MOVING from **A** to **Z(ero) NET**

Presentation Date 09/27/12

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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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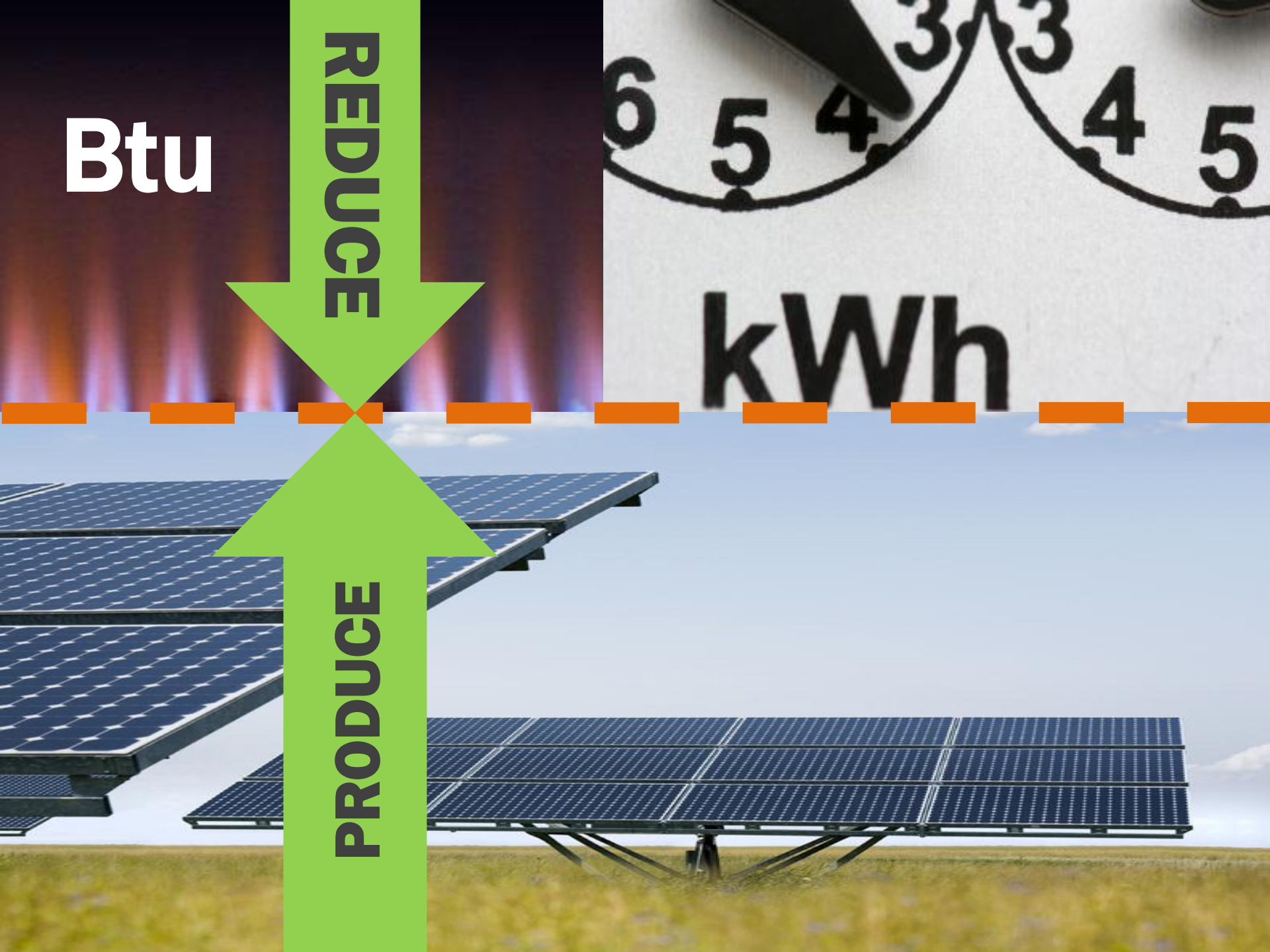
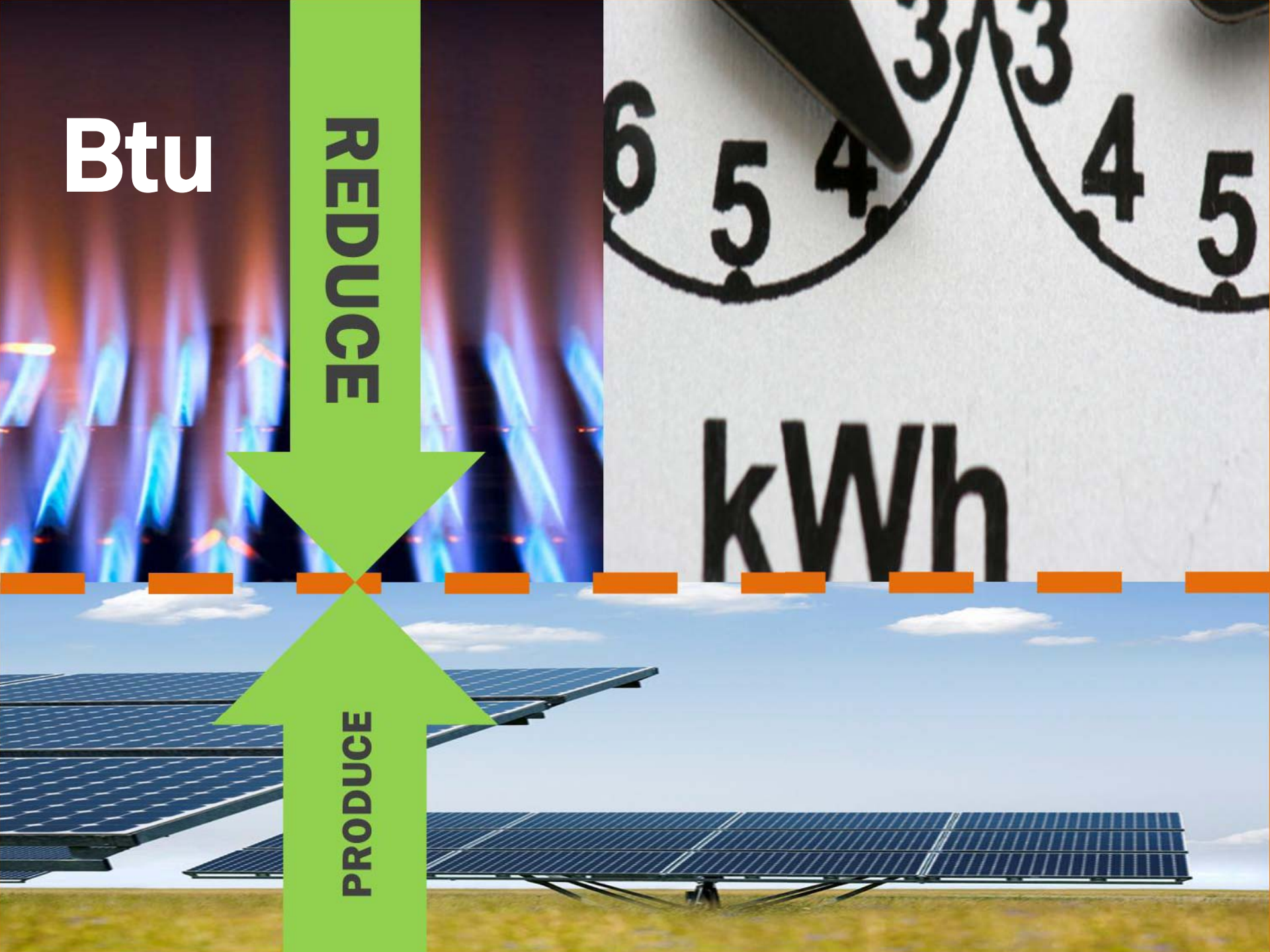

