

The Next Generation of ANSI/ASHRAE/IESNA Standard 100-2006R

Energy Conservation in Existing Buildings *



* Revised Title *Energy Efficiency in Existing Buildings*

ANSI/ASHRAE/IESNA Standard 100-2006R



ANSI/ASHRAE/IESNA Standard 100-2006
(Supersedes ANSI/ASHRAE/IESNA Standard 100-1995)

ASHRAE STANDARD

Energy Conservation in Existing Buildings

Approved by the ASHRAE Standards Committee on June 24, 2006; by the ASHRAE Board of Directors on June 25, 2006; by the Illuminating Engineering Society of North America on July 17, 2006; and by the American National Standards Institute on June 30, 2006.

ASHRAE Standards are scheduled to be updated on a five-year cycle; the date following the standard number is the year of ASHRAE Board of Directors approval. The latest copies may be purchased from ASHRAE Customer Services, 1791 Tullie Circle, NE, Atlanta, GA 30329-2305. E-mail: orders@ashrae.org. Fax: 404-321-5478. Telephone: 404-639-8400 (worldwide) or toll free 1-800-527-4723 (for orders in US and Canada).

© Copyright 2006 ASHRAE, Inc.

ISSN 1041-2336



American Society of Heating, Refrigerating
and Air-Conditioning Engineers, Inc.
1791 Tullie Circle NE, Atlanta, GA 30329
www.ashrae.org

ANSI/ASHRAE/IESNA Standard 100-2006R

Purpose of Today's Presentation:

To discuss changes being made to
update the Standard for 2011

What is the Standard? –
it provides the minimum
requirements for energy efficient
design and operation of existing
residential , commercial, institutional
and industrial buildings

ANSI/ASHRAE/IESNA Standard 100-2006R

Objectives

- Provide guidance to building owners and operators on processes and procedures needed to improve the energy efficiency of their buildings
- Provide a code ready standard that can be used by state and local jurisdictions to write directly into building codes
- Provide a verifiable process that federal & state authorities and utility companies can use to support tax incentive, rebate and other programs.

ANSI/ASHRAE/IESNA Standard 100-2006R

Developments

- **ASHRAE. Standard 100 SPC has been re-established to further develop the standard.**
- **The Standard will establish mandatory Energy Use Intensity targets for all existing buildings.**
- **The Standard will define the Processes and Procedures that Owners should follow in undertaking major energy efficiency retrofits**
- **The standard will include suggested Energy Efficiency Measures (EEMs) for Existing Buildings and recommended Life Cycle Cost Analysis techniques.**

ANSI/ASHRAE/IESNA Standard 100-2006R

Developments

Title

1.Purpose

2.Scope

3.Definitions

4.Compliance Requirements

5.Energy Management Plan

6.Operation and Maintenance Requirements

7.Energy Use Analysis and Target Requirements

8.Energy Audit Requirements

9.Implementation and Verification Requirements

10.Residential Buildings & Dwelling Units

11.References , Annex & Forms

ANSI/ASHRAE/IESNA Standard 100 Revision

Title, Purpose, Scope

- **TITLE: ENERGY EFFICIENCY IN EXISTING BUILDINGS**
- **PURPOSE:**
 - This standard provides criteria that will result in energy efficiency in existing buildings, including single family dwellings, low & high rise residential, commercial, industrial and historic buildings.
 - This standard is directed toward:
 - a. Providing procedures and programs essential to energy efficient operation, maintenance, management and monitoring;
 - b. Increasing the energy efficiency of the energy-using systems and equipment; and
 - c. Upgrading the thermal performance of the building envelope.

ANSI/ASHRAE/IESNA Standard 100-2006R

Developments

SCOPE:

This standard applies to existing buildings, portions of buildings, and complexes, including the envelope and all energy systems in the building.

