

Moving Towards
Net-Zero Energy Hospital Building

Presented by
Ted Jacob

Building Life Cycle

- Phase 1 - Manufacturing of Products
- Phase 2 - Transportation of Product to Construction Site
- Phase 3 - Construction
- Phase 4 - Operation
- Phase 5 - Demolition and Recycle

Definitions

- **Net-Zero Energy Building:**
A net-zero building produces as much energy as it uses over the course of one year
- **Carbon Neutral Building:**
Carbon neutral or net-zero carbon footprint is achieved by balancing the carbon released with an equivalent amount sequestered or offset.

Carbon Cycle

The carbon cycle

Carbon is a basic building block of life. The element follows a continuous path around Earth's biosphere, passing through the atmosphere, living things and underground in the form of fossil fuels.

Naturally released into the air: Wildfires and volcanic eruptions send carbon into the atmosphere. Living organisms emit carbon through the process of respiration.

Burning of fossil fuels: Fossil fuels like coal and oil are burned by factories and cars, releasing carbon dioxide into the atmosphere. Scientists say these emissions have caused significant changes to the world's climate.

Atmosphere

Sunlight

Forest fires

Plants

Natural gas

Coal

Oil

Absorbed by plants: Plants containing chlorophyll use sunlight and water, together with carbon dioxide absorbed from the air, to produce food, releasing oxygen.

Carbon stored: Trees store carbon for a long time, and when harvested, the carbon continues to be stored in wood products. Under certain geological conditions, living things that are buried become fossil fuels after millions of years.

Fossil Fuel Reduction Standards

- 60% in 2010
- 70% in 2015
- 80% in 2020
- 90% in 2025
- Carbon-Neutral in 2030
(Using no Fossil Fuel)

DOE Net-Zero Energy Commercial Building Initiative

- Launched August 5, 2008.
- Strives to make buildings capable of generating as much energy as they consume by 2025.
- Accelerate innovation and market adoption.
- Onsite renewable energy generating systems, i.e. solar, PV.



DOE Energy Smart Hospital Initiative

- Launched July 23, 2008.
- Part of the Net-Zero Energy Commercial Building Initiative.
- Focus on developing the strategies, partnerships, tools, and resources to promote the use of Energy – Efficient Technologies.

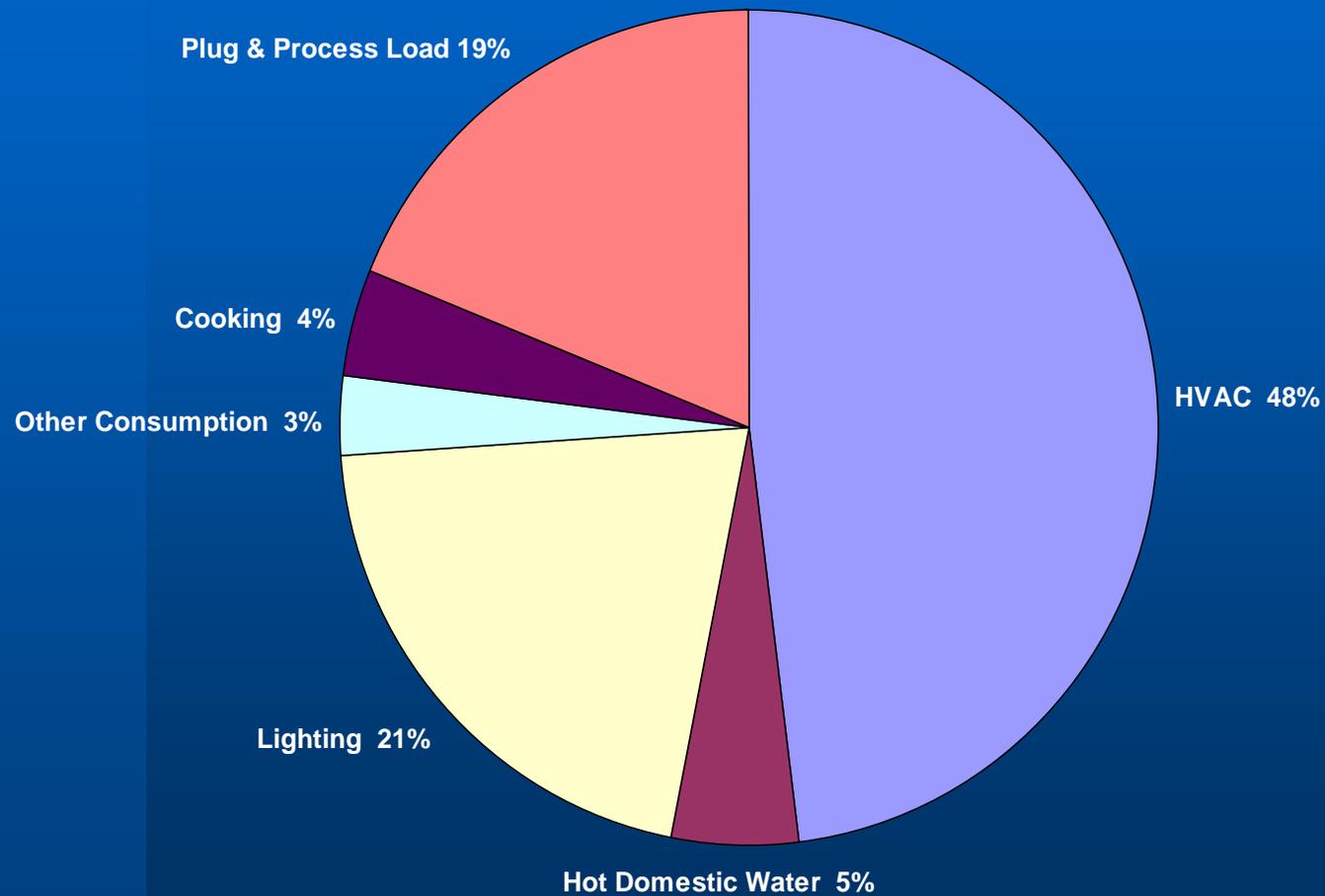
Energy Smart Hospital Goals

- Promote 30% improved efficiency in new hospitals .
- Promote 20% improved efficiency in existing hospitals.
- Increase efficient and renewable energy application.
- Reduce energy use and operating costs.
- Create healthier healing and work environment.

Why Energy Smart Hospitals

- Improve profitability.
- Reduced impact of volatile energy costs.
- Lower operations and maintenance costs.
- Improved environmental performance.
- Reduce carbon footprint.
- Healthier healing and work environment.
- Healthier communities.

Hospital Energy Consumption



Targets May Be Accomplished By Implementing

- Innovative Design Strategies.
- Generating ON-SITE Renewable Energy.
- Purchase Maximum 20% Renewable Energy.

