

Sustaining our Future by Rebuilding our Past

**Energy Efficiency in Existing
Buildings – Our Greatest
Opportunity for a Sustainable
Future**



A satellite view of the Atlantic Ocean, showing the western coast of Europe and the northern part of Africa. The text is overlaid on the image in a bright green color.

ASHRAE's Sustainability Goals

The Path Towards Net Zero Energy Buildings

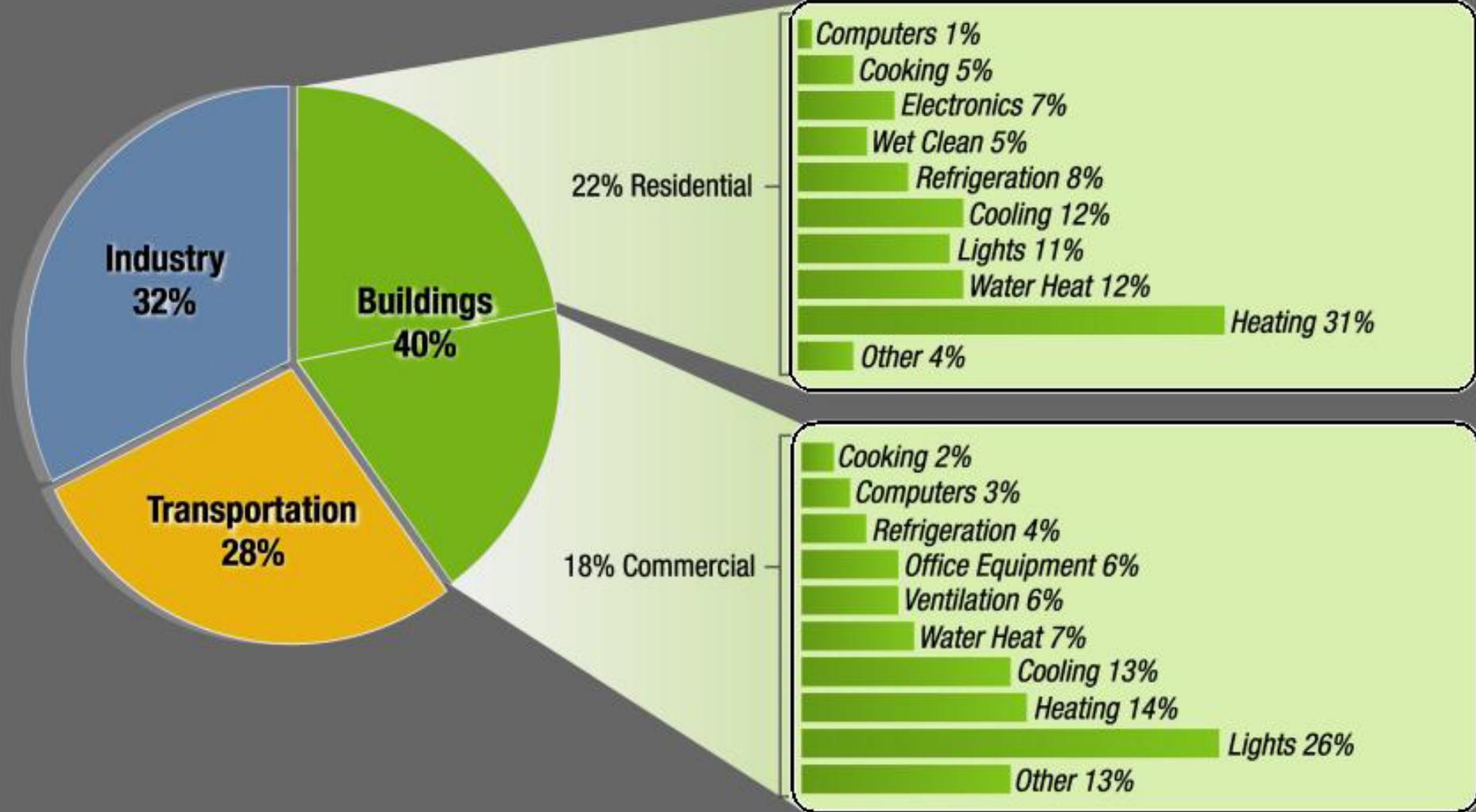
Resolving the Issues of Increasing Demand, Decreasing Supply and Environmental Impact.

ASHRAE Sustainability Initiatives

ASHRAE is working hard in a wide range of areas to support the goals of sustainability for reduction in energy use and green house gas emissions.

