Green Buildings Waste Energy Efficiently

All Models are Wrong: Some are Useful

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Learning Objectives

- Learn the differences between the energy models and the energy meters.
- See the differences between the energy publicity and the actual measured data.
- Find out why most green buildings do not meet energy expectations.
- Learn why energy codes and standards create high energy consumption.

Green Energy Performance

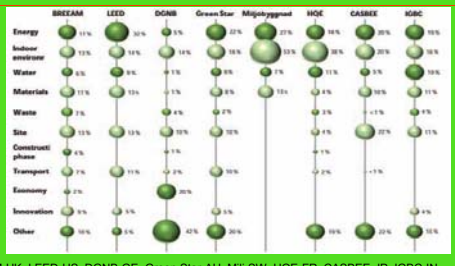
Yes, some very few green buildings have good energy performance

USGBC Would Have Us Believe

- LEED® Certified & Green buildings
  - use less energy
  - have greater value
  - have better indoor air quality
  - are easier to lease
  - cost less to operate
  - are sustainable
- LEED® Certified & Green building owners are more responsible

Green Does Not Mean Energy Efficient

Green System Weights



BREEAM-UK, LEED-US, DGNB-GE, Green Star-AU, Milj-SW, HQE-FR, CASBEE-JP, IGBC-IN
Source: CIBSE J October 2013

What is High Performance? What is Energy Efficient?

- Compared to What?
- How High is High?
- What is Low Performance?
- What is Average Performance?
- Is a Church Used 40 Hrs/Week Low?
- Is the Same Church Used 4 Hrs/Week High?
- Is Net Zero High Performance? Efficient?

Energy Codes & Standards

The role and purpose of energy codes and standards is to stop bad design rather than to promote good design

Understanding ASHRAE Requirements For LEED®

ANSI/ASHRAE Standard 62.1 Prerequisite

Purpose: "to specify minimum ventilation rates and indoor air quality that will be acceptable to human occupants and are intended to minimize the potential for adverse health effects."

ANSI/ASHRAE/IESNA Standard 90.1 Prerequisite

Purpose: to establish the minimum energy-efficiency requirements of buildings other than low-rise residential buildings

ASHRAE 90.1 Common Sense?

- Should it require the same minimum boiler efficiency in Minneapolis as Miami?
- Should it require the same minimum cooling efficiency in Chicago as in Houston?
- Should it require the same minimum building envelope efficiency in a church used 4 hrs/wk as a hospital used around the clock?
- Should it require the same lighting levels in a church as in a hotel?

Cost Effectiveness Challenge for ASHRAE Standard 90.1

- As we approach the technical limits, the cost to increase efficiency increases exponentially and we are finding that some changes **can not be cost justified** as shown by the recent ASHRAE 90.1 chiller efficiency justification
- Overall the capacity weighted payback period was 6.3 years but there is a wide variation by product type and climate zone ranging from -320 years to +37.6 years

ASHRAE 90.1 Product Class	Payback Years			
	Min	Avg	Max	Scalar Limit
AC<150 Tons	1.1	4.7	10.9	9.086
AC>150 Tons	0.9	4.2	9.2	9.086
WC Positive <75 Tons	1.1	5.2	17.5	11.962
WC Positive >75 &<150 Tons	1.6	5.9	17.9	11.962
WC Positive >150 &<300 Tons	1.3	6.1	17.0	11.962
WC Positive >300 &<400 Tons	2.0	9.8	26.2	11.962
WC Positive >400 &<500 Tons	1.5	5.3	12.5	11.962
WC Positive >500 &<600 Tons	1.5	5.3	12.5	11.962
WC Positive >600 Tons	1.0	4.7	15.4	11.962
WC Centrifugal <75 Tons	-320.5	-54.0	37.6	13.626
WC Centrifugal >75 &<150 Tons	-155.3	-24.8	26.2	13.626
WC Centrifugal >150 &<300 Tons	1.0	5.2	15.8	13.626
WC Centrifugal >300 &<400 Tons	2.7	10.9	39.0	13.626
WC Centrifugal >400 &<500 Tons	1.5	10.3	46.3	13.626
WC Centrifugal >500 &<600 Tons	1.3	12.3	39.0	13.626
WC Centrifugal >600 Tons	1.2	7.0	28.5	13.626
USA Weighted Average		6.3		

Justified | Not Justified

Scalar limit is the maximum allowable payback period allowed by ASHRAE 90.1 economic procedures. We know customers really are only willing to accept 3-4 yrs

