



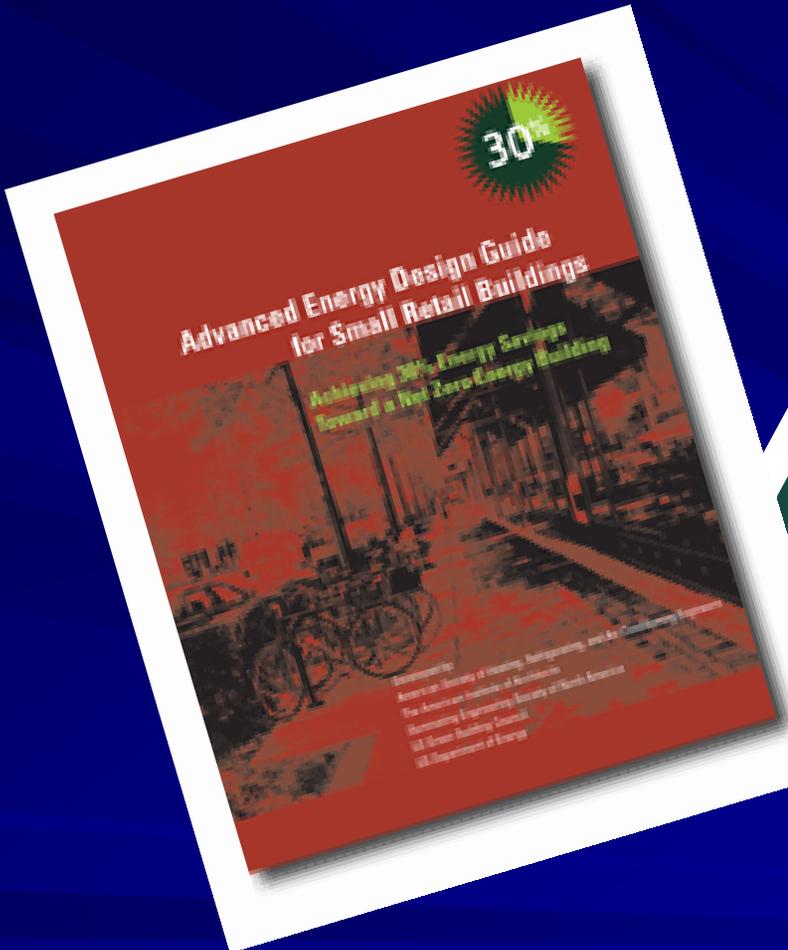
**What's Happening Now?**



**Advanced Energy Design Guides**

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AEDG Steering Committee**





# Material to be covered:

- Development of Guides
- What's in the Guides?
- Where's the energy saved?
- What's next

# Development of the Guides

- Collaboration of Partner Organizations
- Management via Steering Group
- Volunteer team effort
- 13-15 Member Project Committees
- 3500+ to 5000+ person-hrs to develop each
- Reviewed multiple times during writing process



# Goal:

- Present *a way, but not the only way* to build energy efficient buildings that use significantly less energy than those built to the minimum code requirements
- 30% energy savings when compared to ANSI/ASHRAE/IESNA Std 90.1-1999
- 30% progress toward a net zero energy building
- More advanced savings (50% and 70+%) documents to be covered later.

# Development Objectives:

- Content: Specific recommendations (prescriptive measures) and design strategies (“how to implement” tips)
- Target market: contractors, design/build firms and designers
- Format: document should be short, easy to use, and should contain “how-to” guidance
- Publication type: special publication, subject to review, not a standard or code
- Usable for LEED

# Key Elements of Document and Development Process

- A WAY – NOT THE ONLY WAY to achieve target
  - Can't be all things to all people and can't cover all possibilities
  - Not a standard or a code intended document
  - Is intended to serve as initiator of additional ideas for designers
- Energy is independent variable & cost-effectiveness (e.g. payback) is dependent variable
- User friendly – Remember the audience
- Serves as a teaching tool
- Systems integration is critical.