It will set Energy Targets by Building Type and Climate Zone

ANSI/ASHRAE/IESNA Standard 100 Revision

Sec. 5: Energy Management Plan

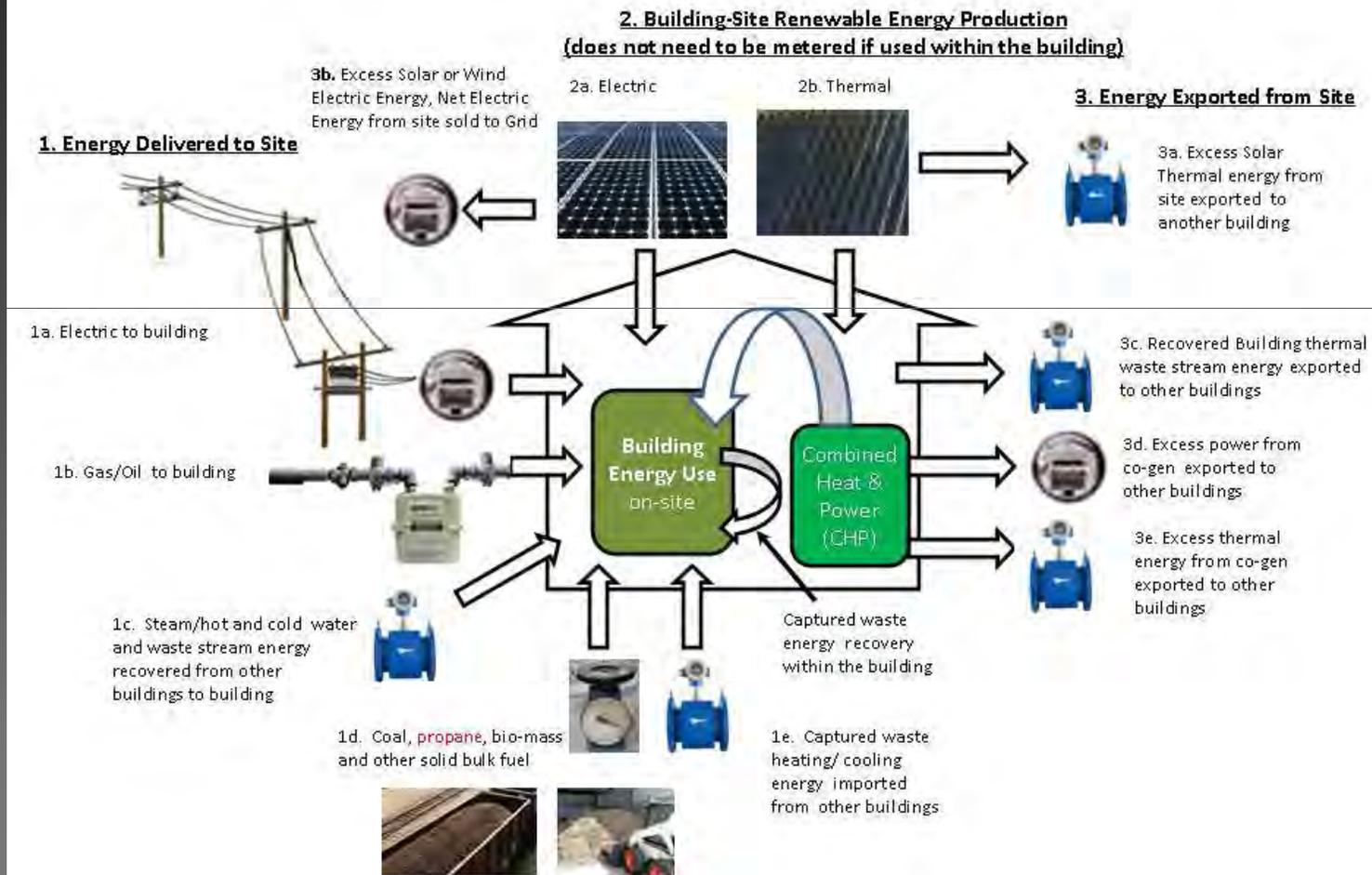
Addresses how to manage and improve the efficiency of energy usage and develop strategies for reducing energy use.

