



# MOVING from A to Z(ero) NET

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# **ZERO NET ENERGY**

**Zero Net Energy (ZNE) buildings have a net energy consumption of zero over a typical year.**

# WHAT IS **ZERO NET** ENERGY?

## **ZERO NET ENERGY (ZNE)**

*Building  
Energy  
Use*

*Distributed Renewable  
Energy Generation*



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**Btu**

**REDUCE**



**kWh**



**PRODUCE**



**Btu**

**REDUCE**



**kWh**



**Btu**

**REDUCE**



**kWh**

**PRODUCE**



# STRATEGIC PLAN for ZNE BUILDING



## GOALS FOR COMMERCIAL BUILDINGS:

- 100% New Commercial Buildings are ZNE by 2030
- 50% of Existing Buildings are ZNE by 2030

## ED FACILITIES REPRESENT A LARGE % OF COMMERCIAL BLDGS:

- 1050 K-12 School Districts = 10,000 Campuses
- 72 Community College Districts = 112 Campuses

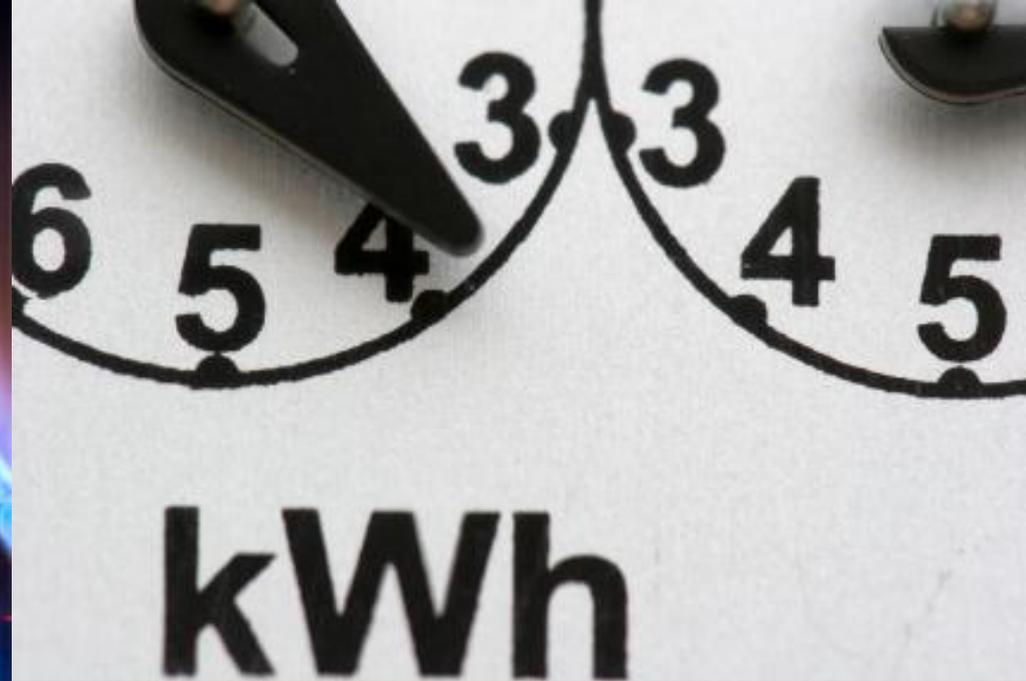


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**Btu**

**REDUCE**



- Natural Day-Lighting
- High-Efficiency Lighting
- High Performance Envelopes with Increased Insulation
- Well Insulated Glazing

**ENERGY EFFICIENT SYSTEMS: REDUCE ENERGY**

- Ground Source Heat Pump
- Solar Thermal

# RENEWABLES: PRODUCE ELECTRICITY

- Photovoltaics (DSA Interpretation of Regs: IR 16-8)
- Wind (DSA Interpretation of Regs: IR A-29)
- Micro-Hydro



# ALTERNATIVE METHODS

- Biomass (Conversion of Methane)
- Biogas (Cow Power)
- BioDigester (Conversion of Garbage)
- Fuel Cells (Water Vapor By-Product)
- Co-Generation Systems (Heat By-Product)



# ZERO NET ENERGY

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# ZNE DEFINITIONS

<b>ZNE Definition</b>	<b>Includes</b>	<b>Description</b>
<b>Site Energy</b>	<b>Electricity + Natural Gas</b>	<b>Energy provided by on-site renewable energy sources is equal to the amount of energy used by the building.</b>
<b>Source Energy</b>	<b>Electricity + Natural Gas</b>	<b>Energy provided by on-site renewables equal to the energy used by the building including the fuel &amp; energy used to generate the energy &amp; transport on grid.</b>
<b>Societal Energy</b> <i>Societal is the Time Dependent Value (TDV)</i>	<b>Electricity + Natural Gas</b>	<b>Energy consumed by the building over the course of a typical year is less than or equal to the societal value of the renewable energy generated on-site.</b>
<b>Grid Neutral</b>	<b>Electric Only</b>	<b>A site that produces as much electricity as it uses in a year.</b>



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## **GRID NEUTRAL:**

A site that produces  
as much electricity  
as it uses in a year.



# DSA GRID NEUTRAL GUIDEBOOK:

1. COMPREHENSIVE PLANNING
2. ENERGY MEASUREMENT
3. ENERGY EFFICIENT DESIGN
4. ENERGY GENERATING TECHNOLOGIES
5. MAINTENANCE & OPERATIONS
6. INNOVATIVE FUNDING

Find the guidebook online at:

[www.dsa.dgs.ca.gov/OtherProg/gridneutral.htm](http://www.dsa.dgs.ca.gov/OtherProg/gridneutral.htm)



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# COMPREHENSIVE PLANNING

- **ASSEMBLING THE TEAM**
  - Sponsors, Beneficiaries, Implementers and Other Plan Review Agencies
  - Use the Integrated Project Delivery (IPD) Method
- **DEVELOP ELECTRICAL POWER MASTER PLAN**
- **DEVELOP DISTRICT WIDE PROGRAM**



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# ENERGY MEASUREMENT

## BENCHMARKING

- Energy Star Portfolio Manager

## UTILITY BILL ANALYSIS

- Utility Companies |

## MONITORING, MAN REPORTING

- Energy Management

## PROGRAM PERSIS



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# ENERGY EFFICIENT DESIGN: TOP 5

## 1. PROGRAM & PLANNING

- Integrated Design Approach

## 2. SITE

- Building Orientation, Shade buildings

## 3. BUILDING

- Building Envelop, Day-Lighting, Cool Roofs

## 4. FURNISHINGS, FIXTURES, & EQUIPMENT

- Electrical & Plug Loads, Lighting Retrofits

## 5. SYSTEMS

- Automatic Controls, Commissioning



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# ENERGY GENERATING TECHNOLOGIES

## PRODUCTION

- **Photovoltaic**
- **Wind**

## ENERGY EFFICIENCY

- **Solar Thermal: Heating Water**
  - Meets 50 - 75% of Water Heating Needs
- **Geexchange Systems: Heating & Cooling**
  - Reduces Energy Costs by 20 - 60%
  - Reduces Maintenance Costs by 20 - 50%
  - Less Space Required for Equipment



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# MAINTENANCE & OPERATIONS

## FACILITY EVALUATION

- Site, Building & Equipment

## ENERGY EVALUATION

- How much and where is energy being used?
- Retrofitting Opportunities
- Commissioning & Recommissioning

## INVESTMENT GRADE ENERGY AUDITS

## TRAINING

- Students, Staff, Teachers & Facility Managers



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**Free Money | Borrow-to-Buy | Self Funding Options**