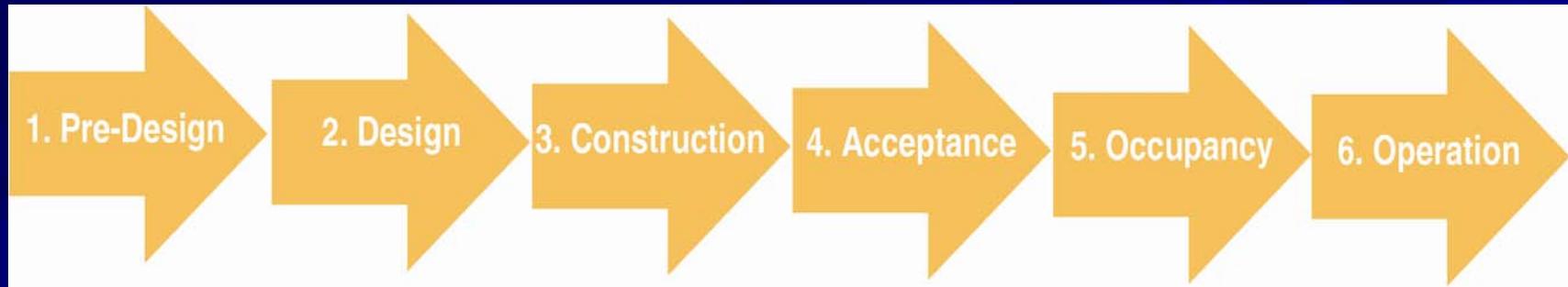
# Scope:

- Not going to be able to “eat the entire elephant of energy efficiency in one bite” – Scope must be manageable
- Building type and size – most prevalent building type - buildings < 20,000 ft<sup>2</sup>
- Base Criteria:
  - 90.1-1999
  - Savings location specific not national aggregate
  - 30% was a hard target – plug loads not included
  - Focus on air-side distribution using unitary equipment
  - Need an easy-to-use, simple and small document
- Use practical, off-the-shelf technology.

# What's In the Guides?

- Section 1 – Introduction
- Section 2 - Integrated design process to achieve energy savings (*how to integrate energy into the design of the building*)
- Sections 3 & 4 - Recommendations by climate zone including example building designs (*the specifics*)
- Section 5 - How-to guidance for implementing recommendations (*helpful hints and cautions*)

