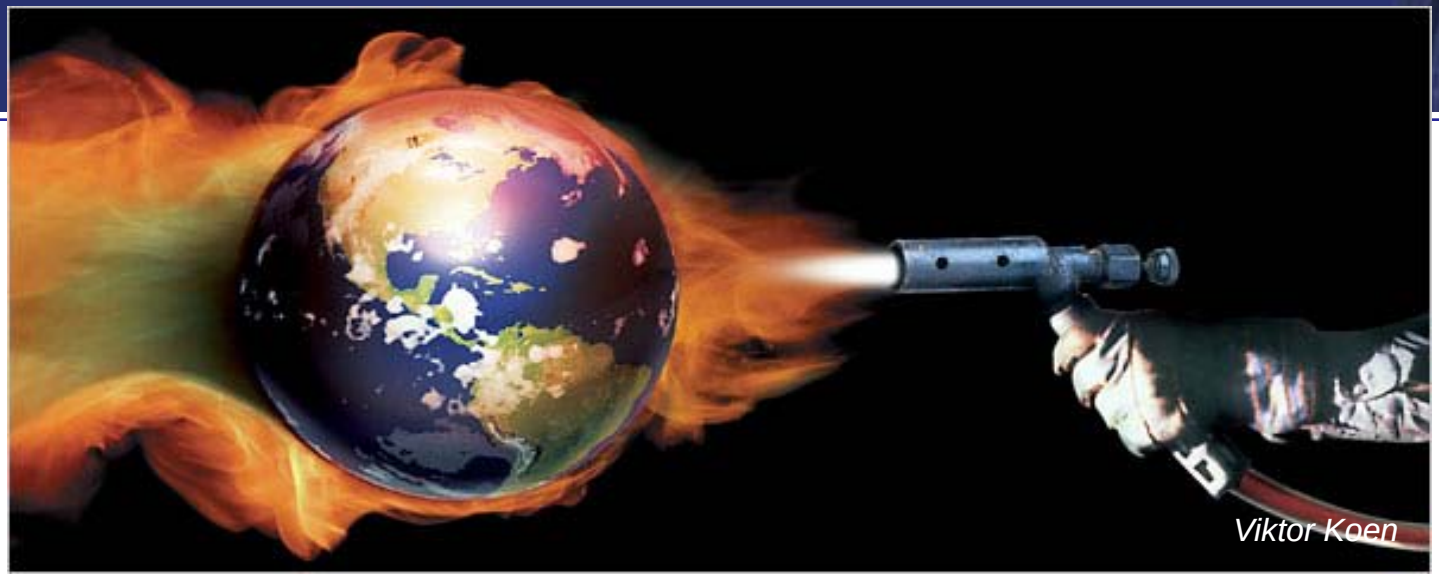
WHAT'S YOUR kBTU/sf/year ?

CoreNet San Francisco

April 2009

PERKINS + WILL

TIMMONS DESIGN ENGINEERS
Engineering & Sustainable Consultants



UN Intergovernmental Panel on Climate Change
4th Assessment Report issued February 2007

Global atmospheric concentrations of *carbon dioxide* have increased markedly as a *result of human activities* since 1750 and now *far exceed pre-industrial values* determined from ice cores spanning many thousands of years.

A very high confidence (at least a nine out of ten chance, or 90% confidence rate) that the globally averaged *net effect of human activities since 1750 has been one of warming*.

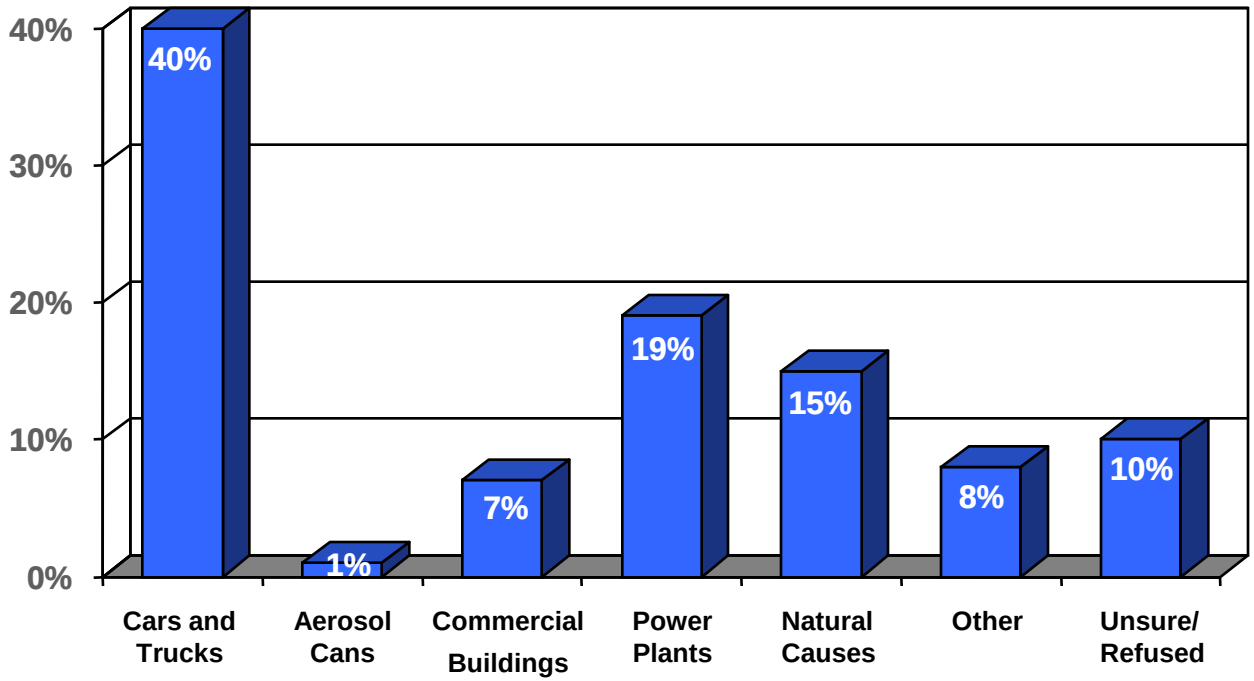
Source: UN Intergovernmental Panel on Climate Change (IPCC)

Greenhouse gas emissions

What do you think is the top cause of greenhouse gas emissions today?

Would you say it is…

- exhaust from cars and trucks
- emissions from aerosol cans
- emissions from commercial buildings
- emissions from power plants, or
- natural causes?



Lake Research Partners
Lake Snell Perry Mermin Meadow Gotoff

THE TARRANCE GROUP

January 21-24, 2007 / N=1,000 Registered Voters / ±3.1% M.O.E.