**INNOVATIVE FUNDING**

# **FOUR STEPS** to **GRID** NEUTRAL:

<b>1</b>	<b>NEW SCHOOL: Set Energy Performance Goal</b> <b>EXISTING SCHOOL: Measure Current Use, Set Goal</b>
<b>2</b>	<b>Implement &amp; Maintain Appropriate Energy Efficiency &amp; Conservation Measures to Lower Electricity Use</b>
<b>3</b>	<b>Install Solar or Wind Systems to Create Electricity to Meet Remaining Needs</b>
<b>4</b>	<b>Maintain Energy Systems</b> <b>Monitor Electricity Consumption &amp; Production</b>



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$$\text{GRID NEUTRAL RATIO} = \frac{\text{PRODUCTION}}{\text{CONSUMPTION}}$$

## GRID NEUTRAL IN THE 2010 CAL Green CODE: VOLUNTARY MEASURE

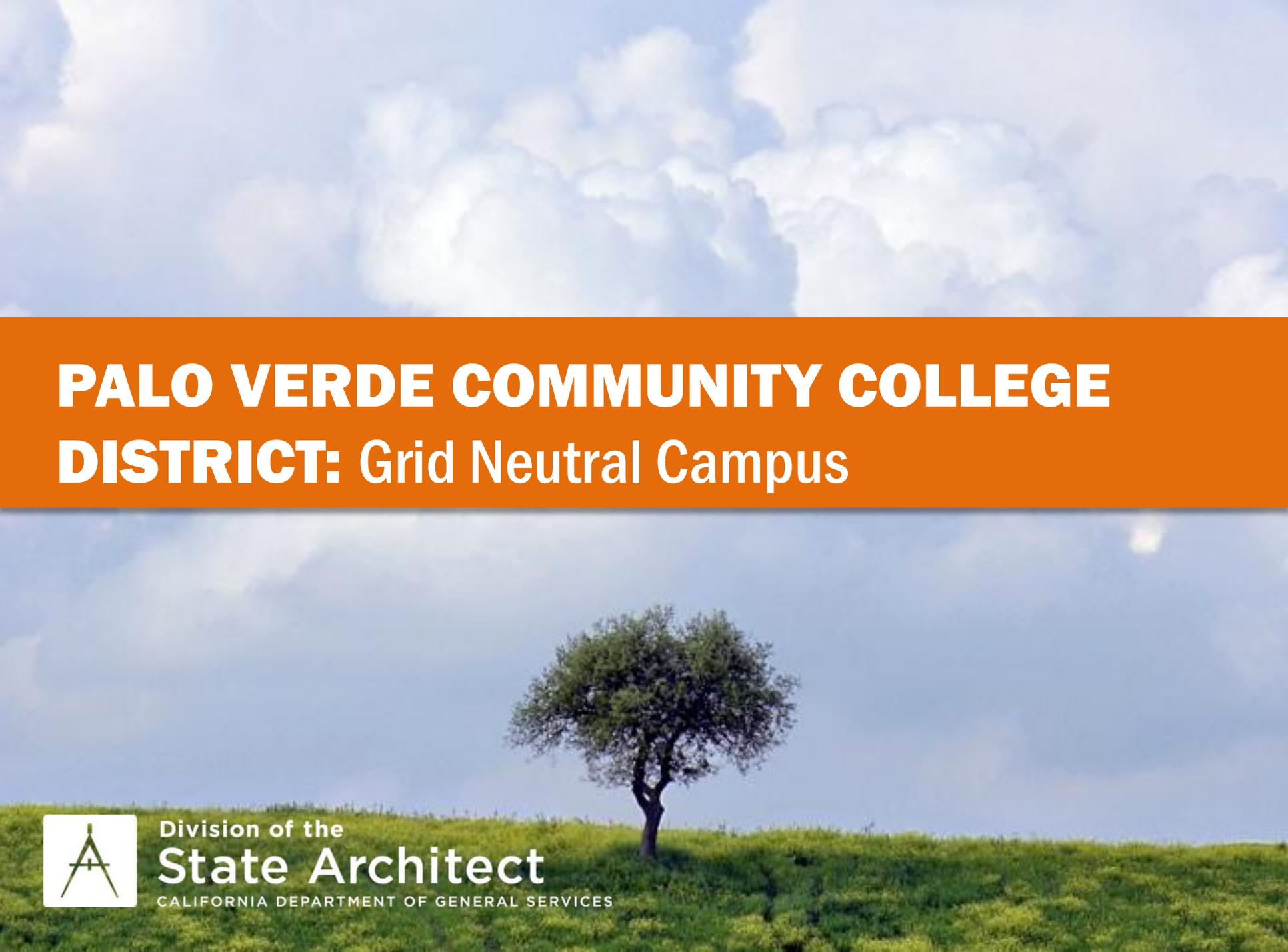
- **NEW BUILDINGS:** Use proposed annual electrical energy budget (kwh) per California Energy Code adding estimated energy consumption of plug loads.
- **EXISTING BUILDINGS:** Need to have data for a year while producing on-site electricity.



**THE MORE CONSUMPTION GOES DOWN WITH  
ENERGY CONSERVATION, THE LESS ELECTRICITY  
NEEDS TO BE PRODUCED TO ATTAIN GRID NEUTRAL.**



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A landscape photograph showing a green field with a single tree in the center, set against a blue sky with white clouds. The image is split horizontally by an orange banner.

# **PALO VERDE COMMUNITY COLLEGE DISTRICT: Grid Neutral Campus**



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- Blythe, California
- August 2009
- No Capital Outlay



# **GRID NEUTRAL CAMPUS: Palo Verde Community College**

- **Objective: Grid Neutral;  
Lower Energy Costs**
- **Installation: Ground  
Mounted System  
Shade Structure Mounted**
- **1.2 Mega Watt**