Chart from ASHRAE 90.1 Addendum ch to the 2010 Standard Justification Analysis, Oct 2012

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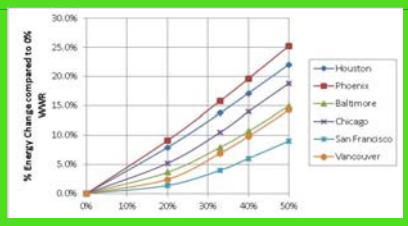
Daylighting Energy Increase



WWR

Source: ASHRAE 189.1 Addendum am May 2013 (Withdrawn)

ASHRAE Addenda Descriptions

- This addendum corrects the calculation…based on an error.
- This addendum modifies the designation for the types of facilities that are eligible.
- This addendum corrects a mistake that was made.
- This proposal is being presented to address an error.
- This proposal is intended to correct a possible flaw in previous addenda.
- This revision clarifies the exception.
- This addendum corrects the calculation.
- This proposal also cleans up some errors.
- The requirements in addendum cx didn't make sense with the revisions to the final version of addendum bb.
- Source: Direct Quotes. ASHRAE Standards Action, March 22 & August 2, 2013

More ASHRAE Addenda

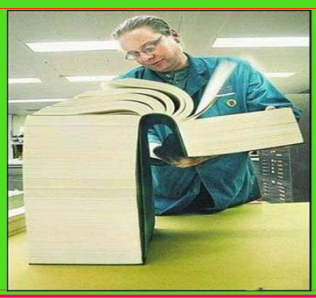
- This addendum makes the Fenestration and Skylight requirements in Appendix G for the baseline building consistent with the prescriptive requirements in Section 6 from 90.1-2004 for compliance with the Performance Rating Method.
- This addendum modifies the fan system operation requirements in the Performance Rating Method (Appendix G) so that fan energy does not have to explicitly be modeled.
- This addendum adds a new section for Chilled Water Coil Selection. The analysis showed that the fan energy increase due to the larger coil was more than offset by the pump energy savings, and net first costs were reduced due to smaller piping and pumps, offsetting higher coil costs.
- This addendum corrects a technical flaw in the calculation where the previous SHGC multipliers could illogically require fenestration to have a lower SHGC on the north side of a building than on the west side of the building when projections are used.
- Direct quotes from ASHRAE Standards Action July 17, 2015

Standard 90.1-2013 Error Examples

Section	Correction	Percent
5.5.3.1.1	17 lb/ft² (~~74~~ 83 kg/m²)	112
6.5.3.2.1	5 hp (~~0.75~~ 3.7 kW)	493
6.5.11.1	1 hp (~~75~~ 0.75 kW)	10000
Table 7.8	300,000 Btu/h (~~61.55~~ 88 kW)	143
G3.1.1g	>3,000,000 Btu/h (~~590~~ 880 kW)	149
G3.1.3.10	16 W/gpm (~~960 kW/1000 L/s~~ 250 W·s/L)	384

Source: BSR/ASHRAE/IES Addendum DY February 2016

New ASHRAE Standard 90.1



Congressional Testimony Green Building Science

- "There then appears to be no scientific basis for institutions such as colleges, universities, or the Federal Government to require LEED® certification as a GHG or energy reduction strategy for its buildings."
- "It is my experience that what LEED® designers deliver is what most LEED® building owners want – namely, green publicity, not energy savings."
- Professor John Scofield, Oberlin College, May 8, 2012
- The Science Behind Green Building Rating Systems

Case Studies

High Performance Definition

- Energy Use Intensity (EUI)(Site)
  - 31,750 to 47,800 Btu/SF/Yr
  - 100 to 150 kWh/m^2/Yr
  - 360 to 540 MJ/m^2/Yr
- Water Use Intensity
  - 5 to 10 gallons/SF/Yr
  - 2 to 4 liters/m^2/Yr
- Jerry Yudelson, PE, LEED® Fellow
  - Source: EDC Magazine, February 2013
  - Most US weather has cold winters

