1. What industry trends are affecting existing buildings?
2. What is ZNE, and how close can you get?
3. How can you be more prepared?
Outline

1. What industry trends are affecting existing buildings?

2. What is ZNE, and how close can you get?

3. How can you be more prepared?
Key California Laws and Regulations: Reduce Emissions, Carbon, Energy and Water Use

**AB 32 – Global Warming Solutions Act of 2006**

**AB 1103 – Nonresidential Building Energy Use Disclosure**

**AB 758 – Comprehensive Efficiency Program For Existing Buildings**

Reduce **Water** use 20% by 2020, from current 192 gallons per capita

**SB 1 Solar Energy** – 3,000 MW goal

**SB 107 Renewables Portfolio Standard**

**SB 1368 Emissions Performance Standards** for utility base load generation
The Water / Energy Nexus

CPUC Embedded Energy In Water Studies » Summary

Aggregating the data from Study 1 and Study 2 provides an updated view of the California Statewide Water-Energy Connection

» Water infrastructure in California consumes 7.7% of the state’s electricity use
» Similarly, nationwide the amount is estimated to be 4%

California Statewide Electricity Use


Source: Study 1 and Study 2

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Energy Action Plan

Loading Order:

1. Energy efficiency
2. Demand response (DR)
3. Renewable energy resources and distributed generation
4. Cleaner and more efficient fossil fuel generation
Loading Order #1: Energy Efficiency aka “NegaWatts”

Energy efficiency:

Using less energy to provide the same or improved level of service to the energy consumer in an economically efficient way; includes using less energy at any time, including during peak periods.

Use energy efficiency and demand response as preferred means of meeting growing energy needs.
Loading Order #2: Why Demand Response?

California uses 5% of capacity for less than 50 hours per year!

Last 25% of capacity needed less than 10% of the time

Capacity used to support peak demand is expensive, inefficient and environmentally unfriendly.

Source: California Independent System Operator Corporation
Loading Order #2: Demand Response

Time-Of-Use Pricing (TOU)
- On-peak, mid-peak, off-peak
- Various tariffs – what is right for your facility?

The Value of Demand Response
- Incentives for DR
- Low and no-cost techniques
- How to benefit financially from TOU pricing

What’s Available for Utility Customers
- Rate options, programs, incentives
Loading Order #3: Renewables and Distributed Generation

**Action on the Utility Side:**
Renewables Portfolio Standard (RPS)

- Requires investor-owned electric utilities to increase procurement from eligible renewable energy resources to 33% of total procurement by 2020.

- Allows for: wind, solar, geothermal, biomass and small hydroelectric facilities.
Loading Order #3: Renewables and Distributed Generation

1. **Utility-side or wholesale procurement**
   - Can be located at a customer site
   - Connected directly to the utility distribution system and exports all electricity to the utility

2. **Customer-side generation**
   - Also called self-generation or “behind the meter” systems
   - Typically sized to directly serve the customer’s on-site electricity needs
   - Examples: PV, wind, combined heat and power
SDG&E 2012 Electric Generation Portfolio Mix

The three combined cycle Fossil Fuel plants are:
- Palomar - 556 MW
- Desert Star – 495 MW (this is located in Nevada)
- Otay Mesa – 603 MW (located in Otay Mesa and owned by Calpine, under long term contract to SDG&E)
Loading Order #4: Clean and Efficient Fossil-Fuels

To the extent the above are unable to satisfy energy and capacity needs, support clean and efficient fossil-fuel fired generation.
The Value of Linking Energy Management Programs to Organizational Prosperity

- Lower energy costs
- Lower carbon intensity
- Path to zero net energy
- Improved branding
- Increased employee satisfaction

all may contribute to:

EE
DR
DG
Renewables
Big Bold Goals for New Buildings:
ZNE Res 2020
ZNE Commercial 2030

on-site electricity demand
distributed renewable generation

zero net energy
Big Bold Goals for Existing Buildings: 50% Reduction by 2030
Market Pull: AB1103 for Non-Residential Buildings

BASICS: Requires Energy Use Benchmarking and Disclosure

- Trigger is financial transaction for the whole building
- Allows prospective buyers and tenants to compare building performance with similar buildings
- Motivates owners to improve building’s energy profile
  - Compared with competition
  - Impact on building valuation
- A benchmarking system, drawing on Energy Star Portfolio Manager
## Market Pull: AB1103 – When is it Effective?

