO$_2$OL节能原理

PowerCO$_2$OL ENERGY-SAVING ENABLERS

- **Power CO$_2$OL 高效系统**
  Power CO$_2$OL High Efficiency System
  - 应用开利专利可调节喷射器技术
    Use of Carrier patented modulating ejectors
  - 半满液运行模式
    Semi flooded operation
  - 改进后的气冷器设计
    Improved gas cooler design
  - 整合热回收模块
    Heat recovery integration
  - “Smart” 智能热回收控制
    “Smart” heat recovery control
  - 适应环境的系统
    Adaptation of surrounding systems





COP 改善
COP Improvement

- 保守数值, 没有考虑热回收
  Conservative values, not taking HR in to consideration
- 基于开利选型压缩机多项式拟合数据
  Based on Carrier selected compressor polynomial values
- -8°C 半满液运行回到喷射器，压力得到提升
  -8°C Semi flooded to ejector lift

PowerCO$_2$OL可调节式喷射器

PowerCO$_2$OL MODULATING EJECTOR

- **可调节式喷射器**
  Modulating Ejector
- 抬升压缩机吸气压力 通过带动所有流量的方式，实现更高的效率
  Increased suction pressure (compressor) by driving the full mass-flow = better efficiency
- 申请专利的可调节式喷射器 优化了部分负荷 & 降低了中压部分的压力波动
  Patented Modulating Ejector: optimized part-load & lower fluctuation of the MP pressure
- 泵辅助运行 来用弥补亚临界时，较低喷射器压力提升
  Pump assisted during subcritical operation (to compensate the lower ejector uplift)
- 通过PLC控制 使用专有的、经过长时间优化的控制程序
  Driven by a PLC using proprietary & already over-time optimized control routines

