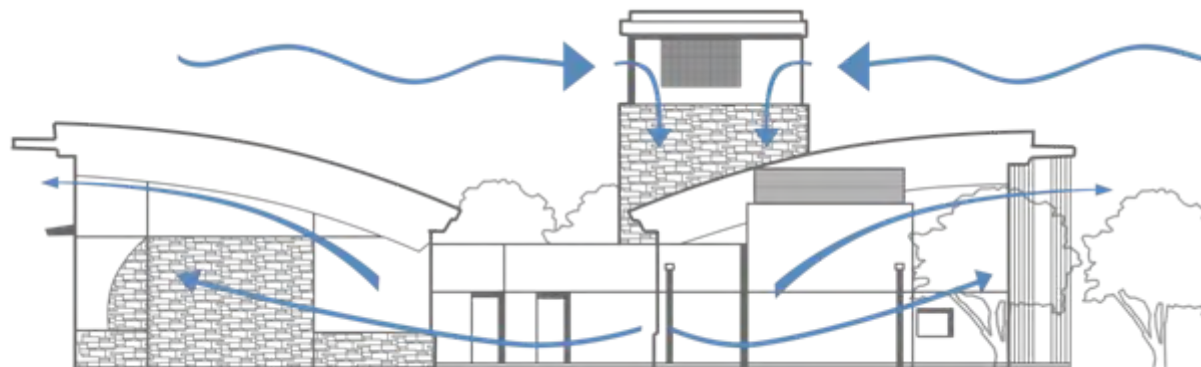


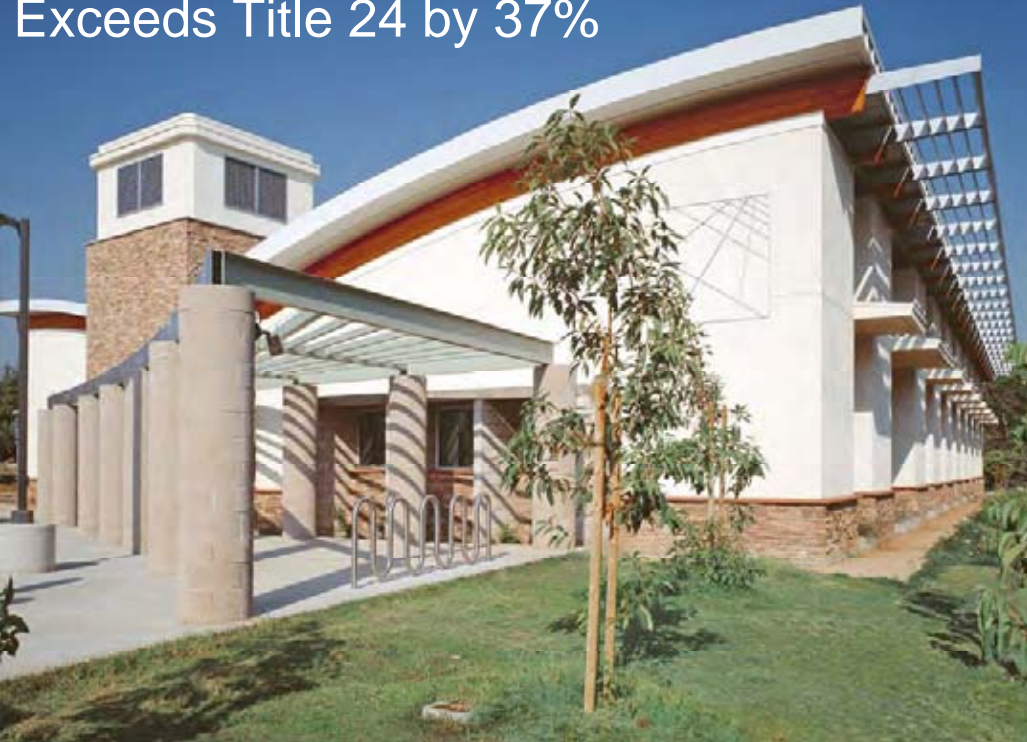
SUSTAINABILITY COLLABORATIVE

NET ZERO ENERGY BUILDINGS

Lake View Terrace Overview



LEED Platinum
Exceeds Title 24 by 37%



- ❑ South orientation, fixed overhangs & light shelves
- ❑ Evaporative cooling tower
- ❑ Mechanically actuated windows
- ❑ Mixed mode HVAC system
- ❑ Daylighting controls
- ❑ 13 kW PV system



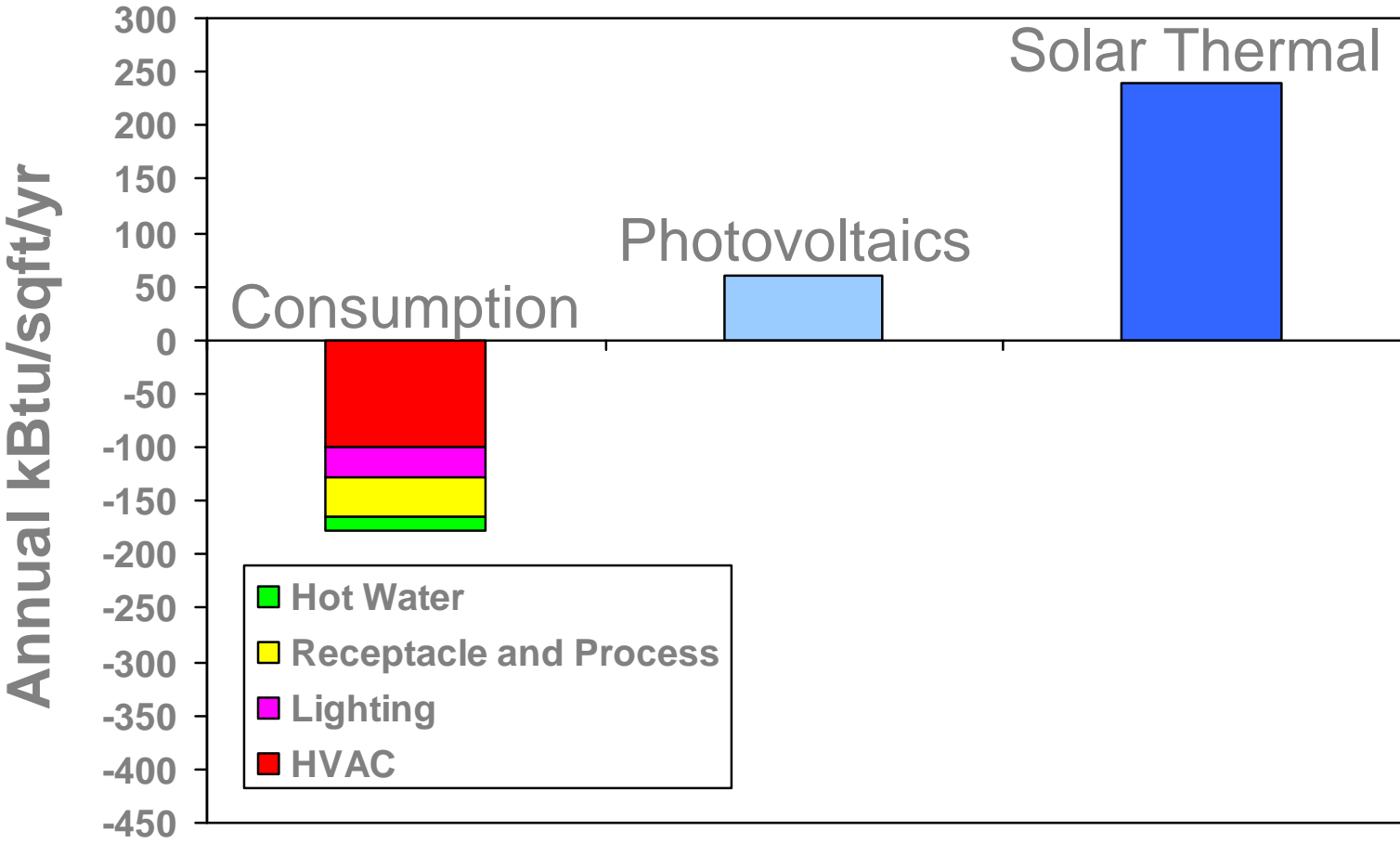
HARLEY ELLIS DEVEREAUX



GREENWORKS STUDIO

Lake View Terrace

Solar Budget



□ Consumption is 177 kBtu/sqft/yr based on available roof area



LAUSD #12

Overview

- ❑ East - West axis orientation
- ❑ Exterior shading on South facing windows
- ❑ Light shelves and daylighting windows
- ❑ Low LPD lighting system
- ❑ SEER 12 - 14 on rooftop packaged systems
- ❑ High performance glazing
- ❑ Cross ventilation in assembly and multipurpose areas