# Section 2. Integrated Design Process to Achieve Energy Savings

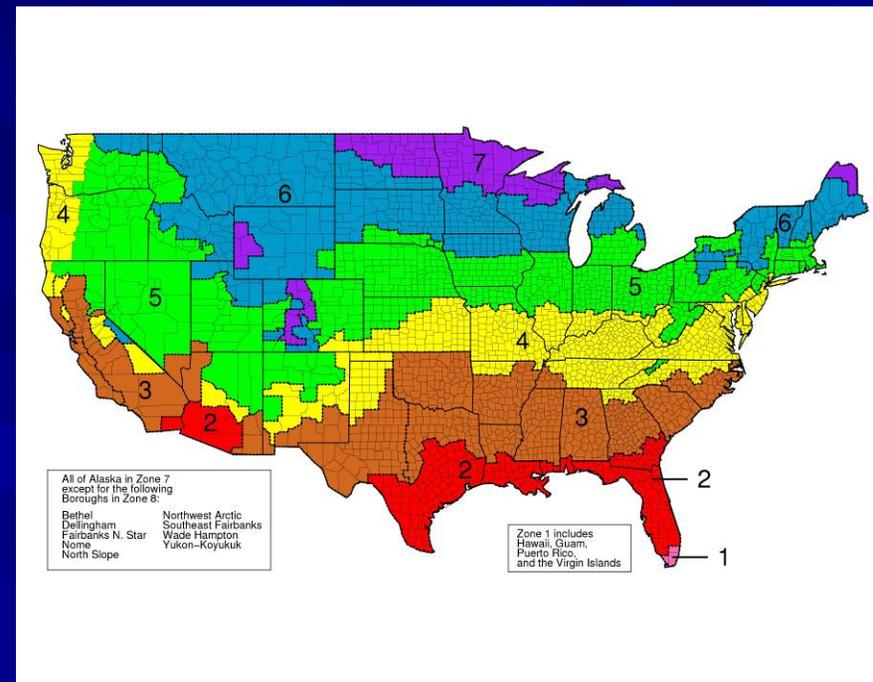


- A narrative discussion of the design and construction process that points out the opportunities for energy savings in each phase.
- A reference table or matrix that leads the user through the process of identifying and selecting energy savings measures to meet major energy design goals.

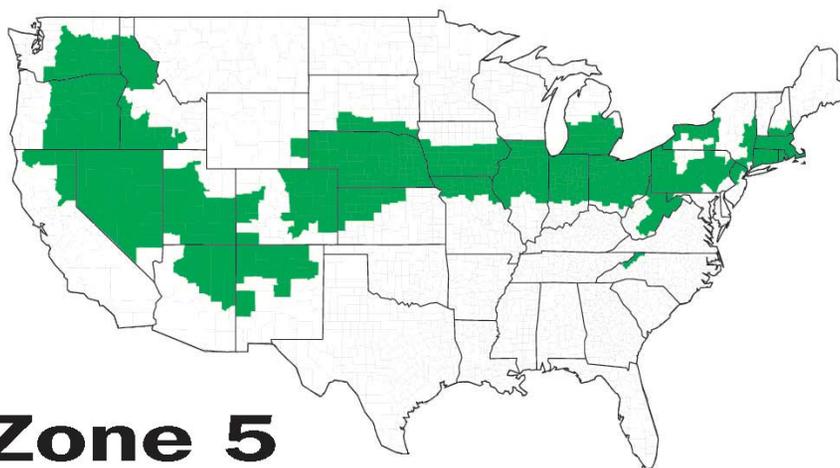
# Section 3.

## Recommendations Tables

- Given by climate zone
- Combined energy savings based on “systems approach” where all recommendations are used
- Recommendations based upon many DOE2 and Energy+ simulations



# Recommendations by Climate Zones



## Zone 5

<b>Arizona</b>	Lewis	Jackson	Winnebago	Muskegon	Sussex	Pike	Carbon
Apache	Lincoln	Jefferson	Winneshek	Oakland	Warren	Sooto	Daggett
Cocumino	Minidoka	Jennings	Worth	Ottawa		Washington	Duchesne
Navajo	Nez Perce	Knox	Wright	Saginaw	<b>New Mexico</b>		Morgan
	Owyhee	Lawrence		Shilawasse	Catron	<b>Oregon</b>	Rich
<b>California</b>	Payette	Martin	<b>Kansas</b>	St. Clair	Colfax	Baker	Summit
Lassen	Power	Monroe	Cheyenne	St. Joseph	Harding	Crook	Uintah
Modoc	Shoshone	Ohio	Cloud	Tuscola	Los Alamos	Deschutes	Wasatch
Nevada	Twin Falls	Orange	Decatur	Van Buren	Mckinley	Gilliam	Washington
Plumas	Washington	Ferry	Ellis	Washitaw	Mora	Grant	
Sierra		Pike	Gove	Wayne	Rio Arriba	Harney	
Siskiyou	<b>Illinois</b>	Posey	Graham	<b>Missouri</b>	Sandoval	Hood River	<b>Washington</b>
	All counties	Ripley	Greeley	Adair	San Juan	Jefferson	Adams
<b>Colorado</b>	except	Scott	Scott	Andrew	San Miguel	Klamath	Asotin
Adams	Alexander	Spencer	Hamilton	Atchison	Santa Fe	Lake	Benton
	Bond	Sullivan	Jewell		Taos	Malheur	Chelan
		Switzerland	Lane				

- Climate zone highlighted on U.S. map in consistent color
- States covered by the climate zone are listed below the map
- Specific counties within the climate zone are listed for reference (no counties are split)