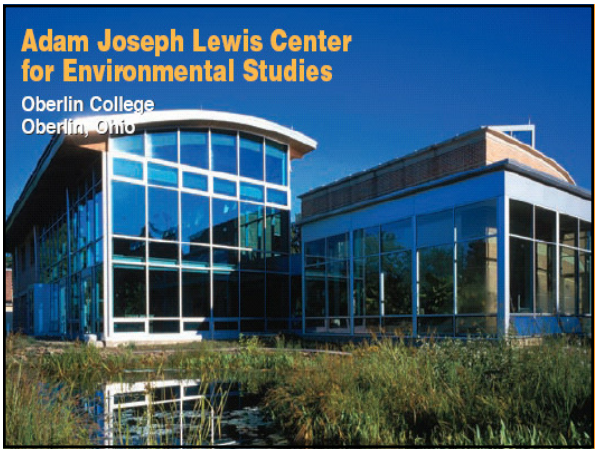
2012 CBECS By Year Built
March 2016, Data on 6,700 Buildings

Year constructed	kBTU/Sf/Yr	kWh/m^2/Yr	MJ/m^2/Yr
Before 1920	59.8	188	677
1920 to 1945	69.4	219	788
1946 to 1959	72.7	229	824
1960 to 1969	87.0	274	986
1970 to 1979	93.3	294	1058
1980 to 1989	76.4	241	868
1990 to 1999	79.8	251	904
2000 to 2003	80.2	253	911
2004 to 2007	80.9	255	918
2008 to 2012	84.5	266	958

CBECS 2003 - Major Fuels Use By Building Type and Year Built

	Sum of Fuels kWh/M^2			
Principal Building Activity	All Yr	1959 & Bef	1960 1989	1990 2003
Education	262	245	279	254
Food Service	814	455	914	1139
Health Care	592	560	680	428
Lodging	315		352	278
Retail (Other Than Mall)	233	233	200	272
Office	293	295	298	277
Public Assembly	296	195	339	377
Religious Worship	137	147	126	136
Warehouse and Storage	142	257	122	105

Source: Tables 3 and 12



Second Year Energy Use

- Utility 124,475 kWh
- Solar 59,166 kWh
- Total 183,641 kWh
- Or 135 kWh/m^2/Yr
- Or 521 MJ/m^2/Yr
- For a zero energy building

Oberlin Net Zero Claims

- "The addition of the parking lot solar pavilion boosted photovoltaic production slightly above energy consumption, resulting net export to the city of Oberlin."
- Dr. John Petersen, Oberlin College
- ASHRAE HPB Winter 2011

Quotes from Oberlin HPB Author Dr. John Petersen

- "Although I stand by the methods I used in evaluating and presenting data on the building, there is one important correction to the article that I must make. In the fall of 2011, we discovered that the data that we have been collecting directly from a city-owned utility meter -- *the data used in the HPB article* as our best measure of total integrated solar production -- *is in fact, inaccurate*. Specifically it turns out that we have inadvertently and unknowingly been recording and reporting data on apparent power instead of real power (i.e. kVa instead of kW). This inaccuracy resulted in an overestimate of total solar production by about 6%."
- Source: HPB winter 2011 and obscure HPB Internet posting February 6, 2012

Green Office Performance

- Philadelphia Office Building 2011
- LEED® Platinum & Energy Star® 89
- 20,000 Square Meters
- Estimated Energy 225 kWh/m^2/Yr or 810 MJ/m^2/Yr
- Actual Energy 254** kWh/m^2/Yr or 914 MJ/m^2/Yr
- All Existing Buildings 293* kWh/m^2/Yr
- All Existing Buildings 2000-2003 251* kWh/m^2/Yr
- Estimated Water 3.6 Million Liters
- Actual Water 10.2 Million Liters**
- *CBECS 2003 Table C3
- **Philadelphia Benchmarking 9/25/2014

Another Green Office Building

- Philadelphia Office Building 2005
- LEED® Platinum & Energy Star® 81
- 7,350 Square Meters
- Actual Energy 178** kWh/m^2/Yr or 641 MJ/m^2/Yr
- All Existing Buildings 293* kWh/m^2/Yr
- All Existing Buildings 2000-2003 251* kWh/m^2/Yr
- PA DEP Recognizes This As State's Highest Performing Building***
- *CBECS 2003 Table C3
- **Philadelphia Benchmarking 9/25/2014
- ***DEP Press Release 8/22/2006

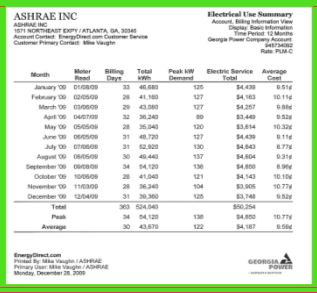
Hospital Energy Cost
Dollars per Square Meter/Yr

