Innovations in Design

Emerging and Future Trends for Healthcare Facilities

Presented by

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HOSPITAL BUILD ASIA
Exhibition & Congress 2010

TED JACOB ENGINEERING GROUP

Green Trends in Healthcare

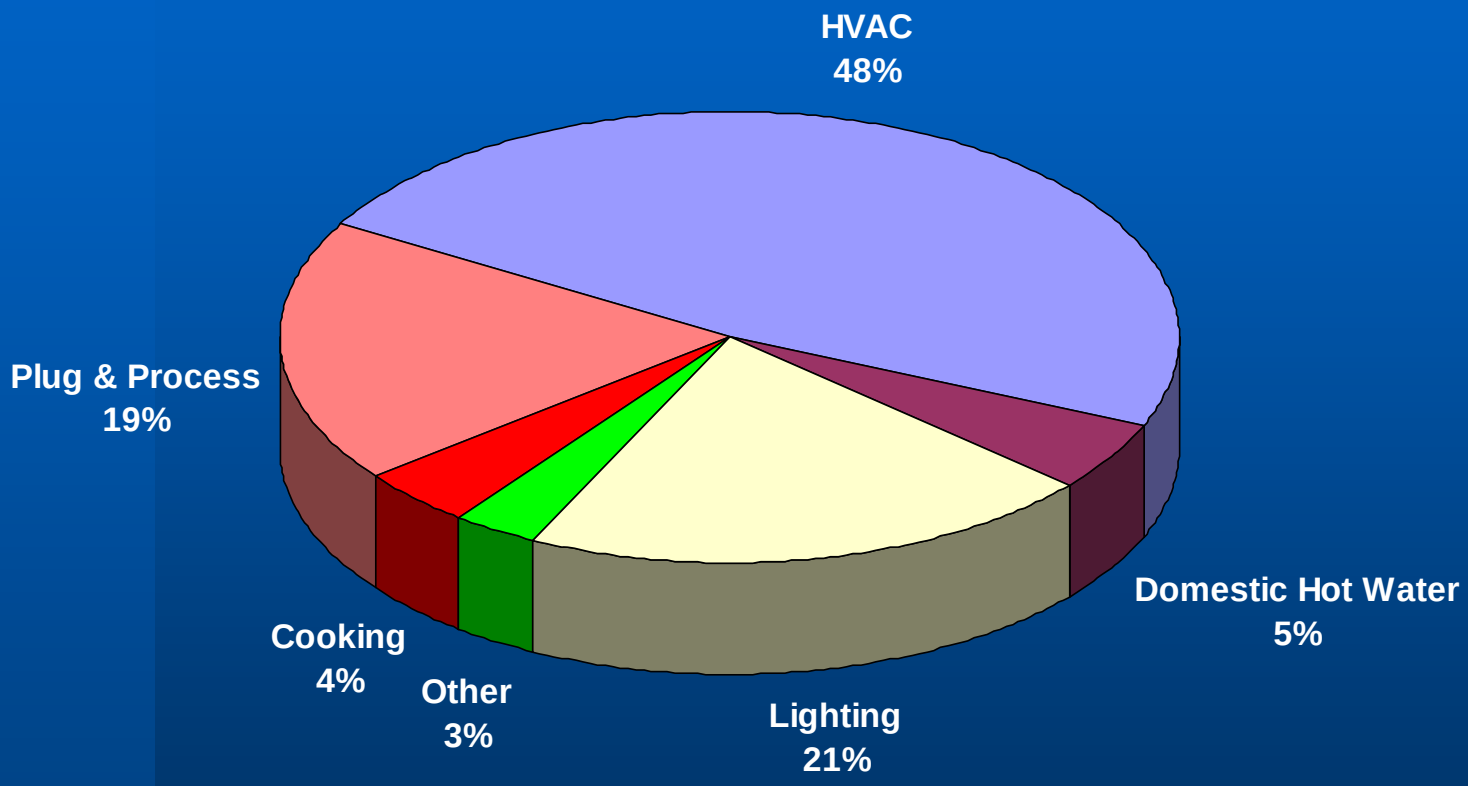
- Net-Zero Energy Building by 2025:
  A net-zero building produces as much energy as it uses over the course of one year

- 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.

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

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%

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)	Hot & Humid Climate (Singapore)
On-Site Innovation Design					
Passive Solar & Architecture	7.0%	10.0%	11.0%	11.0%	9.0%
Day Lighting	2.0%	2.0%	2.0%	2.0%	2.0%
Plug & Process Load	7.0%	7.0%	7.0%	7.0%	7.0%
Water Savings	1.5%	1.5%	1.5%	1.5%	1.5%
Heat Recovery (Primary) Constant Air Volume	8.8%	8.0%	-0.7%	10.0%	-1.6%
Heat Recovery (Primary) Variable Air Volume	12.6%	11.9%	10.1%	9.1%	10.5%
Heat Recovery (Secondary) VAV	0.8%	1.2%	3.0%	3.2%	3.4%
Heat Recovery (Tertiary) VAV	1.4%	2.0%	3.9%	4.0%	4.4%
Unoccupied Setback	0.9%	0.8%	0.8%	0.5%	0.8%
Displacement Ventilation	1.4%	1.4%	1.4%	1.4%	1.4%
Fuel Cell / Cogeneration	2.5%	2.5%	2.5%	2.5%	2.5%
Lighting	7.8%	7.8%	7.8%	7.8%	7.8%
Sub-Total Innovative Design	54.0%	56.0%	50.0%	60.0%	48.70%
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%	20.0%
TOTAL:	100%	100%	100%	100%	100%

Green Guidelines

- US Green Building Council (USGBC) LEED Green Building Rating
- Green Guide for Healthcare (GGHC)
- Abu Dhabi Green Buildings (ADGB)
- Singapore Building & Construction Authority (SBCA)

Design & Construction Rating Systems

CATEGORY	USGBC	GGHC	ADGB	BCA(*) Green Mark
Sustainable Sites	14	21	15	32
Energy & Atmosphere	17	21	20	99
Water Efficiency	5	6	30	14
Materials & Resources	13	21	15	-
Indoor Environmental Quality	15	24	15	8
Innovation & Design Process	5	4	5	7
Total Points	69	97	100	160

CERTIFICATION	USGBC	GGHC	ADGB	BCA(*) Green Mark
Certified	26 - 32	N/A	45	50 - 74
Silver *(Gold)	33 - 38	N/A	55	75 - 84
Gold *(Gold Plus)	39 - 51	N/A	65	85 -89
Platinum	52 or more	N/A	75 or more	90 or more

Operations

CATEGORY	USGBC	GGHC	ADGB	BCA
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

