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Advanced Energy Guides

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Advanced Energy Design Guides

Provide prescriptive energy savings guidance and recommendations by building type and geographic location:

- Design packages and strategies to help owners and designers achieve 50% site energy savings over Standard 90.1
- Two series:
  - 30% savings over 90.1-1999
  - 50% savings over 90.1-2004
- Educational guidance to enable high-performance design beyond minimum code requirements
- Developed in collaboration with ASHRAE, AIA, IES, USGBC, DOE and National Labs
- Available as a free download from www.ashrae.org/freeaedg

Advanced Energy Retrofit Guides

Provide commercial building energy managers with comprehensive guidance for planning and executing successful retrofit projects:

- Objective discussion of retrofit measures that should be considered:
  - Building type
  - Level of energy savings / depth of retrofit
  - Climate region
- Methods for calculating complex, multi-year cash flows in support of a strong business case
- Sample analysis and recommended packages
- Developed in collaboration with E Source, RMI, NAESCO, PECI, DOE
- Available as a free download from www.eere.energy.gov/buildings/commercial/aerg.html

Published/Planned Guides

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50% AEDG:

- Small to medium office
  - PNNL
- K-12 school
- Medium to big box retail
- Large hospitals

AERG:

- Office Buildings
  - PNNL
- Retail Stores
  - PNNL
- Grocery Stores
- K-12 Schools
- Healthcare Facilities
  - September 2013

Purpose & Objectives

Problem Statement: The majority of building designers/energy managers lack ready access to resources needed to prioritize energy efficiency investments.

Impact of Project: The Advanced Energy Guides provide integrated solutions to help designers and managers incorporate energy efficiency into the design, construction, and remodeling process. These guides achieve broad market adoption due to high credibility, appropriate detail, and proven effectiveness in saving energy. In addition, AEDGs interface with current code requirements, and influence future code development and savings targets (Standard 90.1 and 189.1).

Project Focus: The Advanced Energy Guides are aligned with several BTO goals:

AEDG:

- Accelerate the adoption of advanced building construction techniques
- Develop systems and applications that reduce energy consumption by 50% compared to baseline code, and aligning with an owner's proposed design

AERG:

- Increase awareness among commercial building owners and operators of opportunities to cost-effectively save energy while maintaining or improving occupant comfort and safety
- Improve building performance through multiple approaches, including building operations and developing the workforce

AEDG Approach

Approach: The new construction and retrofit market audiences require different information, and the Advanced Energy Guides target the specific needs of each audience:

AEDG:

1. Develop pre-engineered modeled solution sets for 50% energy savings over code specific to building type and location; in essence taking a performance path and creating prescriptive measures that can easily be integrated in the marketplace
2. Provide these solutions in an easy-to-use prescriptive format
3. Provide how-to tips and implementation detail
4. Actively encourage industry collaboration to create buy-in by including five professional organizations from different commercial building disciplines at every step and performing two open industry peer reviews
5. Documenting industry best practices and case studies of successful implementations
6. Create technical support documents (TSDs) with assumptions, detailed simulation results, and analysis to provide depth to the guides without sacrificing usability

Key Issues: Deployment can be enhanced by leveraging the collaborating organizations member base for broad market awareness.

Distinctive Characteristics: The Advanced Energy Guides are unique in that they utilizes the cross-industry expertise of the collaborating organizations paired with National Laboratory modeling capabilities to develop an integrated easy-to-use guide.

AEDG Recommendation Tables

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Each guide contains recommendations developed from precomputed analysis on:

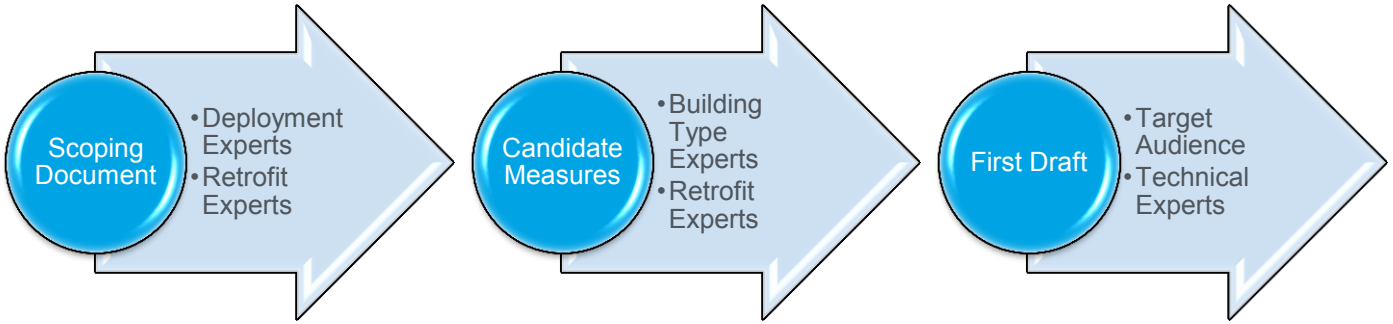
- Insulation levels for opaque envelope (roofs, walls, floors, slabs, doors)
- Fenestration performance characteristics and glazing criteria
- Interior lighting power densities (LPDs)
- Daylighting strategies
- Exterior lighting recommendations
- Plug load selection and control
- Kitchen equipment selection and operation
- Service water heating (SWH) equipment efficiencies
- HVAC equipment types and component efficiencies
- Commissioning, measurement and verification, and renewable energy
- All recommendations by climate zone in a single page for easy use

Envelope	Roofs	Insulation entirely above deck	R-30.0 c.i.
		Solar reflectance index (SRI)	Comply with Standard 90.1*
	Walls	Mass (HC > 7 Btu/ft^2)	R-13.3 c.i.
		Steel framed	R-13.0 + R-15.6 c.i.
		Below-grade walls	R-7.5 c.i.
	Floors	Mass	R-14.6 c.i.
		Steel framed	R-38.0
	Slabs	Unheated	Comply with Standard 90.1*
		Heated	R-20 for 24 in.
	Doors	Swinging	U-0.50
		Nonswinging	U-0.50
	Vestibules	At primary visitor building entrance	Comply with Standard 90.1*
	Continuous air barriers	Continuous air barriers	Entire building envelope
	Vertical fenestration (full assembly—NFRC rating)	Window-to-wall ratio	40% of net wall (floor-ceiling)
		Thermal transmittance	Nonmetal framing windows = 0.35 Metal framing windows = 0.42
		Solar heat gain coefficient (SHGC)	Nonmetal framing windows = 0.25 Metal framing windows = 0.25
		Light-to-solar gain ratio (LSG)	All orientations ≥ 1.5
		Exterior sun control	South orientation only – PF = 0.5
Daylighting/ Lighting	Form-driven daylighting option	All spaces	Comply with LEED for healthcare credits IEQ 8.1 (daylighting) and IEQ 8.2 (views)
		Diagnostic and treatment block	Shape the building footprint and form such that the area within 15 ft of the perimeter exceeds 40% of the floorplate.
		Inpatient units	Ensure that 75% of the occupied space not including patient rooms lies within 20 ft of the perimeter.
		Staff areas (exam rooms, nurse stations, offices, corridors); public spaces (waiting, reception); and other regularly occupied spaces as applicable	Design the building form to maximize access to natural light, through sidelighting and toplighting.
	Nonform-driven daylighting option	Staff areas (exam rooms, nurse stations, offices, corridors) and public spaces (waiting, reception)	Add daylight controls to any space within 15 ft of a perimeter window.
	Interior finishes	Room interior surface average reflectance	Ceilings ≥ 80% Walls ≥ 70%
	Interior lighting	Lighting power density (LPD)	Whole building = 0.9 W/ft^2 Space-by-space per Table 5-4
		Light source efficacy (mean lumens per watt)	T8 & T5 > 2 ft = 92 T8 & T5 < 2 ft = 85 All other >50
		Ballasts—4 ft T8 Lamps	Nondimming = NEMA Premium Dimming= NEMA Premium Program Start
		Ballasts—Fluorescent and HID	Electronic

AERG Approach

AERG:

1. Assemble team of experts in retrofit technology, cost estimating, M&V, and energy modeling
2. Develop general guidance for retrofit process
3. Define methodology for life cycle cost analysis
4. Identify highest priority retrofit measures
5. Perform example energy modeling analysis
6. Peer review at multiple points in the process



Typical Retrofit Process
(Example from Grocery Store AERG)

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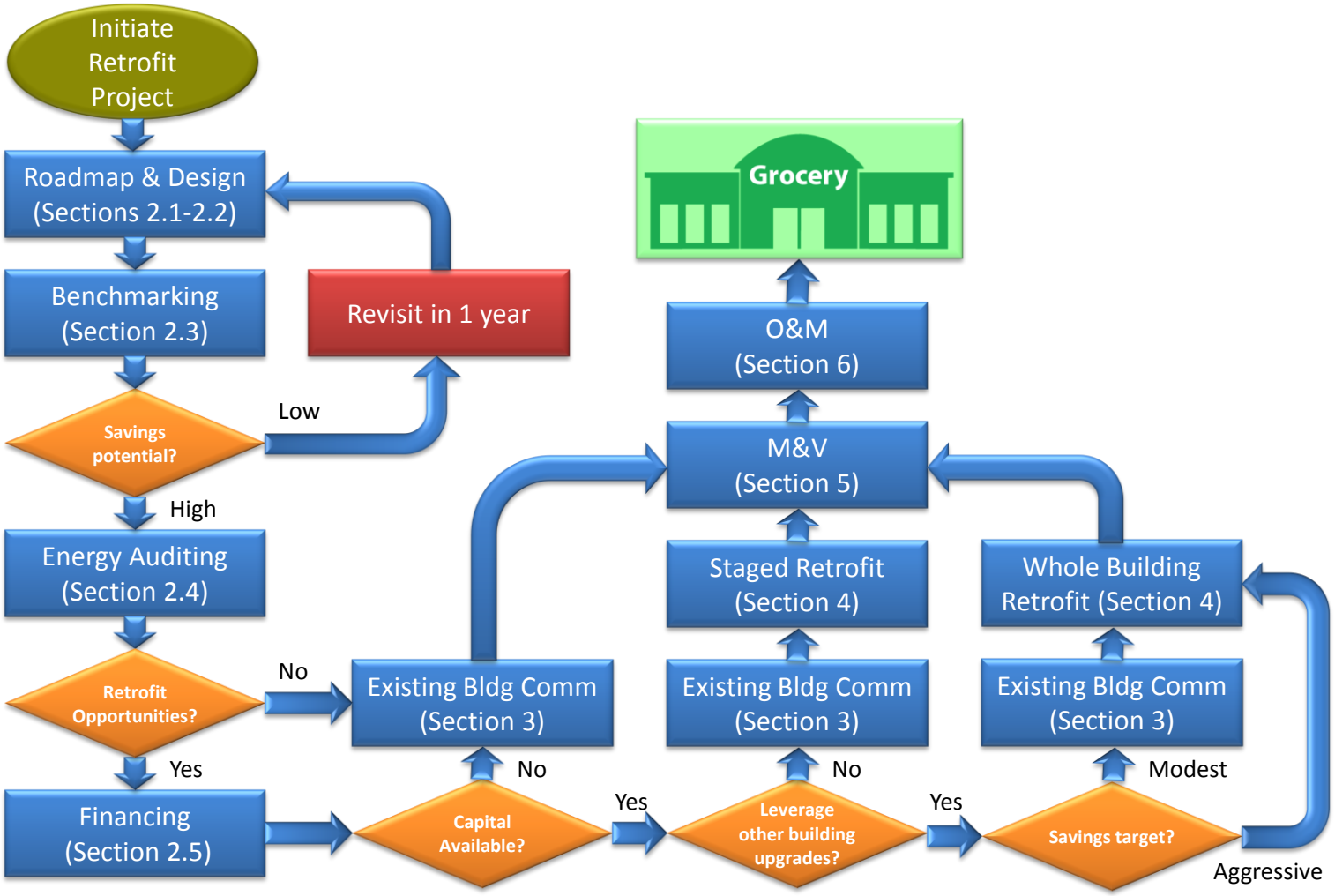
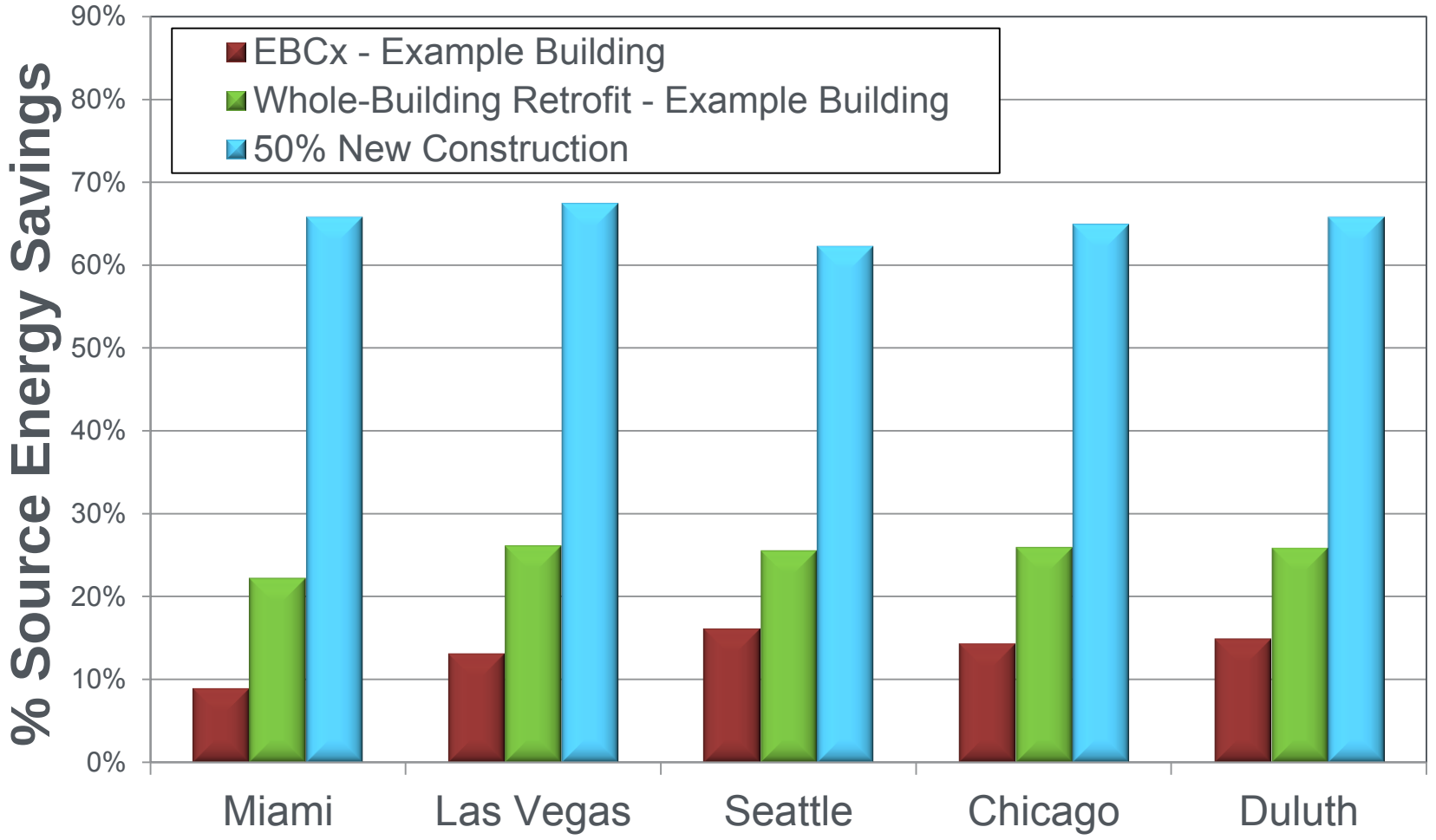