	Percentile			
Form	90	50	10	Mean
Total Utilities	52.83	36.05	13.56	34.75
Electric	36.15	25.29	11.08	24.75
Fuel Oil	0.65	0.15	0.04	0.32
Nat Gas	13.45	9.15	2.58	8.72
Chilled Water	24.53	2.58	0.32	10.87
Steam	16.57	12.91	2.15	11.30
Domestic Water	6.56	3.12	0.65	3.44
Sewer	4.09	1.61	0.22	2.04

Source: June 2013 HFM Magazine

ASHRAE Headquarters Renovations - 2008

ASHRAE Utility Billing History



ASHRAE INC

Electrical Use Summary

Month	Meter Read	Billing Days	Total kWh	Peak kW Demand	Electric Service Total	Average Cost
January '08	01/08/09	33	46,680	125	$4,439	9.51¢
February '09	02/05/09	28	41,160	127	$4,163	10.11¢
March '09	03/06/09	29	43,080	127	$4,257	9.88¢
April '09	04/07/09	32	36,240	89	$3,449	9.52¢
May '09	05/05/09	28	35,040	120	$3,614	10.32¢
June '09	06/05/09	31	48,720	127	$4,439	9.11¢
July '09	07/06/09	31	52,920	130	$4,643	8.77¢
August '09	08/05/09	30	49,440	137	$4,604	9.31¢
September '09	09/09/09	34	54,120	136	$4,850	8.96¢
October '09	10/08/09	28	41,040	121	$4,143	10.10¢
November '09	11/03/09	26	36,240	104	$3,905	10.77¢
December '09	12/04/09	31	39,360	125	$3,748	9.52¢
Total		363	524,040		$50,254	
Peak		34	54,120	138	$4,850	10.77¢
Average		30	43,670	122	$4,187	9.58¢

ASHRAE LEED® Platinum First Year Economics

- Complete renovation, small addition
- About 3,000 square meters total
- Spent $7.65 million, excluding contributions
- Electric budget about 658 MJ/m^2/Yr
  - Solar production data not available
- Electric savings about $17,500 per year
- Simple payback = 437 years

ASHRAE LEED® Platinum Second Year Performance

- Electric use 422,880 kWh
- Net Purchased Energy Budget down to 148 kWh/m^2/Yr or 533 MJ/m^2/Yr
- 20 kW solar system produced 22,448 kWh & added 8 kWh/m^2/Yr or 28 MJ/m^2/Yr

ASHRAE HVAC Only Energy Performance

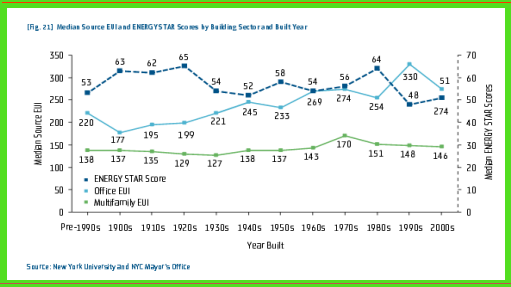
	kWh/m^2/Yr		MJ/m^2/Yr	
TYPE	2010	2011	2010	2011
GSHP	22.6	18.2	81	66
VRF	35.5	33.4	128	120
Max/Min	1.6	1.8	1.6	1.8

- Source: Manufacturer Presentation June 14, 2012
- GSHP=Ground Source Heat Pump
- VRF=Variable Refrigerant Flow
- Also September 2014 ASHRAE Journal shows VRF 44% higher than GSHP energy per square foot.

ASHRAE Problems

- Design failed to comply with ANSI/ASHRAE Standard 15, *Safety Standard for Refrigeration Systems*
- Issued stop work and change order
  - Estimated to be over $¼ million or $86 per square meter
- Discovered inadequate cooling for server area
- Installing several hundred thousand dollars of new IT equipment to compensate

NYC Benchmarking Report

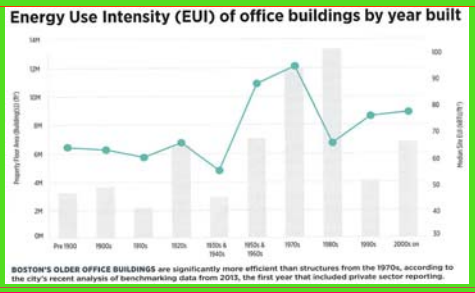


Seattle Energy by Age

Minneapolis Benchmarking

Buildings Magazine on Benchmarking

January 2016



Heifer International Headquarters

Heifer International Headquarters

Little Rock, AR

- First feature cover story in ASHRAE *High Performing Buildings* magazine in 2008
- Completed 2006
- LEED® Platinum and many other awards
- Initial energy use 44.8 kBtu/SF/Yr or 508 MJ/m²/Yr
- In 2007, Energy Star® 90, but ES 72 in 2011
- Did recommissioning to get to ES 91
- Source: Building Operating Management, October 2014

