

***Oral Testimony * of
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at

***National Institute of Building Science
Hearing on
Commercial Building Data Needs***

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**** Written Testimony has been submitted***

Objectives of Testimony

1. **Identify prevalence of “Promises without Performance”:** *Why we need an accurate database of building performance.*
2. **Describe limitations of CBECS Database.**
3. **Present examples of successes and failures in achieving expected energy use targets and other performance outcomes.**
4. **Advocate for development and maintenance of an empirical and accurate database in the Whole Building Design Guide that includes all of the attributes defined for a High Performance Building.**

Purpose of Buildings:

Basis of Performance

- ***Provide shelter with secure, safe, and healthy conditions***
- ***Facilitate well being and productivity of occupants, owners, and managers***

To achieve this purpose, energy resources must be consumed to provide acceptable lighting and electrical power, heating and humidification, cooling, ventilation, and acoustic control.



Accountability for Performance

- *Two objectives must be achieved to assure measurable improvements in energy utilization for safe, secure and healthy environments:*
 - *Establish credible and measurable criteria*
 - *Establish a continuous accountability process*
- *The criteria must be consistent and measurable at each stage of the life-cycle of the building.*
- *An evidence-based, empirical database is needed to establish these criteria as a basis for accountability.*

*The AIA 2030 Challenge**

(Promise of Energy Performance)

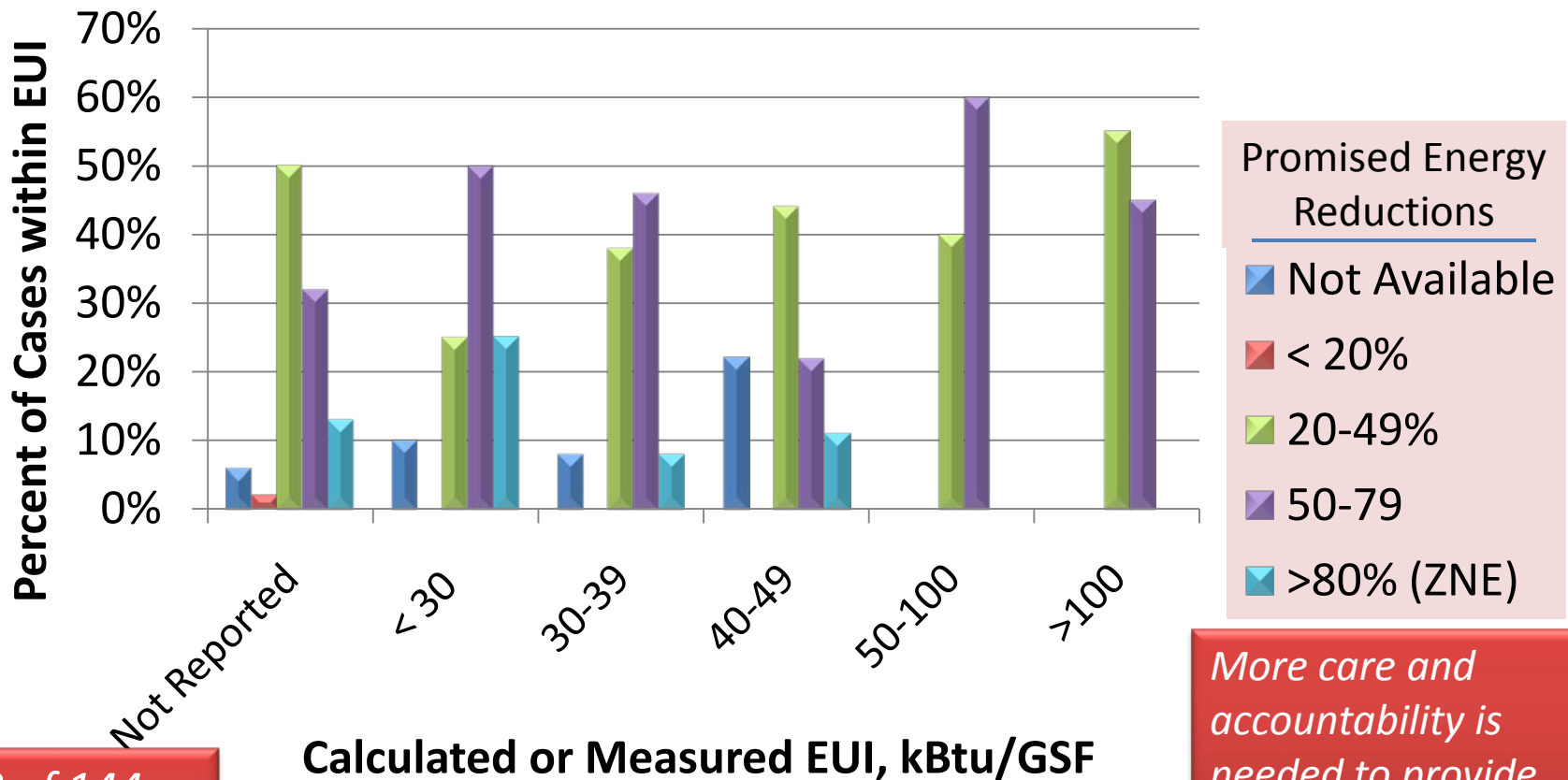
Global architecture and building community to adopt the following targets:

