The Weidt Group®

The Company for Energy Decision Makers℠

twgi.com

Collaboration	Analysis	Research

Energy Design℠

Life-long Energy Performance

Real Zero
## Conceptual Framework Based on Practice

- **Asset Creation**
  - Whole Building Analysis for New Construction and Deep retrofit projects

- **Operational Management**
  - What to hold constant and what to vary

- **Asset Ratings and Operational Ratings Together**

The Weidt Group
Tools and Consulting for Energy Decision Makers

- Energy Design Assistance
    - On more than 1,600 commercial buildings
    - 6 utility DSM programs
    - Design models are within **2%** of metered usage without weather correction
    - Net zero building consulting since 2000
- On-going Energy Performance
    - LEED Measurement and Verification
    - Utility DSM On-Going Performance Tracks
- Benchmarking
    - For over 10,000 public buildings
- WeidtSim^{SM} software tools
    - Web-based energy modeling applications

Utility Consulting

Net Zero Design

Energy Software
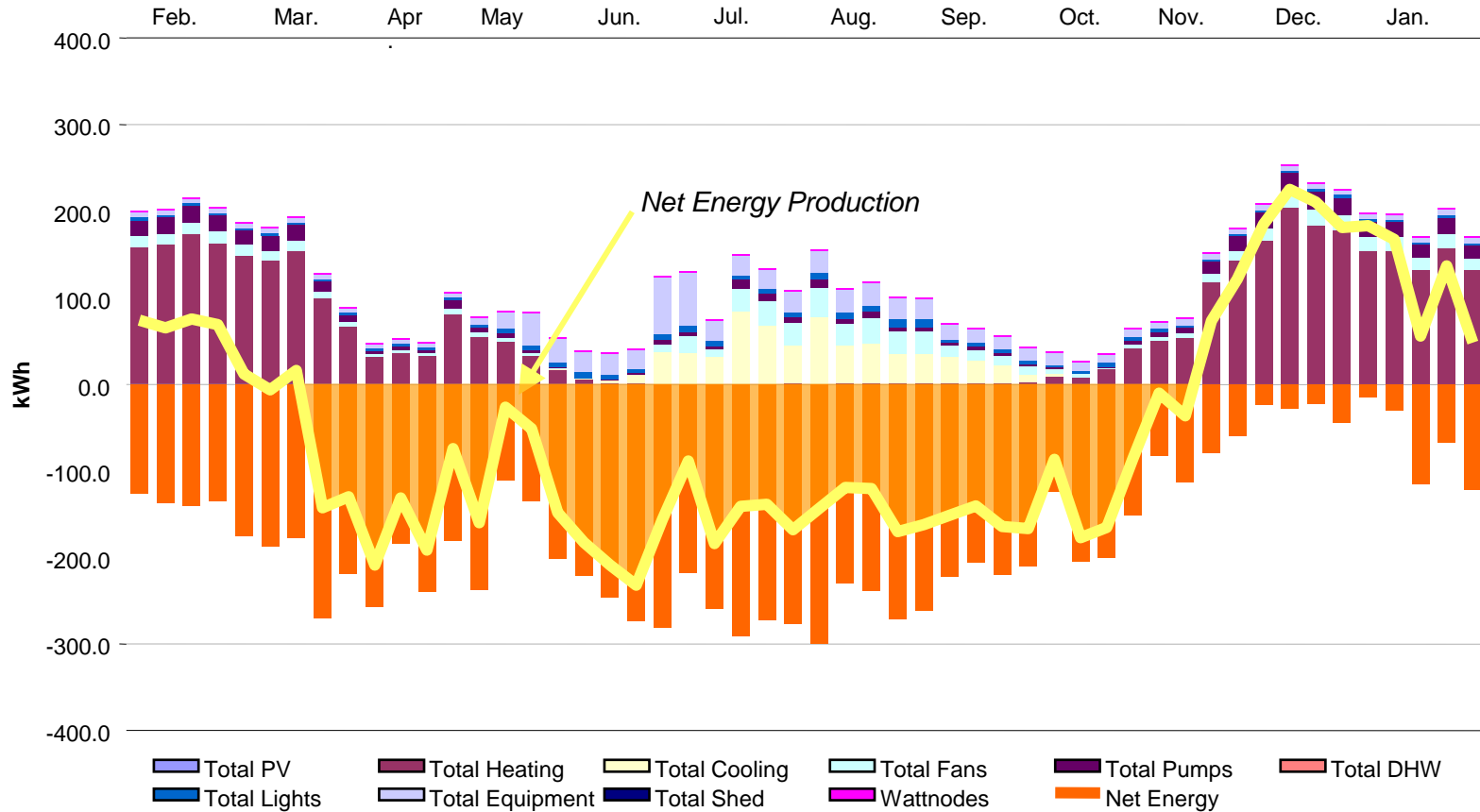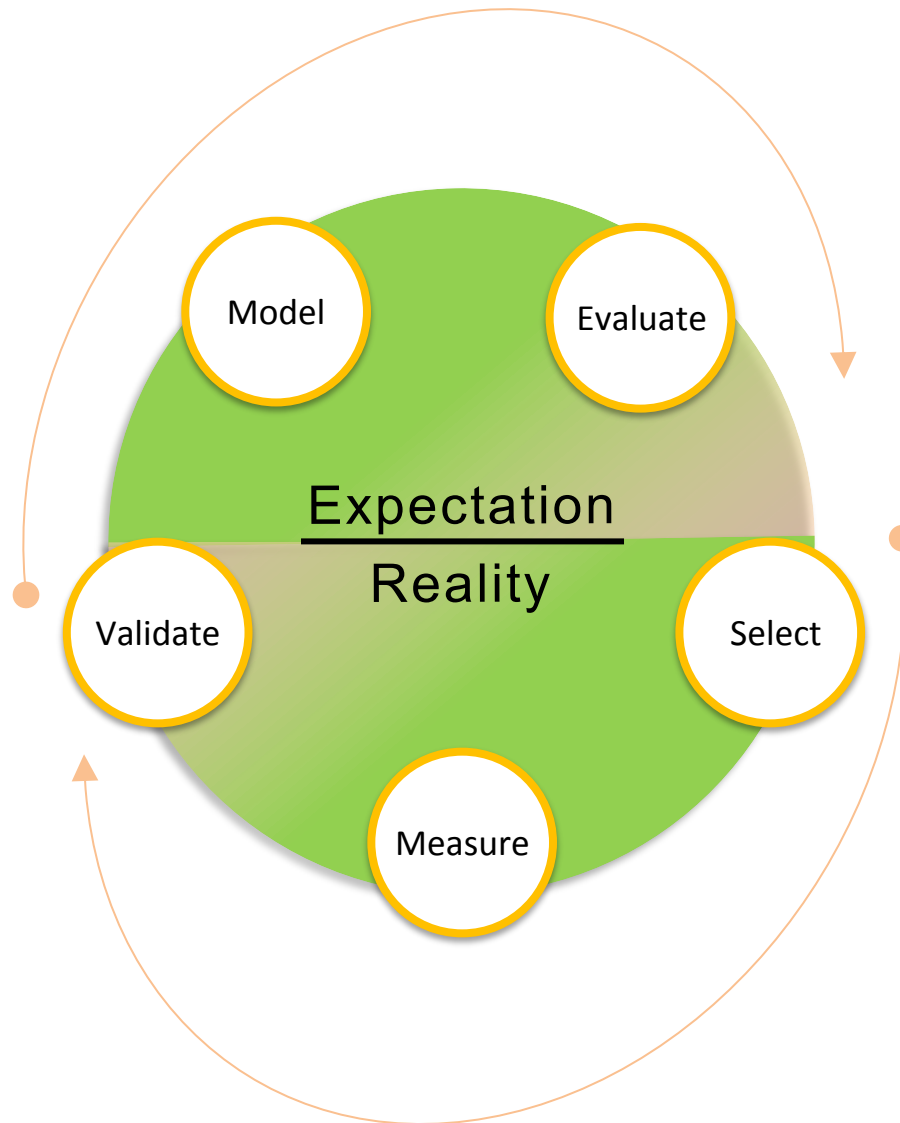
IAMU
Net Zero Ready 1999
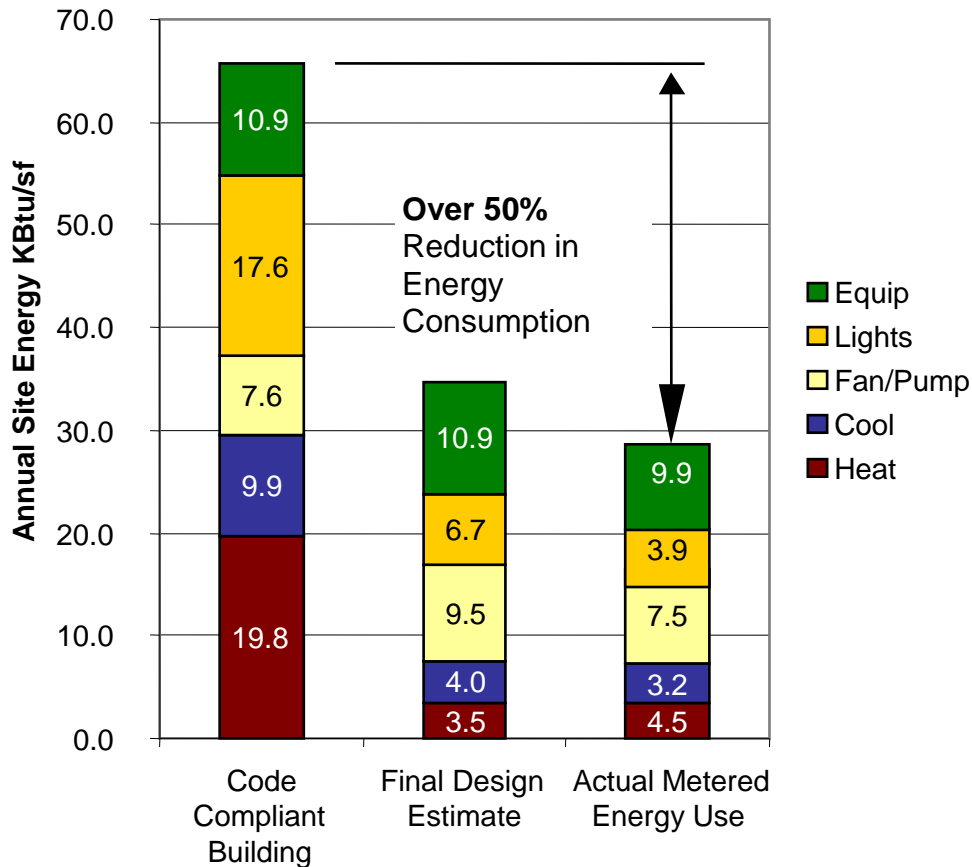
The Iowa Association of
Municipal Utilities
Office and Training Facility
Ankeny, Iowa