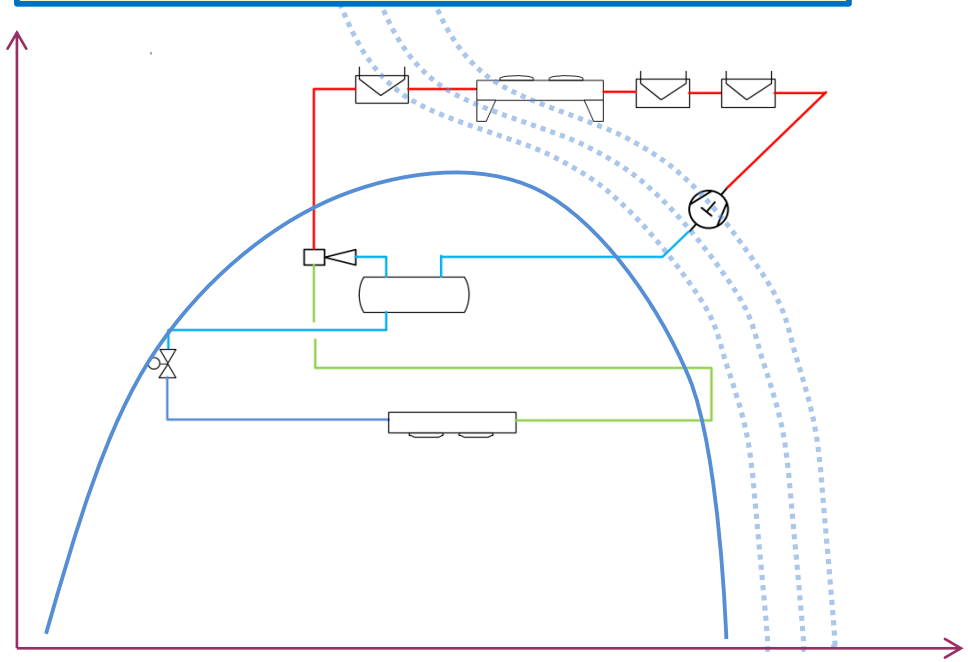
With Modulating Vapour Ejector

40+ 专利patents

~150 应用delivered

喷射器: 高压功回收，用于提升压缩机吸气压力

Ejector: HP work recovery to uplift the compressor suction P



CO2泵: 当环境温度很低时，喷射器无法提供足够的压力提升，因此CO2泵用来提供足够的压头，以维持蒸发器膨胀阀的正常工作。

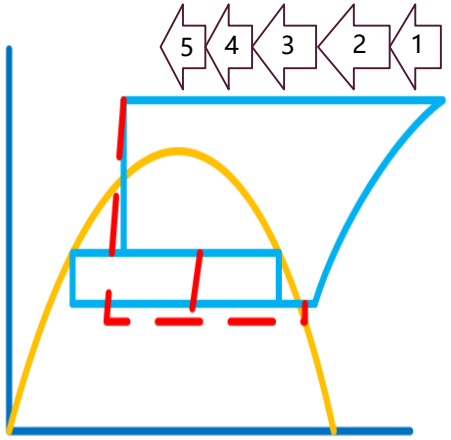
CO2 pump: during low ambient T°, ejector can not deliver enough P uplift, therefore the CO2 pump is used to maintain enough delta P at the evaporator EXV

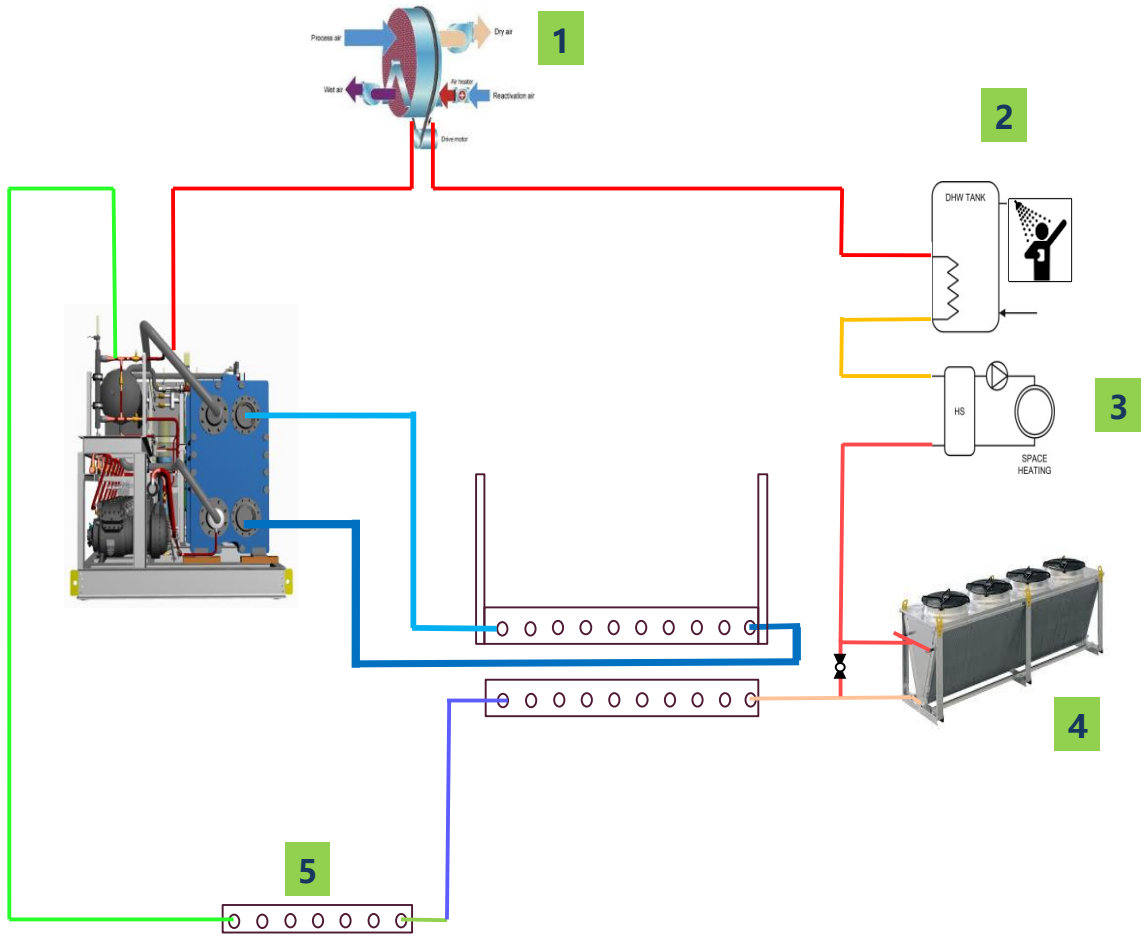
PowerCO$_2$OL热回收选项

PowerCO$_2$OL HEAT RECOVERY OPTIONS

❖ **多级品位热回收**
Multiple Heat Recovery Option

1. 除湿 Dehumidification
2. 卫生用水 Sanitary hot water
3. 空间加热 Space heating
4. 气冷器（可以旁通）Gas cooler (bypass)
5. 热气除霜 Defrost





