

US CASE STUDY

非电空调美国用户案例



PREFACE 前言

BROAD Group is a private manufacturing enterprise dedicated to original innovation. All technologies developed by BROAD are focused on energy efficiency, material conservation, air quality improvement, durability, and intelligence. The mission of BROAD Group is "For Humanity's Future". BROAD is committed to protecting the earth with disruptive and innovative energy-saving and durable technologies, and protecting human life with disruptive and innovative clean and safe technology.

Since 1996, BROAD absorption chillers have been the top seller worldwide. In 2018, BROAD invented the titanium-tubed absorption chiller, extending the design lifespan to 60 years, which has created an unparalleled value for customers. BROAD absorption chillers have dozens of core energy-saving patented technologies, and the chiller energy efficiency is 15% to 30% higher than other chillers in industry worldwide and greatly reduce the customer's carbon footprint. Compared with centrifugal chillers, BROAD waste heat absorption chillers can reduce carbon dioxide emissions by 90%, and energy costs by 80%.

远大科技集团是一家只搞原始创新的私营制造型企业，自创业以来从未模仿过同行业技术。远大所有技术都以节能、节材、洁净、耐久和智能化为核心。“为了人类未来”是远大集团的使命。远大致力于用颠覆性创新的节能、耐久科技保护地球家园，用颠覆性创新的洁净、安全科技保护人类生命。

自1996年起，远大一直是全球行业销量第一，2018年发明钛管非电空调，使产品设计寿命达到60年以上，创造了独一无二的客户价值。远大非电空调拥有数十项核心节能专利技术，主机能源效率比全球同行业高15%~30%，以降低碳足迹。与传统离心式冷水机相比，远大废热型非电空调可降低90%二氧化碳排放量和80%能源成本。



BROAD TOWN

Changsha · Hunan · China

Occupied area: 247 acres

Workshop area: 17.5 acres

Building area: 81 acres

Opening date: January 1th, 1995

远大城

中国 · 湖南 · 长沙

占地面积：1平方公里

厂房面积：7.08万m²

建筑面积：32.75万m²

开城日期：1995年1月1日

This book contains many innovative applications of BROAD absorption chillers in different industries across the United States. Inside this guide you will see a BROAD chiller driven by recovered heat from a wastewater treatment facility in Utah; BROAD chillers can be powered by hot water generated by microgrids, which reduce the burden on the public grid and provide customers with a resilient cooling source at virtually no cost. A microgrid operated by a public safety dept in Maryland provides a great example of a chiller driven by hot water recovered from the microgrid's engine heat. You will also see how universities use absorption chillers to improve the system efficiency of the campus energy plant, reduce carbon emissions and create a "green campus", and how resorts enjoy "free cooling" by using absorption chillers to reduce operating costs and create a sustainable environmental brand.

Due to its economical operation and environmental protection, CCHP (Combined Cooling Heating and Power) systems are widely used in healthcare facilities, commercial buildings and other institutions. You will see how a hospital in Massachusetts and a biopharmaceutical company in Maryland both power their BROAD steam chillers from the heat recovery steam generator in their CCHP system to achieve the goals of zero carbon and low energy cost. There are also other case studies describing how BROAD absorption chillers use one or multiple heat sources to turn waste into a valuable resource, thereby providing customers with flexible, efficient, zero-cost, low-carbon and emission-reducing air conditioning, achieving a win-win situation for the customer and for environmental protection.

BROAD: continuously innovates sustainable solutions for the environment-naturally.

本册总结了远大非电空调在美国多个行业用热制冷的创新应用。例如犹他州的污水处理厂如何利用废热水制冷满足厂区设施需求；马里兰州的公共微电网如何利用发电机的缸套水提供清洁可靠制冷，降低微网运营成本；美国大学如何利用非电空调提高校园集中能源站的系统效率，降低碳排放，打造“绿色校园”；度假村酒店如何利用非电空调享受“免费制冷”，降低运行成本，打造可持续环保品牌理念等等。

冷热电联产得益于系统的经济性和环保性广泛应用于美国医院、商业等机构中，你会在本册看到麻州的医院和马里兰州的生物制药公司如何在冷热电联产系统中结合余热锅炉和蒸汽型非电空调实现企业的零碳低成本能源目标。还有诸多案例介绍远大非电空调如何使用一种或多种热源实现变废为宝，从而为客户提供了韧性高效，成本为零，低碳减排的空调，实现了客户利益和环境保护双赢。

远大：为自然环境的可持续化发展不断创新。



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A HYBRID MICROGRID TECHNOLOGY TO WEATHER THE STORM

MONTGOMERY COUNTY PUBLIC SAFETY HEADQUARTERS 混合微网保运行 — 蒙哥马利公共安全总部

Background

The Public Safety Headquarters (PSHQ) is a landmark building in Montgomery County. Built in 1968, the building is nearly 400,000 square feet, which is the county's largest and primary administrative facility for a range of critical public services including transportation management, County's Office of Emergency Management and etc.

Maryland is among the states most vulnerable to climate changes. Since 2010 extreme weather events caused at least 26 times power outages in Maryland, including one that lasted 11 days as a result of Hurricane Sandy. In order to mitigate the risks from severe weather events, acts of terrorism and high energy costs, along with the County government's goal of reducing greenhouse gas emissions 80% by 2027, PSHQ developed an advanced hybrid microgrid combined PV technology with combined cooling, heating and power (CCHP) system.

This project is financed at zero upfront cost, which received grants from the Maryland Energy Administration (MEA) and is awarded through a 25-year microgrid as a service power purchase agreement (PPA) that allows the county to pay for the project by purchasing the usage right of the equipment and the energy generated. Also the project leveraged utility incentives by the local utility company Pepco.

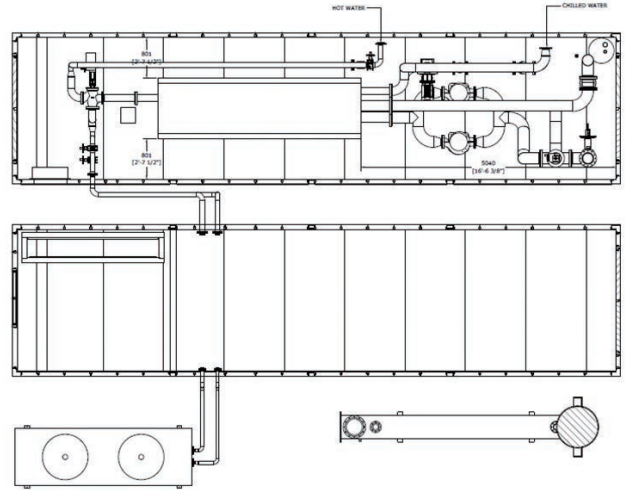
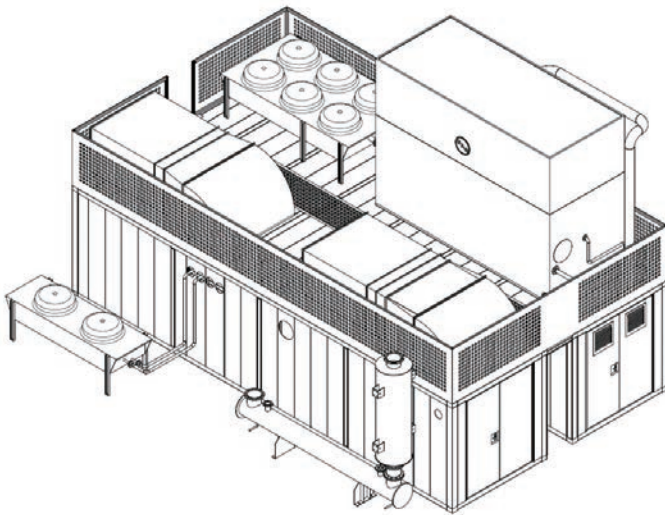


客户背景

蒙哥马利公共安全总部是马里兰州蒙哥马利县的一座地标性建筑。该建筑建于1968年，占地面积近4万平米，是该县最大的主要行政设施，提供包括运输管理、县紧急管理等一系列重要公共服务。

马里兰州是美国最易受气候变化影响的州之一。自2010年以来，该州因极端天气事件造成至少26次停电，其中包括飓风桑迪引发的长达11天的停电事故。为了降低恶劣天气事件和恐怖主义行为带来的风险及高昂的能源成本，并实现蒙哥马利县政府到2027年温室气体减排80%的目标，蒙哥马利县公共安全总部安装了一套结合光伏技术与冷热电联产(CCHP)系统的混合微电网系统。

该项目获得了马里兰州能源管理局(MEA)的拨款，并通过为期25年的微电网购电服务协议实现了初期零投资，使该县可以通过购买设备的使用权及产生的相关能源以支付项目初投资。此外，该项目还获得了当地公用事业公司Pepco的激励补助。



BROAD Absorption Chiller Package Design Drawing 远大非电空调封装设计图

System Introduction

The microgrid system includes 2MW solar photovoltaic canopies mounted over the existing parking lot, providing shade to cars while powering the facility. Also a new CCHP system, electric vehicle charging stations and a cyber security system are installed.

The microgrid system can generate 11.4 million kWh annually, providing an estimated 90-95% of the facility's annual electricity consumption and nearly infinite backup capacity with minor adjustments to operations.

2G Energy provided the new 800 kW CCHP package system including a natural gas reciprocating engine, coupled with heat recovery devices to drive a BROAD absorption chiller to supplement existing building chillers. The system comprehensive energy efficiency can reach up to 76%.

系统介绍

该微电网系统包括在现有停车场上安装2MW太阳能光伏顶篷，在为汽车遮阳的同时为设施供电。还包括一套新冷热电联产系统、电动汽车充电站和网络安全系统。

该微电网系统年发电量为11.4GWh，约占整个设施年用电量的90%~95%，并且在对运行稍作调整后能提供近乎无限的备用容量。

2G能源公司作为国际领先的冷热电联产机组设备生产供应商提供了一套全新的800kW成套系统。主要设备包括一台燃气发电机组、热回收装置和一台远大非电空调，以回收发电机烟气和缸套水废热驱动远大非电空调制冷，其系统综合能效可达76%。



About Microgrids

Microgrids are miniature versions of the centralized electric grid that dispatches, distributes, and regulates the flow of electricity. Microgrids are a growing segment of the energy industry, representing a paradigm shift from remote central station power plants toward more localized, distributed generation, especially in cities, communities and campuses. The power to isolate from the larger grid makes microgrids resilient, and the ability to conduct flexible, parallel operations permits delivery of services that make the grid more competitive.

By “islanding” from the grid in emergencies, a microgrid can both continue serving its included load when the grid is down, and serve its surrounding community by providing a platform to support critical services from hosting first responders and governmental functions, to providing key services and emergency shelter.

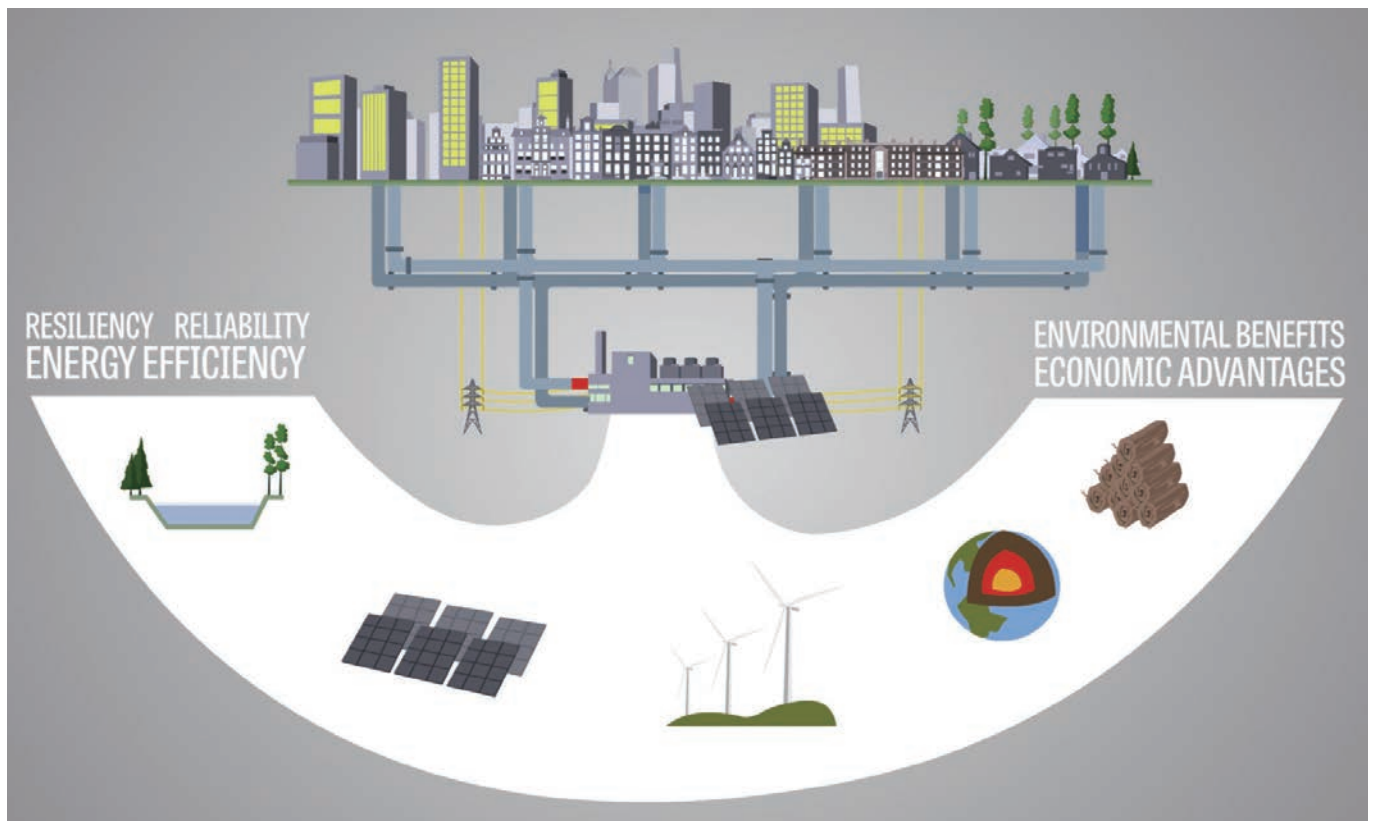
Microgrids provide efficient, lowcost and clean energy, enhance local resiliency, and improve the operation and stability of the regional electric grid. They provide dynamic responsiveness unprecedentedly as an energy resource.

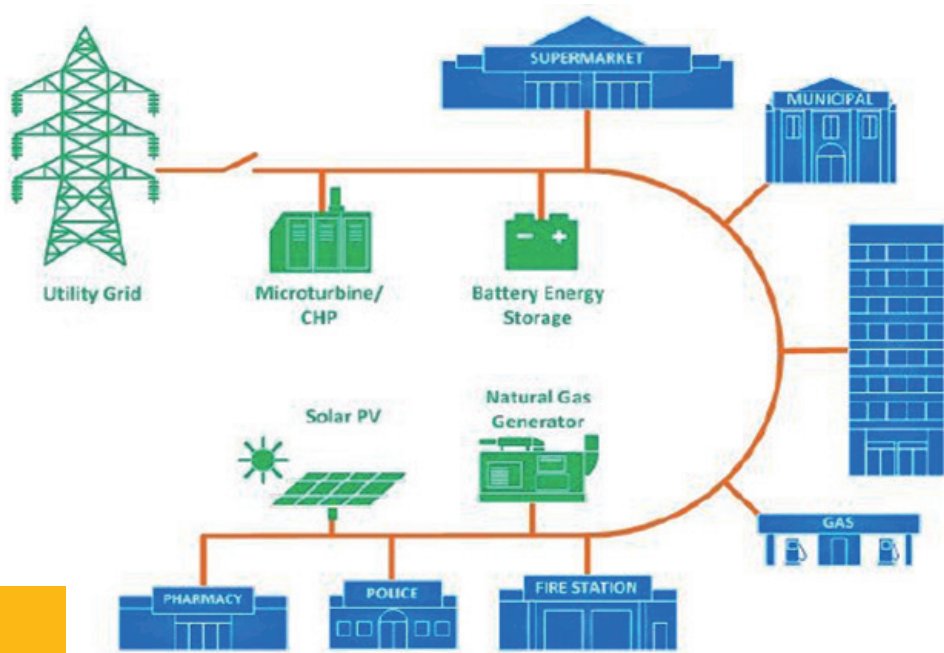
关于微电网

微电网是将分布式电源、负荷、储能装置、变流器以及监控保护装置等有机整合在一起的小型发电配电系统。微电网的研究应用在当今能源行业中不断增长，代表了从偏远的集中发电厂向本地化、分布式发电（特别是在城市、社区和校园中）的转变。由于微电网独立于主电网，实现自给自足和弹性供电，且操作灵活，可并网运行，使其在未来智能电网的建设中更具竞争力。

通过在紧急情况下由并网运行转为“孤岛”运行，微电网既可以在主电网故障时继续为其包含的负载供电，又可以为急救人员和重要政府职能部门提供关键服务，从而保障周围社区服务和提供紧急庇护。

微电网能提供高效、低廉、清洁的能源，增强本地系统弹性，并改善区域电网的运行稳定性，实现对能源的动态需求响应。





Community Microgrids
社区微电网示意图

Benefits of Microgrids

- Provide efficient, lowcost, clean energy.
- Improve the stability of the regional grid.
- Increases reliability and resilience of critical infrastructure.
- Reduce grid “congestion” and peak loads.
- Enable highly-efficient CCHP, reducing fuel use, line losses, and carbon footprint.
- Integrate CCHP, renewables, thermal and electric storage, and advanced system and building controls.
- Make RTO markets more competitive.
- Offer grid services including: energy, capacity, and ancillary services.
- Support places of refuge in regional crises and first responders.
- Use local energy resources and create job opportunities.
- Diversify risks rather than concentrate risks.
- Using electric and thermal storage capabilities, a microgrid can provide local management of variable renewable generation, particularly on-site solar.
- When properly designed, a regional power grid that combines both large central plants and distributed microgrids can be built with: less total capital cost, less installed generation equipment, higher capacity factor on all assets, and higher reliability.