Design 1997
Completed 1999

Science Museum of Minnesota Science House

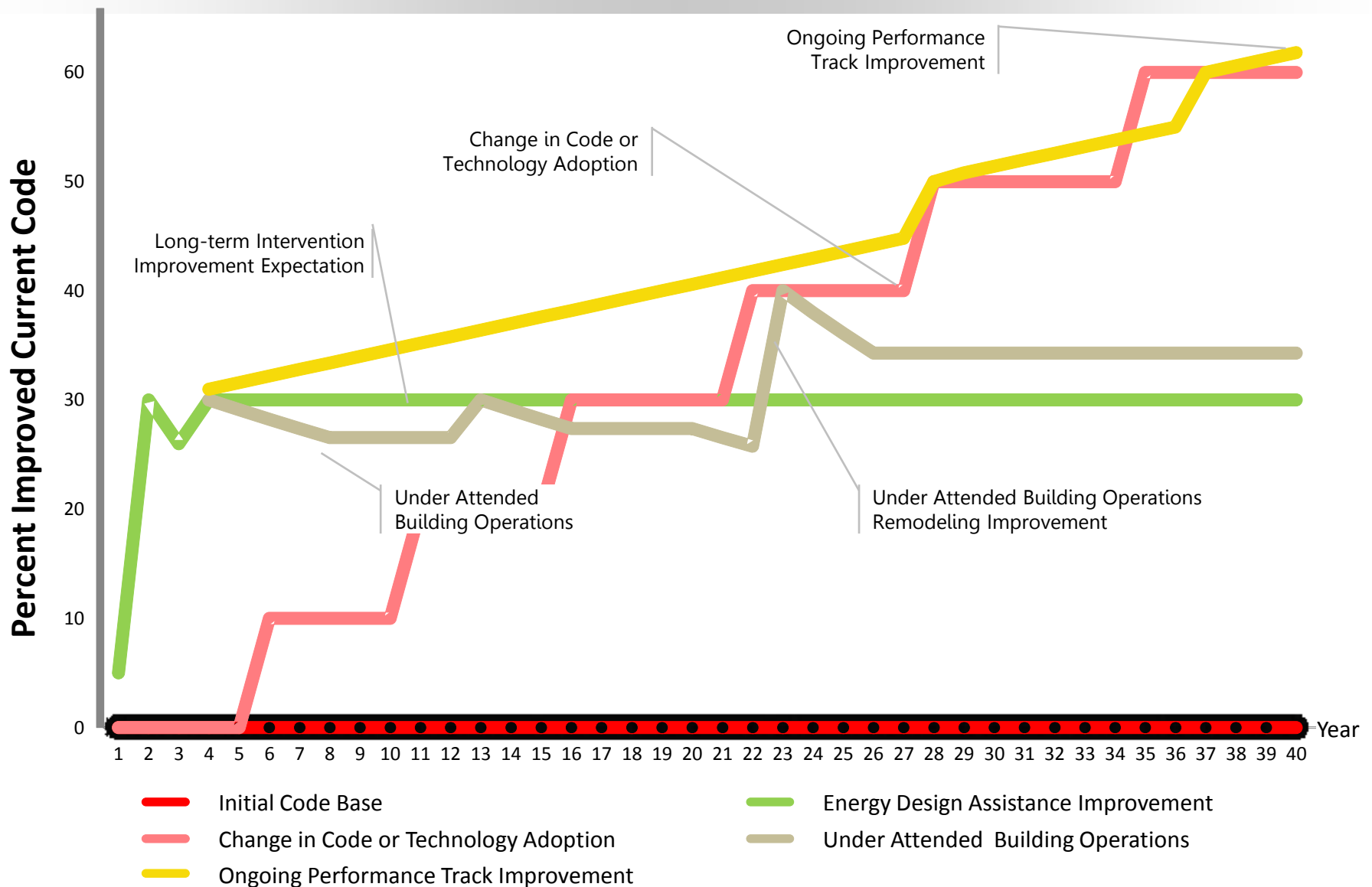## 2003 – An Operating Prototype

The greatest obstacle to discovery is not ignorance —
It is the illusion of knowledge

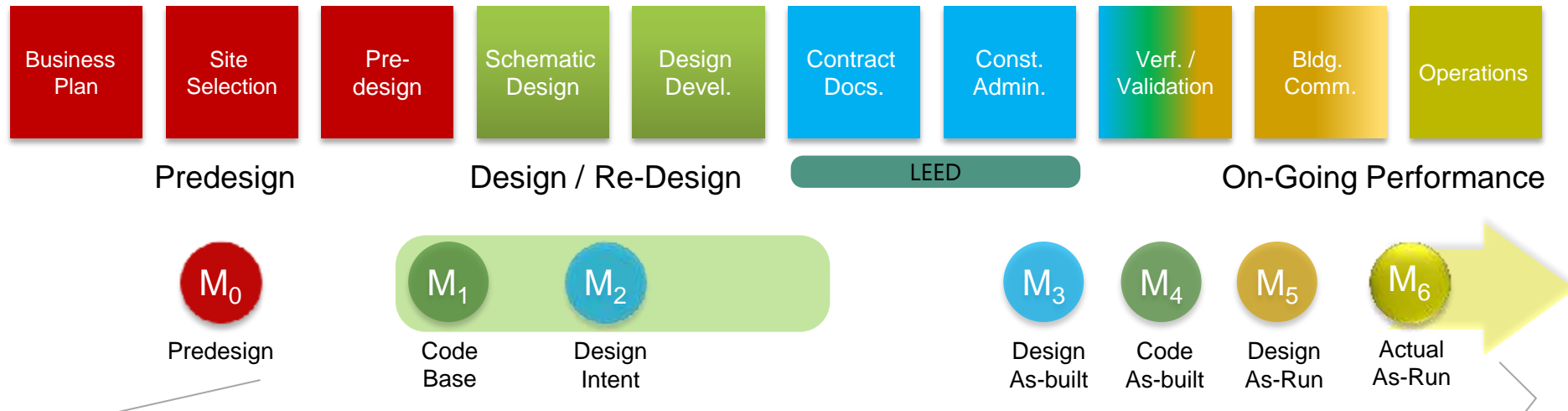*Daniel J Boorstin, Librarian of Congress*

Perspective
Performance Maintenance Cycle and Ongoing Performance

Percent Improved Current Code (y-axis)

Year (x-axis): 1–40

Labels within chart:
- Ongoing Performance Track Improvement
- Change in Code or Technology Adoption
- Long-term Intervention Improvement Expectation
- Under Attended Building Operations
- Under Attended Building Operations Remodeling Improvement

Legend:
- Initial Code Base
- Change in Code or Technology Adoption
- Ongoing Performance Track Improvement
- Energy Design Assistance Improvement
- Under Attended Building Operations

Emergent View of Energy Models
Intentional Models from Guidance Through Operations

Business Plan	Site Selection	Pre-design	Schematic Design	Design Devel.	Contract Docs.	Const. Admin.	Verf. / Validation	Bldg. Comm.	Operations

| | Predesign | | Design / Re-Design | | LEED | | | On-Going Performance | |

M_0 — Predesign

M_1 — Code Base M_2 — Design Intent

M_3 — Design As-built M_4 — Code As-built M_5 — Design As-Run M_6 — Actual As-Run

Models together with regularly updated <u>real</u> information, including metered data, create the best opportunity for continuous reductions in energy consumption.

Modeling Variables
Setting Asset and Operational Expectations

Physical Design

Physical variables partially fixed by Codes but with significant independent variables negotiated throughout design and construction

Code

Model

Weather
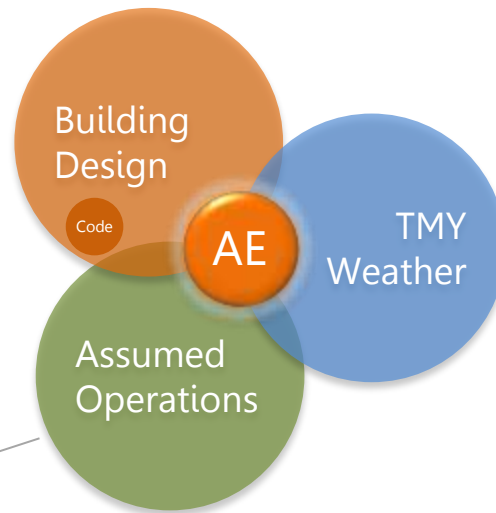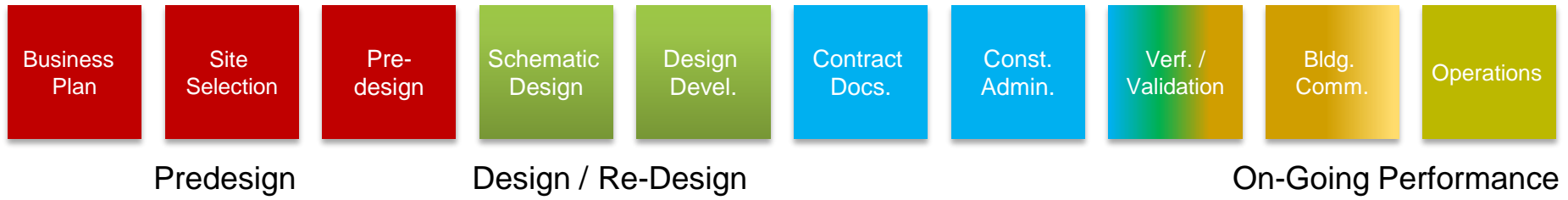
Design models use a Typical Meteorological Year that will see variables based on microclimate, by hour and by year