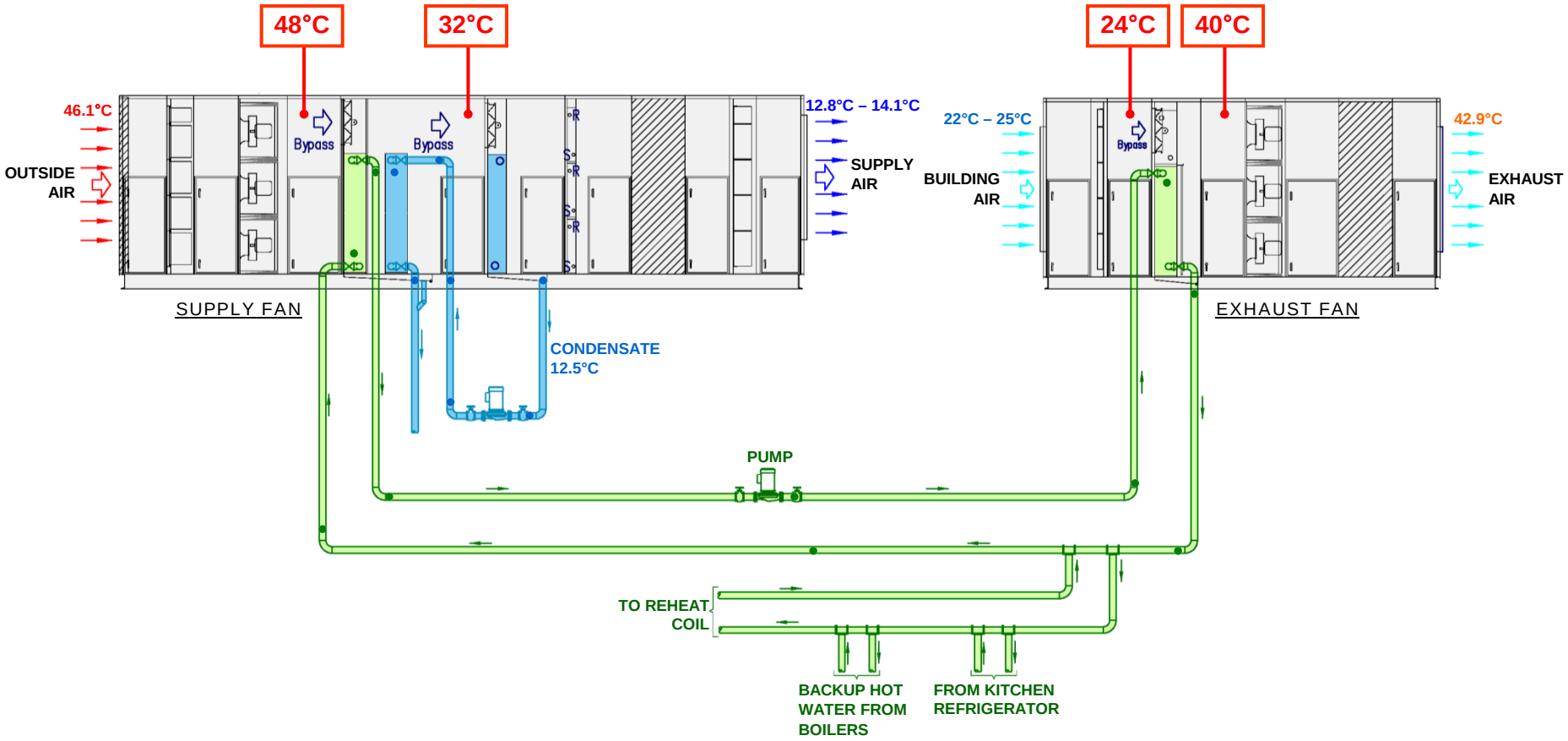
Scope: 360-490 Bed
4.8 Million sf.