- *All new buildings, developments and major renovations shall be designed to meet a fossil fuel, GHG-emitting, energy consumption performance standard of 60% below the regional average for the building type.*
- *Fossil fuel reduction “standard” shall be increased to:*
 - *70% in 2015*
 - *80% in 2020*
 - *90% in 2025*
 - *Carbon neutral in 2030*
- ***Targets may be accomplished by:***
 - *Implementing “innovative sustainable design strategies”*
 - *Generating on-site renewable power (which do not produce GHG)*
 - *Purchasing (20% maximum) renewable power (for the lifetime of the building)*

Availability of valid and reliable “regional” databases has not been established.

** <http://architecture2030.org/index.php>*

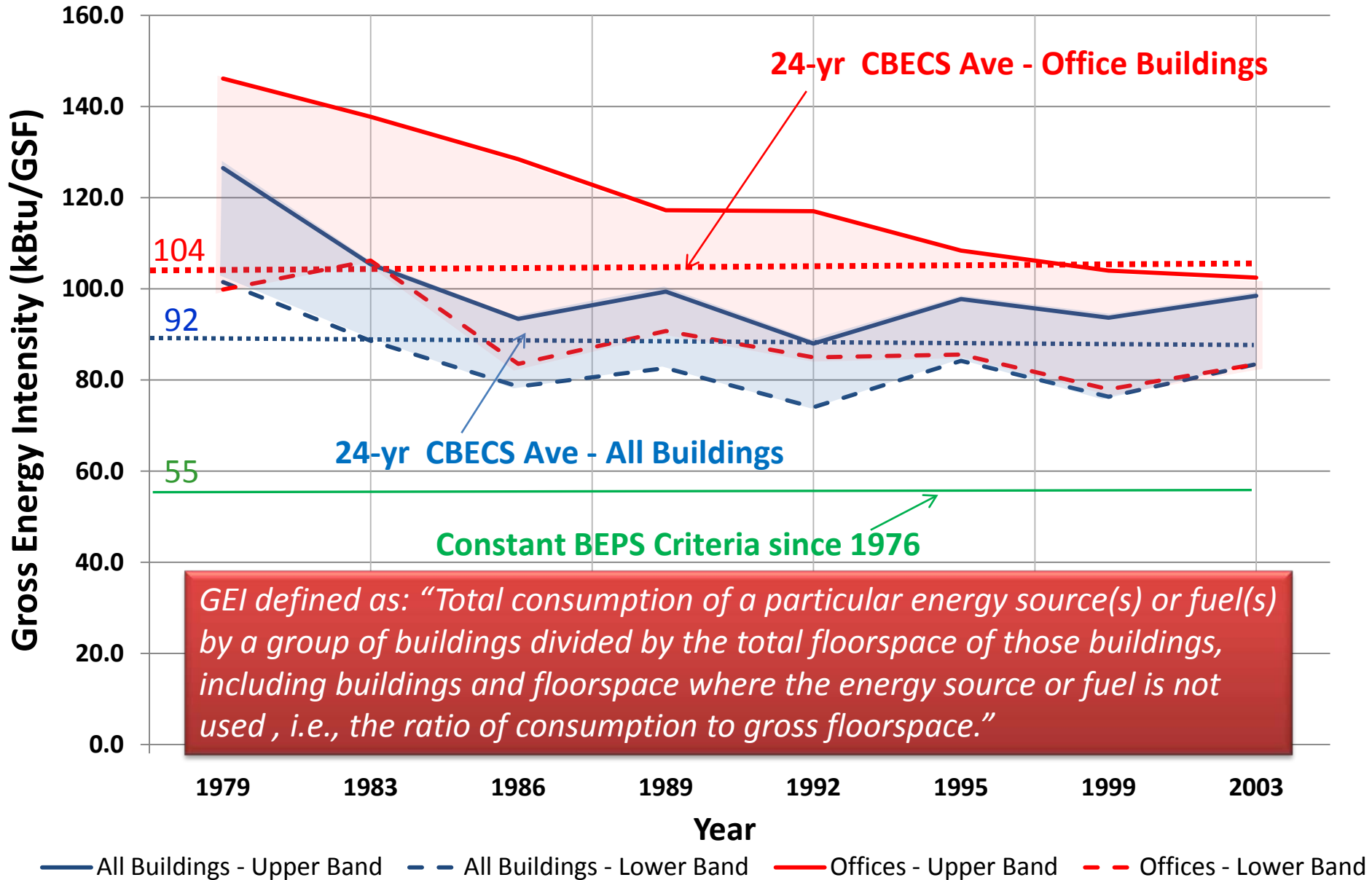
AIA 2030 Challenge Case Studies: Promised Energy Reductions vs. Calculated or Measured (?) EUI (kBtu/GSF)