CHPS Certified
Exceeds Title 24 by 27%



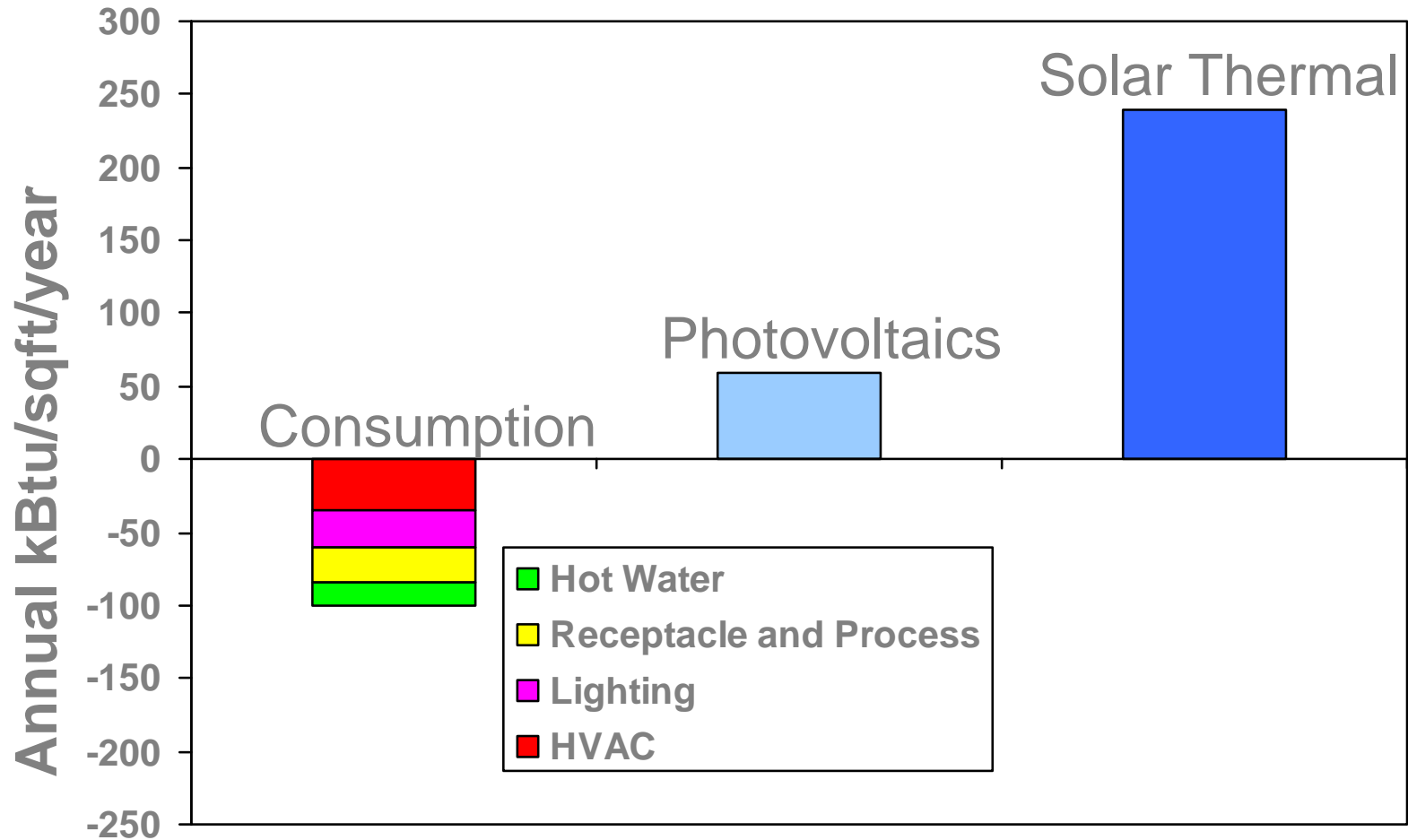
HARLEY ELLIS DEVEREAUX



GREENWORKS STUDIO

LAUSD #12

Solar Budget



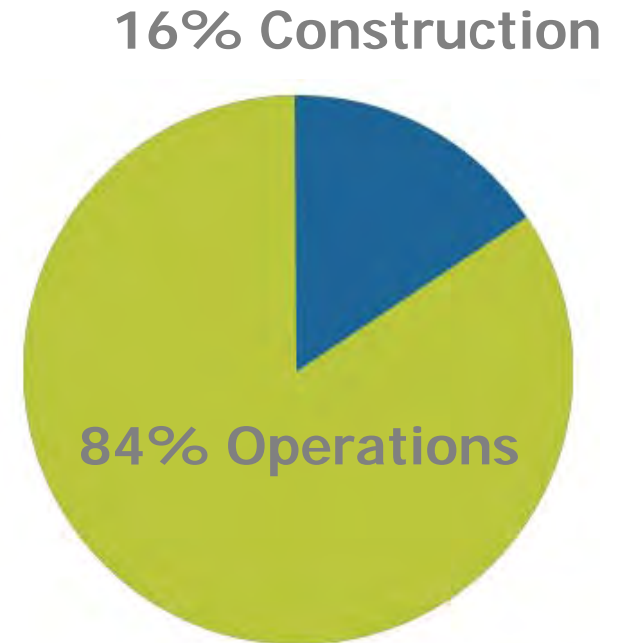
- Consumption is 100 kBtu/sqft/yr based on available roof area



Why Design for NZE?

Definition

- ❑ A Net Zero Energy Building (NZE) is one which consumes no more energy in a year than it generates from renewable sources
- ❑ Typically this definition concerns operational, not embodied energy
- ❑ Also referred to as “Grid Neutral” and “Carbon Neutral”
- ❑ Includes all building related energy consumption (plug + process)
- ❑ Assumes grid connectivity



Energy Consumption for a Typical School Building
(www.buildcarbonneutral.org)



Why Design for NZE?

Definition

Site NZE - Produces as much energy as it uses in a year at the site.

Source NZE - Produces as much energy as it uses in a year at the source.

Cost NZE - Annual payments from the utility to the owner equal the payments from the owner to the utility.

Carbon NZE - Produces annually as much carbon free renewable energy as it uses from carbon emitting sources.

Grid Neutral - Produces as much electricity as is used annually.



Why Design for NZE?

Post-Occupancy Performance

	Code Performance	NZE Performance
Includes all direct building energy loads	No	Yes
Includes on-site renewables	No	Yes
Can be verified against utility bills	No	Yes
Performance rating remains constant	No	Yes
Provides credit for innovative design strategies	No	Yes
Creates an incentive to model actual building operation	No	Yes



Why Design for NZE?

