General Session

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General Session

- National Energy Situation and Prognosis
- The Future of the Built Environment
- Transition to Renewables
National Energy Situation
US Energy Use (Quads)

Total Energy up 14% by 2035

Source: Annual Energy Outlook 2010
U.S. Primary Energy Consumption by Source and Sector, 2008

Total U.S. Energy = 99.3 Quadrillion Btu

Share of Energy Consumed by Major Sectors of the Economy, 2008

- Commercial: 19%
- Industrial: 31%
- Residential: 22%
- Transportation: 28%

World-wide demand yielded to the pressures of high prices and the deteriorating global economy.
Actual Production
2002 - 27.40 Gb
2003 - 28.33 Gb
2004 - 29.55 Gb
2005 - 30.10 Gb
2006 - 30.09 Gb
2007 - 30.03 Gb
2008 - 30.40 Gb
2009 - 30.09 Gb

Source: USDOE 2010
International Energy Agency 2009 Assessment of Oil

- NGLs
- Unconventional oil
- Crude oil – fields yet to be developed or found
- Crude oil – currently producing fields
Illinios Natural Gas Prices

Source: DOE/EIA Jan 2010

First 10 months
Horizontal Wells to Fracture Shale
# Natural Gas Technically Recoverable Resources

<table>
<thead>
<tr>
<th>Natural Gas Resource Category</th>
<th>As of January 1, 2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Trillion Cubic Feet)</td>
<td></td>
</tr>
<tr>
<td><strong>Nonassociated Gas</strong></td>
<td></td>
</tr>
<tr>
<td>Undiscovered</td>
<td>373.20</td>
</tr>
<tr>
<td>Onshore</td>
<td>113.61</td>
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<tr>
<td>Offshore</td>
<td>259.59</td>
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<tr>
<td><strong>Inferred Reserves</strong></td>
<td>220.14</td>
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<tr>
<td>Onshore</td>
<td>171.05</td>
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<tr>
<td>Offshore</td>
<td>49.09</td>
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<tr>
<td><strong>Unconventional Gas Recovery</strong></td>
<td>644.92</td>
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<tr>
<td>Tight Gas</td>
<td>309.58</td>
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<tr>
<td>Shale Gas</td>
<td>267.26</td>
</tr>
<tr>
<td>Coalbed Methane</td>
<td>68.09</td>
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<tr>
<td><strong>Associated-Dissolved Gas</strong></td>
<td>128.69</td>
</tr>
<tr>
<td><strong>Total Lower 48 Unproved</strong></td>
<td>1366.96</td>
</tr>
<tr>
<td>Alaska</td>
<td>169.43</td>
</tr>
<tr>
<td><strong>Total U.S. Unproved</strong></td>
<td>1536.38</td>
</tr>
<tr>
<td><strong>Proved Reserves</strong></td>
<td>211.09</td>
</tr>
<tr>
<td><strong>Total Natural Gas</strong></td>
<td>1747.47</td>
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Source: Energy Information Administration - Annual Energy Outlook 2009
Historical Average Weekly Coal Commodity Spot Prices (Dollars per Short Ton)
The rise in fossil energy prices was driven by structural changes in the world economy that produced rapidly increasing demand at the same time rising costs of production.

We have a dip now, but higher prices will return once the world economy recovers.

Electrical restructuring will result in continued price increases (and you haven’t see anything yet.)
Transforming the Built Environment
Impacts of Energy & Buildings

- Energy production and use account for early 80% of air pollution, more than 88% of greenhouse gas emissions, and more environmental damage than any other human activity.

- Residential & Commercial Buildings in the United States are responsible for:
  - 74.5% of electricity production.
  - 50.1% of total energy flows.
  - 49.1% of CO2 emissions.
  - 50% of the CFC emissions.

- Overall energy consumption by the building sector continues to increase.
Impact of Buildings on Energy

Energy Use by Sector

- Buildings
- Industry
- Transportation

Quads

U.S. energy related CO₂ emissions by sector
Energy Efficiency

- The cost of saving energy is going down while the price of energy is going up.
- Efficiency is the cleanest, cheapest, safest, and most secure source energy we have.
- These savings from energy efficiency to date have not yet come close to tapping the full potential for savings.
AIA 2030 Position Statement

- Promote sustainable design including resource conservation to achieve a minimum 50 percent reduction from the current level of consumption of fossil fuels used to construct and operate new and renovated buildings by the year 2010, and promote further reductions of remaining fossil fuel consumption by 10 percent or more in each of the following five years.

