

Moving Towards
Net-Zero Energy Hospital Buildings

Presented by
Ted Jacob



HOSPITAL BUILD
MIDDLE EAST
Exhibition & Congress 2010

TED JACOB ENGINEERING GROUP

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

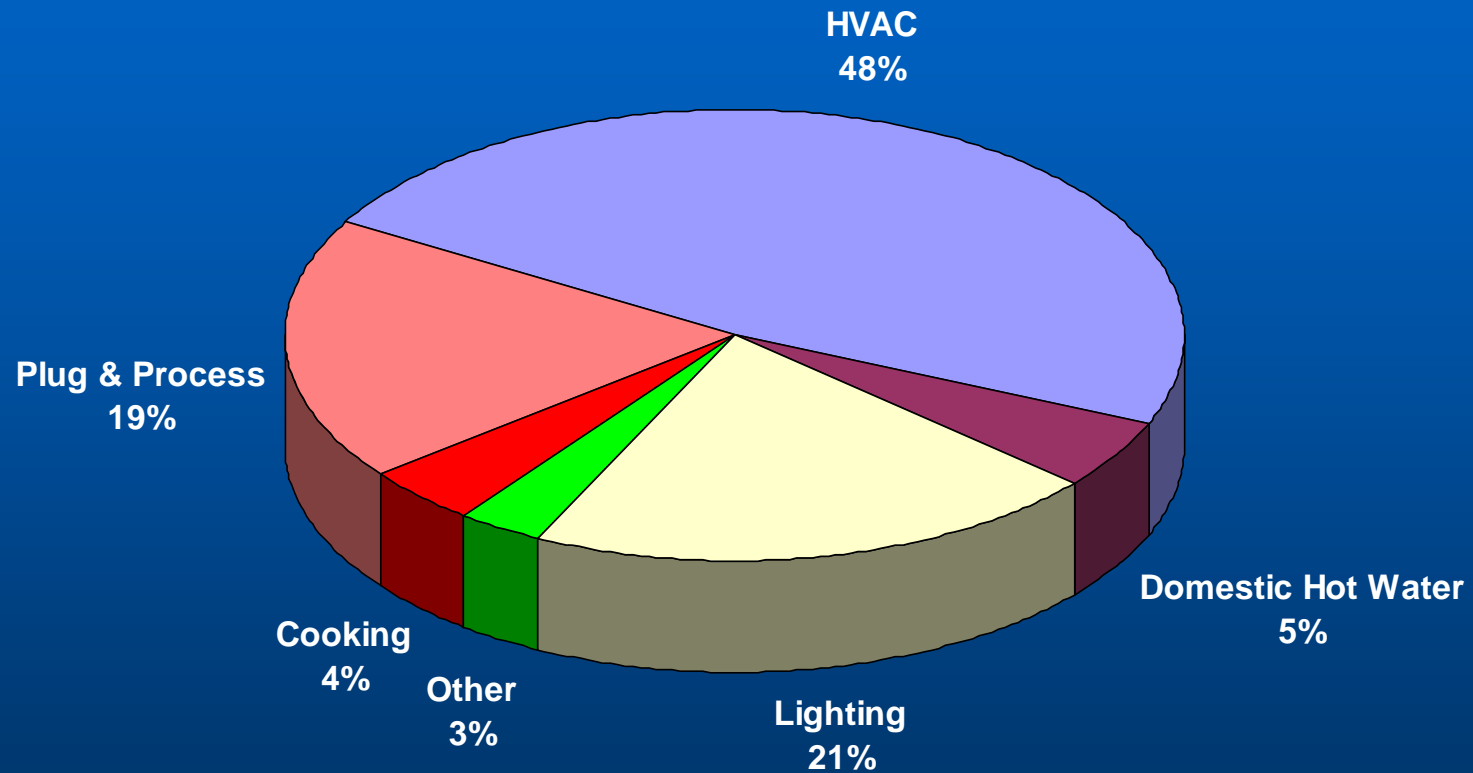


Green Trends in Healthcare

- **Net-Zero Energy Building by 2025:**
A net-zero building produces as much energy as it uses over the course of one year
- **Carbon Neutral Building by 2030:**
Carbon neutral or net-zero carbon footprint is achieved by balancing the carbon released with an equivalent amount sequestered or offset.



Hospital Energy Consumption



Net Zero Energy Targets

Categories	ASHRAE 90.1
Innovative Design Strategies	50%
On-Site Renewable Energy	30%
Off-Site Renewable Energy	20%
Net Zero Energy	100%



NZEB Design Options by Climate

	Mild Climate (San Francisco Bay Area)	Cold / Hot & Humid Climate (Chicago)	Hot & Humid Climate (Abu Dhabi)	Hot & Dry Climate (Riyadh)	Pay Back (Years)
Innovative Design					
Passive Solar & Architecture	7.0%	10.0%	11.0%	11.0%	3
Day Lighting	2.0%	2.0%	2.0%	2.0%	3
Plug & Process Load	7.0%	7.0%	7.0%	7.0%	1
Water Savings	1.5%	1.5%	1.5%	1.5%	2
Heat Recovery (Primary) Constant Air Volume	8.8%	8.0%	-0.7%	10.0%	0
Heat Recovery (Primary) Variable Air Volume	12.6%	11.9%	10.1%	9.1%	0
Heat Recovery (Secondary) VAV	0.8%	1.2%	3.0%	3.2%	2
Heat Recovery (Tertiary) VAV	1.4%	2.0%	3.9%	4.0%	2
Unoccupied Setback	0.9%	0.8%	0.8%	0.5%	3
Displacement Ventilation	1.4%	1.4%	1.4%	1.4%	1
Fuel Cell / Cogeneration	2.5%	2.5%	2.5%	2.5%	5
Lighting	7.8%	7.8%	7.8%	7.8%	2
Sub-Total	54.0%	56.0%	50.0%	60.0%	2-3
On-site Renewable Energy					
Solar	8.0%	7.0%	10%	10.0%	5
Photovoltaic	8.0%	7.0%	10%	10.0%	10
Geothermal	5.0%	5.0%	5.0%	0.0%	10
Wind Turbines	5.0%	5.0%	5.0%	0.0%	10
Sub-Total	26.0%	24.0%	30.0%	20.0%	5-10
Off-site Renewable Energy					
Purchase from Utility Company	20.0%	20.0%	20.0%	20.0%	N/A
TOTAL:	100%	100%	100%	100%	



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



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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Unique UAE Design Conditions