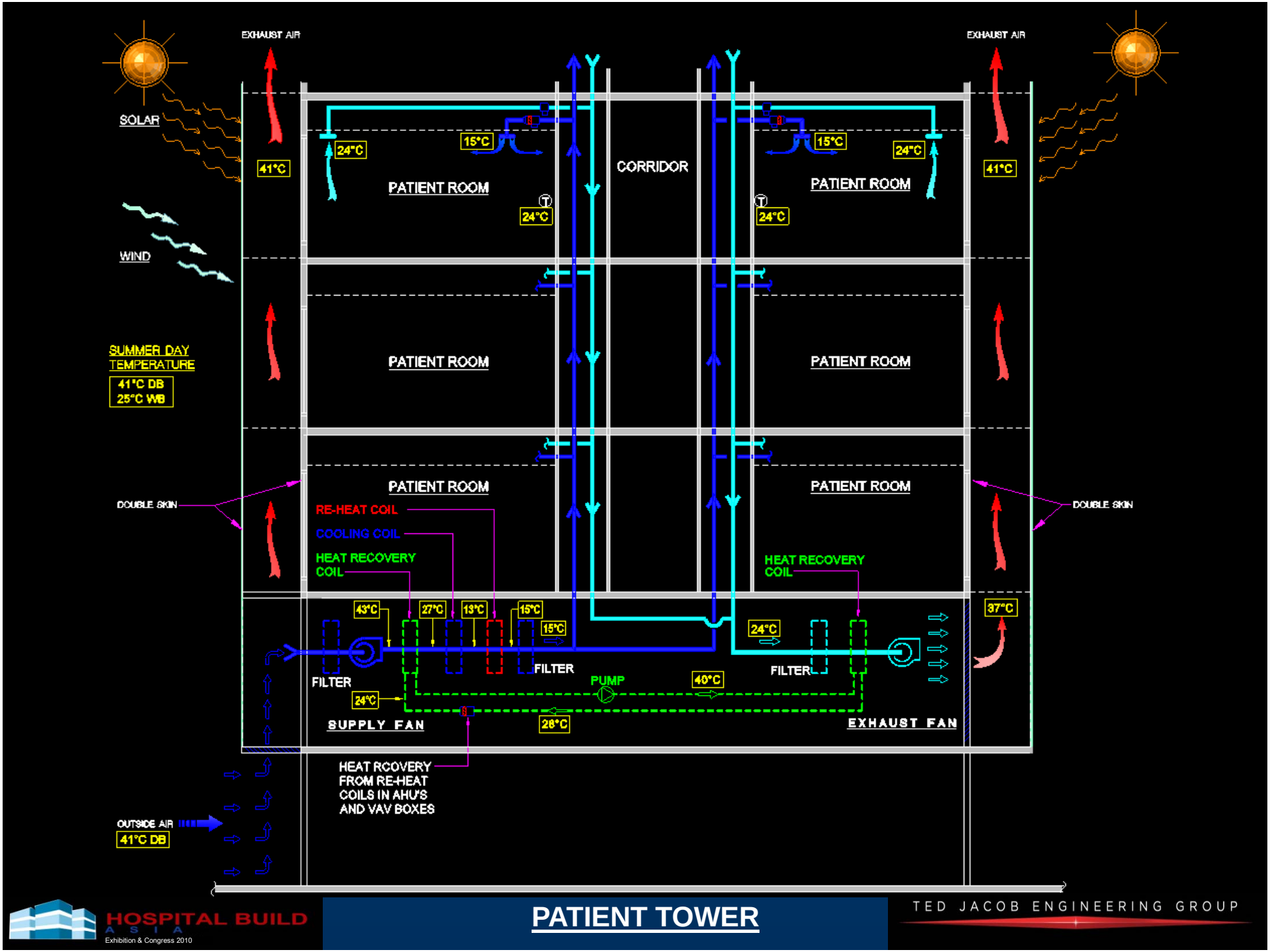
Completion: 2013

Unique UAE Design Conditions

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

Heat Recovery





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PATIENT TOWER

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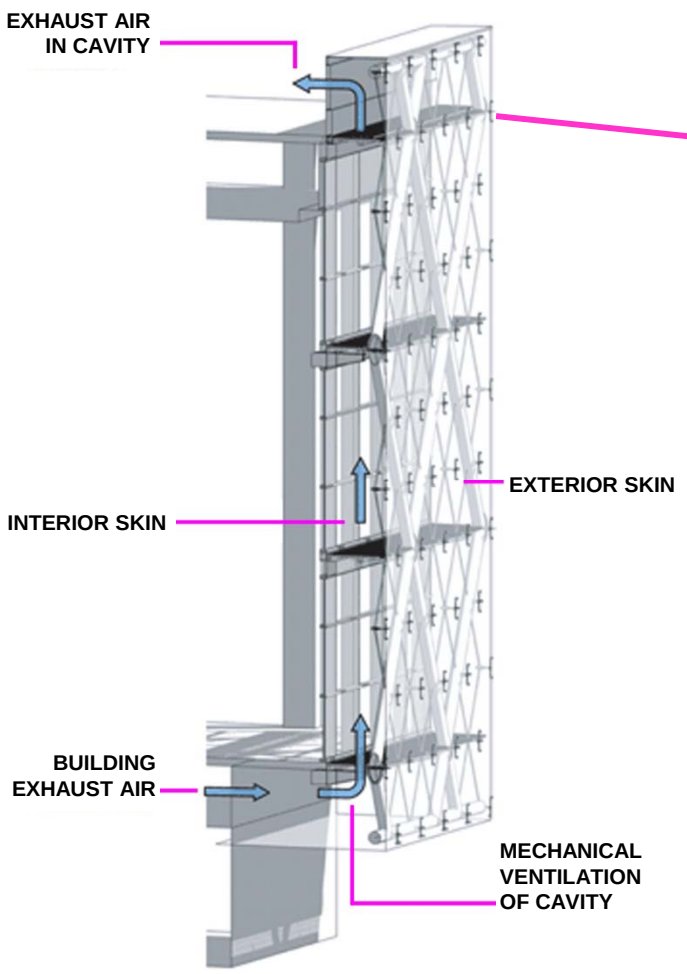
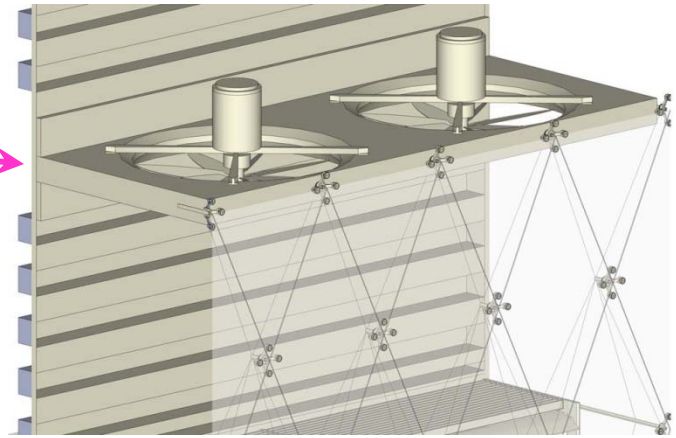
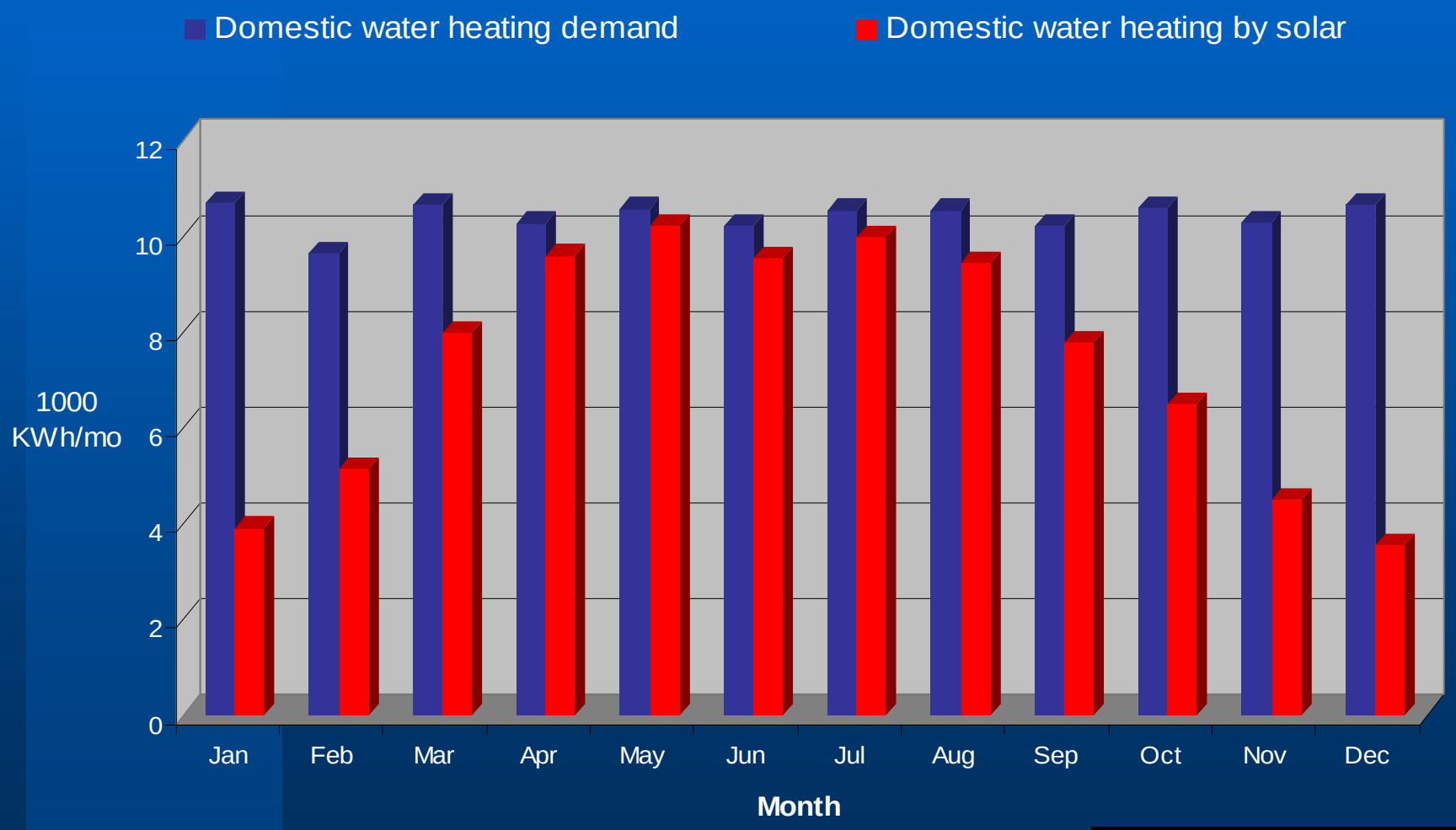
Curtain Wall