Operations

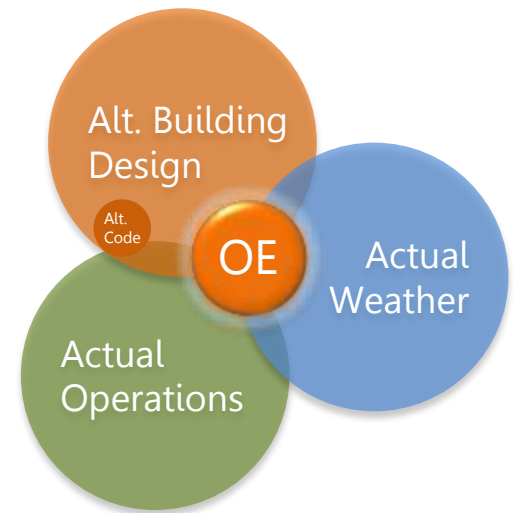Independent variables not governed by code includes occupancy, set points and plug loads

COMNET is a solution to most of these issues for many purposes

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Emergent View of Energy Models
Intentional Models from Guidance Through Operations

Business Plan	Site Selection	Pre-design	Schematic Design	Design Devel.	Contract Docs.	Const. Admin.	Verf. / Validation	Bldg. Comm.	Operations

Predesign　　　　　**Design / Re-Design**　　　　　**On-Going Performance**

Building Design
Code
AE
TMY Weather
Assumed Operations

Alt. Building Design
Alt. Code
OE
Actual Weather
Actual Operations

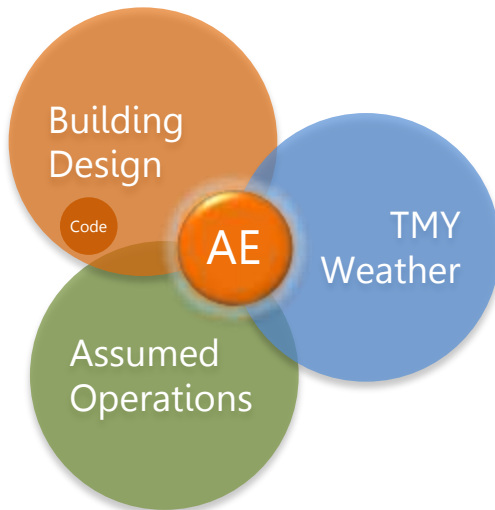Everything starts out as an assumption

Assumptions are gradually replaced with information which must be replenished
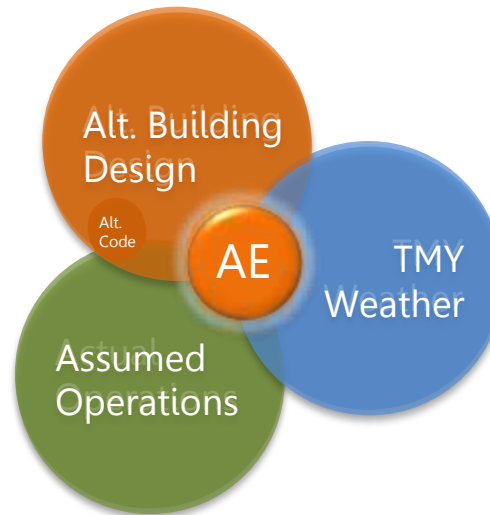
Emergent View of Energy Models
Intentional Models from Guidance Through Operations

Design and Re-Design

Building Design
Code
AE
TMY Weather
Assumed Operations

- Of interest to everyone
- Best available assumptions
- Compares to Code or targeted performance

On-Going Performance Incentive View / **As-Built Code and Design**

Alt. Building Design
Alt. Code
AE
TMY Weather
Assumed Operations
Actual

- Of interest to utility for adjusted design incentive
- Best available information with minimal assumptions
- Best available information and assumptions
- Standard Weather to even out expectations
- May compare to meter

On-Going Performance Operations / **Asset Rating**

Alt. Building Design
Alt. Code
AE
TMY Weather
Standard Operations
Actual
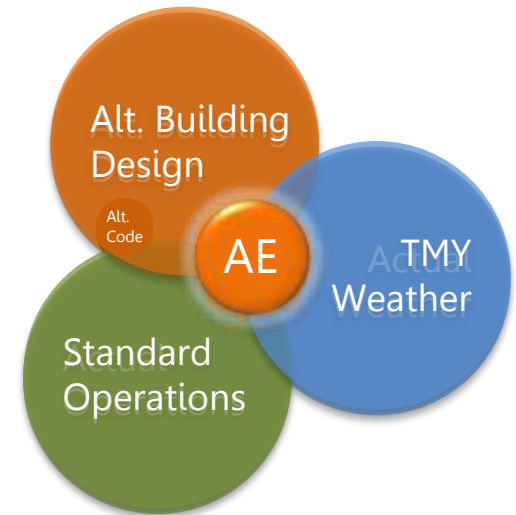
- Of interest to the market
- Of interest to Owner
- Best available Asset information
- Best available information with minimal assumptions
- Standardize Weather and operations
- Compares to meter and operations

Integrated Design
For Net Zero

PHASE

STEP 1 2 3 4 5
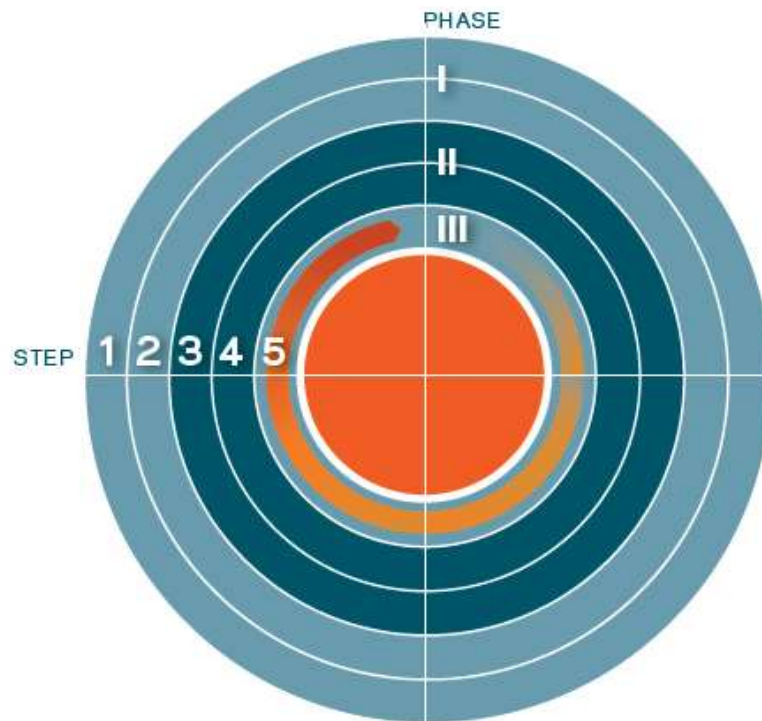
PHASE I
PRE-DESIGN

STEP #1
ORGANIZE FOR ZERO CARBON EMISSIONS:
Develop a plan for learning and deciding.