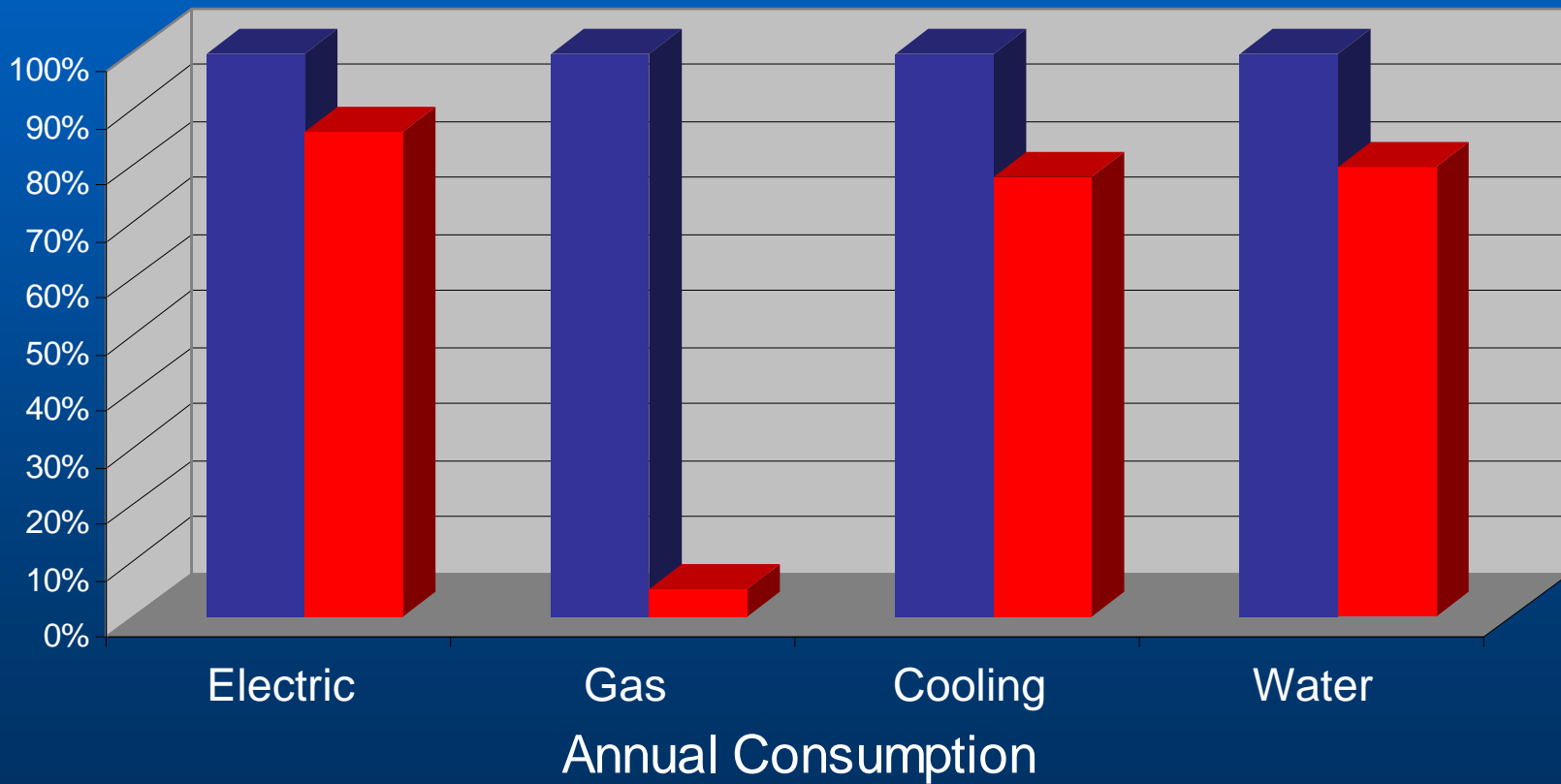
- High Temperature
- High Humidity
- Sand Storms
- Water Shortage