ZEB Design Options by Climate

	Mild Climate (San Francisco Bay Area)	Cold / Hot & Humid Climate (Chicago)	Hot & Humid Climate (Abu Dhabi)	Hot & Dry Climate (Riyadh)
On-Site Innovation Design				
Passive Solar & Architecture	7.0%	10.0%	11.0%	11.0%
Day Lighting	2.0%	2.0%	2.0%	2.0%
Plug & Process Load	7.0%	7.0%	7.0%	7.0%
Water Savings	1.5%	1.5%	1.5%	1.5%
Heat Recovery (Primary) Constant Air Volume	8.8%	8.0%	-0.7%	10.0%
Heat Recovery (Primary) Variable Air Volume	12.6%	11.9%	10.1%	9.1%
Heat Recovery (Secondary) VAV	0.8%	1.2%	3.0%	3.2%
Heat Recovery (Tertiary) VAV	1.4%	2.0%	3.9%	4.0%
Unoccupied Setback	0.9%	0.8%	0.8%	0.5%
Displacement Ventilation	1.4%	1.4%	1.4%	1.4%
Fuel Cell / Cogeneration	2.5%	2.5%	2.5%	2.5%
Lighting	7.8%	7.8%	7.8%	7.8%
Sub-Total Innovative Design	54.0%	56.0%	50.0%	60.0%
On-Site Renewable Energy				
Solar	8.0%	7.0%	10%	10.0%
Photovoltaic	8.0%	7.0%	10%	10.0%
Geothermal	5.0%	5.0%	5.0%	0.0%
Wind Turbines	5.0%	5.0%	5.0%	0.0%
Off-Site Renewable Energy	20.0%	20.0%	20.0%	20.0%
TOTAL:	100%	100%	100%	100%



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Green Guidelines

- US Green Building Council (USGBC) LEED Green Building Rating
- Green Guide for Healthcare (GGHC)
- Emirates Green Building Council (EGBC)
- Abu Dhabi Green Buildings (ADGB)



Design & Construction Rating Systems

CATEGORY	USGBC	GGHC	EGBC	ADGB
Sustainable Sites	14	21	13	15
Energy & Atmosphere	17	21	16	20
Water Efficiency	5	6	12	30
Materials & Resources	13	21	11	15
Indoor Environmental Quality	15	24	15	15
Innovation & Design Process	5	4	5	5
Total Points	69	97	72	100

CERTIFICATION	USGBC	GGHC	EGBC	ADGB
Certified	26 - 32	N/A	29 - 35	45
Silver	33 - 38	N/A	36 - 43	55
Gold	39 - 51	N/A	44 - 57	65
Platinum	52 or more	N/A	58 or more	75 or more

Operations

CATEGORY	USGBC	GGHC	EGBC	ADGB
Integrated Operations	N/A	5	N/A	N/A
Transportation Operations	N/A	3	N/A	N/A
Energy Efficiency	N/A	18	N/A	N/A
Water Conservation	N/A	8	N/A	N/A
Chemical Management	N/A	5	N/A	N/A
Waste Management	N/A	6	N/A	N/A
Environmental Services	N/A	9	N/A	N/A
Environmental Preferable Purchases	N/A	11	N/A	N/A
Innovation in Operations	N/A	7	N/A	N/A
Total Points	N/A	72	N/A	N/A

Kaiser Los Angeles Medical Center
Los Angeles, California

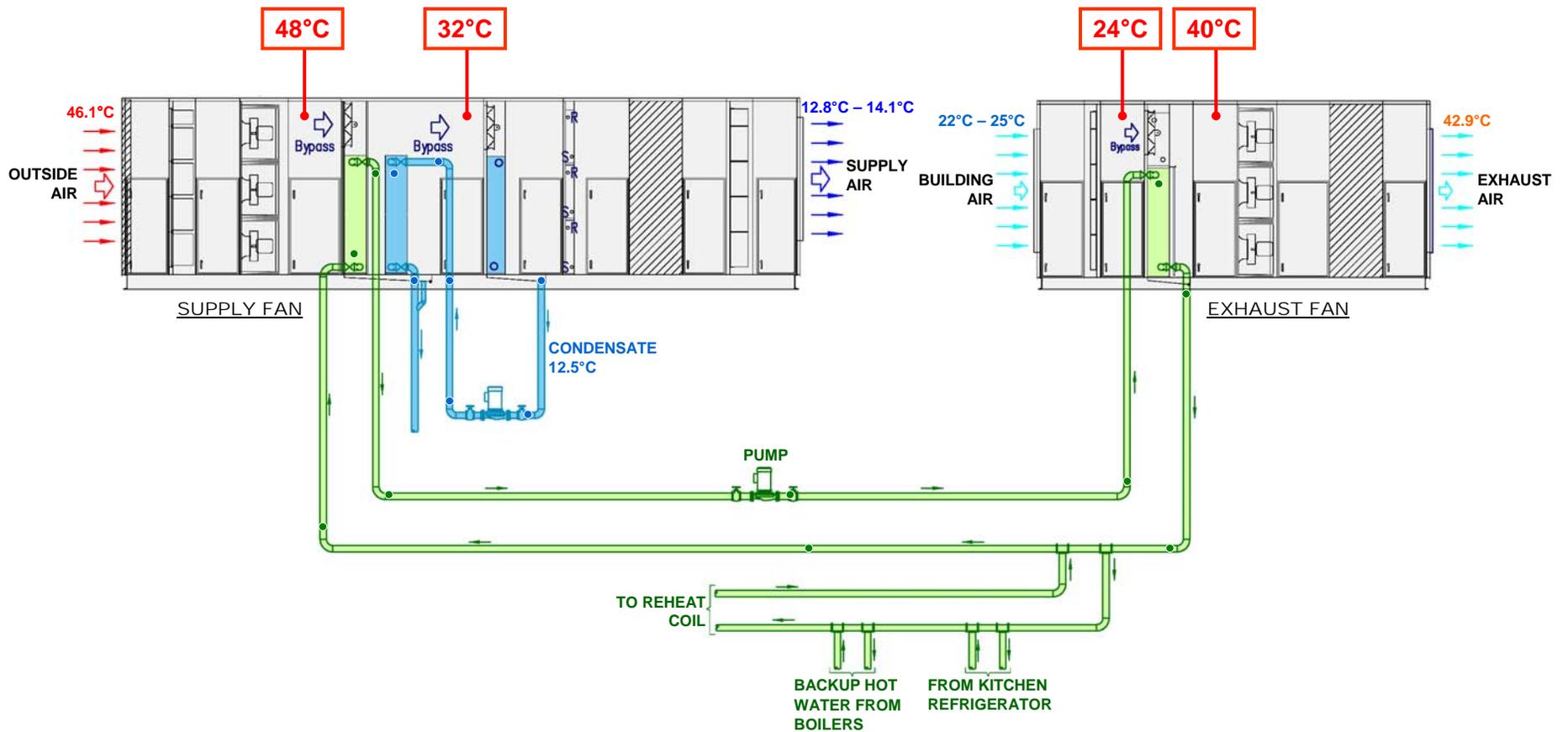
Client: Kaiser Permanente
Oakland, California

Scope: 450 Bed Hospital
900,000 sq. ft.

