Newman Consulting Group, LLC

Consultants for Energy-Efficient & Sustainable Buildings

ASHRAE bEQ and ASTM BEPA

What the Difference Is Between Them – and How You Can Use Them to your Advantage

ASHRAE DL – Golden Gate / San Jose - 12/11/13

James L. Newman

CEM, CSDP, LEED AP BD+C, ASHRAE OPMP & BEAP, FESD

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

- Trainer, Energy Standard 90.1
- Past Member, Air-to-Air Energy Recovery Technical Committee
- Past Vice-Chair, Industrial Air Conditioning Technical Committee
- Past Board Member; Distinguished Service Award (Local), 2005
- Distinguished Lecturer, 2010-Present
- Distinguished Service Award, 2012, 2013

BUILDING OWNERS & MANAGERS ASSOCIATION (BOMA)

- Member, Energy & Environment Committee (National)
- Judge, TOBY Awards (The Office Building of the Year, Local)
- Chair, Sustainability for $uccess Committee (Local)

ENGINEERING SOCIETY OF DETROIT (ESD)

- Distinguished Service Award, 2007; Fellow, 2010
- Member, Construction & Design Committee
- Spokesperson on Energy & Environmental Issues
- Past Chair, Council of Affiliated Societies

U.S. GREEN BUILDING COUNCIL (USGBC)

- Past Board Member; Distinguished Service Award (Local), 2008
- Past Chair, Public Policy Committee (Local)
- Member, Green Schools Advocacy Committee (Local)

2

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This ASHRAE Distinguished Lecturer is brought to you by the Society Chapter Technology Transfer Committee

Complete the Distinguished Lecturer Event Summary Critique

- CTTC needs your feedback to continue to improve the DL Program
  - ✓ Distribute the DL Evaluation Form to all attendees
  - ✓ Collect at the end of the meeting
  - ✓ Compile the attendee rating on the Event Summary Critique
  - ✓ Send the completed Event Summary Critique to your CTTC RVC and ASHRAE Headquarters

Forms are available at:
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YOU ARE NEEDED FOR:

- ❖ Membership Promotion
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- ❖ Student Activities
- ❖ Chapter Technology Transfer Technical Committees

Find your Place in ASHRAE! Visit www.ashrae.org

Contents – more or less ☺

- General & Background Information
- Codes, Standards, Labels and other stuff
- Lots of Discussion
- How to Use this Information

6

Why Do People Change?

Only Two Reasons:

1. They *realize* it's in their best interests

2. They're forced to

Both of these are happening today

Why "Green" in Today's Tough Times ?

Save Costs

- Natural Resources
- Paper, Waste Recycling
- Travel: Webcasts, Teleconferencing

Improve Productivity

- Indoor Environmental Quality
- *People* are highest cost of a building

Sustain Financial Viability of Organization

Q: What is a “Green” Building?

A. Intelligent, Integrated Systems

B. Above Standards

C. Costs Less to Operate & Maintain

Two Driving Forces

- Regulatory
  - Building energy use disclosure
  - Benchmarking against peers
- Business

Driving Forces – Regulatory – 11/13

- EU since 2003
- States requiring Performance Disclosure: CA, WA, FL, HI, OK, UT, ME, D.C.
- Cities requiring Performance Disclosure: Seattle, New York, Boston, Philadelphia, Chicago, Austin, TX; Westchester, PA; Burlington, VT
- Federal legislation being discussed

State and Local Governments Leveraging Portfolio Manager

12

Driving Forces - Business

- Energy efficient buildings
  - Lower operating costs
  - Higher net operating income
  - More valuable
  - More attractive to tenants
- Energy inefficient buildings
  - Less competitive in the marketplace
  - In danger of obsolescence

What's in It for Me and My Building(s) ?

It's All about Market Forces

- Can't manage what you don't measure
- Transparency: good for energy-efficient buildings bad for poor performing buildings
- Energy usage data available to
  - Consumers
  - Tenants
  - Prospective purchasers
  - Investors

14

ASTM's BEPA Standard: E2797-11 (published 02/10/11)

- Building Energy Performance Assessment
- 5 components:
  - Site Visit
  - Records Collection
  - Review and Analysis
  - Interviews
  - Report
- *Not* building benchmarking
- Precursor to bEQ, energy audit & retro-commissioning

15

What Was the Problem?