- 2006 Strategic Plan
 - Green Guide 2nd Edition
 - Sustainability Roadmap
 - Vision 2020 Report – NZEB goals
 - Building Performance Metrics Projects
 - ASHRAE Building Energy Labeling Program
 - Educational, Certification & Research Programs
-
- **Advanced Energy Design Guides (AEDG)**
 - **Standard 90.1 Provisions**
 - **Standard 189.1 P**
 - **Standard 100**

Total Energy Consumption



www.highperformancebuildings.gov

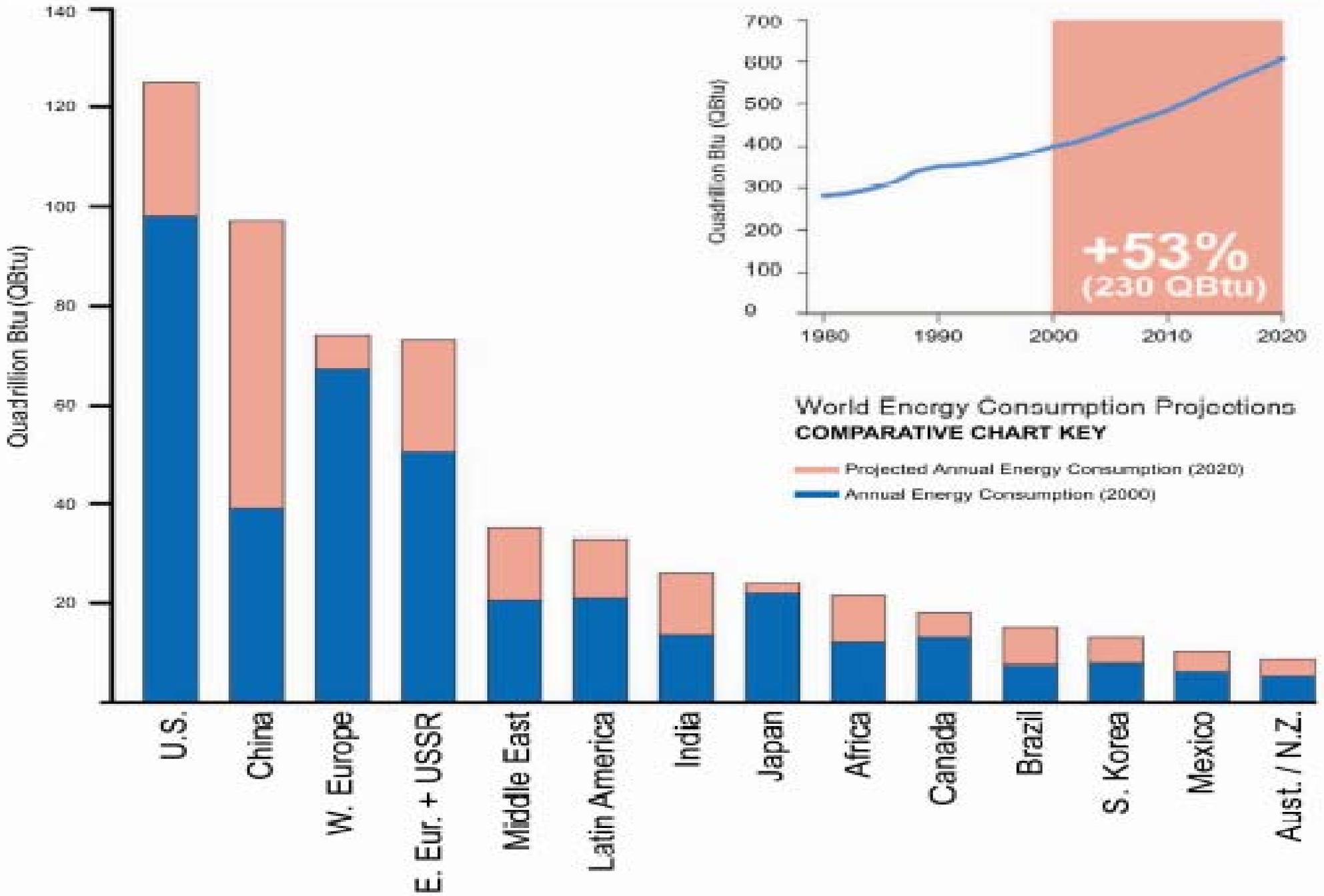
**Buildings Consume
40% of US Primary Energy**

Buildings Represent

- 17% of fresh water consumption
- 25% of wood consumption
- 33% of CO2 emissions
- 30% of waste generation
- 40% of energy use
- 55% of natural gas use
- 72% of electrical energy use

PER CAPITA ENERGY CONSUMPTION

Worldwide Average	200 Kwh/capita/year
China	1800 Kwh/capita/year
Europe	6000 Kwh/capita/year
USA	16,000 Kwh/capita/year



Country / Region Energy Consumption Projections

Source: U.S. Energy Information Administration Statistics Center

USA Energy Production and Imports

	1975	2005	2030
Oil	70%/30%	30%/70%	???
Gas	100%	70%/30%	???

The Cost of Being Green

- ▣ 2006 Global Emissions: 28,000,000,000 MT
- ▣ 2006 USA Emissions: 5,700,000,000
United States Share: 20%
- ▣ Global cost of mitigation: \$10,500,000,000,000
- ▣ US Share: \$2,100,000,000,000

What is the cost of taking energy out of existing buildings?

Our Greatest Opportunities?

2% of Building Projects are New
Construction

86% of Construction Dollars go into
Existing Buildings

75% to 80% of All Buildings
That will Exist in 2030

Exist Today!