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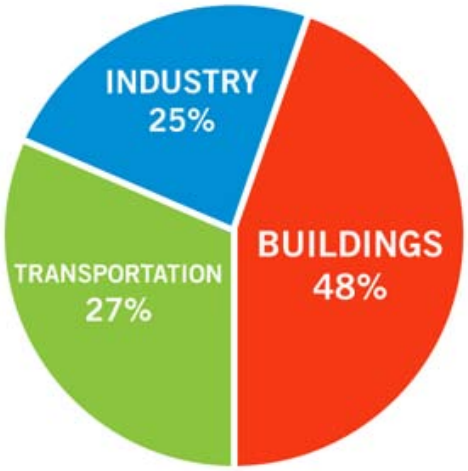
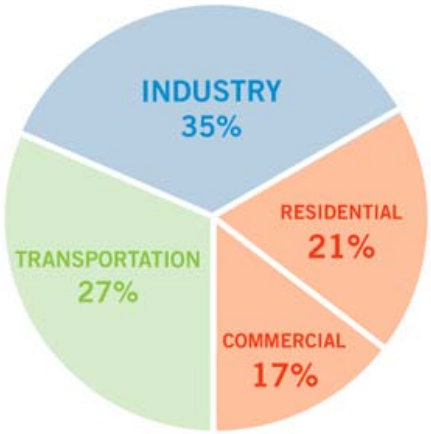
It’s the buildings …

Building design, construction, materials and operation **consume more energy than any other part of the US economy** !



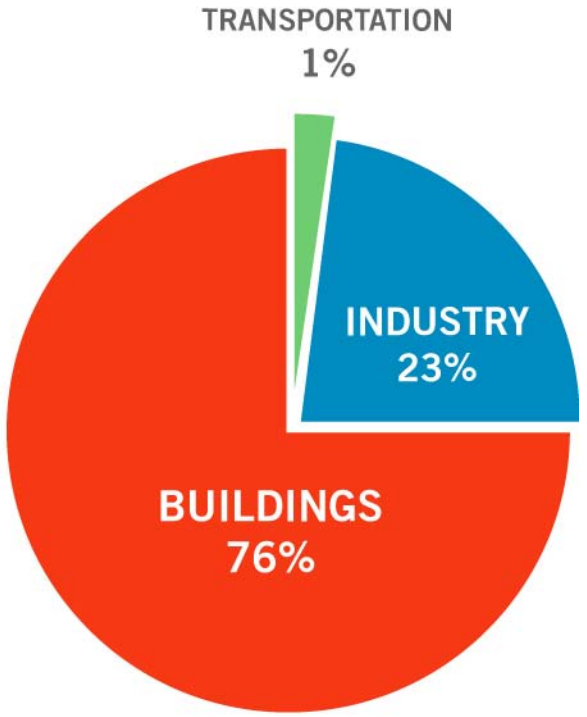


Combining the annual energy required to operate residential, commercial, and industrial buildings along with the embodied energy of industry-produced building material like carpet, tile, glass, and concrete exposes buildings as the largest energy consuming and greenhouse gas emitting sector

source: architecture 2030

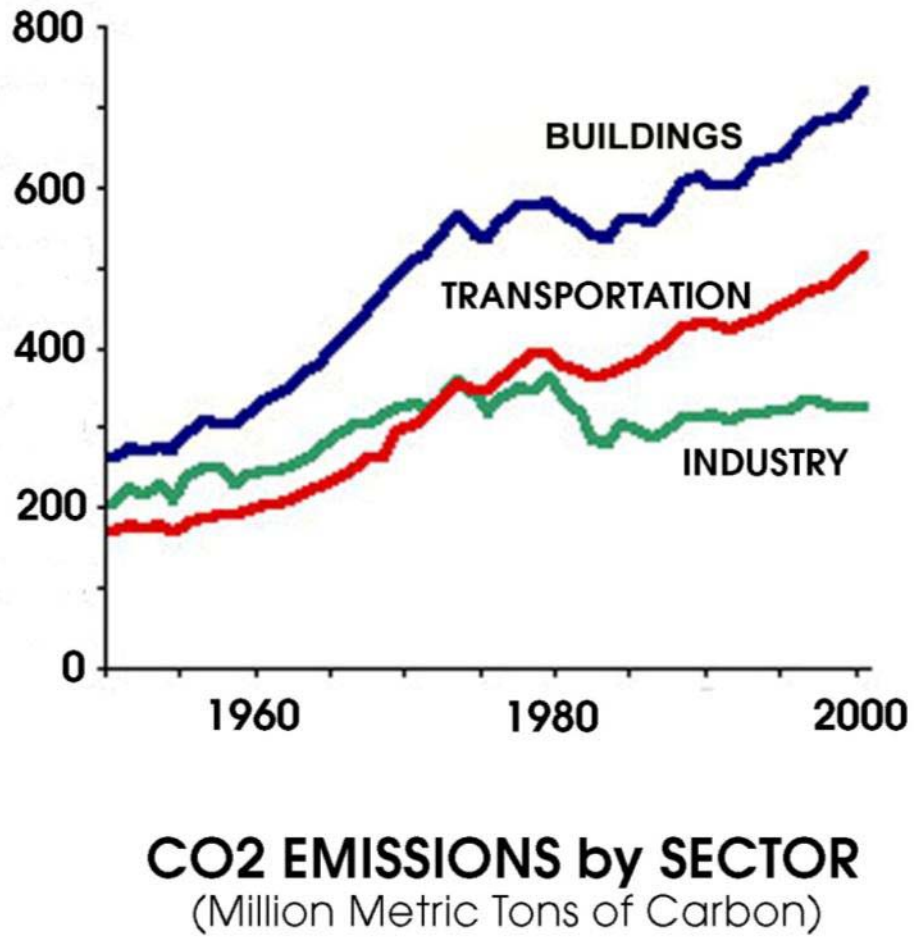
It’s the operations…

- The average Life of a US Building is 75 Years
- Buildings consume US electrical power at an amazing rate!



source: architecture 2030

CO2 Emissions compared



CO2 EMISSIONS by SECTOR
(Million Metric Tons of Carbon)