Heifer International Headquarters
2012 Recommissioning Findings

- Sensors not working or not calibrated properly
- Outside air damper minimums set too high or too low
- Fan speed minimums (variable frequency drives) set too high
- Loose fan belts
- Chilled and hot water valves not functioning properly
- Hot-water pump running with boiler cycled off
- Excessive air in the hot water heating system
- Hot water reset schedule not functioning
- Lead/lag on hot water pumps not functioning
- Minimum OA damper position set to 25% instead of 0% with CO_2
- CO_2 set points found at the ASHRAE standard of 500 PPM, instead of 700 PPM
- Humidity sensors not reading accurately due to air leakage from the floor system
- Manufacturer defects with the lighting controller

LEED® Gold Office Building

The Pennsylvania Department of Environmental Protection's (PA DEP) Southeast Regional Office Building (SROB) in downtown Norristown was intended by PA DEP to be **Pennsylvania's "Greenest Building."** In line with the building's conception, it received the Environmental Design and Construction (EDC) Excellence in Design Award Grand Prize in 2005 for government buildings.

7Group provided LEED® consulting and documentation, charette facilitation, energy modeling, renewable energy consulting, and extensive commissioning services for the PA DEP SROB facilities. Energy savings measures achieved a **41% reduction compared to an ASHRAE 90.1-1999** claimed baseline building. For the 12 months ending April 2012, the metered energy use was:

Form	kWh/m²/YR	ASHRAE Baseline
Electric	190	323
Gas	81	137
Total	271	460

LEED® Gold Office Buildings

12 Months Ending July 2012
Per Square Meter Per Year

Building	Electric kWh	CHW BTU
A	294	27316
B	56	26947
C	81	22124
D	80	36398
E	107	31213
Max/Min	5.3	1.6

8 Month Garden Apartment Electric
1970 Construction 207 Units
Nine Identical 3 Story All Electric Buildings

		All apartments		By floor: Ground		By floor: Top	
Bldg	KWH	Average kWh/ dwell unit	% of Avg	Average kWh/ dwell unit	% of Avg	Average KWh/ dwell unit	% of Avg
A	156,019	6,783	83	7,008	78	5,633	81
B	187,603	8,157	100	7,106	79	5,615	81
C	190,117	8,266	101	9,828	109	7,442	107
D	148,245	6,445	79	8,209	91	5,758	83
E	207,665	9,029	111	12,867	143	5,563	80
F	211,084	9,178	113	9,197	102	9,390	135
G	200,166	8,702	107	9,762	108	8,005	115
H	169,132	7,353	90	7,720	86	7,590	109
J	217,145	9,441	116	9,559	106	7,606	109
Max/Min		1.46		1.84		1.69	

Renewable Energy
Promise versus Reality

Aurora CO		Expected	Measured	
Type	kW	MWh	MWh	%
Crystalline PV	50	63.0	56.2	89
Crystalline PV	52	61.0	60.3	99
Thin Film PV	33	41.3	31.0	75
Wind Turbine	50	94.6	7.18	8
McKinney TX		**Expected**	**Measured**	
Type	kW	MWh	MWh	%
Polycrystalline	11.0	14.6	13.1	90
Amorphous PV	4.6	5.7	2.2	39
Crystalline PV	34.4	25.9	24.1	93
Thin Film PV	6.8	8.3	8.3	100
Wind Turbine	50	80.0	21	26

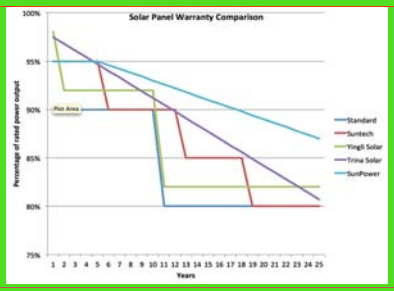
Source: Michael Deru, ASHRAE Journal, October 2007 on Walmart
Extensive Monitoring by USDOE National Renewable Energy Laboratory