<table>
<thead>
<tr>
<th>Building Type</th>
<th>Planned Effective Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan 1, 2014</td>
<td>Jul 1, 2014</td>
</tr>
<tr>
<td>Commercial Buildings, All Occupancies</td>
<td>&gt; 10,000 sf</td>
</tr>
<tr>
<td></td>
<td>&gt; 5,000 sf</td>
</tr>
</tbody>
</table>

Energy Star is a 12 month “look-back”

*Last year’s energy use is part of the disclosure!*
Market Pull:
Faster Leasing
Lower Vacancy
Higher Rates
Higher Asset Value
Outline

1. What industry trends are affecting existing buildings?
2. What is ZNE, and how close can you get?
3. How can you be more prepared?
What is *High Performance*?
What is ZNE?

Zero Net:
- Electricity
- Energy
- Emissions
- Energy Cost
- Site or Source?
The Net Zero music has themes …

1. Efficiency embedded in design
   Building geometry, orientation, glazing, insulation; daylighting and shading; thermal mass; natural ventilation potential …

2. Efficiency in equipment
   HVAC, lighting, hot water, plug and process, controls, commissioning …

3. Efficiency in operations
   Maintenance, behavior, ongoing monitoring …

4. Renewable energy offset
   PV, solar thermal, fuel cell …
Example: Options to reduce EUI
Example: Natural Ventilation Opportunity
Hybrid Natural Ventilation

| Mechanical AC Only | Hybrid, Mixed Mode | Hybrid, Mixed Mode | Hybrid, Mixed Mode | Hybrid, Mixed Mode | Hybrid, Mixed Mode | Natural Ventilation Only |

*Wide range of possible Natural Ventilation contribution, influenced both by design and by occupant preferences.*
Hybrid Natural Ventilation

Variations:

- Manual or automatic
- Times of day, or seasonal
- Zones with or w/o AC
- Concurrent operation
Example: Perceived Temperature

![Temperature Graph]

- **Inside Temperature**
- **Radiant Temperature**
- **Operative Temperature**
- **Outside Temperature**
Example: Airflow Modeling
Example: Perceived Temperature
Example: Daylighting Opportunity
Example: How low can you go?
HGW Bacon Street Office Renovation: 
Net Zero: Case Study

Existing Building Condition
– built in 1955

New Building Condition
Metrics: who’s counting?

Title 24  ...  LEED  ...  Net Zero:

HGW Office: Annual Electric Use (KWH)

<table>
<thead>
<tr>
<th>KWH / SF</th>
<th>Title 24 Standard</th>
<th>Title 24 Proposed</th>
<th>Exceptional LPD 0.30 w/sf</th>
<th>Exceptional LPD 0.30 w/sf Nat Vent</th>
<th>Exceptional LPD 0.30 w/sf No AC</th>
<th>Exceptional LPD 0.30 w/sf No AC Reduced Recep</th>
<th>Renewable Energy</th>
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<td>14.0</td>
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<td>8.4</td>
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</tbody>
</table>

HGW Bacon Street Office – Case Study
What if …

every single act
of design and construction
made the world a better place?