微电网优势

- 提供高效、低成本的清洁能源。
- 改善区域电网的运行稳定性。
- 增强关键设施的可靠性和弹性。
- 减少电网“拥堵”和峰值负荷。
- 实现高效的冷热电联产，减少燃料耗量、线路损失和碳排放。
- 集冷热电联产、可再生能源、蓄热和蓄电以及先进楼宇控制系统于一体。
- 使区域输配市场更具竞争力。
- 为电网供能、增容及提供辅助服务。
- 在地区出现危机时提供避难和第一响应。
- 使用当地的能源，增加当地就业机会。
- 分散风险。
- 利用蓄电和蓄热能力，微电网可提供对可变可再生能源发电的本地管理，尤其是对于太阳能就近发电。
- 若设计合理，可构建将大型集中电厂和分布式微电网相结合的区域电网：总投资成本更低，发电设备更少，容量系数以及可靠性更高。

Equipment Information

Generator: MWM
 Fuel: Natural gas
 Rated power output: 800 kW
 Electrical Efficiency: 42.4%

BROAD Absorption Chiller

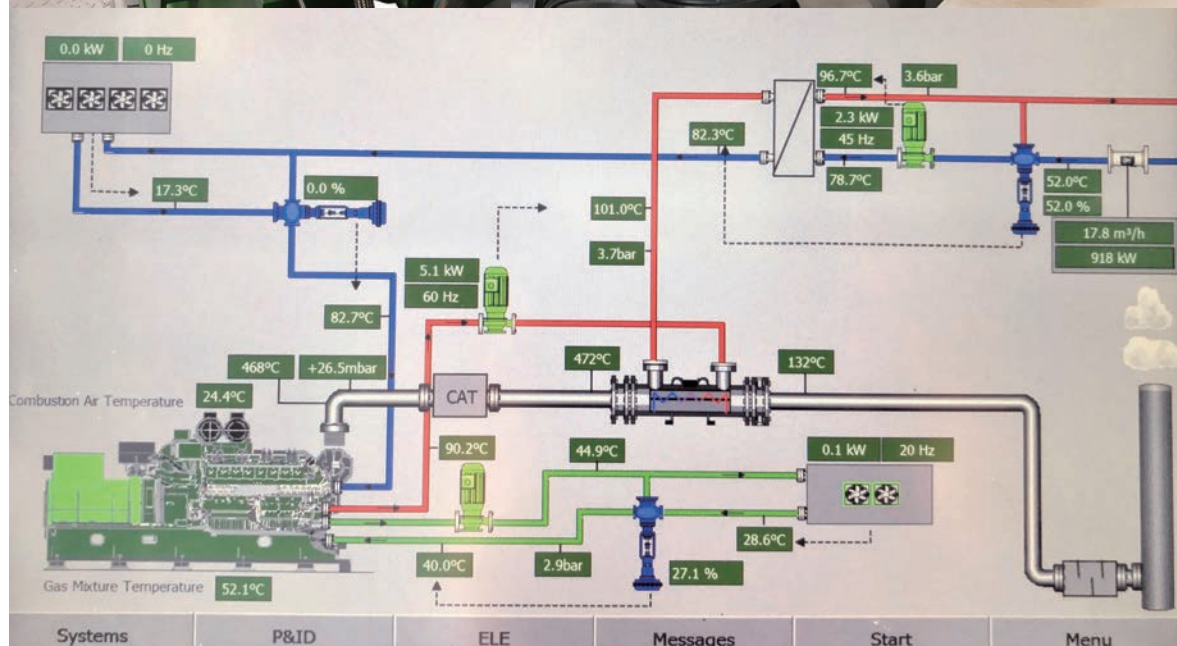
Model: Single-stage hot water chiller BDH100
 Cooling Capacity: 180 RT
 Heat Source: Hot water from engine heat recovery loop

设备信息

发电机组品牌: MWM
 燃料: 天然气
 额定发电功率: 800kW
 发电效率: 42.4%

远大非电空调

型号: 单效热水机 BDH100
 制冷量: 633kW
 驱动热源: 发电机组热水



PSHQ Mechanical Room & Control Panel 蒙哥马利公共安全总部机房及控制屏

Project Value

The advanced hybrid community microgrid in the PSHQ incorporates natural gas, solar PV and CCHP system to provide uninterrupted 24/7 electricity service to ensure the resiliency of critical public services during major electric distribution system outages.

From the graph of PSHQ daily power utilization below, the CCHP system operates 24/7 at a constant output of 760 kW, provides two thirds of the electrical load, which can operate in grid parallel mode and in island mode when the grid is not available.

As a key element of a CCHP system, the BROAD absorption chiller recovers waste heat from the generator and provide 180 tons of “free” cooling to the facility, reducing the electricity consumption by 946 MWh per year and improving energy efficiency up to 76%.

As of October 2018, the microgrid has saved 12 million kWh of energy, mitigated 11 kilotons of GHG emissions which is the equivalent of taking more than 2,376 cars off the road, and has saved operating cost of 486,000 USD.

Because of its outstanding performance on energy efficiency, Montgomery County Public Safety Headquarter is the first of its kind to achieve PEER (Performance Excellence in Electricity Renewal) Platinum certification - equivalent to the U.S Green Building Council's LEED green building rating system.

This project is a national model to improve the resiliency of local governments and won a 2018 National Association of Counties (NACo) Achievement Award to recognize its innovative county government program.

项目价值

公共安全总部的社区混合微电网结合了天然气、太阳能光伏发电和冷热电联产多种清洁能源，可提供全天候电力服务，以保障重大配电系统中断事故期间关键公共服务的系统弹性。

从PSHQ日发电量图表中（下图）可以看出，该冷热电联产系统以760kW的恒定输出功率全天候运行，可满足公共安全总部三分之二的电力需求，并可在并网模式和孤岛模式下运行。

作为冷热电联产系统的关键设备，远大非电空调回收发电机废热，提供633kW的“免费”制冷量，减少了年制冷用电量946MWh，系统能源效率提高到76%。

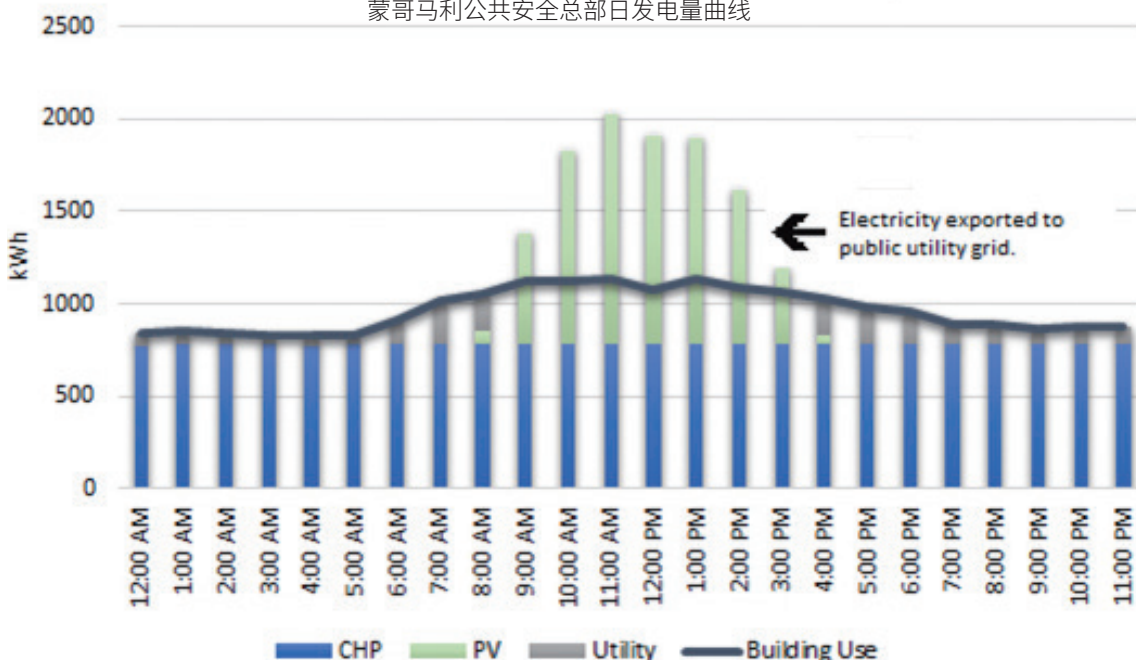
到2018年10月，该微网系统节省了 1.2×10^7 kWh能源，减少了11000吨温室气体排放，相当于减少了2376辆行驶汽车的排放量，并节省了48.6万美元的运营成本。

由于其在能源效率方面的出色表现，蒙哥马利县公共安全总部是首家获得PEER 白金认证的公共机构，其对电力系统的评级相当于美国绿色建筑委员会的LEED绿色建筑评级系统。

该项目是提高地方政府设施弹性的国家典范，获得了2018年全国县协会（NACo）成就奖。

PSHQ Actual Generation in One Day

蒙哥马利公共安全总部日发电量曲线





BIOGAS CCHP

CENTRAL VALLEY WATER RECLAMATION FACILITY

生物天然气CCHP—盐湖城中央谷污水回收厂

Background

Central Valley Water Reclamation Facility (CVWRF) is a state-of-the-art facility in Salt Lake City, Utah that treats wastewater using a combination of processes. As Utah's largest wastewater treatment facility, CVWRF has a capacity of 75 million gallons of water treated daily from nearby member entities. Those millions of gallons of water are processed, impurities are separated and treated, and harmful bacteria, protozoa, and viruses are eliminated so that only clean water is returned to the Jordan River system.

System Introduction

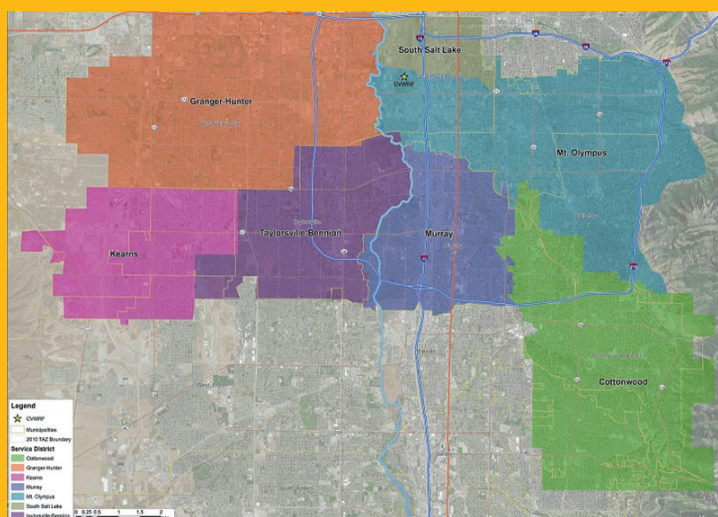
CVWRF upgraded its over 30 year old CCHP system in 2018, which is a critical element in the plant's daily operation. The CCHP system serves as the primary power source and currently produces over 85% of the facility's electrical power needs. In addition, the heat from the biogas/natural gas fuel reciprocating engines is harnessed by a heat recovery system for sludge digester heating and for building and tunnel space heating. In addition, the recovered heat feeds a BROAD single-stage hot water absorption chiller to provide cooling for the facility.

客户背景

中央谷污水回收处理厂（简称“处理厂”）是犹他州盐湖城最大最先进的污水处理厂。每天可处理来自附近成员单位的污水28.5万吨。污水经过多级分离和处理过滤了杂质，消除了有害细菌、原生物和病毒，处理后的净水再返回附近约旦河水系。

系统介绍

为保障处理厂的日常运营，处理厂于2018年对其已有30多年历史的冷热电联产系统进行了升级。该冷热电联产系统作为处理厂的主要电源，目前可满足该厂超85%的电力需求。此外，热回收系统通过回收沼气/天然气发电机组产生的废热，用于污泥消化池加热以及建筑物供暖。此外，回收的废热还驱动一台远大单效热水机，为处理车间及办公区域供冷。



CVWRF Service District Map
中央谷污水回收处理厂服务区域地图

Equipment Information

Generator

Brand: Jenbacher
Fuel: Biogas/ Natural gas
Power output: 1500 kW
Electrical Efficiency: 41.4%

BROAD Absorption Chiller

Model: Single-stage hot water chiller BDH200
Cooling Capacity: 400 RT
Heat Source: Hot water from engine heat recovery loop

设备信息

发电机组

品牌: 颜巴赫
燃料: 沼气/天然气
发电功率: 1500kW
发电效率: 41.4%

远大非电空调

机型: 单效热水机 BDH200
制冷量: 1407kW
驱动热源: 发电机缸套水



CVWRF Water Distributed System
处理厂供水系统



CVWRF Mechanical Room
制冷机房

Project Value

The BROAD absorption chiller uses anticorrosion high purity titanium tubes, thus in this project it can utilize treated wastewater directly instead of a cooling tower to take the heat away and discharge it to the Mill Creek nearby, minimizing the land coverage and initial investment of cooling tower, and saving over 17 million gallons city water annually.

The BROAD absorption chiller recovers engine waste heat to provide 400 tons of “free” cooling, saving electricity consumption more than 950 MWh per year for cooling.

With the absorption chiller, the energy efficiency of the whole system rises to above 80%.

Compared to a central station power plant, the CCHP system saves 15,514 MMBtu of fuel annually, saving operation costs about 700,000 dollars*.

System annual CO₂ reductions: 4,272 metric tons, which is equivalent to carbon sequestered by 70,488 trees grown for 10 years*.

