ASHRAE Annual Meeting

ASHRAE Standard 189.1 Committee
June 29, 2011
Montreal Canada

U.S. Department of Energy
Energy Efficiency and Renewable Energy

189.1 Progress Indicator Report

Energy Use Comparison between 189.1-2009 and 90.1-2010

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Pacific Northwest National Laboratory

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PNNL-80869

Outlines

- PNNL's Progress Indicator and Prototype Models
- Energy Use Comparison Between 189.1-2009 and 90.1-2010

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What is Progress Indicator

- PNNL developed energy use simulation platform to quantitatively measure energy impacts of Standard 90.1
- Used to closely track the 90.1-2010 development for its 30% energy saving goal
- Used for DOE's Determination on 90.1-2007 and 90.1-2010
- Now expand the application by comparing 189.1-2009 with 90.1-2010 using the same methodology

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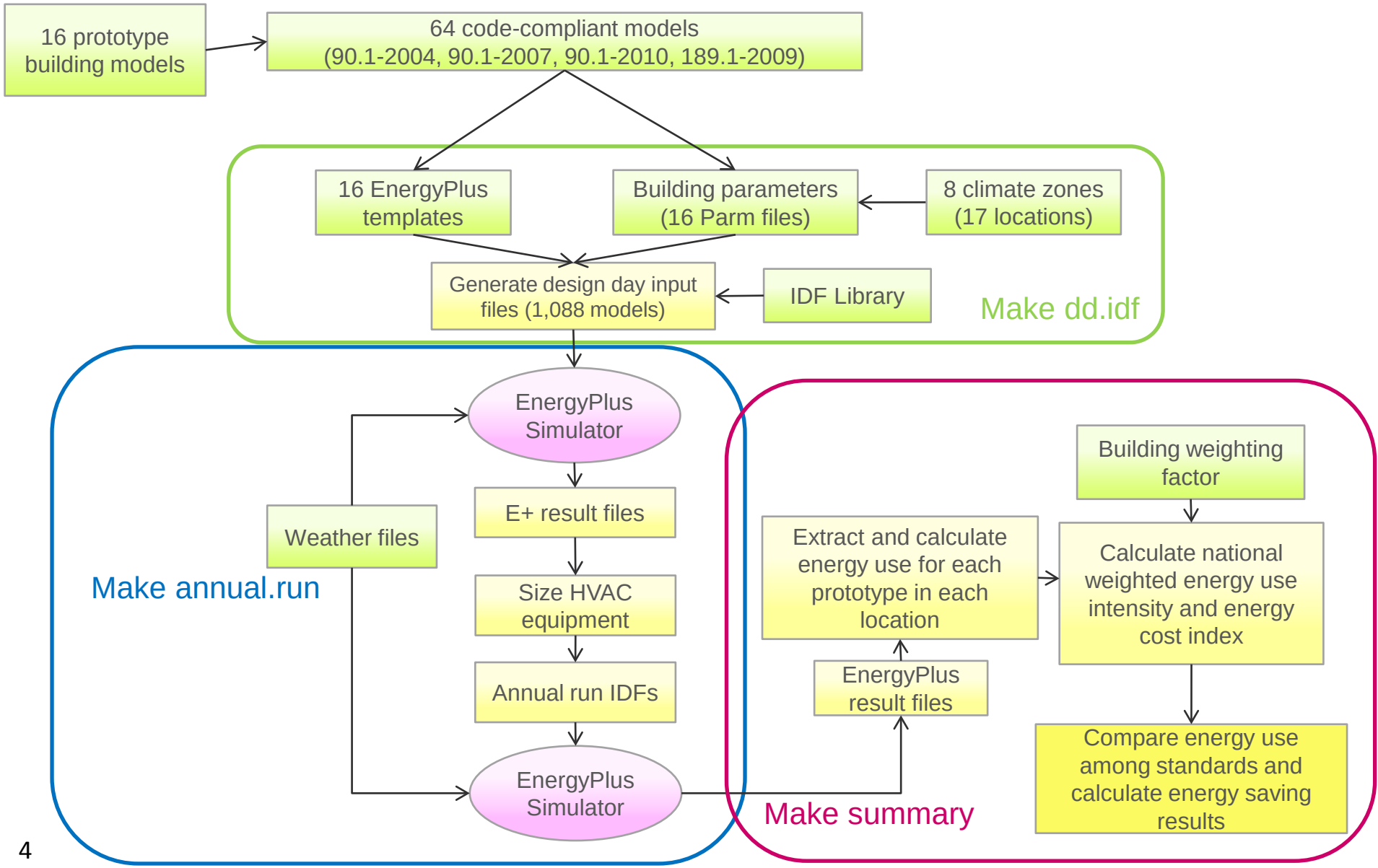
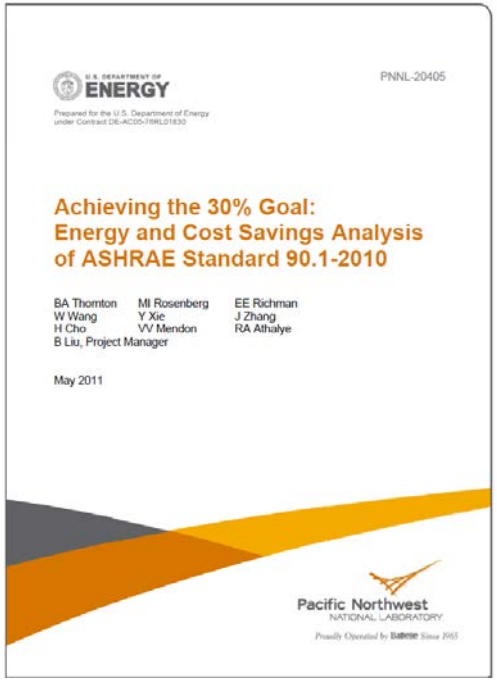
Progress Indicator Structure