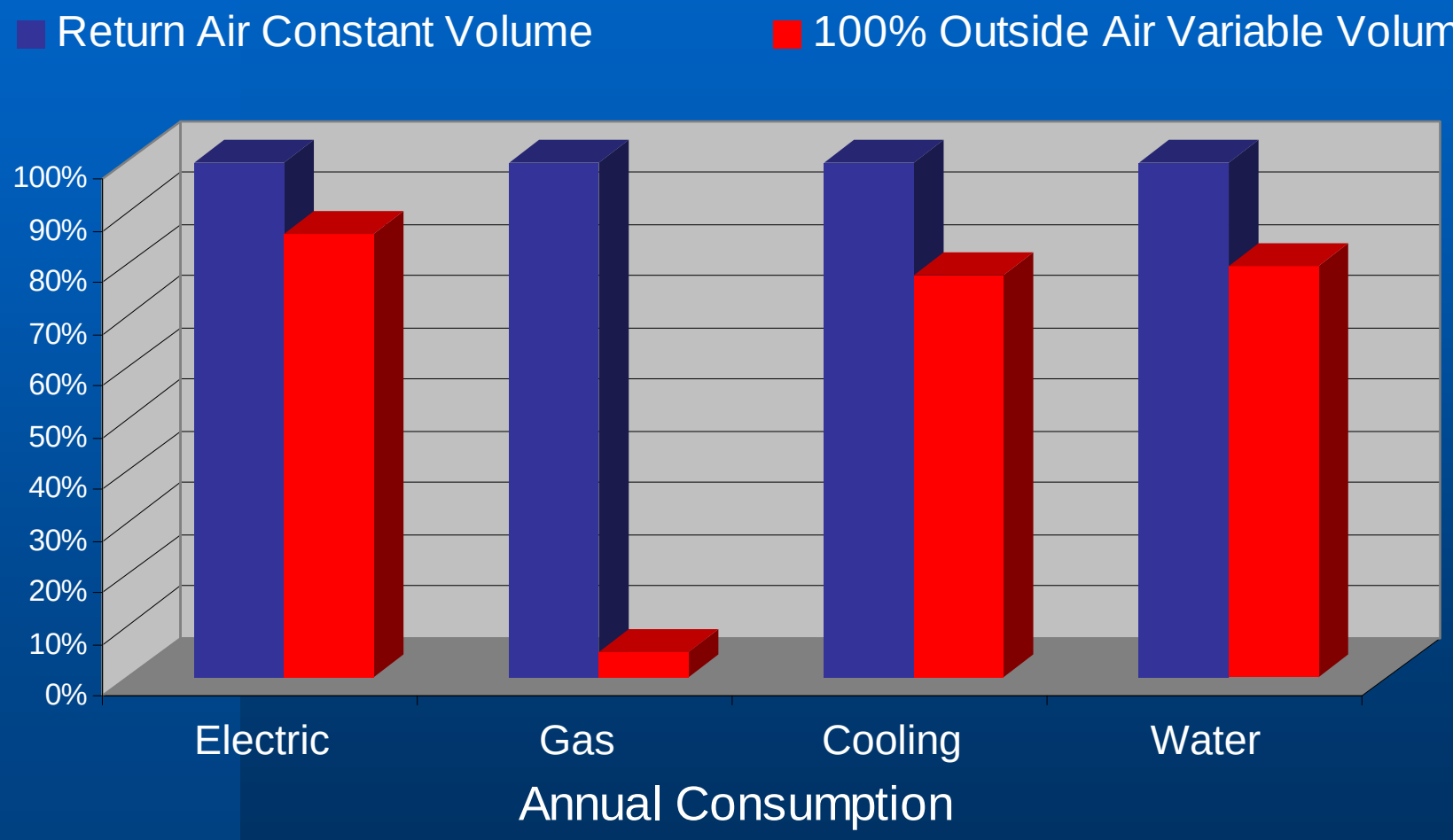


Turbines Option

Solar Hot Water



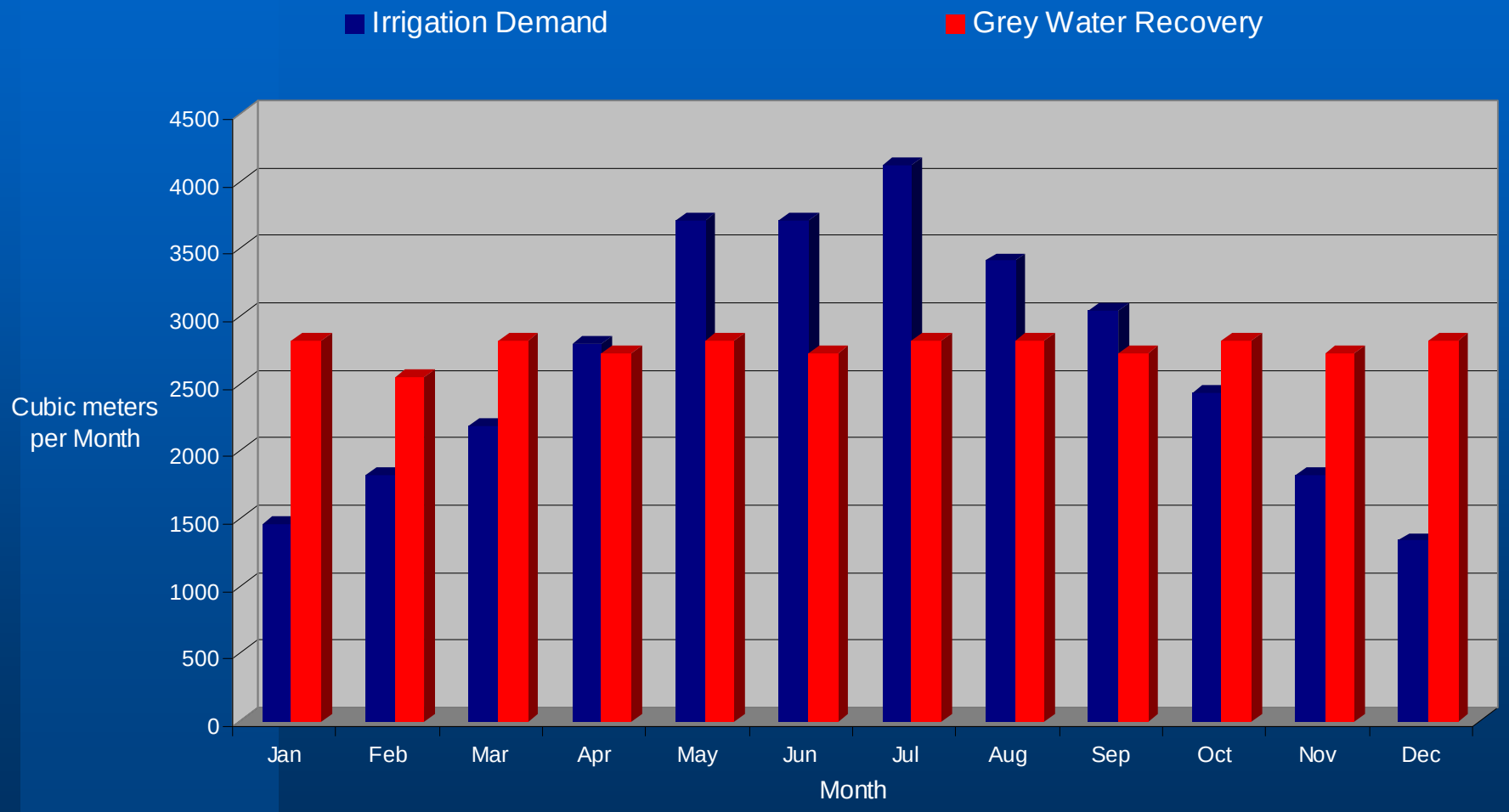