项目价值

远大非电空调采用耐腐蚀高纯度的钛管，因此在该项目中可直接利用处理后的水代替传统冷却塔将热量带走，排放到附近的河流中，从而最大程度地减少了冷却塔的占地面积和初期投资，且每年可节省城市用水超6.5万吨。

远大非电空调回收发电机废热，提供1407kW“免费”制冷，每年可减少超950MWh制冷用电量。

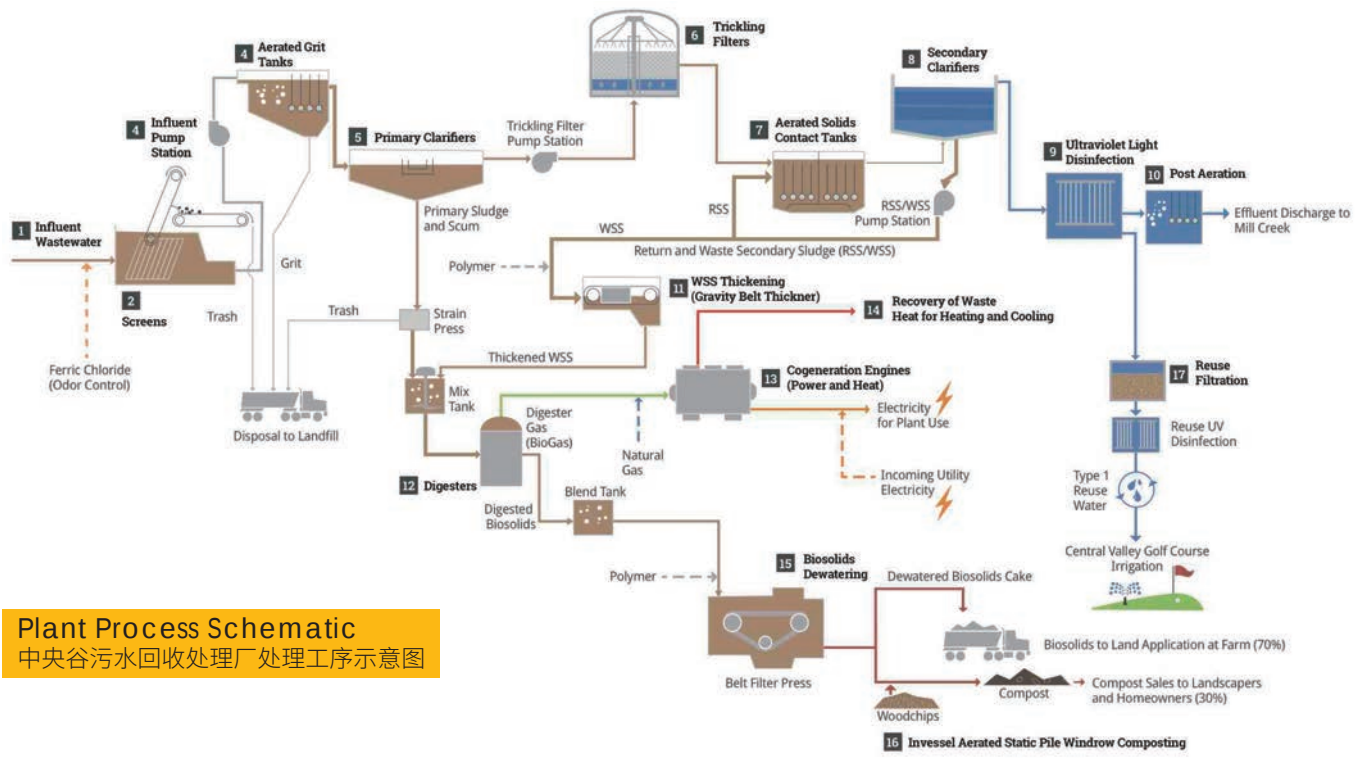
远大非电空调使整个冷热电联产系统的能源效率提高到80%以上。

与传统集中电站相比，该CCHP系统年节能 1.6×10^{10} kJ（约390吨原油当量），减少运营成本约70万美金*。

系统年二氧化碳减排量4272吨，相当于10年种7万多棵树的碳吸收量*。

* Results are based on US EPA CHP Energy and Emissions Savings Calculator, which may vary from the actual operation data.

* 结果基于美国能源局CHP能源及排放量计算所得，可能与实际运行数据有偏差



Specific Benefits for Wastewater Treatment Plant (WWTP) CCHP:

- Produces power at a cost below retail electricity.
- Replaces purchased fuels for thermal needs.
- May qualify as a renewable fuel source under state renewable portfolio standards and utility green power programs.
- Enhance reliability for the plant.
- Produces more useful energy than if the WWTP were to use biogas solely to meet digester heat loads.
- Reduces emissions of green house gases and other air pollutants.
- Utility peak load shedding.

Fun Facts of WWTP CCHP:

- In the U.S. a typical WWTP processes 100 gals per day of wastewater for each person.
- Each million gallons per day (MGD) of wastewater flow can produce biogas in an anaerobic digester to produce 30kW of electric capacity and 2.4 MMBtu/day of thermal energy in a CCHP system.
- The cost to generate electricity using CCHP at WWTPs ranges from 1.1¢ to 8.3¢ per kWh depending on the CCHP prime mover and other factors. (Current retail electric rates range from 3.9¢ to over 21¢ per kWh)

污水处理厂CCHP优势

- 自发电电价低于电网零售价。
- 替代购买燃料以满足热需求。
- 产生的沼气作为可再生能源可加入各州可再生能源投资项目和绿色电力计划。
- 提高污水处理厂运行可靠性。
- 与仅使用沼气来满足消化池热负荷的污水处理厂相比，其产生的有用能量更多。
- 减少温室气体和其他空气污染物的排放。
- 削减能源高峰负荷。

污水处理厂CCHP小常识

- 美国污水处理厂通常要处理每人每天100加仑的污水（454L）。
- 每天每百万加仑（MGD）的污水在厌氧消化池中产生的沼气可供CCHP系统产生30kW的发电量及每天 2.5×10^6 kJ的热能。
- 污水处理厂使用CCHP发电的成本在每千瓦时1.1至8.3美分之间，取决于CCHP原动机和其他因素。（目前美国零售电价为每千瓦时3.9至21美分）



MULTI-ENERGY DRIVEN CHILLER IN CCHP

PINELLAS COUNTY JAIL

多能源CCHP — 皮涅拉斯县监狱



Pinellas County Jail Infrastructure Building
皮涅拉斯县监狱基础设施楼



Pinellas County Jail
皮涅拉斯县监狱内部

Background

The Pinellas County Jail is located on 54 acres of land in central Pinellas County, and adjacent to the Criminal Justice Center. It is the only jail in Pinellas County and serves all law enforcement agencies. The jail complex houses an average daily population topping 3,000 inmates, including pretrial and sentenced offenders.

The Pinellas County Jail is the 28th largest jail in the nation, and is nationally accredited by Detention and Inmate Healthcare professional associations.

客户背景

皮涅拉斯县监狱（以下简称“监狱”）位于佛罗里达州皮涅拉斯县中部，占地面积近22万平方米，毗邻县刑事司法中心，是皮涅拉斯县唯一的监狱并为该县所有执法机构提供服务。该监狱日均容纳3000名囚犯，包括审判前和已判刑的罪犯。

皮涅拉斯县监狱是美国第28大监狱，获得了全国拘留及囚犯医疗保健专业协会的认可。

System Introduction

Due to Florida's unpredictable weather and yearly hurricanes, in 2015, the Pinellas County Commission approved a nearly \$100 million upgrade project renovating parts of the Pinellas County Jail.

Phase I of this upgrade project includes the design and construction of two new buildings. One houses the facility's kitchen, laundry room and central energy plant; the second new building houses the warehouse operations, facilities maintenance and a warehouse. This project was completed in 2018 and was awarded the Best Overall Project by Design-Build Institute of America Florida in 2019.

The new central energy plant for Pinellas County Jail is designed with a state-of-the-art CCHP system including a 2MW gas engine and a 1,000-ton BROAD multi-energy absorption chiller. Phase II project would employ an identical system and already reserved the space.

Instead of only operating during an emergency or outage, the CCHP system is running 24/7 all year round to lower energy costs and improve efficiency. The BROAD absorption chiller can provide a maximum of 1,000 tons of cooling, in which 500 tons of "free" cooling is from reclaiming the waste heat from engine exhaust and jacket water. The jacket water is also used to preheat the hot water and steam systems. The plant also includes two 1,500-ton centrifugal chillers with space for expansion.

Unlike the common CCHP system, the chiller can also use natural gas to provide a supplementary energy source and full back up. Thus when the engine is under maintenance or shutting down, the chiller alone can still provide chilled water to serve the facilities, providing redundancy and resiliency for the whole system.

系统介绍

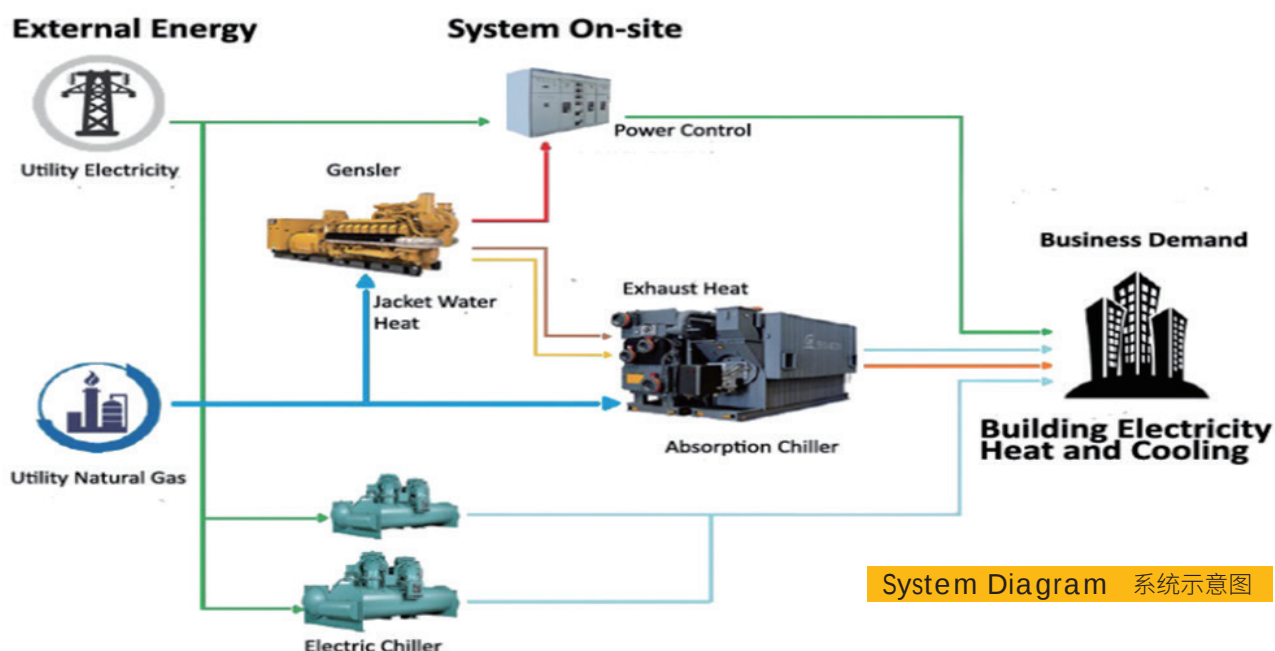
由于佛罗里达州变化多端的天气和每年的飓风季，2015年皮涅拉斯县委员会批准了一项近1亿美金的升级改造项目，用于对监狱进行部分翻新。

该监狱升级项目一期工程包括新建两栋建筑：一栋设有厨房、洗衣房及集中能源站，另一栋作为仓库并提供仓储运营和设施维护。该项目于2018年完工，被美国佛罗里达州设计施工一体化协会评为2019年度最佳项目。

监狱新集中能源站采用了先进的冷热电联产系统，包括一台2MW燃气发电机和一台远大多能源非电空调。二期工程计划采用相同的系统设计，且已预留出机组空间。

该冷热电联产系统全年24小时不间断运行，而非仅在紧急情况或电力中断时使用，以降低能源成本并提高效率。该项目远大非电空调最多可提供3500kW制冷量，其中一半的“免费”制冷量来自于回收发动机烟气和缸套水废热。此外发电机缸套水还用于预热热水和蒸汽系统补水预热。该能源站还包括两台5275kW的离心式冷水机组用于未来扩容。

与常见冷热电联产系统不同，这台远大多能源非电空调可利用天然气提供补燃和完全备份。当发动机处于维护或停机状态时，非电空调仍可为建筑供冷，从而为整个系统提供冗余和弹性。



System Diagram 系统示意图



Mechanical Room of Pinellas County Jail 皮涅拉斯县监狱机房

Equipment Information

Generator

Model: CAT G3516H
 Fuel Type: Natural Gas
 Maximum Continuous Rating: 2,027 kW
 Maximum Electrical Efficiency: 44.7%

BROAD Absorption Chiller

Model: Multi-energy chiller BZHE300
 Cooling Capacity (CCHP/Max): 500/1,000 RT
 Heat Source: Exhaust, Hot Water, Natural Gas

Project Value

The BROAD multi-energy chiller realizes the step-by-step utilization of waste heat, achieving a comprehensive energy efficiency of approximately 83%, saving nearly 3,500 MWh per year electricity consumption for cooling.

The natural gas backup of absorption chiller ensures the redundancy and consistency in the chilled water loop, thus when the generator is intelligently switched off based on the control system's analysis, the absorption chiller can smoothly change to direct-fired mode to ensure stable operation.

The BROAD absorption chiller is able to meet 80~100% of the building's cooling requirement, allowing the electric chillers to be turned off at the current stage.

Compared to the central station power plant, annual energy savings from the CCHP system: 11,428 MMBtu of fuel*.

System annual greenhouse gas emissions reduction: 1,837 metric tons of carbon dioxide equivalents, which is equivalent to carbon sequestered by 30,310 trees grown for 10 years*.

System simple payback period: 4.5 years.

设备信息

发电机组

机型：卡特彼勒 G3516H
 燃料：天然气
 最大发电功率：2027kW
 最高发电效率：44.7%

远大非电空调

机型：多能源机组 BZHE300
 制冷量（仅CCHP/最大）：1750/3500kW
 驱动热源：发电机组烟气和缸套水，天然气

项目价值

远大多能源非电空调实现了余热的逐级利用，综合能效提升至83%，每年节省近3,500MWh制冷电力需求。

远大非电空调使用天然气作为备用能源保障了冷水回路的冗余性和稳定性。因此，当发电机根据其智能控制系统的分析停机时，非电空调可以平稳地切换至直燃模式，以确保系统稳定运行。

远大非电空调现阶段能够满足80%~100%建筑制冷负荷，目前电冷机处于停机状态以节约用电。

与传统中央电站相比，该CCHP系统年节省能源约 1.2×10^{10} kJ（约290吨原油当量）*。

系统年温室气体减排量：1837吨二氧化碳当量，相当于10年种3万多棵树的碳吸收量*。

系统投资回收期约4.5年。

* Results are based on US EPA CHP Energy and Emissions Savings Calculator, which may vary from the actual operation data.

* 结果基于美国能源局CHP能源及排放量计算所得，可能与实际运行数据有偏差



HOT WATER DRIVEN DISTRICT ENERGY

RUTGERS UNIVERSITY

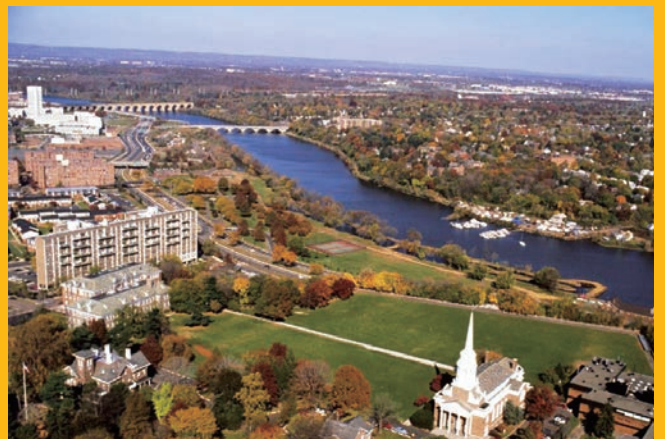
热水区域能源 — 罗格斯大学

Background

Rutgers University, The State University of New Jersey, is an American public research university in New Jersey. Rutgers was originally chartered as Queen's College in 1766. It is the eighth-oldest college in the United States and one of the nine colonial colleges chartered before the American Revolution.

Rutgers is the largest institution of higher education in New Jersey. It has three campuses located throughout New Jersey: the New Brunswick campus, the Newark campus, and the Camden campus. The university has additional facilities elsewhere in the state.

Instruction is offered by 9,000 faculty members in 175 academic departments to over 45,000 undergraduate students and more than 20,000 graduate and professional students.



客户背景

罗格斯大学是新泽西州公立研究型大学。罗格斯大学原名女王大学，成立于1766年。它是美国八大最古老大学之一，也是美国独立战争前特许的九所殖民大学之一。

罗格斯大学作为新泽西州最大的高等教育机构，在新泽西州拥有三个校区：新不伦瑞克校区、纽瓦克校区和卡姆登校区。该大学在州内其他地方还设有分支。

全校设有175个学系，共计9000名教职员工、45000多名本科生和20000余名研究生。

**Busch Cogeneration Plant** 布希热电联产能源站

System Introduction

A central energy plant has provided district heating at Rutgers University in Piscataway, NJ since 1950. To meet the increasing heating demand, as well as to improve the efficiency and cost savings, Rutgers built the 13MW Busch Cogeneration Plant on Busch campus in 1995 to provide power and high-temperature hot water to the Busch and Livingston campuses.