Btu
REDUCE
kWh
PRODUCE


Btu
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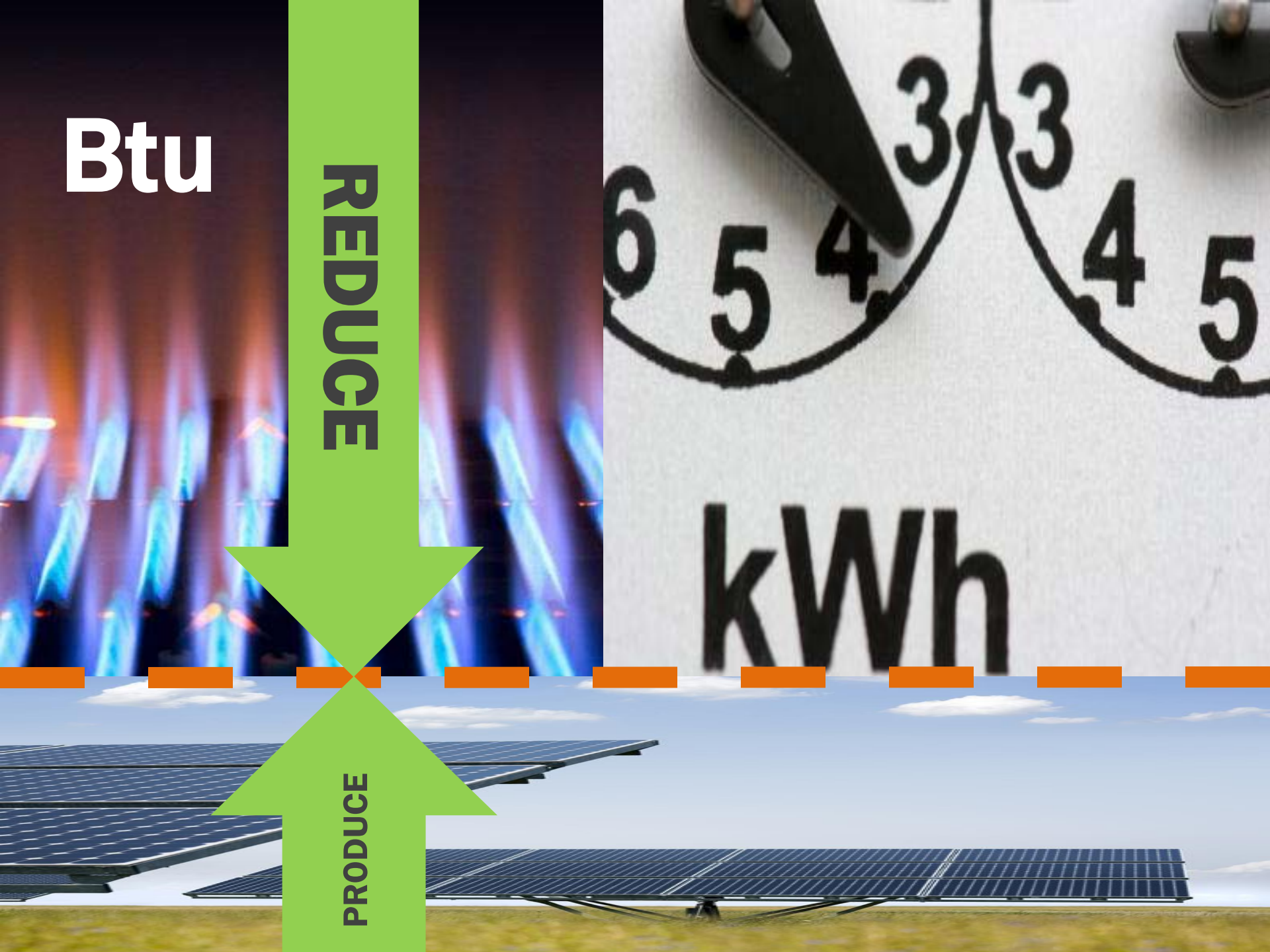
Btu
REDUCE
kWh
PRODUCE

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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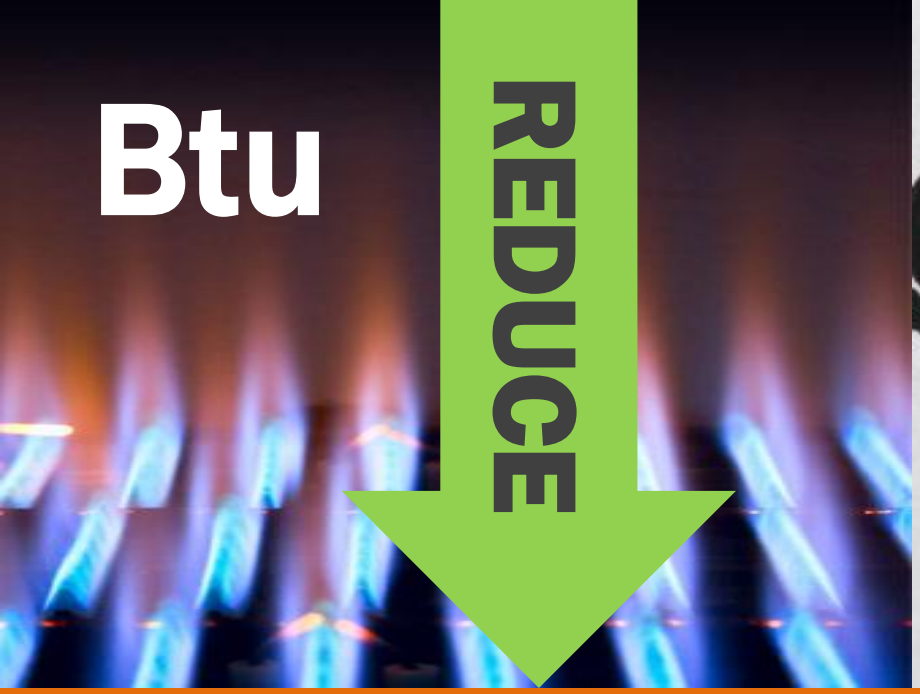
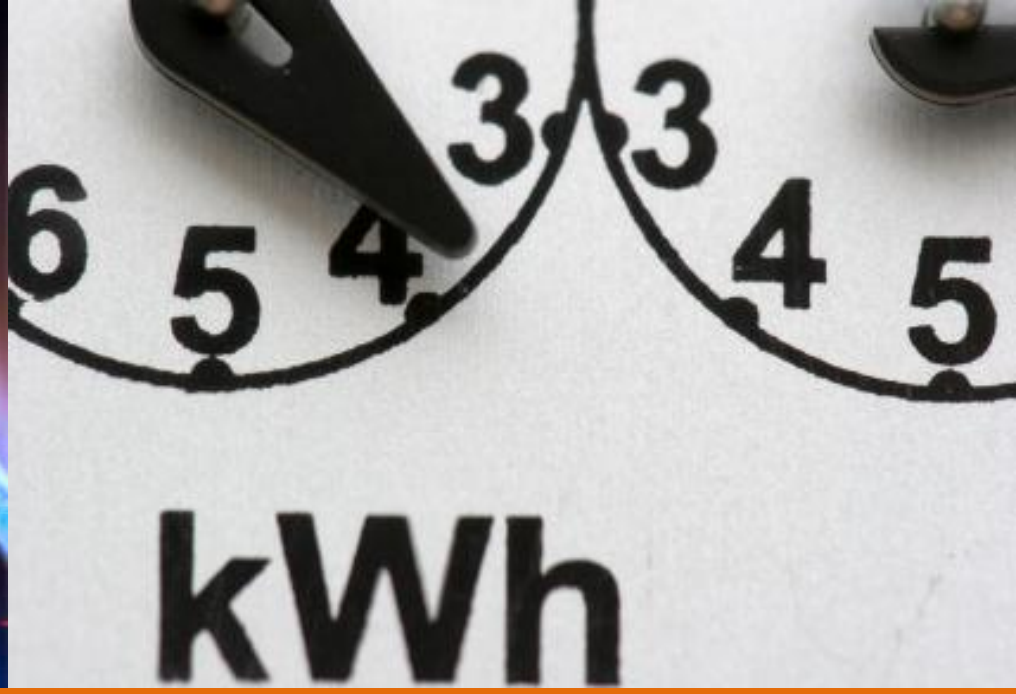




- Natural Day-Lighting
- High-Efficiency Lighting
- High Performance Envelopes with Increased Insulation
- Well Insulated Glazing