**88 of 144
(61%) not
reported**

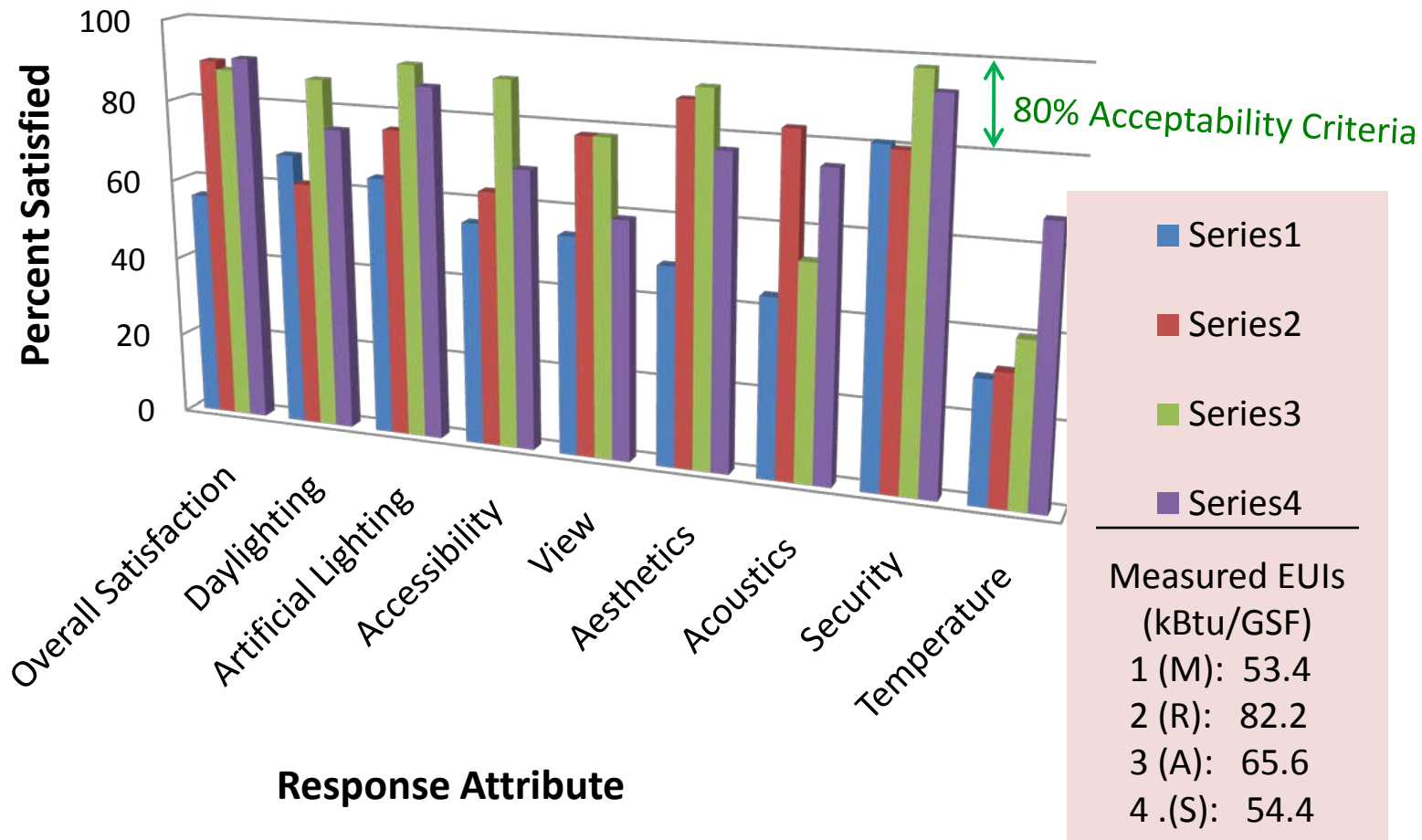
*More care and
accountability is
needed to provide
credible evidence
that the Challenge
is being achieved.*