The cogeneration plant includes three gas turbines with three heat recovery high-temperature water heaters, which together produce up to 14 MW of electricity and 75 MMBtu/hr of heat. When needed, duct burners produce an additional 75 MMBtu/hr of thermal energy increasing the total thermal output of the turbines to 150 MMBtu/hr.

The heat generated from the plant maintains 250,000 gallons of water in the closed loop high-temperature hot water system at a nominal temperature of 370°F. The entire high temperature water system is maintained at 150 psig (above the saturation pressure) to prevent boiling in the system. The water is then piped to campus buildings using four zone pumps.

In 2015 the university saved \$3.4 million by producing instead of purchasing electricity. Another \$2.9 million was saved by avoiding hot water expenditures.

To lower the piping cost and energy loss, from the year of 2012-2020, Rutgers University installed/replaced three absorption chillers in its student apartment buildings. All of those absorption chillers are fed by the campus hot water from the Busch cogeneration plant to provide cooling.

系统介绍

自1950年以来，位于新泽西州皮斯卡塔韦的集中供热厂一直为罗格斯大学供暖。为满足校园不断增长的供热需求，并提高能源效率和节约成本，罗格斯大学于1995年建成了13MW布希热电联产能源站，为布希和利文斯顿校区提供电力和高温热水。

该能源站包括三台燃气轮机和三台热回收高温热水器，可产生高达14MW的电力和1890万大卡/小时的热量。必要时，管道燃烧器可产生额外1890万大卡的热量，从而将涡轮机总热量输出提高至3780万大卡。

能源站产生的热量将950吨的闭式高温热水保持在188°C左右。整个高温水系统维持在1MPa（高于饱和压力）以防止系统沸腾，再通过四个分区水泵将热水输送到校园各建筑。

仅2015年，该大学通过就地发电替代买电，节省了340万美元，通过热回收进一步节省了290万美元热水费用。

为了降低管道成本和能源损失，罗格斯大学在2012至2020年期间在其三处学生公寓楼中分别安装/替换成远大非电空调。这些非电空调均由布希能源站的热水驱动，为公寓提供制冷。



Livingston Apartments & Mechanical Room 利文斯顿公寓及机房

Phase I: Livingston Apartments 第一期项目：利文斯顿公寓

Opened in 2012, Livingston Apartments are one of Rutgers' newest on-campus living spaces. Three up-to-7 floor buildings, A, B, and C, make up the apartments, which can accommodate 1600 students. It is home to continuing students, single graduate students and the Global Roommates Program.

Livingston Apartments have fitness centers, study lounge, communal demo kitchens with seating up to 30 people, an onsite computer lab, etc., building up a comfortable and convenient learning-living community for students.

To increase energy efficiency and lower operation cost, Livingston Apartments installed a 950-ton BROAD two-stage chiller to provide cooling for the buildings. Driven by the hot water (350°F) from the central heating plant, the BROAD chiller covers most of the building cooling load and saves about 570 kW power demand compared to electric chillers, currently, the two on-site electric chillers are barely running.

利文斯顿公寓楼于2012年正式投入使用，是罗格斯大学最新的校园生活区之一。公寓由A、B、C三栋楼组成，最高7层，最多可容纳1600名学生，是继续教育学院学生、单身研究生和全球室友计划的主要住所。

利文斯顿公寓设有健身中心、自习室、可容纳30人的公用展示厨房、计算机实验室等设施，为学生建立了一个舒适便捷的学习生活社区。

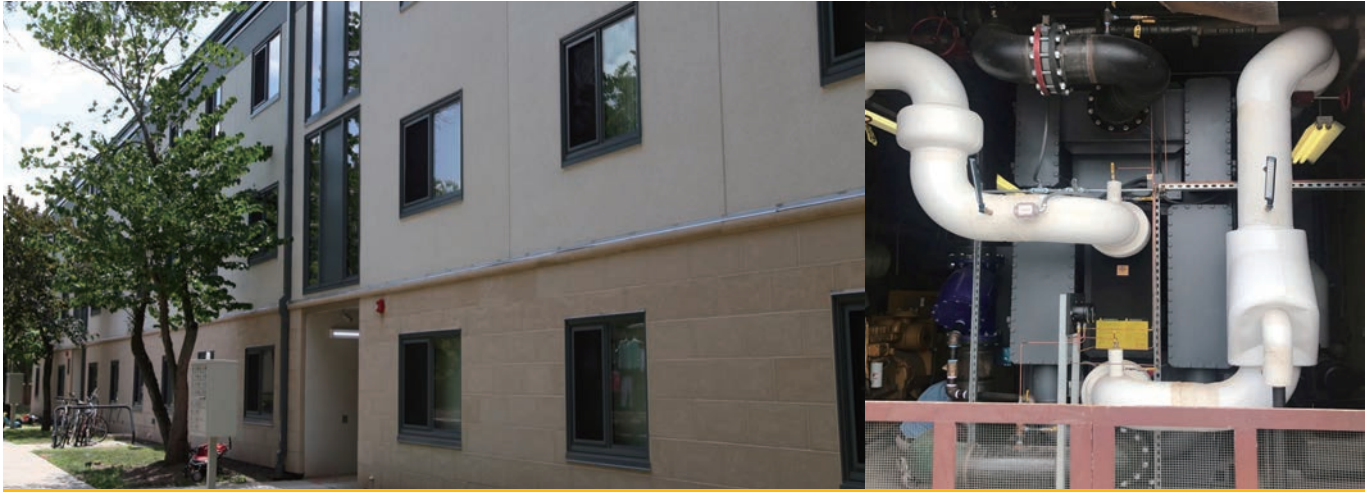
为提高能源效率和可靠性并降低运营成本，利文斯顿公寓安装了一台远大双效热水机，为公寓提供制冷。在177°C校园管网热水的驱动下远大非电空调可满足公寓大部分制冷负荷，与电冷水机相比，节省约570kW电力需求，目前现场两台电冷水机几乎不需要运行。

BROAD Absorption Chiller

Model: Two-stage hot water chiller BH400
Cooling Capacity: 950 RT
Heat Source: Hot water from campus central heating plant

远大非电空调

型号：双效热水机 BH400
制冷量：3340kW
热源：校园管网热水



Nichols Apartments & Mechanical Room 尼科尔斯公寓及机房

Phase II: Nichols Apartments 第二期项目：尼科尔斯公寓

Nichols Apartments is a 3-floor building built in 1975. These apartments house up to 188 continuing students and graduate students and their families. They are garden-style, 2-bedroom apartments with a full kitchen, bathroom, and living room. Four undergraduate students each share a 2-bedroom apartment or they are occupied by a graduate student and their family.

When providing comfort cooling for the student housing complex on campus, Rutgers University always wants to lower operating costs and CO₂ emissions, and improve system reliability and operating flexibility with the optimized design of the HVAC chilled water system.

By providing high quality after-sale service and excellent performance, BROAD won the university's trust. In 2017, Rutgers University installed the second BROAD absorption chiller to replace the old chiller for its Nichols Apartments in Busch campus.

Based on the original building pipes, the absorption chiller is driven by the low-temperature hot water(210°F) from the central heating plant to provide 450 tons of cooling, saving power demand over 250 kW.

尼科尔斯公寓是校园一栋三层楼的建筑，建于1975年。该花园风格的公寓每套房设有两间卧室、厨房、浴室和客厅。每套公寓可由四名本科生共享，或一名研究生及其家人居住。公寓可容纳188名本科生和研究生及其家人。

在为校园学生公寓提供舒适制冷系统的同时，罗格斯大学一直希望通过优化空调系统设计实现降低运营成本和二氧化碳排放，及提高系统可靠性和运营灵活性的目标。

凭借第一期项目卓越的机组性能和高品质的售后服务，远大再次赢得了大学的青睐。2017年，罗格斯大学在布希校区尼科尔斯公寓安装了第二台远大非电空调，以替换原有制冷机。

受原建筑热水管路限制，远大非电空调由热水管网的低温热水（99℃）驱动，为公寓提供制冷，从而节省了超过250kW电力需求。

BROAD Absorption Chiller

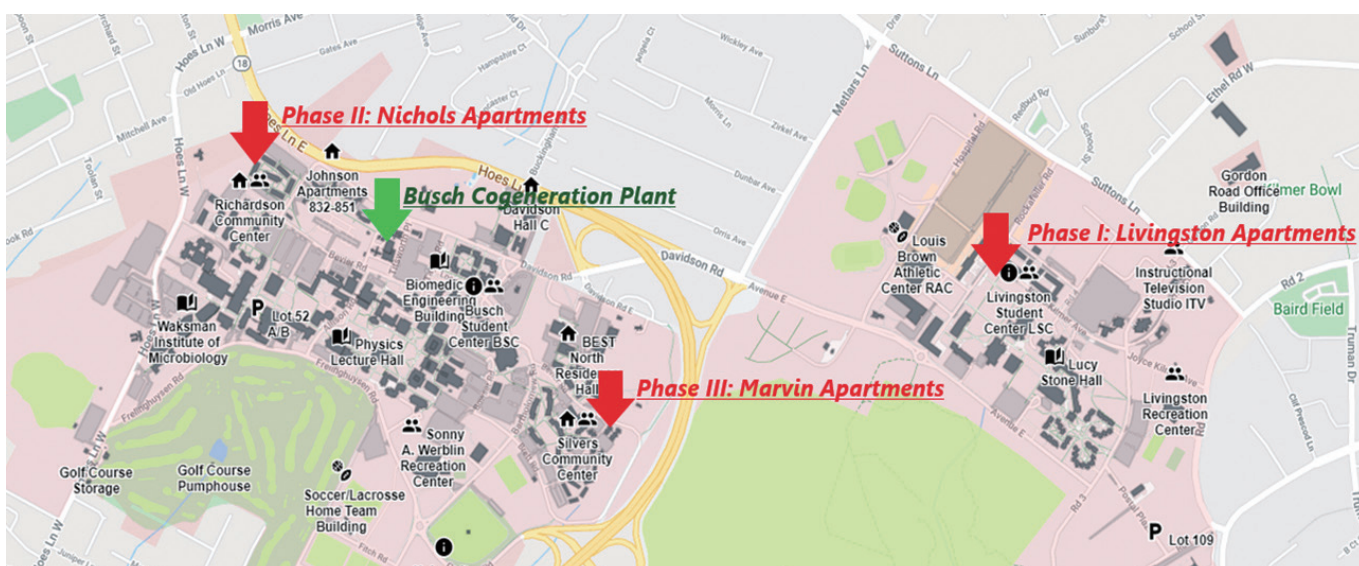
Model: Single-stage hot water chiller BDH200
Cooling Capacity: 450 RT
Heat Source: Hot water from campus central heating plant

远大非电空调

型号：单效热水机 BDH200
制冷量：1580kW
热源：校园管网热水



Marvin Apartments & Mechanical Room 马文公寓及机房



Rutgers University Projects Location Map 罗格斯大学项目地理位置示意图

Phase III: Marvin Apartments 第三期项目：马文公寓

Marvin Apartments is a 3-floor building built in 1973. These apartments are home to up to 130 Rutgers graduate students and their families.

As BROAD's repeat customer, the University facility team impressed by BROAD's excellent product performance, premium after-sales service for the previous two projects and the customized solution for the limited machine room access. In 2019, Rutgers University ordered the third 415-ton BROAD hot water absorption chiller to provide cooling for the entire Marvin Apartments. This chiller started running in the early spring of 2020.

马文公寓是罗格斯大学一栋三层楼的建筑，建于1973年。该公寓可容纳130名研究生及其家人。

凭借前两期项目的口碑积累以及为公寓有限的机房入口而量身定制的解决方案，罗格斯大学于2019年订购了第三台远大热水非电空调为整个马文公寓提供制冷，成为了远大忠实客户。

BROAD Absorption Chiller

Model: Single-stage hot water chiller BDH150
Cooling Capacity: 415 RT
Heat Source: Hot water from campus central heating plant

远大非电空调

型号：单效热水机 BDH150
制冷量：1460kW
热源：校园管网热水



CCHP IN COLLEGE AND UNIVERSITY

BRIGHAM YOUNG UNIVERSITY

大学CCHP — 杨百翰大学

Background

Brigham Young University (BYU) is a private research university founded in 1875 and owned by The Church of Jesus Christ of Latter-day Saints. The main campus in Provo, Utah, sits on approximately 560 acres nestled at the base of Wasatch Mountains and includes 311 buildings. The university is run under the auspices of its parent-organization, the Church Education System (CES), and is classified among "Doctoral Universities: High Research Activity" with "more selective admissions". The famous Republican personality Mitt Romney is an alumni of this school.

BYU has designated energy conservation, products and materials, recycling, site planning and building design, student involvement, transportation, water conservation, and zero waste events as top priority categories in which to further its efforts to be an environmentally sustainable campus. The university has stated "we have a responsibility to be wise stewards of the earth and its resources."

客户背景

杨百翰大学是美国一所私立研究型大学，成立于1875年，由耶稣基督后期圣徒教会拥有。位于犹他州普罗沃市的大学主校区，坐落在沃萨奇山脉山脚，占地约2.3平方公里，园区建筑311栋。该大学是在其上级组织-教会教育系统下主持运行，被评为“更具选择性的”“博士大学：高科研活跃度”。著名的共和党人罗姆尼（Mitt Romney）是该校校友。

杨百翰大学将节能、产品和材料回收利用、场地规划和建筑设计、学生参与、交通、节水和零浪费作为校方首要发展目标，以进一步实现环境可持续发展的校园。该大学表示：“我们有责任成为地球及其资源的明智管理者。”





BYU's iconic Y-branded smokestack
杨百翰大学标志性Y字烟囱



BYU's new Trigeneration Facility
杨百翰大学新冷热电联产能源站

System Introduction

Given the ever-growing concern for cleaner air, reducing greenhouse emissions, improving energy efficiency and reducing operating expenses, the “Y” emblazoned smokestack of BYU's Central Heating Plant, the symbol of 140 years of coal burning, has been demolished in 2016 as the school shifted away from coal-powered utilities to a trigeneration facility.

The new facility replaces the coal boilers with a gas turbine with a heat recovery unit and two BROAD absorption chillers to further reduce environment pollution and improve energy efficiency, while two of the natural gas-fired boilers remain as backup.

The hot water absorbers are connected to the central district cooling loop which serves the cooling requirements of more than 300 buildings on campus. The trigeneration facility provides power, heating and cooling capabilities for the campus offsetting 30%-50% of campus's current electrical needs without burning coal anymore.

系统介绍

随着对清洁空气、减少温室气体排放的日益关注，并提高能源效率及降低运营费用，杨百翰大学集中供热站象征着140年燃煤历史的“Y”字烟囱在2016年被拆除，学校供热由燃煤转为使用冷热电联产系统。

新建的能源站采用燃气涡轮机代替了原燃煤锅炉，另配有热回收装置和两台远大热水非电空调，以进一步减少环境污染并提高能源效率，原有的两台燃气锅炉保留作为备用。

新增的热水非电空调连接到学校区域制冷环路中，以满足校园内300多栋建筑物的制冷需求。该冷热电联产系统为园区提供电力、采暖和制冷，可满足园区目前电力需求的30%-50%，且无需燃烧煤炭。



BYU's Mechanical Room
杨百翰大学机房

Equipment Information

Generator

Model: Solar Gas Turbine Titan 130
 Fuel: Natural gas
 Power output: 16.5 MW
 Electrical Efficiency: 35.5%

BROAD Absorption Chiller

Model: Singlehot water chiller BDH500 X 2
 Cooling Capacity: 1,100 RT /unit
 Heat Source: Hot water

Project Highlights

The campus was previously using coal-based boiler and steam turbines for their electricity and heating requirements on the campus. In the past they replaced it by a gas based combined cycle power plant and later in 2019 they decided to replace their aging and low COP absorption chillers with BROAD's hot water absorption chillers. The hot water from the heat exchangers of the trigeneration plant is used to run the absorption chillers. This implementation will save a huge amount of electricity that would otherwise be required for centrifugal chillers.

Project Value

Remodeling the campus energy structure from traditional coal-burning to a cleaner energy and installing a CCHP system allows the university to benefit from three forms of energy for the price of one, and fulfills its environmental and social responsibility.

The newly CCHP system saves 187,447 MMBtu of fuel compared to the original system*.

Fed by the waste heat from the trigeneration plant, the BROAD absorption chillers offset 1,320 kW electricity demand by providing "free" cooling, saving over 770,000 dollars in electricity costs annually.

System annual carbon dioxide reduction: 68,268 metric tons, which is equivalent to saving 75 million pounds of coal consumption or taking over 14,000 cars off the road for one year*.