Completion: 2008



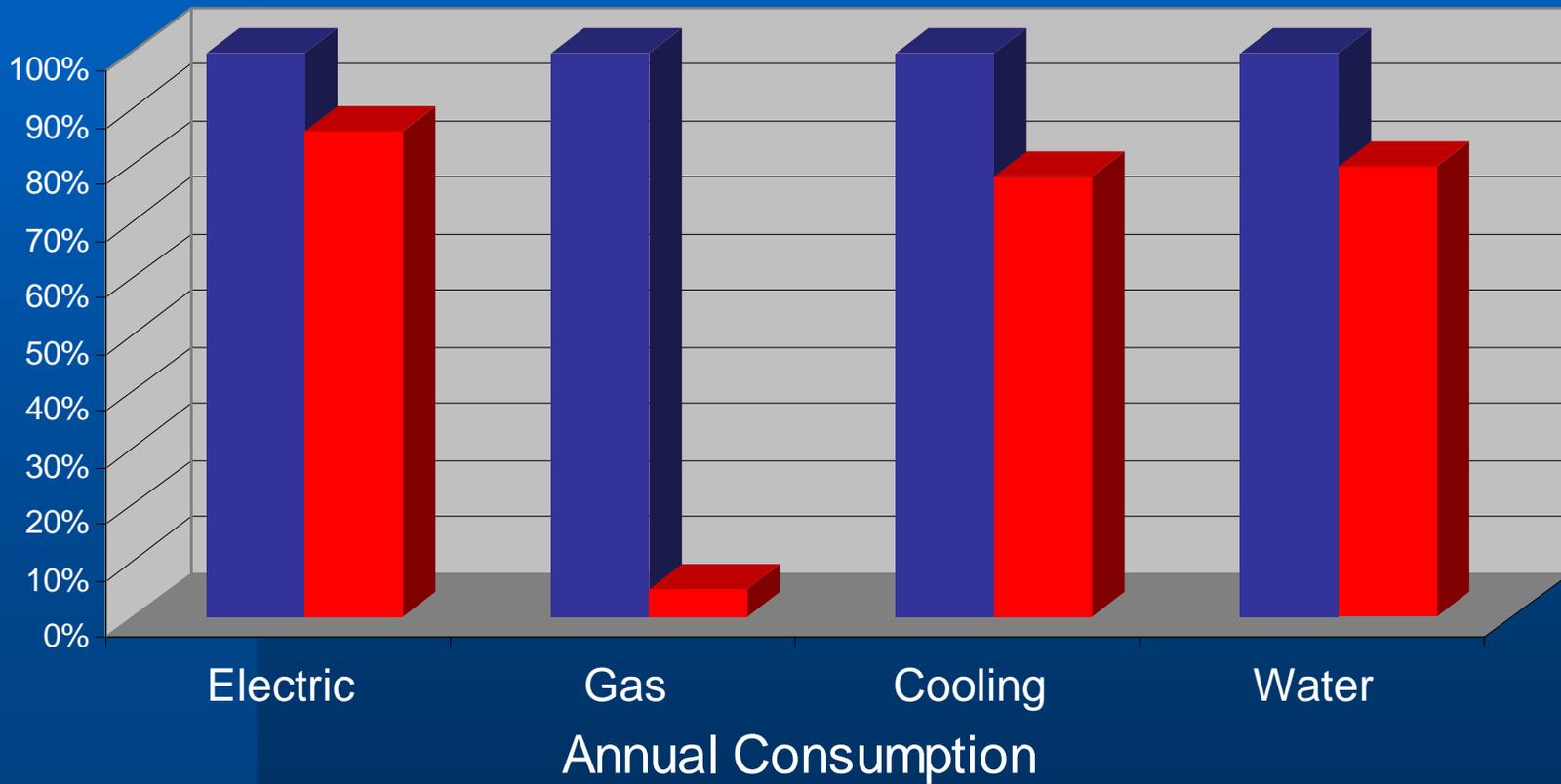
Heat Recovery



HVAC System Options

■ Return Air Constant Volume

■ 100% Outside Air Variable Volume



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**California Pacific Medical Center
San Francisco, California**

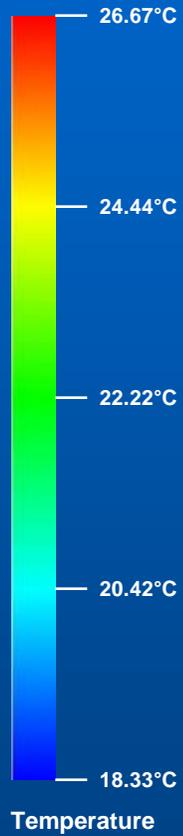
Client: Sutter Medical Group
San Francisco, California

Scope: 550 Bed Women & Childrens
Acute Care Hospital
1.2 million sq. ft.