# Recommendation Tables

- Energy-saving recommendations for each climate zone contained on **single small table**
- Tables color-coded to maps
- Prescriptive recommendations help to achieve energy savings without costly calculations or analysis
- Recommendations must be used with underlying code or standard
- Note references to “how-to” section

**Climate Zone 5 Recommendation Table**

Item	Component	Recommendation	How-to's in Chapter 4
Roof	Insulation entirely above deck	R-20 c.i.	EN2, 17, 20-21
	Metal building	R-13 + R-19	EN3, 17, 20-21
	Attic and other	R-38	EN4, 17-18, 20-21
	Single rafter	R-38 + R-5 c.i.	EN5, 17, 20-21
	Surface reflectance/emittance	No recommendation	
Walls	Mass (HC > 7 Btu/ft <sup>2</sup> )	R-11.4 c.i.	EN6, 17, 20-21
	Metal building	R-13 + R-13	EN7, 17, 20-21
	Steel framed	R-13 + R-7.5 c.i.	EN8, 17, 20-21
	Wood framed and other	R-13 + R-3.8 c.i.	EN9, 17, 20-21
	Below-grade walls	R-7.5 c.i.	EN10, 17, 20-21
Floors	Mass	R-10.4 c.i.	EN11, 17, 20-21
	Steel framed	R-30	EN12, 17, 20-21
	Wood framed and other	R-30	EN12, 17, 20-21
Slabs	Unheated	No recommendation	EN17, 19-21
	Heated	R-10 for 36 in.	EN14, 17, 19-21
Doors	Swinging	U-0.70	EN15, 20-21
	Non-swinging	U-0.50	EN16, 20-21
Vertical Glazing	Window to wall ratio (WWR)	20% to 40% maximum	EN23, 36-37
	Thermal transmittance	U-0.42	EN25, 31
	Solar heat gain coefficient (SHGC)	N, S, E, W - 0.46 N only - 0.46	EN27-28
	Window orientation	$(A_{N1} * SHGC_{N1} + A_{E1} * SHGC_{E1}) > (A_{E2} * SHGC_{E2} + A_{W1} * SHGC_{W1})$	A <sub>w</sub> - Window area for orientation x EN26-32
	Exterior sun control (S, E, W only)	Projection factor 0.5	EN24, 28, 30, 36, 40, 42 DL5-6
Skylights	Maximum percent of roof area	3%	DL5-7, DL8, DL13
	Thermal transmittance	U-0.69	DL7, DL8, DL13
	Solar heat gain coefficient (SHGC)	0.39	DL8, DL13
	Lighting power density (LPD)	0.9 W/ft <sup>2</sup>	EL1-2, 4, 8, 10-16
Interior Lighting	Light source (linear fluorescent)	90 mean lumens/watt	EL4, 9, 17
	Ballast	Electronic ballast	EL4
	Dimming controls for daylight harvesting for WWR 25% or higher	Dim fixtures within 12 ft of N/S window wall or within 8 ft of skylight edge	DL1, 9-11, EL6-7
	Occupancy controls	Auto-off all unoccupied rooms	DL2, EL5, 6
	Interior room surface reflectances	80%+ on ceilings, 70%+ on walls and vertical partitions	DL3-4, EL3
	HVAC	Air conditioner (0-65 KBtuh)	13.0 SEER
Air conditioner (>65-135 KBtuh)		11.0 EER/11.4 IPLV	HV1-2, 4, 6, 12, 16-17, 20
Air conditioner (>135-240 KBtuh)		10.8 EER/11.2 IPLV	HV1-2, 4, 6, 12, 16-17, 20
Air conditioner (>240 KBtuh)		10.0 EER/10.4 IPLV	HV1-2, 4, 6, 12, 16-17, 20
Gas furnace (0-225 KBtuh - SP)		80% AFUE or E <sub>t</sub>	HV1-2, 6, 16, 20
Gas furnace (0-225 KBtuh - Split)		90% AFUE or E <sub>t</sub>	HV1-2, 6, 16, 20
Gas furnace (>225 KBtuh)		80% E <sub>t</sub>	HV1-2, 6, 16, 20
Heat pump (0-65 KBtuh)		13.0 SEER/7.7 HSPF	HV1-2, 4, 6, 12, 16-17, 20
Heat pump (>65-135 KBtuh)		10.6 EER/11.0 IPLV/3.2 COP	HV1-2, 4, 6, 12, 16-17, 20
Heat pump (>135 KBtuh)		10.1 EER/11.0 IPLV/3.1 COP	HV1-2, 4, 6, 12, 16-17, 20
Economizer	Air conditioners & heat pumps - SP	Cooling capacity > 54 KBtuh	HV23
Ventilation	Outdoor air damper	Motorized control	HV7-8
	Demand control	CO <sub>2</sub> sensors	HV7, 22
Ducts	Friction rate	0.08 in. w.c./100 feet	HV9, 18
	Sealing	Seal class B	HV11
	Location	Interior only	HV9
Service Water Heating	Insulation level	R-6	HV10
	Gas storage	90% E <sub>t</sub>	WH1-4
	Gas instantaneous	0.81 EF or 81% E <sub>t</sub>	WH1-4
	Electric storage 12 kW	EF > 0.99 - 0.0012xVolume	WH1-4
	Pipe insulation (d < 1 1/2 in. / d ≥ 1 1/2 in.)	1 in. / 1 1/2 in.	WH6