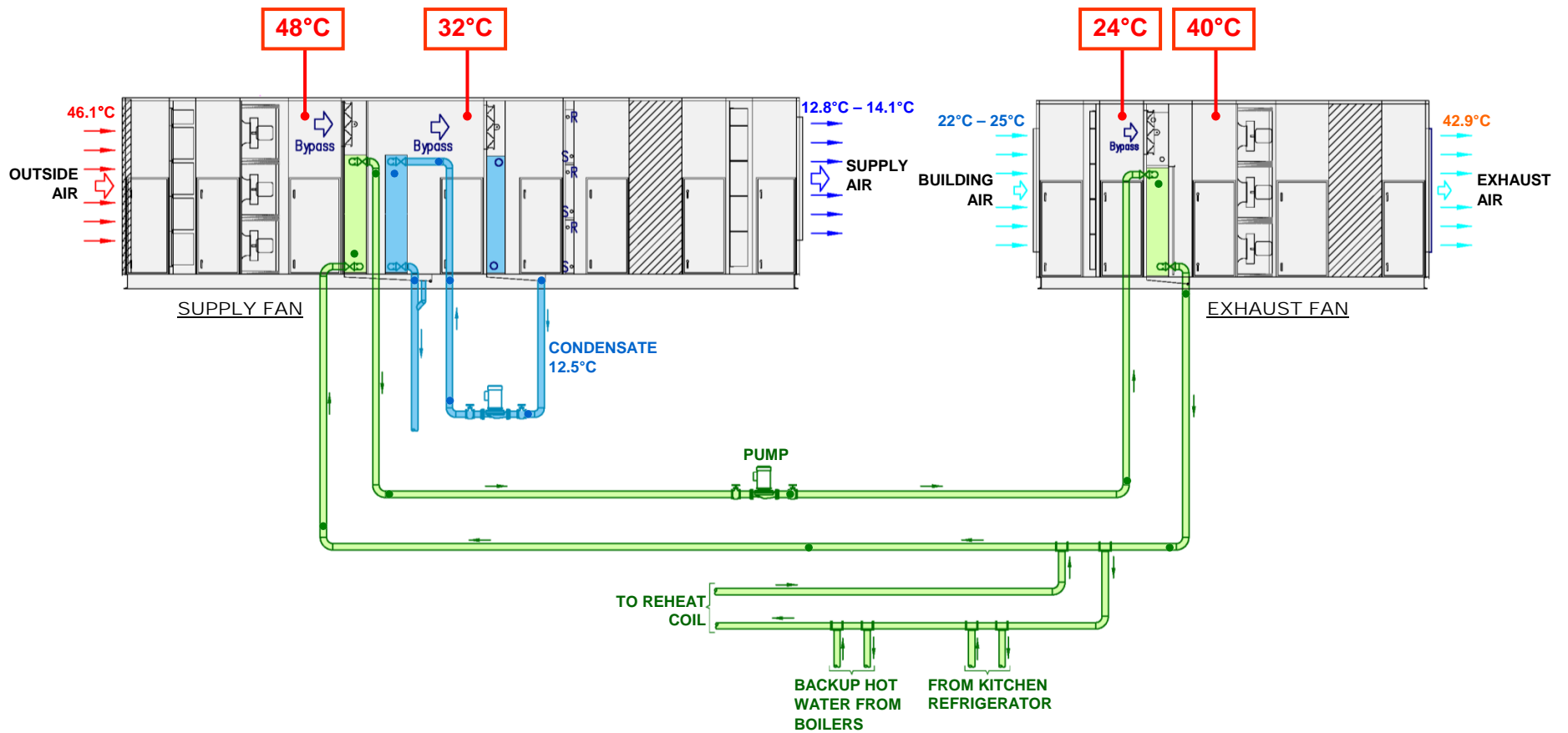
HVAC System Options

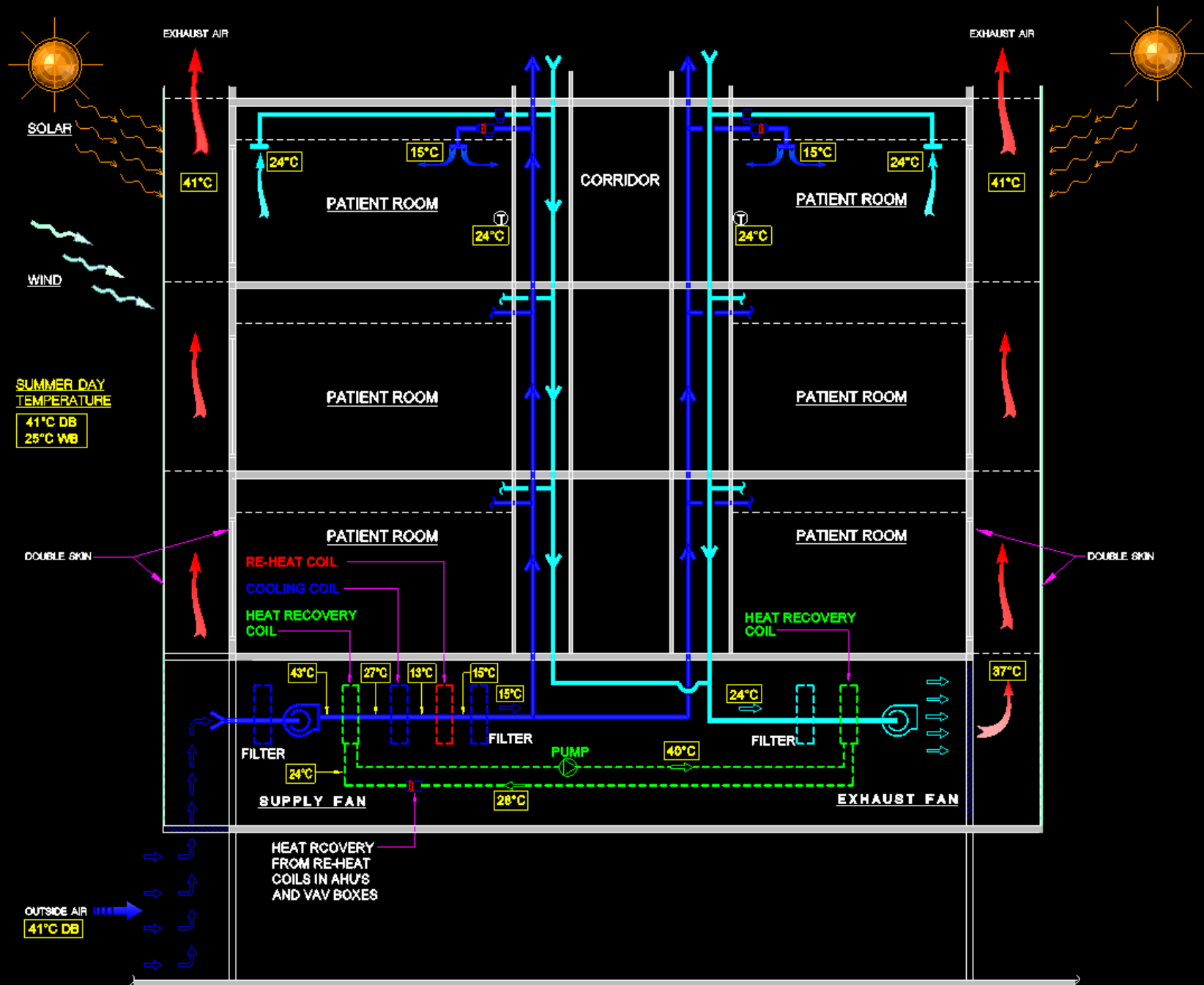
■ Return Air Constant Volume

■ 100% Outside Air Variable Volume