- Significant variability depending on:
  - Period of time chosen over which the data was collected (1 yr, 2 yrs, 3 yrs) and how it was calendarized
  - Whether or not changes in building occupancy were considered
  - How weather conditions were factored in and baseline conditions established
  - How building operating hours were considered
  - Whether or not major building renovations were considered

What does the BEPA Standard Accomplish?

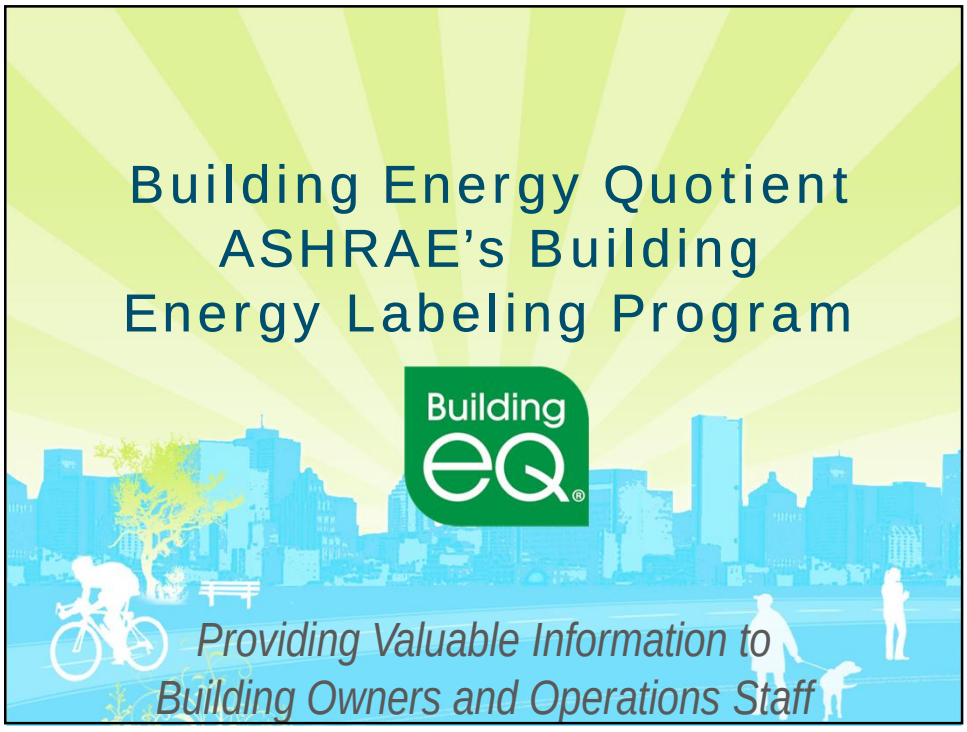
- Standardizes the collection and reporting of energy consumption information for a building involved in a real estate transaction
- Facilitates improved benchmarking (by others)

Report Deliverables

- Pro Forma (representative) building energy ***use***
- Pro Forma (representative) building energy ***cost***
- Projected range of building energy ***use*** for:
  - lower, upper and average case
- Projected range of building energy ***cost*** for:
  - lower, upper and average case
- Actual building energy ***use*** data for each year collected
- Actual building energy ***cost*** data for each year collected

What's the Problem?

- Prospective purchasers - as part of due diligence ask, "What is the building's energy consumption?"
- Pro Forma provided to potential lenders by buyers has line item for utilities under building operating costs
  - Lenders want a "reasonable" and "realistic" value
  - ***No consistent methodology existed to provide answers***

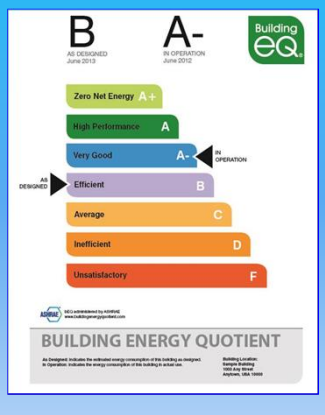


Sustaining our Future by Rebuilding our Past

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

- Gordon Holness,
Former President, ASHRAE

Building Energy Labels. . .



- Promote energy efficiency in real estate
- Differentiate efficient buildings in the marketplace (tenants/buyers)
- Provide feedback on a building's potential & measured energy use
- Identify energy efficiency measures and value in reducing long-term energy costs
- Add to building performance databases

22

Why ASHRAE?