Note: If the table contains "No recommendation" for a component, the user must meet the more stringent of either Standard 90.1 or the local code requirements in order to reach the 30% savings target.

# Prescriptive Recommendations Given for:

## ■ Envelope

- Roof
- Walls
- Floors
- Slabs
- Doors
- Vertical Glazing
- Skylights

## ■ Service Water Heating

## ■ Lighting

- Interior Lighting
- Sales Floor Lighting
- Exterior Lighting

## ■ HVAC

- HVAC
- Economizer
- Ventilation
- Ducts

# Section 4. Example Designs for Climate Zones

- Features real examples of advanced building energy designs
- Demonstrates flexibility offered in achieving advanced energy savings levels
- Text describes energy features used



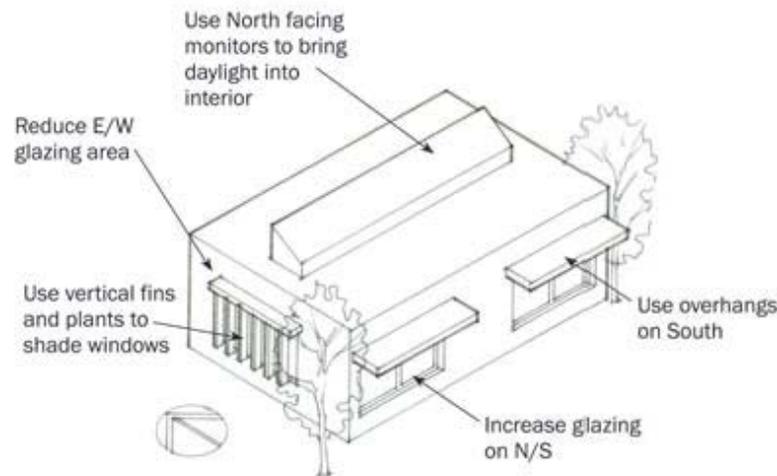
# Section 5. “How-To” Implement Recommendations

- “How to’s” organized by building system
  - Good design practices
  - Cautions
  - References
- Each “how to” numerically referenced in recommendation tables
- Gives Good Design Practice – i.e. The “rules-of-thumb” and “should considers”
- Bonus Savings
  - Plug Loads
  - Exterior Lighting

# “How-to” Guidance - Envelope

EN27

Glazing (Climate Zones: ① ② ③ ④ ⑤ ⑥)