- **Establishing the Energy Management Plan**
- **Building Energy Monitoring**
- **Energy Conversion Factors/ Fuel Types**
- **Role of the Energy Manager**

ANSI/ASHRAE/IESNA Standard 100 Revision

Sec. 5: Energy Management Program

Net energy use concept



ANSI/ASHRAE/IESNA Standard 100 Revision

Sec. 6: Operation and Maintenance Requirements

- **Mandatory requirements for all buildings**
- **Simplified for small buildings with simple systems**
- **Subsections**
 1. **Basic Energy Management**
 2. **Building Envelope**
 3. **Domestic Hot Water Systems**
 4. **Heating, Ventilating and Air-Conditioning Systems**
 5. **Refrigeration Systems**
 6. **Lighting Systems**
 7. **Controls and Building Automation Systems**
 8. **Continuous Commissioning**
 9. **Energy Monitoring**
 10. **Renewable Energy Systems (TBD)**
 11. **Electric Power Distribution Systems (TBD)**
 12. **Other Motors, People Moving Devices (TBD)**

ANSI/ASHRAE/IESNA Standard 100 Revision

Sec. 7: Energy Use Analysis and Target Requirements

- **Benchmarks are being compiled from CBECS & RECS for minimally compliant by building type and climate zone. Enforcer can pick level of compliance in reference to minimal for Target (e.g. Federal Buildings may pick 30% lower)**
- **Conduct energy survey using 2 years of utility bills. Normalize for weather and convert to kBtu/yr and divide by either square feet of conditioned space or other metric (e.g. hospital beds, lbs of dry cleaning) to obtain energy use intensity (EUI) Baseline.**
- **If building type is listed in Target List, compare Baseline to Target. If Baseline < Target, requirement of Sec. 5 met. If Baseline > Target, must complete Sec 7 & 8 or Sec 9.**
- **If building type not listed in Target list, must complete Sec 7.**

ANSI/ASHRAE/IESNA Standard 100 Revision

Sec. 7: Energy Use Analysis and Target Requirements

- **Energy Use Baseline**
- **Building Types from CBECS and RECS**
- **Energy Targets Energy Intensity Units EUIs**
- **EUI Multipliers**
 - **Energy Management Plan**
 - **Building Energy Monitoring**
 - **Conversion Factors/ Fuel Types**
 - **Energy Manager**

ANSI/ASHRAE/IESNA Standard 100-2006R

Table 5.1. Building Types Derived From CBECS and RECS*

No.	Commercial Building Type	EUI**	No.	Commercial Building Type	EUI**
1	Admin/professional office	61	28	Preschool/daycare	71
2	Bank/other financial	87	29	Other classroom education	40
3	Government office	77	30	Fast food	419
4	Medical office (non-diag)	52	31	Restaurant/cafeteria	229
5	Mixed-use office	71	32	Other food service	125
6	Other office	59	33	Hospital/inpatient health	199
7	Laboratory	266	34	Nursing home/assisted living	126
8	Distribution/ship center	34	35	Dormitory/fraternity/sorority	74
9	Non-refrig warehouse	16	36	Hotel	76
10	Convenience store	232	37	Motel or inn	74
11	Convenience store+gas	187	38	Other lodging	71
12	Grocery/food market	193	39	Vehicle dealership/showroom	82
13	Other food sales	58	40	Retail store	47
14	Fire/police station	98	41	Other retail	82
15	Other public order/safety	89	42	Post office/postal center	64
16	Medical office (diagnostic)	44	43	Repair shop	43
17	Clinic/other outpatient health	67	44	Vehicle service/repair shop	49
18	Refrigerated warehouse	103	45	Vehicle storage/maintenance	21
19	Religious worship	35	46	Other service	90
20	Entertainment/culture	35	47	Strip shopping mall	94
21	Library	92	48	Enclosed mall	90
22	Recreation	40		Residential Building Type	
23	Social/meeting	41	49	Mobile home	66
24	Other public assembly	42	50	Single family-detached	44
25	College/university	97	51	Single family-attached	50
26	Elementary/middle school	55	52	Apartment building (2-4 units)	76
27	High school	71	53	Apartment building (5+ units)	54

*CBECS: Commercial Buildings Energy Consumption Survey 2003

RECS: Residential Buildings Energy Consumption Survey 2005

**EUI: Total building energy use intensity in kBtu/sf-yr

ANSI/ASHRAE/IESNA Standard 100-2006R

Table 5.2. Recommended Energy Use Intensity Targets for ASHRAE Standard 100 (top 25%)