Source: Energy Information Administration Statistics

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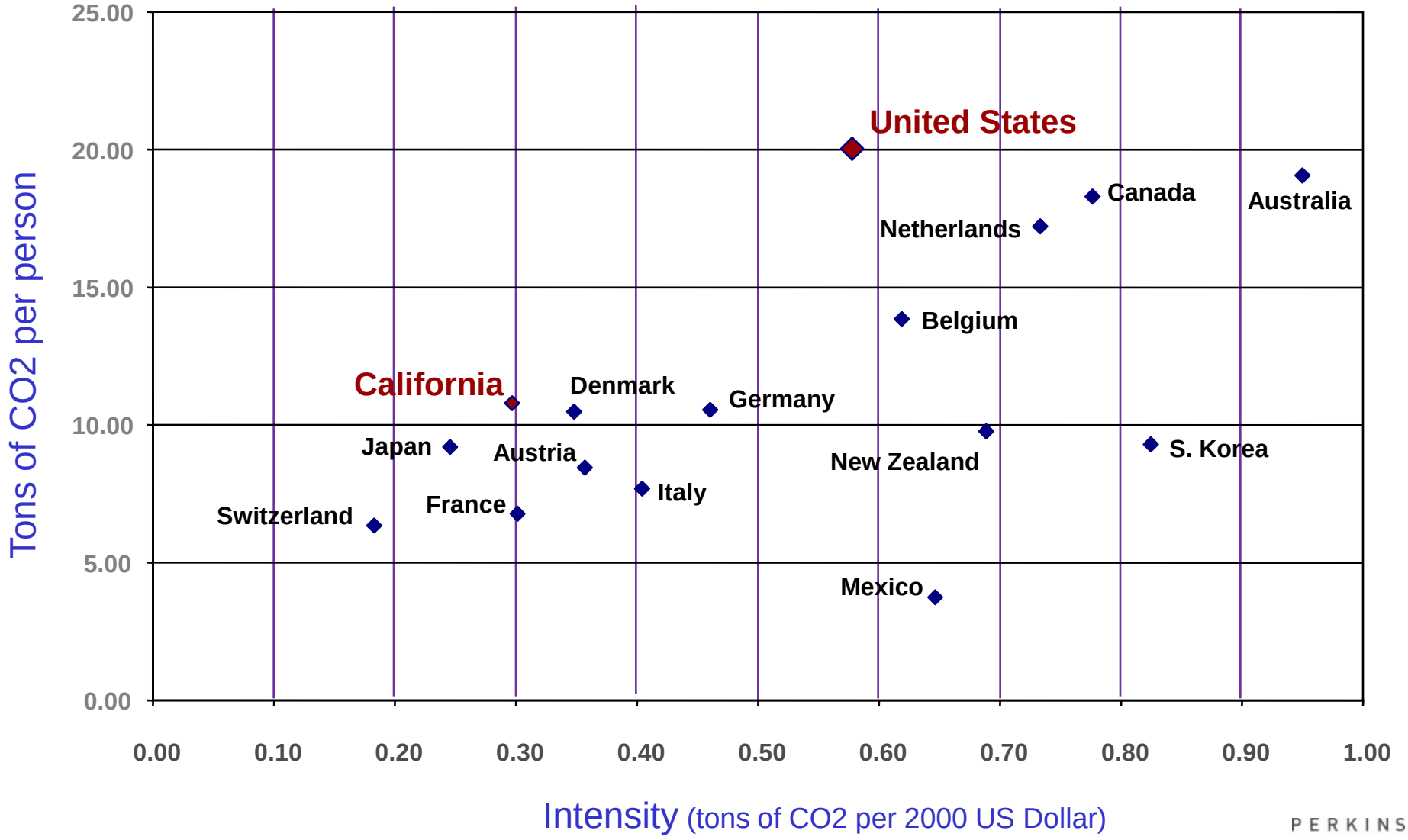
Carbon Dioxide Intensity + Per Capita CO2 Emissions

Year 2001 - Fossil Fuel Combustion Only



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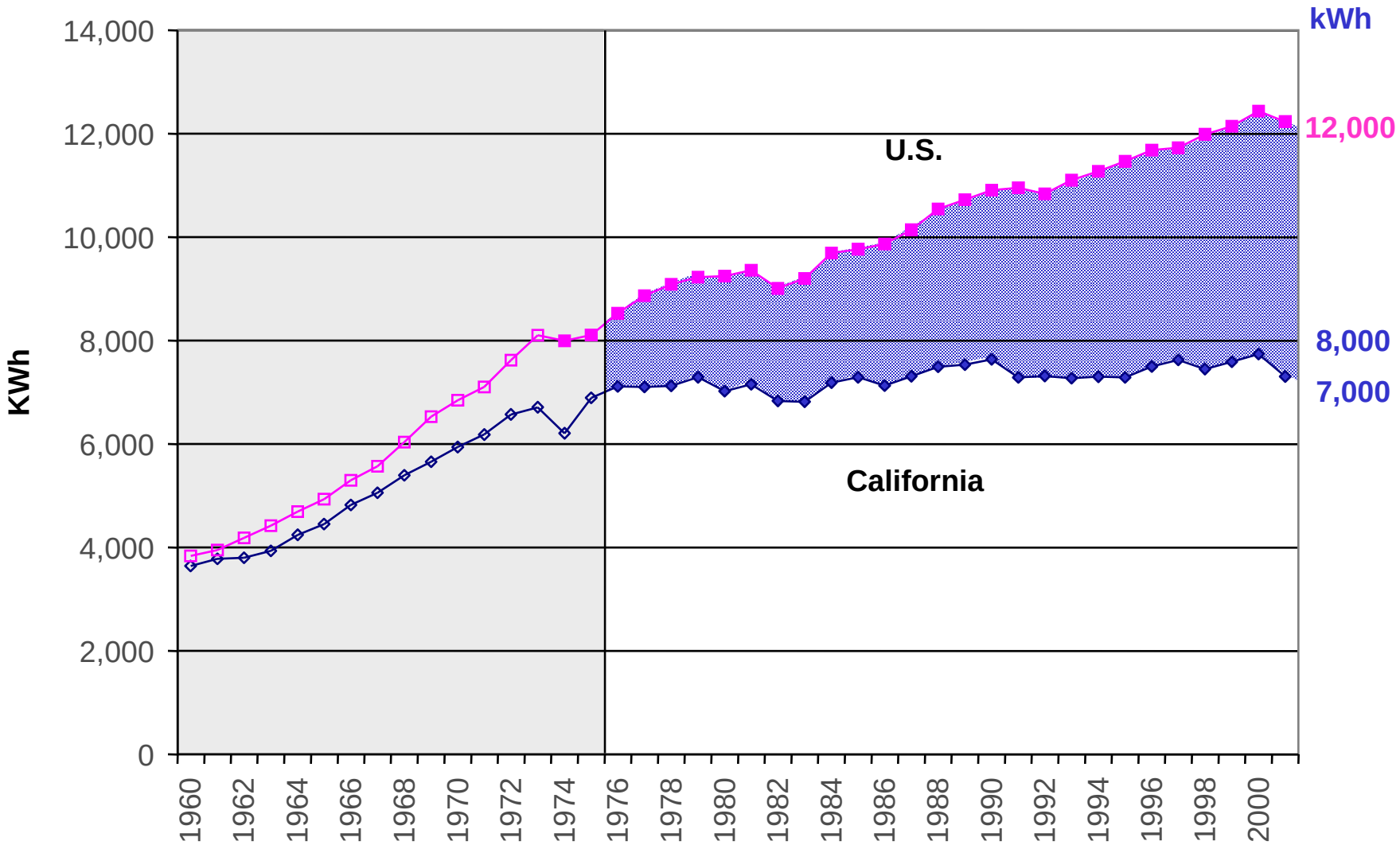
Total Electricity Use - per capita 1960 - 2001



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California's Statewide Goals

Global Warming Solutions Act / AB 32 –Sept 2006

- Reduce Greenhouse Gas emissions statewide
- By 2020 reduce emissions to 1990 levels
- Mix of strategies for 30% reduction
- Air Resources Board (ARB) led 18 month development, workshops & hearings
- 43,000 Individual comments
- ARB approved Plan December 11, 2008

California's Leadership Role

Maintain State's Position :

- Attracting Venture Capital
- Leader developing clean technology
- Guide capital investments
- Energy efficiency saves money
- Promote hundreds of thousands of green jobs

Grow the State's economy in a clean and sustainable direction

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What's In The Plan?