- Over 100 years of experience in building sciences and technology
- Strong technical expertise across all aspects of building design and operation
- Historic focus on developing consensus-based, non-commercial documents
- Respect and credibility within the building community

23

Why Now?

Information labels for consumers to allow educated choices is not new:

- Restaurant Sanitation Ratings
- Car Fuel Economy Estimates
- Nutrition Fact Labels

Opportunity to support consistent mandatory programs worldwide

24

Two Types of Ratings (1)

In Operation (operational) Rating

- Assessment of the building's structure/features and how it is operated
- Based on actual metered energy use of a building
- Applicable for buildings after at least 12-18 months of operation

25

Two Types of Ratings (2)

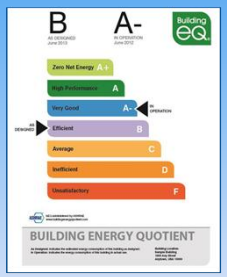
As Designed (asset) Rating

- Assessment of the building's physical characteristics and systems
- Independent of a building's occupancy and operating conditions
- Based on results of a standardized energy model as compared to a baseline
- Applicable to both new and existing buildings

26

How is bEQ Different from "Green" Programs like LEED® or Green Globes® or others?

- Focuses solely on a building 's energy use and Indoor Environmental Quality (IEQ)



- Greater concentration on
  - understanding energy use
  - identifying opportunities for improvement
- Could be used to improve/verify energy component of green building rating systems

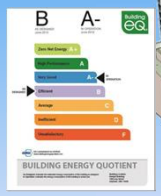
27

How is bEQ Different from Energy Star?

- Greater differentiation for high performing buildings (Energy Star based on CBECS database)
- Greater emphasis on net zero energy
- Able to label building types outside of Energy Star
- Greater focus on energy use and opportunities for improvement
- Documented IEQ
- Assessment conducted by certified assessor (BEAP)

28

These Buildings are "Green"
But How Efficiently Do
They Use Energy?



←This Building has a
Good Energy Quotient

29

Providing Relevant Information (1)

The Label:

- Most visible component of the program
- Simple to understand – targets general public
- Zero point on scale set to "zero net energy"
- Median value (100) set to national median EUI of CBECS for building type
- Plaque is suitable for display in building lobbies and marketing materials

30

The bEQ Rating Scale

Scale Range	Rating	Description
≤ 0	A+	Zero Net Energy
1-25	A	High Performance
26-55	A-	Very Efficient
56-85	B	Efficient
86-115	C	Average
116-145	D	Inefficient
>145	F	Unsatisfactory

31

Providing Relevant Information (2)

The Certificate:

- Technical information explains the rating score
- Information useful to building owners, tenants, utilities, and operations and maintenance personnel

Additional Documentation:

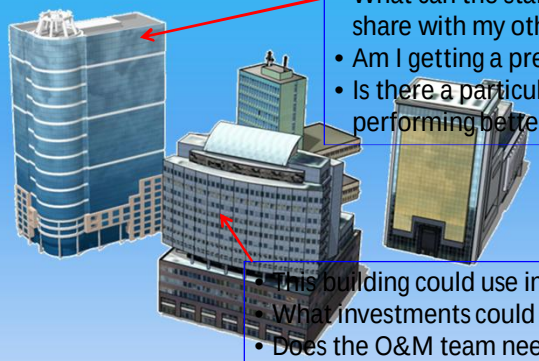
- Background technical information
- Useful for engineers, architects, and technically savvy building owners
- Useful for determining the current state of the building and opportunities for improving its energy use

32

Why Should Owners be Interested? (1)

Manage portfolios and identify investment opportunities

Existing Building Portfolios (*In Operation Rating*):



- What can the staff managing this building share with my other building managers?
- Am I getting a premium for this building?
- Is there a particular reason this building is performing better?

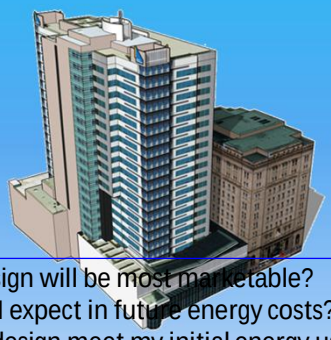
- This building could use improvement.
- What investments could improve energy use?
- Does the O&M team need additional training?
- Can re-commissioning or retro-commissioning address poor performance?