System annual NOx reduction: 85 tons*.

System annual Sox reductions: 33 tons*.

设备信息

发电机组

机型：索拉燃气轮机Titan 130
 燃料：天然气
 发电功率：16.5MW
 发电效率：35.5%

远大非电空调

机型：单效热水机 BDH500 两台
 制冷量：3870kW/台
 驱动热源：来自余热锅炉的热水

项目亮点

校园早先曾使用燃煤锅炉和蒸汽轮机以满足校园用电和供暖需求，后又改进为燃气联合循环发电系统。2019年下半年，校方决定采用远大热水非电空调代替原有的吸收式制冷机。来自冷热电联产系统余热锅炉的热水驱动远大非电空调为校园制冷，从而节省了大量电力。

项目价值

校园能源结构由传统的燃煤改为清洁能源天然气，且通过冷热电联产系统，大学仅需支付一种能源价格即可受益于三种能源，并履行了其环境和社会责任。

新冷热电联产系统较原燃煤系统节省了约 2×10^{11} kJ能源（4700吨原油当量）*。

远大非电空调利用冷热电联产系统的废热提供“免费”制冷，为校园减少约1320kW电力需求，减少超77万美元电费。

系统年二氧化碳减排量超6.8万吨，相当于减少燃煤3.4万吨，或一年内减少路上行驶汽车1.4万辆*。

系统年氮氧化物减排量：85吨*。

系统年硫氧化物减排量：33吨*。

* Results are based on US EPA CHP Energy and Emissions Savings Calculator, which may vary from the actual operation data.

* 结果基于美国能源局CHP能源及排放量计算所得，可能与实际运行数据有偏差。



STEAM DRIVEN DISTRICT ENERGY

THE UNIVERSITY OF MINNESOTA

蒸汽区域能源 — 明尼苏达大学

Background

The University of Minnesota, Twin Cities (hereafter “the University”) is a public research university in the Twin Cities of Minneapolis and Saint Paul, Minnesota. The Twin Cities campus is the oldest and largest in the University of Minnesota system and has the sixth-largest main campus student body in the United States, with over 50,000 students in 2019-2020, which is organized into 19 colleges, schools, and other major academic units.

Malcolm Moos Health Sciences Tower (hereafter “Moos Tower”), as the tallest building and the largest and most consistent chilled water user on campus, is located on the east bank of the Mississippi River near downtown Minneapolis. It is named after Malcolm Moos who was the president of the University from 1967 to 1974. Inside Moos Tower are labs, classrooms and faculty offices for the College of Dentistry.

To meet the growing demand of chilled water and to further reduce the peak electric demand at Moos Tower Chiller plant for the health sciences district, the University plans to add a 1000-ton steam absorption chiller to provide additional cooling capacity for the Tower and the neighboring buildings.

客户背景

明尼苏达大学（以下简称“大学”）是位于明尼苏达州明尼阿波利斯和圣保罗两城市之间的一所著名公立研究型大学。双子城校区是明尼苏达大学系统中最古老、规模最大的校园，也是美国第六大学生最多的主校园。2019学年共有50000多名注册学生，分布在其19所学院和其他学术机构中。

马尔科姆·穆斯健康科学楼（以下简称“穆斯楼”）位于密西西比河东岸明尼阿波利斯市中心附近，以1967年至1974年担任大学校长的马尔科姆·穆斯命名。作为学校牙科学院的实验室、教室和教职办公室，穆斯楼是校园中最高的建筑物，也是校园中最大的用冷建筑。

为了满足不断增长的制冷需求及进一步减少穆斯楼所在的科学健康区制冷站的高峰用电需求，大学计划增加一台3500kW的蒸汽吸收式冷水机，为穆斯楼及其邻近建筑提供额外的制冷量。

BROAD Absorption Chiller

Model: Two-stage steam chiller BS400

Cooling Capacity: 1,000 RT

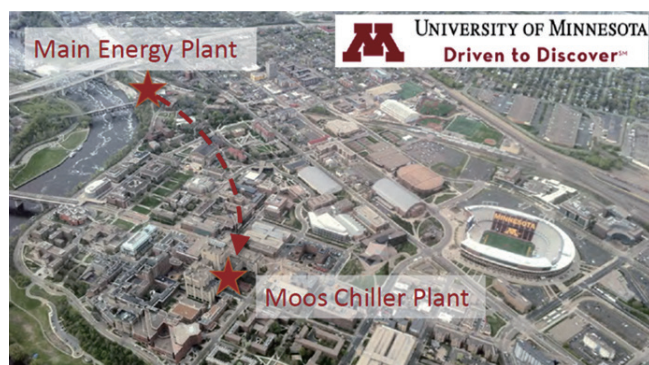
Heat Source: Steam from central energy plant

远大非电空调信息

机型：双效蒸汽机 BS400

制冷量：3500kW

驱动热源：集中能源站蒸汽



The Locations of Main Energy Plant and Moos Chiller Plant 主能源站和穆斯楼冷水站位置

System Introduction

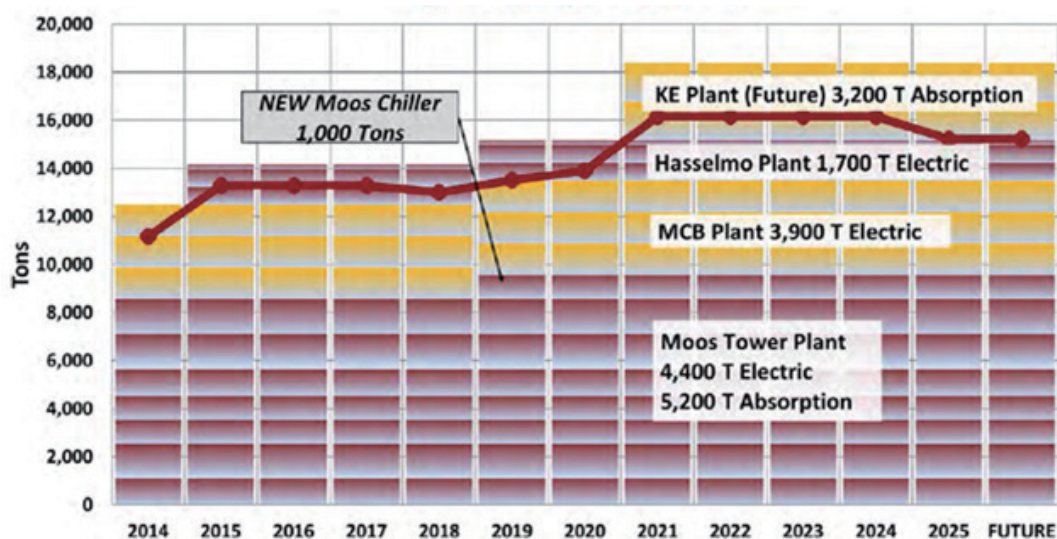
Inside the chiller plant at Moos Tower, there are nine existing electric chillers, and four steam driven absorption chillers to provide chilled water. The peak cooling load for this district is estimated to be over 10,000 tons. High pressure steam, coming from a 24MW gas turbine in the campus main energy plant, is distributed and supplied through the campus steam grid.

The added BROAD steam absorption chiller provides 1,000 tons of cooling to help alleviate the cooling load pressure during the peak cooling season, as shown in the cooling load projection below.

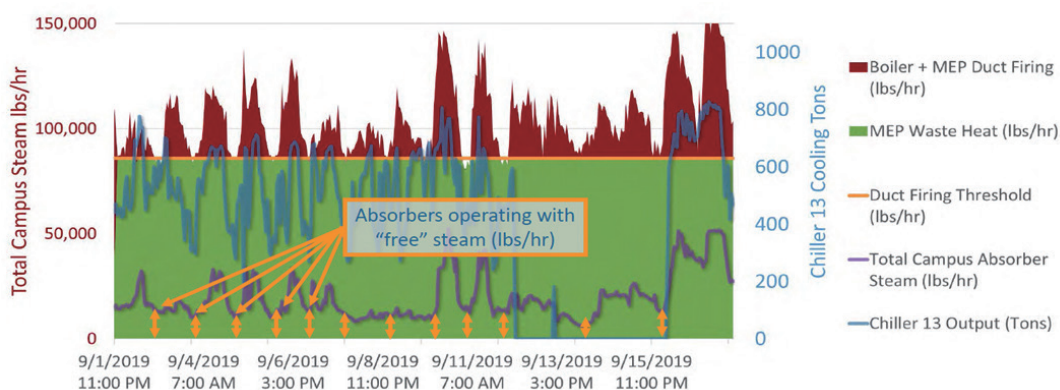
系统介绍

穆斯楼制冷站机房中现有9台电冷机和4台蒸汽非电空调以提供冷水。该区域最大制冷负荷预计超过4800kW。高压蒸汽由校区集中能源站的24MW燃气轮机产生，通过蒸汽网分配和供应整个校园。

如下图明尼苏达大学健康科学区域系统容量及高峰需求曲线所示，新增的远大蒸汽非电空调可提供3500kW的制冷量，以帮助缓解制冷高峰季节的负荷压力。



UMN Health Science District System Capacity & Peak Demand
明尼苏达大学健康科学区系统容量和高峰需求



Moos Chiller 13 Operation vs. MEP Operation
穆斯楼冷水站和主要能源站日运行曲线

Project Highlights

The University issued an RFP (Request for Proposal) in March 2018, and the new absorption chiller was installed and in operation for the cooling season in 2019. Heavy rigging and tight clearance space, mandatory factory performance testing and onsite field acceptance performance testing with bonus and penalties made this project a challenge, meanwhile, gave chiller manufacturers an opportunity for demonstration and statement.

After extensive review and evaluation by the University, BROAD was awarded to be the absorption chiller supplier for its well proved rigging solution, experience in performance testing, the high reputation in superior energy efficiency and product quality, as well as various installation references in US.

1. Four-pieces Supply and Reassembly Onsite

Moos Tower mechanical room is 50ft below grade, posing rigging challenges for equipment. BROAD absorption chiller was knocked down to four separate sections (after passing the factory performance testing) with an individual rigging frame that enabled vertical rigging from the ground level sidewalk opening and then horizontal rigging to the basement mechanical room of the Tower building. Then the chiller was reassembled onsite by the BROAD service team to deliver the desired cooling performance.

2. Factory and Onsite Performance Test

Factory acceptance testing is an essential part of BROAD's standard scope of supply, and the customers are warmly welcomed to the factory to witness.

In this project, the BROAD chiller is customized per requirements (four-pieces supply and engineer-specified tube metallurgy) to provide 40°F (4.4°C) chilled water.

In the presence of the University customers and engineers, the BROAD steam absorption chiller has successfully passed all the required performance tests, including ZERO-tolerance full load capacity and performance tests, and part-load capacity and performance tests (at specified load points) per the AHRI-560-2000 standard.

项目亮点

该大学于2018年3月发布了招标文件，在2019年制冷季安装并运行新的非电空调。重型起吊、紧凑的净空空间、指定的工厂性能测试和有奖惩的现场验收测试是对各大冷水机制造商的一个巨大挑战，同时也提供了一次自我展示和证明的机会。

经过校方多方面的审查评估，远大因其针对吊装限制给出的可靠解决方案、丰富的性能测试经验、卓越产品能效和质量声誉以及美国各种安装案例，赢得了该项目。

1. 四片式供货和现场组装

穆斯楼机房位于地下15m，对设备吊装提出了挑战。远大非电空调在通过工厂性能测试后被拆分为四片配有单独吊架的部分，可以使其从地面人行道开口进行垂直吊装，然后再水平运至地下机房。远大专业的服务团队再将冷水机组进行现场组装，以保证要求的制冷性能。

2. 工厂和现场性能测试

工厂验收测试是远大标准供货范围的重要组成部分之一，远大热忱地欢迎客户到工厂见证测试。在该项目中，远大非电空调按客户要求定制设计（四片分体和指定管材），以提供4.4°C冷水。

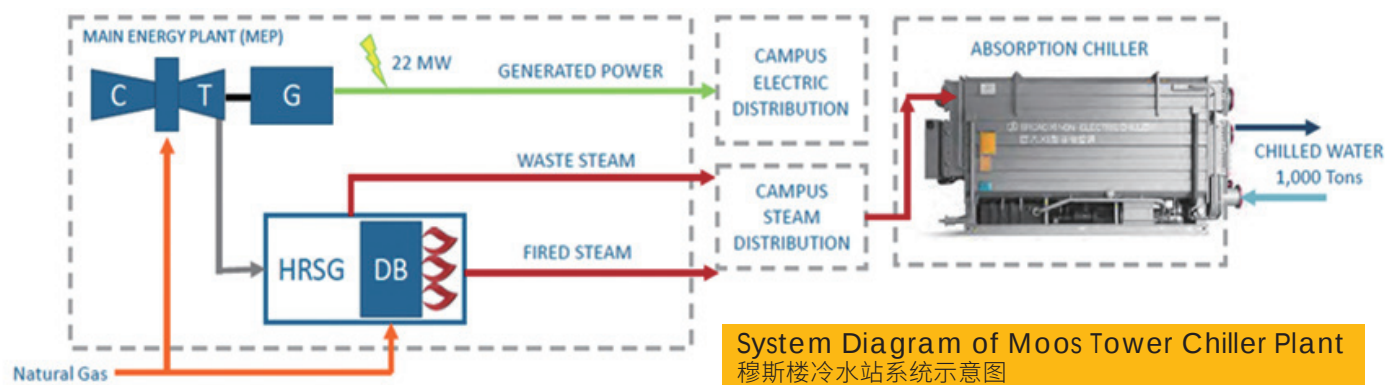
在校方代表和工程师现场见证下，远大蒸汽非电空调成功通过了所有要求的性能测试，包括零容忍满负荷容量测试和性能测试，和按照AHRI560-2000标准在指定的部分负荷点进行的容量及性能测试。



Onsite Rigging 吊装现场



Onsite Performance Test 现场性能测试



Project Value

The newly installed steam absorption chiller started operation in May 2019, and has already presented attractive economic and environmental benefits to the health sciences district and campus. Absorption cooling became a key element to balance the trigeneration system and maximize its value. Compared to the electric centrifugal chiller, absorption chiller with waste steam heat has a 40% lower CO₂ footprint and 80% lower fuel cost.

In this iconic project, BROAD again demonstrates its capabilities, flexibility and innovative solutions in providing high quality and reliable chiller products with customization.

项目价值

新的蒸汽非电空调于2019年5月投入运行，已经为健康科学区及整个校园带来了可观的经济和环境效益，成为了平衡冷热电联产系统并最大化价值的关键因素。与电冷机相比，回收蒸汽余热的非电空调减少了40%的二氧化碳排放量，降低了80%的燃料成本。

在该标志性项目中，远大再次展示了其实力、灵活性和创新性，为客户提供高质量可靠的定制冷水机组。





CCHP IN PHARMACEUTICAL COMPANY

MEDIMMUNE

制药公司CCHP — 免疫医疗

Background

MedImmune is the biologics and biotechnology research and development arm of the pharmaceutical and biopharmaceutical manufacturer, AstraZeneca. In 2007, Astra-Zeneca bought the company for a whopping \$15.6 billion — one of the largest biotech deals of that decade.

MedImmune has more than 150 product pipelines in Oncology, Cardiovascular, Renal and Metabolic, Respiratory and Immunology and other diseases.

MedImmune employs over 3,500 employees in the D.C. area with over \$1.81 billion in revenue in 2017, making it the largest employer in the local industry, according to Washington Business Journal data. Its nine-story Gaithersburg headquarters comprises 1.27 million square feet.

MedImmune's impact on Maryland's biotech corridor is arguably unparalleled, pioneering innovation and discovery locally with a robust alumni network embedded within the industry.



客户背景

免疫医疗是英国生物制药公司阿斯利康旗下生物制剂和生物技术研发部门。2007年,阿斯利康以高达156亿美元的价格收购了该公司——是十年来最大的生物技术交易之一。

免疫医疗在肿瘤、心血管、肾脏和代谢、呼吸系统和免疫学以及其他疾病方面拥有150多个产品研发线。

根据《华盛顿商业杂志》的数据,免疫医疗在华盛顿特区附近雇用了3500多名员工,2017年的收入为18.1亿美元,使其成为当地相关行业最大的雇主。其九层楼的盖瑟斯堡总部建筑面积约12万平方米。

免疫医疗因其在当地行业内强大的校友网和大胆创新对马里兰州生物技术走廊有着极其重要的影响。

System Introduction

With a goal of reducing its carbon footprint, decreasing facility operational costs, increasing power reliability and increasing resiliency against outages, MedImmune deployed a CCHP system in its Gaithersburg campus.