A cityscape at dusk or dawn, featuring a variety of buildings. In the foreground, there is a large, abstract, grey sculpture on a white base. To the left, a tall, slender skyscraper with a pointed top is prominent. In the center, a large, multi-story building with a classical facade and a central archway is visible. To the right, another tall building with a distinctive top section is seen. The sky is a mix of light blue and white clouds, suggesting a clear day. The overall scene is a mix of modern and traditional architecture.

Energy Efficiency in Existing Buildings

What Have We Learned?

Why Energy Efficiency and Sustainable Buildings

In the Life Cycle of a Building

Initial Construction Cost is only 2%

Operational and Energy Cost is only 6%

Occupancy Cost Accounts for 92%





Our Greatest Opportunities Existing Buildings

Barriers To Success

- 1. Legislative/ Political**
- 2. Economic**
- 3. Technical**



ASHRAE – Cohesive Program to Promote Energy Efficiency in Existing Buildings

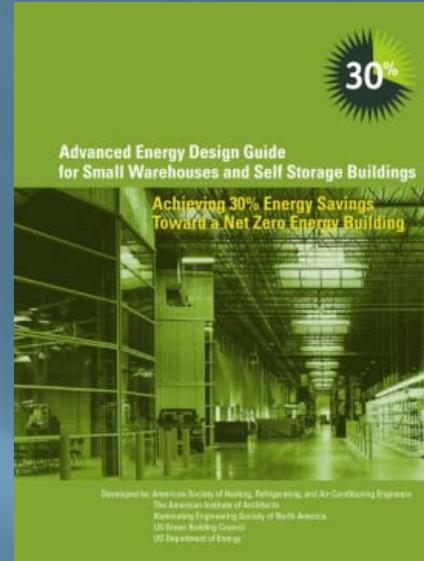
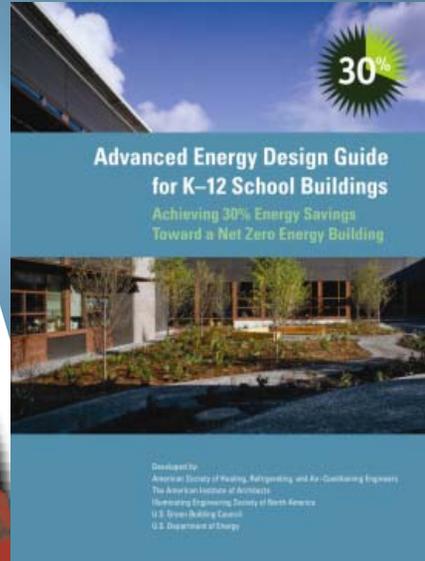
- Standards
- Guidelines
- Design Guides
- Design Manuals
- Handbooks
- Educational Programs

Net-Zero-Energy Buildings

Buildings which, on an annual basis, use no more energy than is provided by on-site renewable energy sources.



ASHRAE Sustainability Initiatives



- Advanced Energy Design Guides (AEDG)
- 30% Series –Retail, Office , K-12 Schools, Warehouses - Already Published
Highway Lodgings, Health Care Facilities

ASHRAE AEDGs

If Every One of the 185,000 Downloads of the AEDGs Resulted in Just One Project Being Designed at 30% Saving

We Would Save:

98 Trillion Btu/Year

16.5 Million Tons CO₂/Year

\$1.15 Billion Per Year

Development of the Guides

- Collaboration of Partner Organizations
- Management via Steering Group
- Volunteer team effort
- 8-15 Member Project Committees
- 3500+ to 5000+ person-hrs to develop each
- Reviewed multiple times during writing process



Now What?

Additional Advanced Energy Design Guides Planned or In Process

Energy Efficiency Guides for Existing Buildings

- Business Case
- Technical Guide
- Owning and Operating Guide

Our Path Forward for the AEDGs

- **Complete the 30% Guide Series**
- **Complete the Existing Building Guide Series**
- **Develop the 50% and NZEB Design Guides**
- **Target completion of the 50% series is 2009-2011**
- **Target completion of the NEZB series is 2013-2015**

50% and NZEB Design Guides

- ▣ 50% and NZEB guides are being planned
- ▣ Strategic planning has been done to provide structure and identification of research needed
- ▣ Anticipated these will have more emphasis on integrated design process
- ▣ Target completion of 50% series is 2009-2011
- ▣ Target completion of NZEB series is 2013-2015

Standards Development

**90.1 - Design of Commercial Buildings,
Except Low-Rise Residential**
**Goal: 30% increase in stringency
between 2004 and 2010 versions**

**189.1P – Design of High-Performance Green
Buildings**
Initial target is 30% over 90.1-2004

**100 – Energy Conservation in Existing
Buildings**

Our Path Forward for Standard 90.1

- **Consider Plug and Process Loads**
- **Evaluate use of Cost Based Site or Source EUIs**
- **Develop the User's Manual**
- **Consider Performance Based Analysis**

ANSI/ASHRAE/IESNA Standard 189.1 P

ANSI/ASHRAE/IES/USGBC Standard 189.1-2009



ASHRAE STANDARD

Standard for the Design of High-Performance, Green Buildings Except Low-Rise Residential Buildings

Approved by the ASHRAE Standards Committee on June 2009; by the ASHRAE Board of Directors on June 2009; and by the American National Standards Institute on June 2009.