STEP #2
ACCEPT YOUR CONDITIONS:
Define environmental, comfort and financial goals before beginning design.

PHASE II
DESIGN AND CONSTRUCTION

STEP #3
RESOLVE THE MACRO-SCALE:
Develop site and architectural strategies that reduce energy needs and optimize energy generation.

STEP #4
DEVELOP INTEGRATED SOLUTIONS:
Define whole building systems to tunnel through cost barriers.

PHASE III
STEWARDSHIP

STEP #5
MAINTAIN ZERO:
Provide a plan that will equip the owner and tenants to occupy and operate the building with zero emissions.

http://netzerocourt.com/

1.Design

2. Operations

In design, If you are not measuring how close you are to your energy goal (net zero) you don't know how far you have to go to get there.

In operation, If you are not measuring how close you are to your energy target, you don't know how far you have strayed away from it.

M_0

Predesign

M_1

Code Base

M_2

Design Intent

M_3

Design As-built

M_4

Code As-built

M_5

Design As-Run

M_6

Actual As-Run

Building Energy Rating and Labeling
Two Types of Rating Systems

- **Asset Ratings**
    - An energy simulation model based on architectural and systems characteristics that holds operational variables constant to project a building's energy efficiency
- **Asset Ratings rate the building's energy efficiency potential based on its physical components under standard operating conditions**
    - It can be used to measure its retrofit potential of physical building assets only

Asset Rating
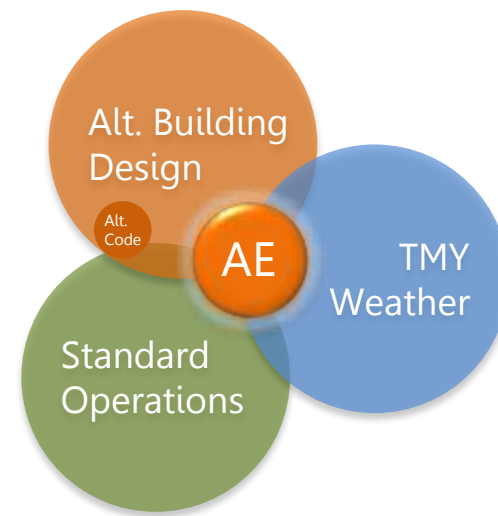
- Of interest to the market
- Best available Asset information
- Standardize Weather and operations

Building Energy Rating and Labeling
Two Types of Rating Systems

- Operational Ratings
  - Compare a building's actual energy consumption to an operational energy simulation model of that building
- Operational ratings combine both a building's operational and retrofit potential

On-Going Performance Incentive View
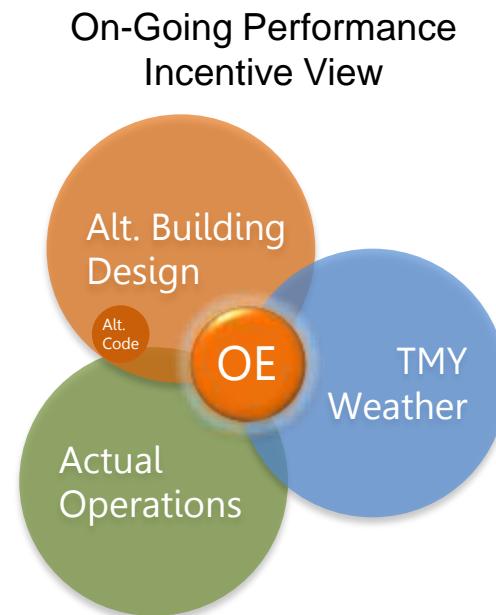
- Of interest to utility
- Best available information with minimal assumptions
- Standard Weather to even out expectations

Building Energy Rating Systems
Introduction

- **Energy consumption in buildings is the result of**

  - Efficiency of the physical assets – walls, windows, lighting, and HVAC system efficiencies

  - Level of service – hours of use, and activity type

  - Operation and maintenance – how well the controls are operated and how well the buildings physical assets have been maintained

Design

Code

OE

Weather

Operations
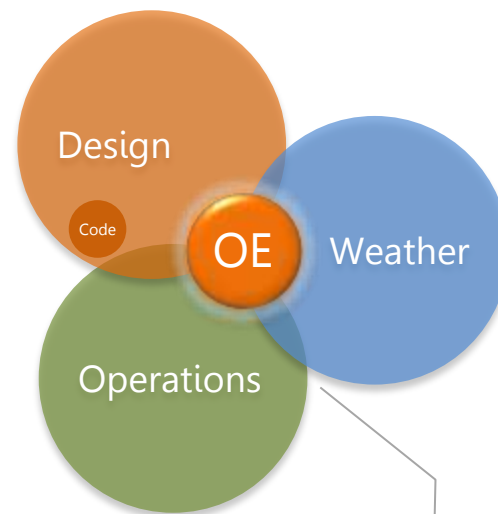
Models for ratings isolate these factors to find strategies to improve s building and compare to others in fair and credible ways

Building Energy Rating Systems
Asset Ratings

- National Asset Ratings are early in the adoption cycle

  - Massachusetts DOER and NEEP in 2012 conducted a phase 1 pilot project on 11 office buildings using three firms to test different methods

  - Phases 2 will begin next month developing Asset Ratings for 40 office buildings using The Weidt Group and Retrofficency to continue to test different methods

  - California has been conducting similar research

  - DOE is piloting an Asset Rating program to provide an Asset Rating on a scale of 0 to 100