**Figure 4-19.** (EN27) Exterior sun control.

For north- and south-facing windows, select windows with a low solar heat gain coefficient and an appropriate visible light transmission (VLT). See EN32. Certain window coatings, called selective low-e, transmit the visible portions of the solar spectrum selectively, rejecting the nonvisible infrared sections. These glass and coating selections provide superior view and daylighting, while minimizing solar heat gain. Window manufacturers market special “solar low-e” windows for warm climates. For buildings in warm climates that do not utilize daylight-responsive lighting controls, north and south window glazing should be selected with a solar heat gain coeffi-

For north- and south-facing windows, select windows with a low solar heat gain coefficient and an appropriate visible light transmission (VLT). See EN32. Certain window coatings, called selective low-e, transmit the visible portions of the solar spectrum selectively, rejecting the nonvisible infrared sections. These glass and coating selections provide superior view and daylighting, while minimizing solar heat gain. Win-

# How Much Energy Is Saved and Where Was It Saved?

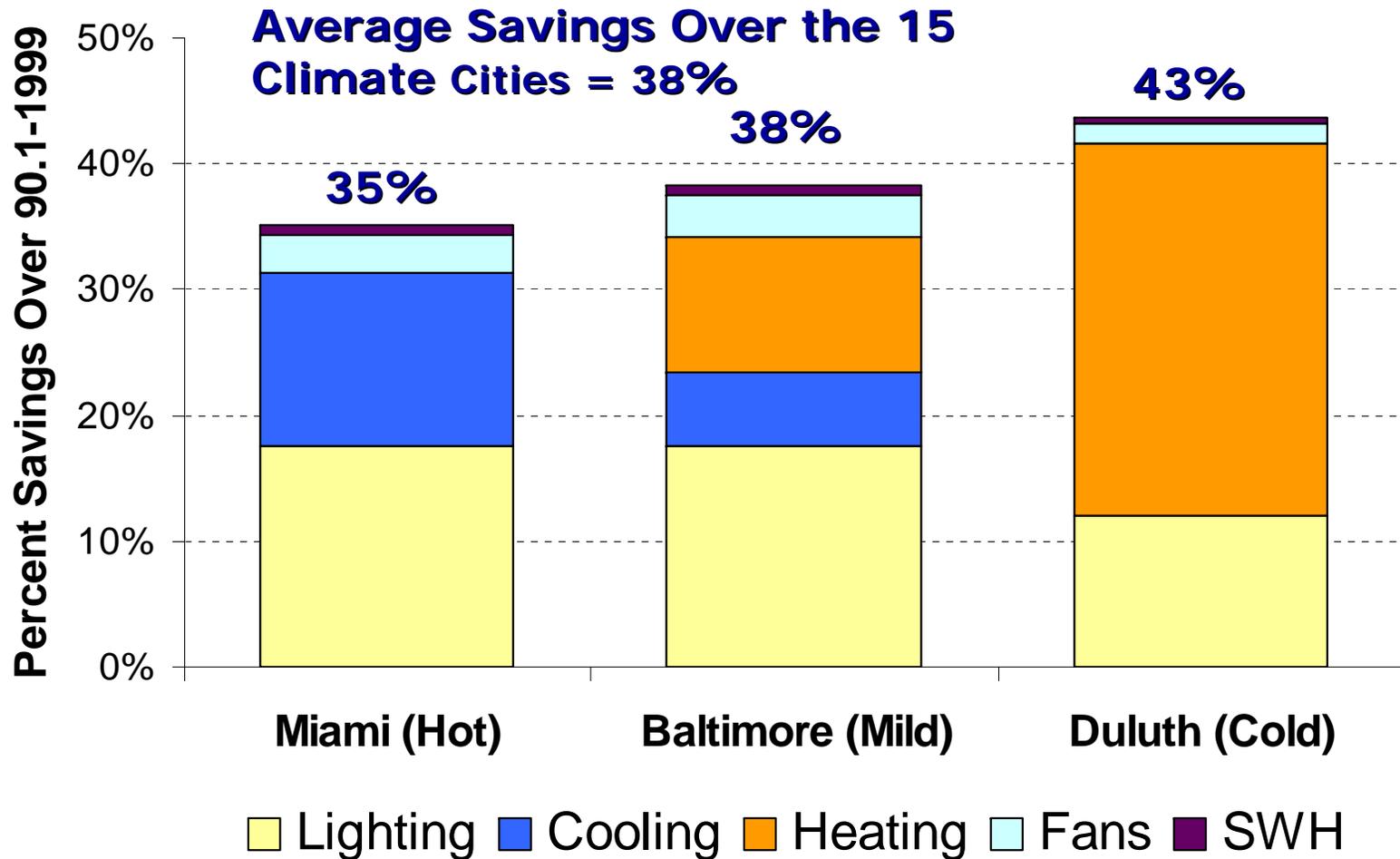
- Simulated buildings at 15 locations to estimate the energy used by a building just meeting 90.1 and then a building built to recommendations of AEDG.