Completion: 2012

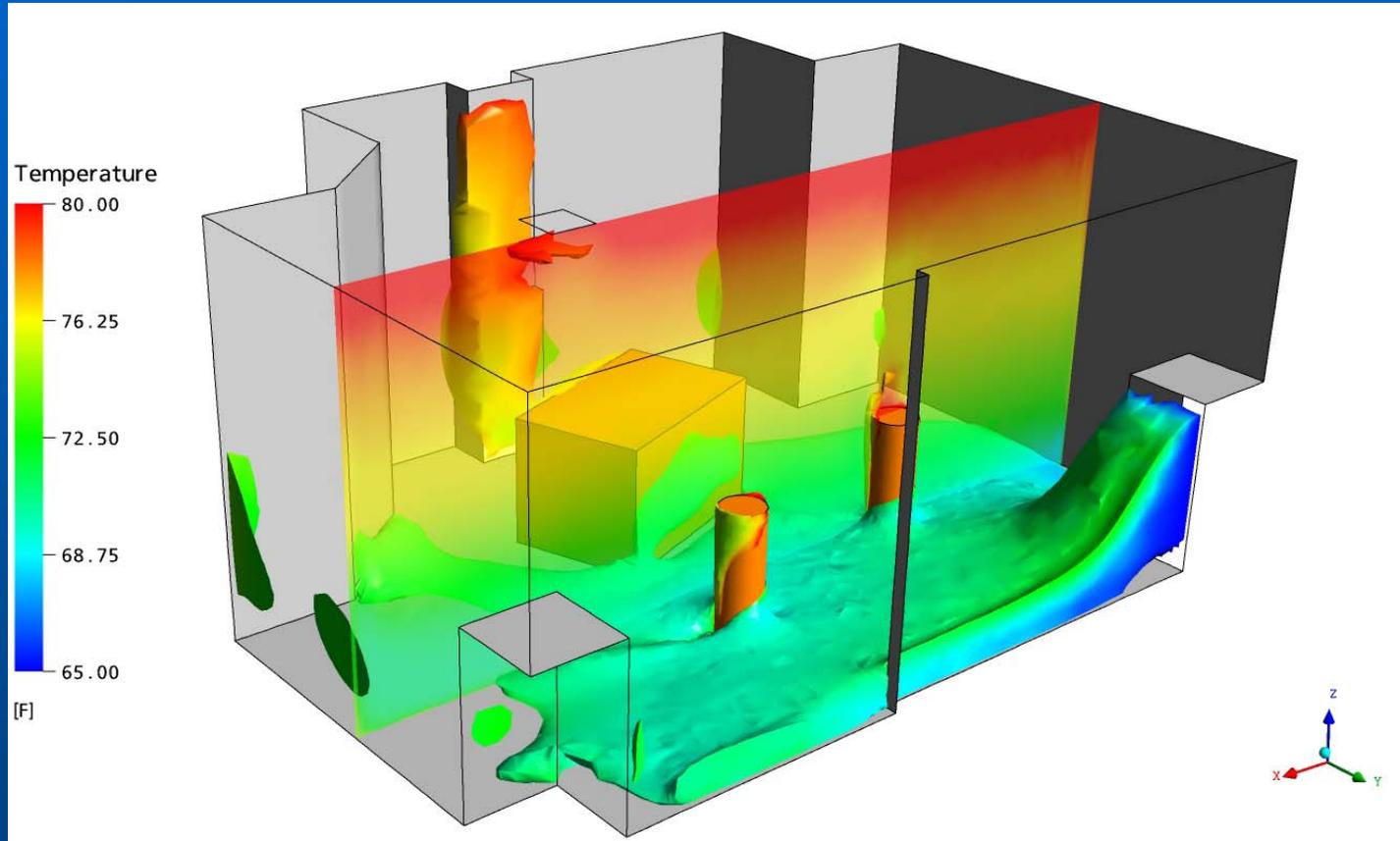


Displacement Ventilation



Smoke Test

Displacement Ventilation



Displacement Ventilation

240 CFM @ 7.2 AC/HR

Cooling: 18.0 °C Supply Air

Height	Room	Window	Bath
9'-0"	-	-	-
8'-6"	23.6	24.7	22.2
8'-0"	23.3	23.6	21.9
7'-0"	22.8	23.6	21.9
6'-0"	22.8	22.5	21.7
5'-0"	22.7	22.5	21.8
4'-0"	22.7	22.3	22.2
3'-0"	22.0	21.9	22.2
2'-0"	21.0	21.6	21.3
1'-0"	-	-	-

120 CFM @ 3.6 AC/HR

Cooling: 18.0 °C Supply Air

Height	Room	Window	Bath
9'-0"	-	-	-
8'-6"	24.1	24.4	21.1
8'-0"	23.7	24.4	21.3
7'-0"	23.6	23.5	21.6
6'-0"	23.4	23.3	21.9
5'-0"	23.3	23.3	22.2
4'-0"	23.3	23.3	22.2
3'-0"	23.0	23.3	22.3
2'-0"	21.2	20.5	22.5
1'-0"	-	-	-

Room Temperature Profile

Cleveland Clinic Abu Dhabi
Abu Dhabi, UAE

Client: Mubadala
Abu Dhabi, UAE

Scope: 360-490 Bed
4.8 Million sf.