LIVING BUILDING CHALLENGE™ 2.0
A VISIONARY PATH TO A RESTORATIVE FUTURE

www.ilbi.org

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Applying ideas to the built environment …

Living Building Challenge

- Site
- Water
- Energy
- Health
- Materials
- Equity
- Beauty

What if … every single act of design and construction made the world a better place?
Bullitt Center
Living Building Challenge, Seattle
Net Zero Energy, Net Zero Water, ...
Bullitt Center
Living Building Challenge, Seattle
1. What industry trends are affecting existing buildings?
2. What is ZNE, and how close can you get?
3. How can you be more prepared?
Timing is Key to Profitable Deep Retrofits

Top ‘ripeness’ indicators

1. Planned capital improvements
2. Major occupancy change
3. Major ‘system’ replacement
4. Code required upgrades
5. Change in ownership

Presented at USGBC Greenbuild 2012
How To Improve Building Performance

Continuous Monitoring!!

Mid & Long Term Capital Improvements

Implement No-Cost and Low-Cost Measures

Retro-commissioning and Audits

Diligent Maintenance

Benchmark
Benchmarking: Energy Star Portfolio Manager

Use Portfolio Manager

You've heard it before: you can't manage what you don't measure. That's why EPA created ENERGY STAR Portfolio Manager®, an online tool you can use to measure and track energy and water consumption, as well as greenhouse gas emissions. Use it to benchmark the performance of one building or a whole portfolio of buildings, all in a secure online environment.

Not sure if Portfolio Manager is for you? It is!


All you need are your energy bills and some basic information about your building to get started.

Join the rest of the industry.

When you add your buildings, you'll be joining 40 percent of U.S. commercial building space that's already benchmarked in Portfolio Manager — making it the de facto industry standard. You'll also be joining 35 percent of the Fortune 500®, half of the largest U.S. healthcare organizations, major league sports teams, colleges and universities, and entire cities.

Benchmarking: to Bldg’s own historical trends
Benchmark to your Optimized Use

- Actual Use
- Optimized Use

KWh/Month

Jan  Feb  Mar  Apr  May  Jun  Jul  Aug  Sep  Oct  Nov  Dec
Average Office Buildings’ Energy End-Use in CA, Grouped by Activity

Based on data from the Department of Energy, Energy Information Administration, Building End-Use Consumption Survey, 1999.

Image Source: http://www.fypower.org/bpg/index.html?b=offices
Where do your Utility Costs Go?

What Is Your Building’s Energy End-Use Consumption?

- Gas
- Water
- Electric
Center for the Built Environment (CBE)
Occupant Comfort Survey: Average

General Satisfaction-Building  0.65
General Satisfaction-Workspace  0.69
Office Layout  1
Office Furnishings  0.58
Thermal Comfort  -1.05
Air Quality  -0.34
Lighting  0.93
Acoustic Quality  -1.13
Cleanliness and Maintenance  0.08

N=151
Examples: Energy Efficiency Strategies

- Lighting
- HVAC: Zone and central plant
- Glazing and Shading
- Plug load reduction
- Processes: refrigeration, data, etc.
- Hot water and steam
- Water: Inside, outside, process
- Equipment & system level controls
- Energy Management Systems and dashboards
Recap: Simple Menu of DSM/IDSM Components

- Active management
- RCX and ongoing Cx
- Component energy efficiency measures
- Deeper retrofits: integrated design
- Water and energy nexus
- Maintenance and equipment life
- Onsite Distributed Generation (DG)
- Renewables: PV and solar water heating
- Rates and tariffs

*Keep in mind: components interact!*
How Low Can You Go?