33

Why Should Owners be Interested? (2)

Make educated decisions on new building design

Design Options for a New Building (*As Designed Rating*):



- Which design will be most marketable?
- What can I expect in future energy costs?
- Does the design meet my initial energy use expectations?
- What will I need to do to assure the building performs to its potential?

34

Why Should Owners be Interested? (3)

Tenants are looking to understand energy use and cost

Potential Lessees:

- Is this a bad building or just not measured?
- What will my energy bills be?
- How do I compare energy use for different buildings?
- Does the building owner invest in necessary operations and maintenance?

- This is a high-performance building.
- My energy costs will be manageable.
- The building owner pays attention to operations and maintenance.
- I can afford to put more money towards rent.

35

Benefits for Owners – (of High-Performance Buildings)

- Side-by-side comparison of *As Designed* (asset) and *In Operation* (operational) Ratings
- Measurement-based Indoor Environmental Quality (IEQ) indicators to assure levels of service are maintained
- List of operational features including commissioning activities, energy efficiency improvements
- Provides information on how the building is using energy and how performance can be improved
- *Differentiate building from peers to attract tenants or potential buyers*

36

Sustainability for ASHRAE

Energy Efficiency

and

Healthy and Productive Indoor Environments

ASHRAE's Strategic Plan for Sustainable Buildings

1. Lead the advancement of sustainable building design and operations.
2. Focus on innovative designs to provide elegant solutions for high performance buildings.
3. Focus on the operation of high performance buildings.
4. Position itself as the premier provider of HVAC&R expertise.

A Key Sustainability Goal: Improved Operating Strategies

The Opportunity:

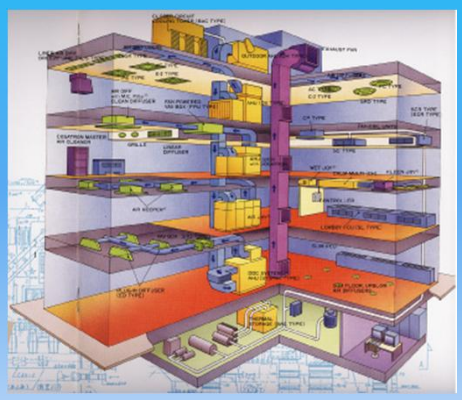
Improved operational strategies alone could save 10% - 40% in energy.

These savings come about through improvements in software and use of expert knowledge, *not* large capital investment.

Conclusion:

Must first upgrade and then maintain the capabilities of the operations staff. Without ongoing maintenance of skills, building performance will soon slide back to the default value of a poorly operated property.

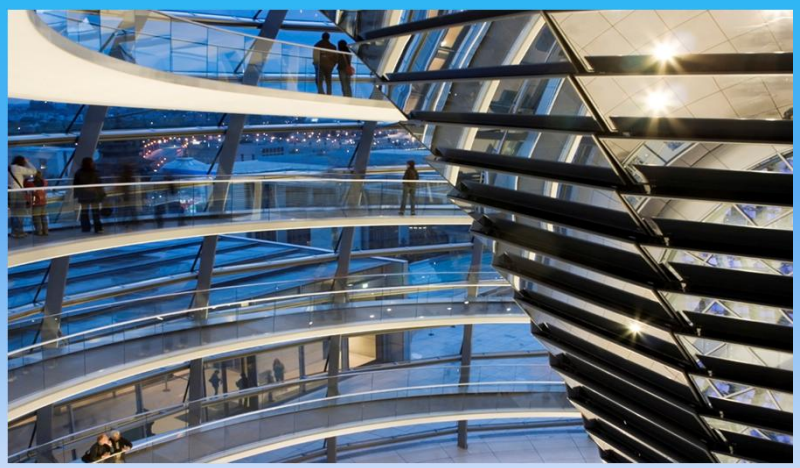
Why Be So Concerned about HVAC Systems??



HVAC
is
"Heart and Lungs"
of
Building

Why compromise?