**Recent Energy Conservation Measures are  
Contributing to Grid Positive Results**



# **YUBA CITY UNIFIED SCHOOL DISTRICT: Star Campus**



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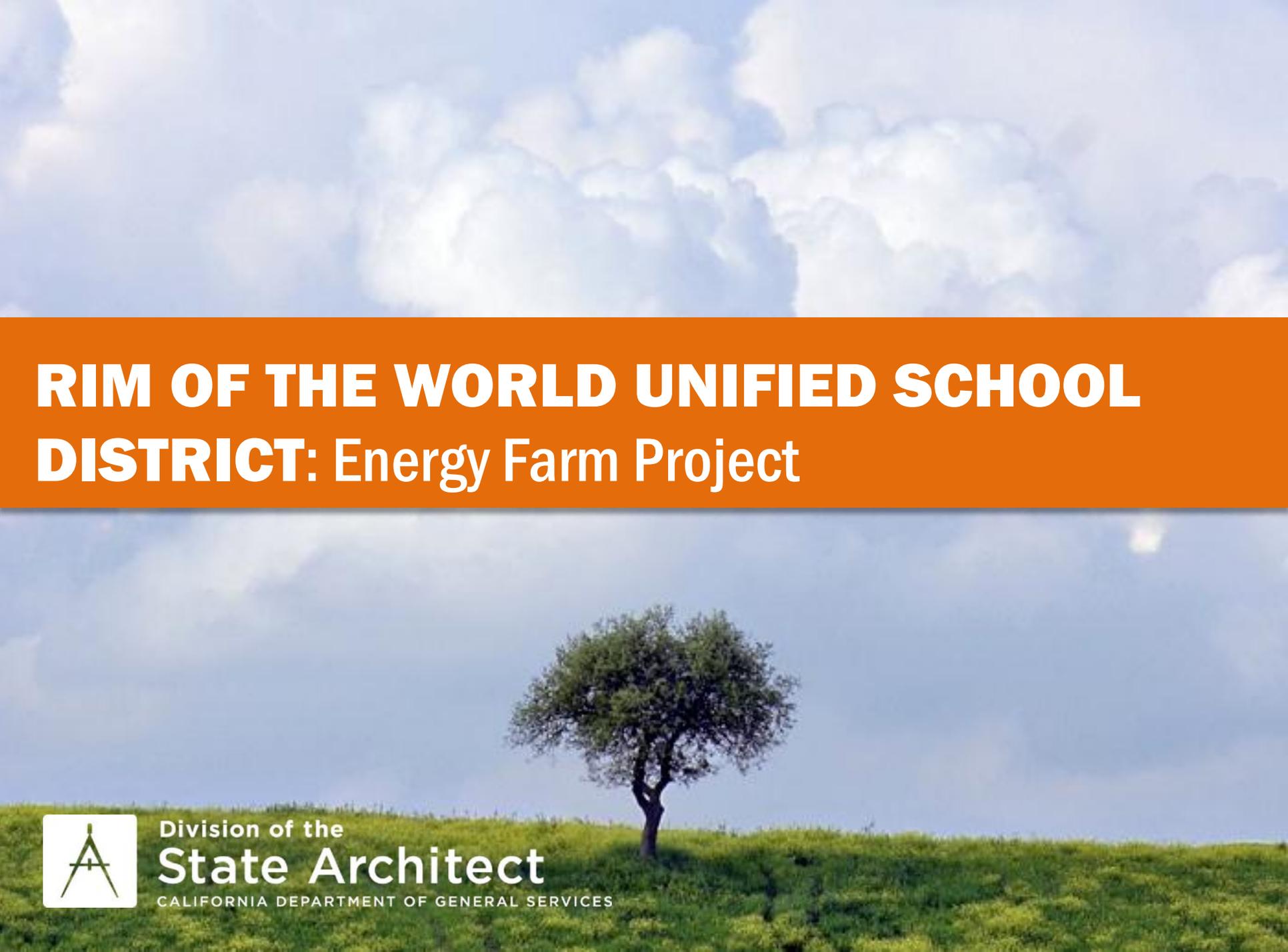
# **YUBA CITY USD: Riverbend Elementary School**

- 2010 Grid Neutral Award for Distinguished Campus
- 93 Energy Star Rating

- Objective: Model School Campus
- Installation: New Construction Roof Mounted PVs
- Currently 40% Grid Neutral



**YUBA CITY USD**

A landscape photograph showing a green field with a single tree in the center, under a blue sky with white clouds. The image is split horizontally by an orange banner.

# **RIM OF THE WORLD UNIFIED SCHOOL DISTRICT: Energy Farm Project**



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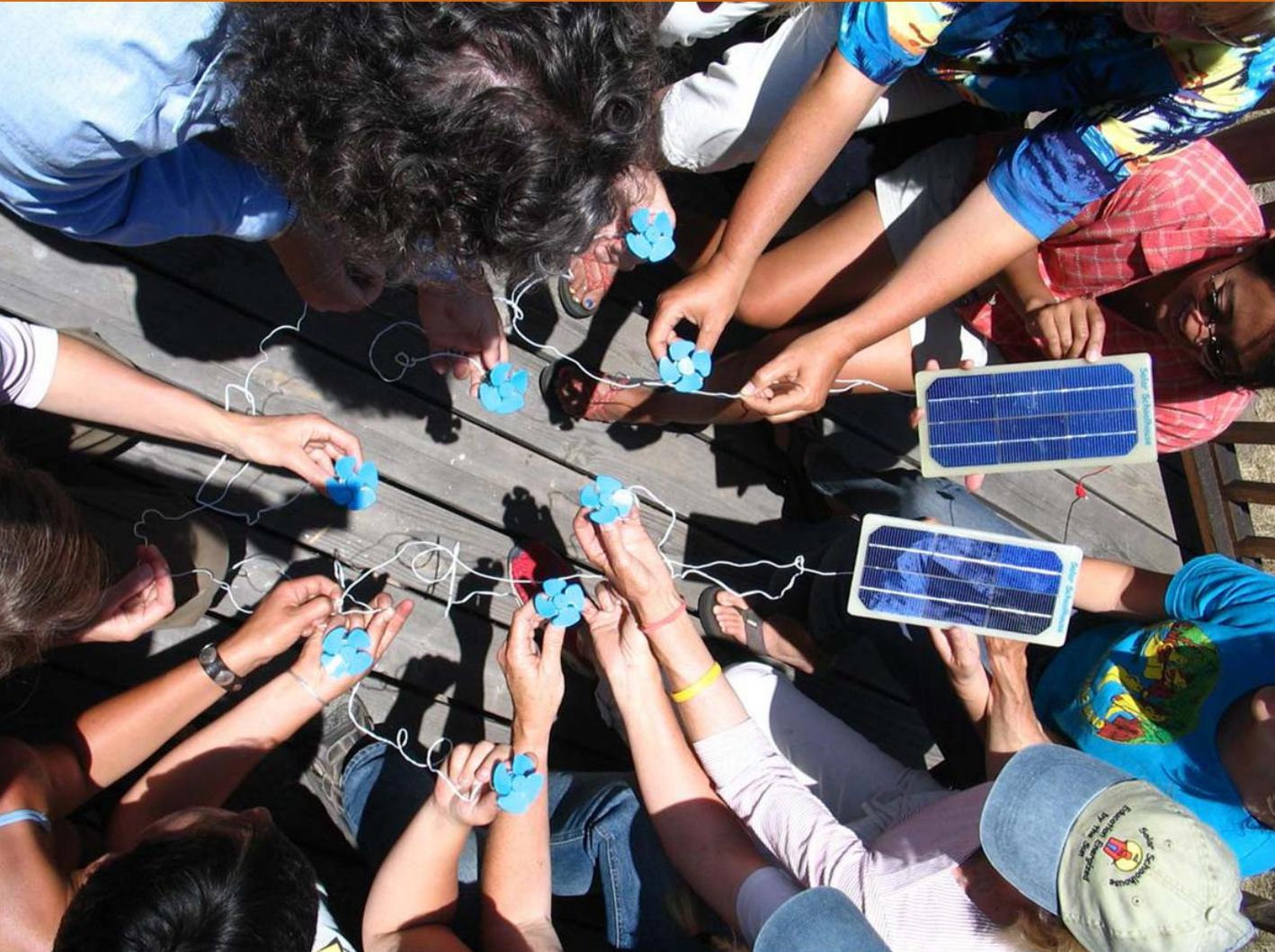
# **SOLAR & WIND: Rim of the World High School**



- **Objective: Energy Curriculum Science Courses**
- **Installation: 4 Wind Turbines - 100 Watts**
- **8 PV panels ground mounted – 220 Watts**
- **Fully Fenced, Accessible Teaching Station**
- **Averages 500 Kwh per month**

Photo Courtesy of  
Urban Green Energy

# SCIENCE CURRICULUM: Teaching Energy Concepts



- Measuring Energy Output & Wind Speed
- Career Paths to Green Energy Industry

# **BISHOP UNIFIED SCHOOL DISTRICT:** Energy Conservation & Solar



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# **SMALL SCHOOL DISTRICT:**

## **Two Elementary Schools**

- **Objective: Generate Savings to Maintain Programs**
- **Installation: Roof Mounted**
- **300 Kilowatts for 2 campuses**

# ENERGY EFFICIENCY PROGRAM: Creating Green Champions Out of Students & Staff

- Annual Energy Campaign Slogans

*“Let’s Not Be Power Hungry”*

*“We’ve Gone Green, So Let’s Get Lean & Mean”*

- Manual Thermostats Shut Down by Custodial Staff
- Custodial Staff Reporting on Energy Issues
- **RESULTS: 17% Drop in Utility Bills in a Year!**