Implementation Plan includes:

- 74 Measures requiring action
- Implementation dates from 2010 to 1015
- Green Building Strategy(GB-1) addresses –
  - Greening New & Existing State Buildings
  - Greening Public Schools
  - **Greening New Residential & Commerical Construction**
  - **Greening Existing Homes & Commericail Buildings**
- Potential 29 MMT CO2 Reduction

"Green buildings are a vital tool for meeting the objectives of AB 32 because they provide a mechanism for reducing GHG emissions from multiple sectors – principally energy, water, waste and transportation, while minimizing other undesirable environmental and community impacts."

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Greening New Residential & Commercial Construction

Anticipate 2 million homes & 1.3 billion commercial SF 2010 -2020

- California Green Building Standards Code mandatory 2011
- 2011 Commercial Building target -25% of new buildings reduce energy & water consumption by at least 25% beyond code
- Local governments have “explicit authority” to pass ordinances and standards more stringent than GBSC
- State & local governments collaborate on certification, incentives, reporting and verification programs
- Net Zero Energy Targets 2020 - 2030

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Greening New Residential & Commercial Construction

Existing buildings greatest potential within the building sector

- 8 million homes & apartments, 2/3 of existing before 1982
- 5.25 billion SF commercial building before 1978
- Establish performance rating system to inform owners & prospective buyers how a building performs relative to its peers (benchmarking)
- CEC & CPUC to develop details
- Utilities play a role in such programs

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Mandatory Performance Reporting

AB 1103 Approved Oct 12, 2007

Requires electric & gas utilities to maintain energy consumption data on all nonresidential buildings

After January 1, 2009 :

- Data must be compatible to upload to EPA Energy Star Portfolio Manager for at least recent 12 months
- Upon owner authorization, utility uploads preserving customer confidentiality
- PG&E Automated Benchmarking Service (ABS) developed in response

Mandatory Performance Reporting

AB 1103 Approved Oct 12, 2007

After January 1, 2010:

- Building Owner or Operator required to disclose Energy Star benchmarking data & ratings for most recent 12 months to:
  - Prospective Buyer,
  - Prospective Lessee and /or,
  - Prospective Lender.

- Additional benchmarking or performance data is not required to be disclosed.

What is kBTU/SF/YR?

- 1000 BTUs per Square Foot per Year *
- Measure of Energy Use Intensity
  - Benchmarking unit of measure
  - Compare similar building types
  - Compare within a region
- EPA Commercial Buildings Energy Consumption Survey (CBECS)

** A BTU is defined as amount of heat required to raise the temperature of one pound of liquid water by one degree from 60° to 61°F at a constant pressure of one atmosphere*

What is current performance benchmark?

California Office Buildings -1991

- 62.9 kBTU/SF/YR – median
- 21.8 kBTU/SF/YR – low
- 131.0 kBTU/SF/YR – high

1979 -1990

- 57.4 kBTU/SF/YR – median
- 37.6 kBTU/SF/YR – low
- 113.5 kBTU/SF/YR – high

1941 - 1978

- 54.9 kBTU/SF/YR – median
- 38.5 kBTU/SF/YR – low
- 122.6 kBTU/SF/YR – high

Source: EnergyIQ – Lawrence Berkeley Laboratories

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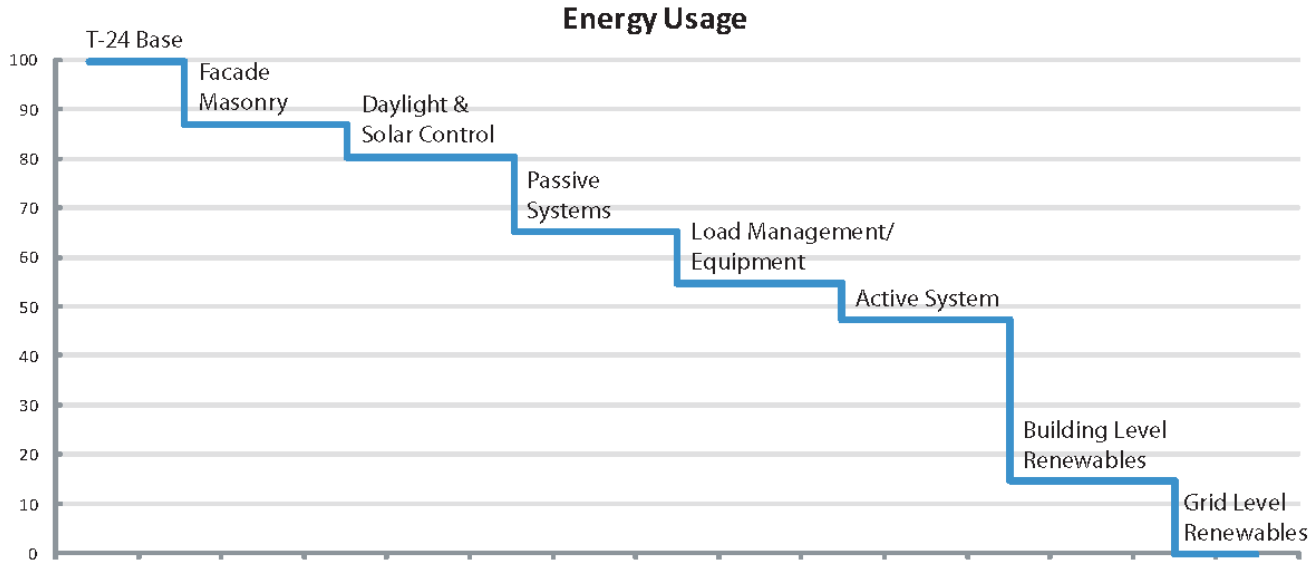
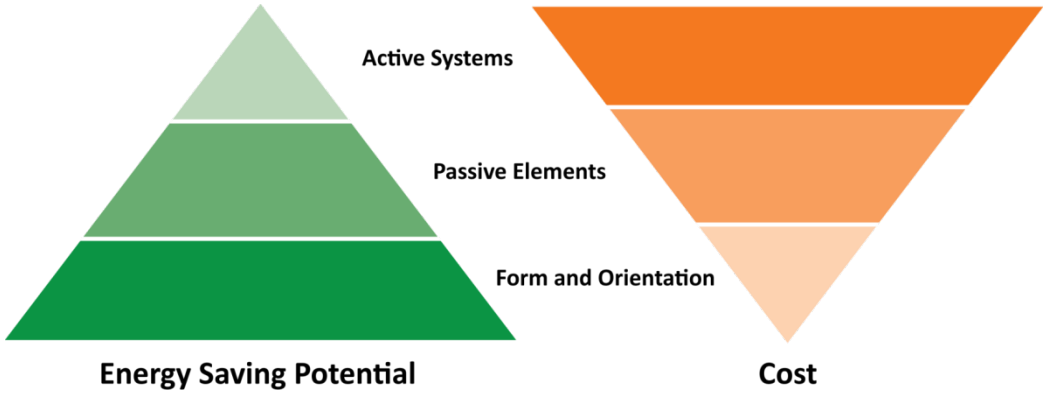
Not all kBTU/SF/YR are created equally