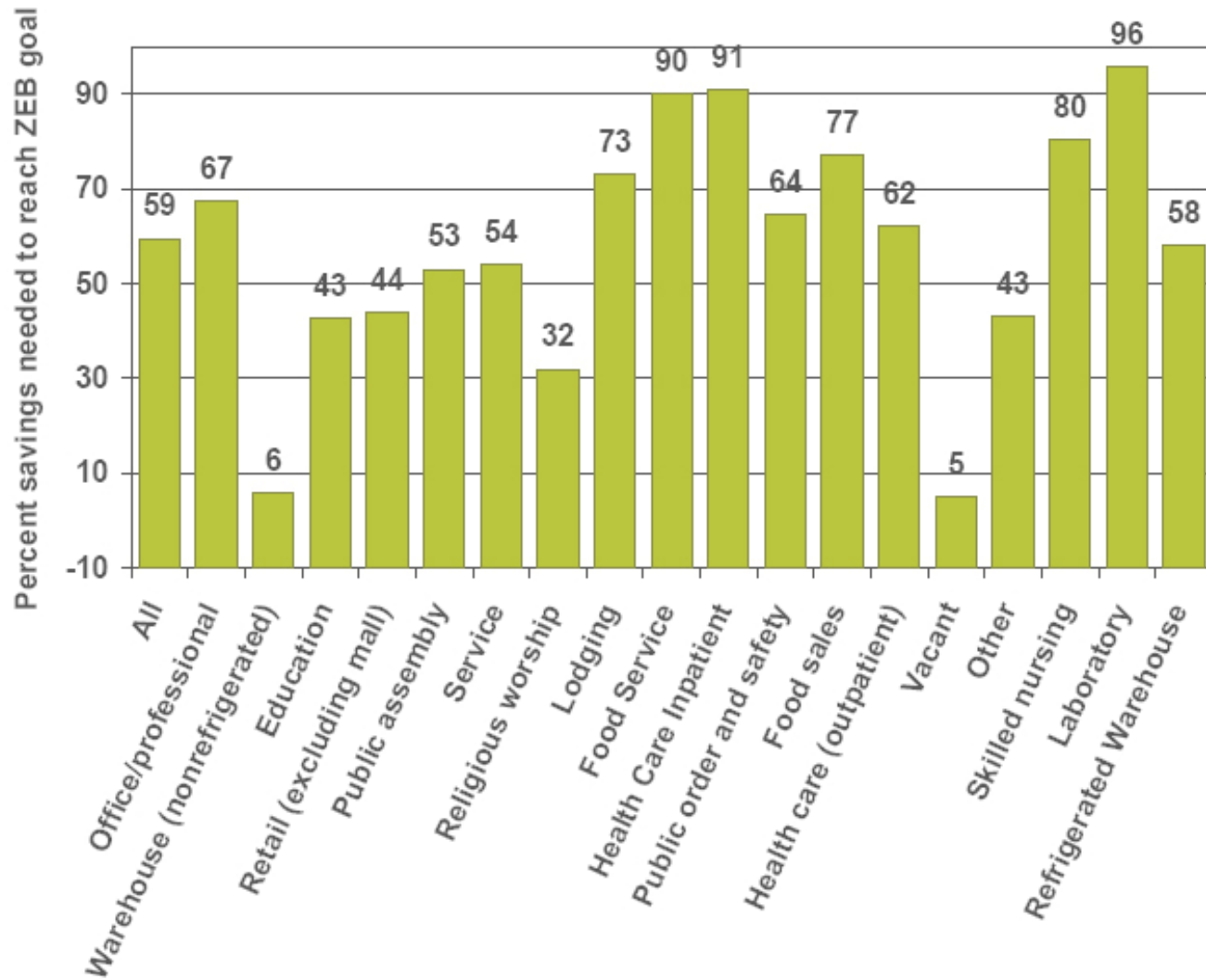
Drivers

- ❑ Government : Global Warming Solutions Act of 2006 (AB32)
- ❑ Non Profits: Architecture 2030
- ❑ State:
 - ❑ California Public Utilities Commission,
 - ❑ California Energy Commission,
 - ❑ Division of the State Architect (DSA)
- ❑ Institutions: Los Angeles Community College District
- ❑ Corporations: Nike, Yahoo, Fiji Water, HSBC
- ❑ Green Building Rating Systems: LEED, CHPS



Is NZE Feasible?

Savings over ASHRAE 90.1-2004 required to meet NZE



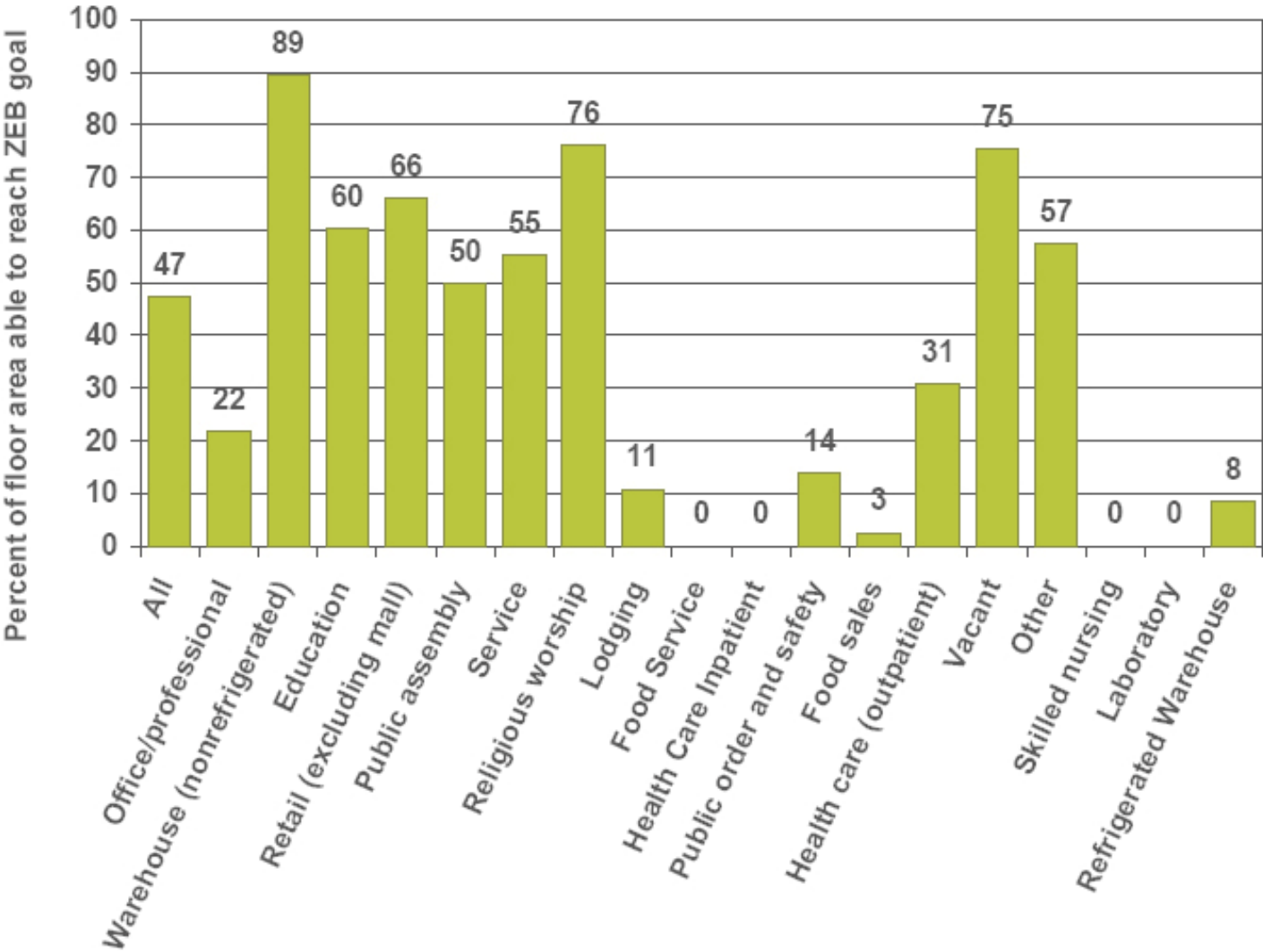
Source: National Renewable Energy Laboratory, Assessment of the Technical Potential for Achieving Net Zero-Energy Buildings in the Commercial Sector, December 2007



GREENWATTS STUDIO

Is NZE Feasible?

Percentage of floor area that could achieve NZE



Source: National Renewable Energy Laboratory, Assessment of the Technical Potential for Achieving Net Zero-Energy Buildings in the Commercial Sector, December 2007

