long beach unified school district

BUILDING ON SUCCESS - SCHOOLS FOR THE NEXT GENERATION

MEASURE K BOND PROGRAM

Board of Education Workshop

March 25, 2010

Daylighting

Sustainable Design

"Green" Buildings

GREEN

PV

Commissioning

Water

Green Technology

Sustainability

CHPS

LEED

Eco-Friendly

Solar Energy

GRID NEUTRAL

CEQA

High Efficiency

Conservation

Carbon Neutral

Clean Energy

High Performance Schools

Cool Roofs

Environmentally-Friendly

Renewable Energy

Carbon Footprint

Sustainable Buildings

Sustainable Development

GREEN SCHOOLS

ENERGY

cpm. complexity simplified.

Presentation Summary

Sustainability Guidelines

I. Introduction
II. Guidance Documents
III. Current Projects and District Efforts
IV. PV Solar Energy
V. Looking Into the Future

Terms

Sustainable Buildings or "Green" Buildings:

- Practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle: from siting to design, construction, operation, maintenance, renovation, and deconstruction
- Expands and complements the classical building design concerns of economy, utility, durability, and comfort

(Source: Wikipedia)

Terms

Grid Neutral:

- Electricity consumed is equal to electricity generated on an annualized basis

Carbon Neutral:

- Achieving net zero carbon emissions by balancing measured amount of carbon released with equivalent amount sequestered or offset, or buying enough carbon credits to make up the difference

Carbon Footprint:

- Total set of greenhouse gas (GHG) emissions caused by an organization, event or product

Terms

Clean Energy or Renewable Energy:

- Energy that is generated from natural resources such as sunlight, wind, rain, tides, and geothermal heat, which are renewable (naturally replenished) and do not generate pollution

Green Schools:

- "Green" school is primarily focused on sustainable attributes
- May be used interchangeability with High Performance School
- School facility that is "green" can also be high performance and vice versa

Terms

CHPS:

(Collaborative for High Performance Schools)

- United States' first green building rating program especially designed for K-12 schools
- Provides information and resources to schools to facilitate construction and operation of high performance institutions
- High performance schools are energy and resource efficient as well as healthy, comfortable, well lit, and contain amenities for a quality education

High Performance Schools:

“Good teachers and motivated students can overcome inadequate facilities and perform at a high level almost anywhere, but a well-designed facility can truly enhance performance and make education a more enjoyable and rewarding experience.”

(Source: CHPS)

Terms

High Performance Schools are:

- Healthy
- Comfortable
- Energy Efficient
- Material Efficient
- Easy to Maintain and Operate
- Commissioned
- Environmentally Responsive Site
- A Building That Teaches
- Safe and Secure
- Community Resource
- Stimulating Architecture
- Adaptable to Changing Needs

(Source: CHPS)

Board Policies

Resolution 010703-C

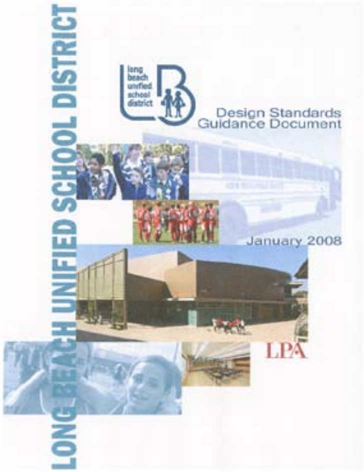
Energy Conservation Guidelines

- Resolution adopted by Board in January 2003
- Guidelines revised in January 2009
- Conserve energy and natural resources while exercising sound fiscal management
- Maintain records of energy consumption and cost
- Energy management and audit requirements

II. Guidance Documents

Board Policies

Resolution 012208-A



Design Standards Guidance Document

- Board adopted January 2008
- Guiding Principles:
    - Support student’s personal and intellectual success
    - High performance learning environments
    - Exhibit responsibility toward environment
    - Establish equity across District
    - Balance safety and security with open, inviting designs

Board Policies

Resolution 012208-A (cont.)