# **BUTTE-GLEN COMMUNITY COLLEGE**

## **DISTRICT : Grid Positive Campus**



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# **BUTTE COMMUNITY COLLEGE**

**• 2009 National Campus Sustainability Leadership Award**



# **GRID POSITIVE** by 2012

- **Objective: Grid Positive by 2012;  
Carbon Neutral by 2015**
- **Installation: Ground & Roof Mounted  
on Walkway Structures**
- **6.5 Megawatts**

# ZNE ACTIVITIES

## RESEARCH BY THE INVESTOR OWNED UTILITIES:

- ZNE Technical Potential Study
- Road to ZNE Study

## ZNE DEMONSTRATION BUILDINGS:

- **SDG & E:** ZNE Projects, SCE Sustainable Communities
- **PG & E:** ZNE Pilot Program
- DGS State Buildings per Executive Order B-18-12
- Five ZNE Buildings in CA; 18 in Nation



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**THE MORE CONSUMPTION GOES DOWN WITH  
ENERGY CONSERVATION, THE LESS ELECTRICITY  
NEEDS TO BE PRODUCED TO ATTAIN GRID NEUTRAL**

... and **Zero NET ENERGY.**

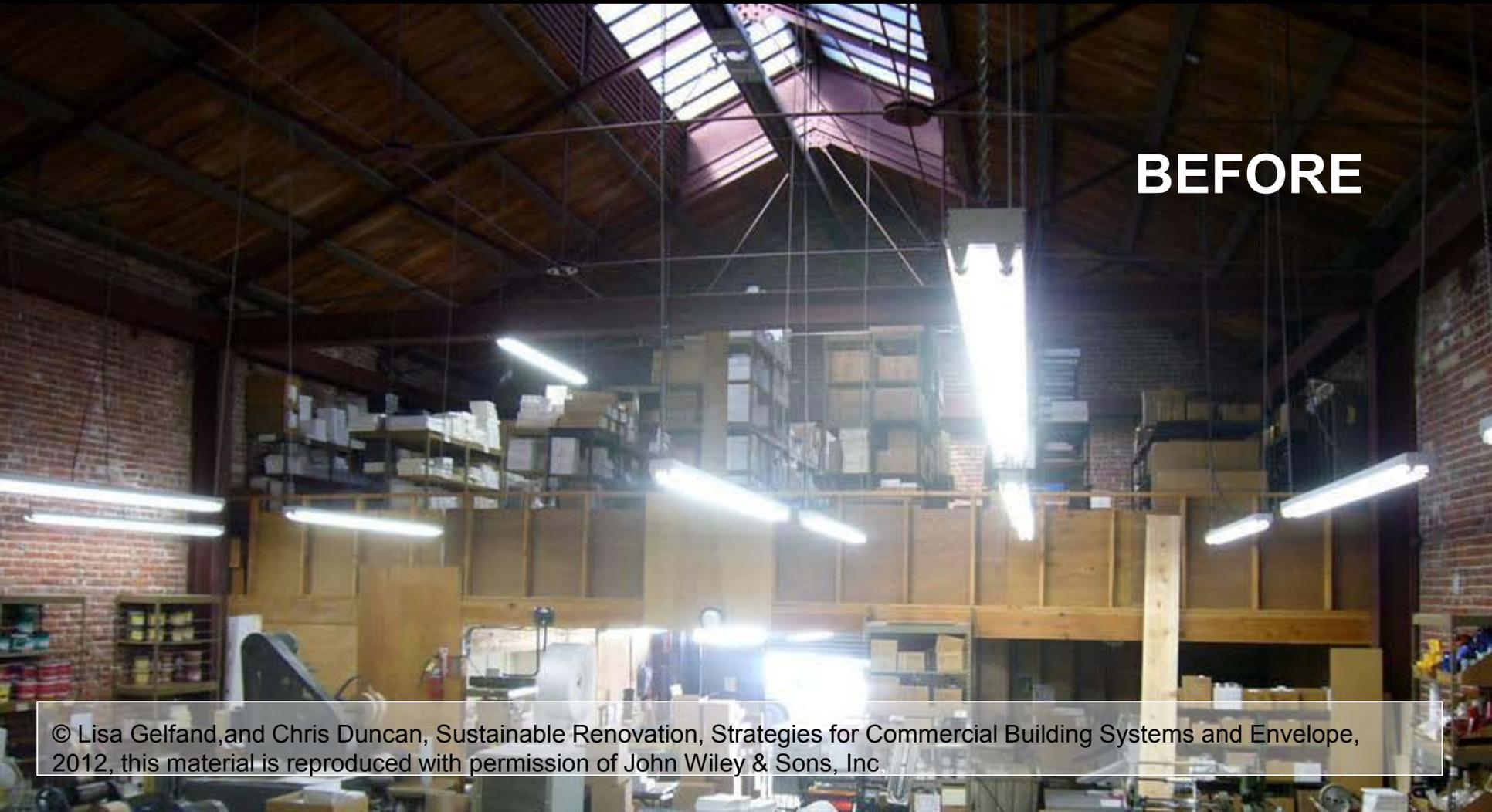


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# SUSTAINABLE MODERNIZATION

Strategies for Building Systems and Envelope

Lisa Gelfand – Gelfand Partners Architects



**BEFORE**

© Lisa Gelfand, and Chris Duncan, Sustainable Renovation, Strategies for Commercial Building Systems and Envelope, 2012, this material is reproduced with permission of John Wiley & Sons, Inc.

# SUSTAINABLE MODERNIZATION

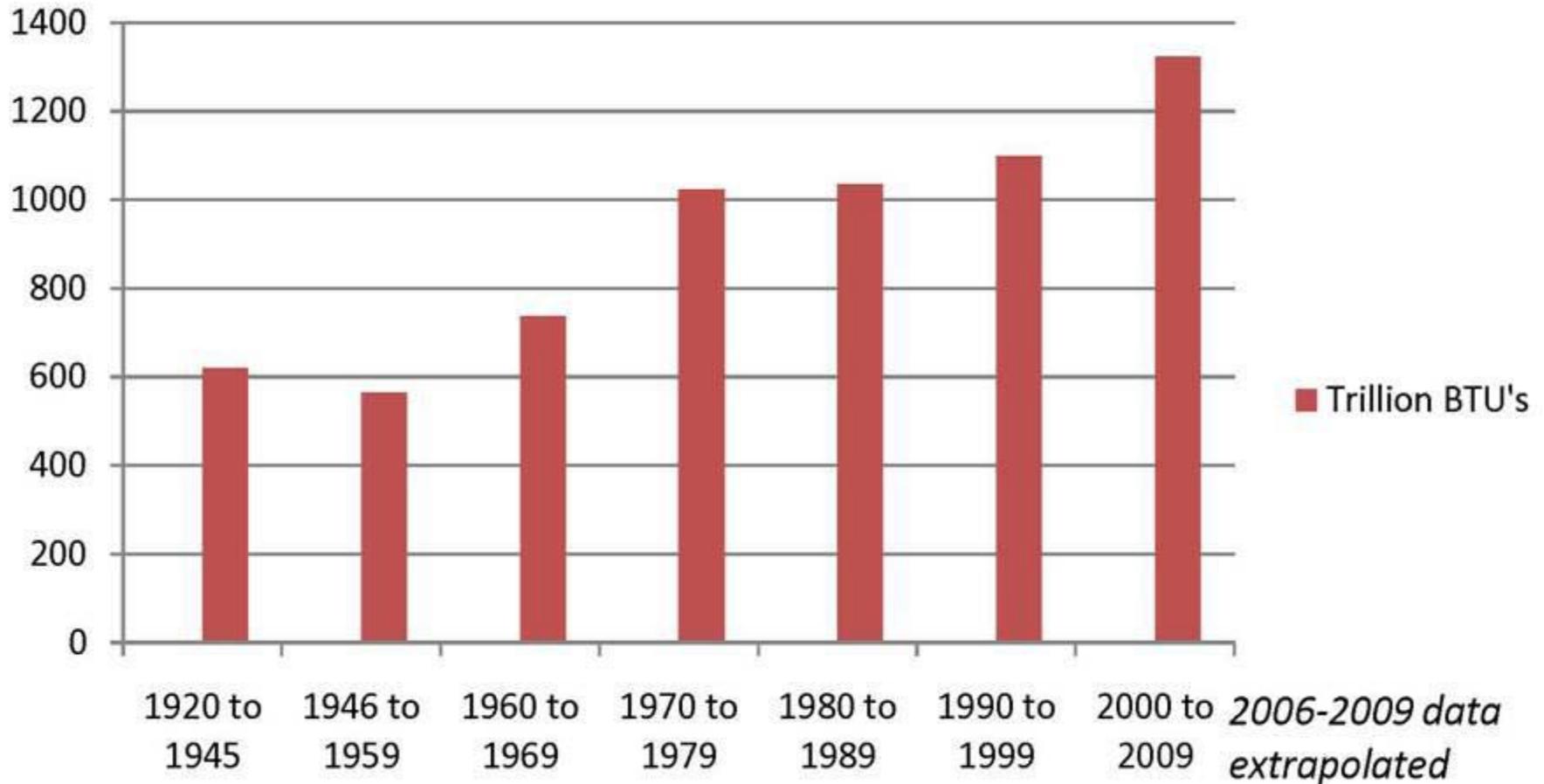
Strategies for Building Systems and Envelope