Passive Site Resources

Climate Zone 8, August 12:00PM



Passive Site Resources

Climate Zone 8, August 6:00PM



Passive Site Resources

Climate Zone 8, August 12:00AM

**Microclimate
issues created by
local topography**

**Dry bulb 64
Wet bulb 61
Dew point 60**

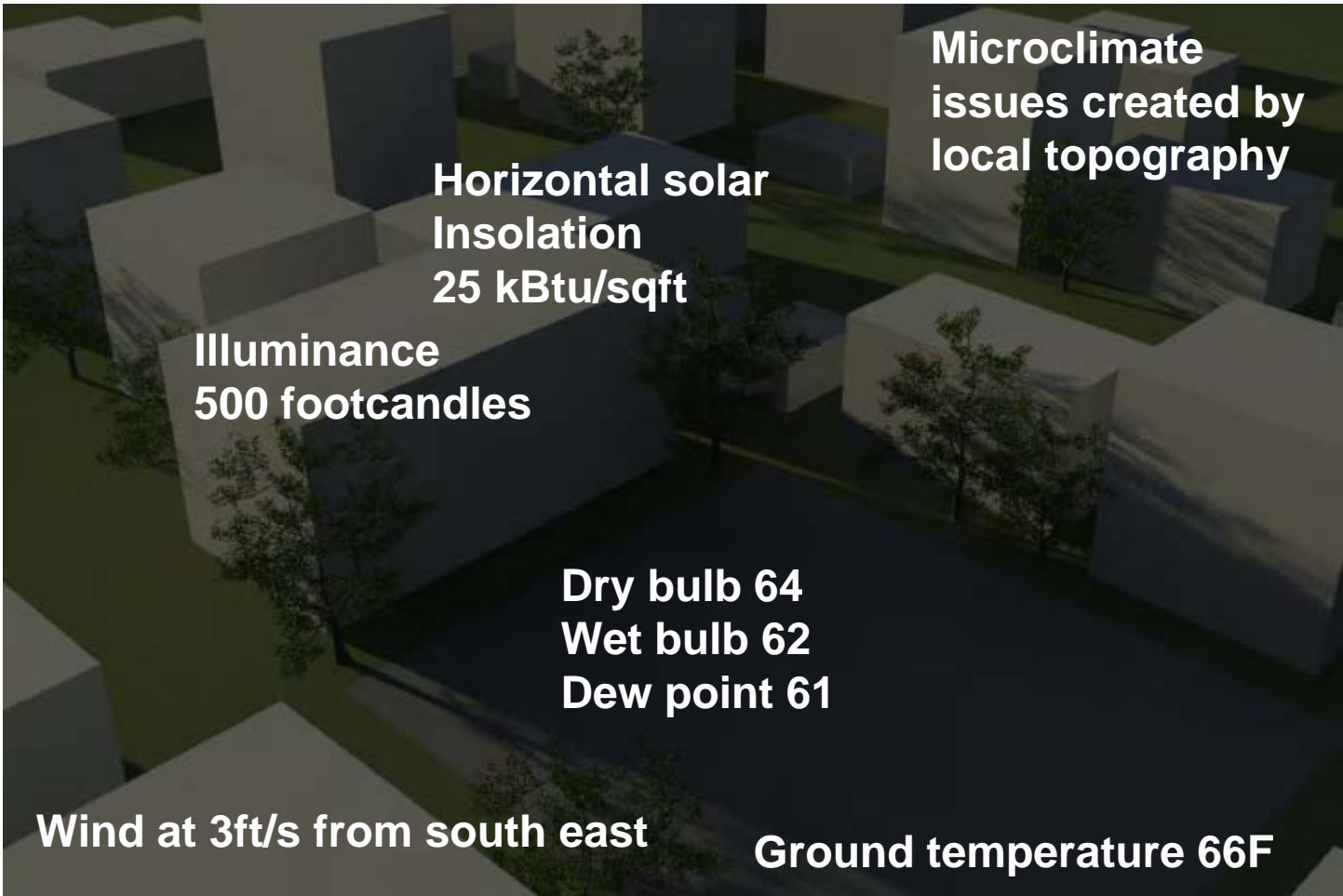
Wind at 4ft/s from south east

Ground temperature 66F



Passive Site Resources

Climate Zone 8, August 6:00AM



Design Tools

Simulation Software

- ❑ Accurate and flexible simulation modeling tools are critical for NZE design
- ❑ Code compliance tools often too limited to inform design decisions
- ❑ Need to move to more sophisticated tools which also address:
 - ❑ Human comfort
 - ❑ Natural ventilation
 - ❑ Passive and active radiant heating and cooling
 - ❑ Innovative envelope design
 - ❑ Renewable energy generation
 - ❑ Lifecycle cost analysis
 - ❑ Parametric comparison of design options



Design Tools

Simulation Software

- ❑ No one tool will do it all – may need a suite of tools
 - ❑ Weather analysis
 - ❑ Hourly thermal simulation
 - ❑ Network and computational fluid dynamics airflow models
 - ❑ Daylighting
- ❑ Cost is now less of an issue
 - ❑ Many of very capable tools are free
 - ❑ Costs coming down for sophisticated airflow modeling tools
- ❑ There can be a significant learning curve - requires upfront investment in training support and resources



Net Metering

Utility Tarrifs

- ❑ Net metering provides a mechanism for receiving credit for on-site electrical generation
- ❑ Lack of credit for excess production can encourage undersizing PV systems
- ❑ New electricity tariffs likely to provide additional options
 - ❑ CREST: Southern California Edison will purchase output from systems up to 1.5 MW
 - ❑ Virtual Net Metering: Would allow transfer of excess generation between facilities owned by same customer



Designing NZE Buildings



Designing NZE Buildings

French School, Damascus

Name of Project: Ecole Française de Damas – Lycée Charles de Gaulle

Client: Ministry for Foreign Affairs and the Association des Parents d'Elèves

Begin Design: June 2001

Begin Construction: August 2006

Completion: Summer 2007 (first phase), Summer 2008 (complete)

Occupancy: 900 children

Building Area: 60,250 sqft (usable floor area), 78,550 sqft (gross area)

Construction Cost: 5,640,000 dollars (May 2006)

Design Team: GEC Ingénierie (Structural Engineering)
Barbanel Liban (HVAC-E Engineering)
Transsolar (Climate Design)
Dagher & Hanna (Architect of Record)

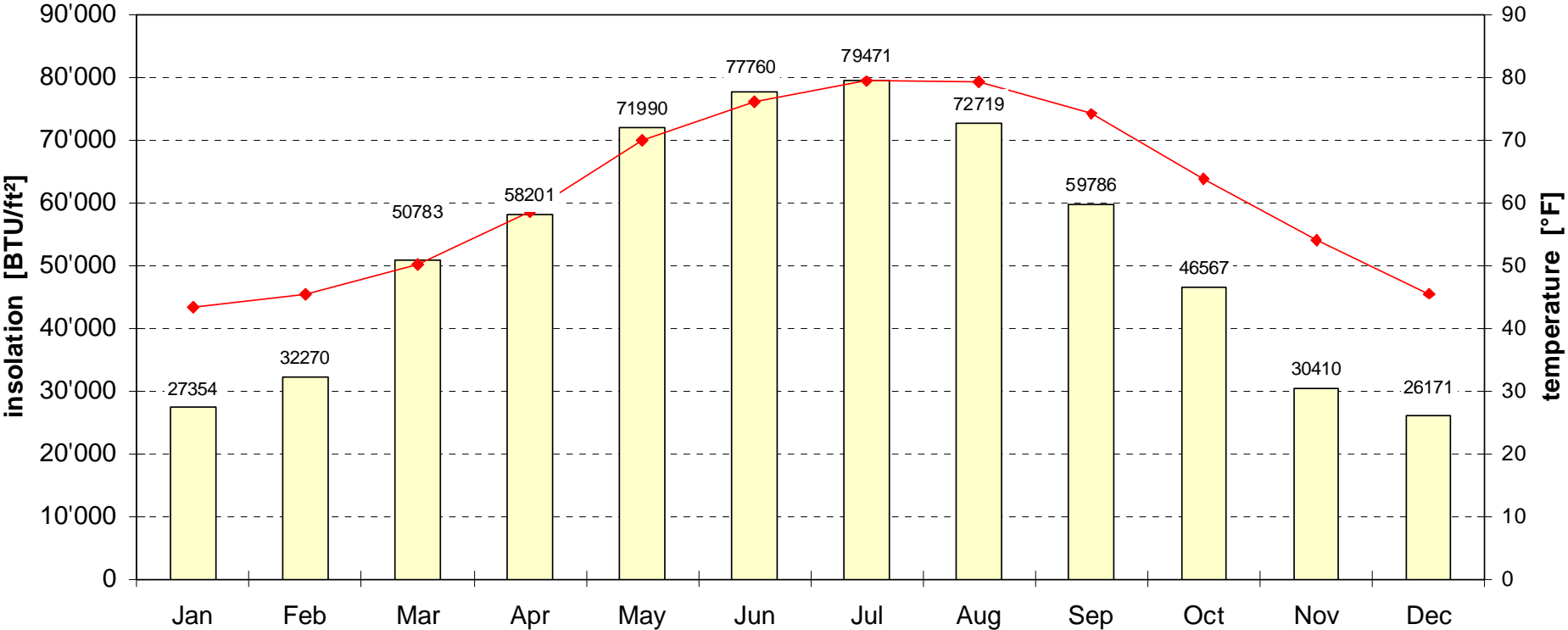
Designing NZE Buildings

Design Objectives

- ❑ Minimize building operation cost (energy, maintenance)
- ❑ Natural, comfortable and inspiring environment
- ❑ Climate responsive design by passive use of renewable sources
- ❑ Daylight
- ❑ Night cooling of thermal mass
- ❑ Natural ventilation - natural fan: wind and solar supported chimney
- ❑ Ground heat exchanger