# Representative Climate Locations

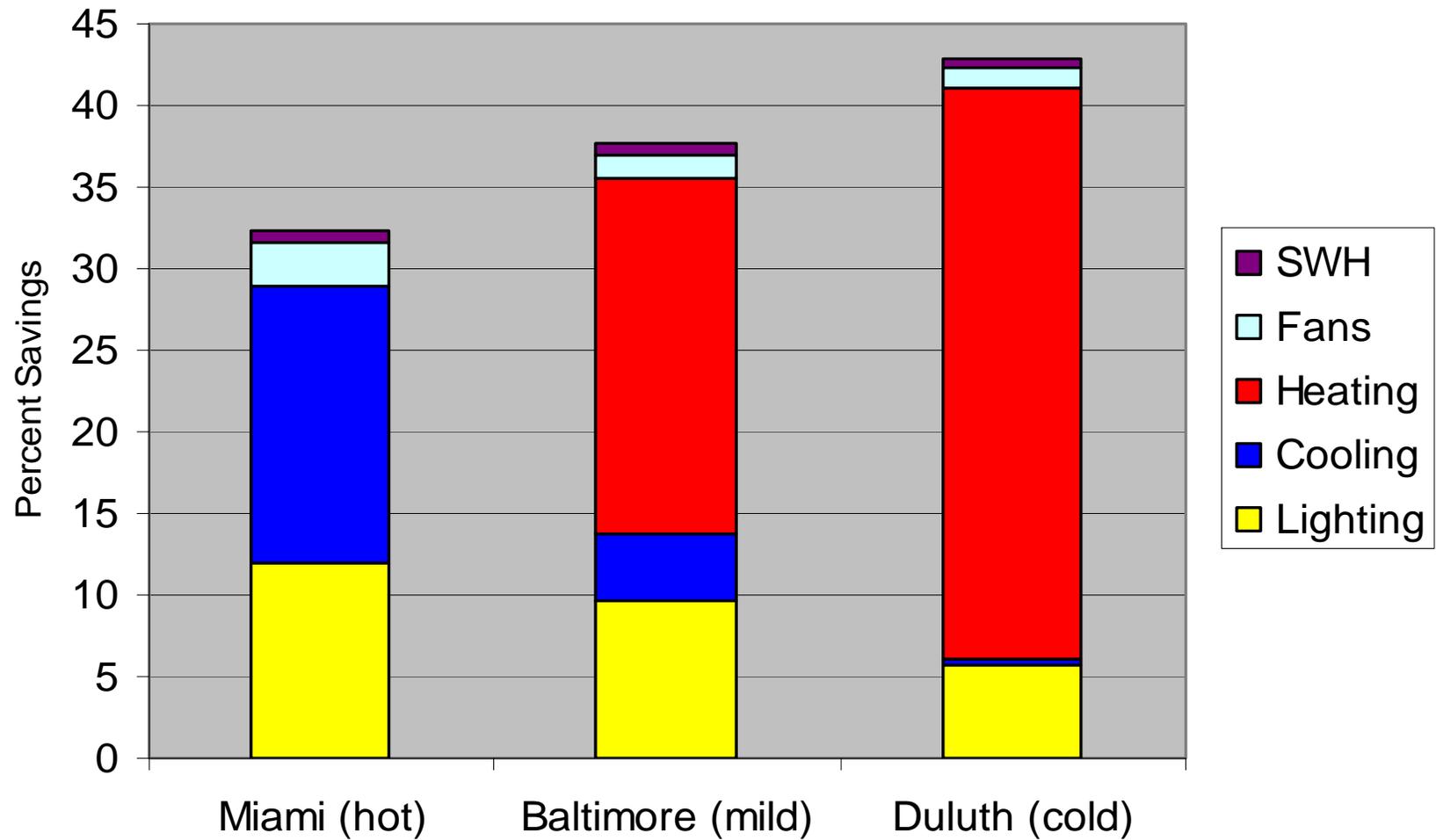


# Source of Energy Savings

20,000 sf Office Building



## Source of Energy Savings (Stand Alone Retail Store)



# In Summary

- Provides simple, easy-to-use document
- Clear prescriptive path to 30% savings
- Recommendations easily found in a single table
- How-to tips and Bonus Savings
- Case Studies of Actual Applications
- Average over all climate zones is 37% savings relative to 90.1-1999 and is 30% relative to 90.1-2004

# What's Next?



## **AEDG – K12 Schedule**

- Document Approval – August 2007
- Publication – November 2007

## **AEDG – WHSE Schedule**

- Document Approval – September 2007
- Publication – December 2007

# AEDG for K-12 Schools

- More complex buildings & not limited on size
- Prototypical Models for Elementary, Middle, & High
- Space types: Classroom, Hallway, Gym, Administration, Cafeteria, Media room, Auditorium, Speciality use
- Greater emphasis on daylighting
- Greater variety of HVAC systems
- Recommendations tables have more options

# What's After That?

## Additional Advanced Energy Design Guides Planned or in Process

- Goal is to produce two guides per year
- Goal is to complete 30% guides within next 2 years
- 30% for Highway Lodging
- AEDGs for Existing Buildings
- 50% and Beyond towards Net Zero Energy Buildings

# 50-, and 70+% Design Guides

- 50% and 70+% guides are being planned
  - K-12 School Buildings will start soon after 30% is done
  - Big-box retail currently being considered
- Strategic planning has been done to provide structure and identification of research needed
- Anticipated these will have more emphasis on integrated design process