ASHRAE Standards are scheduled to be updated on a five-year cycle; the date following the standard number is the year of ASHRAE Board of Directors approval. The latest copies may be purchased from ASHRAE Customer Service, 1791 Tullie Circle, NE, Atlanta, GA 30329-2305. E-mail: orders@ashrae.org. Fax: 404-321-5478. Telephone: 404-636-8400 (worldwide) or toll free 1-800-527-4723 (for orders in US and Canada).

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Our Path Forward for Standard 189.1

- **Complete and Publish the Standard in 2009**
- **Set a Clear Timeline to Get to Net Zero in 2030**
- **Develop the User's Manual**
- **Identify Application of Renewables in Dense Urban Areas**
- ▣ **Consider Two Tiers of Energy Performance**

ANSI/ASHRAE/IESNA Standard 100-2010?



ANSI/ASHRAE/IESNA Standard 100-2006
(Supersedes ANSI/ASHRAE/IESNA Standard 100-1995)

ASHRAE STANDARD

Energy Conservation in Existing Buildings

Approved by the ASHRAE Standards Committee on June 24, 2006; by the ASHRAE Board of Directors on June 29, 2006; by the Illuminating Engineering Society of North America on July 17, 2006; and by the American National Standards Institute on June 30, 2006.

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Our Path Forward for Standard 100

- **Further develop the standard**
- **Include Energy Conservation Measures (ECMs)**
- **Include Life Cycle Cost Analysis techniques.**
- **Consider requirements to do Energy Modeling and Load Simulation**

ASHRAE Energy Targets

ASHRAE ENERGY TARGETS

Year	Standard 90.1*	Standard 90.1 **	Standard 189.1		AEDGs ###	
			1#	2##	1#	2##
2004	43.75	70.70	--	--	-	-
2007	40.60	--	33.1	49.0	37.3	54.26
2010	30.6*	49.0 !	28.2	40.95	26.7	38.27
2013	27.0*	42.0 !	24.7	36.1	24.0	35.70
2016	23.0*	36.0 !	18.0	31.85	18.0	31.85
2020	18.0*	24.0 !	12.6	18.2	Zero	Zero
2025	14.0*	18.0 !	6.30	9.10	Zero	Zero
2030	10.0*	16.0 !	Zero	Zero	Zero	Zero