Grocery Store AERG Energy Savings Summary

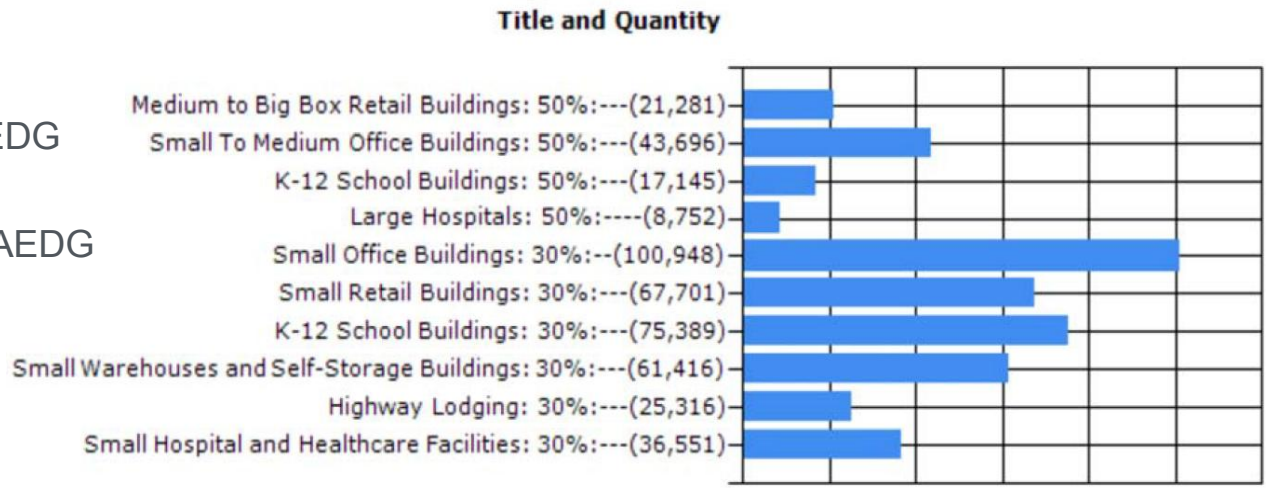


Accomplishments and Progress

Accomplishments:

Published in 2011-2013

- Small to Medium Office AEDG
- K-12 School AEDG
- Medium to Big Box Retail AEDG
- Office Buildings AERG
- Retail Buildings AERG
- Large Hospital AEDG
- Grocery Store AERG
- K-12 Schools AERG
- Healthcare Facilities AERG (September 2013)



Outreach

- Over 90,000 copies of the 50% AEDGs distributed in the past two years
- Over 480,000 copies of all the AEDGs distributed in the past five years
- Numerous presentations, webinars, and journal articles have been produced about the AEDGs; including annual and local ASHRAE meetings, ACEEE meetings, and DOE webinars
- The AERGs are new documents and we are working to develop an effective deployment plan modeled after the AEDG successes.

AEDG Market Impact

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- Free electronic distribution began January 17, 2008
- As of March 8, 2013
  - **483,970** AEDG copies in circulation
    - 458,195 electronic | 25,775 print
- Referenced in RFP specifications
- Influence ASHRAE Standard 90.1 and Standard 189.1
- Alternative compliance path for LEED v4 rating system
  - Option 1. Whole-building energy simulation
  - Option 2. Prescriptive compliance: AEDGs (**5-6 credits possible**)
    - Implement and document compliance with the applicable recommendations and standards in Chapter 4, for the appropriate AEDG and climate zone
      - Building envelope
      - Interior lighting
      - Exterior lighting
      - Plug loads

AEDG Market Impact

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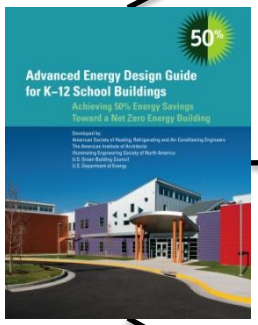