HVAC System Options



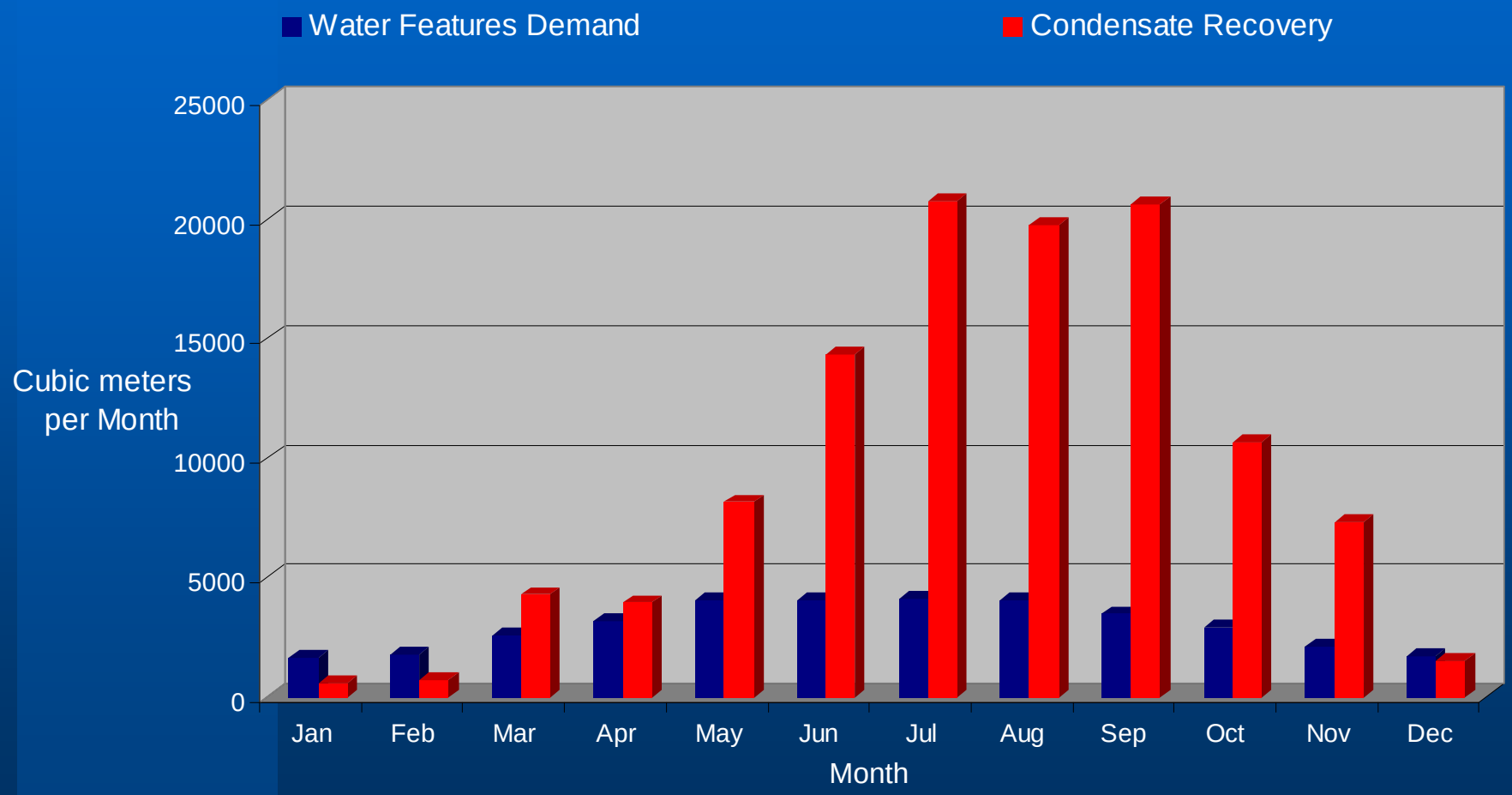
Water Efficiency

- 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.