CO2冷库工程案例集锦

CO2 CASE STUDY-DISTRIBUTION CENTER

澳大利亚 Australia

项目配置：5×MaxiCO2OL
Racks: 5×MaxiCO2OL

运行时间：2016
Operation Date: 2016

>2 MW
中温（MT）

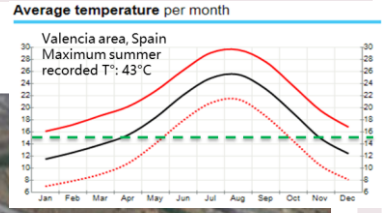
英国 United Kingdom

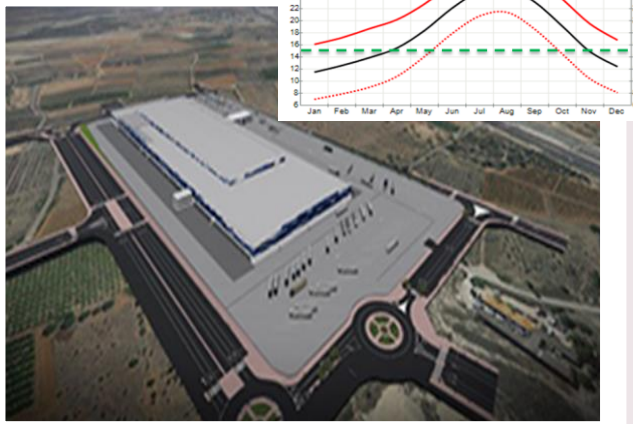
项目配置：标准跨临界CO2系统
Racks: CO2 Transcritical Rack