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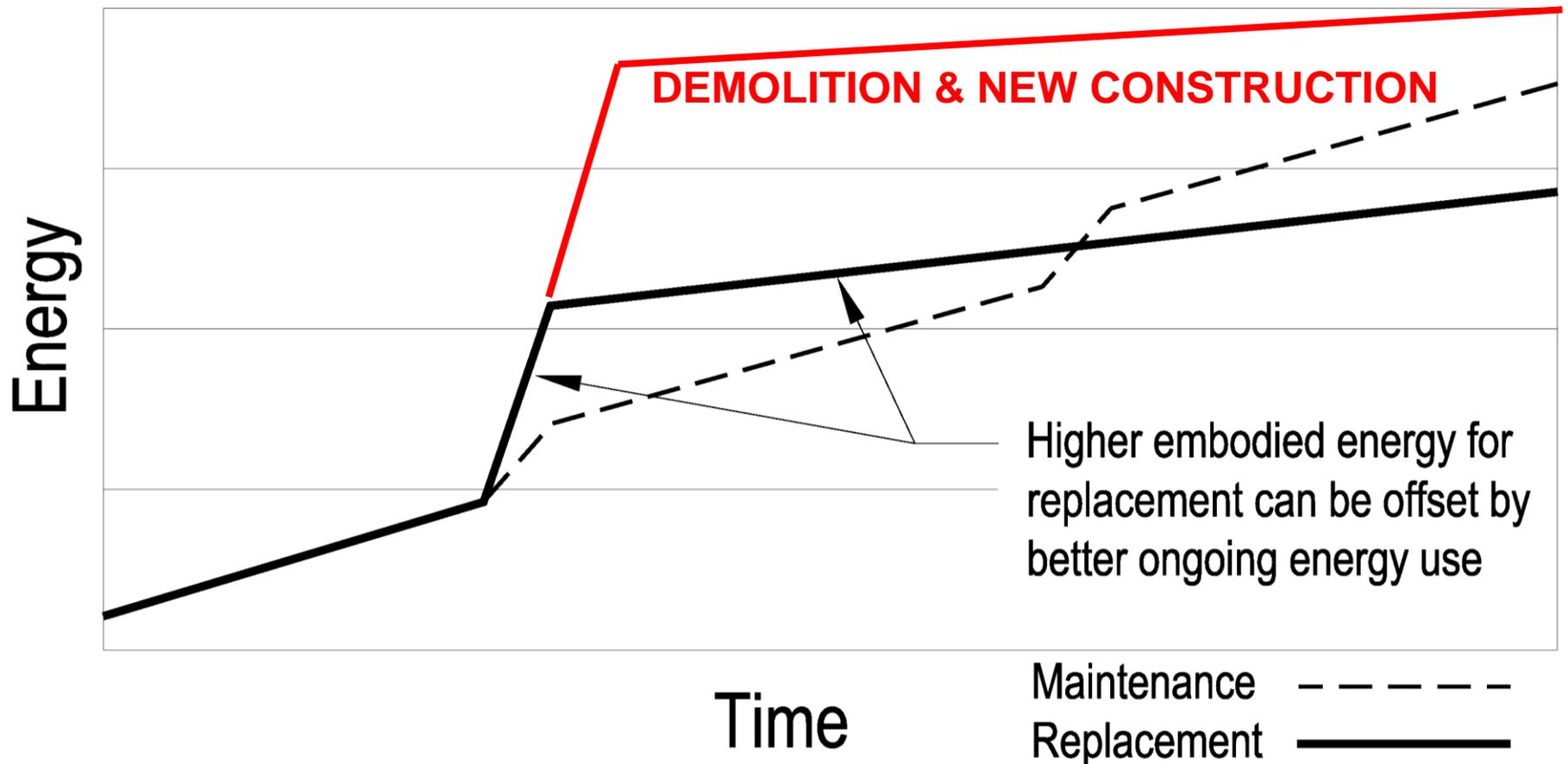
# ENERGY USE BY ERA

More recent buildings use more energy than older buildings.