Completion: 2013

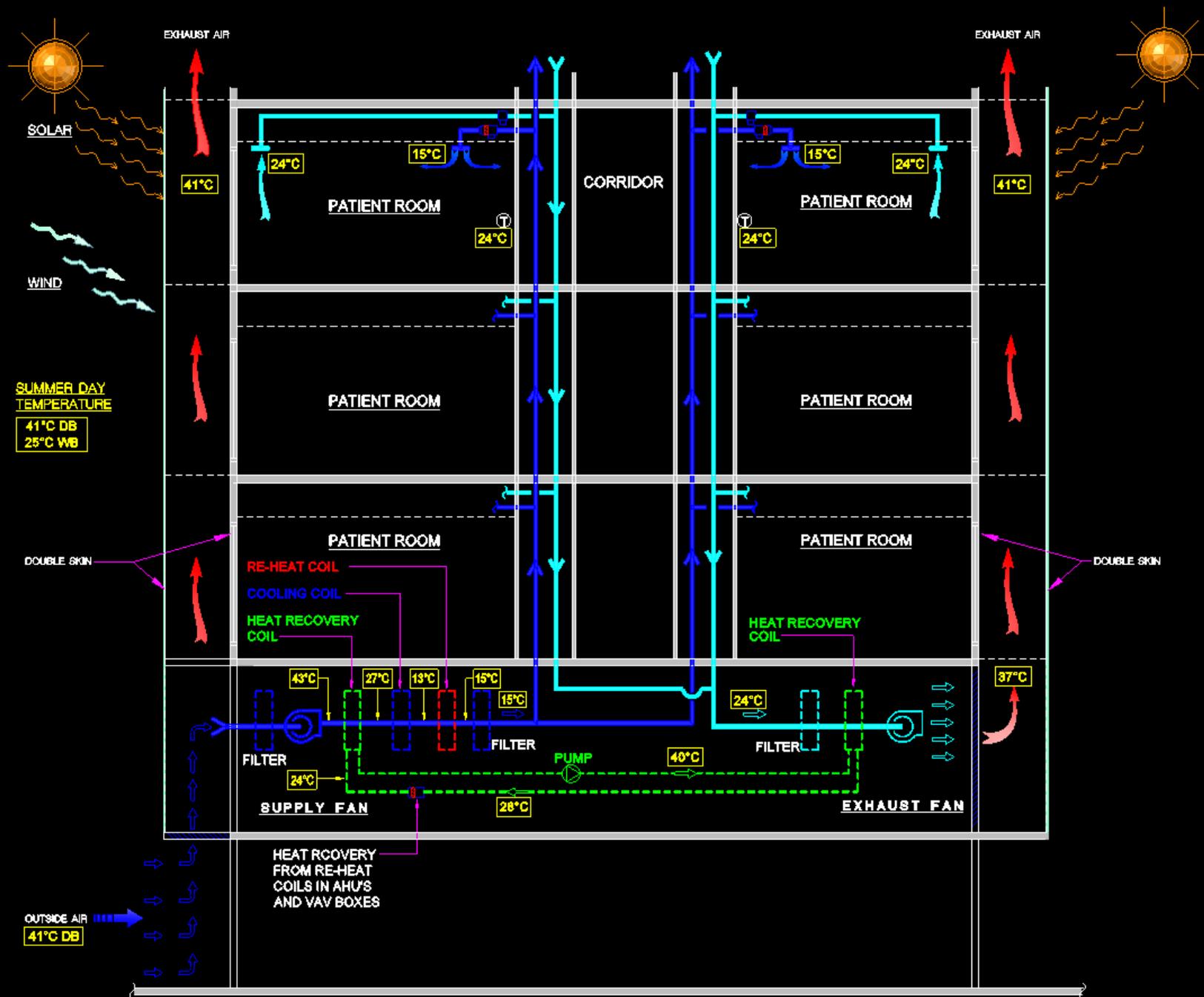


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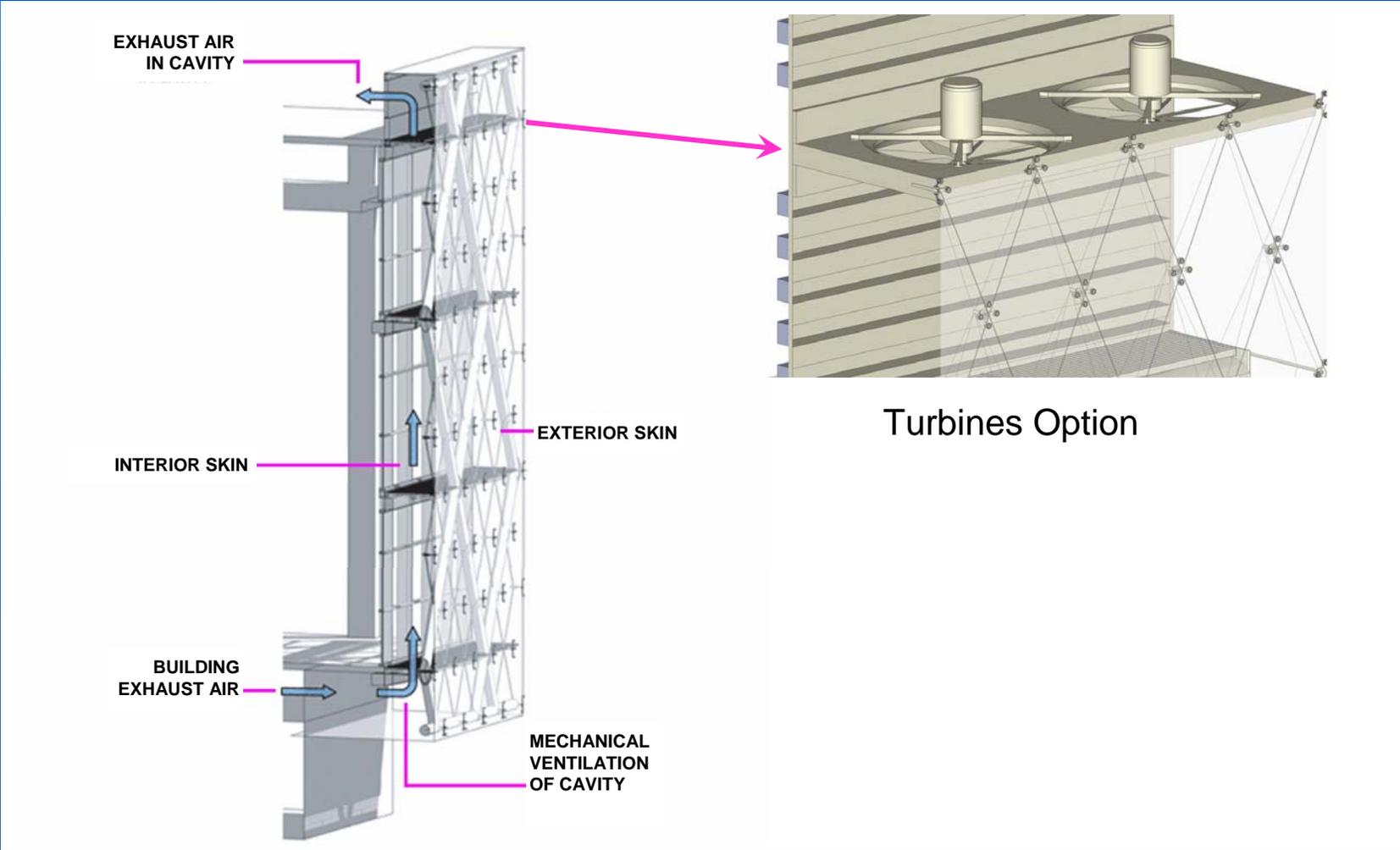
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Unique UAE Design Conditions