High Performing HVAC Systems – a Major Component of High Performing Buildings



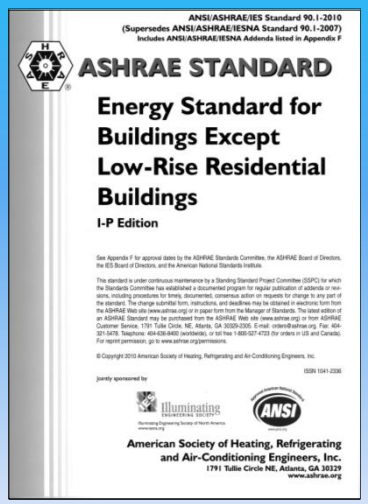
41

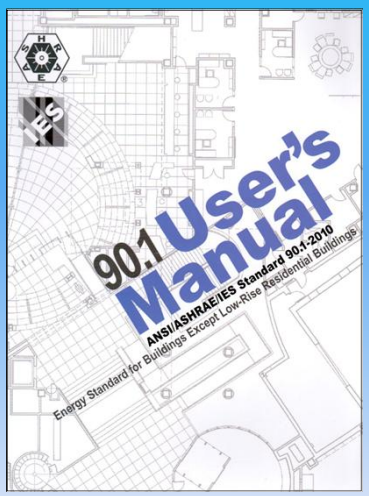
Q: What Is A Building Code Standard?

A: A *Minimum* Standard

42

ASHRAE Energy Standard 90.1-2010 ≈ 30% more stringent than 90.1-2004





43

Changes in Standard 90.1-2010 (1)

- Building Envelope
  (Opaque elements and fenestration) – more stringent requirements
  - 40% max glazing (per prescriptive path)
  - Continuous air barrier
  - Cool/high albedo roof requirements added
  - Orientation requirements

44

Changes in Standard 90.1 (2)

- Electrical
  - Receptacles and some process loads covered
  - Lower interior/exterior lighting densities
  - Additional occupant sensing controls
  - Mandatory daylighting requirements for specific spaces
  - New 5-zone exterior lighting power density table

45

Changes in Standard 90.1 (3)

- HVAC systems
  - Most equipment efficiencies higher
  - Energy recovery required in more applications
  - Economizers required in more climates
  - More energy-conserving controls required
  - Duct sealing and leakage

46

Changes in Standard 90.1 (4)

- Energy modeling
  - Requirements, e.g., for LEED certification, clarified and expanded
  - Energy Cost Budget Method (ECBM) and Trade-offs clearer

47

Architect – Engineer Tradeoffs in Integrated Design

Building Envelope

- Insulation
  - Type
  - Thickness
- Roof
- Walls
- Windows
- Daylight
- Doors

HVAC/Lighting/Plumbing

- HVAC System Type
- HVAC System Size
- No. & Type of Lights, Fixtures
- Plumbing Fixtures

What Does "Green" Mean to HVAC?

- Not Always About Installing a High Efficiency Boiler or High Efficiency Chiller
- Avoiding the Need for That Boiler or Chiller (or at Least Significantly Downsizing Them)
- Providing a High Performance Hybrid HVAC *System*
  - Energy Efficient Components
  - Design Strategies to Maximize Capabilities of Those Components

Electrical Loads

- Lower Electrical Loads = Smaller Starters, Wiring, Switchgear, etc. = Lower First Cost
- This is Something Designers Don't Always Think About When Reducing Size of Mechanical Equipment
- Must Look at *Whole System*, not just Mechanical Portion

50

High Performance HVAC Benefits

Innovative Engineering and Design

- Improves System Performance
- Reduces (Or Maintains) First Costs
- Reduces Energy Costs
- Reduces Life Cycle Costs
- Increases Life of Building Equipment
- Reduces Maintenance Costs
- Improves IAQ and IEQ
- Improves Productivity
- Minimizes Litigation Potential - Maybe

51

Surpass ASHRAE Energy Std. 90.1 and Save Money

- ASHRAE Advanced Energy Design Guides (free download)
  - Building Envelope, Lighting, HVAC Equipment & Systems, Service Water Heating
  - 30% (>90.1-1999)
  - 50% (>90.1-2004) – also, larger buildings
- ASHRAE Energy Standard 90.1
  - Energy Standard 90.1-2010 => considerably more stringent than -2004 and -2007
  - New Systems
  - New Equipment
  - New Ideas
- Think Outside-the-Box
  - Different (smarter) ways of using existing systems
  - Ah-ha moments
- *Convince the People Who Are Paying the Bill*

52

But Is It All About Energy?