- Gas
- Electricity (converted from kWhr/sf/yr)

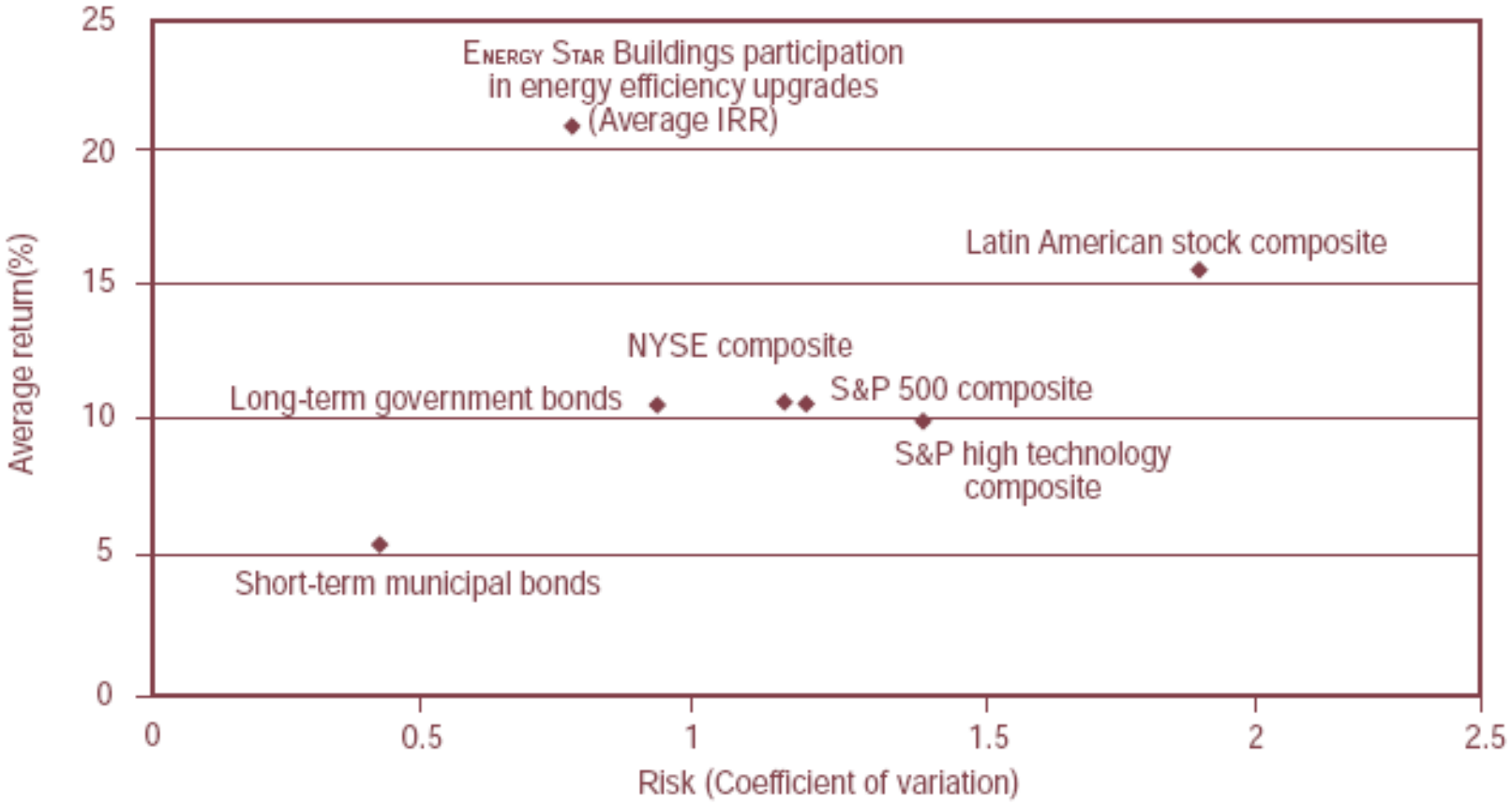
Target Energy Performance Results	
Energy	**Target**
Energy Performance Rating (1-100)	97*
Energy Reduction (%)	60
Source Energy Use Intensity (kBtu/S.F./yr)	117.4
Site Energy Use Intensity (kBtu/S.F./yr)	40.3
Total Annual Source Energy (kBtu)	164,082,033
Total Annual Site Energy (kBtu)	56,362,162.00
Total Annual Energy Cost ($)	$ 1,680,909
Pollution Emissions	
CO2 Emissions (tons/year)	0
CO2 Emissions Reduction (%)	100%

What are the things to examine in an existing building to impact energy use?