The system includes 2.5 megawatts of natural gas powered generation set, steam and hot water heat recovery heat exchangers and a 500-ton BROAD multi-energy absorption chiller. Also a paralleling switchgear was added to tie together two existing 3 megawatt diesel generators to the CCHP systems. This allows the MedImmune campus to respond quickly to an immediate outage, as well as sustain long-term generation during a prolonged outage event by transitioning to island mode.

Exhaust gas from the CCHP system feeds a heat recovery steam generator (HRSG) boiler to produce steam. The absorption chiller uses this steam and jacket hot water to produce chilled water, maximizing the year-round CCHP energy efficiency and reducing carbon emissions.

In 2014, MedImmune Gaithersburg campus qualified for a Silver Superior Energy Performance (SEP) award, a certification for industrial facilities based on ISO50001's global energy management system standards.

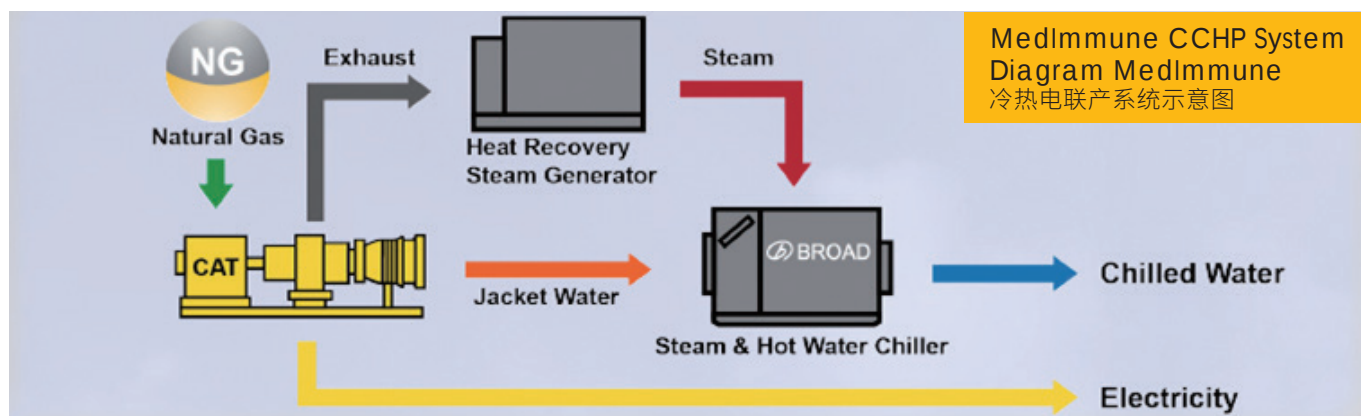
系统介绍

为减少碳足迹，降低设施运营成本，提高供电可靠性和抗故障能力，免疫医疗在其盖瑟斯堡园区安装了一套冷热电联产系统。

该系统包括2.5MW的天然气发电机组、蒸汽和热水热回收交换器以及一台1700kW远大多能源非电空调。此外该系统还增加了并网开关装置，用于将两台现有的3MW柴油发电机与冷热电联产系统连接在一起，使免疫医疗园区能够迅速地响应瞬间停电，并能在电网长时间故障时过渡到孤岛模式维持长期的发电能力。

冷热电联产系统的烟气进入余热锅炉以产生蒸汽，然后非电空调使用蒸汽和缸套热水生产冷水，最大限度地提高全年冷热电联产能源效率并减少碳排放。

2014年，免疫医疗盖瑟斯堡园区获得了基于ISO50001全球能源管理体系标准的卓越能源绩效（SEP）银奖。



Equipment Information

Generator

Model: CAT CG260
Fuel: Natural gas
Power output: 2,500 kW
Electrical Efficiency: 42.2%

BROAD Absorption Chiller

Model: Multi-energy BHS250
Cooling Capacity: 500 RT
Heat Source: Engine jacket water & Steam from Heat Recovery Steam Generator

设备信息

发电机组

机型：卡特彼勒 CG260
燃料：天然气
发电功率：2500kW
发电效率：42.2%

远大非电空调

机型：多能源热水蒸汽机 BHS250
制冷量：1760kW
驱动热源：发电机缸套水和热回收蒸汽

Project Value

One of the biggest challenges for the pharmaceutical industry is implementing highly reliable energy solutions at their research and manufacturing facilities that not only support sustainability goals, but also improve competitiveness by reducing costs, reducing energy price volatility, and providing other value-added benefits. This is where CCHP comes in.

CCHP plants produce both electricity and thermal energy simultaneously, which can be used for heating, cooling, and for the production of high-pressure process steam. CCHP technology is currently experiencing a revival in pharmaceutical manufacturing facilities because of the operational benefits it can provide, as well as its mitigation of energy price volatility and greenhouse gas emissions.

- On-site trigeneration effectively strengthens MedImmune against outages.
- Offsets more than 2 million dollars in energy costs and operational costs annually.
- The BROAD absorption chiller provides 500 tons of “free” cooling from the waste heat, improving the overall energy efficiency to 72%, reducing annual electricity consumption for cooling by 1,840 MWh*.
- Utilizing steam and hot water demonstrates the flexibility of the BROAD absorption chiller.
- This system reduces over 30% carbon emissions compared to the conventional electric utility grid, which is equivalent to over 7,500 metric tons of carbon emission yearly, or taking over 1,600 passenger vehicles off the road*.



项目价值

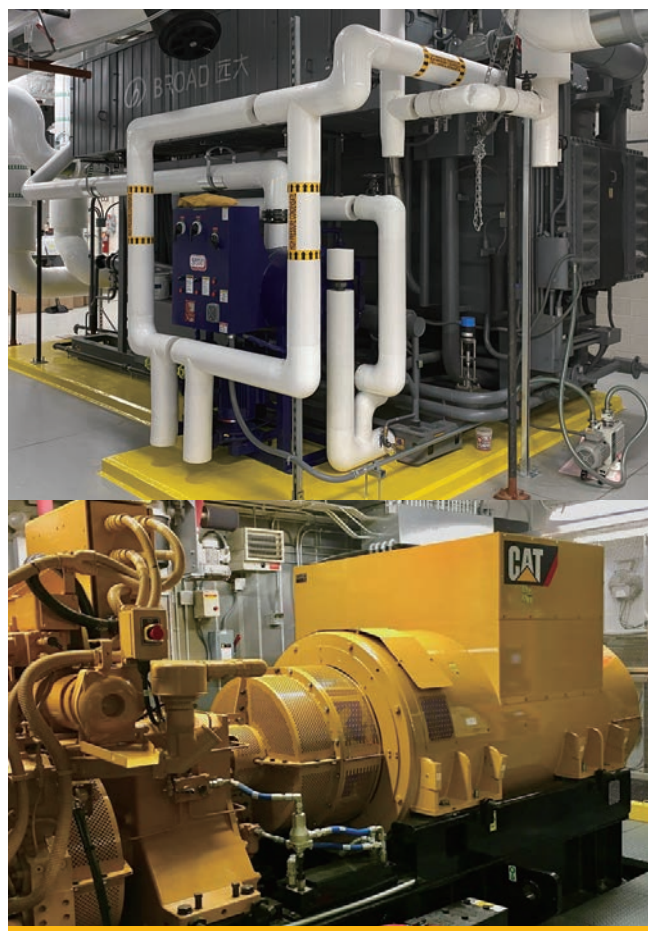
医药行业面临的重大挑战之一是在其研究和生产设施中采用高度可靠的能源解决方案,以支持企业的可持续发展目标并通过降低成本、降低能源价格波动和提供其他增值收益提高企业竞争力。这正是冷热电联产系统的优势所在。

冷热电联产系统在发电的同时利用热能制热、制冷和生产高压工艺蒸汽。由于冷热电联产技术带来的运营优势并缓解能源价格波动和温室气体排放,该技术在医药生产行业正在复兴。

- 冷热电三联供系统有效地增强了免疫医疗的抗停电能力。
- 冷热电三联供系统每年可减少2百万美元能源和运营成本。
- 远大非电空调回收废热,可提供1760kW“免费”制冷,将整体能源效率提高到72%,年制冷用电量减少约1840MWh*。
- 蒸汽和热水的综合利用体现了远大非电空调的灵活性。
- 与传统的电网相比,该系统减少了30%以上的碳排放量,每年减少碳排放量7500吨以上,相当于减少路上1600多辆汽车*。

* Results are based on US EPA CHP Energy and Emissions Savings Calculator, which may vary from the actual operation data.

* 结果基于美国能源局CHP能源及排放量计算所得,可能与实际运行数据有偏差。



MedImmune Mechanical Room
免疫医疗机房



CCHP IN HOSPITAL

BAYSTATE MEDICAL CENTER

医院CCHP — 贝斯泰医学中心

Background

Baystate Health is a nonprofit, integrated health care system headquartered in Springfield, Massachusetts, serving over 800,000 people throughout Western New England. The system has 4 hospitals, over 80 medical practices, and 25 reference laboratories.

Baystate Medical Center (BMC) is the biggest hospital in Baystate Health system with 716 beds. It is an independent academic medical center and a training site for the University of Massachusetts Medical School. BMC is also the community's major referral hospital, providing the highest level of care for conditions such as cancer, acute and chronic cardiovascular illness, nervous system illness, digestive illness, and other diseases that affect the major organs. In 2016, U.S. News & World Report ranked BMC the third-best hospital in Massachusetts.

BMC has over 1,100 medical staff physicians, 10 residency training programs and 99 clinical trials underway.

客户背景

贝斯泰医疗是一个非营利性综合医疗保健系统，总部位于麻省斯普林菲尔德，为整个新英格兰西部80多万人提供服务。该系统有4家医院，80多家医疗机构和25个参比实验室。

作为贝斯泰医疗系统中最大的医院，贝斯泰医学中心（以下简称“医学中心”）是一所拥有716张病床的独立研究型医学中心，也是马萨诸塞大学医学院的培训基地。医学中心作为社区主要的转诊医院，为癌症、心血管疾病、神经系统疾病、消化系统疾病等疾病患者提供最高水平的护理。2016年医学中心被《美国新闻与世界报道》杂志评为马萨诸塞州三大最佳医院之一。

贝斯泰医学中心拥有1100多名医务人员，10项住院医师培训计划和99项正在进行的临床试验。



Baystate Medical Center CCHP Plant
贝斯泰医学中心冷热电联产能源站



Baystate Medical Center Mechanical Room 贝斯泰医学中心机房

System Description

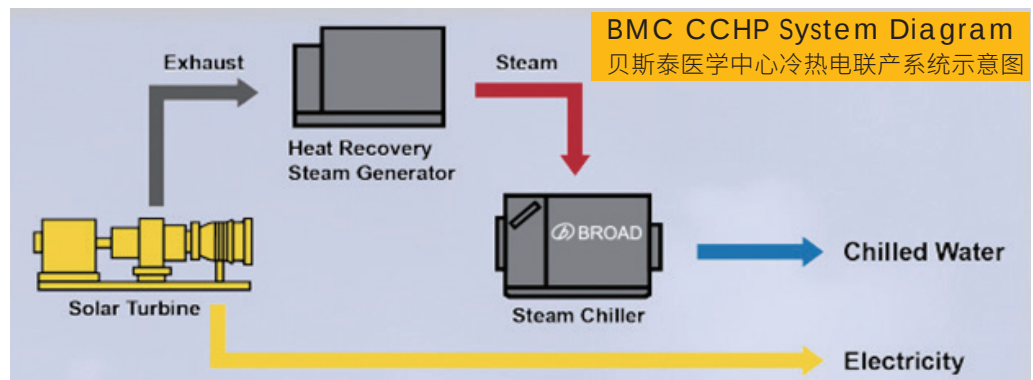
In 2016, Baystate Health initiated a \$27 million CCHP plant that provides non-grid energy sources to critical facilities in the event of power loss during a disaster. The CCHP plant is part of the Housing & Urban Development (HUD) National Disaster Resilience Competition, a program that awarded the City of Springfield over \$17 million to facilitate disaster resiliency.

The trigeneration power plant is located at the largest level I trauma center in western Massachusetts, replacing an 80-year-old facility. The plant includes a 4.6-megawatt gas turbine to produce 80% of its own power, bringing much needed relief to the stressed energy grid. The steam, the byproduct of the combustion associated with the spinning natural gas engine, is also used for sterilization, to heat the hospital and to drive a BROAD two-stage steam absorption chiller for summer cooling.

系统描述

2016年，贝斯泰医疗开始修建一耗资2700万美元的冷热电联产能源站，可在紧急事件断电时为关键设施提供非电网能源。该冷热电联产能源站是美国住房与城市发展部（HUD）国家抗灾竞赛的一部分，斯普林菲尔德市政府提供了超过1700万美元的资助，以提高中心抗灾能力。

该冷热电能源站位于马萨诸塞州西部最大的一级创伤中心，以取代其已有80年历史的老能源站。该能源站装有一台4.6MW燃气轮机，可产生80%的自用电，极大地减轻了医学中心能源网的负担。蒸汽作为燃气轮机的副产品，用于医院消毒、采暖并驱动远大非电空调提供制冷。



Equipment Description

Generator

Model: Solar Gas Turbine Mercury 50
Fuel: Natural gas
Power output: 4,600 kW
Electrical Efficiency: 38.5%
Steam Production: 13.1-103.9 klb/hr

BROAD Absorption Chiller

Model: Two-stage steam chiller BS300
Cooling Capacity: 925 RT
Heat Source: Steam from Heat Recovery Steam Generator

设备信息

发电机组

机型：索拉燃气轮机 Mercury 50
燃料：天然气
发电功率：4600kW
发电效率：38.5%
蒸汽产量：5900-47000 kg/hr

远大非电空调

机型：双效蒸汽机 BS300
制冷量：3253kW
驱动热源：余热锅炉蒸汽

Project Value

The CCHP system produces 80% of the electricity and 98% of the steam utilized at Baystate.

The system is capable of operating in island mode for at least 30 days uninterrupted during a utility crisis.

The BROAD absorption chiller uses waste heat from the trigeneration plant, increasing Baystate's energy efficiency by roughly 25% and saving 3,400MWh/year electricity for cooling*.

The CCHP system reduces annual utility costs by a minimum of 1.45 million dollars.

The system reduces greenhouse gases by 4,507 tons, which is equivalent to the carbon sequestered by 74,524 trees grown for 10 years.

Why CCHP in Hospitals?

More than 220 hospitals in the U.S. operate CCHP systems. Hospitals are ideal candidates for CCHP systems. The high and constant 24/7 demand of electric power, heating and cooling allows CCHP system to reduce energy costs, increase energy efficiency and reliability, and improve environmental performance.