No.	Commercial Building Type	EUIs by Building Type by Climate Zone (kBtu/ft ² -yr)															
		ASHRAE Climate Zone															
		1A	2A	2B	3A	3B	3B	3C	4A	4B	4C	5A	5B	6A	6B	7	8
1	Admin/professional office	38	40	38	42	33	38	33	48	40	40	48	42	64	47	68	81
2	Bank/other financial	55	57	58	58	48	66	47	65	58	57	68	68	78	87	82	116
3	Government office	48	50	48	62	41	48	42	57	48	50	60	62	87	68	72	101
4	Medical office (non-diag)	33	34	33	36	28	33	28	38	34	34	41	38	48	40	48	68
5	Mixed-use office	45	48	45	48	38	46	38	53	48	47	58	48	82	66	87	94
6	Other office	38	39	38	40	32	37	32	44	38	39	47	40	62	48	68	78
7	Laboratory	178	178	171	176	147	186	168	194	173	179	209	187	232	211	248	331
8	Distribution/ship center	12	18	18	20	11	18	14	27	23	22	38	30	48	40	80	113
9	Non-refrig warehouse	8	8	8	10	6	8	7	13	11	11	17	14	24	18	28	64
10	Convenience store	135	148	135	162	127	138	141	188	150	167	178	182	193	178	208	283
11	Convenience store+gas	108	118	109	122	102	112	114	133	121	128	144	130	168	144	188	212
12	Grocery/food market	112	122	113	127	108	118	118	138	126	131	149	136	181	148	174	219
13	Other food sales	34	37	34	38	32	36	38	42	38	40	45	41	48	46	63	68
14	Fire/police station	88	86	83	84	64	81	68	71	84	68	77	88	86	78	82	122
15	Other public order/safety	80	69	67	68	48	66	63	66	68	60	70	83	78	71	84	111
16	Medical office (diagnostic)	33	32	32	32	30	32	27	32	30	28	30	30	31	30	31	36
17	Clinic/other outpatient health	50	48	48	48	46	48	40	48	48	42	48	46	47	46	48	62
18	Refrigerated warehouse	88	88	88	88	67	84	82	76	87	89	81	72	90	82	88	128
19	Religious worship	23	23	22	23	19	22	21	26	23	23	27	26	30	28	33	43
20	Entertainment/culture	23	23	22	23	19	21	21	26	23	23	27	24	30	28	32	43
21	Library	81	81	68	80	60	67	66	67	80	81	72	84	80	73	88	114
22	Recreation	28	28	26	28	22	24	24	28	28	28	31	28	34	31	37	48
23	Social/meeting	28	27	28	27	23	28	26	30	27	28	32	28	38	33	38	61
24	Other public assembly	28	28	27	28	23	28	26	31	27	28	33	30	37	33	38	62
25	College/university	82	81	80	82	46	68	60	72	80	86	78	86	80	78	88	147
26	Elementary/middle school	38	37	38	37	30	36	32	41	38	38	42	37	48	41	48	72
27	High school	45	45	44	48	33	42	37	52	44	47	67	48	88	67	72	107
28	Preschool/daycare	48	48	48	48	38	46	41	52	48	47	64	47	80	63	63	83
29	Other classroom education	26	26	26	26	18	24	21	28	26	28	32	27	37	32	40	60
30	Fast food	281	288	283	277	237	288	263	306	280	284	332	301	384	333	383	487