- Target for 50% series is 5 years
- Target for 70+% series is 7-10 years

# Closing Remarks / Challenges:

- It is still possible to save a considerable amount of energy using off-the-shelf technology and good practices
- There is a demand for recommendations going beyond codes
- Need for giving guidance rather than requirements (i.e. “should” rather than “shall”).

# Closing Remarks / Challenges:

- Much of energy usage is other than heat loss/gain through opaque/insulated surfaces
  - Larger fraction of savings have to come from “non-opaque envelope” measures
  - Challenge between permanent/fixed building items and occupant/user items
- Performance vs Prescriptive
  - Complex interactions
  - Multiple ways to achieve goal

# Conclusions

- Our organizations have heard and are responding to the requests of members to do more to giving guidance on how to design, build, and operate energy efficient buildings
- The framework has been established for producing documents which can give this guidance
- The commitment and enthusiasm are tremendous for this type project.

A pair of hands is shown holding a small, colorful globe of the Earth. The globe is positioned in the center-left of the frame, with the hands cupping it from below and the sides. The globe shows continents in various colors (green, yellow, red) and oceans in blue. The word 'ATLANTIC' is visible on the globe. The background is a plain, light-colored surface.

# Now What?

## ■ How Obtain?

– [www.ashrae.org](http://www.ashrae.org)

– [www.iesna.org](http://www.iesna.org)

– [www.aia.org](http://www.aia.org)

## ■ LEED Points

– 4 E&A credits