项目价值

该冷热电三联供系统可满足贝斯泰医学中心80%的电力需求和98%的蒸汽需求。

冷热电三联供系统使医学中心能在公共危机期间至少连续孤岛运行30天。

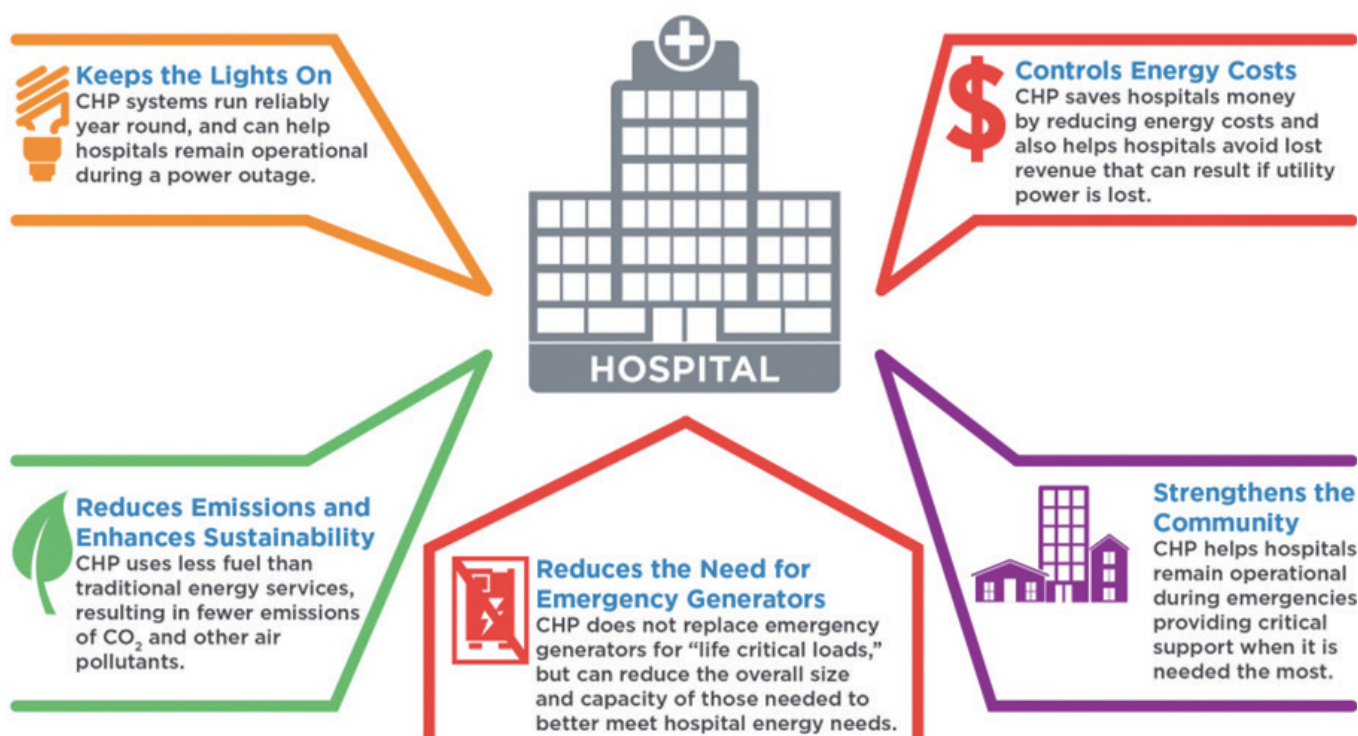
远大非电空调回收系统废热，使贝斯泰医学中心的能源效率提高了约25%，每年减少3400MWh制冷用电量*。

该冷热电三联供系统每年至少可节约145万美元的能源成本。

系统每年可减少温室气体4507吨，相当于10年种植约7.5万棵树的碳吸收量。

为什么在医院使用冷热电联产系统？

目前美国有220多家医院安装了冷热电联产系统。医院是冷热电联产系统的理想安装地点。医院24/7全天候运行，并且有大量的电力、采暖和制冷需求。冷热电联产系统降低医院能源成本的同时，提高了能源效率和可靠性，并实现了环境绩效的改进。



* Results are based on US EPA CHP Energy and Emissions Savings Calculator, which may vary from the actual operation data.

* 结果基于美国能源局CHP能源及排放量计算所得，可能与实际运行数据有偏差。



SEISMIC CERTIFIED CHILLERS BUILT TO LAST

EL CAMINO HOSPITAL

医院抗震机组 — 埃尔卡米诺医院

Background

El Camino Hospital includes two nonprofit acute care hospitals in Los Gatos and Mountain View and multiple urgent care, multi-specialty care and primary care locations across Santa Clara County, California. Opened in 1961, its Mountain View Main Campus covers 41 acres with 443 beds and 1,459 physicians.

El Camino Hospital serves residents in Silicon Valley, as well as people in surrounding communities. The key specialties include heart and vascular, cancer and lifestyle medicine.

The hospital has earned numerous awards for clinical excellence and nursing care, such as a 5-Star Overall Hospital Quality Rating from Centers for Medicare & Medicaid Services (CMS), and three consecutive American Nurses Credentialing Center Magnet Recognitions for Nursing Care. U.S. News ranked the hospital as the No.25 out of 428 hospitals for Best Hospitals in California.

客户背景

埃尔卡米诺医院包括加利福尼亚州洛斯加托斯和山景城的两家非营利性急诊医院，以及圣克拉拉县多家急诊、综合专科和初级保健机构。其山景主园区于1961年对外开放，占地16.6万平方米，拥有443张床位和1459名医师。

埃尔卡米诺医院为硅谷以及周边社区的居民提供医疗服务。医院核心医学专业包括心脏和血管、癌症和生活方式医学。

因其在临床和护理方面的卓越表现，医院被CMS（Centers for Medicare & Medicaid Services）评为五星级医院，并连续三届获得美国护理证书中心授予的护理磁性认证。埃尔卡米诺医院在《美国新闻与世界报道》评选的加州最佳医院排名中位列第25位。



Project Introduction

As part of the expansion project, El Camino Hospital installed two BROAD two-stage steam absorption chillers in 2017 to fully utilize the existing boiler's capacity and reduce the energy costs.

The absorption chillers operate 24/7, and three electric chillers are on site for cooling supplement and future expansion.

Project Highlight

BROAD won the bid as the only absorption chiller manufacturer in this project that has the Special Seismic Certification Pre-Approval (OSP) from California's Office of Statewide Health Planning and Development (OSHPD). OSHPD OSP is a prerequisite for the equipment installed in California healthcare facilities, meaning the equipment is able to maintain the structural integrity and functionality in a seismic event.

BROAD chillers have passed the test at both seismic loads of 2.0g and 3.2g in the UC Berkley PEER center. A seismic load test of 3.2g is the highest level in the world and so far BROAD is the first and the only chiller manufacturer who has successfully passed the seismic test at this level and obtained the seismic certification, which is representing the top level of "Made in China".

The added BROAD chillers met most of the hospital's cooling requirements, meanwhile improved the existing boilers' efficiency and reduced emissions by running them at full load consistently.

Annual electricity saving: over 2,900MWh, save electricity costs nearly 350,000 USD.

项目介绍

作为扩建项目的一部分，埃尔卡米诺医院于2017年安装了两台远大双效蒸汽机以充分利用现有锅炉容量并降低医院的能源成本。

非电空调全年不间断运行，另有三台电制冷机组用于制冷补充和未来扩展。

项目亮点

远大作为该项目中唯一获得加州健康规划与发展办公室（OSHPD）特殊地震认证预审（OSP）的空调厂商，赢得了此次竞标。设备特殊地震认证预审（OSP）是在加州医疗机构中安装设备的先决条件，这意味着设备能在地震时保持其结构完整性和功能性。

远大非电空调在加州伯克利大学地震研究中心分别通过了2.0g和3.2g重力加速度抗震测试。3.2g是世界最高抗震测试等级，迄今为止，远大是第一家也是唯一一家成功通过该地震等级试验并获得认证的空调制造商，代表了“中国制造”的顶级水准。

新增的远大非电空调可满足医院大部分制冷需求，同时使现有锅炉始终保持满负荷运行以提高其效率和减少排放。

年节省电量超2900MWh，节约电费约35万美金。



El Camino Hospital Mechanical Room
埃尔卡米诺医院机房



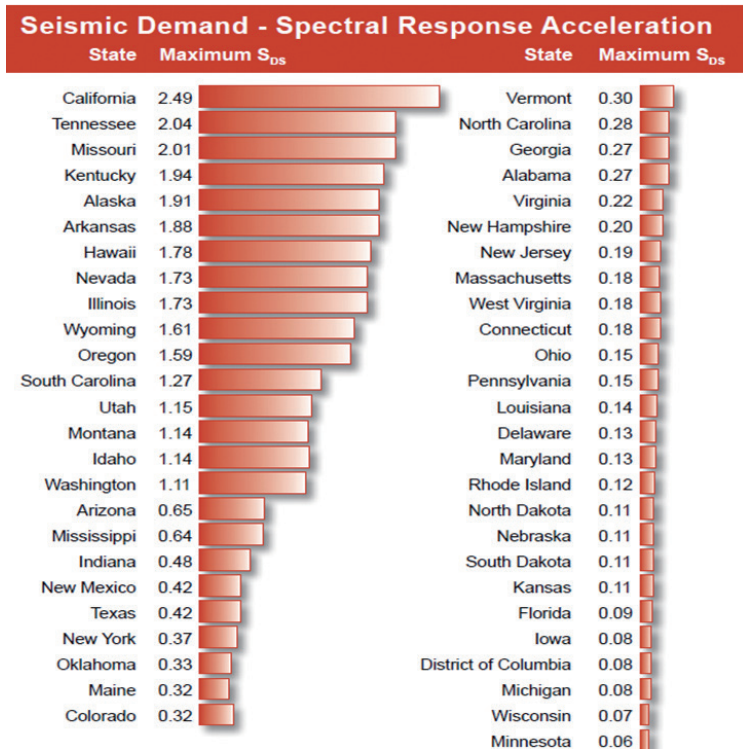
BROAD Chiller on the Shake Table in UC Berkley
远大空调在加州伯克利大学抗震测试台

BROAD Absorption Chiller

Model: Two-stage steam chiller BS150 x2
Cooling Capacity: 400 RT/unit
Heat Source: Steam from gas boiler

远大非电空调信息

机型：双效蒸汽机BS150两台
制冷量：1407kW/台
驱动热源：燃气锅炉蒸汽



Anti- earthquake Demand By State
美国各州抗震需求

UNIT UNDER TEST (UUT) SUMMARY SHEET

TRU PROJECT NO. 16059



Manufacturer: Broad USA, Inc.		UUT 1				
Model Line: BS Series Steam Absorption Chillers						
Model Number: BS16X10.79-35/27.8-5.6/13.3-150		Serial Number: 16120021				
Product Construction Summary: Heavy gauge carbon steel construction.						
Options/Subcomponent Summary: Includes seismic bracing upgrades between main shell and HTG shell.						
UUT Properties						
Weight (lb)	Dimension (in)		Lowest Natural Frequency (Hz)			
	Depth	Width	Height	Front-Back	Side-Side	Vertical
45,020	257	91.5	110	13.6	9.7	19.7
UUT Highest Passed Seismic Run Information						
Building Code	Test Criteria	$S_{DS}(g)$	z/h	I_p	$A_{1.0-1.5}(g)$	$A_{1.5-2.0}(g)$
CBC 2016	ICC-ES AC156	2.0	1.0	1.5	3.2	2.4
		3.2	0.0			2.13
Test Mounting Details:						
Unit was rigid base mounted using 5" long 1/4" fillet welds every 12" along four base channels. Unit maintained structural integrity and remained functional per manufacturer requirement after shake table test. Contents were included in testing per operating conditions.						

TRU Compliance, LLC - A Tobolski Watkins Affiliate

Third Party Seismic Test Report for
BROAD Chiller 远大空调第三方抗震测试报告

About OSHPD Seismic Certification

California is in earthquake-prone zone, to ensure the local hospitals could remain operable after a seismic event, California OSHPD requires the critical equipment in healthcare facilities must pass stringent seismic testing and certification.

In the regulations, each manufacturer's specified model family has to have a minimum of two shake table tests for seismic capacity, meet the requirements of ICC-ES AC-156 and be certified by independent third party structural engineers. Also, it must be reviewed by the OSHPD office and issued an OSHPD OSP number.

The results required by the testing:

1. Structural Integrity of components, supports, and attachments shall be maintained.
2. Functionality of components shall be maintained equivalent to preshake table test functionality test.

Seismic compliance is no longer only for earthquake-prone zones or only for buildings and structures today. More and more local building codes require HVAC equipment to be certified to minimize the risks brought from earthquakes.

关于OSHPD地震认证

加州处于地震多发带，为确保当地医院在地震发生后仍能继续运行，加州健康规划与发展办公室（OSHPD）要求医院的关键设备必须通过严格的地震测试和认证。

规定要求每个制造商指定的机型系列必须至少进行两次振动台抗震测试。设备必须符合ICC-ES AC-156要求并获得独立的第三方结构工程师的认证，且须经过OSHPD审查并获得OSHPD特殊地震认证预审（OSP）号。

测试结果要求：

1. 组件、支撑件和附件应保持结构完整。
2. 组件的功能应与抗震测试之前等效。

如今地震合规不再仅局限于地震多发区或建筑物。越来越多的地方建筑法规要求对暖通设备进行认证以最大程度地降低地震所带来的风险。



CCHP IN HOTEL

MGM NATIONAL HARBOR RESORT & CASINO

酒店CCHP — 米高梅国家港口赌场度假村

Background

MGM National Harbor Resort & Casino (hereafter “MGM National Harbor”) is a US\$1.4 billion commercial complex that integrates a 4-star luxury hotel, retails, dining, entertainment and casino. It is located on the banks of the Potomac just outside Washington DC, and has a 3,000 seat theater, 308 luxurious hotel rooms, restaurants with acclaimed chefs and a 135,000 square feet gaming space that is bigger than the White House. The resort opened on December 8, 2016, and is owned and operated by MGM Resorts International.

To fulfill the commitment of being a sustainable enterprise, MGM National Harbor integrated a series of comprehensive environmentally responsible practices including installing a 750kW CCHP energy plant to increase energy efficiency meanwhile reduce the negative impacts on environment.

项目背景

米高梅国家港口赌场度假村（以下简称“米高梅国家港口”）是一个耗资14亿美元，集四星级豪华酒店、零售、餐饮、娱乐和赌场于一体的商业综合体。它位于华盛顿特区郊外的波托马克河岸，包括一间可容纳三千名观众的剧院、一家拥有308间豪华客房的酒店、享誉盛名的餐厅和一家1.2万平方米的赌场。米高梅国家港口于2016年12月8日开业，由米高梅国际酒店集团所有和运营。

为履行成为可持续企业的承诺，米高梅国家港口采取了一系列的环保措施，其中包括安装一套750kW冷热电联产系统，在提高能源效率的同时减少对环境的负面影响。

System Description

The energy plant MGM National Harbor has designed and built is one of the largest privately operated CCHP energy plants in the Washington D.C. region to generate onsite electricity for the resort and at the same time provides chilled water and heating water from waste heat off the gensets.

The whole plant includes one 750 kW gas generator, three diesel gensets, an exhaust boiler, six magnetic bearing chillers and a BROAD absorption chiller. The absorption chiller recovers heat from the gas engine to provide space cooling all year round.

The CCHP system has been operated since July 2017, and now runs 24/7, supplying energy to the resort continuously. The CCHP system combined with three diesel gensets can operate in island mode during an outage to ensure the normal operation.

Equipment Information

Generator

Model: CAT CG132
Fuel: Natural gas
Power output: 750 kW
Electrical Efficiency: 42.4%

BROAD Absorption Chiller

Model: Multi-energy chiller BHE100
Cooling Capacity: 260 RT
Heat Source: Jacket water and exhaust from the engine

系统描述

米高梅国家港口的能源站是华盛顿特区最大的私营冷热电联产系统之一，为度假村提供自主发电的同时回收发电机余热提供冷水和采暖水。

整个能源站包含了一台750kW燃气发电机组、三台柴油发电机组、一台余热锅炉、六台磁悬浮电冷机和一台远大非电空调。远大非电空调回收燃气发电机组的废热为赌场提供全年制冷。

该冷热电联产系统自2017年7月开始全年24小时运行，持续地向度假村供能。冷热电联产系统结合三台柴油发电机组可在断电时以孤岛模式运行，以保障赌场正常运营。

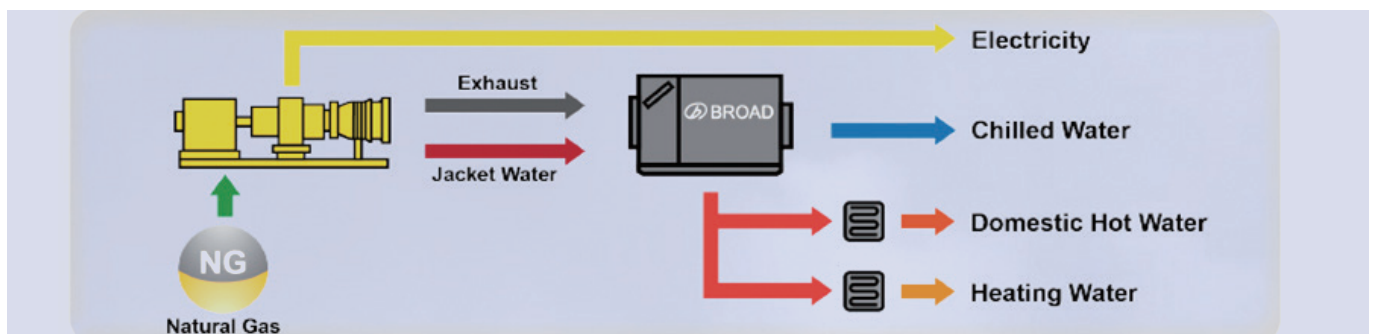
设备信息

发电机组

机型：卡特彼勒 CG132
燃料：天然气
发电功率：750kW
发电效率：42.4%

远大非电空调

机型：多能源机 BHE100
制冷量：915kW
驱动热源：发电机缸套水和烟气



MGM National Harbor System Diagram 米高梅国家港口冷热电联产系统示意图



MGM National Harbor Mechanical Room 米高梅国家港口机房

Project Value

By multi-stage utilization of the engine exhaust heat, the BROAD absorption chiller effectively improves energy efficiency and lowers the emission levels.