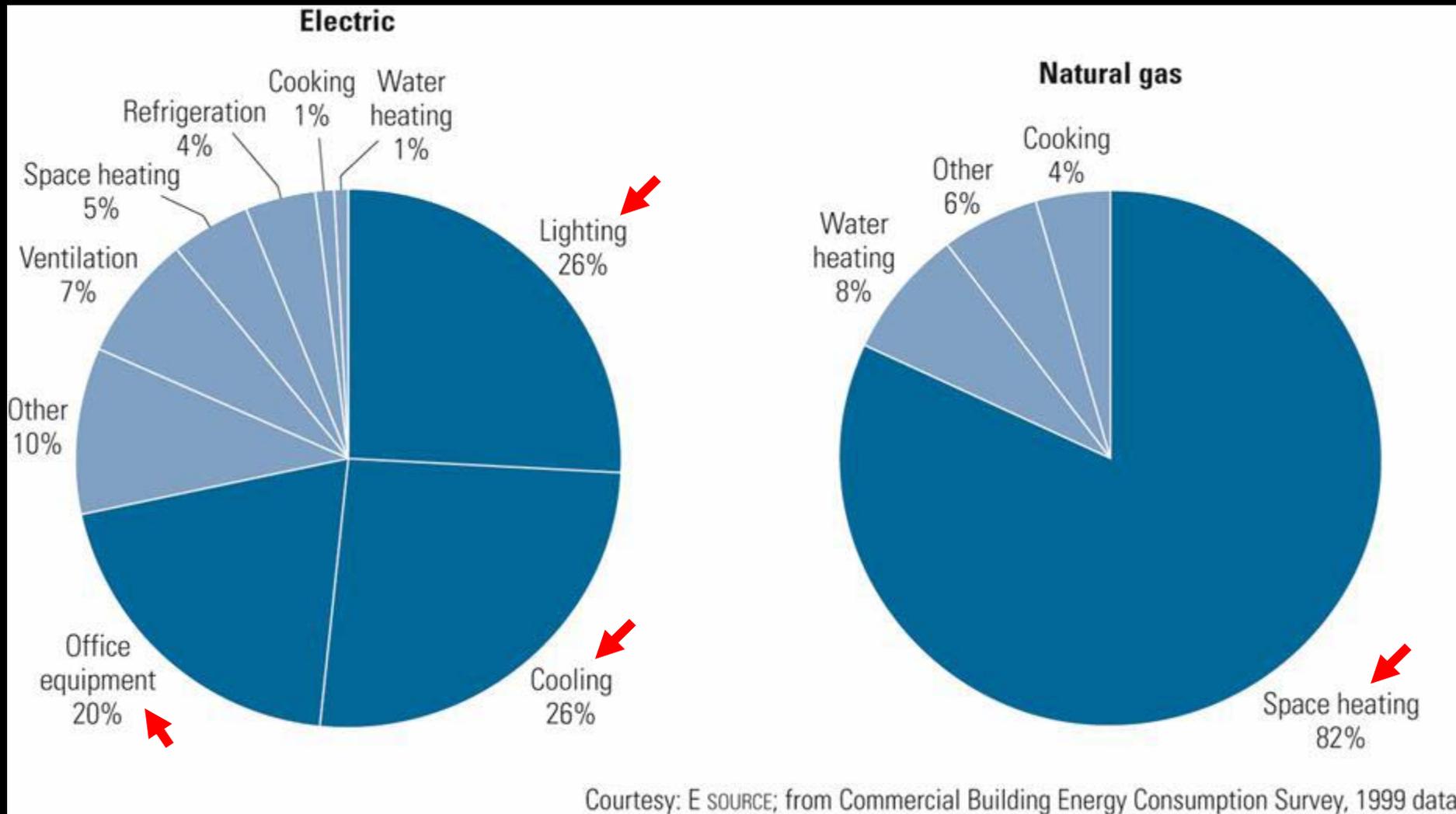


# EMBODIED ENERGY

## Maintenance vs Replacement

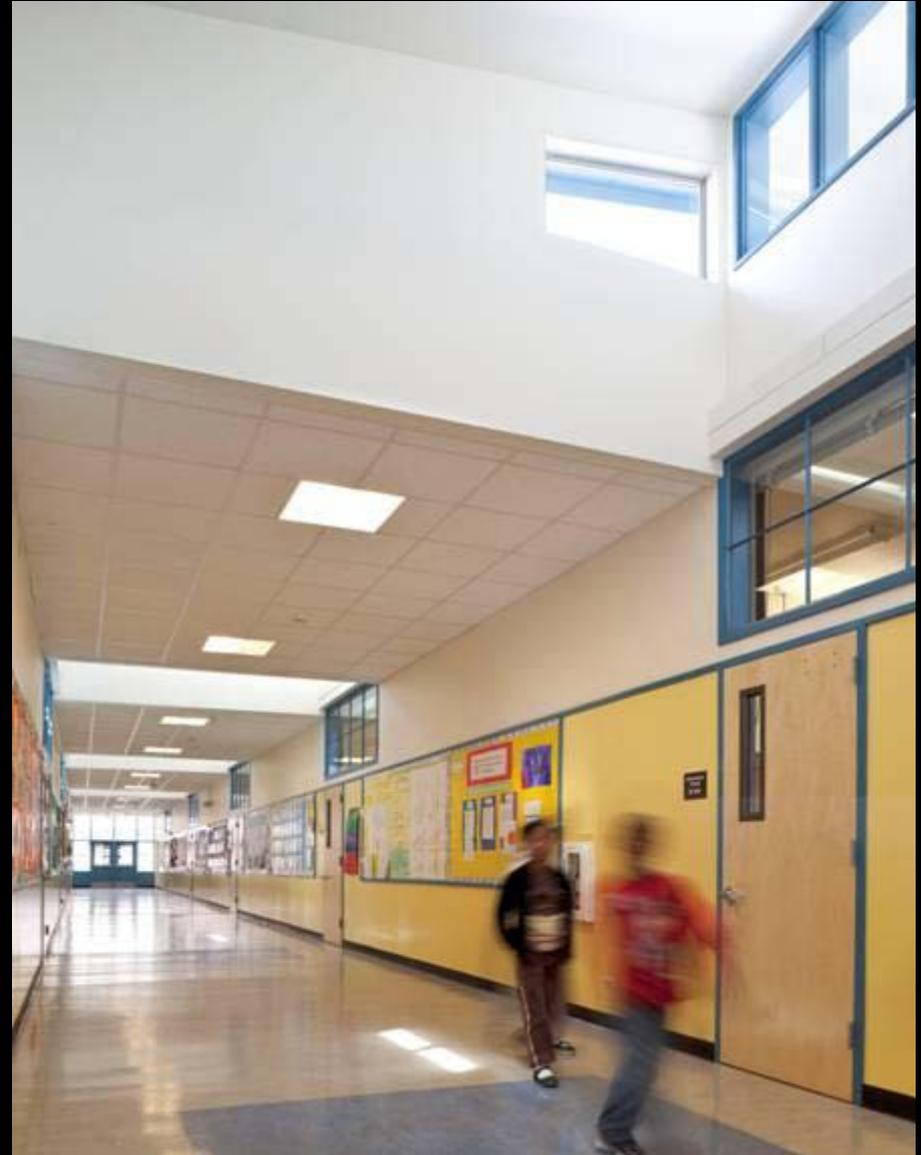


# ENERGY USE



# STRATEGIES

- Immediate Benefits
- Phased Benefits
- Transformation



# IMMEDIATE BENEFITS

## Low & No Cost Improvements

- Behavior Modification
- Retro-commissioning
- Weatherization
- Lighting Upgrades (lamps)
- Water Heating Upgrade (insulation, controls)
- Other Equipment Upgrades



# IMMEDIATE BENEFITS

## Low & No Cost Improvements

- Behavior Modification 4.3%
- Retro-commissioning 3.7%
- Weatherization 3.2%
- Lighting Upgrades 8.8%
- Water Heating 2.9%
- Other Equipment 3.6%