Designing NZE Buildings

Damascus Temperatures and Insolation



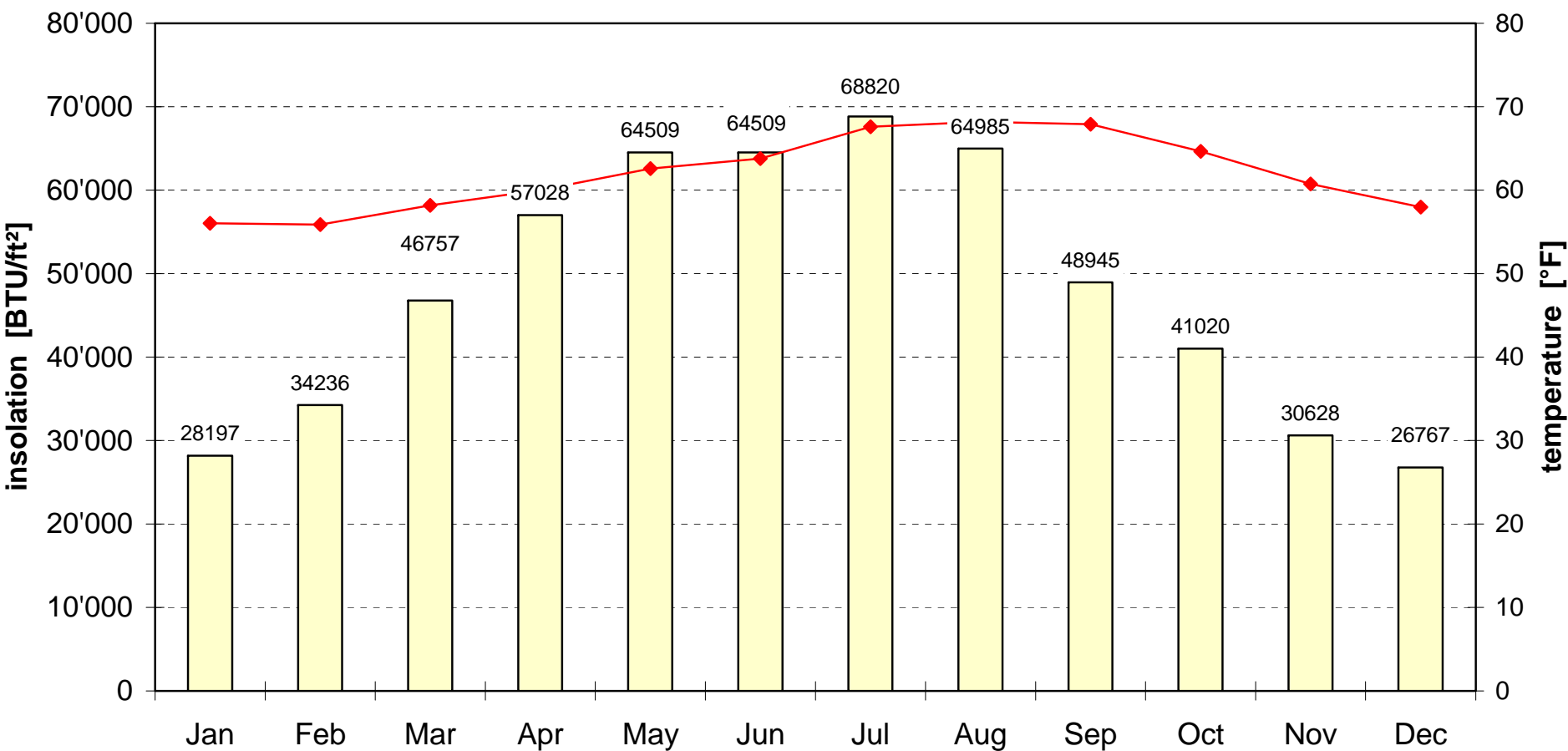
global insolation: 633363 BTU/ft²/a
 yearly mean outside air temperature: 61.74 °F
 hours with outdoor air temperature >77 °F: 1771 h
 hours with absolute humidity >11 %: 269 h

global insolation per month
 monthly mean air temperature



Designing NZE Buildings

Los Angeles Temperatures and Insolation

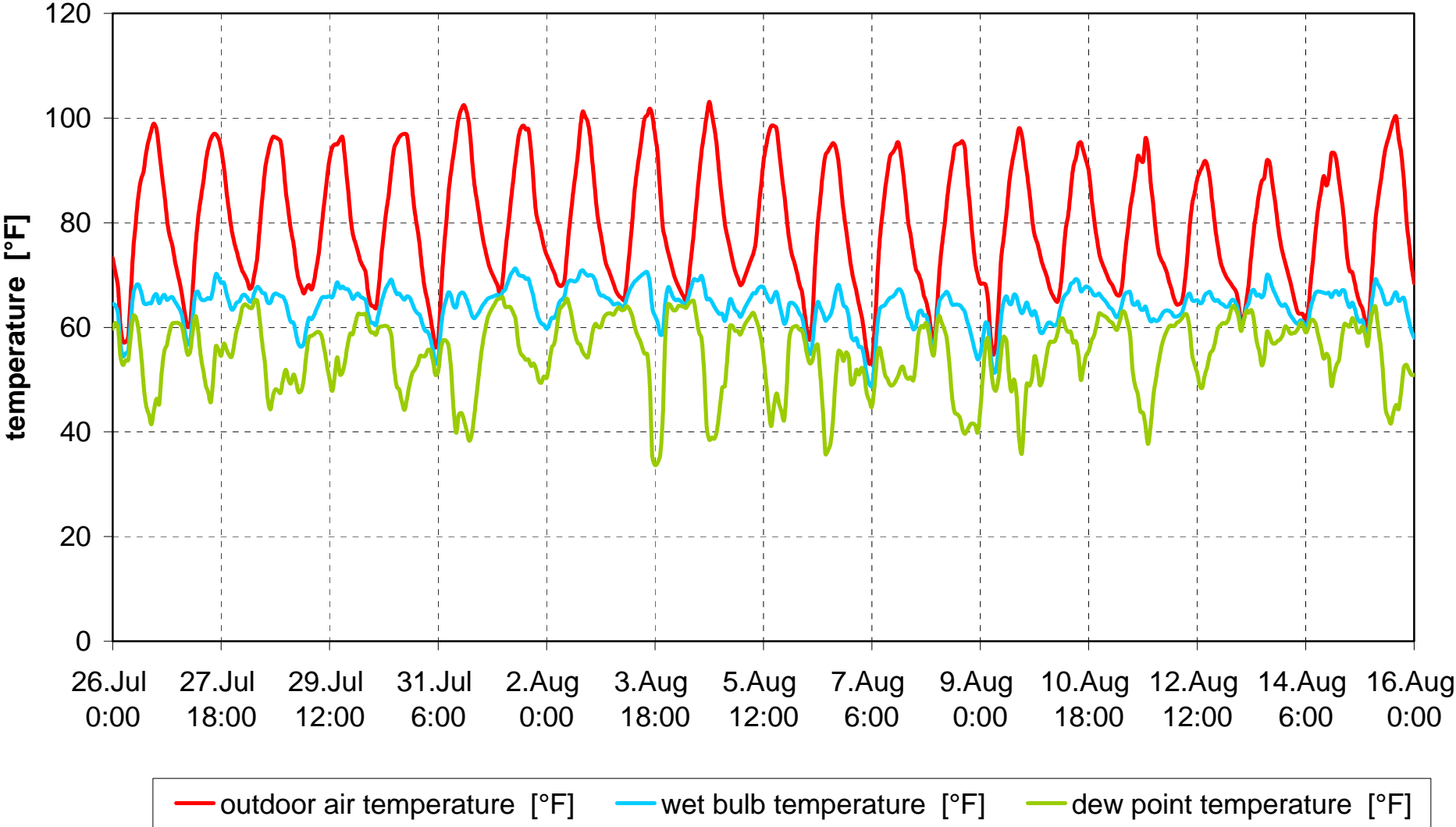


global insolation: 576303 BTU/ft²/a
 yearly mean outside air temperature: 61.99 °F
 hours with outdoor air temperature >77 °F: 149 h
 hours with absolute humidity >11 ‰: 484 h