CBECS Data for All Buildings and Offices (1979-2003) (95% Confidence Intervals)



Occupant Responses from Four US Courthouse POEs

(NIBS Study)

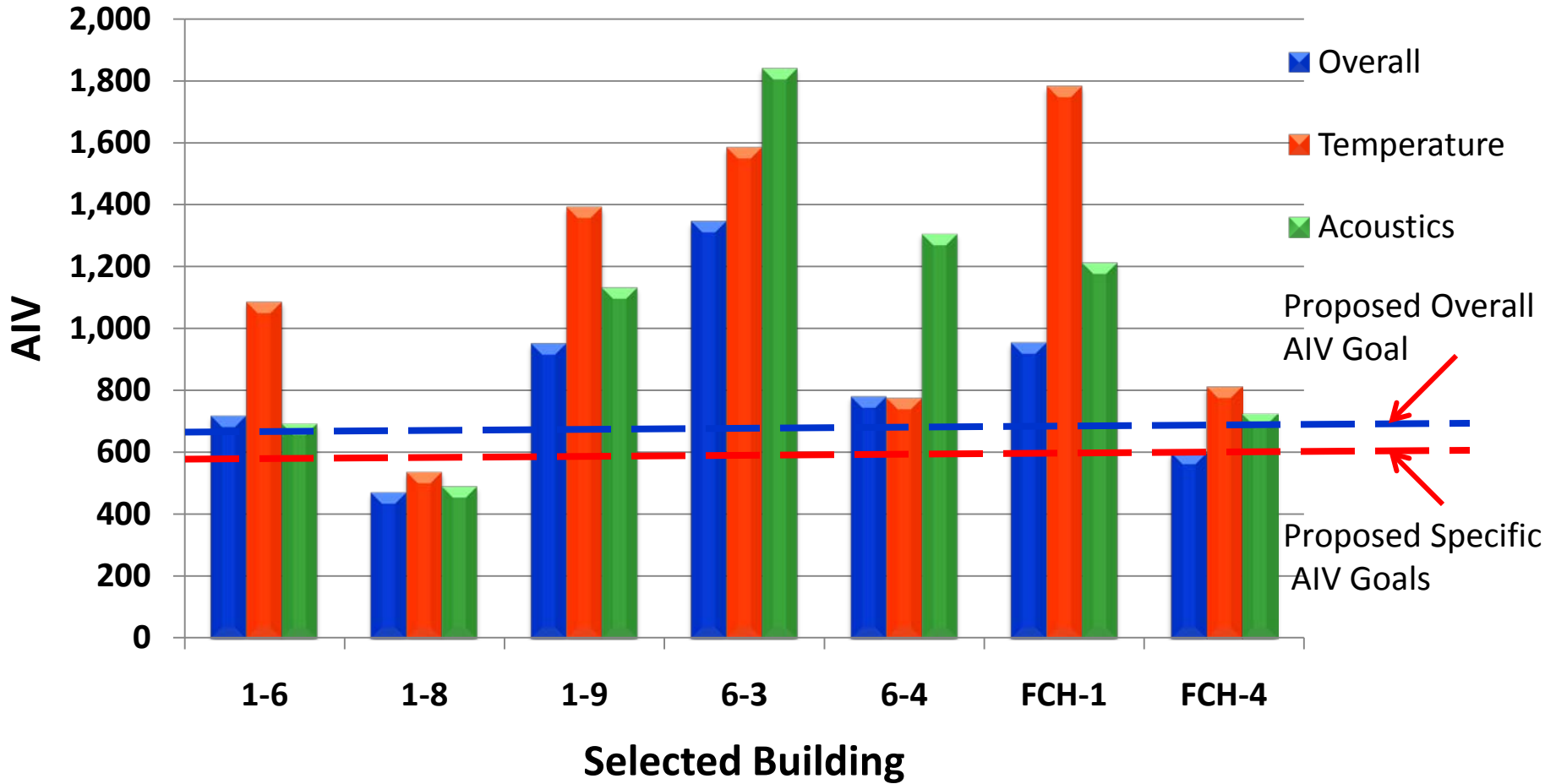


Summary of Selected Building Characteristics

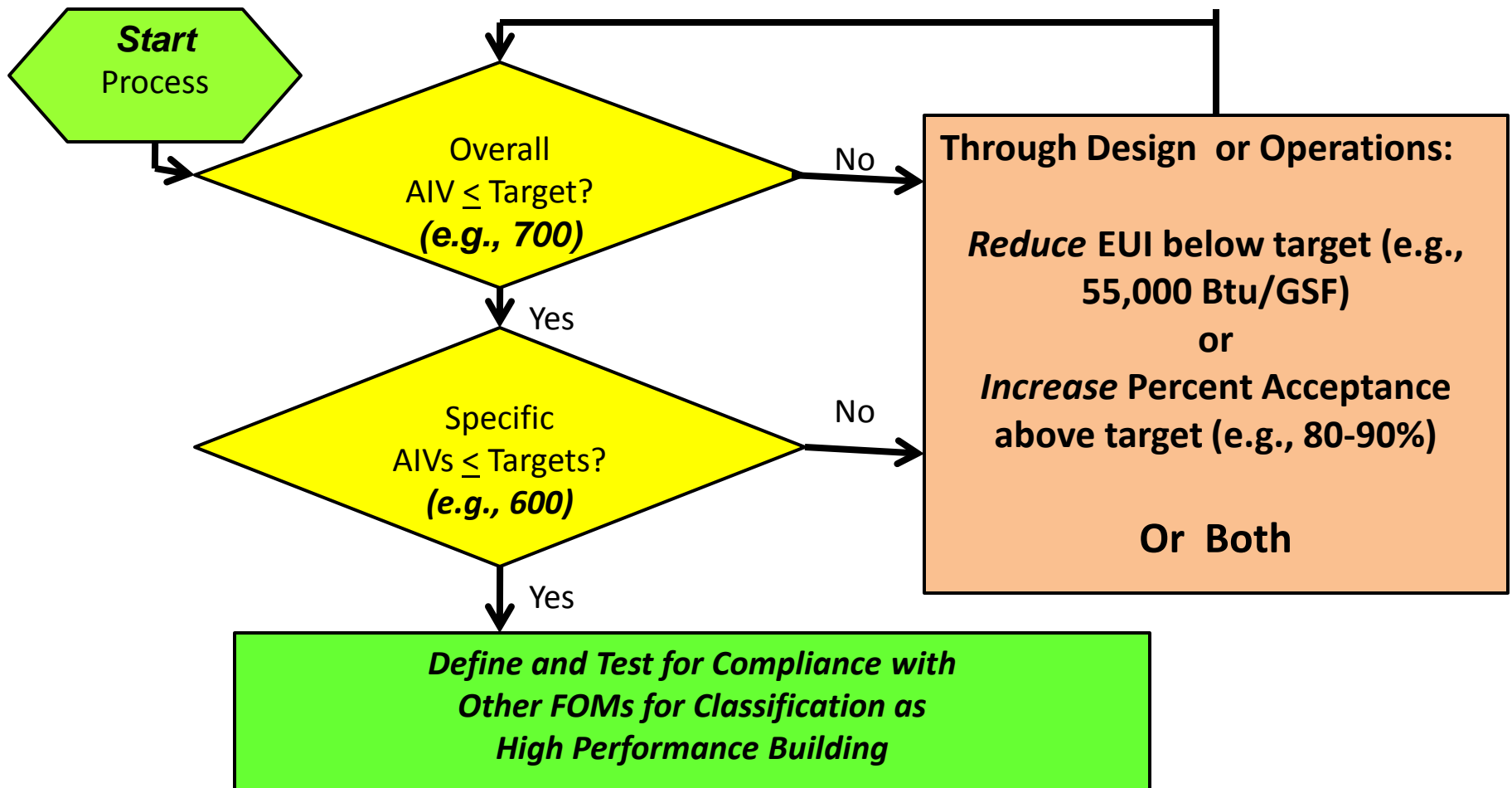
(Screened from Two of Five Data Sets)