ANSI/ASHRAE/IESNA Standard 100-2006R

31	Restaurant/cafeteria	141	145	141	160	128	143	137	188	161	168	179	183	186	181	213	288
32	Other food service	77	78	77	82	88	76	76	81	83	85	88	88	107	88	118	148
33	Hospital/inpatient health	142	143	140	141	134	138	130	143	128	135	138	128	142	130	144	188
34	Nursing home/assisted living	84	83	81	83	88	78	76	81	82	84	88	88	108	100	118	168
35	Dormitory/fraternity/sorority	40	43	42	47	31	43	40	58	48	54	65	55	75	88	85	118
36	Hotel	60	61	48	62	47	48	48	55	62	62	67	65	81	68	85	75
37	Motel or Inn	55	53	52	61	48	60	48	52	60	48	53	60	68	62	67	88
38	Other lodging	53	50	50	48	48	48	44	48	48	48	60	48	53	60	65	88
39	Vehicle dealership/showroom	48	50	48	63	38	48	42	80	62	62	68	68	78	88	87	124
40	Retail store	28	28	28	30	21	27	24	34	30	30	38	33	45	40	60	71
41	Other retail	48	50	48	62	37	48	42	68	62	62	67	68	78	88	88	124
42	Post office/postal center	43	42	41	42	35	38	38	48	41	43	60	45	68	61	80	78
43	Repair shop	28	28	27	28	23	26	26	31	28	28	33	30	37	34	40	53
44	Vehicle service/repair shop	33	33	32	32	27	31	28	38	32	33	38	35	43	38	48	61
45	Vehicle storage/maintenance	14	14	14	14	12	13	13	18	14	14	17	16	19	17	20	27
46	Other service	60	60	58	68	60	66	64	85	68	80	71	83	78	71	84	112
47	Strip shopping mall	58	58	58	82	48	67	61	71	82	83	82	70	84	84	108	151
48	Enclosed mall	68	68	65	68	44	64	48	88	68	80	78	87	90	80	101	144
		ASHRAE Climate Zone															
	Residential Building Type	1A	2A	2B	3A	3B	3B	3C	4A	4B	4C	5A	5B	6A	6B	7	8
49	Mobile home	38	40	40	45	30	41	38	54	45	61	62	62	71	82	80	112
50	3F-detached	28	30	30	33	22	30	28	40	34	38	48	38	62	48	60	83
51	3F-attached	32	34	34	38	25	35	32	48	38	43	53	44	80	63	88	98
52	Apartment building (2-4 units)	47	50	50	58	37	61	47	68	57	64	77	65	88	78	101	140
53	Apartment building (5+ units)	32	34	34	38	25	35	32	48	38	43	53	44	80	63	88	98

ANSI/ASHRAE/IESNA Standard 100-2006R

Table 7.3 EUI Multipliers for Different Operating Shifts

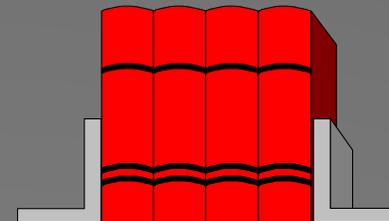
Operating Shift Multipliers					Operating Shift Multipliers				
No.	Building Activity/Type	Weekly Hours			No.	Building Activity/Type	Weekly Hours		
		50 or less	51 to 167	168			50 or less	51 to 167	168
1	Admin/professional office	1.0	1.0	1.4	28	Preschool/daycare	0.8	1.3	1.3
2	Bank/other financial	1.0	1.0	1.4	29	Other classroom education	0.8	1.3	1.3
3	Government office	1.0	1.0	1.4	30	Fast food	0.4	1.1	2.1
4	Medical office (non-diag)	1.0	1.0	1.4	31	Restaurant/cafeteria	0.4	1.1	2.1
5	Mixed-use office	1.0	1.0	1.4	32	Other food service	0.4	1.1	2.1
6	Other office	1.0	1.0	1.4	33	Hospital/inpatient health	1.0	1.0	1.0
7	Laboratory	1.0	1.0	1.0	34	Nursing home/assisted living	1.0	1.0	1.0
8	Distribution/ship center	0.7	1.4	2.1	35	Dormitory/fraternity/sorority	1.0	1.0	1.0
9	Non-refrig warehouse	0.7	1.4	2.1	36	Hotel	1.0	1.0	1.0
10	Convenience store	1.0	1.0	1.4	37	Motel or inn	1.0	1.0	1.0
11	Convenience store+gas	1.0	1.0	1.4	38	Other lodging	1.0	1.0	1.0
12	Grocery/food market	1.0	1.0	1.4	39	Vehicle dealership/showroom	0.8	1.2	1.8
13	Other food sales	1.0	1.0	1.4	40	Retail store	0.8	1.2	1.8
14	Fire/police station	0.8	0.8	1.1	41	Other retail	0.8	1.2	1.8
15	Other public order/safety	0.8	0.8	1.1	42	Post office/postal center	0.7	1.5	1.5
16	Medical office (diagnostic)	1.0	1.0	1.5	43	Repair shop	0.7	1.5	1.5
17	Clinic/other outpatient health	1.0	1.0	1.5	44	Vehicle service/repair shop	0.7	1.5	1.5
18	Refrigerated warehouse	1.0	1.0	1.0	45	Vehicle storage/maintenance	0.7	1.5	1.5
19	Religious worship	0.9	1.7	1.7	46	Other service	0.7	1.5	1.5
20	Entertainment/culture	0.8	1.5	1.5	47	Strip shopping mall	1.0	1.0	1.0
21	Library	0.8	1.5	1.5	48	Enclosed mall	1.0	1.0	1.0
22	Recreation	0.8	1.5	1.5	Residential Building Activity/Type				
23	Social/meeting	0.8	1.5	1.5	49	Mobile home	1.0	1.0	1.0
24	Other public assembly	0.8	1.5	1.5	50	SF-detached	1.0	1.0	1.0
25	College/university	0.8	1.3	1.3	51	SF-attached	1.0	1.0	1.0
26	Elementary/middle school	0.8	1.3	1.3	52	Apartment building (2-4 units)	1.0	1.0	1.0
27	High school	0.8	1.3	1.3	53	Apartment building (5+ units)	1.0	1.0	1.0