Smarter Water for a Smarter Planet

Q: How many gallons of potable water do Americans use every day – *just to flush toilets*?

A: Almost 5 billion!

Water Savings

- Exterior – Irrigation
  - Water efficient landscaping
  - No potable water use or no irrigation

- Interior Water Use Reduction
  - Toilets & urinals (low-flow or waterless)
  - Sinks (low-flow, with or without sensors)
  - Showers (low-flow)
  - Shower with a friend

Water Saving, Reuse

Gray Water ≡ Water that can be recycled & reused:

- Condensate from (clean) drain pans
- Water from sinks
- Water from washing machines, dishwashers
- Rainwater
  - Collection cisterns
  - "Green" Roofs

Be Careful What You Ask For

- Less potable water being used for flushing toilets
  - Good
    - Conserve water
    - Lower power requirements for water plants
  - Not so good
    - Drains plug up
    - Treatment in waste plants not being rebalanced for higher waste/water ratio, or for more and different chemicals being flushed down drains

What Happens to HVAC Systems as Time Passes?

Green → Grey

How Do You Maintain Sustainability?

A. Energy Audits

B. Re-commissioning and Retro-commissioning

Energy Audits

- Purpose:

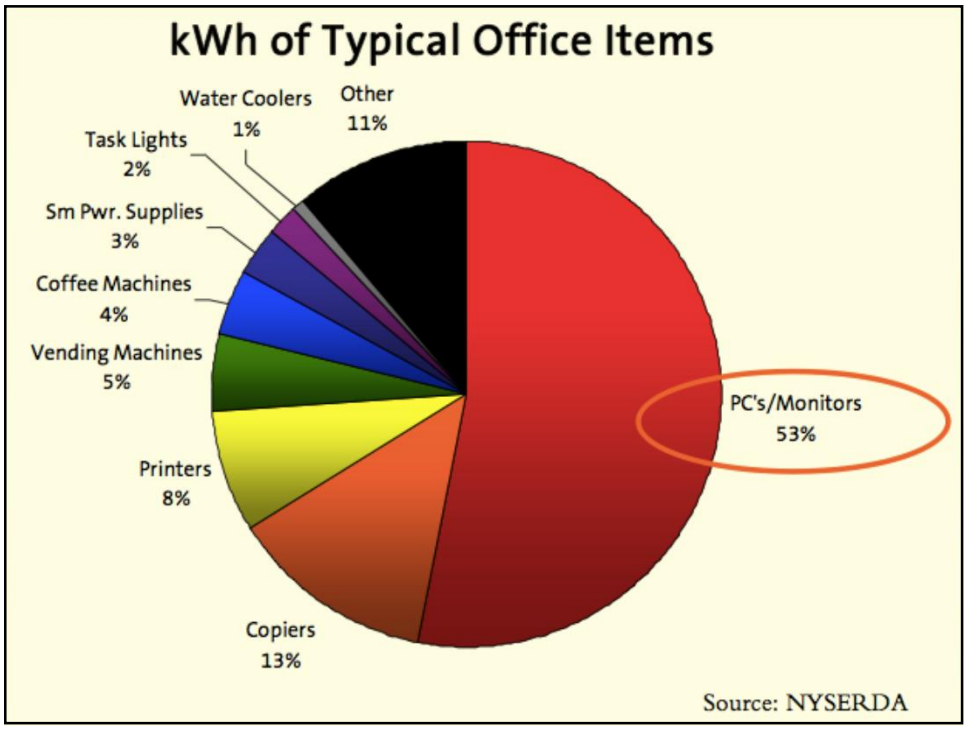
  Identify and develop modifications to reduce energy use and/or cost of operating a building

- Type(s):
  - -- Preliminary: Analysis of Utility Bills to Compare
  - – Level I: Walk-Through Analysis (very basic)
  - – Level II: Energy Survey & Analysis
  - – Level III: Detailed Analysis of Capital Intensive Modifications

Energy Audits – What Do They Examine?

- Building Energy Consumption:
  - Envelope* (Walls, Windows, Roof)
  - Lighting* (Interior & Exterior)
  - HVAC*
  - Domestic & Process Water* (Hot & Cold)
  - Laundry
  - Food Preparation
  - Conveying Systems
  - Plug Loads
  - Other Systems – Compressed Air, etc.