* Excludes Plug and Process Loads

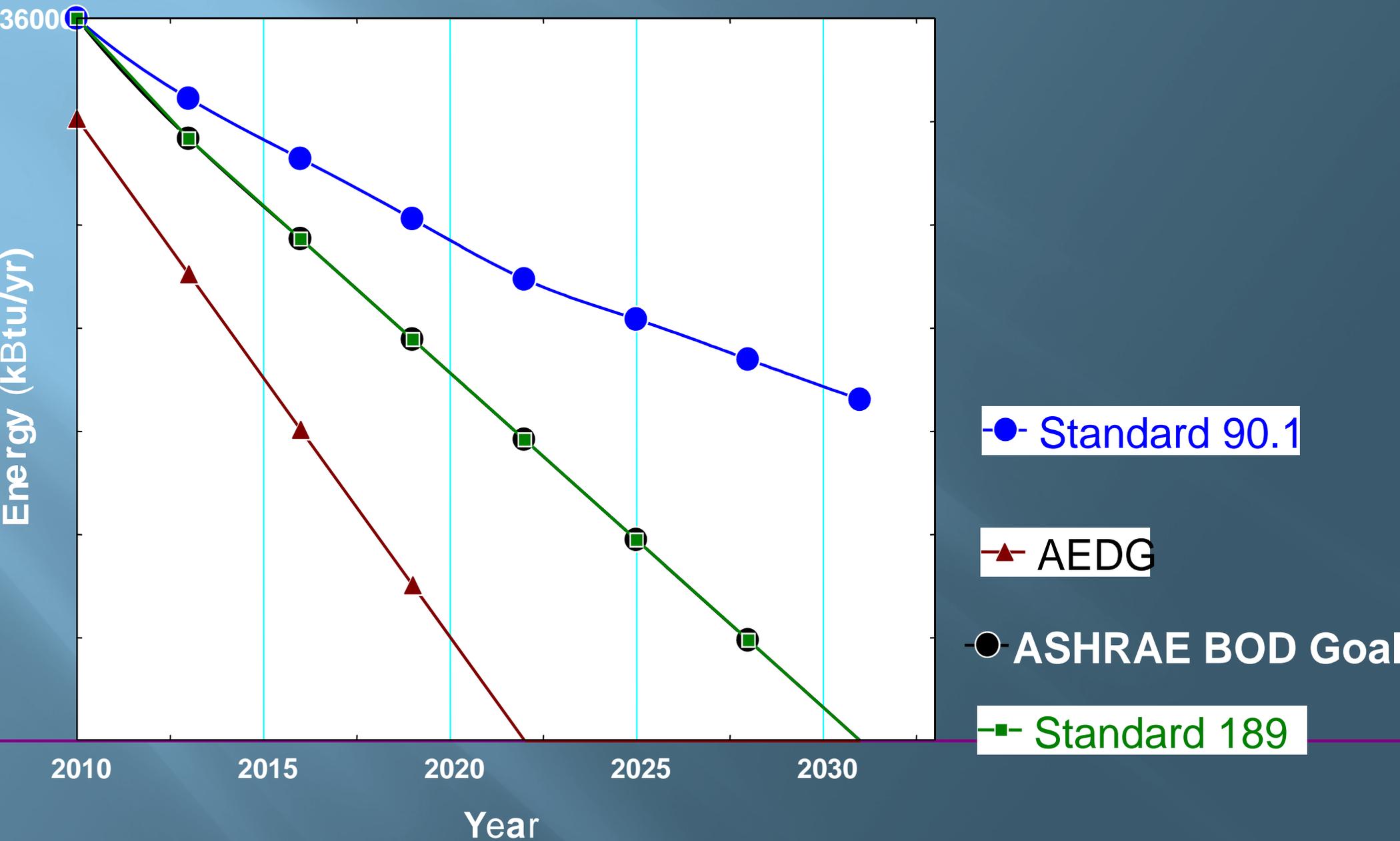
** Including Plug and Process Loads

Targeted at 30% below Standard 90.1-2004 Excludes Plug and Process Loads

Targeted at 30% below Standard 90.1-2004 Includes Plug and Process Loads

Targeted to be at 30% below Standard 90.1 for 2007-09 50% for 2009-11 and net zero 2013-15

Energy Reduction Proposal



Identify Potential Energy Saving Measures for Existing Buildings

- Routine Maintenance and Repairs
- Retro – Commissioning
- Utility Tariffs/Negotiations
- Tenant Fit Out and Improvements
- Equipment Replacement
- Major Renovations

Identify Potential Energy Saving Measures for Existing Buildings

Building Envelope

- Window Replacement
- Solar Films
- Caulking/Sealing
- Enhanced Insulation

HVAC Systems

- Higher Equip. Efficiencies
- Heat Recovery
- Displacement Ventilation
- DOAS
- GSHP

Lighting Systems

- T8 Versus T12 Lamps
- Compact Fluorescent Bulbs
- Electronic Ballasts
- Day Lighting Controls
- Motion Sensors

Controls/Other

- Management Systems
- Maintenance Systems
- Monitoring/Auditing
- Applied Photo Voltaics
- Variable Speed Drives

Identify Potential Energy Saving Measures for Existing Buildings

Role of Commissioning and Retro Commissioning

Why is Cx or RCx so Critical?

- **Buildings are very complex prototypical machines**
 - Unique
 - Built on-site
 - Built by hand
 - Thousands of independent components
- **Most buildings do not operate as intended**

ASHRAE Guidelines

ASHRAE Guideline 0-2005, *The Commissioning Process*

Describes the commissioning process capable of verifying a facility and its systems meet the owner's project requirements

ASHRAE Guideline 1-2007, *The HVAC Commissioning Process*

Describes the technical requirements for the application of the commissioning process that will verify HVAC systems achieve the owner's project requirements

Our Path Forward for Commissioning

- **Promote the Value of Commissioning**
- **Provide Training through the Chapters**
- **Provide Educational Programs**
- **Provide Certification Programs**
- **Continue Development of our
Commissioning Guidelines**

Our Path Forward for Operation and Maintenance

- Complete the Work of the TRGs
- Provide Training through the Chapters
- Provide Educational Programs
- Provide Certification Programs

ASHRAE Sustainability Initiatives

Integrated Building Design

IBD Manual of Practice

Building Information Modeling

BIM Guide

“SMART” Documents

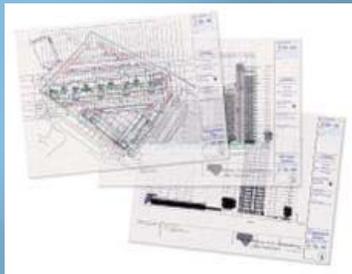
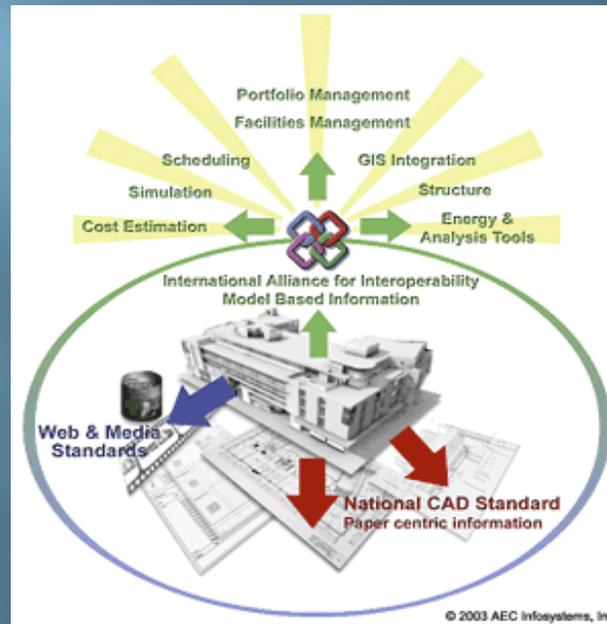
Building Performance Metrics