Source: AIA November 2005
AIA 2030 Glidepath

Zero Fossil
ASHRAE Vision 2020

- Providing tools by 2020 to enable the building community to produce market-viable NZEBs by 2030.
- NZEB means the building produces as much energy as it uses when measured at the site.
Types of NZEB

- NZEB A: Renewables within the building footprint and directly connected.
- NZEB B: A plus renewables on the building site and directly connected.
- NZEB C: A and B plus renewables off-site to generate electricity on-site.
- NZEB D: A, B, and C plus purchase of certified off-site renewable energy and continue to purchase throughout life.
ASHRAE Path to Net Zero Energy

Energy Use Targets
For Code-Intended Standards

Targets in kbtu/square foot/year

- 2010: 36 kbtu/square foot/year
- 2013: 30 kbtu/square foot/year
- 2016: 25 kbtu/square foot/year
- 2019: 20 kbtu/square foot/year
- 2022: 15 kbtu/square foot/year
- 2025: 10 kbtu/square foot/year
- 2028: 5 kbtu/square foot/year
- 2031: 0 kbtu/square foot/year
ASHRAE/IESNA Actions

Advanced Energy Design Guides:
- 30%, 50%, 70%--Net Zero Energy
- Small Buildings (20-50ksf)
- Small Office, Small Retail, K-12 Schools, Warehouses, Highway Lodging, Small Healthcare, and Existing Buildings.

Schedule:
- Complete 50% guides by 2011.
- Complete 70% guides by 2015 to include “net-zero” guidance.

Tools in place by 2020 and market viable NZEBs by 2030. Std 90.1–2031 Net Zero Energy.
ASHRAE AEDGs

Download free: http://www.ashrae.org/aedg
Climate Legislation

- Sec. 201 of the American Clean Energy and Security Act of 2009 (H.R. 2454) passed by the House calls for national building code energy reduction targets of:
  - 30% below the baseline energy code in 2010
  - 50% below the baseline energy code in 2014-2015
  - 5% additional reduction every three years to 2029-2030.
- The Senate bill contains a similar provision, requiring 30% improvements in 2010 and 50% improvements in 2016, but without the additional 5% improvements every three years.
Impact of Climate Legislation
Percent Energy Usage

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<tr>
<td>Usage</td>
<td>100</td>
<td>80</td>
<td>60</td>
<td>50</td>
<td>40</td>
<td>30</td>
<td>20</td>
<td>10</td>
<td>5</td>
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IECC 2009

- New state law.
- Applies to both residential and commercial buildings.
- Results in efficiencies about 17% beyond IECC 2006 in Residential & 5-7% in Commercial Buildings.
- New requirements
  - Building envelope tightness
  - Duct testing
  - Lighting equipment
  - Pool controls and covers
  - Snow melt controls
ASHRAE Standard 90.1–2007

- If there is any state money in the project then, you must meet Std 90.1.
- Gives similar results to IECC 2009 as it was the reference standard.
- Slight variations in requirements.
The Code Council along with AIA and ASTM are developing a green construction code.

First edition scheduled for March 2012.

Energy baseline is 30 percent beyond 2006 IECC.

10 percent beyond baseline for energy minimum and tiers up to 50 percent beyond baseline with a combination of efficiency gains and renewables.

Prescriptive and Performance paths offered.

Other aspects of green building included, some choice by code agencies.
ASHRAE High-Performance Green Building Standard

- Standard 189.1, Standard for the Design of High Performance, Green Buildings Except Low-Rise Residential Buildings, is being developed ASHRAE in conjunction with the Illuminating Engineering Society (IES) and the U.S. Green Building Council (USGBC).

- The standard is slated to be the first code-intended commercial green building standard in the United States.

- It is expected to be published in early 2010.

- The standard provides a total building sustainability package and will set the foundation for green buildings through its adoption into local codes.
Energy Performance Rating of existing and new buildings is coming.

ASHRAE developing a rating system of A-F.

The new climate bill in Congress requires model rating system development by EPA.

Disclosure of building energy usage is voluntary.