- High Temperature
- High Humidity
- Sand Storms
- Water Shortage



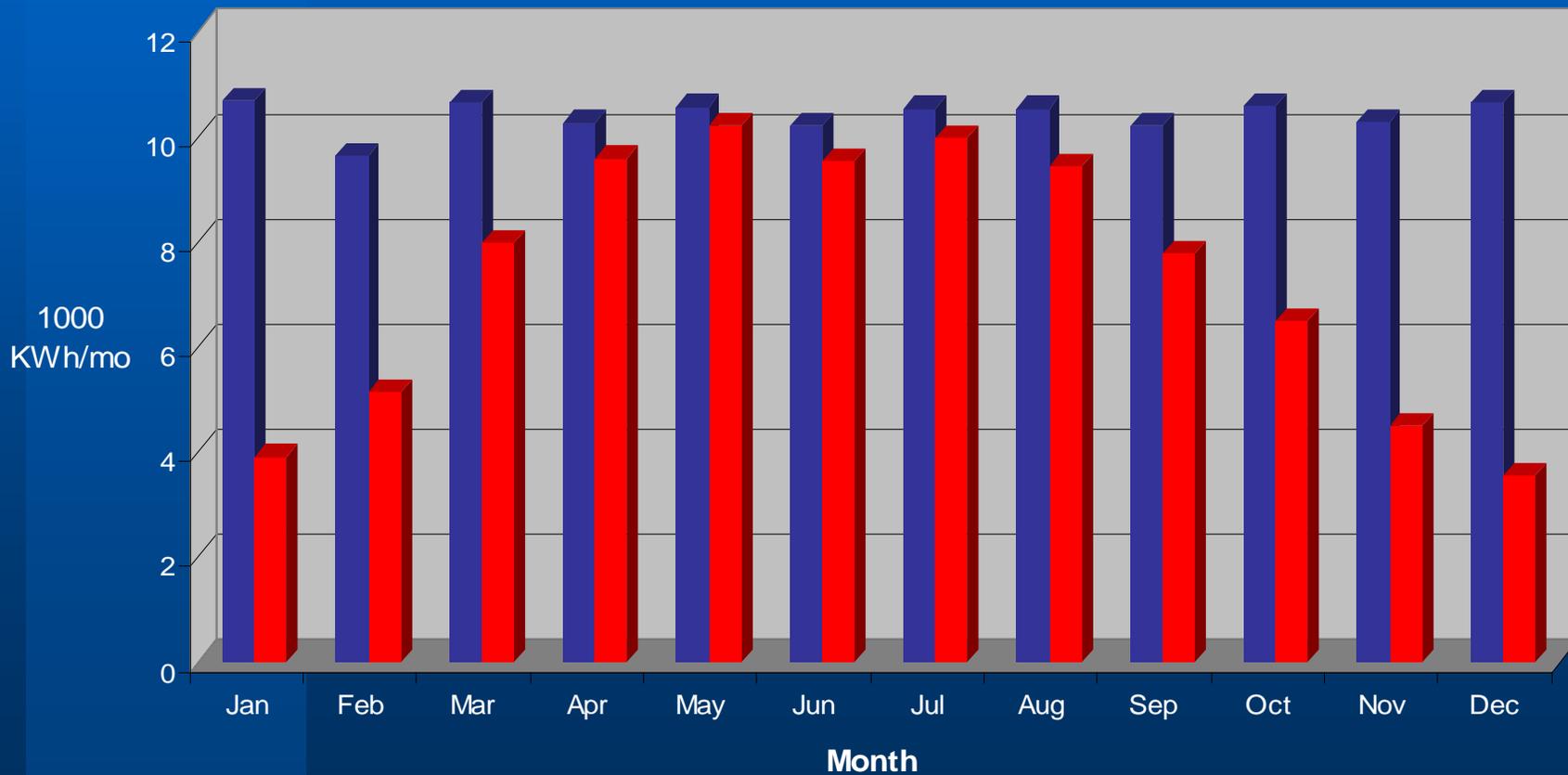
Curtain Wall



Solar Hot Water

■ Domestic water heating demand

■ Domestic water heating by solar



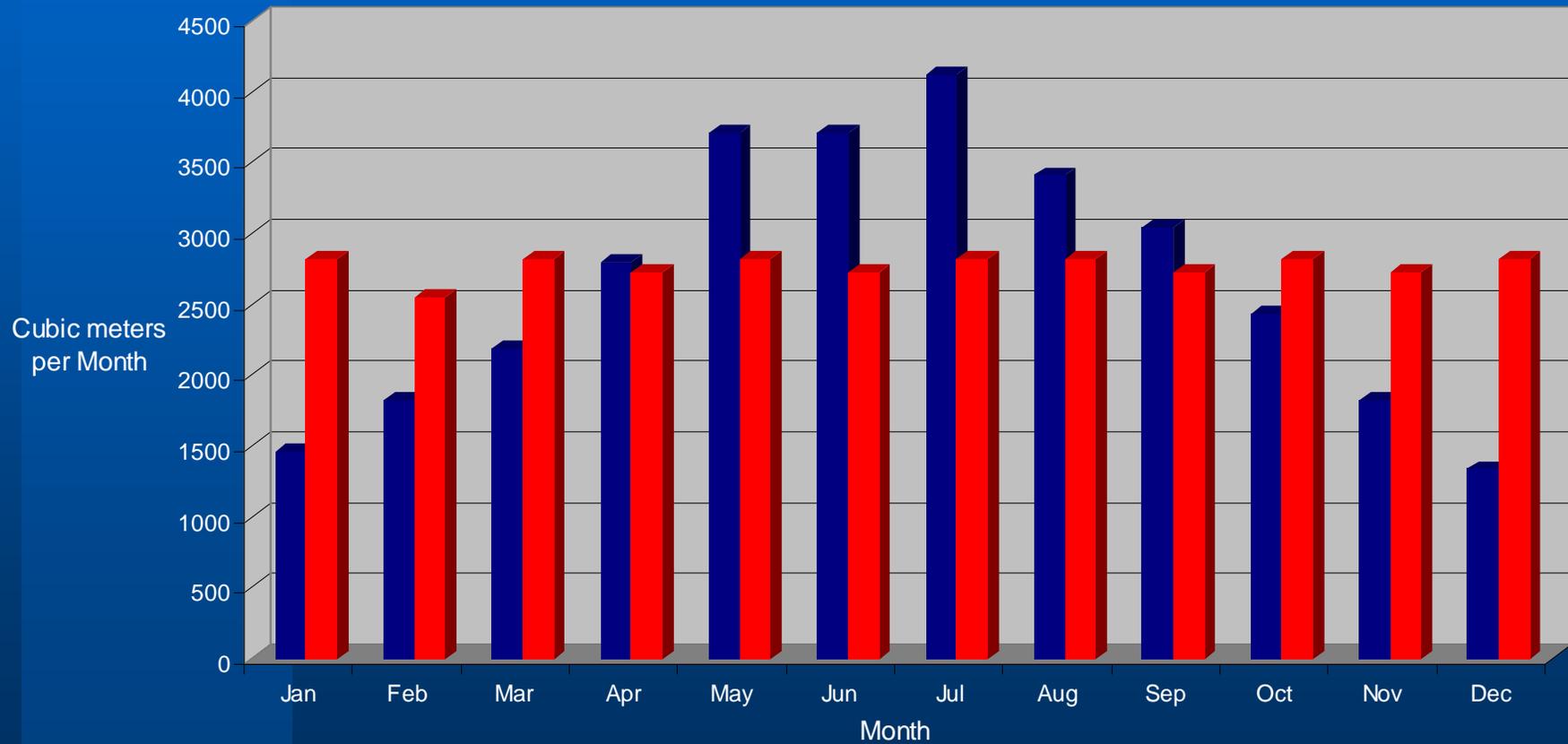
Water Efficiency

- Eliminate Potable Water Use for Medical Cooling.
- Potable Water Measurement and Verification.
- Reduce Use of Potable Water in Building Systems Equipment.
- Provide System to Capture AHU Condensate.