ENERGY EFFICIENT SYSTEMS: REDUCE ENERGY

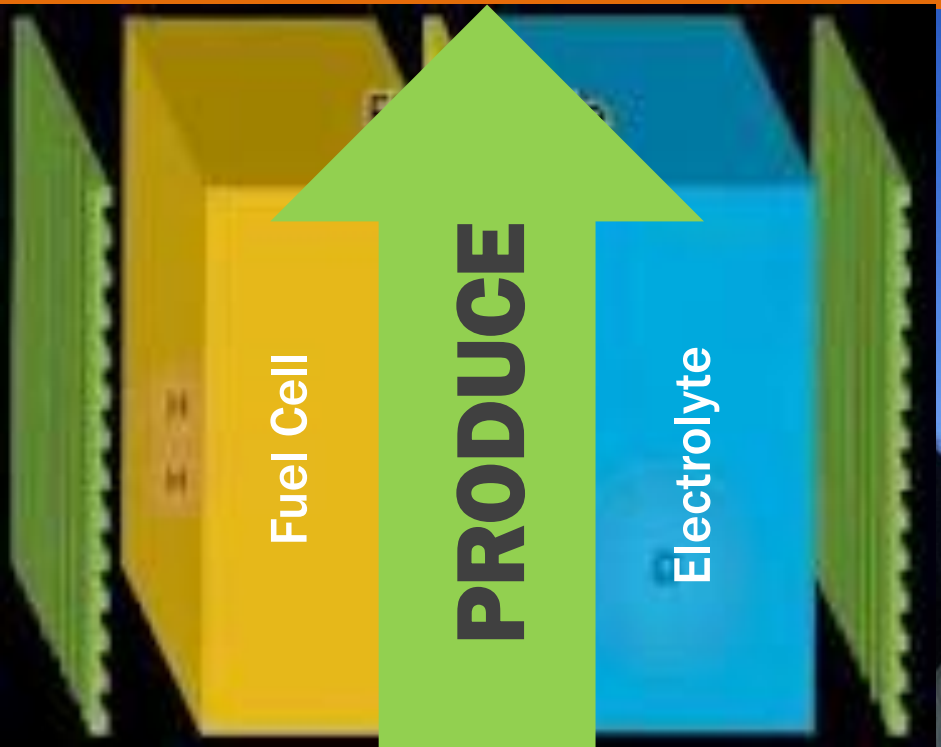
- Ground Source Heat Pump
- Solar Thermal

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

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

ZNE DEFINITIONS

ZNE Definition	Includes	Description
Site Energy	Electricity + Natural Gas	Energy provided by on-site renewable energy sources is equal to the amount of energy used by the building.
Source Energy	Electricity + Natural Gas	Energy provided by on-site renewables equal to the energy used by the building including the fuel & energy used to generate the energy & transport on grid.
Societal Energy *Societal is the Time Dependent Value (TDV)*	Electricity + Natural Gas	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.
Grid Neutral	Electric Only	A site that produces as much electricity as it uses in a year.

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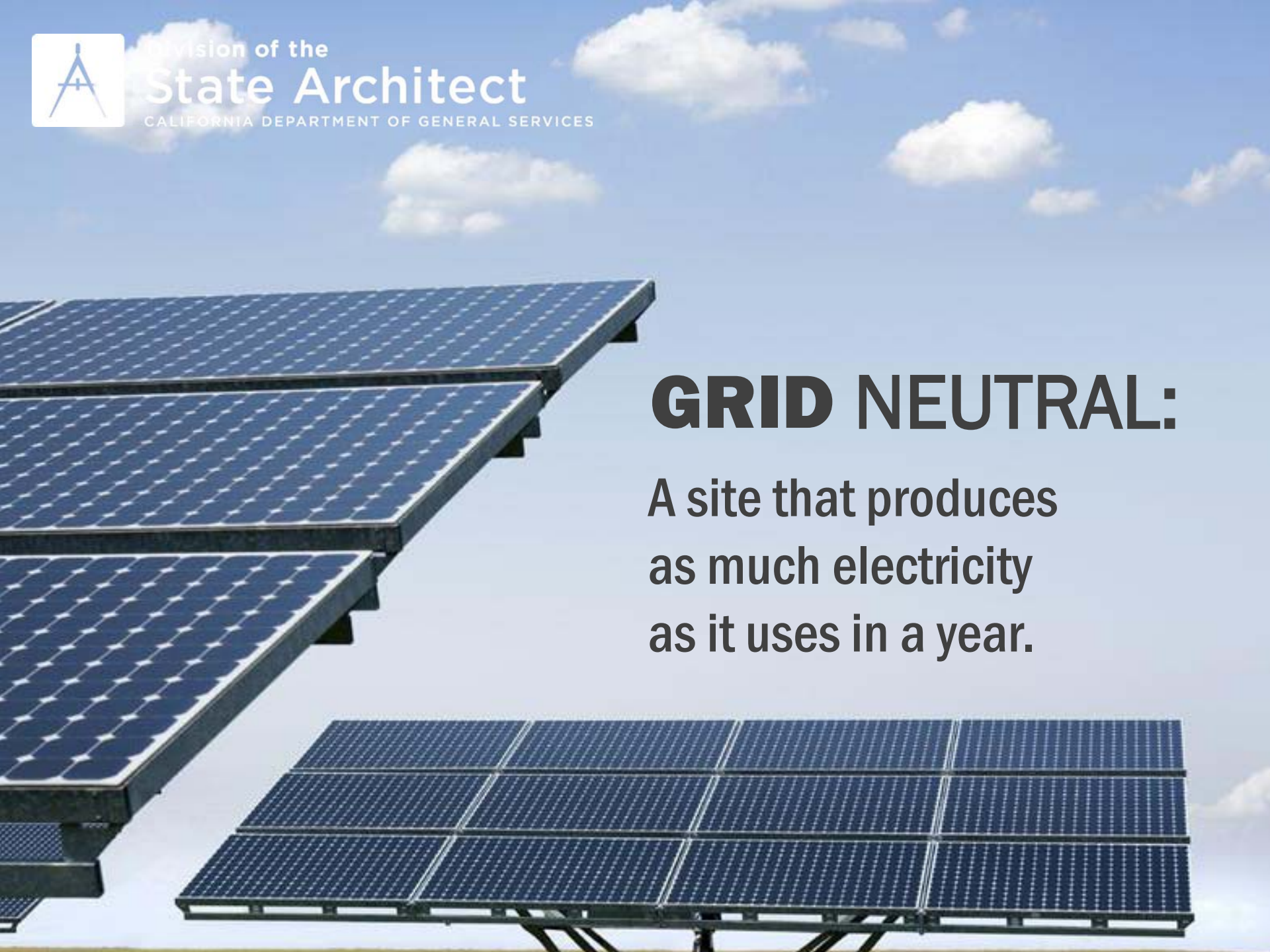

GRID NEUTRAL:

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

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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 provide Training Programs

MONITORING, MANAGEMENT & REPORTING

- Energy Management System

PROGRAM PERSISTENCE

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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
- **Geoexchange 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:

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

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

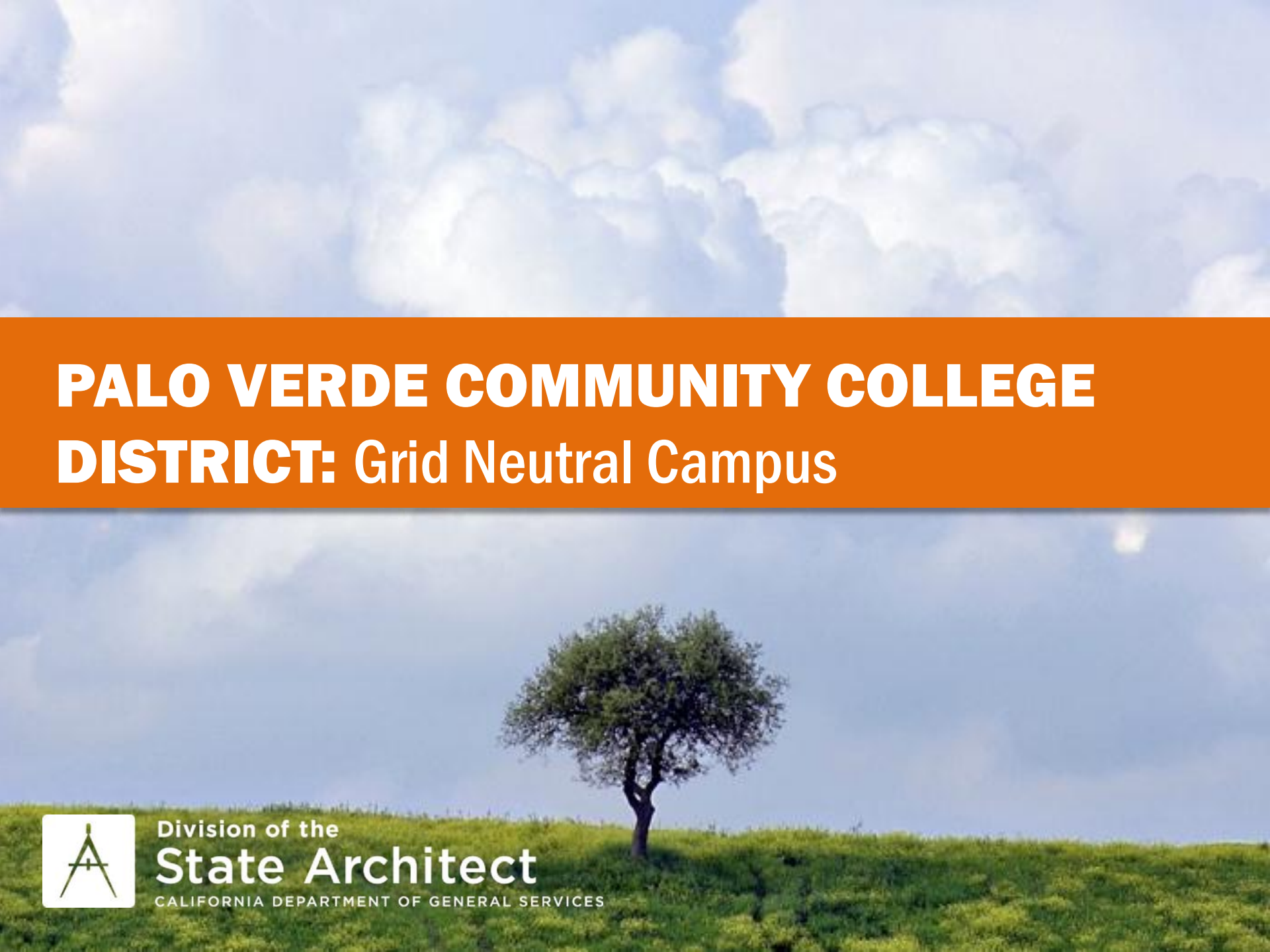
GRID NEUTRAL IN THE 2010 CALGreen CODE:

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.

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

Recent Energy Conservation Measures are Contributing to Grid Positive Results

YUBA CITY UNIFIED SCHOOL DISTRICT: Star Campus

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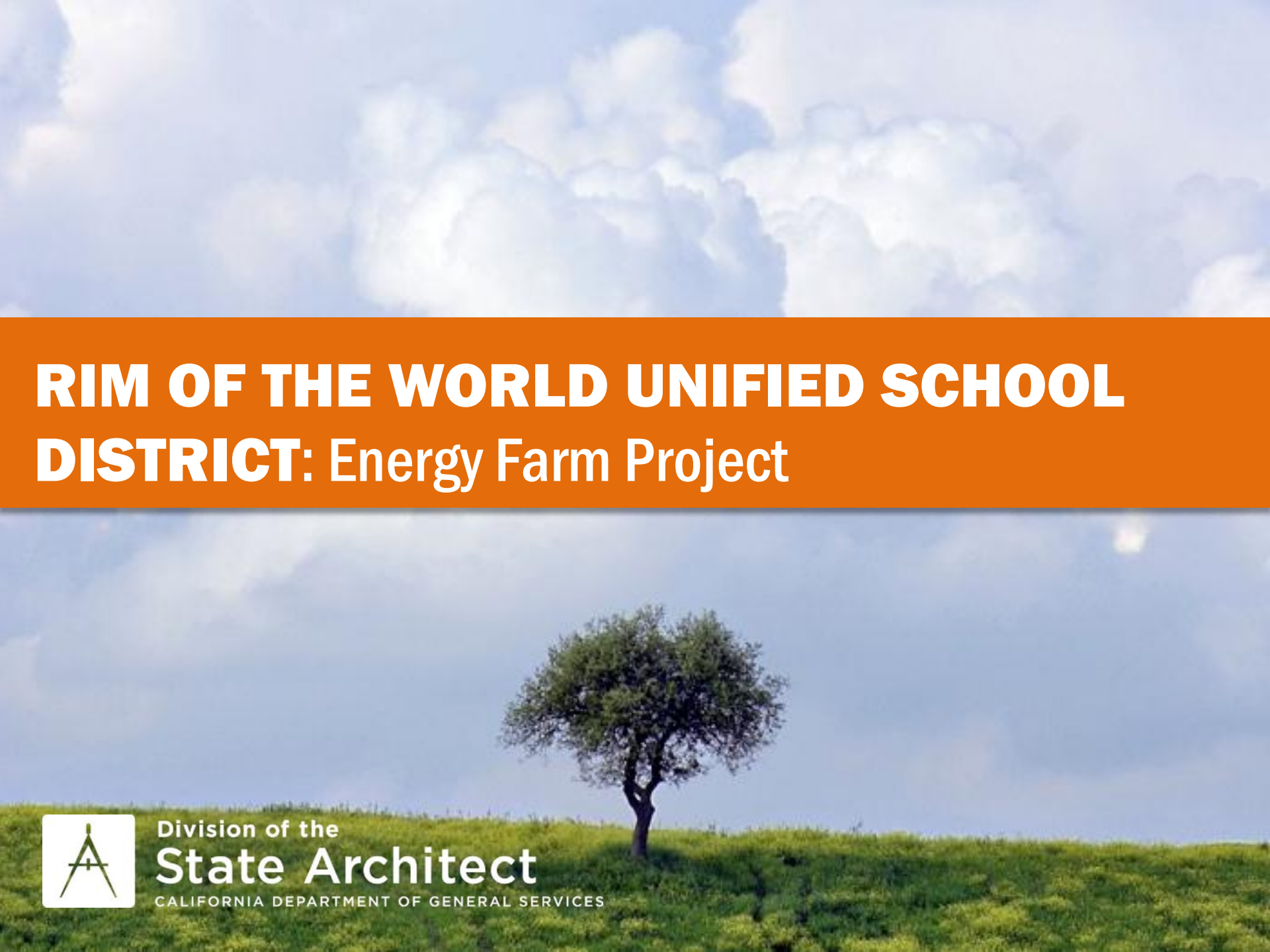
YUBA CITY USD:
Riverbend Elementary School

- 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

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**

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!