运行时间：2016
Operation Date: 2016

100 KW
中温（MT）

400 KW
低温（LT）





西班牙 Spain

保鲜区：20000 m2
Fresh area: 2000 m2

冷藏区：8000 m2
Cold Area: 8000 m2

冷冻区：5000 m2
Frozen Area: 5000 m2

2400 KW
高温（HT）

1100 KW
中温（MT）

959 KW
低温（LT）

德国 Germany

项目配置：氨系统改造
Highlights: NH3
Reconstruction

运行时间：2012
Operation Date: 2012

950 KW
中温（MT）

65 KW
低温（LT）

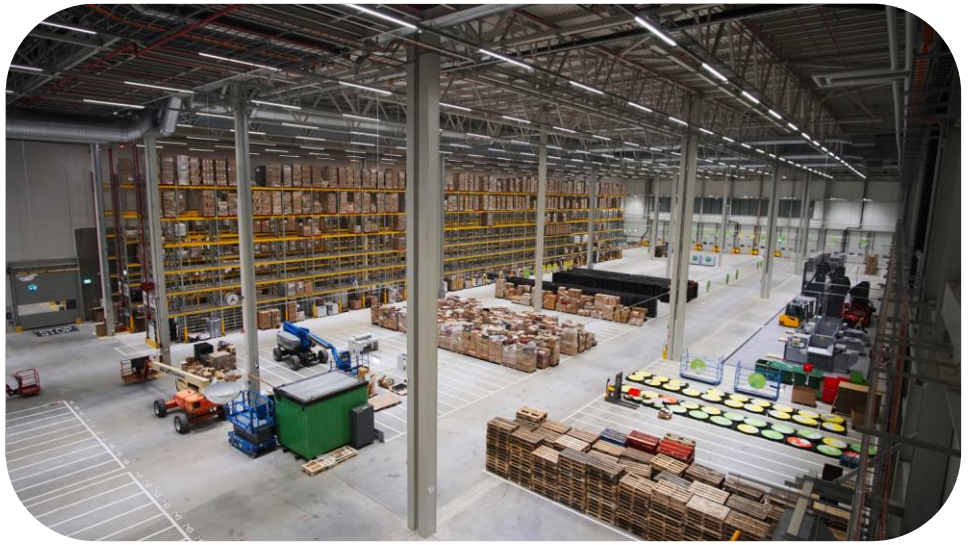
1.095 KW
热回收（HR）

PowerCO$_2$OL工程案例-芬兰耶尔文佩冷库

CASE STUDY- Järvepää DC FINLAND

- 冷藏区 (+2°C) 24 000 m^2
  Cold area (+2°C) 24 000 m^2
  - 2 400 kW (蒸发温度 -10°C)
- 冷冻区 (-26°C) 5 000 m^2
  Frozen area (-26°C) 5 000 m^2
  - 740 kW (蒸发温度 -34°C)
- 速冻区(-42°C) 200 m^2
  Blast freezer (-42°C) 200 m^2
  - 280 kW (蒸发温度 -48°C)

- 62 000 m^2 总面积
  62 000 m^2 total area
- 仓储总容量 1 000 000 m^3
  Total volume above 1 000 000 m^3
- 温控区域 29 000 m^2
  Temperature controlled area 29 000 m^2
- 22m库内高度
  22m indoor height



PowerCO$_2$OL工程案例-芬兰耶尔文佩冷库

CASE STUDY- Järvepää DC FINLAND

- 1000m^3 洒水器水箱，在冬季用作供暖的热量缓冲，在夏季作预冷使用
  1000m^3 Sprinkler water tank used as an energy buffer for heating in winter and sub-cooling in summer time
- 供暖管网的设计充分利用了CO2特性
  Heating network is designed to work together with properties of CO2
- 10°C以下， CO2系统比NH3系统有更好的能效值（EER）；基于全年的分析，前者过冷度和热回收增加的效率更高
  CO2 system has better EER below 10°C compared to NH3 system due to sub cooling and heat recovery on an annual basis
- 由于所处位置，氨的使用受到限制
  Location caused restrictions for the use of ammonia

PowerCO$_2$OL工程案例-芬兰耶尔文佩冷库

CASE STUDY- Järvepää DC FINLAND

- 估算的二氧化碳排放量表明该设施可减少二氧化碳排放带来的影响
  Estimation of CO_2 emissions shows that the property has a negative CO_2 emission impact
- 设施使用无二氧化碳排放量的水力电和风力电
  Property uses emission free electricity produced by the wind and water
- 相比于类似的物流中心，能耗成本削减达到*20%*
  Energy cost is reduced by up to 20% compared to similar logistic centers
- 随着高峰使用量需求负荷的削减，计算总减少量接近*70%*
  With demand load shaving at peak usage the calculated total reduction is near 70%

"For our energy efficient warehouse in Järvenpää, CO_2 system was chosen due to its benefits on overall energy efficiency and its environmental friendly qualities to support our goals"

"在耶尔文佩，为了得到一个高能效的冷库, CO2系统被选中，之所以如此是由于它有利于整体能源效率与环境友好的品质，这些都切合我们的目标。"

Kalle Hintikka, Project leader of Logistic center LIDL Järvenpää
Järvepää LIDL 物流中心主管

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PowerCO$_2$OL工程案例-冷库氨系统改造

CASE STUDY- NH3/R404A TRANSFORMATION

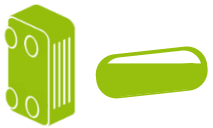
地点: 不来梅，德国
Location: Bremen, Germany

项目配置: 大冷量（半工业级）> 1 MW, 替换现有的NH3和R404A系统
Project Highlights: Large-capacity semi-industrial installation, >1MW. Replacement of existing NH_3 & R404A systems

调试时间: 2017，三季度
Commissioned: 2017，Q3

可调式喷射器
Modulating ejector

CO_2 泵(满液中温)
CO_2 pump (MT)



满液式(低温)
Flooded (LT)

热回收
Heat Recovery

1260 KW 中温 (MT)
480 KW 低温 (LT)

开利中国CO2技术实力及实施能力

CO2 R&D CENTER TECHNOLOGY AND CAPABILITIES

CO2 展示厅和测试中心
Showroom and Test Center

- 提供CO2的服务应用产品培训
  Provide CO2 product and application training
- CO2蒸发器的验证测试
  Evaporator testing and verification
- CO2亚临界和跨临界机组的性能测试
  Sub-critical/Transcritical system performance test