Massachusetts BAR Project
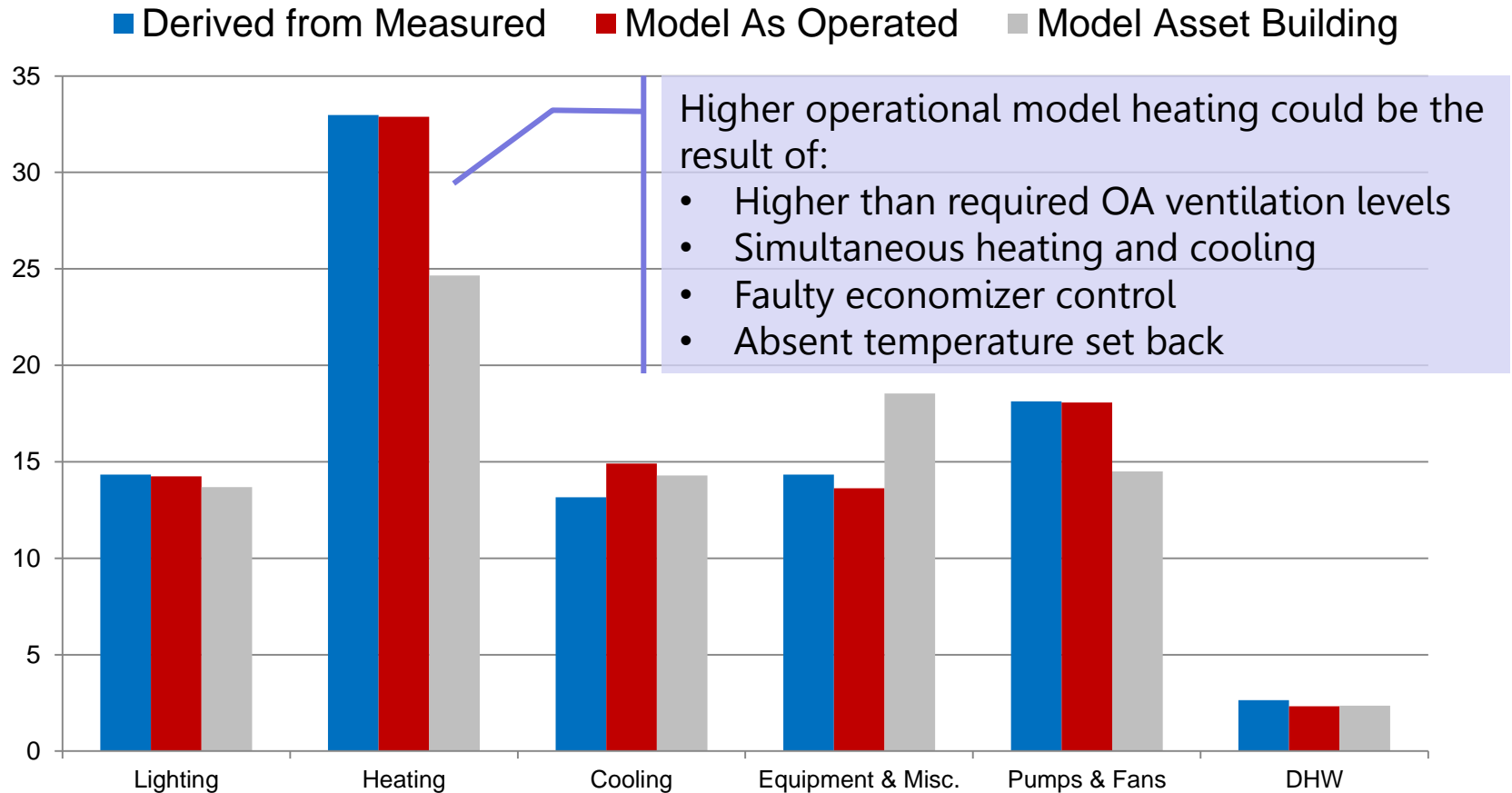## Building Asset Rating

- Develop a cost-effective and accurate method for developing an Operational model EUI and an Asset model EUI to develop a rating method to compare how well a building is preforming compared to itself and to others

Operation and Asset Model Results
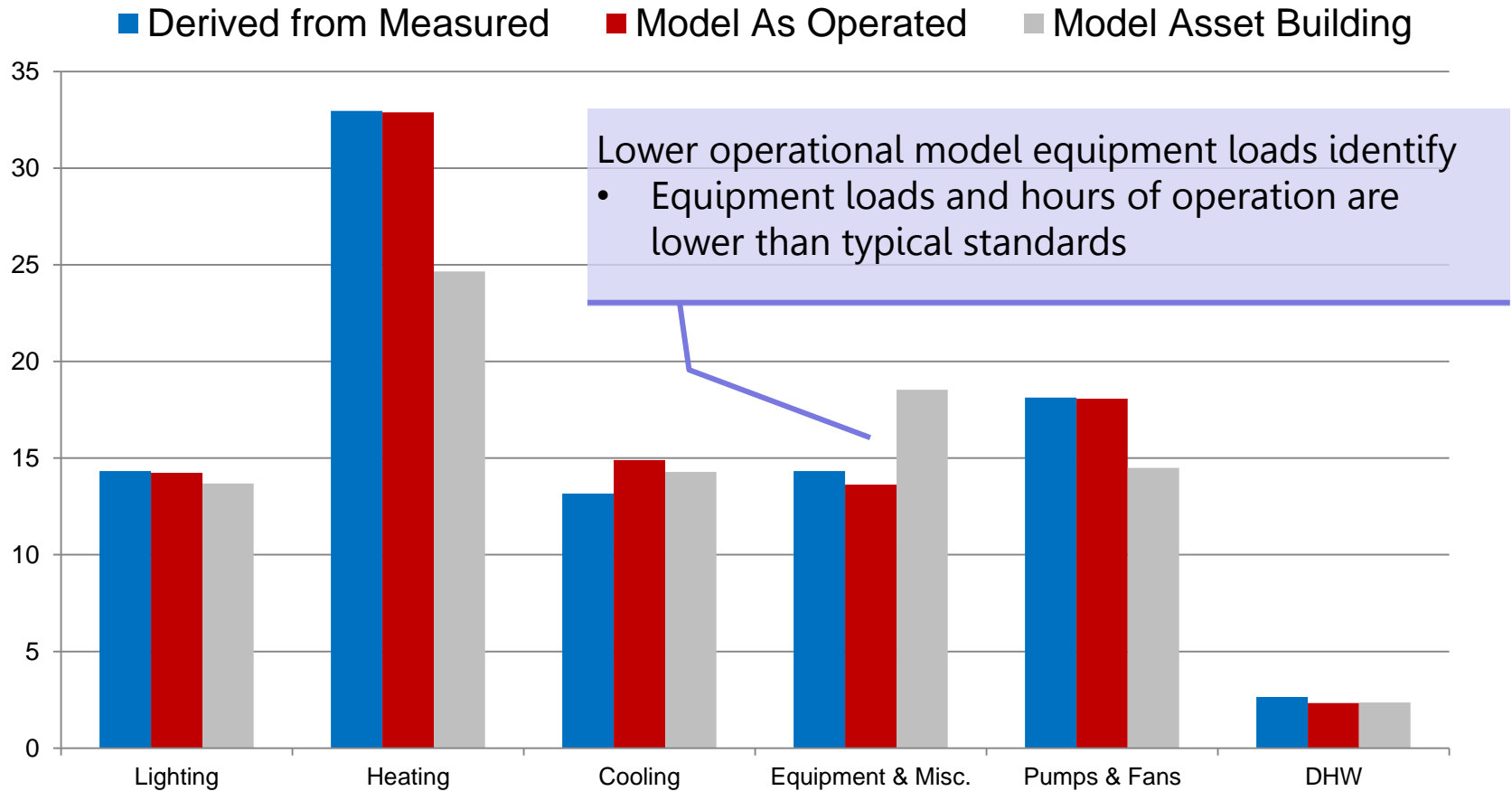## Comparison of end-use between the Operational and Asset Models