ANSI/ASHRAE/IESNA Standard 100-2006R

Sec. 8: Energy Audit Requirements

Sets Requirements for Buildings with and without Energy Targets

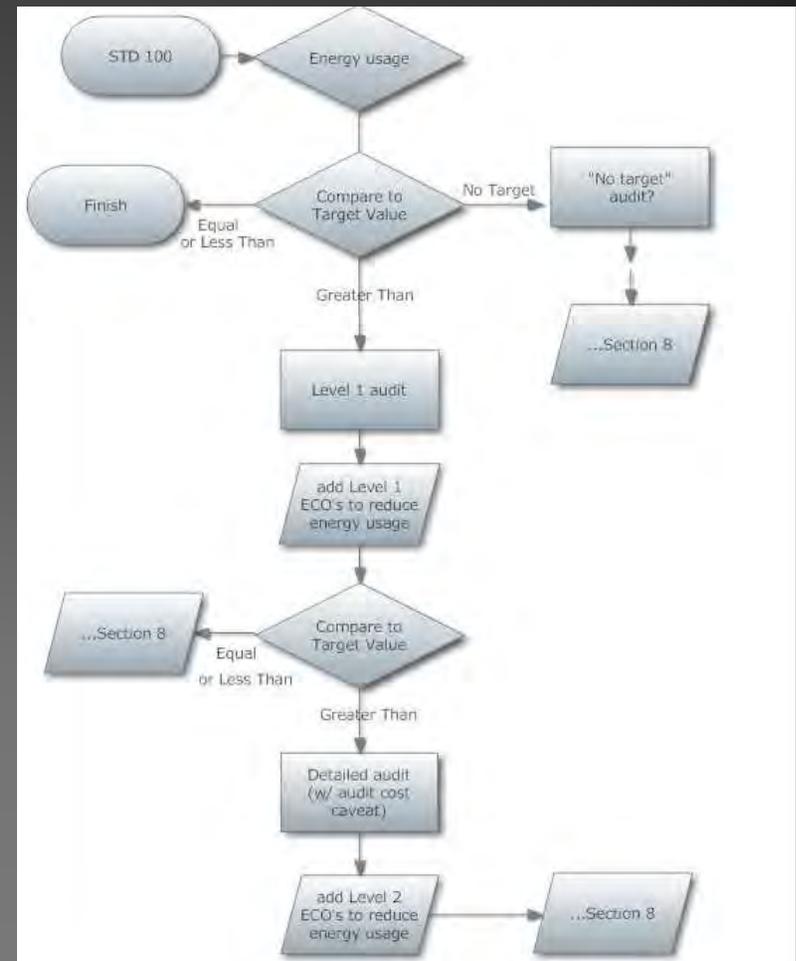
- **Level 1 - Walk Through Assessment**
- **Level 2 – Energy Survey and Analysis**
- **Level 3 – Detailed Analysis of Capital Intensive Modifications**



ANSI/ASHRAE/IESNA Standard 100 Revision

Sec. 8: Energy Audit Requirements

- Walk through audit for all buildings.
- Compare Energy survey with added Energy Efficiency Measures (EEMs) < Target
- If not, Conduct detailed audit, cost not to exceed 10% of annual utility bill (?). Use Modeling (?)
- List of typical EEMs in appendix – by Bldg type/technology
- Certified Energy Auditor required(?)
- Life Cycle Cost method