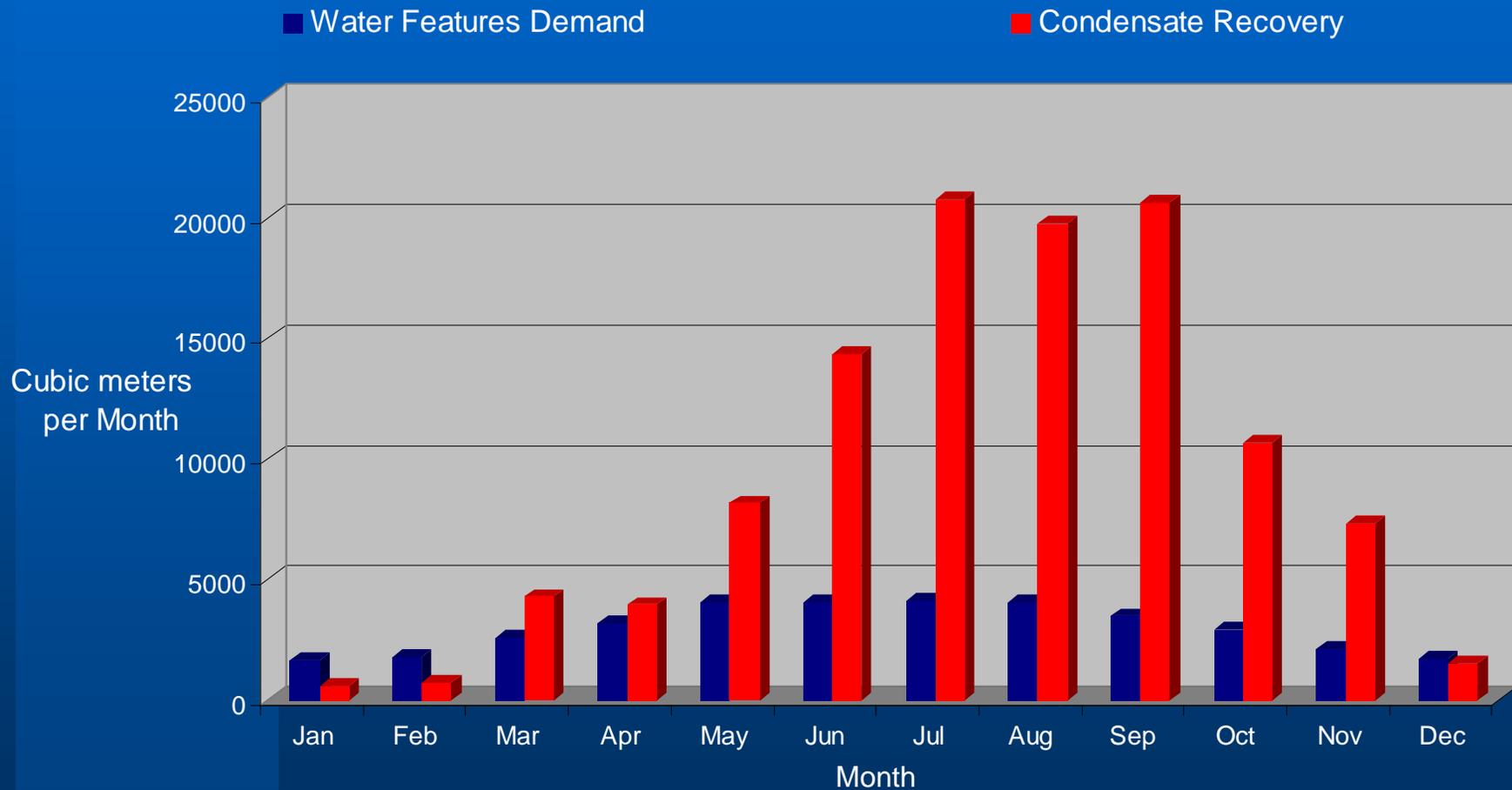
Grey Water Recovery

■ Irrigation Demand

■ Grey Water Recovery



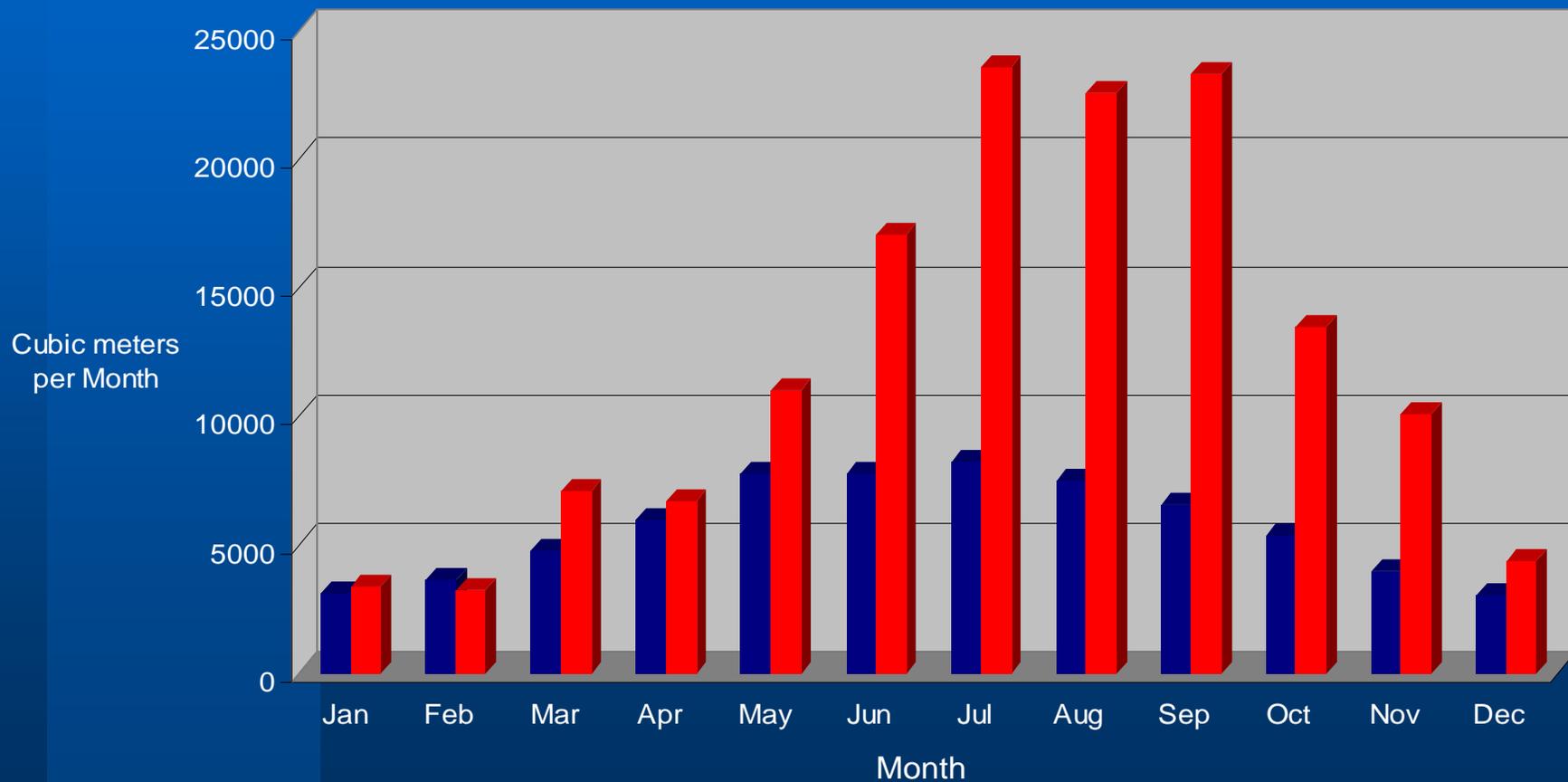
Condensate Water Recovery



Reclaimed Water (Grey Water and Condensate)