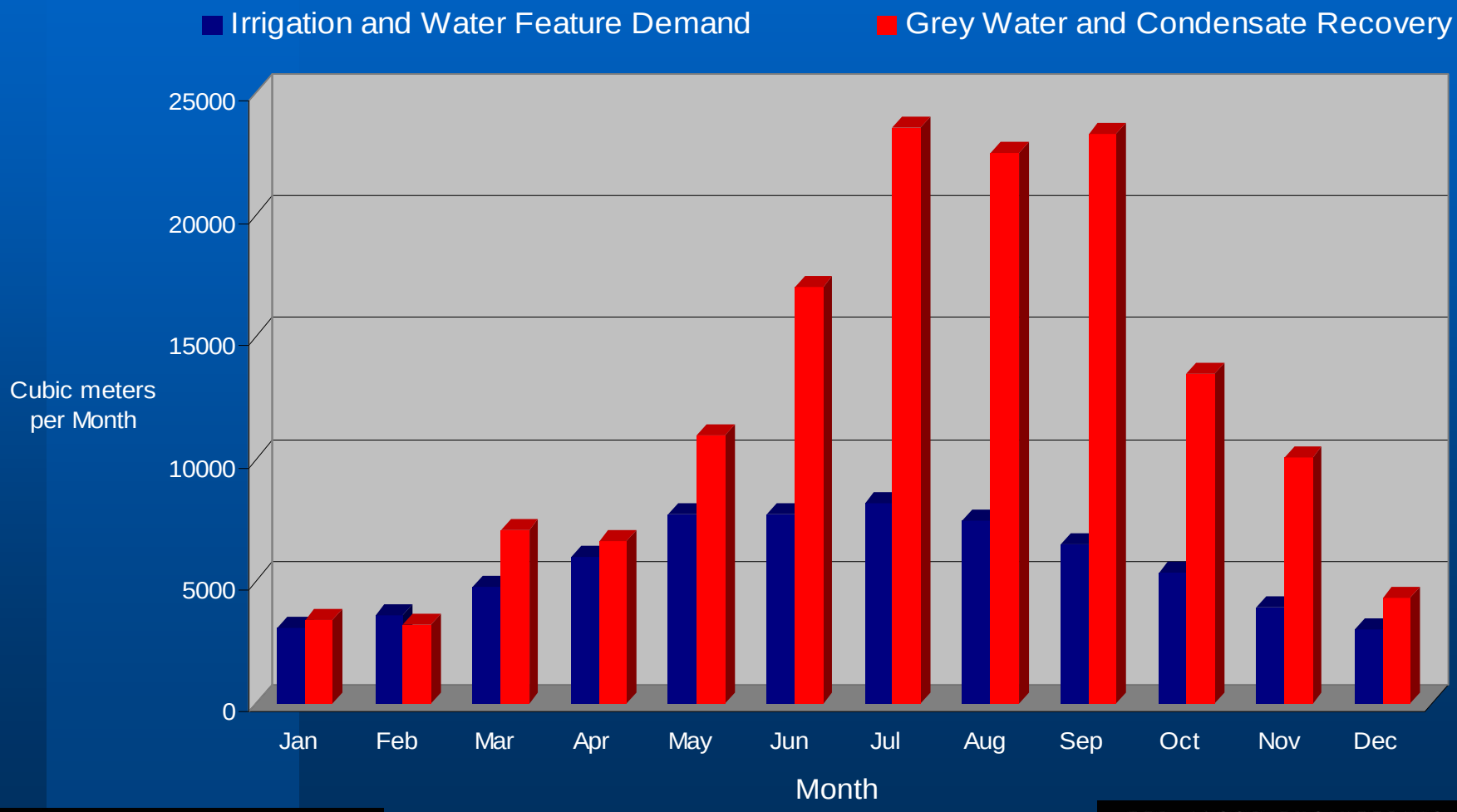
Grey Water Recovery



Condensate Water Recovery



Reclaimed Water
(Grey Water and Condensate)



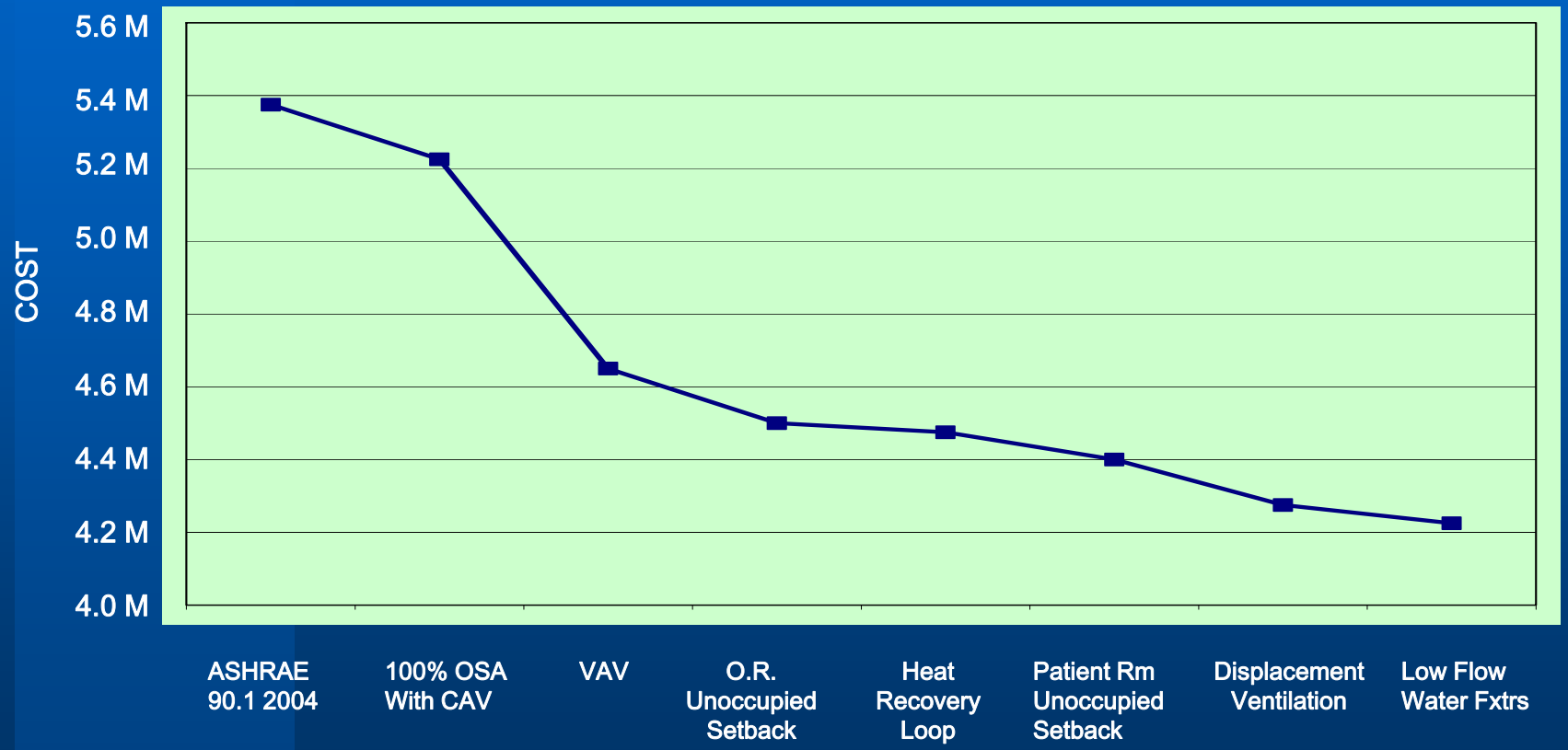
California Pacific Medical Center
San Francisco, California