Walmart Donates Microturbines to Denver Zoo

- Walmart is donating six microturbines from its experimental store in Aurora, Colo., to the Denver Zoo to help further its waste-to-energy system—a process that will convert the zoo's animal waste and human trash into usable energy and heat. Walmart has been utilizing the energy generating units since 2005 as an experimental project to understand the thermal vs. electrical base loading of its buildings, as well as how co-generation might work on a Walmart store in the future.
- September 26, 2014, Energy Manager Today

Solar Performance Warranty

Source: http://energyinformative.org/lifespan-solar-panels/ May 2014



Comparison With US Federal Government Buildings

High Performance Definition

- Energy Use Intensity (EUI)(Site)
  - 31,750 to 47,800 Btu/SF/Yr
  - 100 to 150 kWh/m^2/Yr
  - 360 to 540 MJ/m^2/Yr
- Water Use Intensity
  - 5 to 10 gallons/SF/Yr
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- Jerry Yudelson, PE, LEED® Fellow
  - Source: EDC Magazine, February 2013
  - Most US weather has cold winters

Federal Building Energy Consumption Data

	FY 2007		FY 2013	
Agency	MJ/m^2/Yr	kWh/M^2	MJ/m^2/Yr	kWh/M^2
EPA	3582	995	3316	921
HHS	3557	988	3161	878
DOJ	2718	755	1829	508
DOE	2610	725	1858	516
GSA	846	235	659	183
Govt. Total	1332	370	1220	339

Military Building Energy

Service	kWh/m^2/Yr	MJ/m^2/Yr
DOD	316	1138
Army	270	972
Navy	352	1267
Air Force	360	1296

FY 2011 in kWh/m^2/Yr Site Energy
DOD Report September 2012

Energy Data is Not Enough

- The presence of a laundry in a hotel or hospital can make a 25 to 50% difference in total building energy
- How does one compare the energy data for identical churches on the same block when one is occupied every day and the other is only occupied on Sunday?
- How does one compare the energy use of two schools when ventilation is compromised in one?
- Comparing modeled to metered energy data is not a valid measurement of anything unless all other characteristics are comparable.

Building Energy Models

"All models are wrong, some are useful"

- George Box via Malcolm Bell

Computer Energy Models

- Can anyone design a building today without a computer, computer models, and unverified data from other buildings or databases?
- How could the Panama Canal, Empire State Building, and Hoover Dam be designed without computers?

Improper Energy Modeling

- Energy Cost Budget Model gamesmanship
  - Comparison made to worst allowable budget model
  - Budget model may not meet minimum criteria.
  - Actual design may differ from modeled criteria.
- Model projections rarely match performance
- Better to compare actual building performance against actual data from *comparable* existing buildings in same region
- Best to compare before and after data from the same building for retrofit projects

Energy Models vs. Meters

- If energy models were so good, meters would not be needed
- Even meters are not always that accurate or reliable
- Especially non-utility grade meters

Buildings Use 3.5 Times More Energy Than Expected

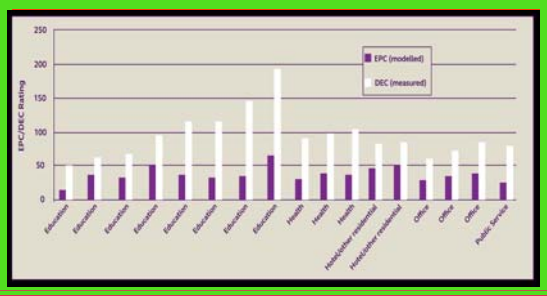
- In a study of 49 'leading-edge, modern buildings', it found that non-domestic buildings 'routinely' use 3.5 times the amount of energy they are designed to consume and rarely live up to performance expectations
- many projects had difficulty integrating new technologies, in particular building management systems. Many also had problems with maintenance, controls and metering
- the average electricity use across the buildings was 369 MJ/m^2/Yr; while the mean for fuel was 329 MJ/m^2/Yr.
- Energy Performance Certificates (EPCs) do not reliably predict actual energy use in Buildings
- Controls are a problem because they are often overcomplicated
- Source: www.cibsejournal.com/news/ March 4, 2016 Innovate UK C16/COO56b 2016