| Bldg ID | Comp Date | Site | LEED Rating | Floors/ GSF | System | Air Dist | Verified EUI (Btu/GSF) | Overall Acceptance (%) |
|---------|-----------|------|--------------|-------------|--------------------------|---------------------|------------------------|------------------------|
| 1-6 | 2004 | PA | Gold | 4/189,500 | Steam/ DX RTUs | VAV/ UFAD | 49,919 | 71 |
| 1-8 | 2003 | CA | Gold | 2/52,300 | Water/ AHUs | VAV/ CAD | 40,717 | 83 |
| 1-9 | 2004 | MO | Plat | 2/109,000 | Steam/ water/ AHUs | CAV/ UFAD | 61,171 | 61 |
| 6-3 | 2004 | NB | Gold | 3/68,000 | Water/ AHUs | VAV/ UFAD | 79,118 | 61 |
| 6-4 | 2005 | MO | Plat | 4/120,000 | Water/ AHUs | VAV/ UFAD | 45,716 | 61 |
| FCH-1 | 2006 | OR | Gold | 5/266,742 | Water/ AHUs | VAV/ 50% UFAD | 53,386 | 56 |
| FCH-4 | 2003 | FL | Not Rated | 15/491,698 | Water/ AHUs | VAV/ CAD | 54,347 | 91 |

Acceptability Index Values



AIV as a Prerequisite for Classifying HP Buildings?



High Performance Building

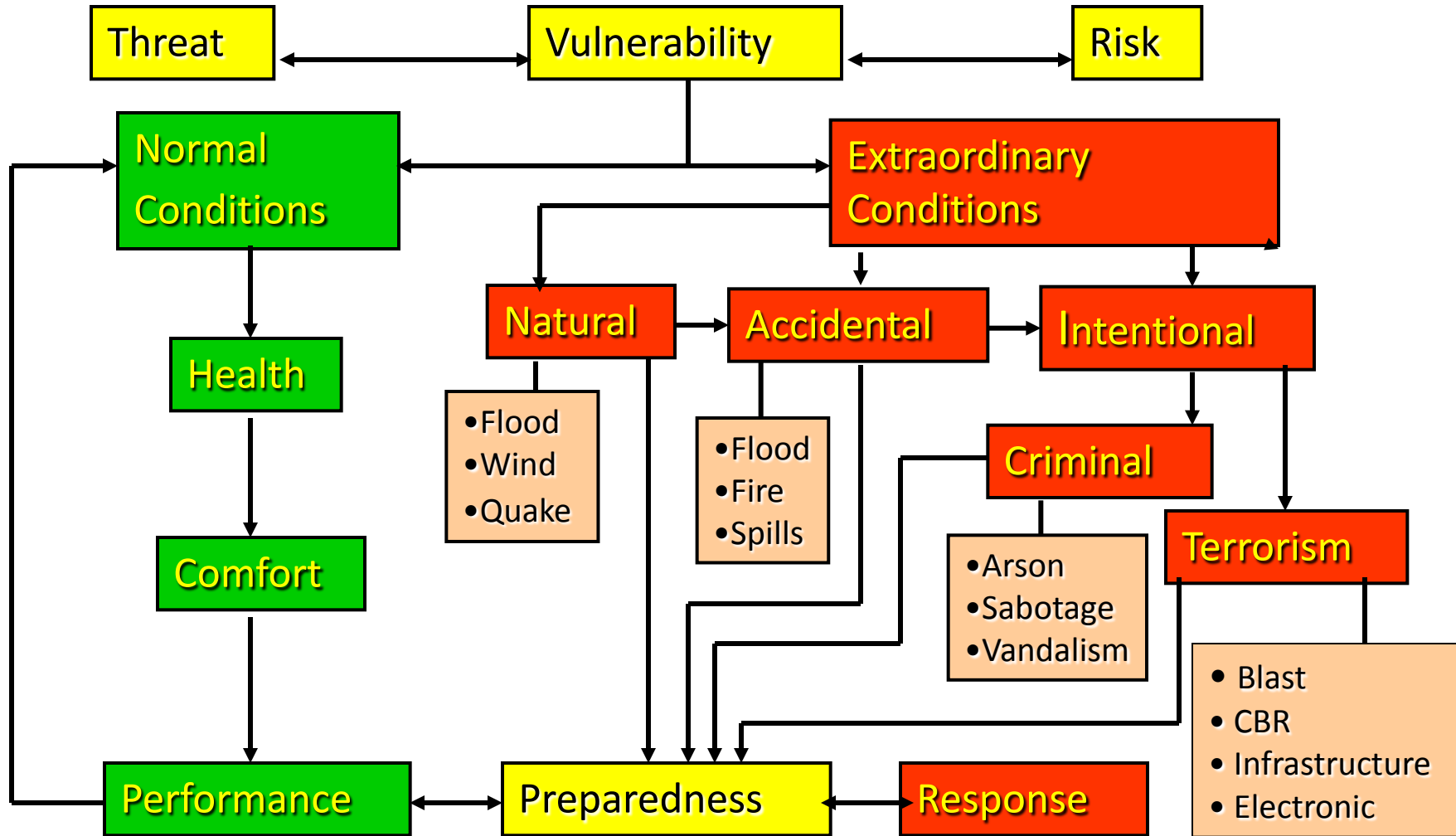
(EISA 2007*)