- Building - As Is
- Passive to Active Energy Mgmt
- Retro-commissioning (RCX)
- Modest Upgrades
- Engage Occupants
- Deep Retrofit
- Renewable Offset
Create an Action Plan
Levels of Retrofit

1. Energy Audit: Begin to Look

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Up to ~15% energy savings</td>
<td>▪ Exhausts ‘low hanging fruit’</td>
</tr>
<tr>
<td>▪ Quick payback</td>
<td>▪ Leaves savings ‘on the table’</td>
</tr>
</tbody>
</table>

2. Energy Retrofit: Separate Components / EEMS

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Up to ~30% energy savings</td>
<td>▪ Exhausts ‘low hanging fruit’</td>
</tr>
<tr>
<td>▪ ESCO potential</td>
<td>▪ Leaves savings ‘on the table’</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ &gt;50% energy savings</td>
<td>▪ Higher construction costs</td>
</tr>
<tr>
<td>▪ Right timed, net zero</td>
<td></td>
</tr>
</tbody>
</table>
Energy Savings Solutions: Financial Analyses

What it is, when to use it

- First Cost
- Simple Payback Period (SPP)
- Internal Rate of Return (IRR)
- Life Cycle Cost Analysis (LCCA)
- Savings to Investment Ratio (SIR)
Finding the Money

• Reduce first costs
  – Design integrations!
  – Utility incentives
  – Tax incentives: CBTD, renewable tax credits
• Self financing, direct savings, and revolving energy fund
• Utility On-Bill Financing and SPP
• Performance-based contracting
• Power Purchase Agreements (PPA)
• Lenders becoming familiar with EE
• Leasing
• PACE financing...

PACE: Property Assessed Clean Energy
A team with many players

- Custodial
- Facility Manager
- Information Technology
- Property Manager
- Building Engineer
- Security
- Occupant
- Groundskeeper
- Owner
- Tenants

Vendors
Insurance Companies
Contractors
Asset Managers
Real Estate Appraisers

Courtesy: USGBC
Owners & Tenants: Both Benefit from Improved Energy Performance

<table>
<thead>
<tr>
<th>Example Project:</th>
<th>Floor Area (sf)</th>
<th>Annual Electrical Usage (kWh) As Designed</th>
<th>Annual Natural Gas Usage (therm) As Designed</th>
<th>Estimated Operational Costs:</th>
<th>With TI Efficiency *</th>
</tr>
</thead>
<tbody>
<tr>
<td>all core</td>
<td>6,000</td>
<td>103,000</td>
<td>100</td>
<td>$3.00/sf-yr</td>
<td>n/a</td>
</tr>
<tr>
<td>1st Floor TI</td>
<td>14,000</td>
<td>406,000</td>
<td>7400</td>
<td>$5.40/sf-yr</td>
<td>$4.60/sf-yr</td>
</tr>
<tr>
<td>2nd Floor TI</td>
<td>17,000</td>
<td>246,000</td>
<td>800</td>
<td>$2.60/sf-yr</td>
<td>$2.30/sf-yr</td>
</tr>
<tr>
<td>3rd Floor TI</td>
<td>17,000</td>
<td>248,000</td>
<td>800</td>
<td>$2.60/sf-yr</td>
<td>$2.30/sf-yr</td>
</tr>
<tr>
<td>4th Floor all</td>
<td>11,000</td>
<td>138,000</td>
<td>700</td>
<td>$2.30/sf-yr</td>
<td>n/a</td>
</tr>
<tr>
<td>Whole building</td>
<td>66,000</td>
<td>1,142,000</td>
<td>9,800</td>
<td>$3.15/sf-yr</td>
<td>$2.80/sf-yr</td>
</tr>
</tbody>
</table>
Energy Management Behavior and Team Building

*Culture and Behavior Change Touch Points:*

- Senior leadership buy-in
- Consider organizational culture and climate
- Define roles and resources
- Internal and external communications plan
- Engage line managers
- Employee motivation and training
- Incentives:
  - Financial
  - Recognition and performance
- Multiplier effect opportunities
Measure Progress!

Report Progress!!

Act on Results...
Key Takeaways ...

- Know why you care
- Include in overall capital planning
- Financial analyses should include Total Cost of Ownership
- Engage occupants and end users!
- *Integrate, integrate, integrate!*
- Yes, you can!
Questions & Discussion