Energy Use Intensity by End Use

Legend: ■ Derived from Measured ■ Model As Operated ■ Model Asset Building

Higher operational model heating could be the result of:
- Higher than required OA ventilation levels
- Simultaneous heating and cooling
- Faulty economizer control
- Absent temperature set back

X-axis categories: Lighting, Heating, Cooling, Equipment & Misc., Pumps & Fans, DHW

Comparison of end-use between the Operational and Asset Models

Energy Use Intensity by End Use

Lower operational model equipment loads identify
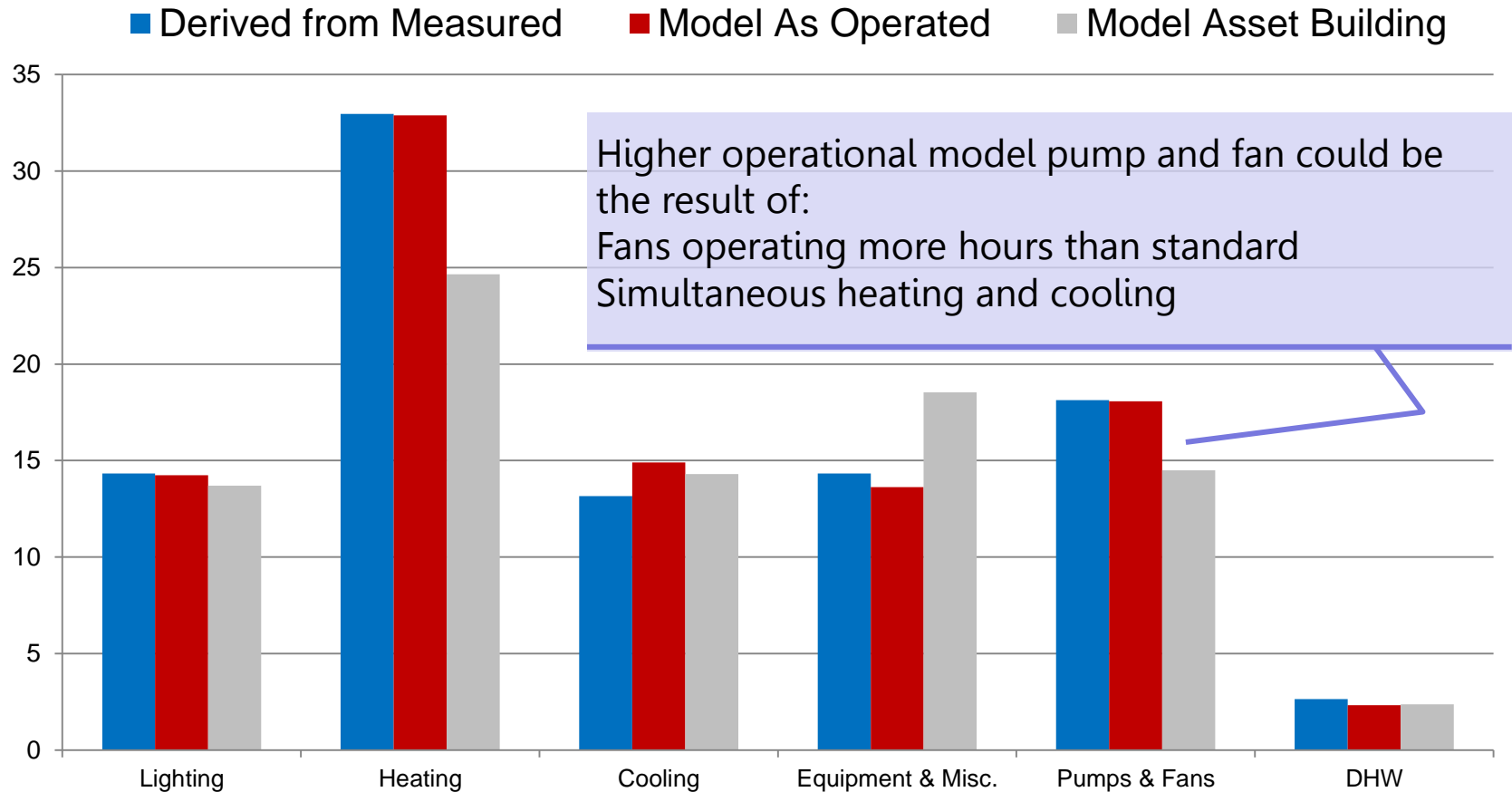* Equipment loads and hours of operation are lower than typical standards

Operation and Asset Model Results
Comparison of end-use between the Operational and Asset Models

Energy Use Intensity by End Use

Higher operational model pump and fan could be the result of:
Fans operating more hours than standard
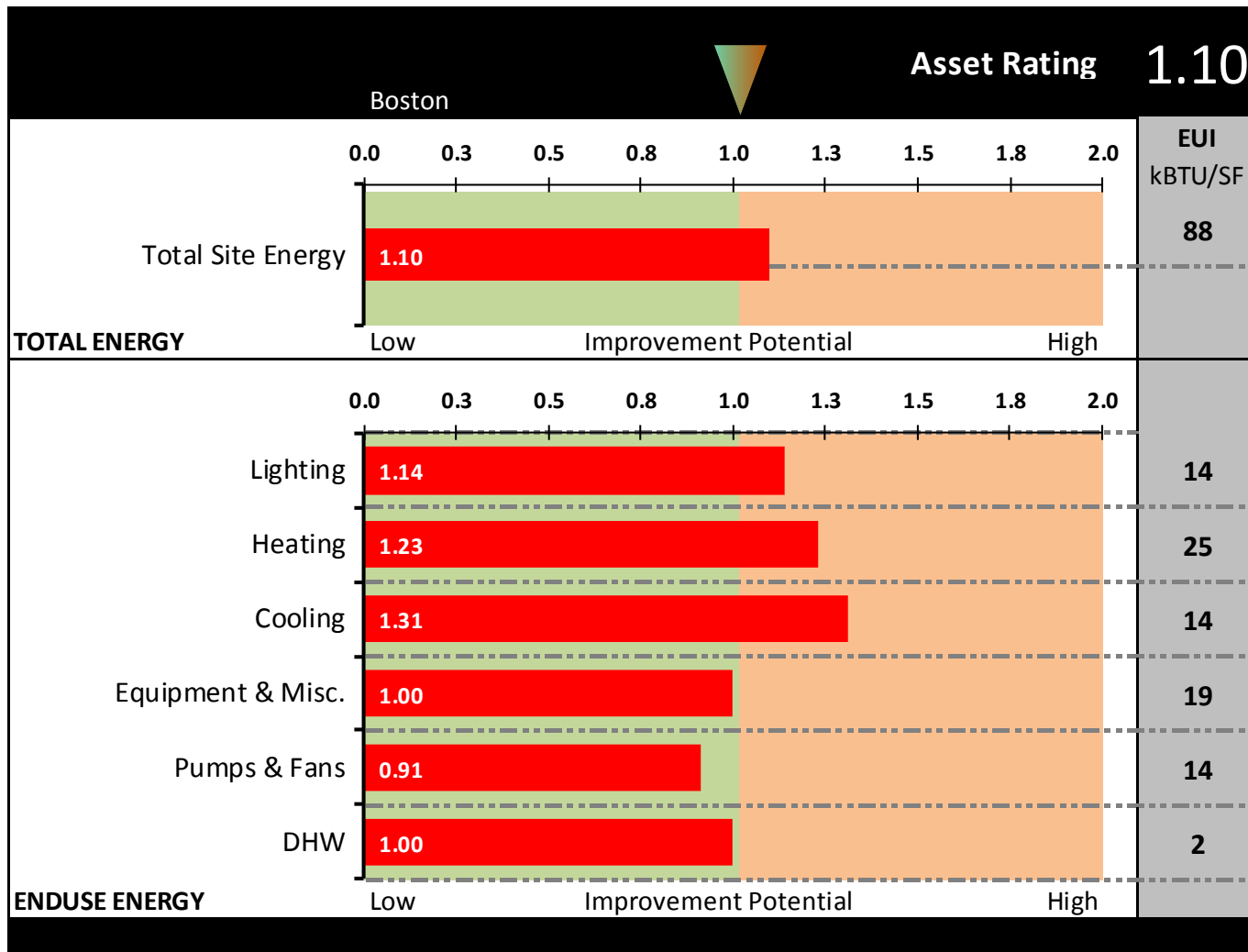Simultaneous heating and cooling