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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

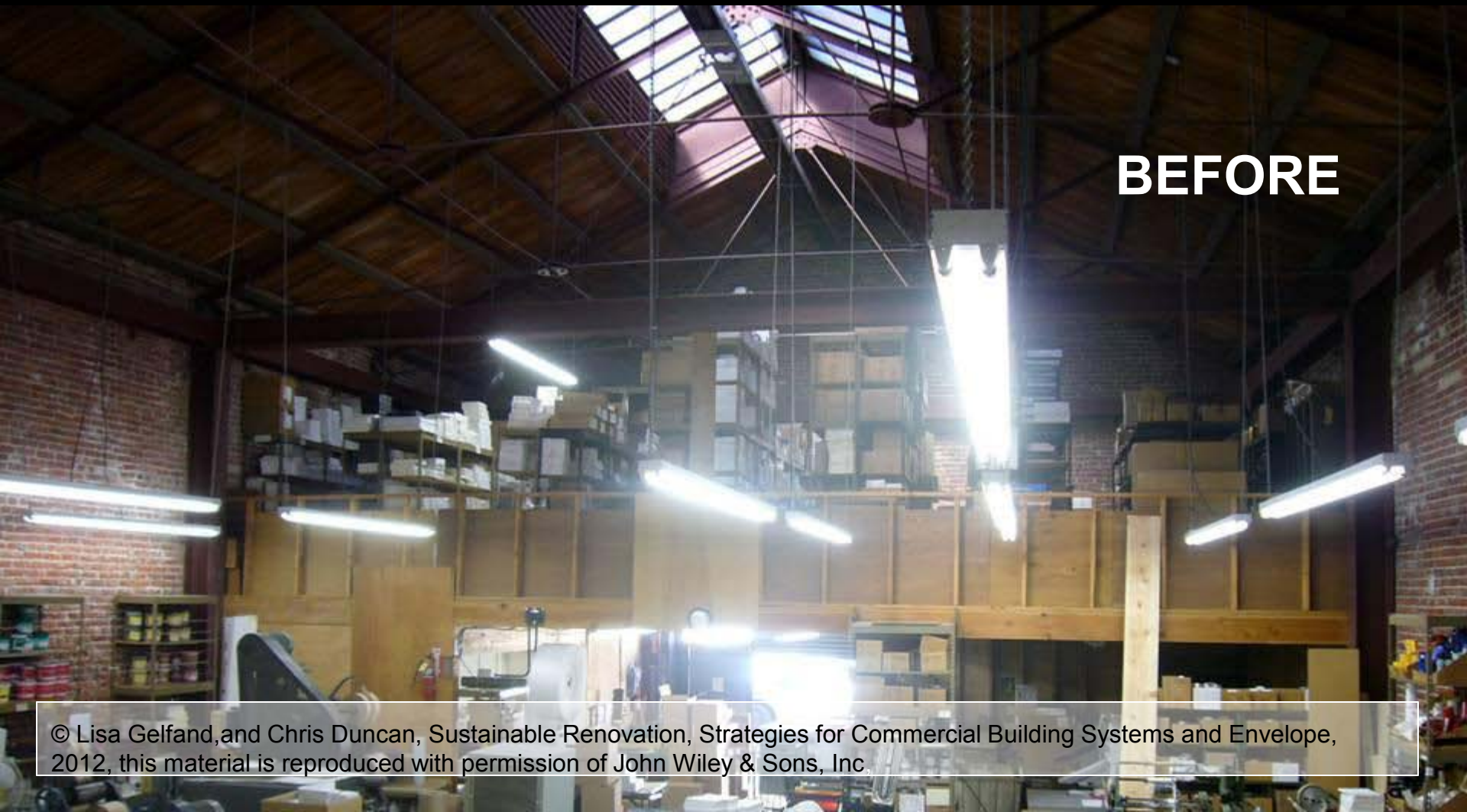
THE MORE CONSUMPTION GOES DOWN WITH ENERGY CONSERVATION, THE LESS ELECTRICITY NEEDS TO BE PRODUCED TO ATTAIN GRID NEUTRAL

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

SUSTAINABLE MODERNIZATION

Strategies for Building Systems and Envelope

Lisa Gelfand – Gelfand Partners Architects



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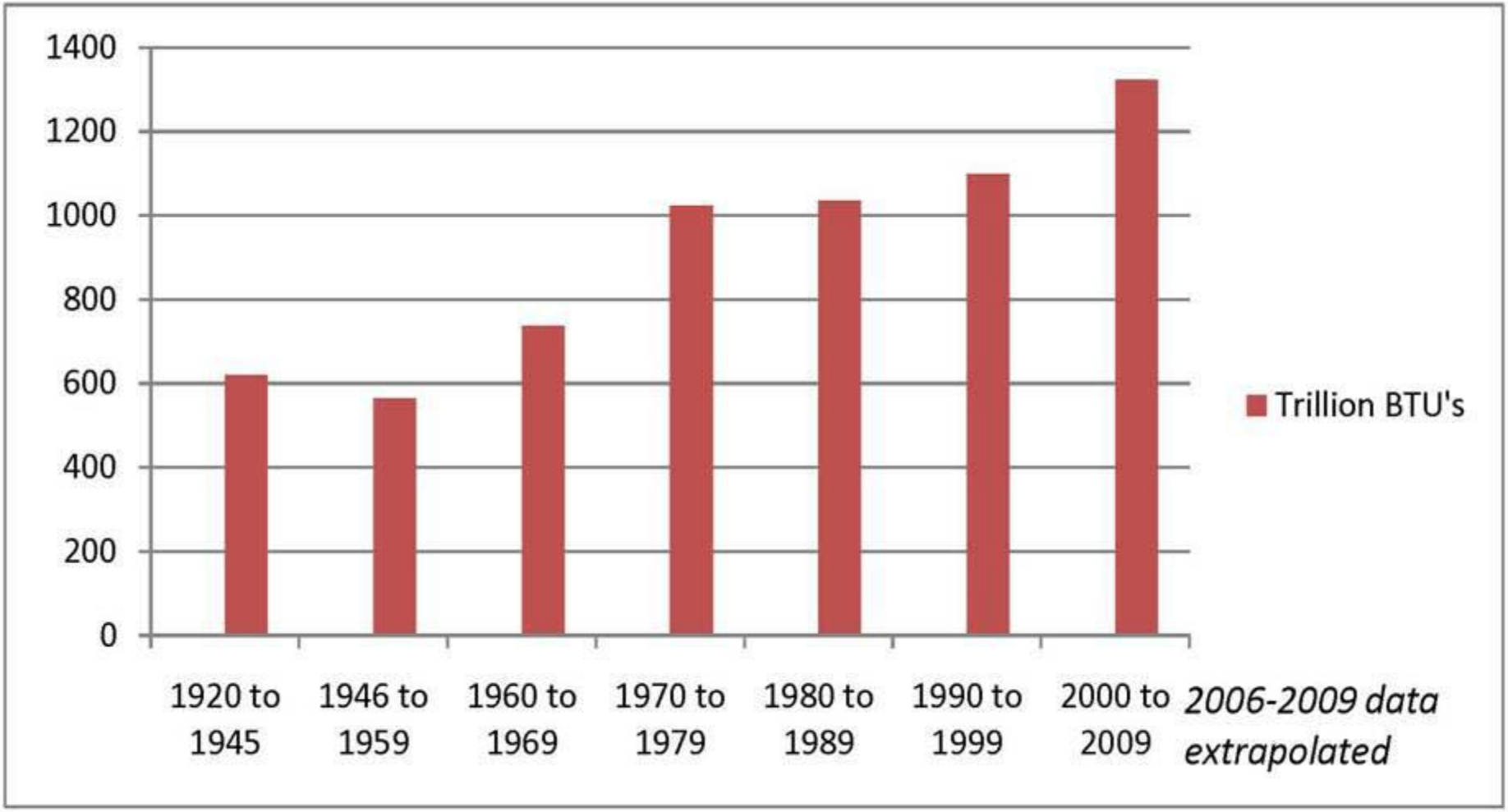
SUSTAINABLE MODERNIZATION