90.1 Prototype Building Models

- Progress Indicator methodology and prototype building models are documented in PNNL's published report
- 90.1 prototype building models (EnergyPlus input/output files) are published at DOE's Building Energy Codes Program web site
  - 16 prototype buildings
  - 17 climate locations
  - 90.1-2004, 90.1-2007 and 90.1-2010 code-compliant models
  - Scorecards (building basic modeling information)
  - National aggregated site energy savings results
  - EnergyPlus weather files



U.S. DEPARTMENT OF ENERGY

Prepared for the U.S. Department of Energy under Contract DE-AC05-76RL01830

PNNL-20405

Achieving the 30% Goal: Energy and Cost Savings Analysis of ASHRAE Standard 90.1-2010

BA Thornton, W Wang, H Cho, B Liu, Project Manager
MI Rosenberg, Y Xie, VV Mendon
EE Richman, J Zhang, RA Athalye

May 2011

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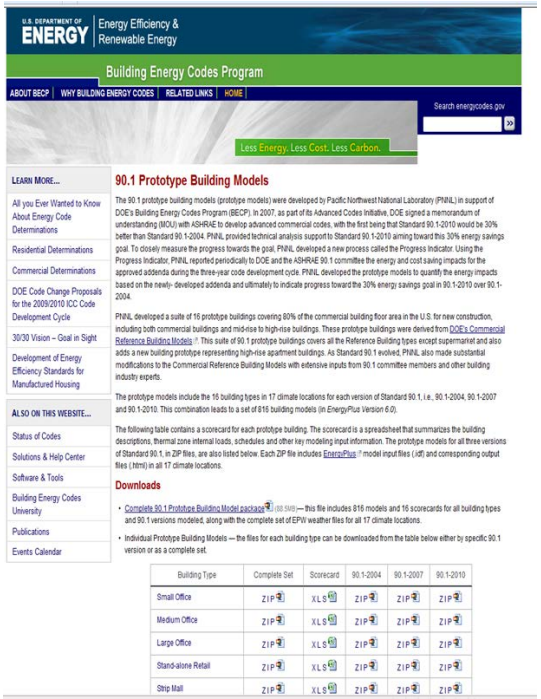

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90.1 Prototype Building Models

The 90.1 prototype building models (prototype models) were developed by Pacific Northwest National Laboratory (PNNL) in support of DOE's Building Energy Codes Program (BECP). In 2007, as part of its Advanced Codes Initiative, DOE signed a memorandum of understanding (MOU) with ASHRAE to develop advanced commercial codes, with the first being that Standard 90.1-2010 would be 30% better than Standard 90.1-2004. PNNL provided technical analysis support to Standard 90.1-2010 aiming toward this 30% energy savings goal. To closely measure the progress towards the goal, PNNL developed a new process called the Progress Indicator. Using the Progress Indicator, PNNL reported periodically to DOE and the ASHRAE 90.1 committee the energy and cost saving impacts for the approved addenda during the three-year code development cycle. PNNL developed the prototype models to quantify the energy impacts based on the newly- developed addenda and ultimately to indicate progress toward the 30% energy savings goal in 90.1-2010 over 90.1-2004.