Client: Sutter Medical Group
San Francisco, California

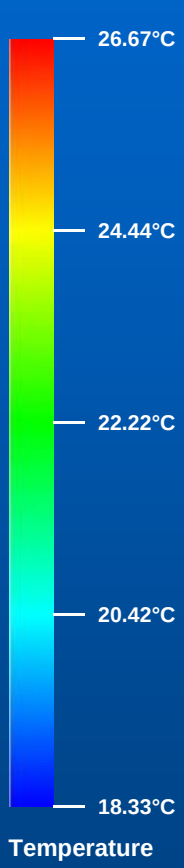
Scope: 550 Bed Women & Childrens
Acute Care Hospital
1.2 million sq. ft.

Completion: 2012

Energy Analysis
(Annual Energy Savings)

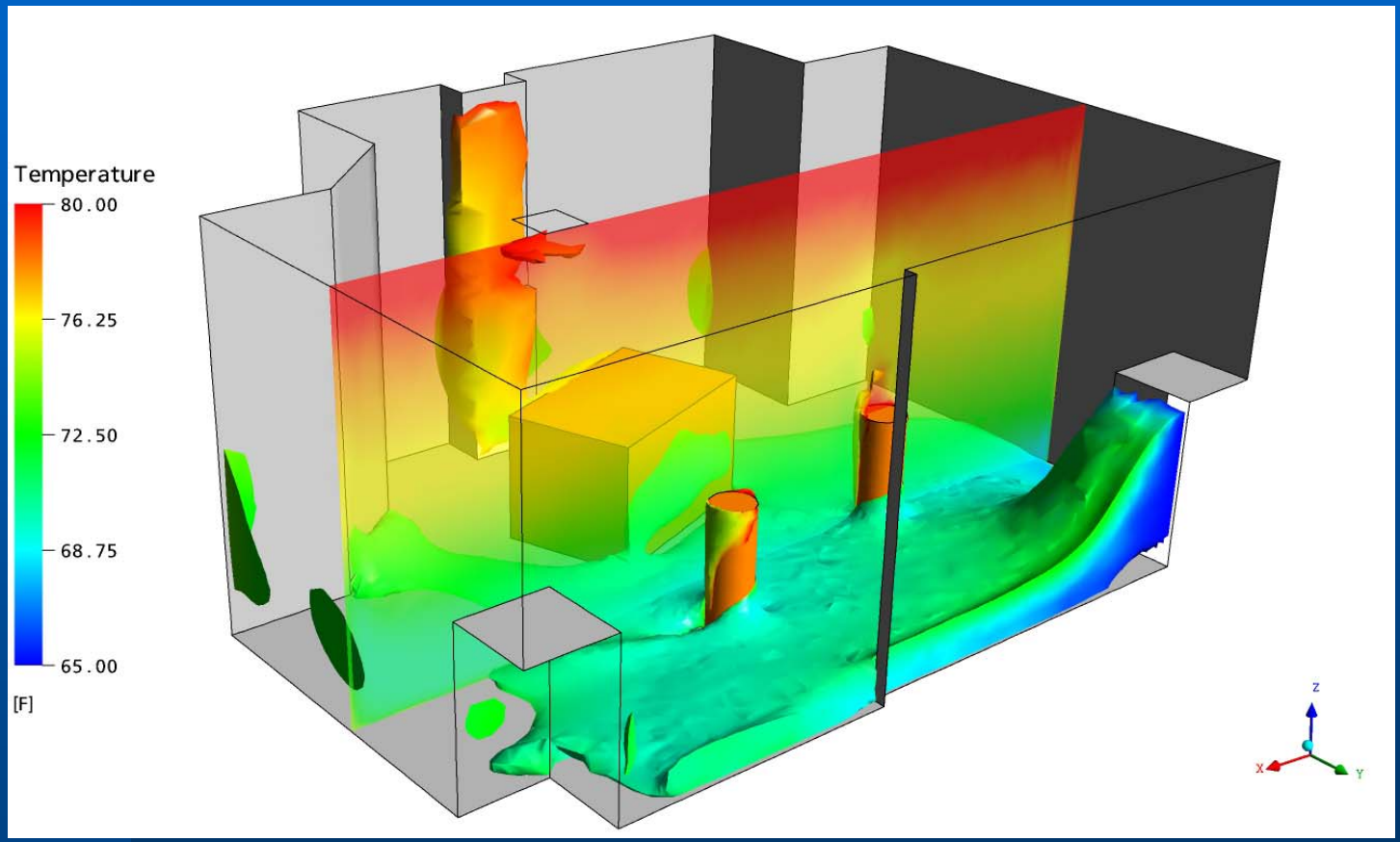


Displacement Ventilation



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”	-	-	-

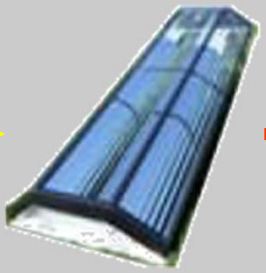
120 CFM @ 3.6 AC/HR