Carbon Equivalency Based

ASHRAE Building Energy Labeling Program

BIM : Overview

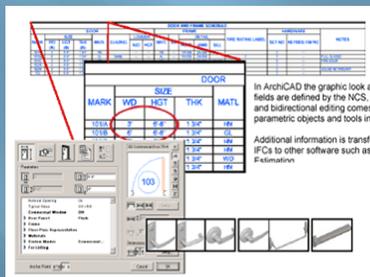
BIM – A central “database” of building information from which data is extracted to generate construction documents and ultimately facilitate operation



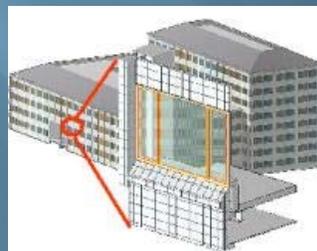
Construction Documents



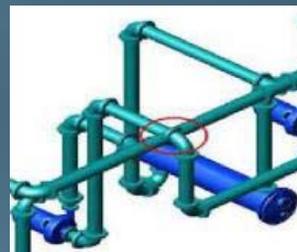
Facility Mgmt



Schedules



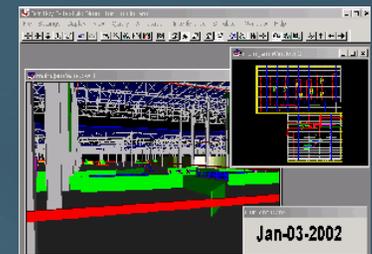
Visualization



Interference Detection

Section Name	Quantity	Volume	Length	Weight	Total Quantities	Total Volume	Total Length	Total Weight
WH0101	54	57.33	869.39	28,100.00	54	57.33	869.39	28,100.00
WH0201	18	31.88	425.11	16,200.00	18	31.88	425.11	16,200.00
WH0102	31	242.16	1,990.73	110,700.00	31	242.16	1,990.73	110,700.00
WH0103	30	253.00	1,940.76	124,007.30	30	253.00	1,940.76	124,007.30
WH0104	14	179.29	637.89	33,918.40	14	179.29	637.89	33,918.40
WH0105	13	172.89	667.76	84,753.00	13	172.89	667.76	84,753.00
WH0106	8	136.37	419.83	66,363.40	8	136.37	419.83	66,363.40
WH0107	21	69.67	732.36	43,527.00	21	69.67	732.36	43,527.00
WH0108	147	626.74	5,100.00	404,310.00	147	626.74	5,100.00	404,310.00
WH0109	20	137.28	686.63	67,286.70	20	137.28	686.63	67,286.70
WH0110	11	153.13	513.37	743,101.00	11	153.13	513.37	743,101.00
Grand Total	311	2,733.74	15,933.44	1,995,652.40	311	2,733.74	15,933.44	1,995,652.40