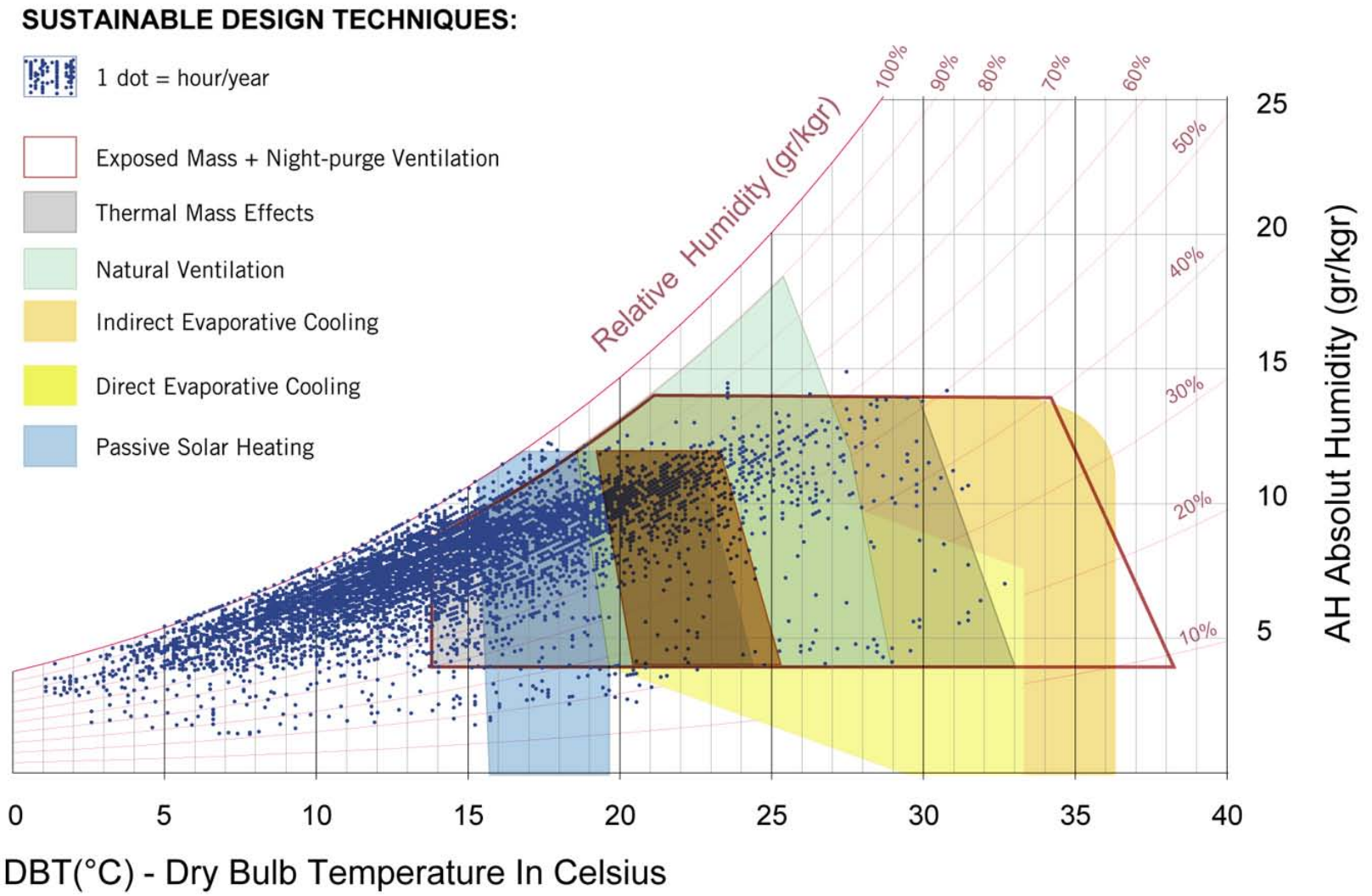




Risk vs. Return



Green Design Approach



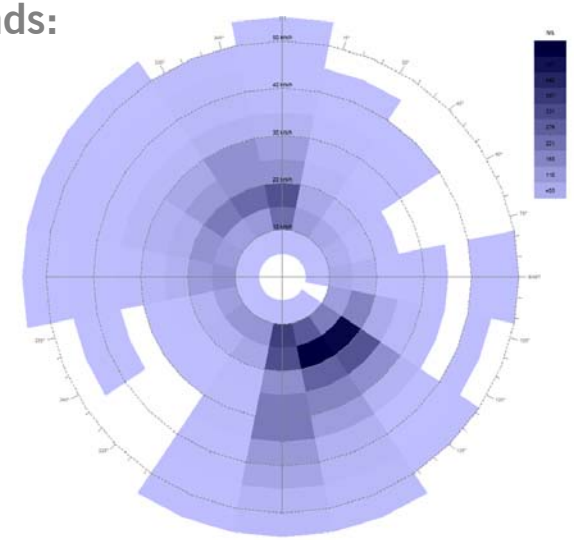
Green Design Approach

Tools for Understanding
Site and Climate Conditions:

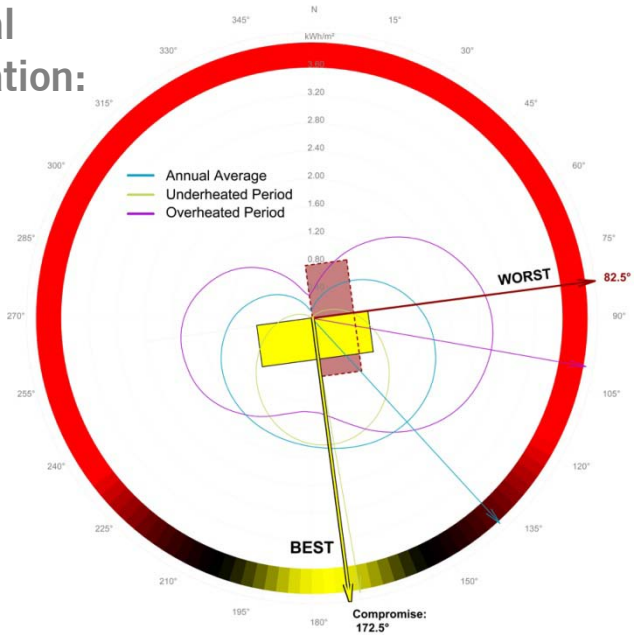
- Temperature
- Winds
- Sun Path

Temperature Averages

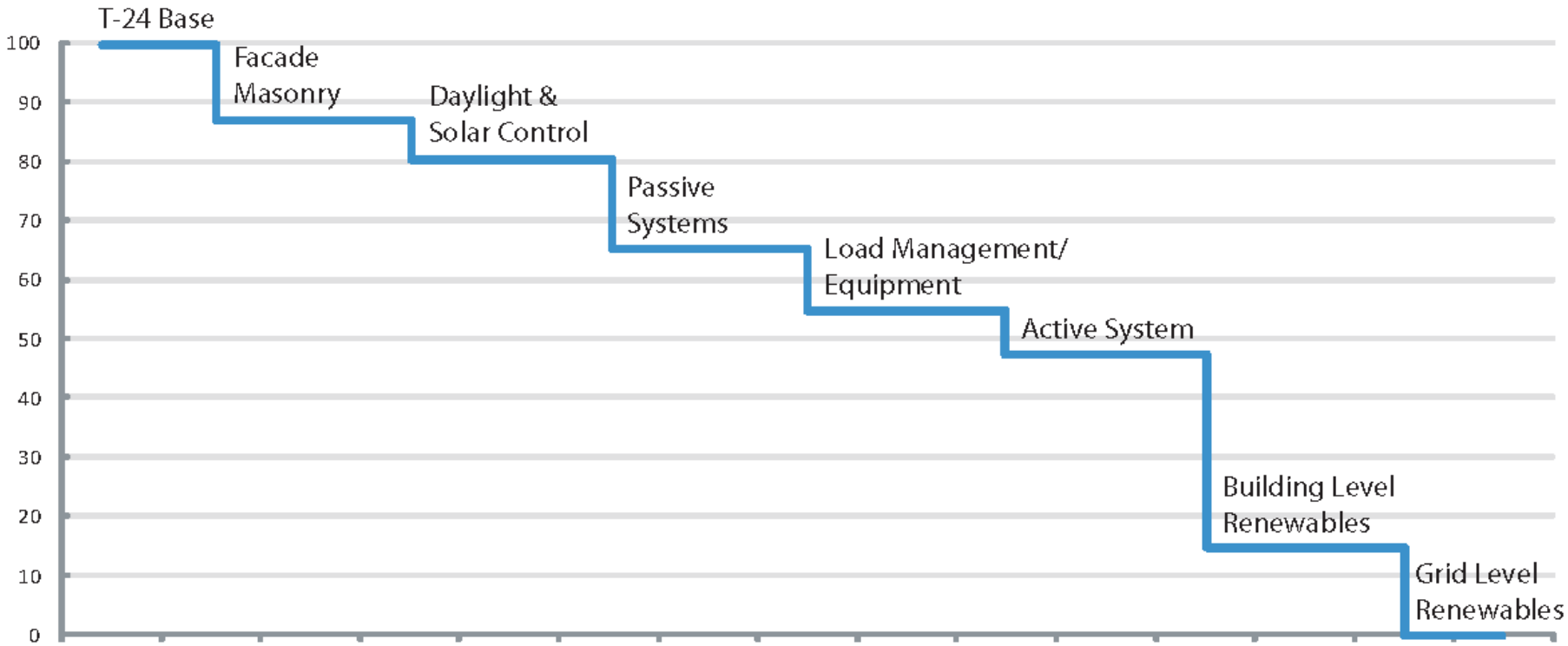
Prevailing Winds:



Optimal Orientation:



Energy Usage



Envelope

Potential Strategies	Description	Benefits
Increase R-value of envelope elements	Additional insulation, Thermal Breaks, Thermally optimized construction details	Reduces peak heating and cooling loads and equipment capacity, Reduces annual heating and cooling energy consumption
High performance glazing	Low-e glass, Thermally broken frames	Reduces summer cooling loads and winter heating loads, Enables effective daylighting without loss of thermal performance
EnergyStar roofing	Install EnergyStar roof or coating	Lowers roof temperature by lowering heat conducted through roof in summer, HVAC inlet air temperatures
Vegitate Outdoor spaces	Enhance outdoor spaces such as balconies, courtyards, patios, etc. with vegitation	Shifts occupants to outside, lowering HVAC system energy usage

Daylighting and Solar Control

Potential Strategies	Description	Benefits
Passive solar design	Design to capture winter sun for space heating while blocking summer sun, Use thermal mass for solar energy collection	Reduces heating and cooling loads
Daylighting	Use light shelves and other daylighting features	Reduces dependence on artificial light, Enables effective lighting control strategies to save lighting (and HVAC) energy, Improves occupant comfort and productivity
Lighting control systems	Install lighting systems to dim or turn off lights based on time or daylight available	Allows for effective harnessing of available daylight and automatic reduction of electric lighting
External shading devices	Overhangs, External screens (fixed or operable), Exterior blinds	Reduces peak solar gain, reduces glare, and improves daylighting performance

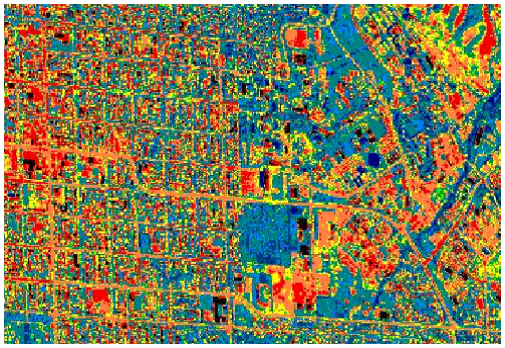
Passive Systems

Potential Strategies	Description	Benefits
Thermal Mass	Implement construction materials with high heat capacities and thermal lag to keep occupants cool during the day, warm during the night	Reduces heating and cooling loads. Takes advantage of temperature swings between day and night, absorbing heat during the day and dissipating it at night
Vegetation and landscaping	Install plantings near buildings and on-site as wind breaks	Improves local air quality, Reduces heating and cooling loads, Can improve natural ventilation functionality
Green roofs	Roofs with vegetation planted on it	Soil adds thermal mass and cooling effect, Vegetation reduces roof surface temperature and HVAC system inlet air temperature, Delays rainwater run-off

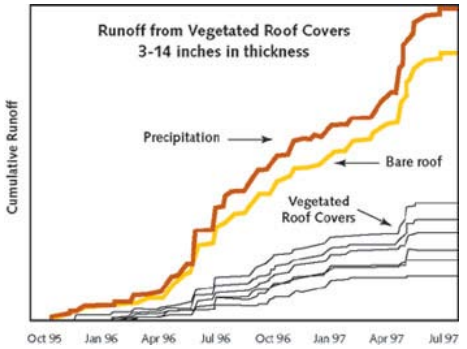
Green Roofs

A continuous layer of vegetation and soil that covers a roof's surface, providing benefits such as:

Reduces summer cooling and winter heating demand



Mitigates urban heat island effect and increases air quality



Reduces peak storm water discharge and acts as natural filter

Extends roof life by 2-3 times

Reduces noise and increases building aesthetic

Creates urban green spaces and ecosystems for wildlife

Load Management/Equipment Efficiency

Potential Strategies	Description	Benefits
High efficacy lighting	Use advanced lighting technology including latest generation fluorescents and LEDs	Lowers lighting energy consumption and consequently HVAC system capacity and energy consumption
Occupancy sensors	Connect occupancy sensors in rooms to lighting and HVAC controls	Allows system to shut-off lighting system and reset HVAC system controls when spaces are un-occupied
Advanced control systems	Use advanced energy management software to manage building and optimize its performance	Can reduce energy consumptions and maintenance calls, Integrates controls of all system components including HVAC, lighting, security, etc. New advances use predictive and adaptive controls to dynamically and automatically optimize its performance
SMART Grid/ Power management systems	Enable the complete shut-off of power equipment in buildings	Eliminates parasitic energy consumption from electrical equipment in standby mode
Energy metering	Meter all energy usage wherever possible	Instills energy responsibility through fiscal impact
Efficient appliances	Use EnergyStar and other efficient appliances and electrical equipment	Reduces electrical energy consumption and peak demand, Reduces HVAC system energy consumption