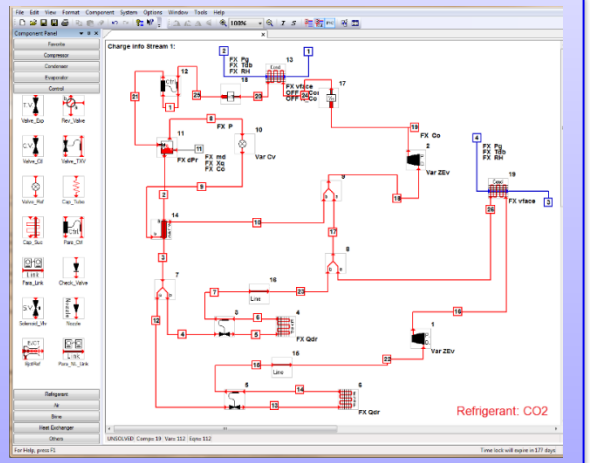
- 从2010年开始，德国研发中心逐渐对上海研发中心的工程师进行CO2的主题培训
  Experts from CO2 R&D center Germany have provided training to SRDC engineers since 2010
- 超过30名的研发工程师在德国的CO2培训中心进行培训，专注于CO2的产品，结构，零部件选型，测试等等
  Over 30 engineers have been trained in CO2 R&D center
- 2018年8月，中国团队总共9人（研发，工程，服务，市场）去欧洲接受了为期三周的培训
  9 engineers from engineering, application, service and marketing team travelled to Europe for technical training for 3 weeks in August 2018

开利中国CO2系统测试及仿真能力

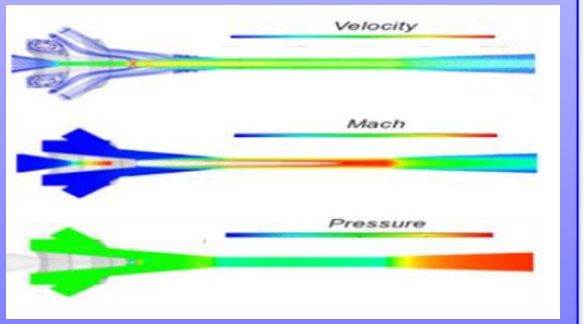
CO2 R&D LAB TEST AND SIMULATION CAPABILITIES

CO2 实验测试
CO2 Lab Test Capability

- 跨临界CO2系统仿真
  Trans-critical CO2 System Modeling



- 喷射器CFD仿真
  Ejector CFD Modeling



CO2 系统模拟仿真
CO2 Modeling and Simulation

开利中国CO2实施项目数总览

CARRIER CHINA CO2 PROJECTS UP TO DATE

HybridCO2OL

低温LT: CO2

中温MT: R134a

CO2OLtec / Eco

低温LT: CO2

中温MT: CO2

CO2OLtec Ejector

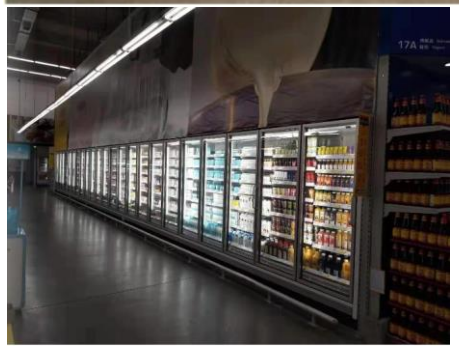
低温LT: CO2

中温MT: CO2

完工 Realized	20	1	1
实施中 On-going	N/A	N/A	N/A
设计完成 Designed	20	4	2

开利中国跨临界CO2项目实施项目-重庆

CARRIER CO2 CHINA PROJECT- CHONGQING



地点: 重庆，中国
Location: Chongqing，China

项目配置: 两套CO2系统 CO2OLtec / Eco + CO2OLtec Ejector
Project Highlights: CO2OLtec / Eco + CO2OLtec Ejector

调试时间: 2019，二季度
Commissioned: 2019，Q2

可调式喷射器
Modulating ejector

280 KW 高温（HT） 200 KW 中温（MT） 140 KW 低温（LT）

感谢您的关注!

Thanks for your attention