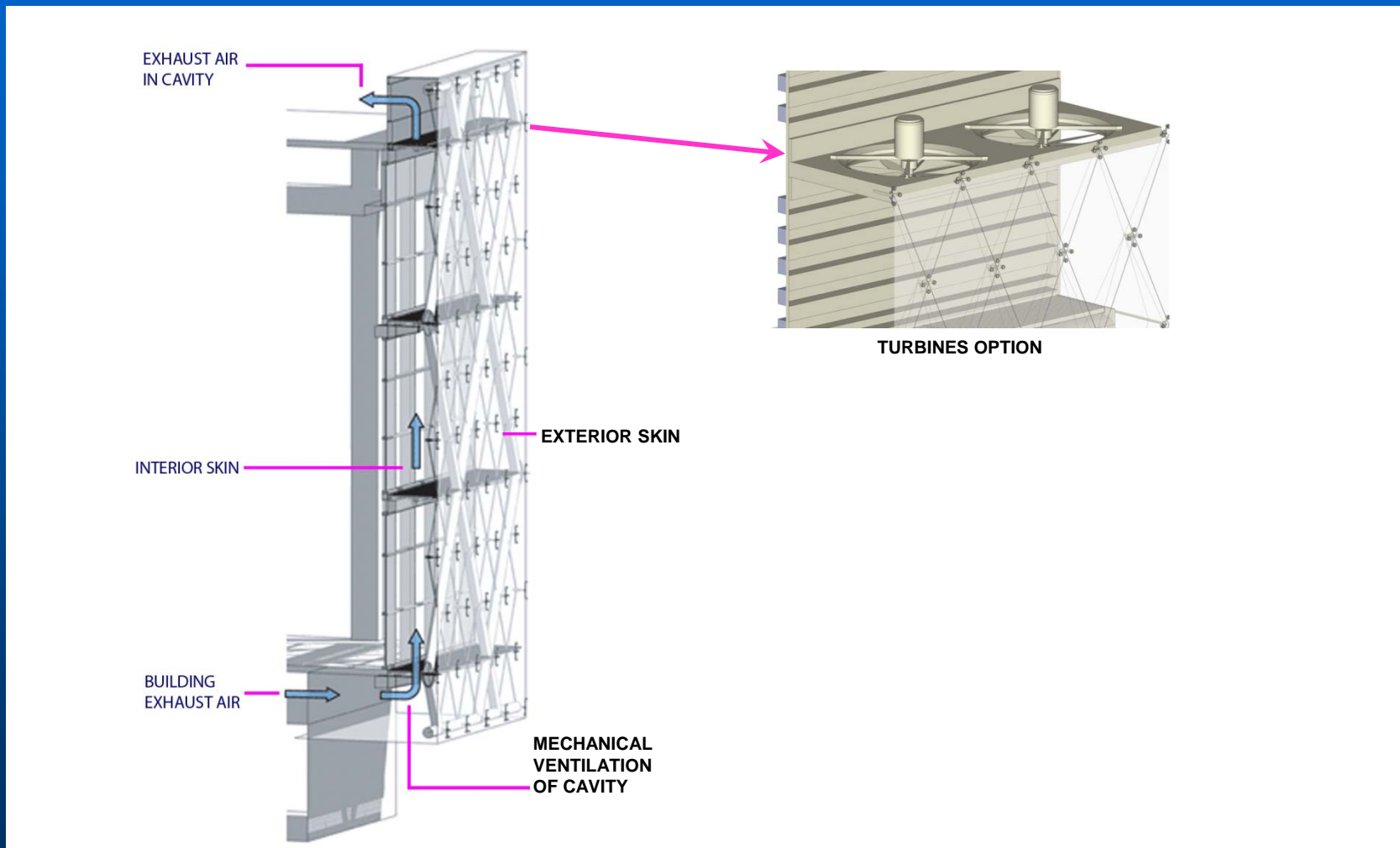


Heat Recovery





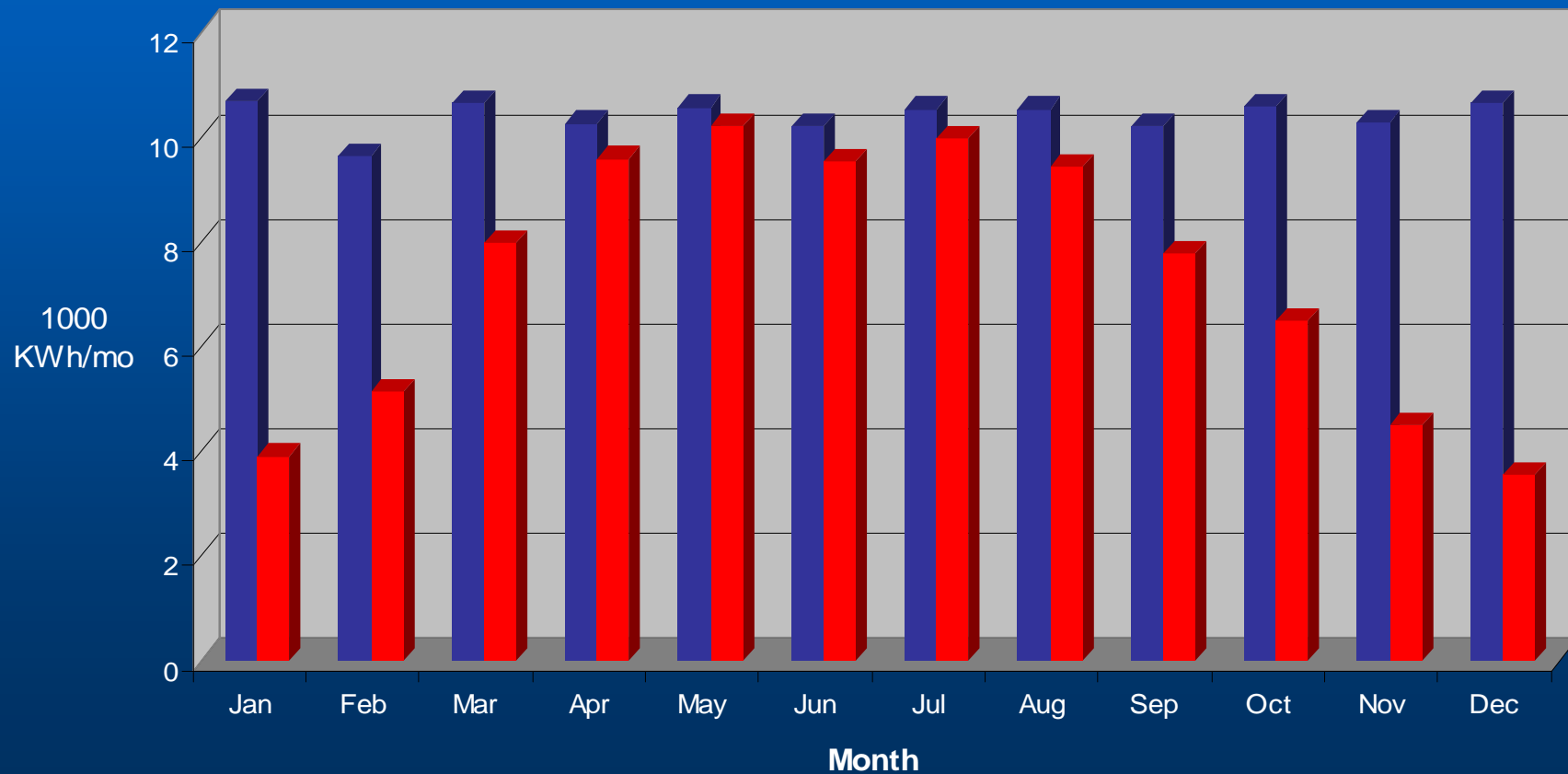
Curtain Wall



Solar Hot Water

■ Domestic water heating demand