Active Systems

Potential Strategies	Description	Benefits
Displacement ventilation	Use moderate temperature low velocity air for space cooling	Reduces cooling load, Improves indoor air quality
Dedicated outside air systems	Pre-conditions outside air, used in conjunction with radiant conditioning	Lowers HVAC energy consumption for heating and cooling, reduces duct size and floor-to-floor height required
Low pressure drop systems	Oversize ductwork for air distribution, piping for water flow, Low face velocity equipment	Lowers HVAC fan and pumping energy consumption, reduce fan or pump size motor, lower equipment costs
Energy recovery	Transfers energy between exhaust air and incoming outside air, Recover heat from other processes such as computer equipment	Lowers HVAC heating, cooling, dehumidification and humidification energy consumption
Radiant systems	Use radiant heating and cooling systems with Dedicated Outside Air (DOA) systems	Saves on HVAC energy by using more efficient hydronic systems instead of air systems, Improves occupant thermal comfort
Variable flow systems	Use variable speed drives on fans and pumps	Lowers fan and pump energy consumption throughout year
Ground Source Heat Pumps	Earth's constant temperature used as a heat source during winter, heat sink during summer	Increased energy efficiency, reduced electricity usage, quiet operation, extended lifespan, increased zone control

Renewables

Potential Strategies	Description	Benefits
Solar thermal	Solar energy is transferred to heat water, collectors on building roof	Reduces water heating demand from water heaters and/or central plant, Applicable for both space and domestic water heating
Building-level renewable power	Install building scale wind, solar photovoltaic, or cogeneration systems	Reduces provides on-site power generation to central systems reducing power draw from utility, saves energy costs, especially as fuel prices increase for utilities

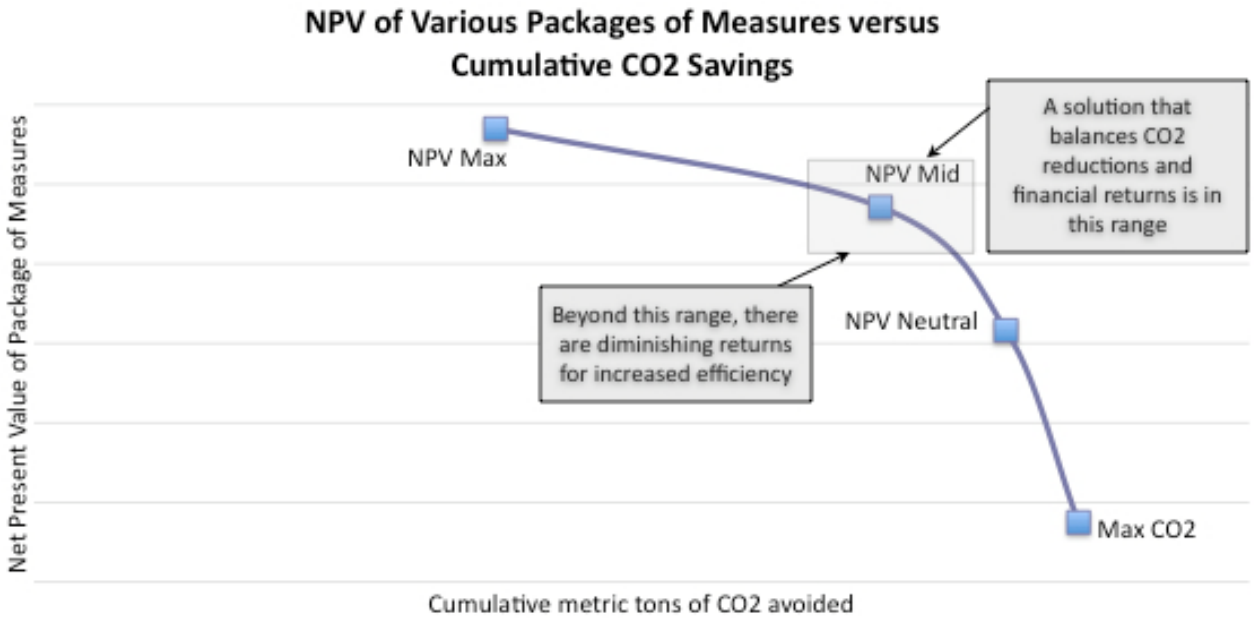
Existing Building Retrofits: Success Stories

- Developing Robust Solutions Requires the Coordination of a Multitude of Key Stakeholders:
  - Owners,
  - Tenants (bulk of energy savings come from “their space”),
  - O&M Staff,
  - Utility companies(Rebates)

- Maximizing Energy Savings Profitably Requires Planning and Coordination
  - Leveraging planned end of life replacement is an important consideration.
  - Large volume of existing commercial buildings suggests that there is a tremendous opportunity to reduce carbon emissions from existing buildings through energy efficiency; however, capturing these reductions in a profitable manner demands careful planning and coordination to ensure that energy efficiency retrofits align with building replacement cycles.
  - If end of life replacement is beyond 5 to 7 years look at retro-commissioning first which has show 5-15% savings

Findings from Empire State Building retrofit:

Max CO2 avoidance comes at a Negative NPV



Source RMI

Costs of Reducing Energy Use

Davis Langdon *The Cost of Green*

Initially 2004, Updated 2006

> "The 2006 study shows essentially the same results as 2004: there is no significant difference in average costs for green buildings as compared to non-green buildings. […] We have also found that, in many areas of the country, the contracting community has embraced sustainable design, and no longer sees sustainable design requirements as additional burdens to be priced in their bids. […]Most notably, few projects attempt to reach higher levels of energy reduction beyond what is required by local ordinances, or beyond what can be achieved with a minimum of cost impact."

Business Opportunity Reducing Energy Consumption

2009 American Council for an Energy-Efficient Economy (ACEEE) Study

- Save Business & Consumers $168.6 Billion by 2020
- Federal Energy Efficiency Resources Standards (EERS)
- Create 222,000 net permanent jobs
- Prevent 262 metric tons GHG emissions
- Avoid building 390 new power plants

Business Opportunity Reducing Energy Consumption

2006 CoStar Group Study

Occupancy Rates

- 87.9% - non-rated
- 91.5% - EnergyStar rated
- 92% - LEED rated

Direct Rental Rates

- $28.15 / SF – non-rated
- $30.55 / SF – EnergyStar rated
- $42.38 / SF – LEED rated

Sale Prices

- $227 / SF – non-rated
- $288 / SF – EnergyStar rated
- $438 / SF – LEED rated

To Learn More :

AB 32 – Scoping Plan
http://www.arb.ca.gov/cc/scopingplan/scopingplan.htm

AB 1103 – Benchmarking
http://www.climatechange.ca.gov/publications/legislation/ab_1103_bill_20071012_chaptered.pdf

EPA EnergyStar CBECS
http://www.eia.doe.gov/emeu/cbecs/

EPA EnergyStar Buildings
http://www.energystar.gov/index.cfm?c=business.bus_index

Davis Langdon *The Cost of Green Revisted*
http://www.davislangdon.com/USA/Research/ResearchFinder/2007-The-Cost-of-Green-Revisited/

CoStar Group Study
http://www.costar.com/uploadedFiles/Partners/CoStar-Green-Study.pdf

USGBC LEED
http://www.usgbc.org/

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