global insolation per month
 monthly mean air temperature

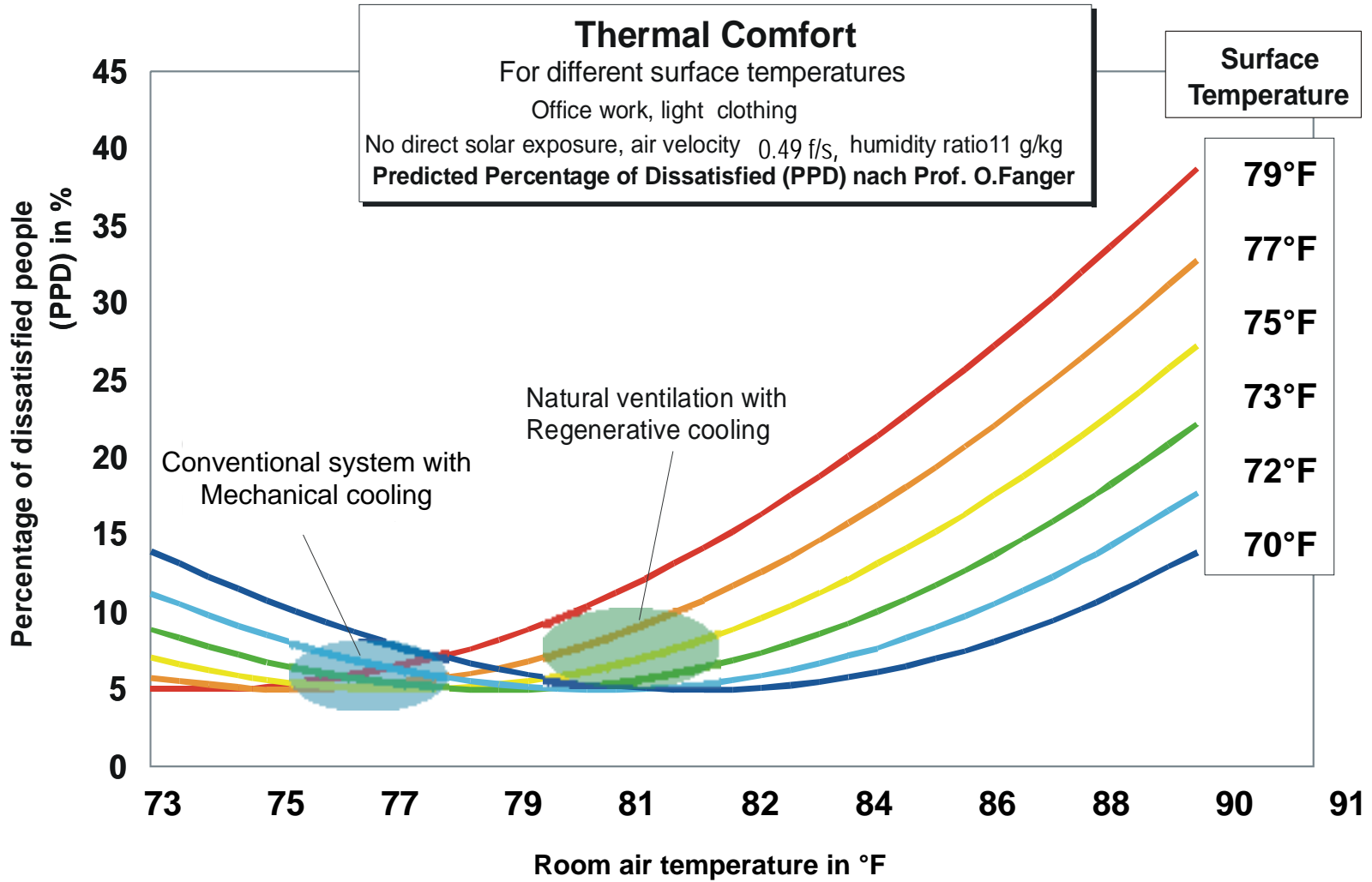
Designing NZE Buildings

Damascus Summer Temperatures



Designing NZE Buildings

Thermal Comfort

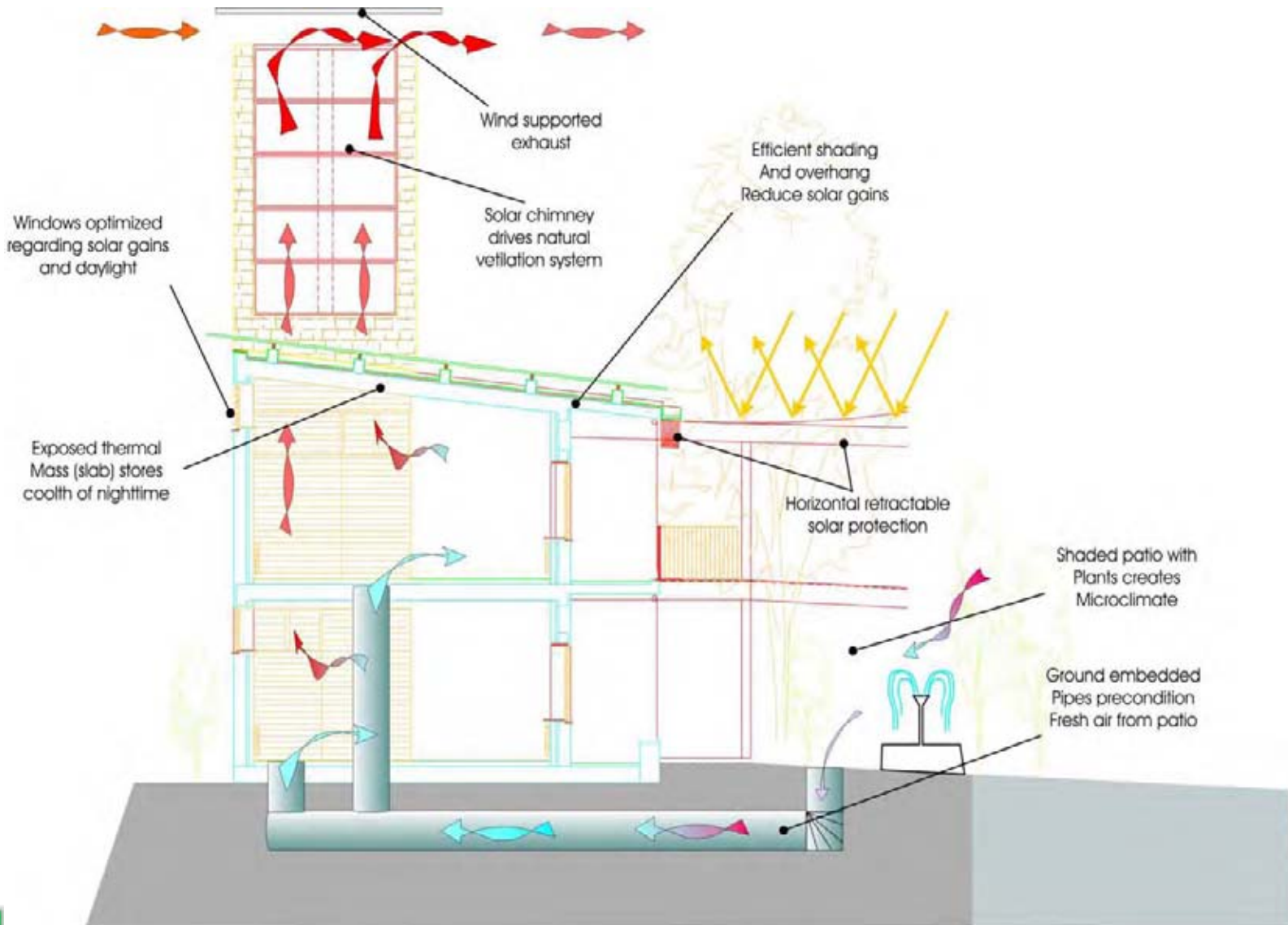


Designing NZE Buildings



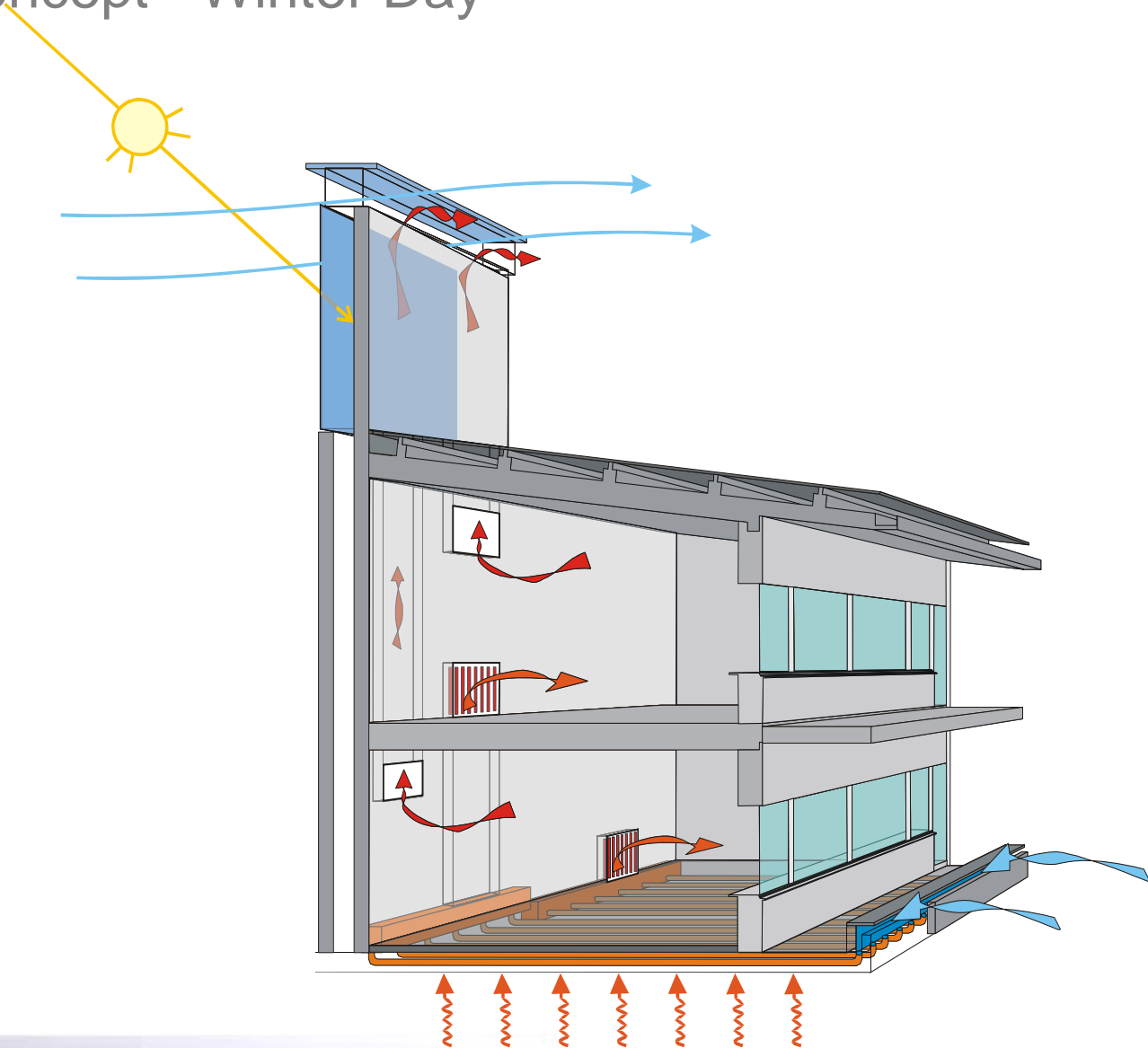
Designing NZE Buildings

Climate-Responsive Design for French School



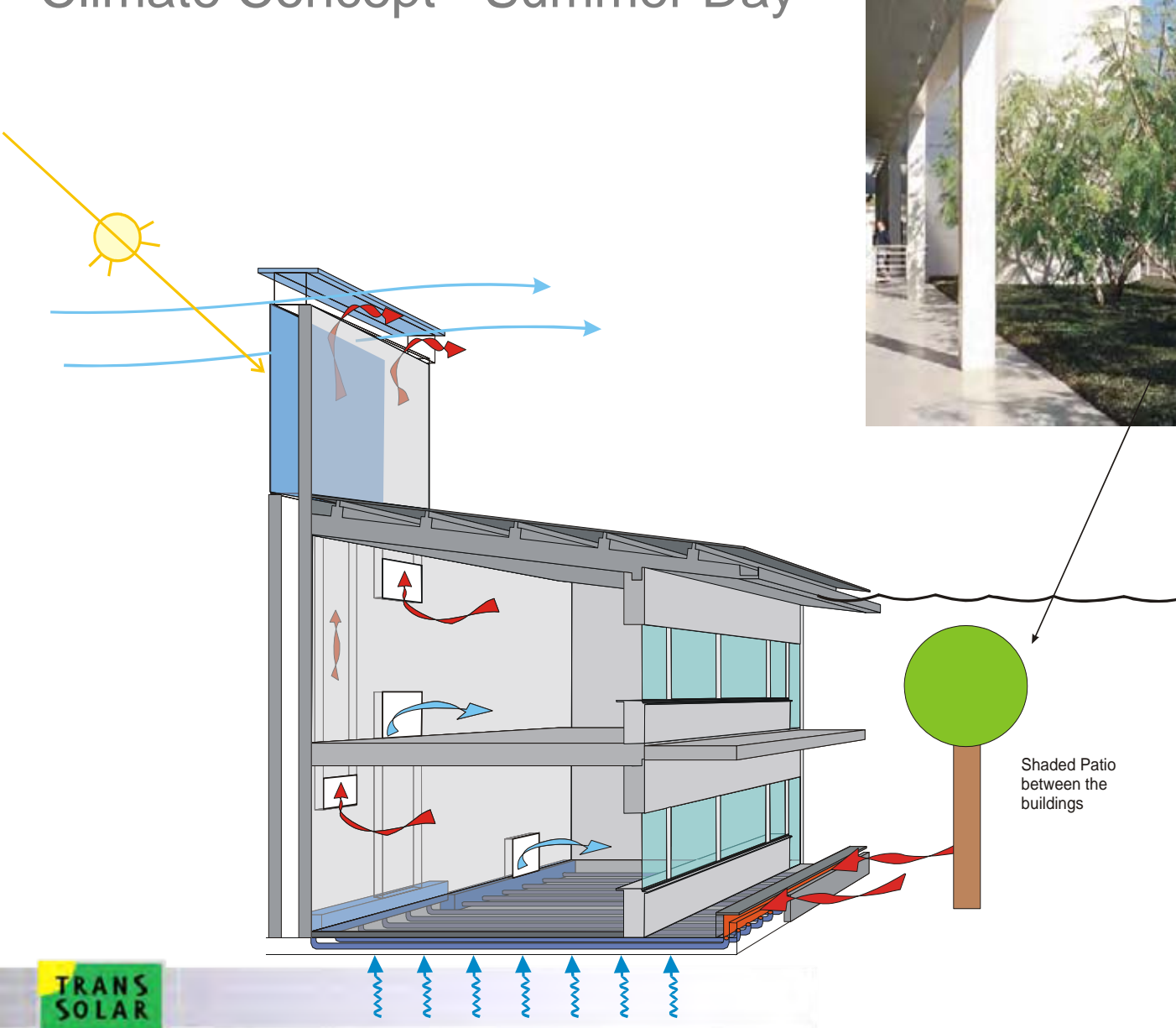
Designing NZE Buildings

Climate Concept - Winter Day



Designing NZE Buildings

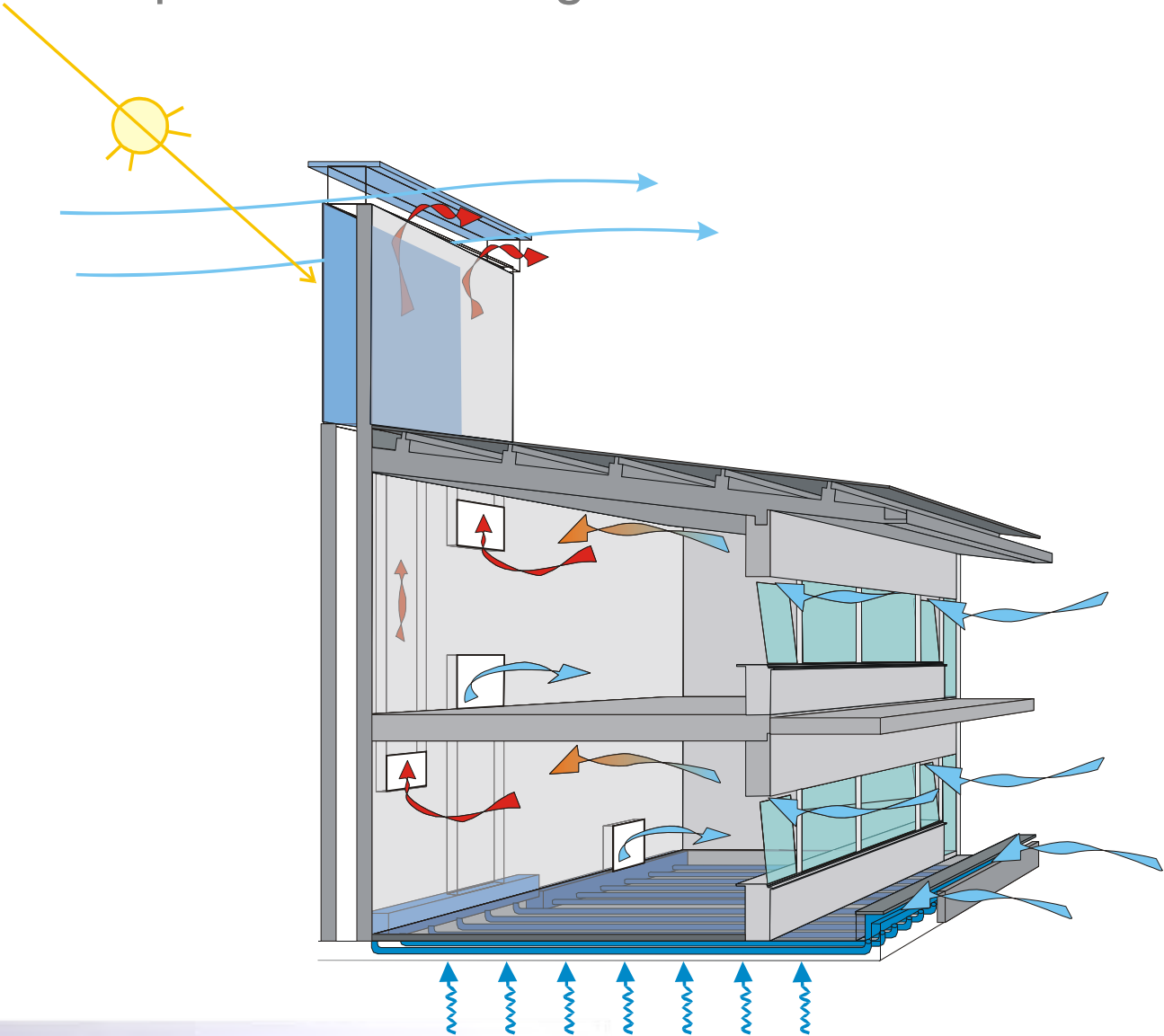
Climate Concept - Summer Day



Shaded Patio
between the
buildings

Designing NZE Buildings

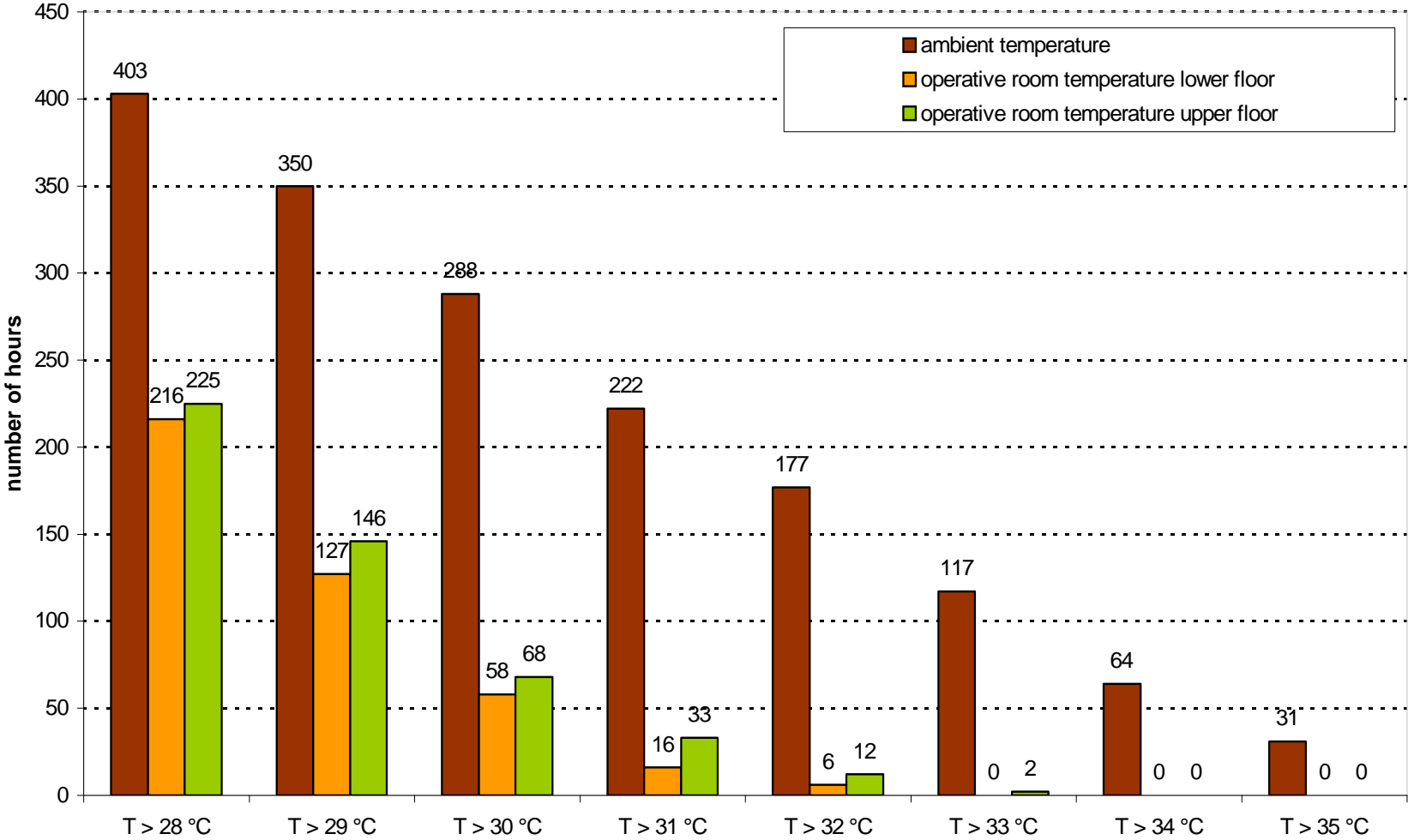
Climate Concept – Summer Night



Designing NZE Buildings

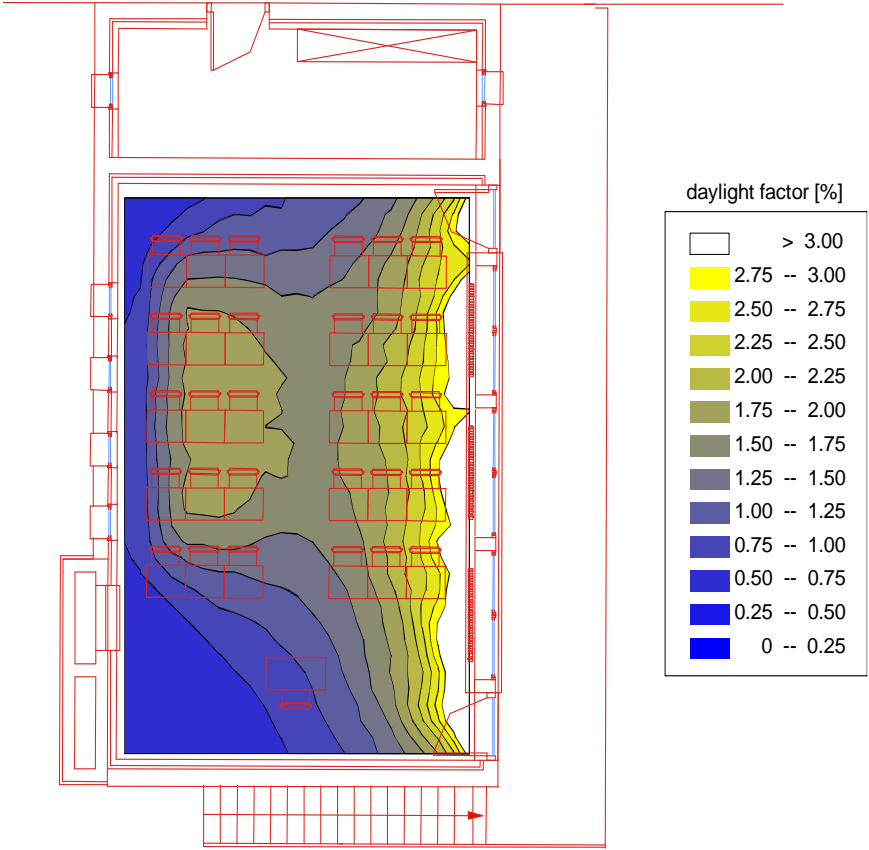