■ Domestic water heating by solar



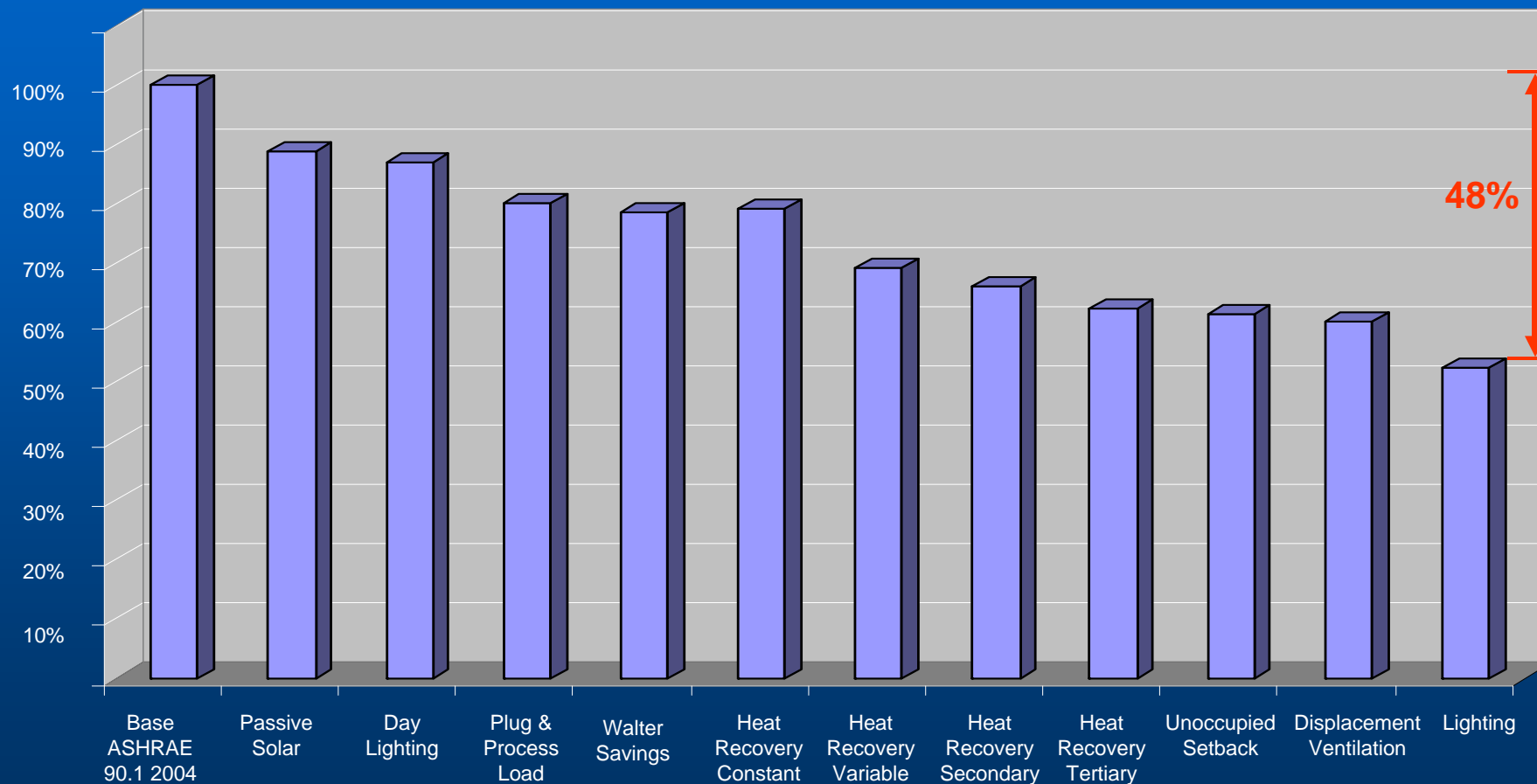
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Energy Analysis