**27% TOTAL**



# BEHAVIOR MODIFICATIONS



# WEATHERIZATION



- Seal Around Windows & Doors
- Add Insulation
- Blower Door Test

# LIGHTING UPGRADES

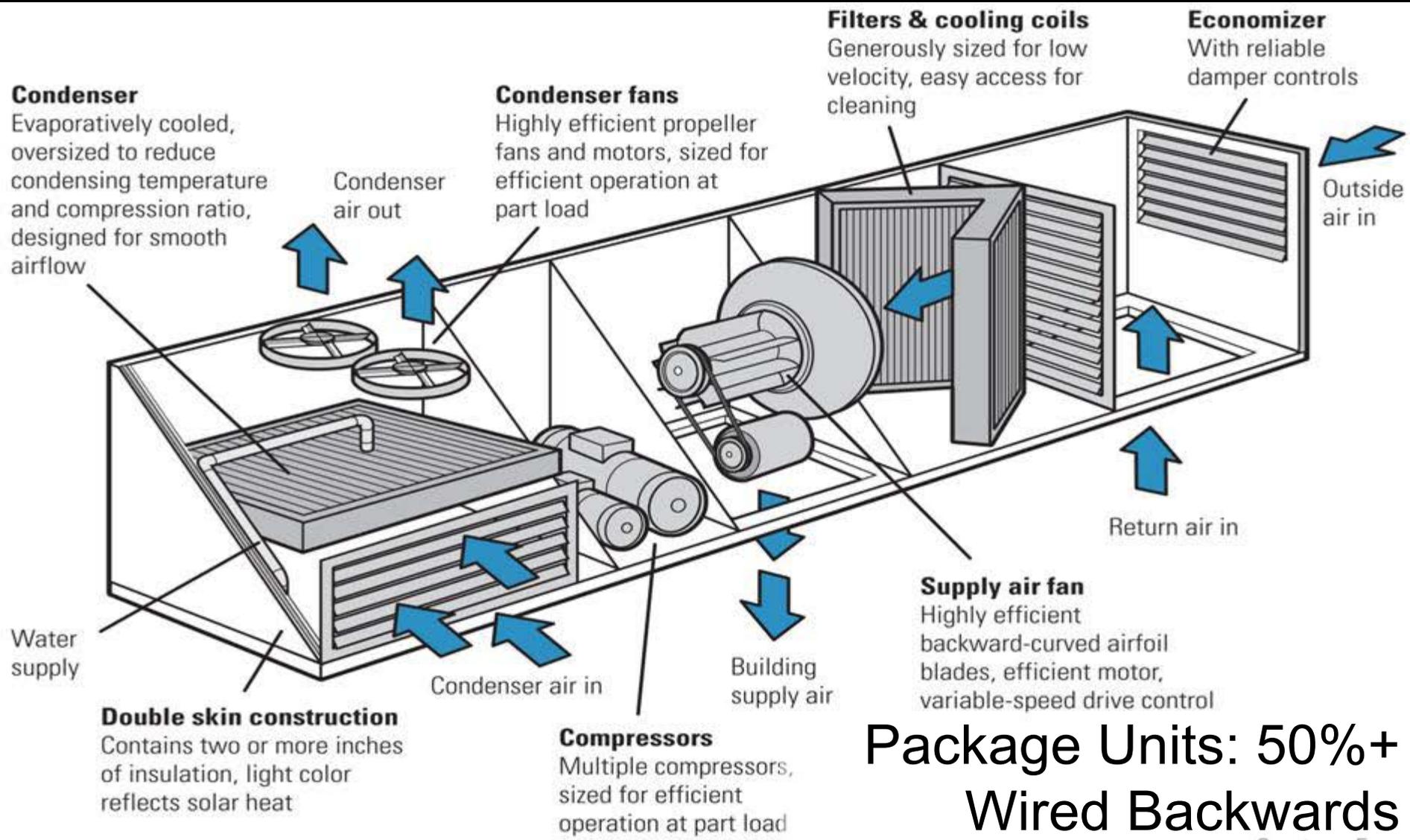


Relamping & Ballasts  
Fixture Replacement

# WATER HEATING UPGRADES



# OTHER EQUIPMENT UPGRADES



Package Units: 50%+  
Wired Backwards

# PHASED IMPROVEMENTS

## Moderate Cost Improvements

- Upgrade Envelope
- Upgrade Equipment
- Reduce Plug Loads
- Utilize Direct Solar



# PHASED IMPROVEMENTS

## Moderate Cost Improvements

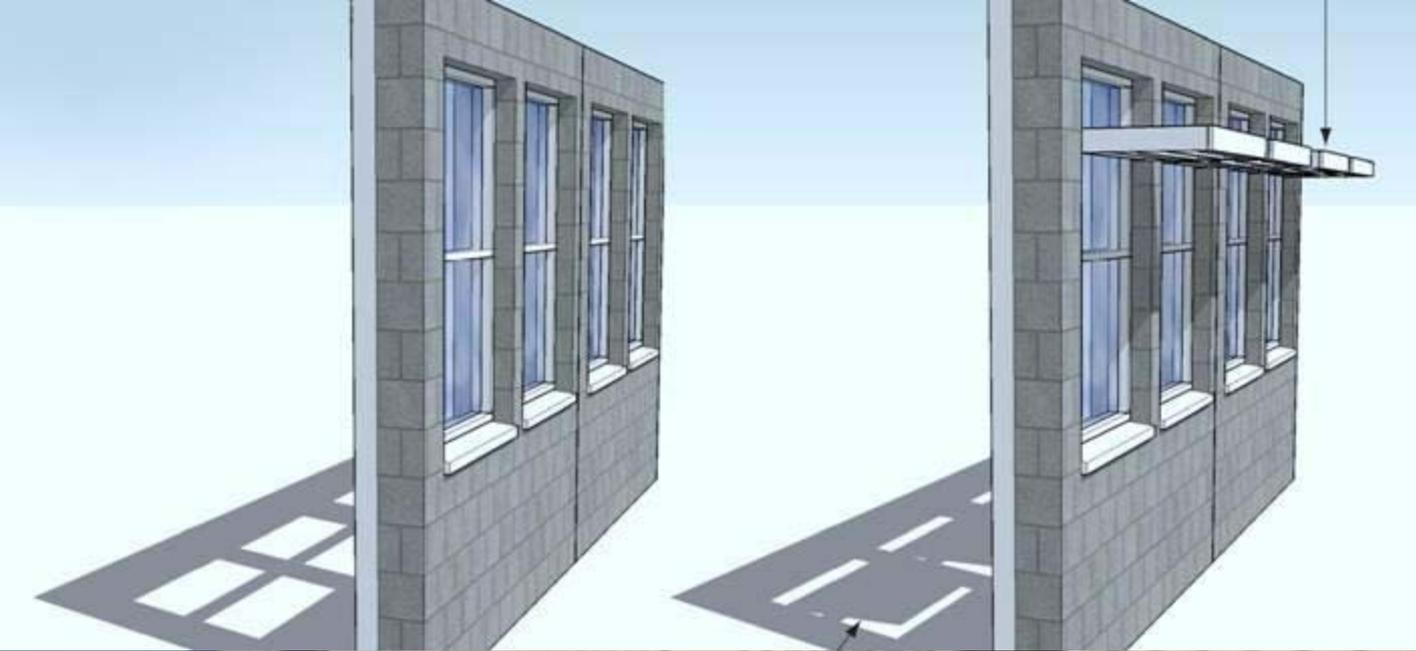
- Upgrade Envelope **7.7%** (ENVELOPE)
- Upgrade Equipment **4.1%** (ALL SYSTEMS)
- Reduce Plug Loads **2.4%** (ELECTRONICS)
- Direct Solar **2.7%** (HEATING)