Strategies for Building Systems and Envelope

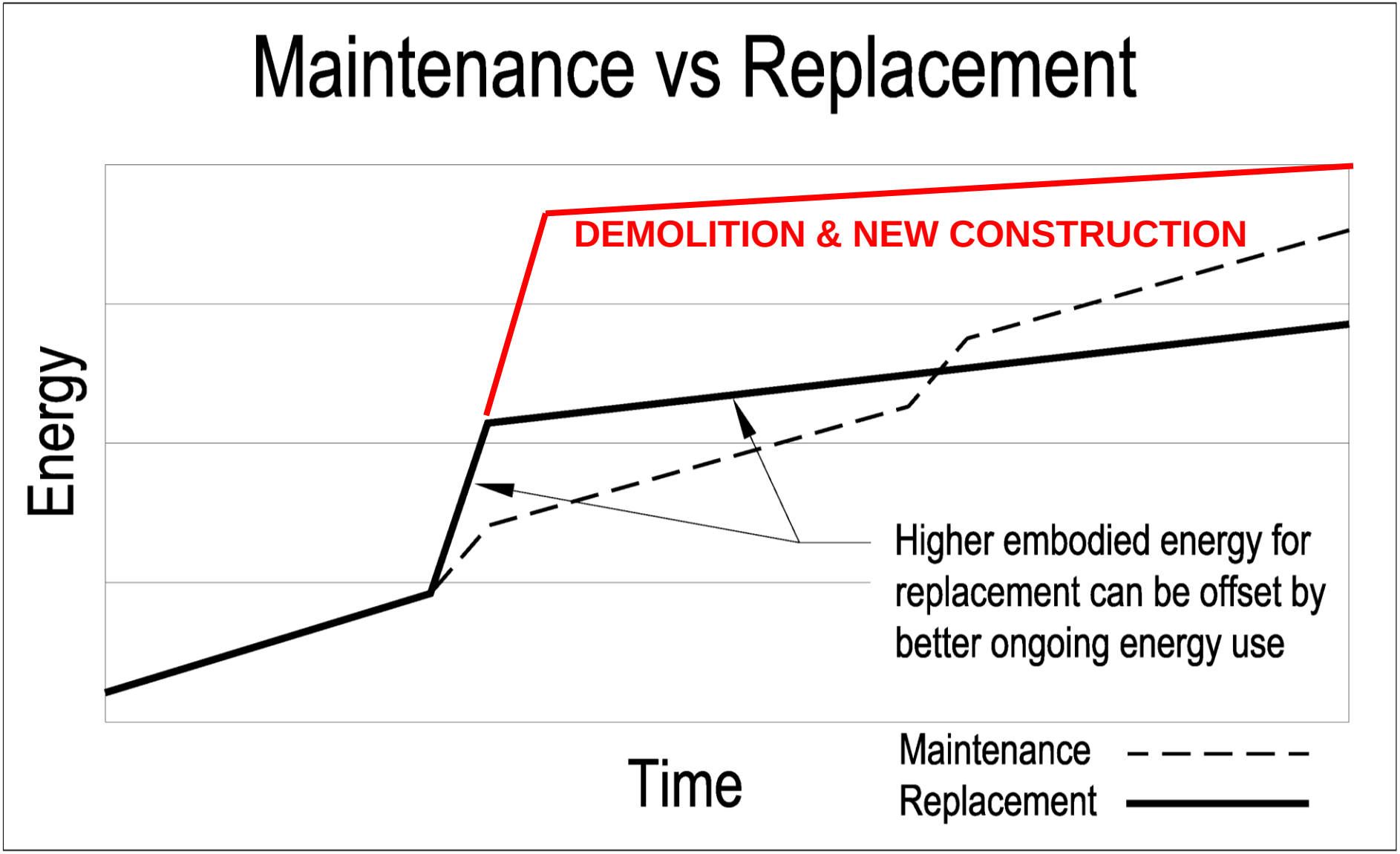
Lisa Gelfand – Gelfand Partners Architects

ENERGY USE BY ERA

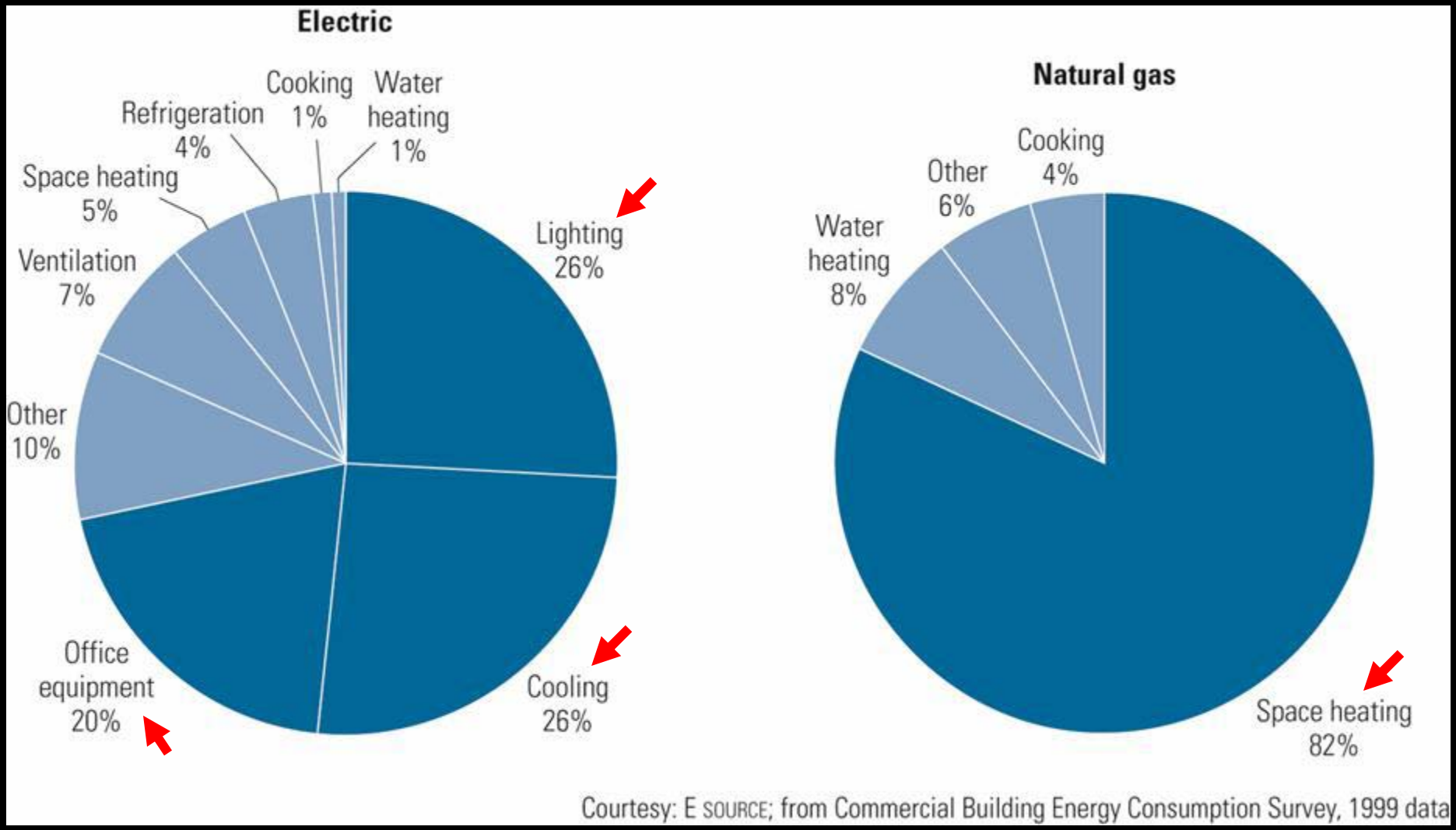
More recent buildings use *more energy* than older buildings.



EMBODIED ENERGY



ENERGY USE



Courtesy: E SOURCE; from Commercial Building Energy Consumption Survey, 1999 data

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%	(ALL SYSTEMS)
- Retro-commissioning	3.7%	(ALL SYSTEMS)
- Weatherization	3.2%	(ENVELOPE)
- Lighting Upgrades	8.8%	(LIGHTING)
- Water Heating	2.9%	(HEATING)
- Other Equipment	3.6%	(HEATING, COOLING)
	27% TOTAL	