Design Standards Guidance Document

Part 1 – “Sustainability Guidelines”

District policy objectives specific to sustainability:

Commitment to efficient use of energy, environmental responsibility, efficient long term operations, and reduced life cycle costs through adoption of CHPS

II. Guidance Documents

Board Policies

Resolution 012208-A (cont.)

District Current Sustainability Policy Objectives:

- Create better learning environments:
  - Indoor Air Quality (IAQ)
  - Acoustics
  - Thermal comfort
  - Daylighting
- Energy conservation
- Reduced maintenance
- Water efficient plumbing, landscaping and irrigation
- Educate students in construction technology, citizenship and responsibility toward the environment

Board Policies

Resolution 012208-B

CHPS Certification

"Therefore be it resolved, that the Long Beach Unified School District Board of Education encourages staff to continue to expand this effort to ensure that every new school, new building, modernization project, and relocatable classroom, from the beginning of the design process, meet or exceed minimum eligibility under the CHPS Criteria and incorporate to the extent feasible CHPS best practices including sustainable design practices as recommended by the Facility Master Plan committee…"

Board Policies

Resolution 012208-B (cont.)

CHPS Certification

- Long Beach Unified School District is 1 of 37 California school districts that has passed CHPS Board Resolutions
- Over 50 school district's nationwide have joined CHPS representing over 1 million students and over 1,500 schools nationwide

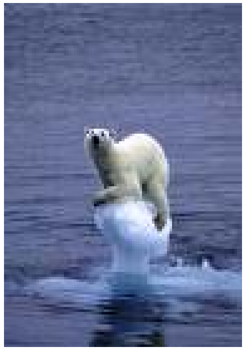
Executive Order S-20-04

Green Building Initiative

- State of California's "Green Action Plan"
- Reduce energy for state-owned buildings by 20% by 2015
- All state-owned facilities to be "LEED Silver" or higher
- Energy Star equipment
- Division of the State Architect (DSA) adopt guidelines by December 31, 2005 to enable and encourage schools built with state funds to be resource and energy efficient

II. Guidance Documents

Assembly Bill (AB) 32



California Global Warming Solutions Act of 2006

- Law requires by 2020 the state's greenhouse gas emissions be reduced to 1990 levels
- Roughly 25-30% reduction under business as usual estimates
- The California Air Resources Board (ARB) prepared plans to achieve the objectives as stated in the Act
- ARB issued “AB 32 Scoping Plan” on how goals will be achieved in December of 2008

II. Guidance Documents

Other Recent Documents

- DSA Grid Neutral Guidebook (2009)

  <u>Four steps to achieve electrical neutrality</u>
  1. Set performance goals
  2. Implement energy efficiency and conservation measures to lower electricity use
  3. Install solar or wind systems to create electricity to meet remaining needs
  4. Maintain energy systems and monitor energy production and consumption

- California Solar Initiative
- CHPS 2009 Standards
- International Green 2010 Construction Code

Upcoming Code Changes

Building Code Change – CalGreen

The purpose of this code is to improve public health, safety and general welfare by enhancing the design and construction of buildings through the use of building concepts having a positive environmental impact and encouraging sustainable construction practices in the following categories:

1) Planning and design
2) Energy efficiency
3) Water efficiency and conservation
4) Material conservation and resource efficiency
5) Environmental air quality

Upcoming Code Changes

Building Code Change – CalGreen

- January 1, 2011 the nation's first mandatory green building code goes into effect in response to governor's mandate raising the floor on sustainable building requirements
- Closely modeled after CHPS and LEED requirements affecting the following areas:
  - Site development
  - Energy efficiency
  - Water conservation
  - Solid waste reduction
  - Building maintenance and operation – Commissioning
  - Indoor and outdoor air quality
  - Acoustics

New 6-8 Middle School #1 (former GTE Site)

Eco-Friendly Features:

- Re-Use and clean-up an existing site
- Storm water run-off improvements
- Increased water-permeable and green spaces
- Use of recycled construction materials
- Energy saving HVAC systems
- High efficiency lighting systems
- Water conservation fixtures
- Indoor air quality management and activity pollution prevention plan during construction

(Source: Project Fact Sheet)
www.lbschools.net

New High School #1 - ECATS

Eco-Friendly Features:

- Reclaimed water for campus irrigation
- High efficiency plumbing fixtures to conserve water
- Operable windows to conserve energy
- High efficiency light fixtures equipped with sensors
- Recycled content, low VOC (Volatile Organic Compound) materials specified
- Recycling 70% Construction debris
- Design to be Photovoltaic (PV) ready (solar power capable)
- Increased water-permeable and green spaces
- High efficiency HVAC systems
- High efficiency building insulation

(Source: Project Fact Sheet)
www.lbschools.net

III. Current Projects and District Efforts

New High School #1 – ECATS (cont.)

- CHPS Score – approximately 40 points
- May be eligible and may receive High Performance Incentive Grant following DSA review and determination

III. Current Projects and District Efforts

Energy Conservation

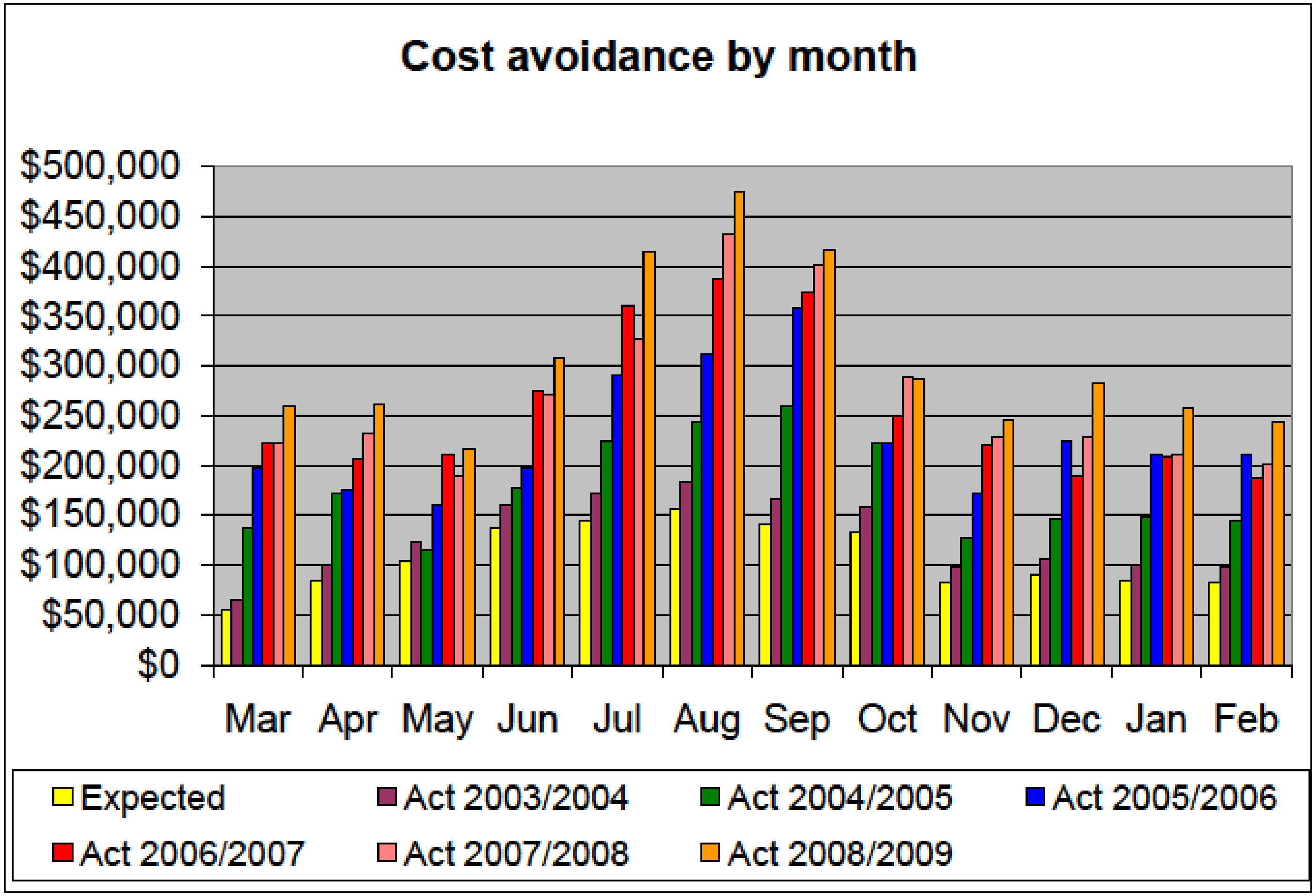
District staff conservation activities:

- Energy audits
- Equipment, controls and systems adjustments and calibrations
- Energy bill monitoring
- Use of energy saving technology

Total cost avoidance from EnergyCap Program from 2003-2010 = $21,900,000

III. Current Projects and District Efforts

EnergyCap Program Savings



III. Current Projects and District Efforts

Additional Efforts

- Reducing District Carbon Footprint:
    - February 2003 – March 2010 all District sites:
        - 1,709,871 MMBTU or 154,852 equivalent metric tons of CO_2 usage
        - Energy reduction impact avoidance of 499,972 MMBTU or equivalent of 8,527 cars removed

(Source: Dept. of Energy)

- Pilot Projects

IV. PV Solar Energy

Photovoltaic (PV) Overview

- Solid State technology converting solar radiation into electricity
- No moving parts
- No fuel required
- No pollutants over life cycle
- Reliable source of power when sun is shining
- Low maintenance
- Proven technology from 1960's space program
- New and constantly changing technology

Types of PV Systems

Crystalline Cells (most common)

Monocrystalline silicon cell modules

- 14% efficient
- 12-14 W / square foot
- More difficult to manufacture than poly, but uses less silicon

Poloycrystalline silicon cell modules

- 12% efficient
- 10 W / square foot
- Easier to manufacture than mono, but requires more silicon

IV. PV Solar Energy

Types of PV Systems

Thin-film Cells

- Various types currently available:
  - Amorphous silicon
  - Copper indium diselenide (CIS)
  - Cadmium telluride (CdTe)
  - Gallium arsenide (GaAs)
- Advantage is lower cost per watt than crystalline
- Disadvantage is much more square footage required due to inefficiencies
  - 4-8% efficient
  - 3-6 W / square foot

IV. PV Solar Energy

Types of Systems

Thin-film Cells (cont.)

New emerging technology

- Copper indium galloum selenide (CIGS)
  - 19% efficient claimed
  - 10-12 W / square foot claimed

Types of Systems

Building Integrated Photovoltaic (BIPV)

- Integration of PV cells into building components
- Available with crystalline or thin film technology
  - Roofing (all types)
  - Equipment screens
  - Shade structures
  - Windows
  - Curtain walls
  - Skylights
  - Building facades

IV. PV Solar Energy

Types of PV Systems

Concentrating Collectors

- Use of mirrors and/or lens to concentrate sun's energy
- Typically used in conjunction with tracking devices to optimize sun angle
- Very efficient, but higher cost
- Emerging and very promising new technologies:
  - Micro plastic reflectors produce similar efficiencies at much lower cost
  - Higher efficiency triple-junction cells
  - Heliotube panels use half-cylinder reflector panels

Systems Components

- Inverters: PV panels generate direct current (DC) and require conversion into 120/208 volt three phase alternating current (AC) power (weak link)
- Batteries: Typically not used where self generated power can be sold back to utility provider
- Tracking devices: Single and dual tracking devices rotate PV arrays to maximize efficiencies – typically only used when other PV applications are not feasible