# ENVELOPE UPGRADES

Replace Glazing Shade Windows

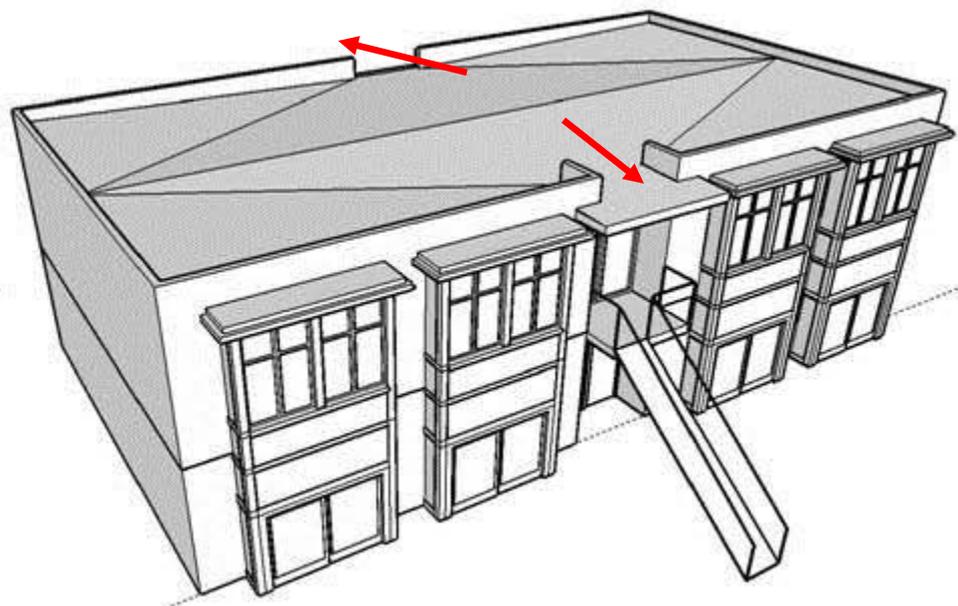
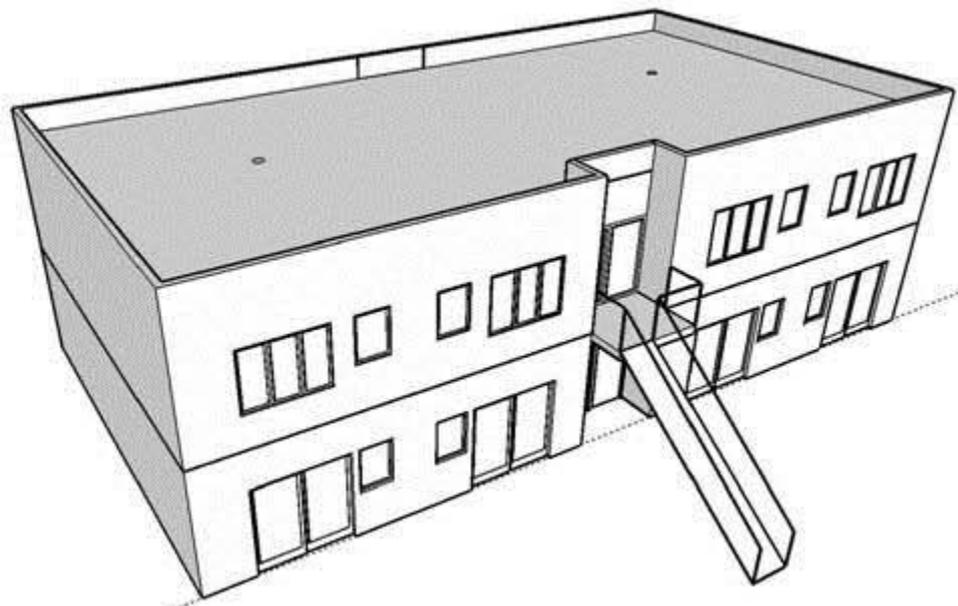
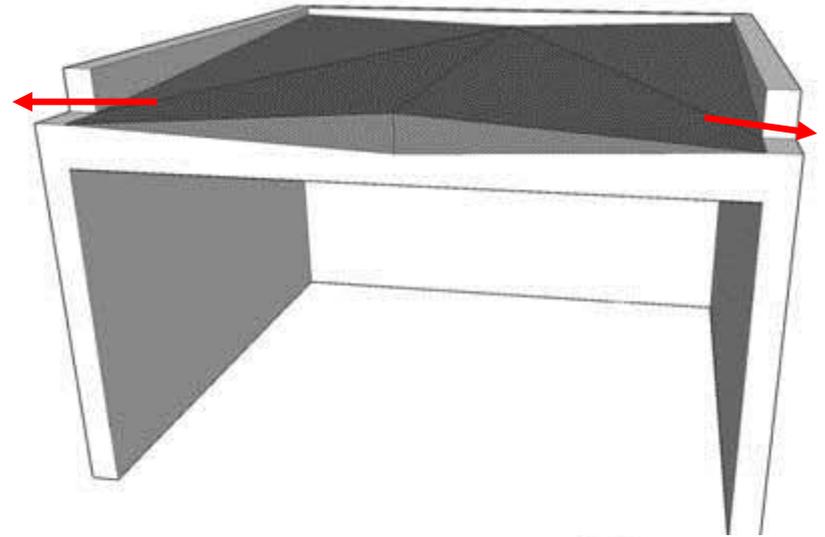
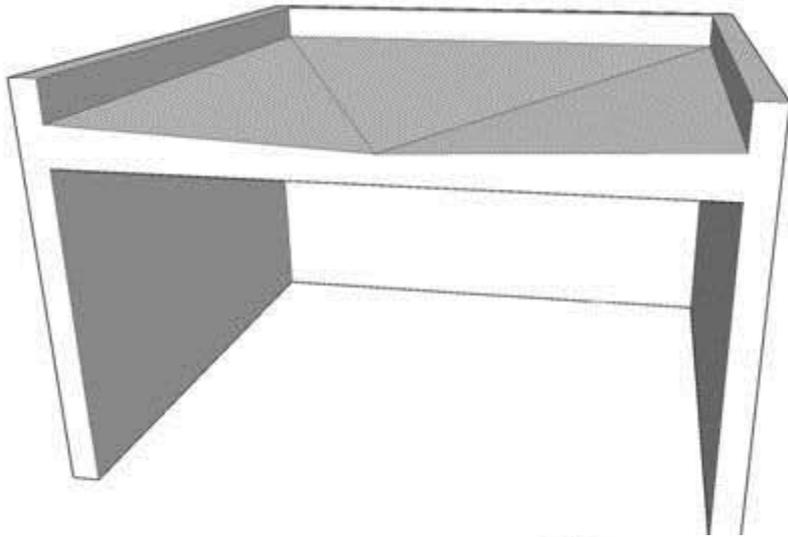




**Replace  
Glazing  
Shade  
Windows**

# ENVELOPE UPGRADES

Flat Roofs: Add insulation Provide Slope for Drainage



# EQUIPMENT UPGRADES

## Steam to Hydronics



# DIRECT SOLAR

## Clerestories with Daylight Sensors



# TRANSFORMATION

## Comprehensive Improvements

- Major Renovation
- Upgrade Equipment
- Plug Loads
- Solar Thermal & Photovoltaic



# TRANSFORMATION

## Comprehensive Improvements

- Major Renovation 7.6% (ALL SYSTEMS)
- Upgrade Equipment 6.9% (ALL SYSTEMS)
- Plug Loads 5.2% (ELECTRONICS)
- Solar 1.7% (ELECTRICAL)

= Additional 21% TOTAL



# TREES ATLANTA

Atlanta, Georgia

Smith Dalia Architects 2008



**Geothermal + Solar Thermal**  
**35% Energy savings**  
**7,500 Gallon cistern**





**7,500 Gallon cistern  
for Irrigation & Flushing**

**Daylighting & Efficient  
Fixtures & Controls**



# Lavin-Bernick Center for University Life

New Orleans, LA VJAA 2007



Zoned Passive Cooling  
Perimeter = 42% Savings



- Variable Shading
- Passive Cooling



# TOP STRATEGIES

## Comprehensive Improvement

- Lighting Upgrade 8 - 20%
- Envelope Improvement 7 - 40%
- Upgrade Equipment 5 - 20%

**20 - 80%**



# TOP STRATEGIES

- **Lighting Upgrade**
  - Relamping / Ballasts
  - New Fixtures & Controls
  - Daylight Harvesting
- **Envelope Improvement**
  - Weatherization
  - Insulation / Cool Roof
  - Reglazing / Daylighting
- **Upgrade Equipment**
  - Steam to Hydronic Conversion
  - High Efficiency Package Units
  - EMS/BMS Controls





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# **INNOVATIVE FUNDING UPDATE**

Free Money | Borrow-to-Buy | Self Funding Options

# The **POWER** of **ZERO**



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