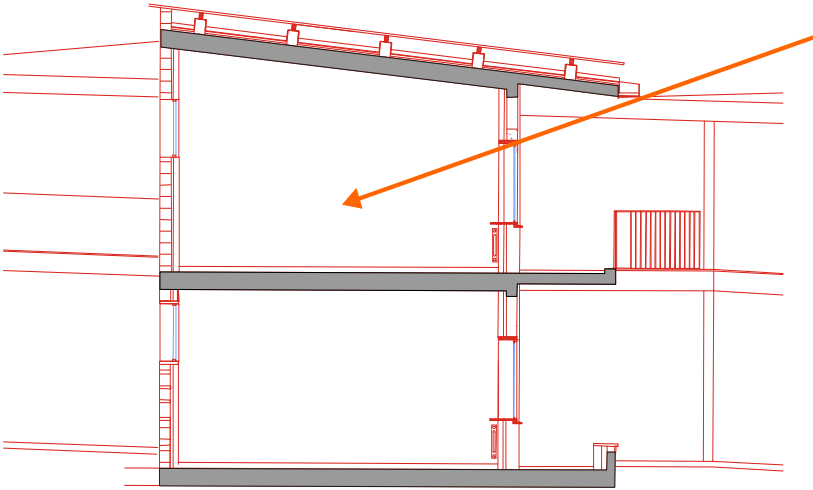
Classroom Thermal Comfort

Typical Class Room - room temperature statistics during time of occupation



Designing NZE Buildings

Daylighting - Upper Floor



Designing NZE Buildings



Designing NZE Buildings



Designing NZE Buildings



Designing NZE Buildings



Designing NZE Buildings



photography by Adria Goula

Designing NZE Buildings



Designing NZE Buildings

French School, Damascus

Natural ventilation and natural cooling system

- ❑ Healthy, natural environment
- ❑ Reasonable thermal comfort conditions
- ❑ Good air quality
- ❑ Bright illuminated space (daylight)
- ❑ Minimized costs for building operation

Designing NZE Buildings

What can be done to change the building delivery process to support NZE?

Project Design & Delivery:

- ❑ Design Bid Build
- ❑ CM at Risk
- ❑ CM Multiple Prime
- ❑ **Design Build**

Designing NZE Buildings

Design Build Process & RFP Requirements

Owner Specified Defaults:

- ❑ Relaxed Thermal Comfort Range
- ❑ Passive Thermal Systems
- ❑ Mechanical Systems added only as supplemental to Passive Systems
- ❑ Stand alone Mechanical Systems used only when necessary
- ❑ Natural Ventilation
- ❑ Daylighting Requirements
- ❑ Survivability

RFP Deliverables:

- ❑ Building Information Modeling (BIM)
- ❑ Parametric Comparisons supporting Design Decisions
- ❑ Specify Simulation Modeling Tools with specific capabilities
- ❑ Network Airflow or Computational Fluid Dynamics models
- ❑ Life Cycle Cost Analysis

Thank You

This presentation can be found online at:

Greenworkstudio.com