* In EPAct 2005



Why Do Building Owners Turn Down Energy Audits?

Cost of the audit?

Cost of what has to be done after the audit?

Fear? Of what?

- lack of expertise of the auditor?
- exposure of poor O & M practices?
- exposure of no maintenance practices?
- exposure of lack of knowledge (or incorrect assumptions) about the building operation?
- more work for the overworked building staff?
- what else?

65

What To Do After the Audit

- Re-commissioning or retro-commissioning based on audit results
  - Repair building envelope (walls, windows, roof) as required
  - Ensure HVAC systems are operating properly and most efficiently – beyond simple thermostat adjustments
  - Remove and replace inefficient HVAC and service water systems

Operation & Maintenance

- Best Designs & Construction
  Doomed to Failure Without *Proper* and *Ongoing* Maintenance
- Retro-Commissioning:
  Return to Original Design Concepts and Operation
- Continuous Commissioning

Where to Get Help

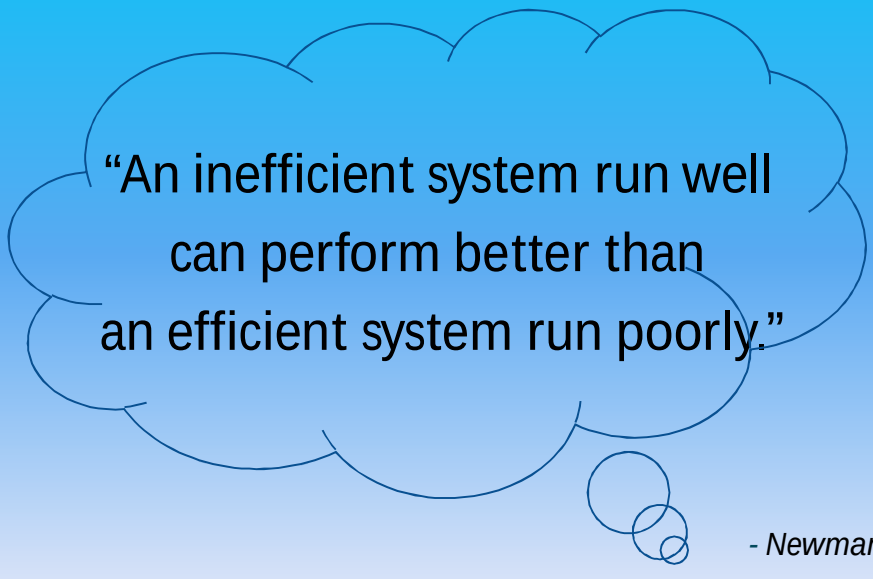
- Federal Government (see dsireusa.org)
- Utility Energy Optimization Programs (these are good!)
- Organizational grants (difficult to get)
- Municipal, county or province energy grants
- Local tax reductions (primarily new construction)
- Faster permitting and inspections from some local jurisdictions if building to LEED® Guidelines (primarily new construction)
- Better insurance rates – from some insurers
- Better bank loan rates – from some banks

Why Do Owners Care?

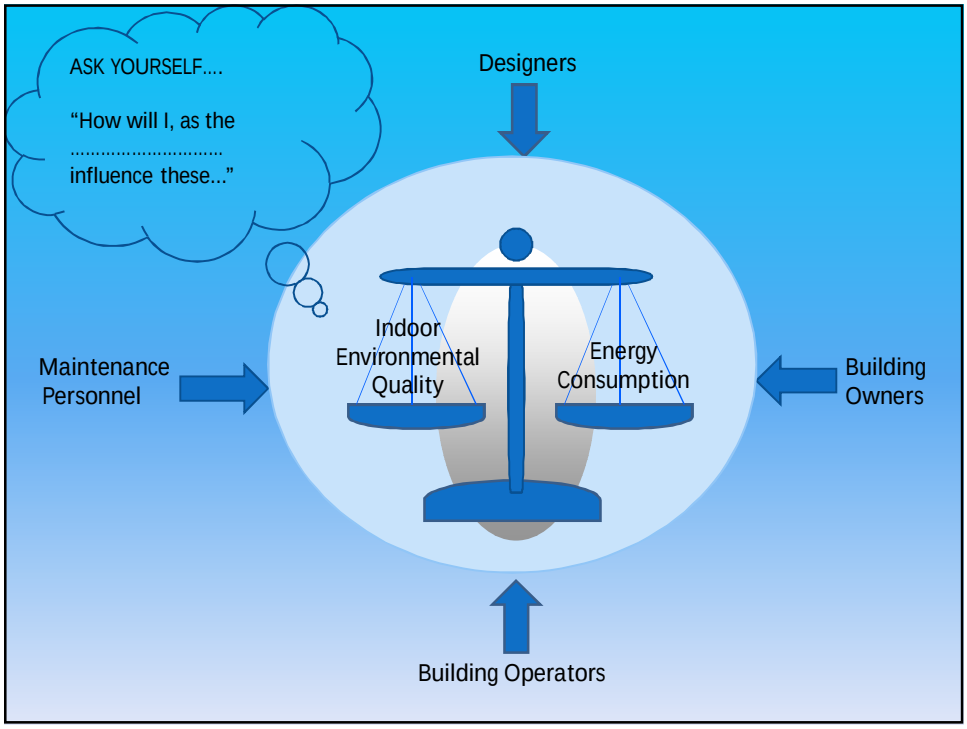
- Their employees and/or their tenants?
- The environment?
- The economy?
- Their R.O.I.?