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

Cooling with Solar Panels

Sunlight



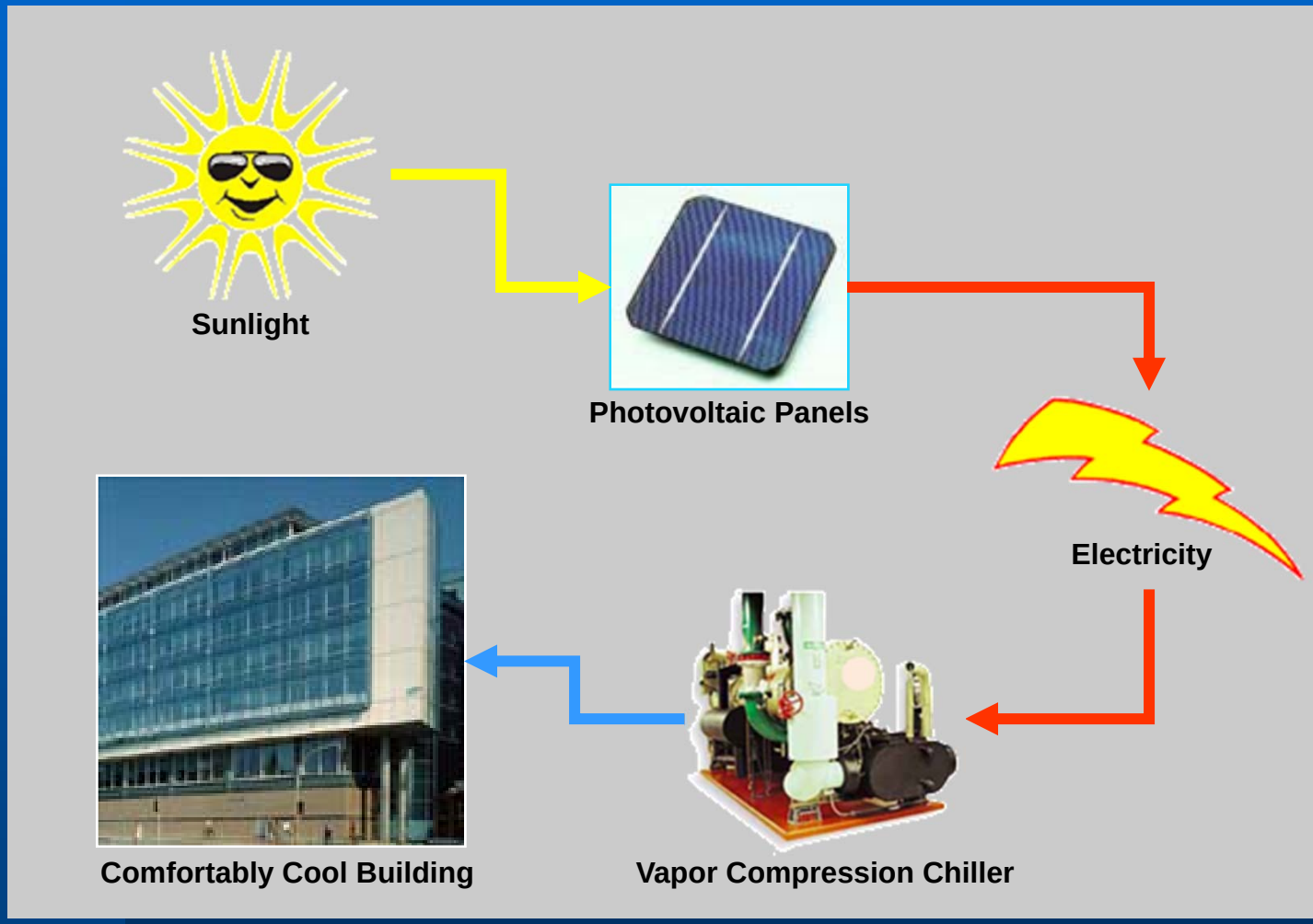
Solar Thermal Panels

Hot Fluid

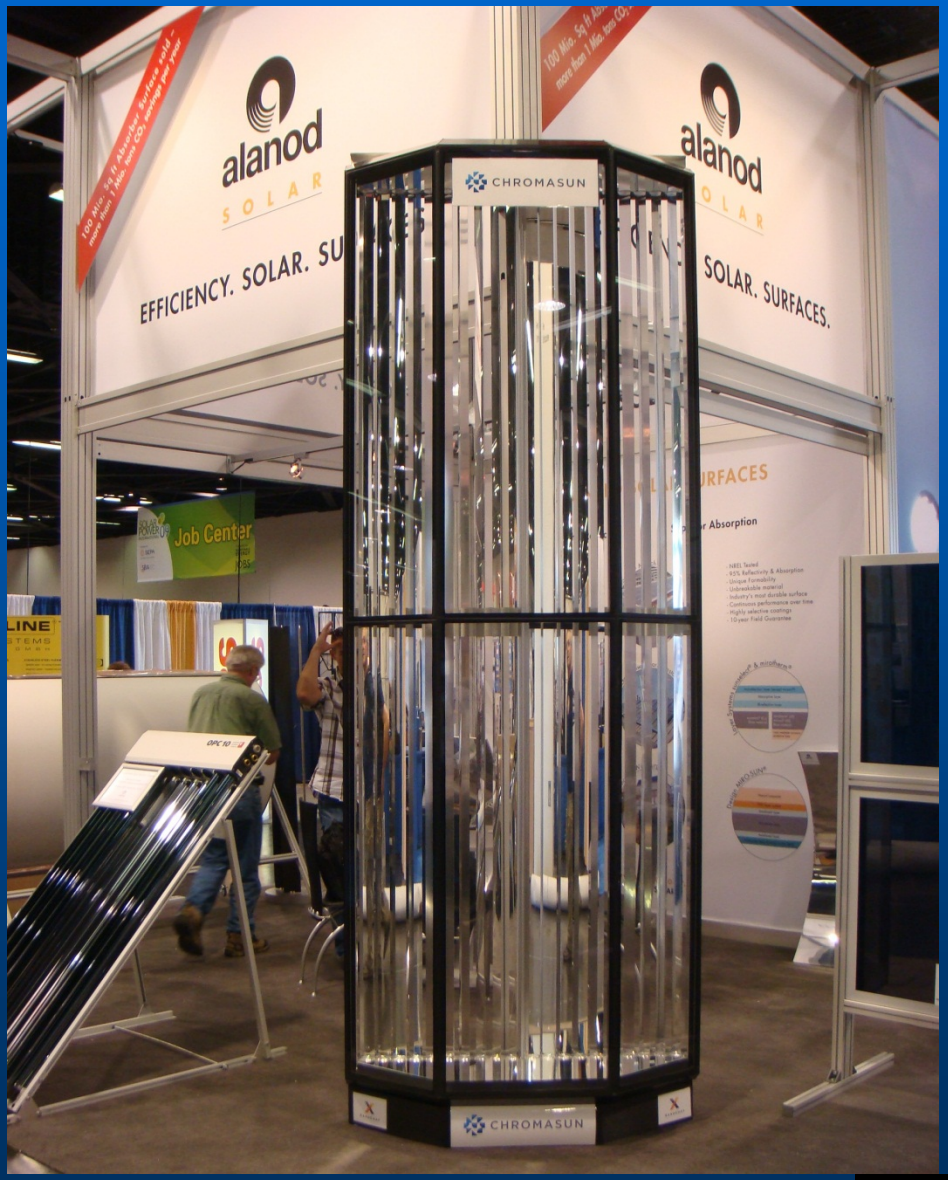
Absorption Chiller

Comfortably Cool Building

Cooling with Photovoltaic 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 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

Together we can achieve

Net-Zero Energy, High-Performance Green Hospital Buildings