ANSI/ASHRAE/IESNA Standard 100 -2006R

Sec. 9: Implementation and Verification Requirements

- **Buildings must have an Implementation Plans for Energy Efficiency and Capital Improvements. Plans use audit results and LCC analysis to determine plan. Jurisdictions adopting this standard can use this section for rebates, incentives or loans to accelerate the implementation.**
- **Buildings with Targets, use implementation plan to meet target in shortest time possible.**
- **Implementation includes commissioning.**
- **Buildings with Targets are conditionally compliant after implementation for 1 year.**
- **Verification is energy survey compared to target, after one year.**
- **Buildings without Targets and Prescriptive approach must have implementation plan and commissioning.**

ANSI/ASHRAE/IESNA Standard 100 -2006R

Sec. 10: Residential Dwelling Units

10.1 Compliance Requirements

10.2 Energy Use Intensity

10.3 Operation and Maintenance

10.4 Energy Analysis and Target Requirements

10.5 Energy Audit Requirements

10.6 Implementation and Verification Requirements

ANSI/ASHRAE/IESNA Standard 100 Revision

Sect. 10 *References*

- **ANSI/ASHRAE Standard 62.1-2007, Ventilation for Acceptable Indoor Air Quality.**
- **ANSI/ASHRAE/IESNA Standard 90.1 2004 Energy Standards for Buildings**
- **ANSI/ASHRAE Standard 105-1984 (RA 1999), Standard Methods for Measuring and Expressing Building Energy Performance.**
- **ASHRAE Guideline 0-2009, The Commissioning Process. ASHRAE Guideline 4-1993, Preparation of Operating and Maintenance Documentation for Building Systems.**
- **DOE/EIA- Nonresidential Buildings Energy Consumption Survey: Characteristics of Commercial Buildings**
- **CBECs 2003 and RECS 2004.**
- **ASHRAE - Procedures for Commercial Building Energy Audits, 2004.**

ANSI/ASHRAE/IESNA Standard 100-2006R

Sect. 11 Normative and Informative Annexes

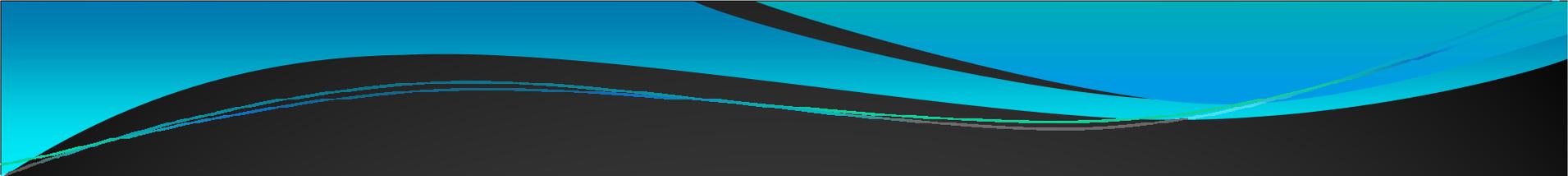
- REFERENCES
- NORMATIVE ANNEX A Alternate Energy Intensity Targets
- NORMATIVE ANNEX B Timeline
- NORMATIVE ANNEX C Forms
 - Form A Compliance
 - Form B EUI Target
 - Form C Energy Use Intensity
 - Form XX Unused form
 - Form D End Use Analysis Requirements Level 1
 - Form E End Use Analysis Requirements Level 2
- INFORMATIVE ANNEX D Energy Efficiency Measures
- INFORMATIVE ANNEX F Climate Zones
- INFORMATIVE ANNEX G Simple Payback & Life Cycle Cost Analysis
- INFORMATIVE ANNEX H Building Energy Modeling
- NORMATIVE ANNEX AA Operation and Maintenance Requirements
- NORMATIVE ANNEX AB Derivation of Building Energy Use Targets

ANSI/ASHRAE/IESNA Standard 100-2006R

Sect. 11 Normative and Informative Appendices

ANNEX D Energy Efficiency Measures

- **Building Envelope**
- **HVAC Systems**
- **Refrigeration**
- **Water Systems**
- **Energy Generation and Distribution**
- **Residential and Non-Residential Lighting**
- **Electrical Systems**
- **Appliances**
- **Building Automation and Controls**



ANSI/ASHRAE/IESNA Standard 100-2006R

Thank You!