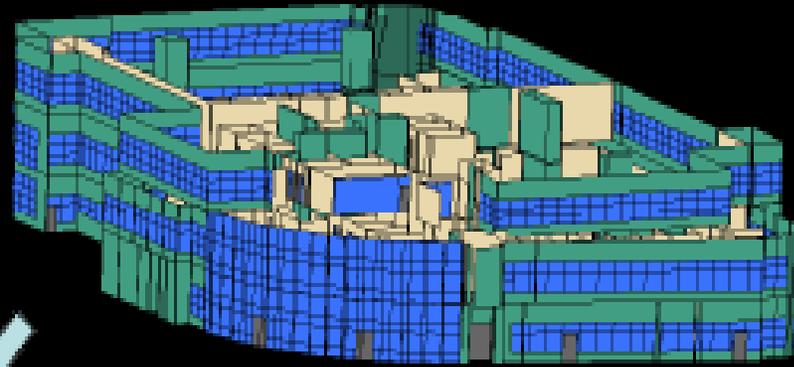
Quantities/BOM



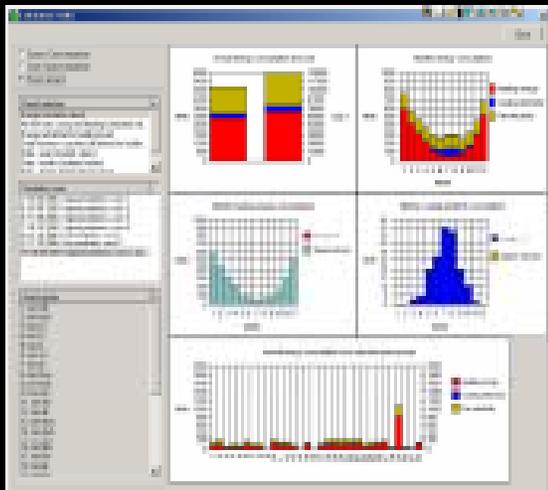
Construction Sequencing

Building Information Modeling

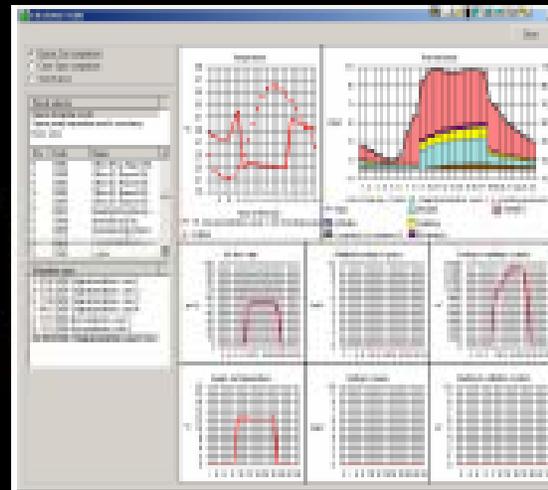
Energy Simulation and Modeling



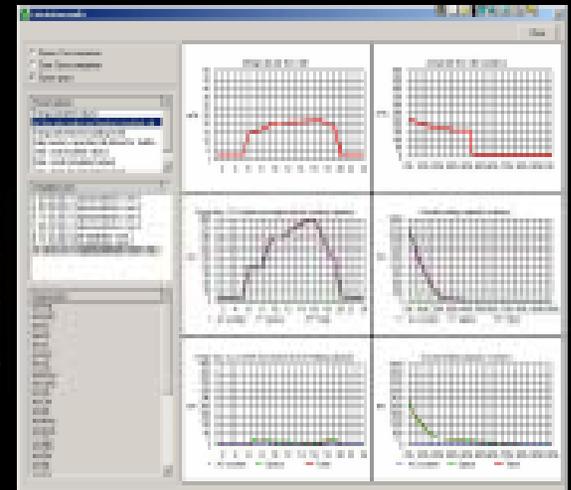
Energy Usage / Cost



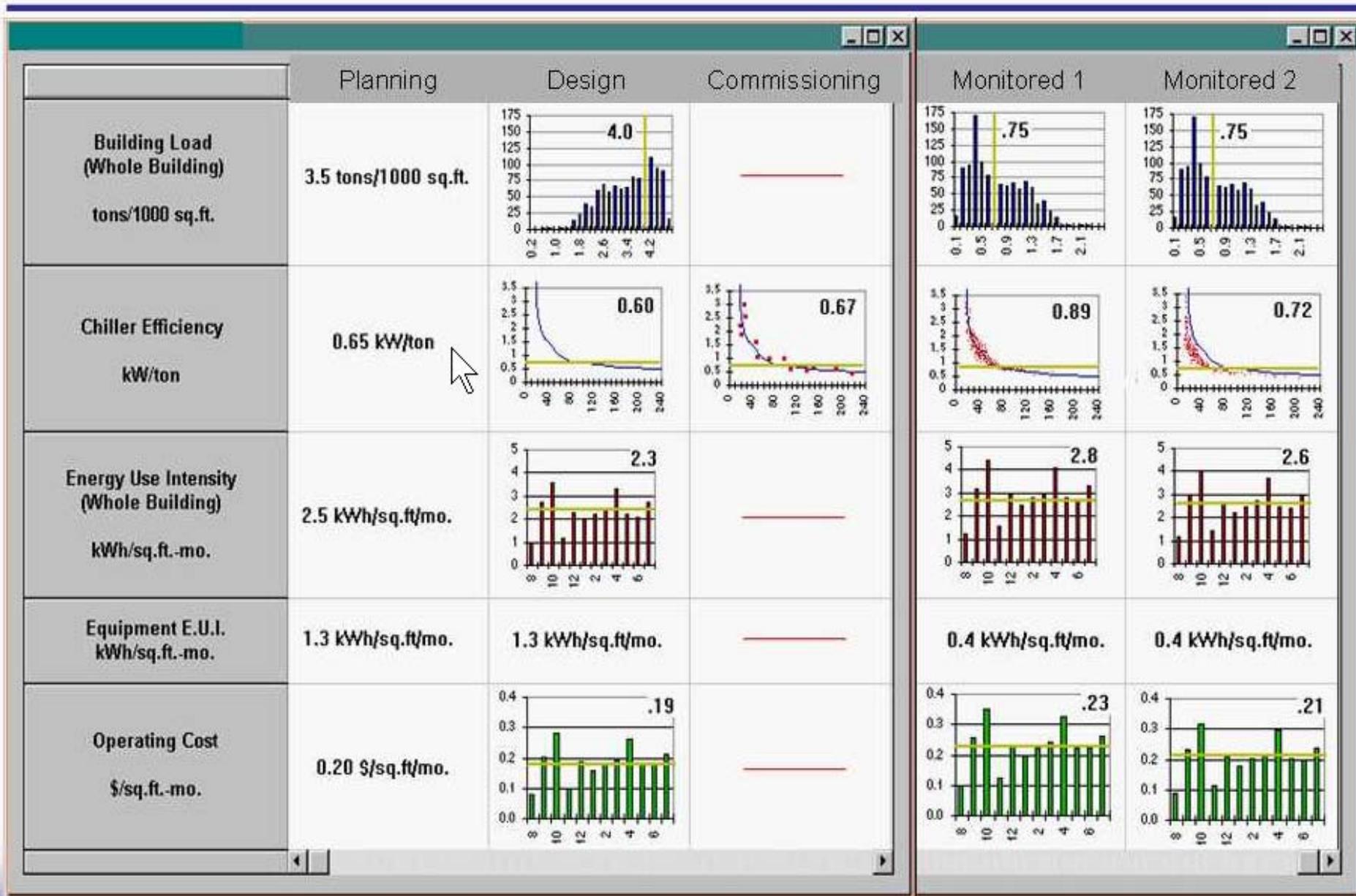
Temperature / Thermal Loads



Air Flow for Heating / Cooling

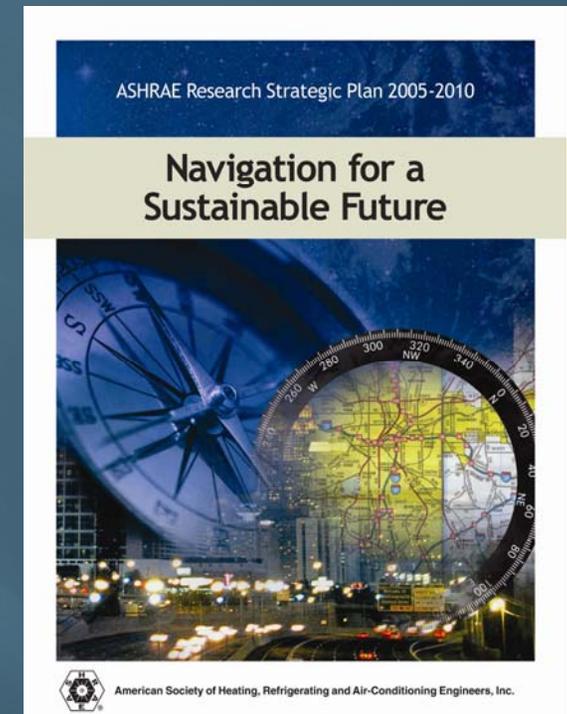


Performance Tracking Visualization



ASHRAE Research Programs

- Research Strategic Plan identifies many energy efficiency topics
- \$2.5 million per year in new projects
- ASHRAE Strategic Plan elements target energy efficiency –given priority in Research Strategic Plan
 - Working with Research Advisory Panel and USGBC Research Committee to identify high priority building energy research