Annual Energy Reduction

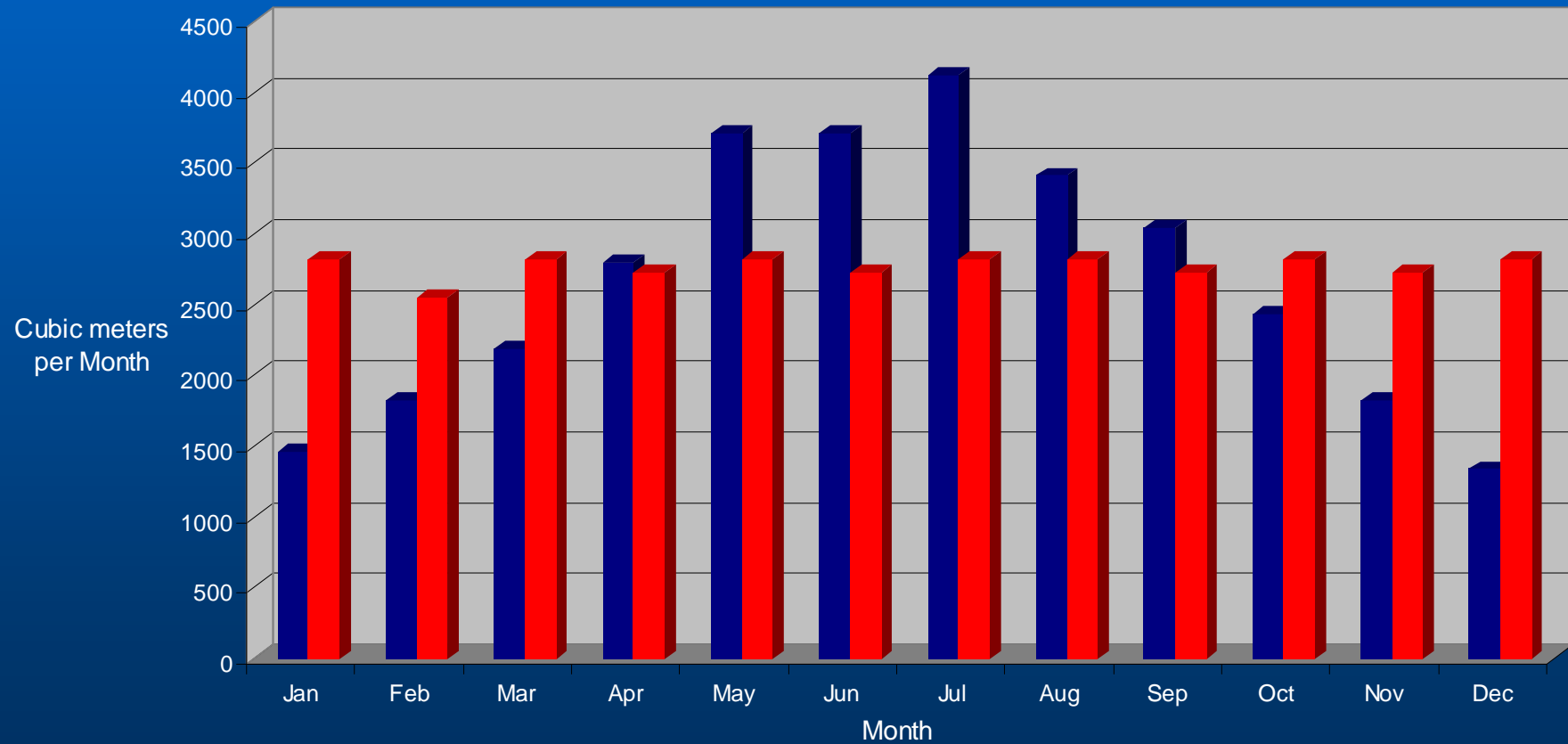
Abu Dhabi



Grey Water Recovery

■ Irrigation Demand

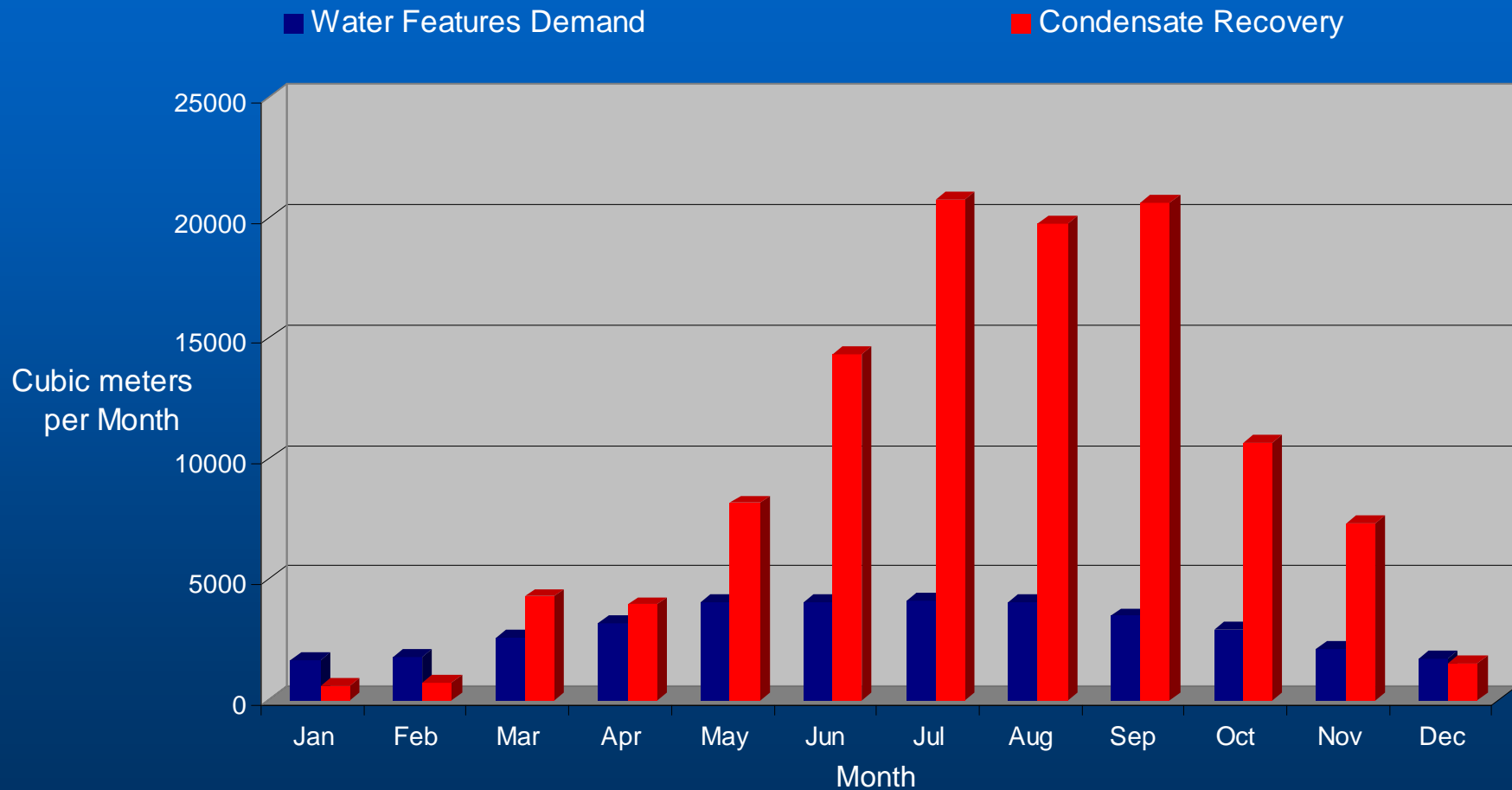
■ Grey Water Recovery



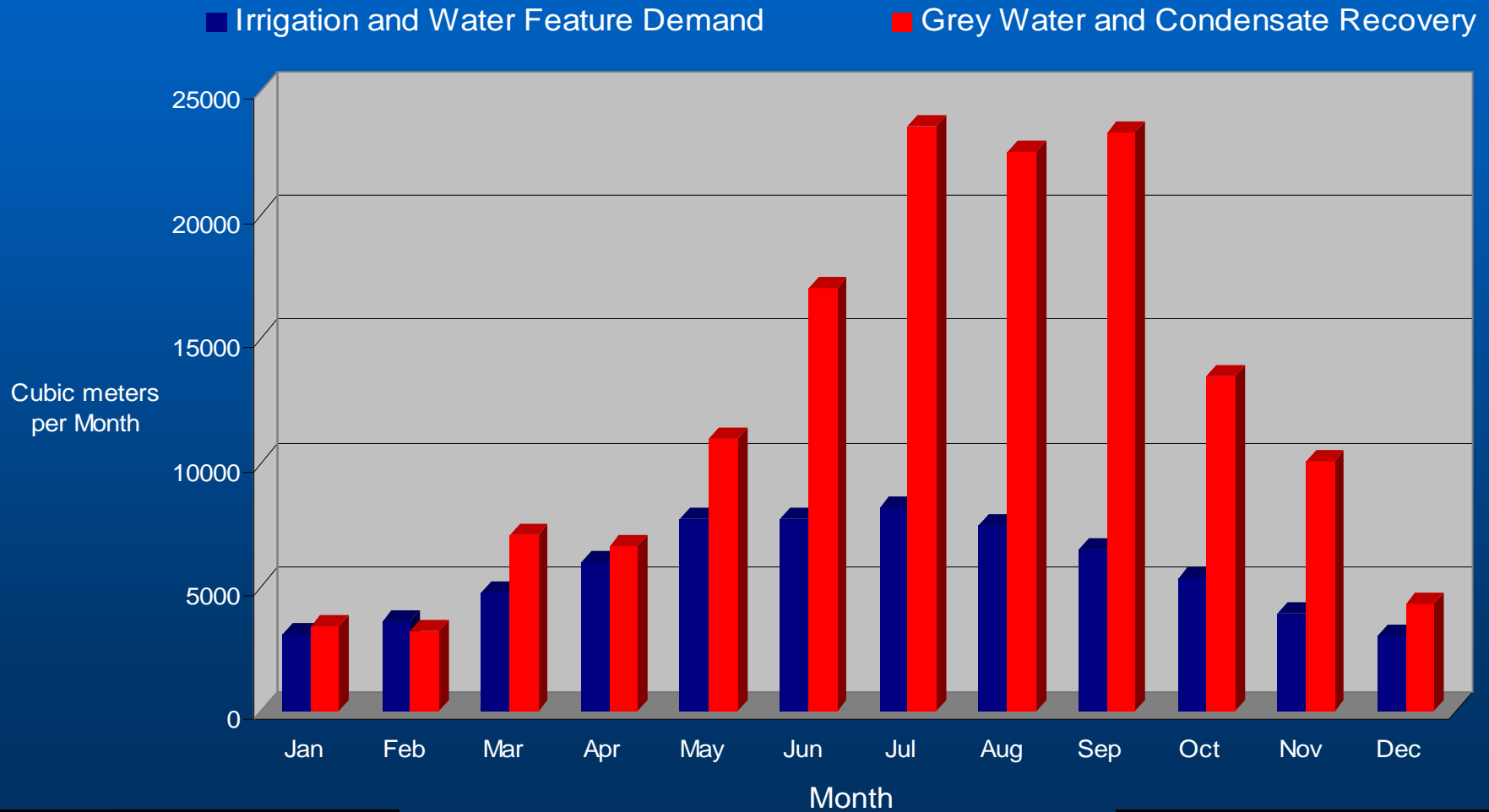
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Condensate Water Recovery



Reclaimed Water (Grey Water and Condensate)



**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



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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"	-	-	-