IV. PV Solar Energy

Economic Analysis

- Becoming more economically feasible:
  - Continuing advances in cell manufacturing and new technologies
  - Government and utility incentives
  - Rising electrical costs
- Several factors contribute to the cost and payback analysis:
  - Type of PV cells and application of system
  - Size of system (economy of scale)
  - Rebates and incentives (constantly changing)
  - Electricity rates
  - Local market conditions (material and labor costs)

IV. PV Solar Energy

Economic Analysis

New versus Existing

- Integration of PV on new construction projects is much more viable than retrofitting
- Retrofitting panels on existing school roofs can be cost prohibitive due to DSA structural requirements
    - Warranty and replacement issues on existing roofing
- Most urban school sites cannot afford to lose significant space necessary for ground-mounted PV - vandalism and theft concerns on school campuses
- Most appropriate retrofit application for impacted urban sites is installation of new shade structure over paved areas – this adds significant costs to the installation

IV. PV Solar Energy

Economic Analysis

Example

- 200-kW Polycrystalline Array - 20,000 square feet
- Installed cost: $1,680,000 ($8.40/watt)
- Potential utility rebates: $662,000
- Net installation cost: $1,018,000
- Average output: 262,850 (0.9 degradation factor)
- Average utility rate of $0.14 /kWh (6.7% escalation)
- Simple payback: 27.7 years (20-year life expected)

(Source: LACCD Greenpaper by Glumac)

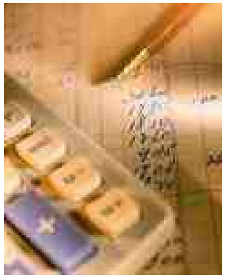
Economic Analysis

Summary

- The cost to integrate PV into building components for new construction can reduce payback period to 16-20 years
- PV systems do not make economic sense on their own
- Even with significant utility incentives, simple payback period exceeds expected life of the system
- Tax exempt entities cannot directly take advantage of the government incentives

IV. PV Solar Energy

Financing Options



District Procures System Directly

- Advantages
  - All power generated is realized as direct savings
  - Reduction in General Fund expeditures
  - No future buy-out required
  - No long term agreements

- Disadvantages
  - Requires significant capital outlay
  - Does not take advantage of current tax credits
  - Requires maintenance

IV. PV Solar Energy

Third Party Financing Option

- Advantages:
  - No upfront cost
  - Fixed energy cost for portion generated from PV installation
  - Guaranteed energy savings can be negotiated
- Disadvantages:
  - Cost difference between market rate and negotiated fixed rates is not significant savings
  - Long term agreement (10-20 years)
  - Cost to buy out system at end of PPA
  - Estimated useful life of 20 years (6-7 years inverters)
  - Requires minimum of 25,000 square feet non-shaded area
  - Location can be problematic
  - Damage, theft, and vandalism

IV. PV Solar Energy

Summary

- Solar energy is only one solution to achieve grid neutrality – other alternatives also explored and considered
- Solar combined with other solutions and systems may produce more benefits
- Challenges and distinctions between new and existing schools – some sites and projects more suited to solar
- Opportunities on new schools better than existing sites and buildings (ie New High School #1 – ECATS)
- Evaluating and reviewing standards and design guidelines – may develop performance standards for projects/sites

IV. Looking Into the Future

- Emerging technology on all fronts of sustainability very exciting and promising:
    - Power conservation - fully integrated building automation systems, nanotechnology, higher efficiency HVAC and lighting systems, high performance building insulation, high performance glazing, power conditioning
    - Power generation - fuel cell technology, more efficient and less costly PV, micro-wind turbines
- Technologies changing quickly
- Uncertainties of incentives, policy changes, and deregulation impacts

For More Information

This Presentation
(along with Board Workbook Materials)
is available at:

www.lbschools.net