Is it about the "Triple Bottom Line" (SEE or PPP) – or what?

Technology ≠ Performance



- Newman



So What Now?

- Use what you're learning today – never stop learning
- Think "Outside the Box"
- Keep up-to-date
  - ASHRAE Standards, LEED Guidelines
  - BOMA/IFMA/USGBC/ASTM
  - Government Regulations
- Join professional organizations
- Get a professional certification
- Be a teacher, not just a student

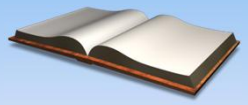
72

Where To Get Information - ASHRAE

- Procedures for Commercial Building Energy Audits
- Energy Conservation in Existing Buildings
- Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems
- Standard Measures of Measuring, Expressing and Comparing Building Energy Performance
- Preparation of O & M Documentation for Building Systems
- Sustainable, High-Performance O & M (2012)
- Advanced Energy Design Guides (AEDG) – 30% / 50% – free!

Where To Get Information - Other

- USGBC: LEED-EB: O & M Guidelines
  Based on EPA Energy Star® Portfolio Manager,
  ASHRAE Energy Standard 90.1.
  Green Operations Guide (2010)
- BOMA: Preventive Maintenance & Building Operation Efficiency (2003 – written by ASHRAE member)
- IFMA Foundation: Sustainability "How-To" Guides
- EPA Energy Star
- Rocky Mountain Institute
- PECI



References & Resources (1)

ashrae.org (American Society of Heating, Refrigerating and Air-Conditioning Engineers)
www.buildingenergyquotient.org - (ASHRAE Bldg. Energy Quotient label information)
ashrae.org/aedg — Advanced Energy Design Guides, available for free download
usgbc.org (U.S. Green Building Council)
usgbc.org/leed/eb — LEED for Existing Buildings: O&M Guidelines
gbci.org (Green Building Certification Institute)
aia.org/cote (AIA Committee on the Environment)
boma.org (Building Owners and Managers Association)
boma.org/evergreen — Guide to Green and Sustainable Operations and Practices
Ifma.org (International Facility Management Association)
ifmafoundation.org — IFMA's guides on sustainability and commissioning

75

References & Resources (2)

dsireusa.org (Info on federal, state, local, utility incentives and policies)
epa.gov/air/caa/peg (Guide to the Clean Air Act)
facilitiesnet.com (specialized site for facility professionals)
myfacilitiesnet.com (social networking site for facility professionals)
energystar.gov/benchmark (EPA Portfolio Manager)
advancedbuildings.org (energy eff. technologies, strategies for commercial buildings, case studies)
bcxa.org (building commissioning)
newbuildings.org (promotes energy efficiency in bldgs. through technology research, guidelines and codes)
buildingEQ.com (ASHRAE bEQ Program)

For Further Information:

Jim Newman
Office: +1-248-626-4910
Jimn@newmanconsultinggroup.us
www.newmanconsultinggroup.us

"We Do Not Inherit the Earth from Our Ancestors – We Borrow It from Our Children" *– Native American Proverb*

Build Green – Everyone Profits! - USGBC

78

Q & A