“The term ‘high-performance building’ means a building that integrates and optimizes on a life cycle basis all major high performance attributes, including:

- ***energy conservation, environment,***
- ***safety, security, durability, accessibility,***
- ***cost-benefit, productivity, sustainability,***
- ***functionality, and operational considerations.”***

* Title IV: Energy Savings in Buildings and Industry, Sections 401(12). *Energy Independence and Security Act of 2007*. Public Law 110-140, December 19, 2007.

Residual Risks



Recommendations

- 1. Retire the CBECS Database***
- 2. Create an Evidence-Based, Empirical, and Accurate Building Performance Database***
- 3. Implement the New Database through the Whole Building Design Guide***

1. Retire the CBECS Database

- *Statistical/inferential database; not empirical.*
- *Latest entries are at least a decade old.*
- *Low sampling rate; large “Relative Standard Errors.”*
- *Inconsistent Protocols.*
- *Not amenable to acquisition of data for other attributes (e.g., safety, security, accessibility, occupant responses).*
- *Figure of Merit (i.e., GEI derived from computer simulations) typically overestimates site-specific values (i.e., EUI).*

2. Create an Evidence-Based, Empirical, and Accurate Building Performance Database

- ***Rational Database should relate to interactions among all of the Primary Attributes in EISA-2007 and WBDG.***
- ***Empirical data should be obtained from actual buildings during normal conditions, and as feasible, under actual or simulated extra-ordinary conditions.***
- ***Validated sources of input data should be from:***
 - ***Sensors, monitors, samplers that interface with the BAS;***
 - ***Portable field instrumentation, including questionnaires;***
 - ***Audited cost and economic data.***
- ***A standardized protocol for data acquisition and data entry should be developed and used that includes a strong QA/QC component.***
- ***The accuracy of this protocol (e.g., 80%) should be determined and published before it is implemented.***

3. Implement the Database through the WBDG

- *The repository for the new Database should be the WBDG.*
- *NIBS should serve as the Clearinghouse.*
 - *Responsible and accountable parties would acquire and submit data per the protocol.*
 - *Data would undergo QA/QC check and be entered into database by staff.*
- *Funding for development, implementation and continued operations should be considered on a long-term basis (i.e., long term less expensive than CBECS):*
 - *Task 1: Draft protocol – one year - \$750,000 – 1,250,000.*
 - *Task 2: Develop hardware and software – one year - \$500,000 - \$700,000.*
 - *Task 3: Pilot-test protocol and database system in 30 buildings; determine accuracy; revise protocol as necessary – two years - \$8 – 10 million, with funding from private and public building owners (i.e., buy-in) and from grants for accuracy testing.*
 - *Task 4: Implement and maintain operations of database through funding for data acquisition by building owners, and data entry and management by staff support through public and private funding.*
- *Timeline and overall cost estimate for initial implementation would be similar to the estimated values for the cancelled 2011 CBECS cycle (i.e., four years and \$8-12 million). Thereafter, the support costs would be less than repeated CBECS cycles.*
- *Benefit would be the availability of a comprehensive, empirical, accurate, transparent, and current database for all Primary Attributes and their interactions for commercial buildings throughout the U.S.*

Questions?