Actual electricity and heating fuel use

Innovate UK C16/COO56b 2016

Comparing certificate ratings

Innovate UK C16/COO56b 2016



UK Building Benchmarking

- 2007 UK Law requires energy certificates for commercial buildings built, sold, or rented
- CIBSE certifies Energy Assessors (ASHRAE)
- By 2012 woefully short of certificates
- Estimated compliance rate ≈ 20%
- How many penalties issued not known, if any
- Energy Assessors lack work
- Functional or Economic Performance Unknown
- Source: CIBSE Journal November 2013

Benchmarking Consultants

- 20 NY firms were responsible for 80% of the third-party reporting for over 9000 buildings.
- City staff met with one consultant whose portfolio had an unusually high percentage of low-scoring buildings, assuming that the consultant was making a reporting error.
- It turned out the consultant had intentionally targeted buildings that performed poorly in the hope of generating more retrofit work.
- Source: Environmental Building News

Why Does This Happen ?

Why LEED® Buildings Often Fail to Deliver

Bill Bordass, Usable Buildings Trust, UK

"We sell dreams and install nightmares. We do not learn fast from emerging issues and unintended consequences."

CIBSE Journal June 2009

Excuses For Non-Performance

- "It was not built as designed"
  - It got value engineered
- "It was not operated as intended"
  - The maintenance person always wins
- "It uses more energy than anticipated"
  - The computer simulation was gamed
- "It is not fully occupied"
  - Not designed to operate that way

Performance of LEED®

- We are piling in often unmanageable complexity into these buildings, so the consequence is unmanageable complexity.
- It's the enemy of good performance.
- Roderick Bunn, Principal Consultant, BSRIA, UK

The Paradox of Automation

- Better automation leads to more sophisticated processes
- More sophisticated processes lead to more opportunities for error
- We "fix" the increasing errors with still more automation
- Complexity defeats efficiency and functionality

One Reason For Energy Waste is Required Controls

- Good mechanical engineers do not know controls
- Good control technicians do not know mechanical systems
- Good programmers do not know a thing about either
- And no one has the time to correct these problems

Controls & Commissioning

- "Owners shouldn't have to commission new buildings."
- "The controls industry business model includes selling inadequate software and sensors that don't work effectively as installed."
- Quotes by Jerry Yudelson, PE, LEED® Fellow
  - EDC Magazine, February 2013

More Reasons for Poor Green Performance

Commissioning and Recommissioning

Who is to say that the recommissioning will

(1) necessarily follow the design intent,

(2) not degrade the building performance, and

(3) who is going to and has the ability to check

Where Is All This LEEDing?

ASHRAE Speaks

"The time has come for us to be more *innovative* in our thinking, more *daring* in our creativity, and more *dedicated* to our pursuit of *best practices* that will dramatically improve building energy performance." (Emphasis added)

Kent Peterson, PE, ASHRAE President, July 2007

ASHRAE Press Release

"Just like the events in Alice in Wonderland, building performance isn't always what it seems."

ASHRAE Press Release, August 3, 2007

USA Today
The Uncertainty of LEED®

- LEED® certification is awarded before occupancy. "That's like the ranking of football teams before the season starts."
- "Energy savings are not closely related to the number of points received," concluded the study by University of Wisconsin researchers.
- USA Today, October 24, 2012

Journalistic Integrity

- "The [Dallas Morning News] story fails an important test of journalistic integrity: to provide the facts and the missing context"
- "That's [the Washington Post's] intellectual sloppiness and bad journalism masquerading as taxpayer advocacy."
- "No wonder the public holds the mass media, along with Congress and big business, in such low esteem."
- Engineering News Record Editorial November 2, 2015

Contractor's View of LEED®

"My personal experience has been for every good LEED® energy performance outcome, there's an equal and opposite bad outcome."

Daniel Kerr, P.E. Director of Energy Services, McClure Company, Mechanical Contractors April 27, 2011
Chairman ASHRAE Technical Committee 7.2

Owner's View of LEED®

"Green building practices have become divorced from energy efficiency"

- Anthony Malkin, Empire State Building, Wall Street Journal, August 16, 2010

An Architect Speaks

"Architects hardly have any vision anymore. They are put into a straightjacket by clients. Now, we are just pussyfooting around."