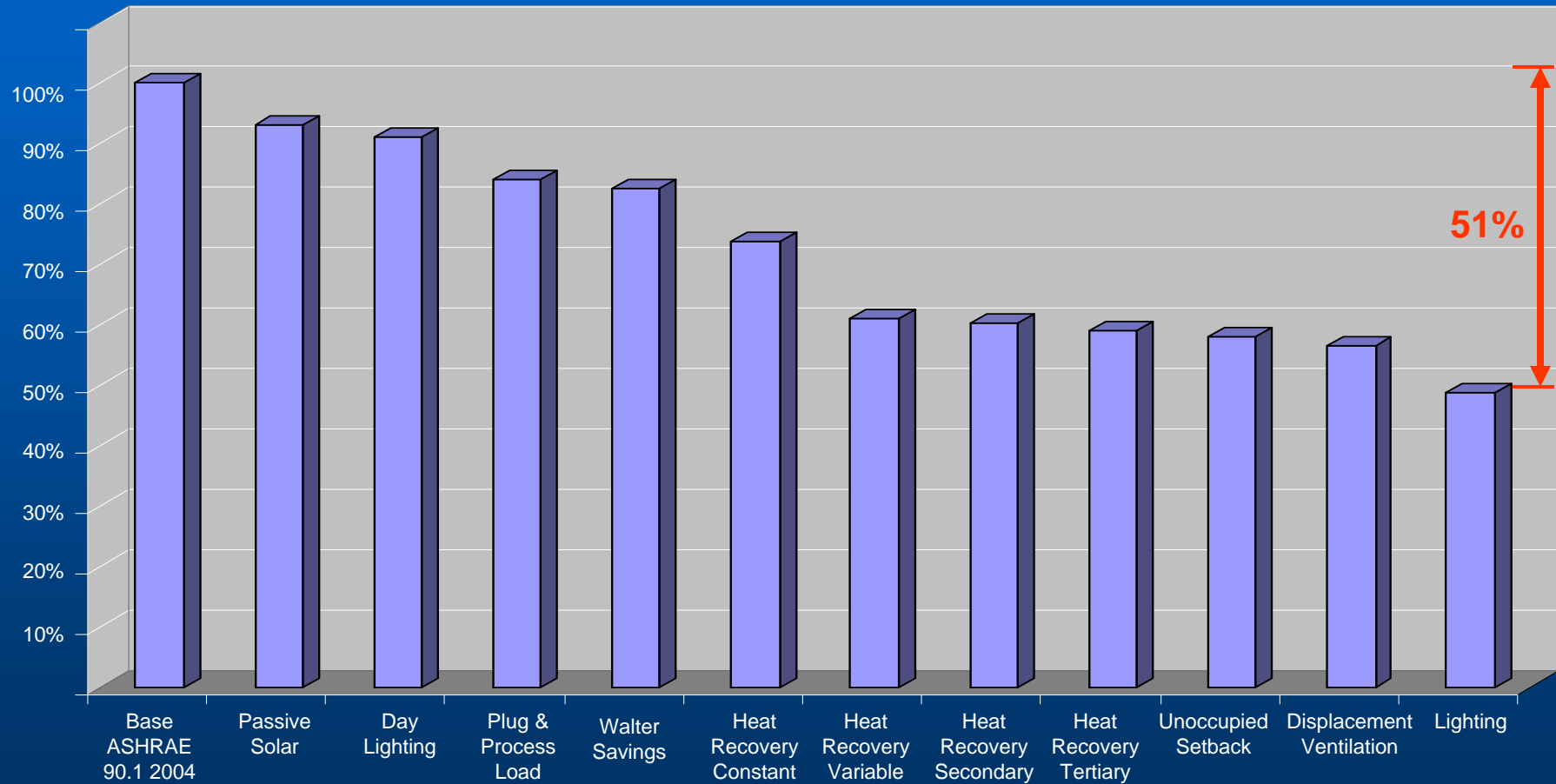
Room Temperature Profile



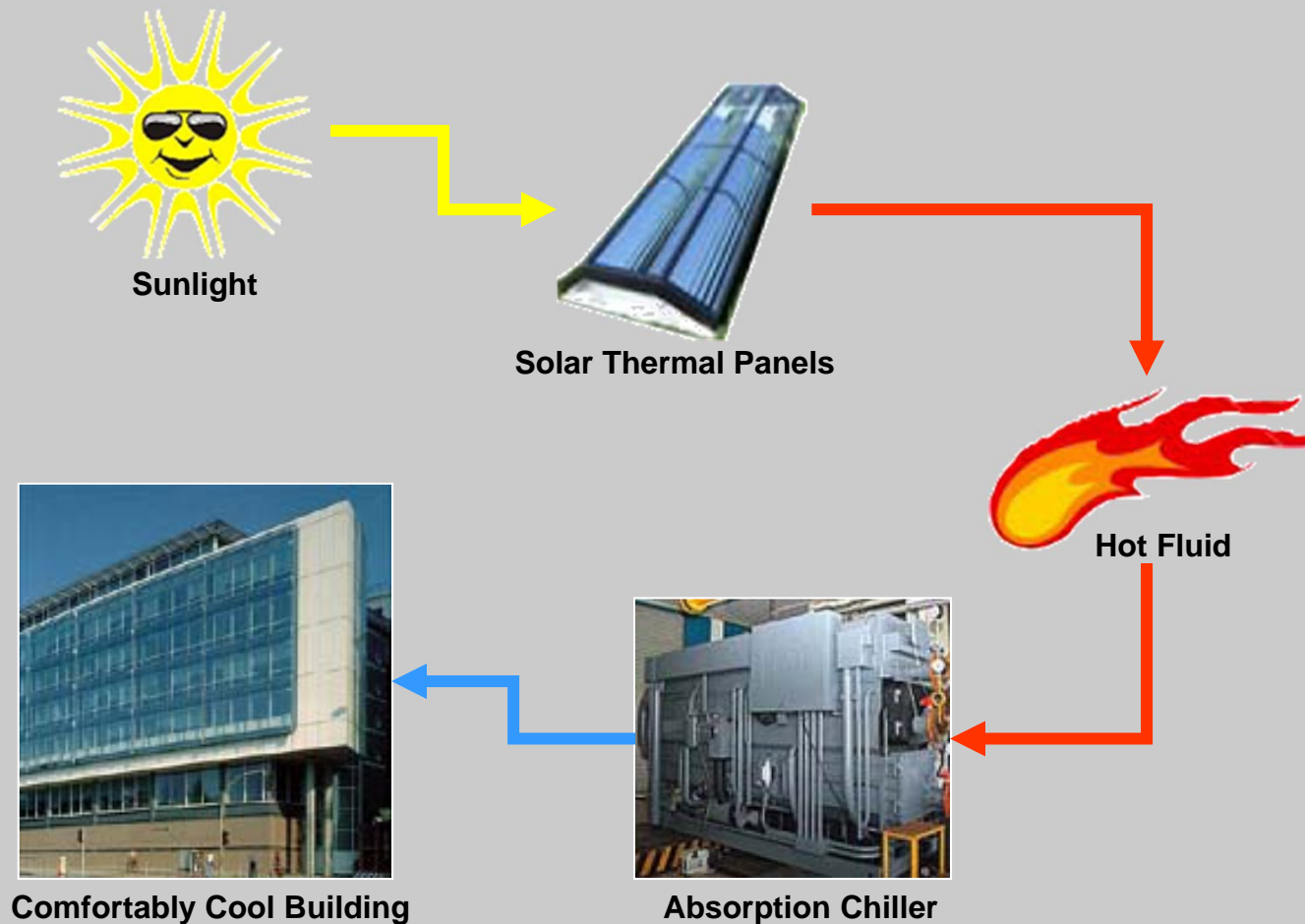
Energy Analysis

Annual Energy Reduction

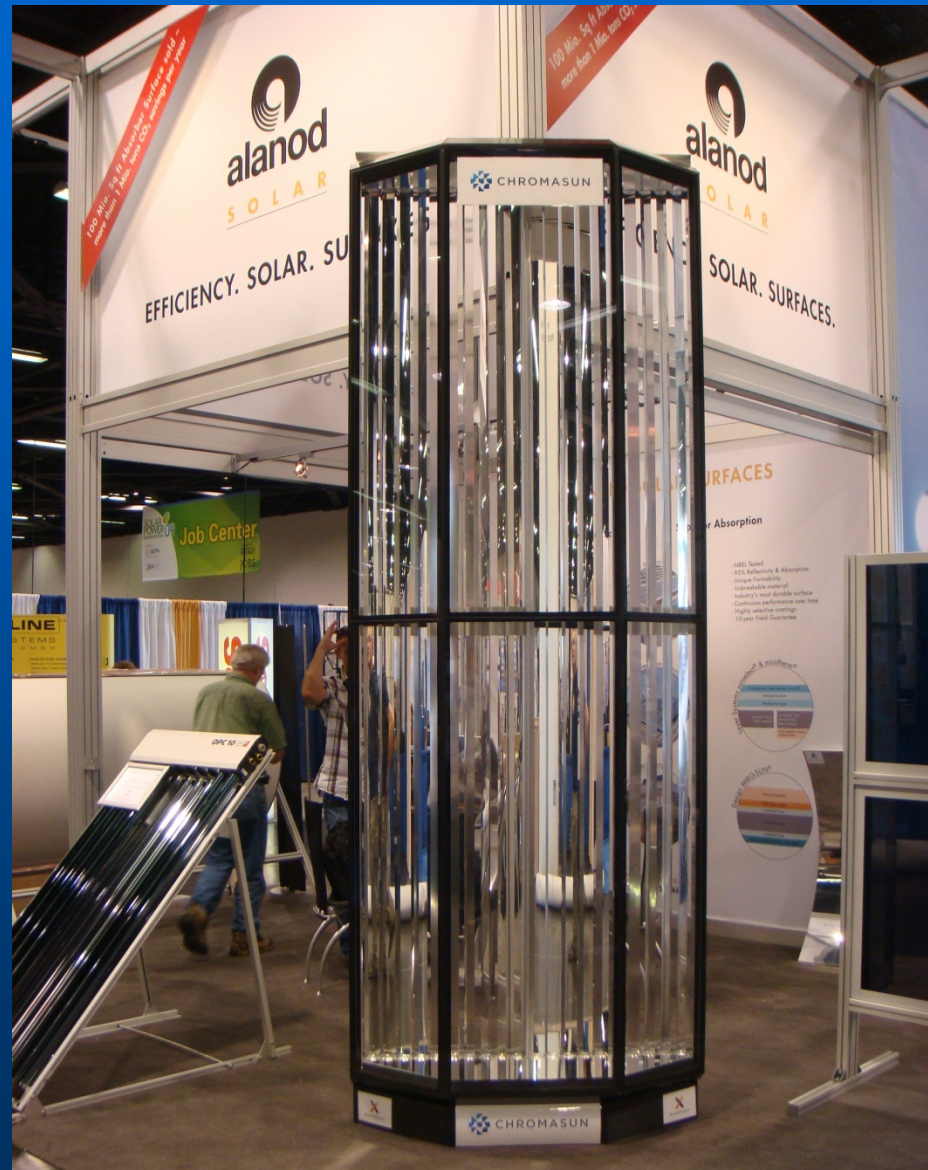
San Francisco



Cooling with Solar Panels



Solar Panel with Glass Backing



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 NZEB 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 NZEB by 2025?



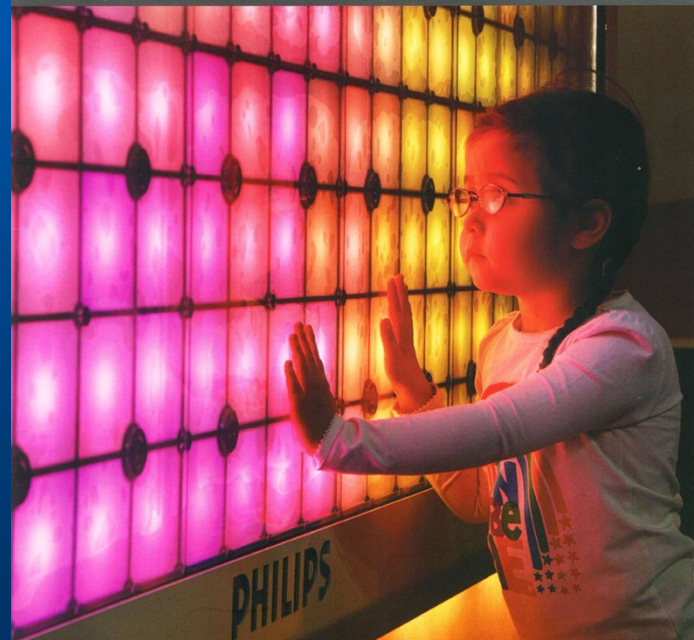
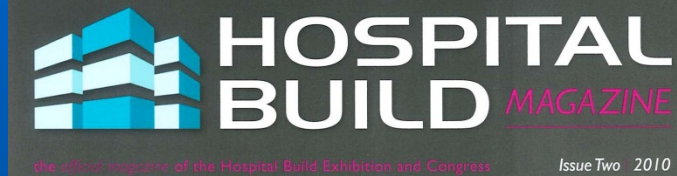
Innovate and Implement



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See article in
Hospital Build Magazine
Issue Two 2010



GREEN HOSPITALS

Moving towards net zero energy in hospital building and design

ACCREDITATION

Evaluating quality of healthcare and increasing customer satisfaction

DESIGN

The design of the patient room of the future is revealed

INTERVIEW

Norman Soto from Burt Hill talks about the Mafraq hospital project

www.lifesciencesmagazines.com



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Together we can achieve

Net-Zero Energy, High-Performance Green Hospital Buildings



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