The marketability of energy hogs may be severely reduced over time with tax base implications for the public sector.
Energy Opportunities

- Potential energy savings ranged from a high of 100% to a low of 3% for existing buildings and between 96% and 12% for new designs (the high end incorporates renewables).

- Data from 339 existing buildings show:
  - 31% energy savings.
  - 30% energy cost savings.
  - Typical savings of $50,43 per year.

- Data from 44 new building designs show:
  - 38% energy savings.
  - 37% energy cost savings.
  - Typical savings of $50,627 per year.

Typical existing building uses $3.08/sf and can save $0.94/sf. Typical new building uses $2.16/sf and can save $0.83.
Untapped Energy Efficiency Opportunities

- Retrofits: 83%
- New Construction: 5%
- Equipment Replacement: 12%
Why Increase Energy Efficiency

- Reduce operating costs of buildings.
- Stabilize atmospheric carbon & reduce global climate change impacts.
- Improve the quality of life in our buildings and communities.
- Enhance economic development.
- Meet increasingly stringent codes, qualify for rebates, and meet LEED criteria.
Transitioning to Renewable Energy
Energy Futures

- Over 80 per cent of the world's primary energy supply is currently derived from fossil fuels.
- Concerns around energy security, climate change, and price volatility and inflation are driving the search for cheaper and more environmentally friendly alternatives.
- It is only recently that technological advances and reduced production costs have meant renewables can fulfill this need.

Representative thin crystalline–silicon photovoltaic cells – these are from 14 to 20 micrometers thick and 0.25 to 1 millimeter across.
What is renewable energy?

- Energy which comes from sources that are regenerative and virtually inexhaustible.
- Several types available, including:
  - Wind
  - Solar Photovoltaic and Thermal
  - Biomass (Plant materials)
  - Hydrokinetic (Hydroelectric, Run of River, Wave, Tidal)
  - Geothermal (Heat from the ground)
Renewable Energy Available with Today’s Technology

Source: UNDP, Johansson et al., IEA
US Renewable Energy 2008

- Petroleum: 37%
- Natural Gas: 24%
- Coal: 23%
- Nuclear Electric Power: 9%
- Renewable Energy: 7%

Note: Sum of components may not equal 100% due to independent rounding.

- Solar/PV grew 12%
- Wind grew 51%
- Biofuels grew 38%
- Coal fell 1.4% (fell 12%)
- Natural Gas grew <1% (grew 3.6%)
- Petroleum fell 6.6% (fell 5%)
- Electricity fell 1.1% (fell 4%)
Present World Energy Path

Total Energy Use

- Oil
- Gas
- Coal
- Nuclear
- Hydro
- Other Renewables
- Wind
- Solar

Mtoe per year

What the future must look like:
Some Sobering Thoughts

- The transition to new renewable energy sources is unavoidable, but there are some issues to consider:
  - Scale of the shift.
  - Energy density (Btu/lb).
  - Power density (Watts/ft$^2$).
  - Intermittency.
  - Geographical Distribution.
US Energy 1850–2008

- Coal
- Natural Gas
- Petroleum
- Hydroelectric Power
- Wood/Biomass
- Nuclear Elec

Quads

Some Sobering Thoughts

The transition to new renewable energy sources is unavoidable, but there are some issues to consider:

- Scale of the shift.
- Energy density (Btu/lb).
- Power density (Watts/ft²).
- Intermittency.
- Geographical Distribution.

### Energy Density
- Coal: 12-15 kBtu/lb
- Petroleum: 19 kBtu/lb
- Biomass: 8-9 kBtu/lb
- Nuclear: 35 BBtu/lb

### Power Density
- Fossil: 10 to 100 W/ft²
- Biomass: <0.1 W/ft²
- PV: 2 W/ft²
- Hydro: <1 W/ft²
- Wind: 22 W/ft²
- Nuclear: 12-50 W/ft²
Putting it Together

- We have entered interesting times.
- Enhancing energy efficiency in new and existing buildings is an imperative.
- Improved energy efficiency & new technology deployment are critical.
- This is not going to go away. The current dip in energy prices is temporary and legislation will require better designs.
- The challenge is enormous – but it can and must be met.
- Each year of delay adds $500 billion to climate change mitigation costs between today and 2030.
Illinois Smart Energy Design Assistance Center

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