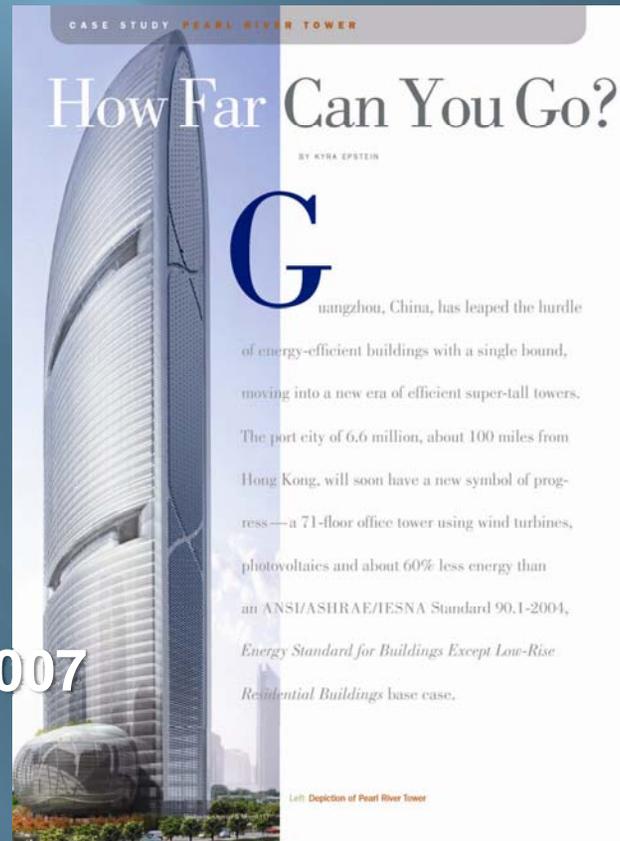


ASHRAE Educational and Certification Initiatives

- **ASHRAE Educational Programs**
 - eLearning
 - Complying with Standard 90.1
 - Building Commissioning
 - Engineering for Sustainability
- **ASHRAE Certification Programs**
 - Engineering for Sustainability Professional
 - Building Ownership and Operation
 - Commissioning



High Performing Buildings Magazine



- Launched November 2007
- Case Studies
- Lessons Learned

Sustaining Our Future By Rebuilding Our Past

Together we can Build a Better World





Sustaining Our Future By Rebuilding Our Past

Together We Can Make A Difference

Sustaining Our Future By Rebuilding Our Past

When we build let it not be for present
use alone. Let it be such work as our
descendants thank us”

John Ruskin 1875

**Thank You
for the Opportunity to Serve**