BEHAVIOR MODIFICATIONS

WEATHERIZATION

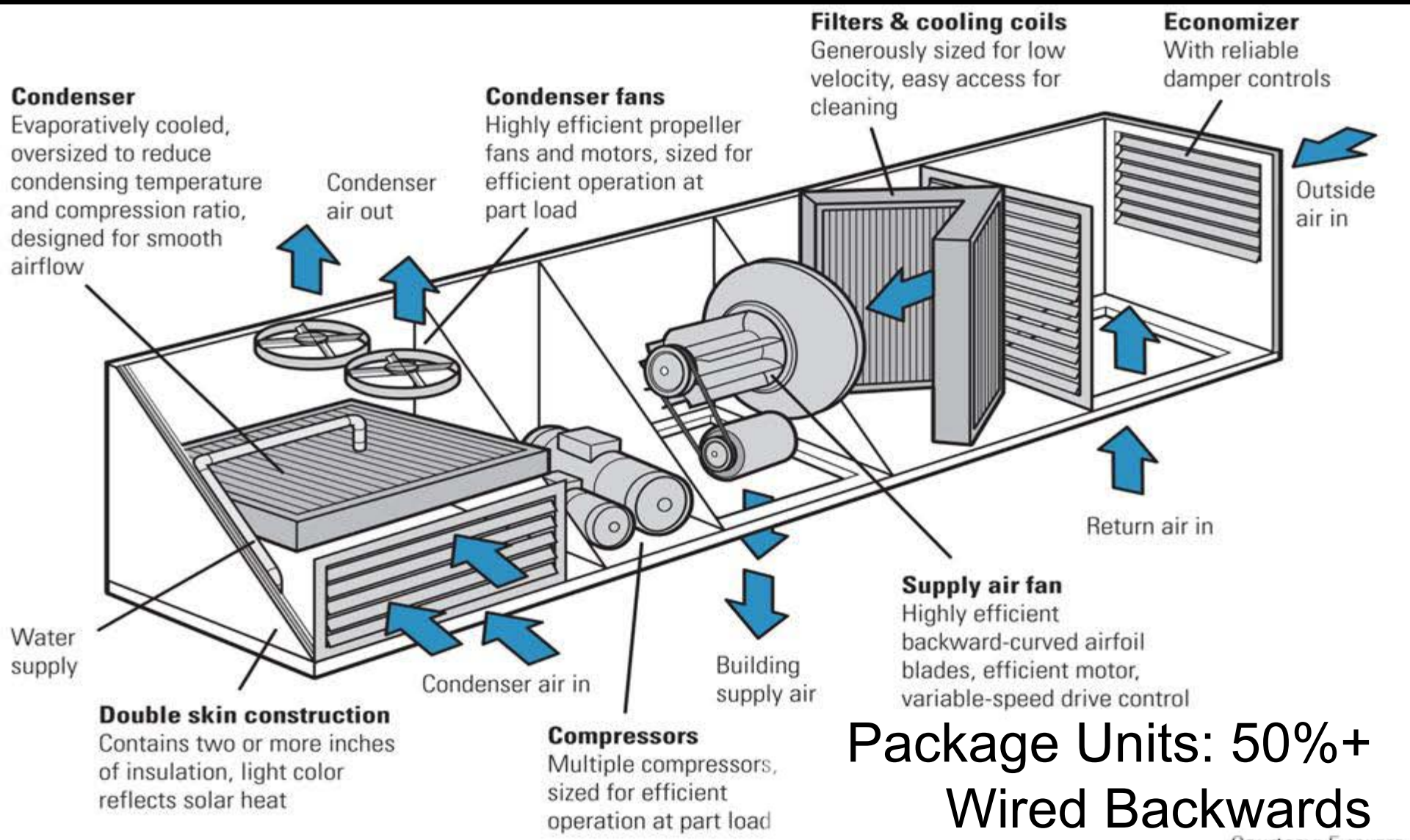
- Seal Around Windows & Doors
- Add Insulation
- Blower Door Test

LIGHTING UPGRADES

Relamping & Ballasts
Fixture Replacement

WATER HEATING UPGRADES

OTHER EQUIPMENT UPGRADES



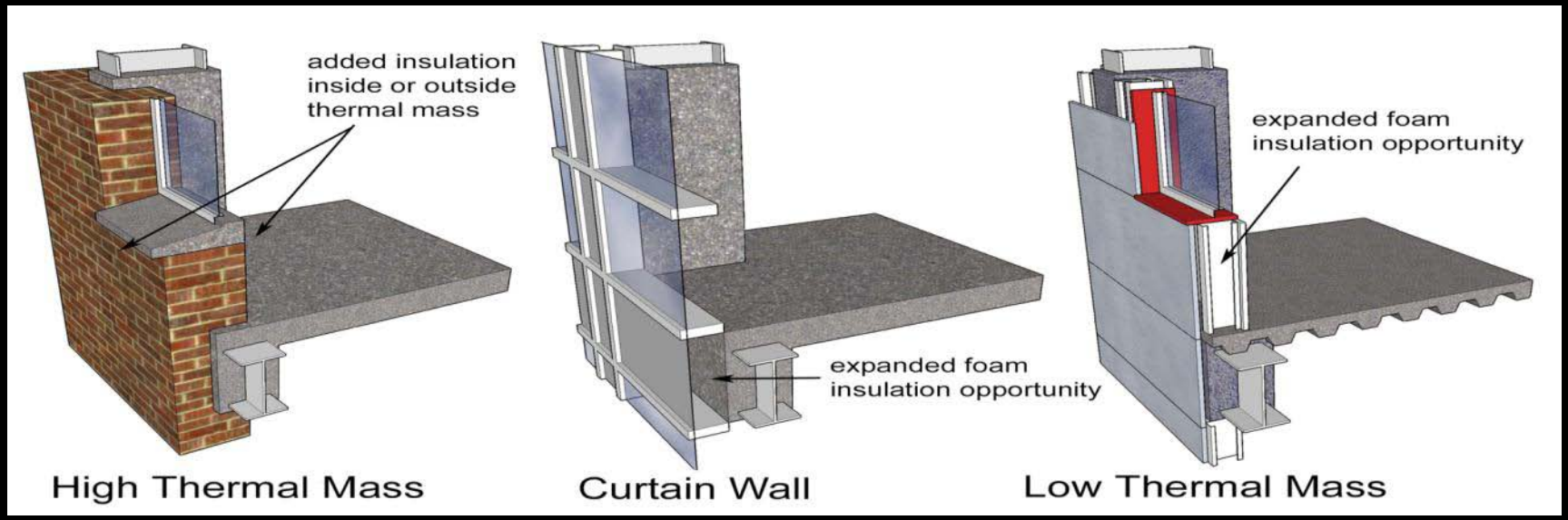
Package Units: 50%+ Wired Backwards

Courtesy: E SOURCE

PHASED IMPROVEMENTS

<u>Moderate Cost Improvements</u>

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



PHASED IMPROVEMENTS

Moderate Cost Improvements

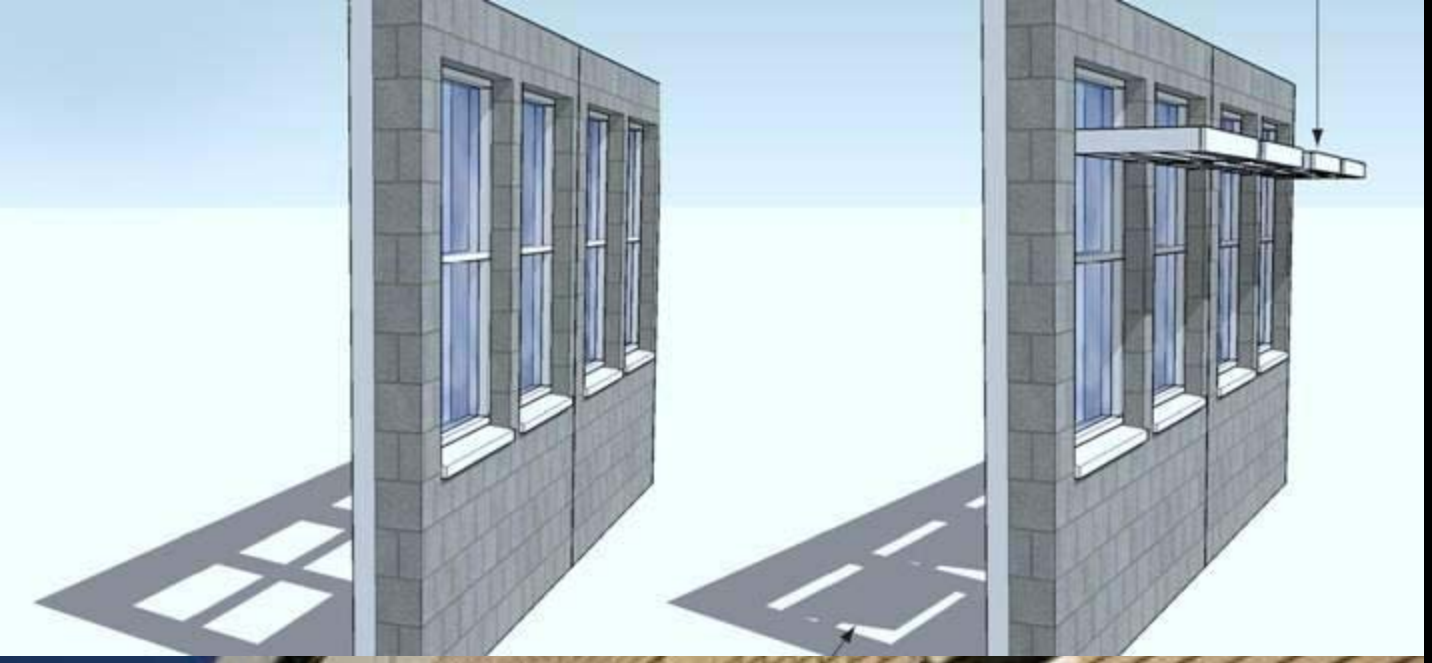
- Upgrade Envelope 7.7% (ENVELOPE)
- Upgrade Equipment 4.1% (ALL SYSTEMS)
- Reduce Plug Loads 2.4% (ELECTRONICS)
- Direct Solar 2.7% (HEATING)