Webinars

YEA

Training

Building Codes and Certifications

Industry Adoption

Standard 90.1

LEED

Standard 189

CBP

TARGET

BBA

Greensburg

New Orleans

Owners' RFPs

Market

- Owners
- Architects
- Designers
- Engineers
- Contractors

Results

Market Assessment Report

>480,000 in Circulation

AEDGs influence the market through multiple paths

Project Integration & Collaboration

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Partners, Subcontractors, and Collaborators:

AEDG:

- The American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE)
- The American Institute of Architects (AIA)
- The Illuminating Engineering Society (IES)
- The U.S. Green Building Council (USGBC)
- The American Society for Healthcare Engineering (ASHE)
- Better Building Alliance and Commercial Building Partnership owners
- Standard 90.1 and 189.1 committee members
- ASHRAE technical committee members
- An industry based peer review process

AERG:

- E Source
- PECI
- Rocky Mountain Institute (RMI)
- National Association of Energy Service Companies (NAESCO)
- The Abo Group
  - RMH
  - Big Ladder Software
  - Cumming
- Peer review process by industry experts and members of the intended audience

Communications:

- Both AEDGs and AERGs have their own website for distribution
- The AERGs are new documents and we are working to develop an effective deployment plan modeled after the AEDG successes, including a DOE/BBA webinar scheduled for April 7, 2013

Project Plan & Schedule

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Project original initiation date: FY2011

Project planned completion date: FY2013

Summary	
WBS Number or Agreement Number	19987
Project Number	NREL-FY13-16,98
Agreement Number	19987

Legend	
	Work completed
	Active Task
	Milestones & Deliverables (Original Plan)
	Milestones & Deliverables (Actual)

Task / Event	FY2012				FY2013				FY2014			
	Q1 (Oct-Dec)	Q2 (Jan-Mar)	Q3 (Apr-Jun)	Q4 (Jul-Sep)	Q1 (Oct-Dec)	Q2 (Jan-Mar)	Q3 (Apr-Jun)	Q4 (Jul-Sep)	Q1 (Oct-Dec)	Q2 (Jan-Mar)	Q3 (Apr-Jun)	Q4 (Jul-Sep)
Project Name: Advanced Energy Guides												
Q1 Milestone: Office Buildings AERG	◆											
Q1 Milestone: Retail Buildings AERG	◆											
Q1 Milestone: Retail 50% AEDG		◆										
Q2 Milestone: Hospital 50% AEDG			◆									
Q2 Milestone: Grocery Stores AERG				◆								
Q2 Milestone: K-12 School 50% AEDG TSD					◆							
Q2 Milestone: K-12 Schools AERG						◆						
Current work and future research												
Q3 Milestone: Retail 50% AEDG TSD							◆					
Q3 Milestone: Hospital 50% AEDG TSD								◆				
Q4 Milestone: Healthcare Facilities AERG									◆			

Project Budget

FY11-12 Project Budget: AEDG: $860,000 | AERG: $1,160,000

Variances: There were no variances from planned budget

FY13 Cost to Date: ~75% of 300K spent to date for TSDs and AERG completion

Additional Funding: None at this time

	DOE/NREL Budget History ($000)					
	FY2010		FY2011		FY2012	
	DOE*	Cost-share	DOE*	Cost-share	DOE*	Cost-share
AEDG	$0	$0	$610	Industry volunteers	$250	$0
AERG	$0	$0	$750	$0	$410	$0
*PNNL created one AEDG (office) and two AERGs (retail and office) under separate funding						

Next Steps and Proposed Future Plans

Next Steps and Proposed Future Plans:

AEDG:

- Complete FY13 Retail and Hospital TSDs
- Additional 50% guides for different building types.
- A next-generation of AEDGs targeting higher energy savings (70+%) or net-zero energy.
- Integration of AEDG recommendations into OpenStudio and Building Component Library
- Targeted outreach effort

AERG:

- Complete the Healthcare Facilities AERG
- Replicate successful promotion of AEDGs to AERGs through:
  - Stakeholder webinars
  - Training curriculum development and pilot
  - Follow-up with users
  - Application case study in an example building
- Spreadsheet-based financial analysis tool
- Interactive measure prioritization tool
- Simple methods to estimate energy savings using curve fits to modeled results