■ Irrigation and Water Feature Demand

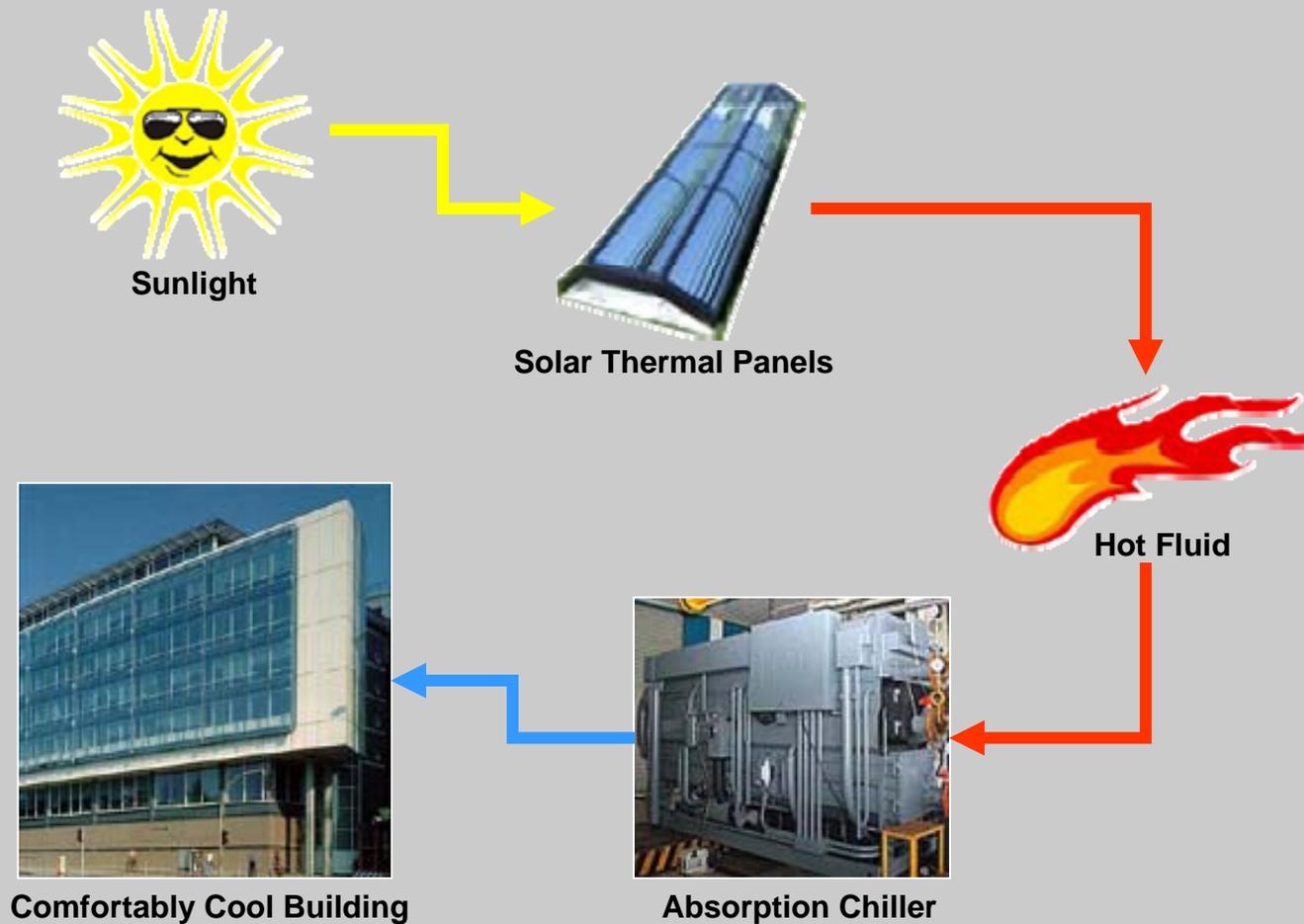
■ Grey Water and Condensate Recovery



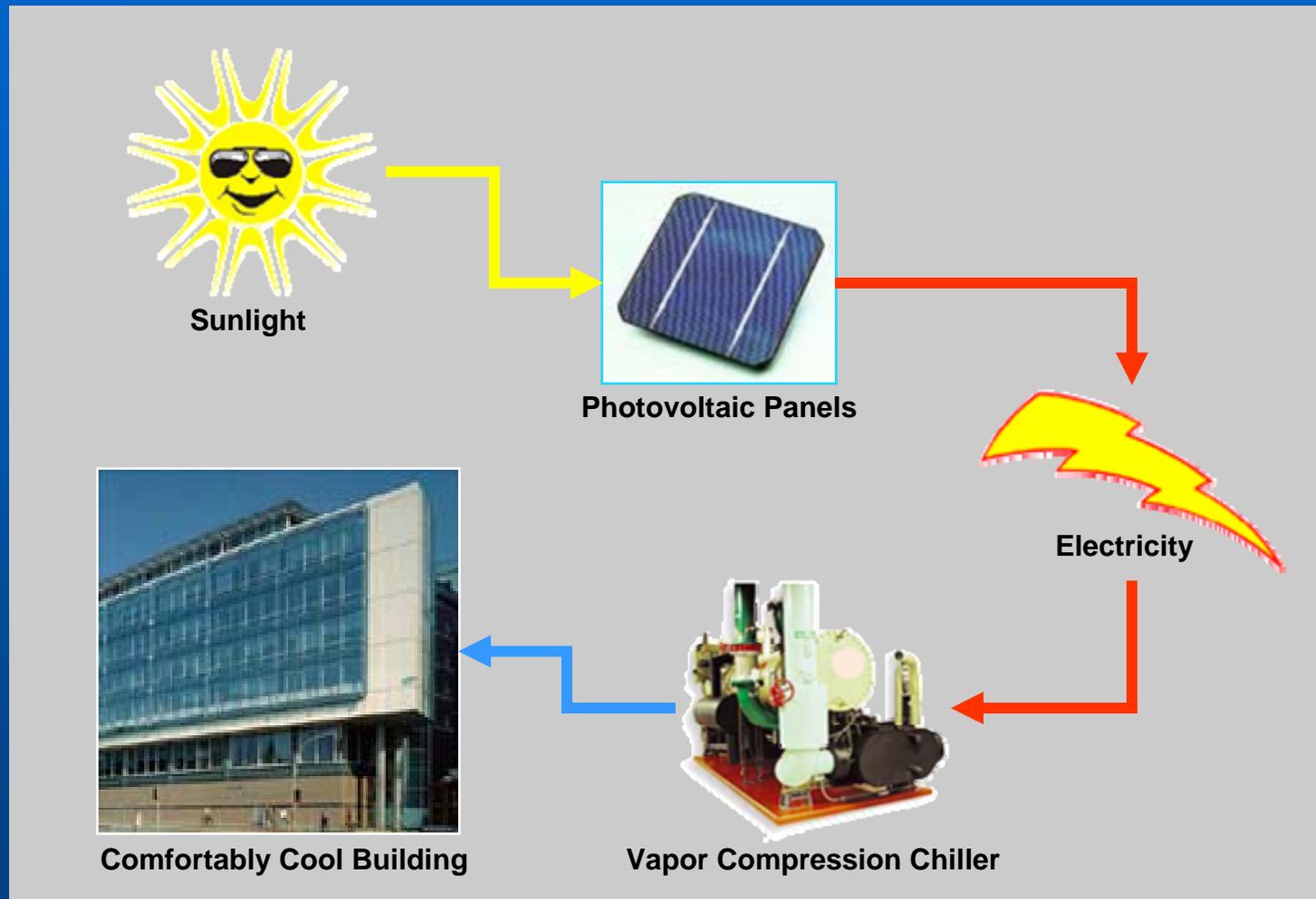
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Cooling with Solar Panels



Cooling with Photovoltaic Panels



Self-Contained Patient Bed



- **Medical Gases**
 - Oxygen Concentrator
 - Medical Vacuum
 - Medical Air
- **Power**
 - New Battery Technology
 - Data Analysis Tools
 - Remote Display and Controls
- **Environmental Controls**
 - Heating
 - Ventilating
 - Cooling

Something To Think About

- How will ZEB reshape our buildings?
- How can we integrate available technologies into our buildings?
- What renewable technologies are available and can we make them feasible?
- What can we do to achieve the ZEB by 2025?

Innovate and Implement



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Together we can achieve

**Net-Zero Energy,
High-Performance
Green Hospital Buildings**



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