The BROAD absorption chiller provides 260 tons of “free” cooling by recovering the waste heat from the engine, improving the overall energy efficiency to 94%, saving 950 MWh/year electricity for cooling.

The system significantly reduces the resort's greenhouse gas emissions and environmental footprint, equivalent to the amount of CO₂ sequestered by 1.2 acres of forests in one year.

Achieved 31.7% of energy cost reduction compared to a code-compliant building.

The estimated payback period is 4.5 years.

Achieved LEED Gold Certification.

MGM National Harbor Sustainability Strategies

- **Energy Efficiency:** In addition to installing a CCHP system, the performance is optimized by using the project's measurement and verification (M&V) plan, a tool for ongoing accountability of energy performance and a tool that helps verify cost savings associated with energy efficiency measures incorporated into the MGM National Harbor's design.
- **Green Vehicles:** Installed twenty-four electric vehicle (EV) charging stations and low-emitting fuel efficient (LEFE) vehicle parking spaces throughout the parking garage for use by guests and employees.
- **Public Transportation :** A new transportation stop is located directly adjacent to the MGM National Harbor to encourage public transportation.
- **Rainwater Harvesting:** Constructed a 700,000 gallon cistern to collect, store, treat, and reuse rainwater captured from the roof structures for irrigation, cooling and sanitary needs instead of municipal water.

项目价值

通过对发电机排气的多级利用，远大非电空调有效地提高了能源效率并降低了排放水平。

远大非电空调通过回收发电机组废热提供了915kW的“免费”制冷，将整体能源效率提高到94%，每年减少制冷用电量950MWh。

该系统显著地减少了度假村温室气体排放和环境足迹，相当于一年内4856平方米森林所吸收的二氧化碳量。

比常规建筑相比，能源成本减少31.7%。

预计投资回收期为4.5年。

该项目获得了LEED金牌认证。

米高梅国家港口可持续发展措施

- **能源效率：**除了安装冷热电联产系统外，还使用项目测量与验证（M & V）计划，对能效进行持续测量，以验证设计中与能效措施相关的节约成本。
- **绿色车辆：**在整个停车场安装了二十四个电动汽车充电桩和低排放节能车位，供客人和员工使用。
- **公共交通：**新设的公交站点位于米高梅国家港口附近，以鼓励公共交通。
- **雨水收集：**建造了一个3200m³水箱，用于收集、存储、处理和再利用从屋顶收集的雨水，代替市政用水以满足灌溉、制冷和卫生需求。





LEASE BUYOUT OPTION FOR HOTEL

MORONGO CASINO RESORT & SPA

酒店机组租赁方案 — 摩洛哥赌场度假村

Background

Morongo Casino Resort & Spa (hereafter “Morongo Casino”) is a Native American luxury resort and casino near Palm Springs built in 1995. Morongo Casino offers Las Vegas-style gaming alongside upscale accommodations on the Morongo Reservation.

The resort has 310 rooms and suites. A 44-acre, 27-story resort, Morongo is one of the largest casinos and one of only six AAA four-diamond casino resorts in California. At 330 feet high, the casino tower is the tallest building in both Riverside County and the larger Inland Empire region.

System Description

Morongo Casino started an expansion project in January 2019. The expansion project includes installing a 13,000 sqft. CCHP system to increase energy independence, provide more reliable power and save operational costs for the casino.

The system is designed to have four gas engines to provide environmentally friendly electricity production and three diesel-fired backup engines. To increase energy efficiency, two exhaust heat recovery boilers and one BROAD 1,100-ton absorption chiller were installed with two centrifugal chillers together to provide cooling, heating and hot domestic hot water for the resort.

项目背景

摩洛哥赌场度假村及水疗中心（以下简称“摩洛哥赌场”）是美国印第安豪华度假胜地。度假村建于1995年，位于加州棕榈泉附近摩洛哥保留地，为周围居民及游客提供拉斯维加斯风格的娱乐项目及高档住宿。

摩洛哥赌场总面积约17.8万平方米，高27层，客房及套房310间，是加州最大的赌场之一，也是加州仅有的六个AAA四钻级赌场度假村之一。赌场塔高100米，是河滨县和内陆帝国区最高的建筑物。

系统描述

摩洛哥赌场于2019年1月开始进行扩建项目。项目包括安装一占地1200平方米的冷热电联产系统，以提高能源独立性，为赌场提供更可靠的电力并节约赌场运营成本。

该系统设计配备四台燃气发电机组，实现绿色发电，并配有三台柴油备用发动机。为了提高能源效率，系统设计安装了两台余热锅炉和一台3870kW远大烟气非电空调和两台离心式冷水机组，为赌场提供制冷、采暖和卫生热水。



Morongo Casino Mechanical Room 摩洛哥赌场机房

Equipment Information

Generator

Model: CAT 3520Cx4
 Fuel: Natural gas
 Power output: 2,000 kW/unit
 Electrical Efficiency: 40.10%

BROAD Absorption Chiller

Model: Single-stage hot water chiller BDH500
 Cooling Capacity: 1,100RT
 Heat Source: Hot water from engine heat recovery loop

Project Value

This 24/7 trigeneration system increases the energy resilience and reliability, and enables the resort to operate in island mode.

Fed by the waste heat of the trigeneration plant, the BROAD absorption chiller provides 1,100 tons of “free” cooling, reducing 4,047 MWh of electricity for cooling and saving over 0.5 million dollars in electricity costs annually*.

The system saves 52,371 MMBtu of fuel compared to the conventional system.

System annual carbon dioxide reductions: 13,842 metric tons, which is equivalent to carbon sequestered by 228,880 trees grown for 10 years.

* Results are based on US EPA CHP Energy and Emissions Savings Calculator, which may vary from the actual operation data.

* 结果基于美国能源局CHP能源及排放量计算所得，可能与实际运行数据有偏差。

设备信息

发电机组

机型：卡特彼勒 3520Cx4
 燃料：天然气
 发电功率：2000kW/台
 发电效率：40.10%

远大非电空调

机型：单效热水机 BDH500
 制冷量：3870kW
 驱动热源：发电机余热回收热水

项目价值

全年24小时运行的冷热电三联供系统提高了赌场能源灵活性和可靠性，并可实现孤岛运行。

远大非电空调由冷热电联产系统产生的余热驱动，提供3870 kW的“免费”制冷，每年可减少制冷用电量4047MWh，节约超过50万美元的电费*。

与传统系统相比，该冷热电联产系统可节省约 5.5×10^{10} kJ能源（1320吨原油当量）

系统每年可减少温室气体13842吨，相当于10年种植约23万棵树的碳吸收量。





Morongo Casino Mechanical Room 摩洛哥根赌场机房



BROAD Lease Buyout Option

To help customers gain access to BROAD equipment without purchasing it in up front and have a better cash flow, BROAD provides an 8-year lease buyout option for Morongo Casino that the customer only need to pay a certain amount of money annually to gain access to BROAD equipment with a full range of maintenance services.

Benefits of BROAD Chiller Lease Buyout

- **Conserve and Control Cash:** Does not require a significant down payment, fixed yearly payments for the full term of lease that helps customers budget more effectively and have a more flexible cash flow to grow customers' business.
- **Expedite Budget Approval:** Leasing equipment uses less departmental budget since payments are made monthly or annually over a multi-year period instead of all up front. As a result, the budget approval process is faster.
- **Lower O&M Costs:** One considerable benefit of leasing is lower O&M costs by outsourcing the ownership function to the manufacturer. In a lease buyout agreement, BROAD provides all-inclusive service and maintenance, ensuring customers always have reliable equipment and negating the need for inhouse technicians.
- **Longer Equipment Lifespan:** professional service and maintenance directly from the manufacturer keeps the equipment operating in good condition, prolonging the life of the equipment.

远大租赁方案

为帮助客户无需提前购买便可使用远大设备并保持良好的现金流，远大为摩洛哥根赌场提供了一套8年设备租赁买断方案，客户每年仅需支付一定的金额即可使用远大空调及全套机组维护服务。

远大非电空调租赁方案的优势：

- **节约和控制现金：**不需要一大笔预付款，仅需每年支付固定金额，帮助客户更有效地进行预算，并拥有更灵活的现金流来发展业务。
- **加快预算批准：**由于设备租赁的付款是分月或分年而非一次性提前付清，因此所需部门预算较少，批准过程更快。
- **降低运营和维护成本：**通过将设备所有权外包给制造商，可以降低客户运营和维护成本。在租赁买断协议中，远大在租赁期将提供全方位维护服务，确保客户始终拥有可靠的设备，而无需额外的现场技术人员。
- **设备使用寿命更长：**直接由制造商提供的专业服务和维护可使设备始终处于良好状态，从而延长设备的使用寿命。



Tri-generation Plant of Morongo Casino
摩洛哥根赌场冷热电联产能源站



ENERGY UPGRADE IN OFFICE BUILDING

WALL STREET PLAZA, NEW YORK

蒸汽制冷升级改造 — 华尔街广场

Background

Wall Street Plaza is an investment office building with commercial and banking facilities located at 88 Pine Street in the Financial District of Lower Manhattan, only one block away from the Wall Street. Built in 1973, the building was designed by the well-known Chinese-American architect I. M. Pei and his firm. It has won many awards including the American Institute of Architects: National Honor Award.

Wall Street Plaza has 32 stories with approximately 624,000 rentable square feet, offers prime building access with several metro stations in walking distance, and easy access to the Brooklyn Bridge and Whitehall Ferry Terminal. It also has a myriad of escapes for lunch or after hours within walking distance, such as Battery Park, museums, Pier 16, the viewing point of Statue of Liberty and etc.

Wall Street Plaza is owned by Orient Overseas (International) Co., Ltd, a Hong Kong listed company. Orient Overseas Limited was founded by the late shipping magnate Haoyun Dong and was later acquired by COSCO Shipping.

客户背景

华尔街广场是一栋位于曼哈顿下城金融区的金融服务和银行办公楼,离华尔街仅一个街口。该办公楼建于1973年,由著名美国华裔建筑师贝聿铭及其事务所主持设计,获得了美国建筑师学会颁发的国家荣誉奖等多个奖项。

华尔街广场楼高32层,可出租面积约58000平方米。交通便利,步行即可到达数个地铁站,近邻布鲁克林大桥和白厅轮渡码头。步行距离内有多处适合午餐或下班后的休闲娱乐场所,如炮台公园、博物馆、16号码头和自由女神像观景台等。

华尔街广场由香港上市公司东方海外有限公司所有。东方海外(国际)有限公司由已故船王董浩云创办,后被中远海运收购。

Project Introduction

In 2012, the superstorm Sandy swept across the east coast of the United States, leaving millions of people without water and power and killed at least 147 people. Causing an estimated \$70.2 billion in damages, Sandy became one of the most costly natural disasters in U.S. history.

New York was severely affected by Sandy, particularly New York City. The public transportation system was paralyzed, Wall Street Financial District in lower Manhattan was flooded with darkness and the New York Stock Exchange closed for two consecutive days.

Wall Street Plaza was also hit hard. Its mechanical room on the basement floor was soaked in flood and equipment was seriously damaged. In 2016, Wall Street Plaza began its renovation project. In order to improve energy efficiency and reduce operating costs, the designer decided to replace the old single-stage steam chillers with two BROAD two-stage steam chillers, providing total 1,600 tons of cooling for the whole building in summer.

Project Value

In this project, BROAD replaced two aged single-stage absorption chillers with its high-efficiency two-stage chillers, which more than doubled the energy efficiency. In 2017 and 2018, the summer steam consumption of Wall Street Plaza was reduced by 46% compared to before the replacement, especially during the peak cooling period, the steam consumption was reduced by 55-60%, and cut steam bills by over 200,000 USD annually.

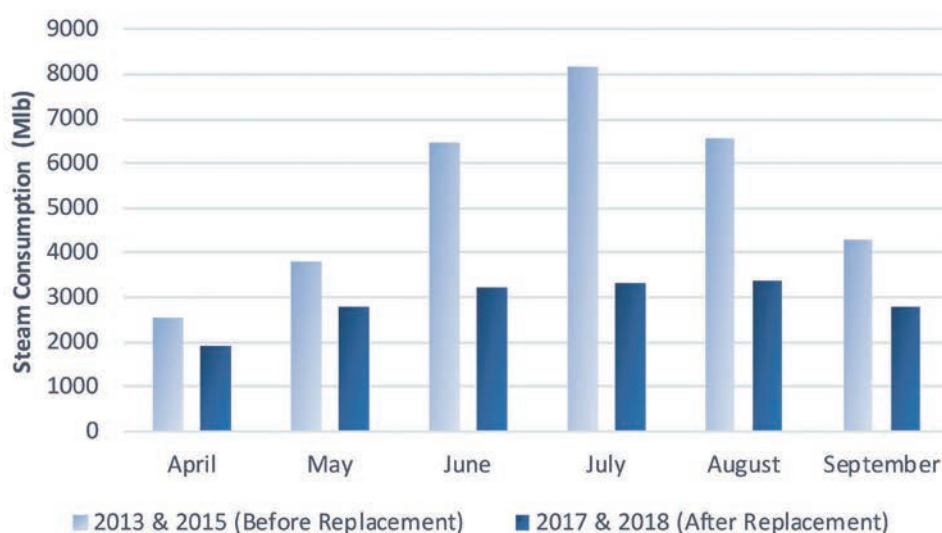
项目介绍

2012年超级飓风“桑迪”席卷了美国东海岸，导致数百万人停水停电，至少有147人在此次灾难中丧生，造成经济损失近702亿美元，成为美国历史上损失最严重的自然灾害之一。纽约市受灾严重，公共交通系统瘫痪、曼哈顿华尔街金融区被洪水和黑暗淹没、纽约证券交易所连续两天关闭。

华尔街广场也遭到重创，其位于地下一层的机房被洪水浸泡，设备受损严重。2016年华尔街广场开始进行整修工程，为提高能源效率并降低运行费用，设计师决定用两台远大双效蒸汽机替代原有的单效蒸汽机，为办公楼提供夏季集中供冷5626kW。

项目价值

在该项目中，远大用其高效的双效蒸汽非电空调替换了两台旧的单效蒸汽机，能源效率提高了一倍多。2017和2018年用户夏季蒸汽耗量较替换前减少46%，特别是在制冷高峰蒸汽耗量减少55-60%，年节约蒸汽费用超20万美元。



In 2017 and 2018, steam consumption reduced by

46% annually

while

Summer peak consumption rates decreased by

55~60%



BROAD Absorption Chiller

Model: Two-stage steam chiller BS250 x 2
Cooling Capacity: 800 RT/unit
Heat Source: District steam

远大非电空调

机型：双效蒸汽机BS250两台
制冷量：2813kW/台
驱动热源：城市管网蒸汽



Buildings on Steam Cooling

Many leading architects, engineers, developers, and property owners are building on steam for cooling because of the efficiency, flexibility and reliability of steam absorption chillers, especially for buildings with existing steam-powered heating. Using steam as a heat source for cooling during the summer can help reduce electric-peak demand, therefore helping to reduce overall operating costs.

Benefits of Steam Absorption Cooling

- Bring steam system reliability into the cooling solution;
- Avoid electric demand charges at peak rates;
- Alleviates electric capacity at peak periods for alternate use;
- Lower risk of interrupted electric service from system strain in peak periods (within buildings and within regions);
- Steam chiller provides economical “on demand” supply of chilled water as opposed to storage systems;
- Use water as refrigerant, effectively reduce ozone pollution in summer;
- No special certifications required for operators of steam absorption chillers.

建筑蒸汽制冷

由于蒸汽非电空调的高效率、灵活性和可靠性，许多建筑师、工程师和开发商都采用蒸汽制冷，尤其是针对已采用蒸汽供暖的建筑。在夏季采用蒸汽作为热源制冷可以帮助减少高峰用电需求，从而有助于降低总体运行成本。

蒸汽吸收制冷的优点：

- 制冷方案融合了蒸汽系统的可靠性；
- 避免高峰需量电费；
- 减少高峰时段制冷电耗，以供他用；
- 降低高峰期 (建筑物内和区域内) 因系统压力导致电力服务中断带来的风险；
- 蒸汽制冷提供经济的“按需”供冷。
- 使用水作为制冷剂，有效降低夏季臭氧污染；
- 蒸汽非电空调无需特殊持证操作员。



NYC Steam System 纽约市地下蒸汽系统

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