Helmut Jahn, FAIA on October 18, 2012

Frank Gehry, FAIA on LEED®

- "A lot of LEEDs are given for bogus stuff"
- "A lot of the things they do really don't save energy"
- "the costs of incorporating those kind of things don't pay back in your lifetime"
- "It's become 'fetishized' in my profession"
- Source: Business Week, April 7, 2010 and April 15, 2010

Architect's LEED® View

- "It is essential that LEED be complicated, otherwise there would be no need for certified professionals to administer it, and the USGBC's primary money-maker would vanish"
- It is "predisposed to Gizmo Green solutions"
- Steve Mouzon. "Is It Time For the Anti-LEED?" 15 Oct 2014. ArchDaily.

Operating Buildings is Not Easy

Every architect and engineer should be required to take a sabbatical for one year out of seven and operate the buildings they have designed

Dramatic Energy Savings

- When I see press releases or articles claiming dramatic energy savings for buildings, I have to ask myself:
  - In new buildings, why would they ever consider building something so wasteful?
  - In existing buildings, how could they waste so much for so long?

"Up To" % Savings Claims

- "substantiation should prove that all or almost all consumers are likely to get that percentage in savings."
- "don't choose atypical [modeling] characteristics that produce inflated results."
- "You may be liable for misleading or unsubstantiated claims you make"
- US Federal Trade Commission (FTC) letter to glass manufacturer Cardinal Industries August 17, 2012

Setting Energy Goals

- A % Below Code or Standard
  - Is economically irresponsible
  - Assumes standard is economic
- Design Challenge
  - Meet Owners' Economic Criteria
  - Wherever that leads

What the Industry Press and Speakers Don't Talk About Today

- Green problems and risks
- Measured Energy Data
- Because they rely on green for advertisers and clients

Unwritten Subtitles to Most HVAC&R Magazine Articles

- How can we promote the sale of more of the products and services we offer?
- There are never any problems with what we do
- It should be used everywhere

Industry Publications Content Today

- Much of the technical content comes from parties selling or promoting products or services.
- It is hard to tell the difference between the technical content and advertising.
- Letters to the Editor challenging that content are often not published.
- It seems that Editors and Publishers do not want to offend advertisers.
- Publish Facts not Fluff

Design Objectives

- Are we forsaking:
  - Quality
  - Economy
  - Performance
  - Simplicity
  - Maintainability
  - Resilience
- For:
  - Green
  - Sustainable
  - Low Carbon
  - Zero Energy

Other Considerations

Repair Parts
Reliability
Maintainability
Complexity
Operability
Repairability Cost
Serviceability

Design Thinking Influences

- Press Releases
- Advertising
- Grants
- Awards
- Programs
- Rebates
- Subsidies
- Reports
- Studies
- Articles
- ASHRAE
- Standards
- Codes
- Tax Credits

Who is Responsible? Who is Accountable?

- Energy Manager
- Enclosure Specialist
- Energy Modeler
- Roofing Consultant
- Innovation Director
- Building Scientist
- Energy Consultant
- Sustainability Manager
- Building Physicist
- Strategic Energy Director
- Energy Consultant
- Commissioning Agent
- Green Consultant
- LEED® Accredited Person

Efficiency Fallacies

Where electricity is from hydro or nuclear, "more efficient" lighting or appliances can actually increase CO_2 emissions, since heating is most often by fossil fuels

Litigation Risks

- At the trial level, the jury awarded approximately $17.6 million to the GC, but the intermediate Court of Appeals reversed the verdict, concluding that the Owner was entitled to just over $2.2 million in liquidated damages, just under $1.0 million for construction defects, and just under $10.7 million in attorneys' fees. In other words, by the time the Texas Supreme Court was asked to weigh in, the GC had gone from nearly an $18-million winner to a $14-million loser! That's a huge swing, one likely to present an existential crisis for many small- and medium-sized commercial construction contractors.
- Pacific Construction Grp. v. Port of Alaska Schools of Deep Liquids, August 29, 2014

Famous Quote

"In the end, the operator always wins"

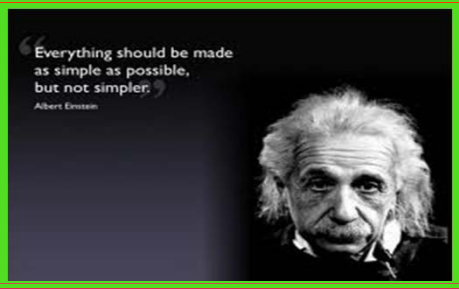
Don Winston, PE
Former Vice President
The Durst Organization
New York

The True Measure of a Great Building

"A great building must begin with the unmeasurable, must go through measurable means when it is being designed and in the end must be unmeasurable."

Louis Kahn, Architect

Complexity



Questions