additional **17%** TOTAL

Phased vs Comprehensive

ENVELOPE UPGRADES

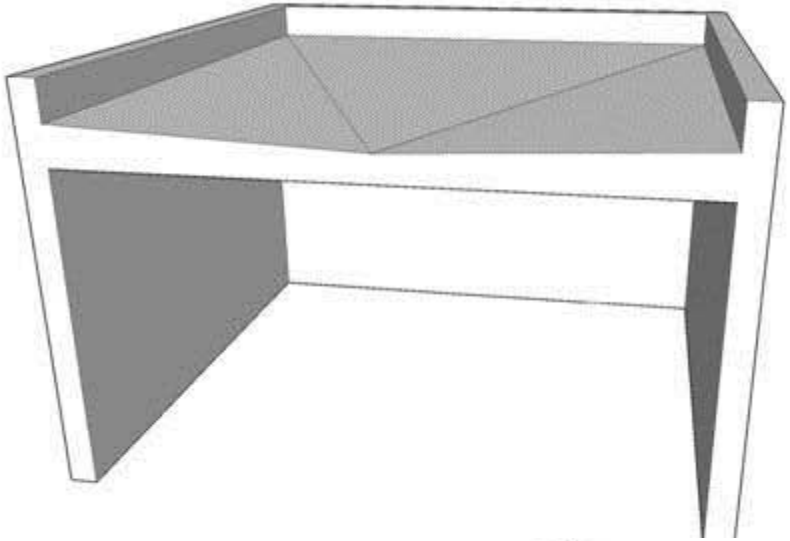
Replace Glazing Shade Windows

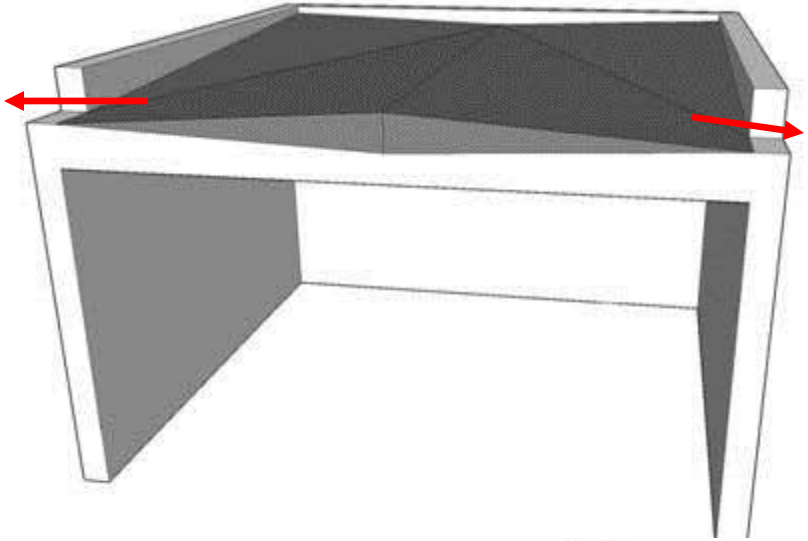


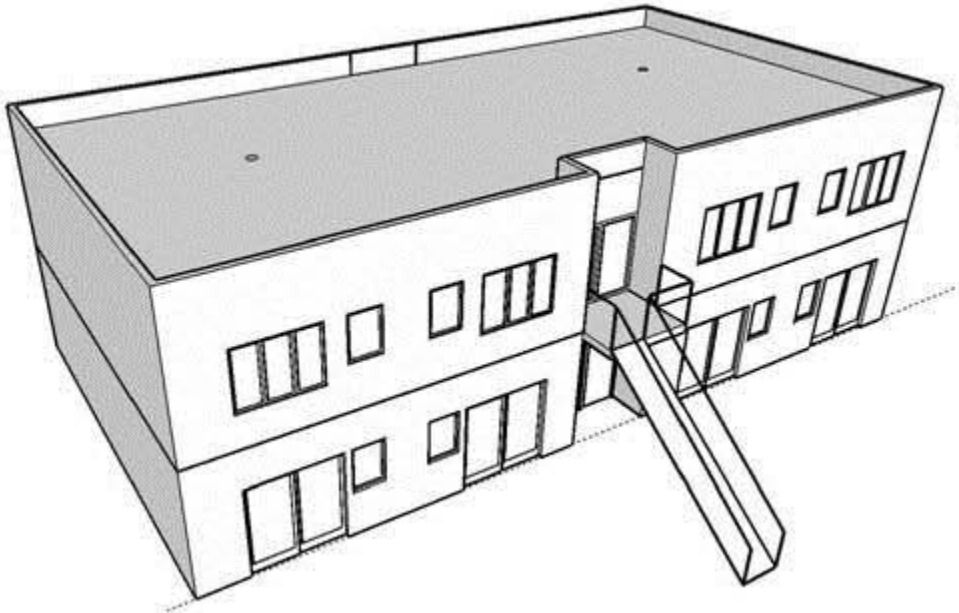
Replace Glazing Shade Windows

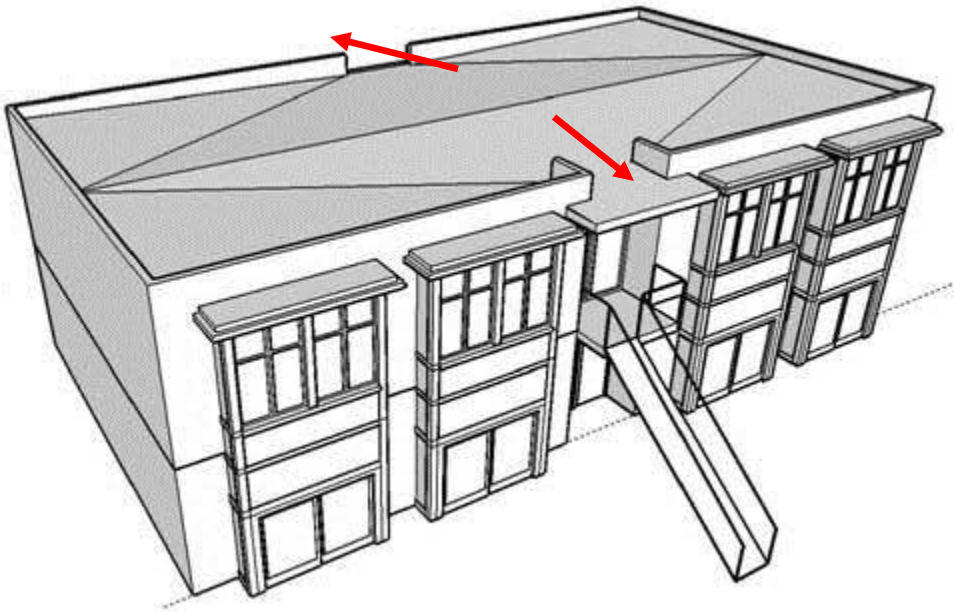
ENVELOPE UPGRADES

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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