The ratio of the Asset Model divided by the an Asset Baseline, using Code or a Stretch Code easily identifies the percent savings achievable by retrofitting the building's physical assets to Asset Baseline levels.
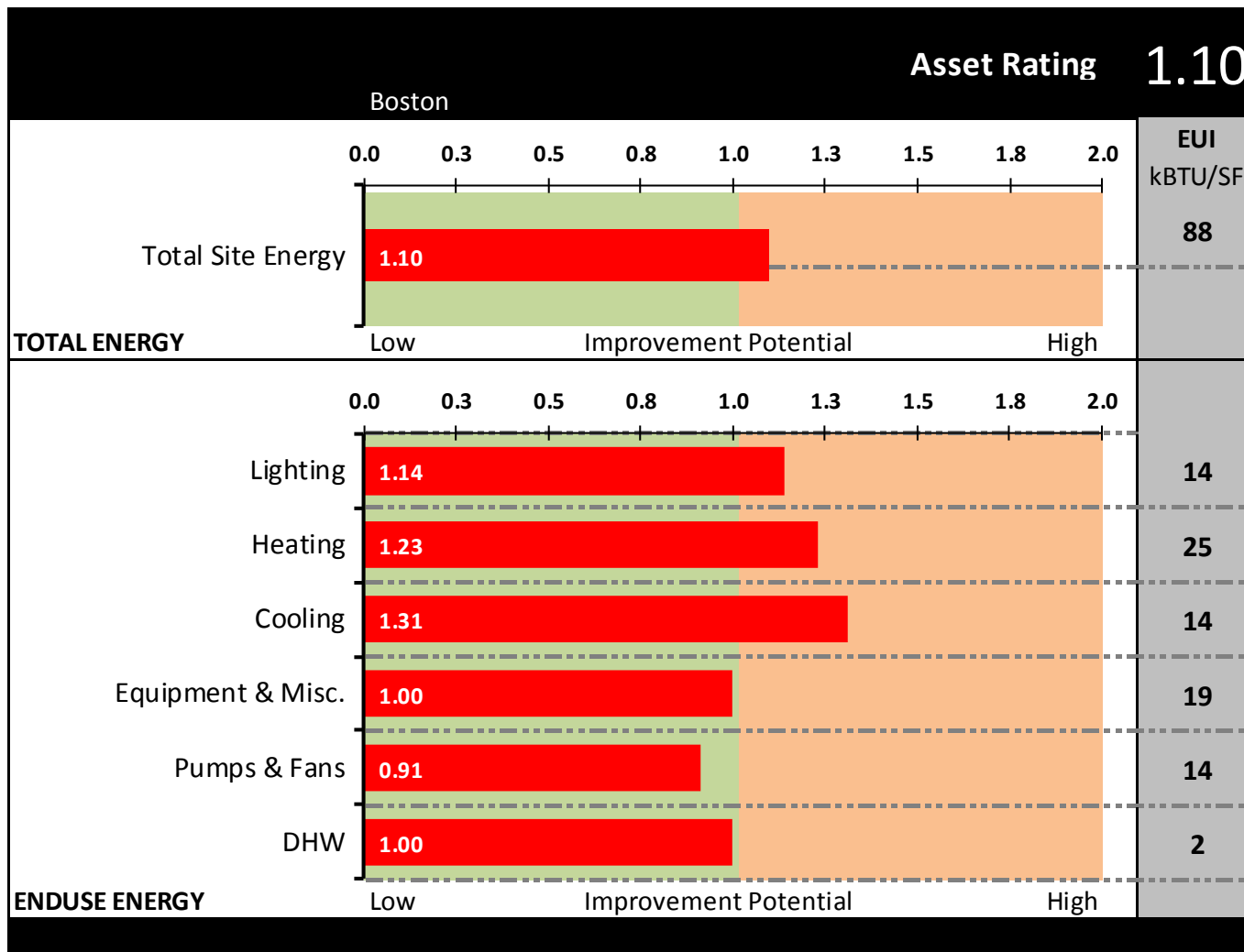
Asset Model Compared to a Baseline

Compare end-uses between the Asset Model and an Asset Baseline to identify physical assets to improve

A ratio of the Asset Model divided by the an Asset Baseline using a current code or a stretch code criteria easily identifies the % savings that could be achieved by retrofitting the buildings physical assets to those levels

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Asset Model Compared to a Baseline

Compare end-uses between the Asset Model and an Asset Baseline to identify physical assets to improve

Asset Rating 1.10

Boston

TOTAL ENERGY

Total Site Energy	EUI kBTU/SF
1.10	88

Scale: 0.0 0.3 0.5 0.8 1.0 1.3 1.5 1.8 2.0

Low — Improvement Potential — High

Improved to the baseline and reduce energy consumption by 10%

ENDUSE ENERGY

End Use	Value	EUI
Lighting	1.14	14
Heating	1.23	25
Cooling	1.31	14
Equipment & Misc.	1.00	19
Pumps & Fans	0.91	14
DHW	1.00	2

Scale: 0.0 0.3 0.5 0.8 1.0 1.3 1.5 1.8 2.0

Low — Improvement Potential — High

Lighting by 14%

Heating by 23%

Cooling by 31%

The future is already here – it's just not evenly distributed.

William Gibson
The Economist, December 4, 2003

Thank you

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