PNNL developed a suite of 16 prototype buildings covering 80% of the commercial building floor area in the U.S. for new construction, including both commercial buildings and mid-rise to high-rise buildings. These prototype buildings were derived from DOE's Commercial Reference Building Models. This suite of 90.1 prototype buildings covers all the Reference Building types except supermarket and also adds a new building prototype representing high-rise apartment buildings. As Standard 90.1 evolved, PNNL also made substantial modifications to the Commercial Reference Building Models with extensive inputs from 90.1 committee members and other building industry experts.

The prototype models include the 16 building types in 17 climate locations for each version of Standard 90.1, i.e., 90.1-2004, 90.1-2007 and 90.1-2010. This combination leads to a set of 816 building models (in *EnergyPlus* Version 6.0).

The following table contains a scorecard for each prototype building. The scorecard is a spreadsheet that summarizes the building descriptions, thermal zone internal loads, schedules and other key modeling input information. The prototype models for all three versions of Standard 90.1, in ZIP files, are also listed below. Each ZIP file includes EnergyPlus model input files (.idf) and corresponding output files (.html) in all 17 climate locations.

Downloads

- Complete 90.1 Prototype Building Model package (1.68 GB) — this file includes 816 models and 16 scorecards for all building types and 90.1 versions modeled, along with the complete set of EPW weather files for all 17 climate locations.
- Individual Prototype Building Models — the files for each building type can be downloaded from the table below either by specific 90.1 version or as a complete set.

Building Type	Complete Set	Scorecard	90.1-2004	90.1-2007	90.1-2010
Small Office	ZIP	XLS	ZIP	ZIP	ZIP
Medium Office	ZIP	XLS	ZIP	ZIP	ZIP
Large Office	ZIP	XLS	ZIP	ZIP	ZIP
Stand-alone Retail	ZIP	XLS	ZIP	ZIP	ZIP
Strip Mall	ZIP	XLS	ZIP	ZIP	ZIP

Download PNNL Report at:
http://www.pnl.gov/main/publications/external/technical_reports/PNNL-20405.pdf

Download the 90.1 Prototype Building Models:
http://www.energycodes.gov/commercial/901models/

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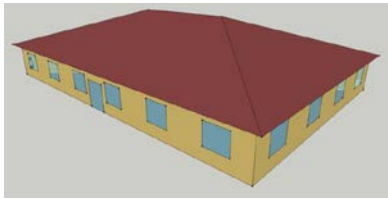
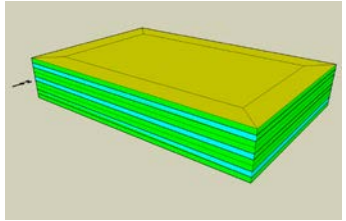
Prototype Building Models

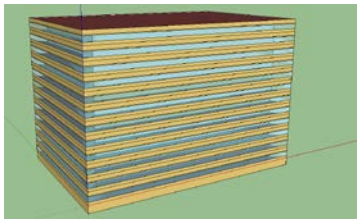
Small Office



Medium Office

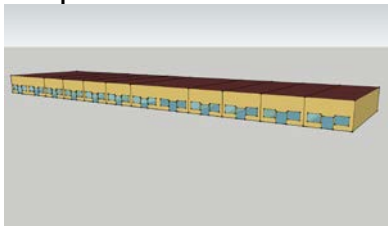


Large Office

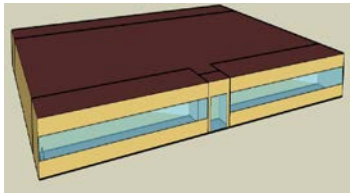


Warehouse

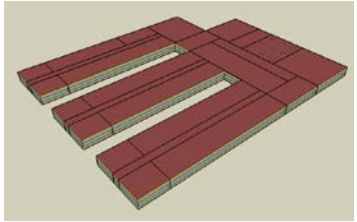
Strip Mall Retail



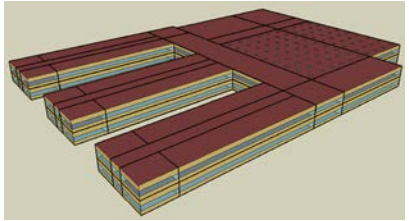
Standalone Retail



Primary School

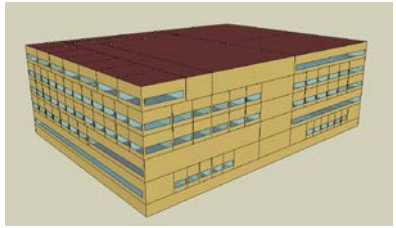


Secondary School

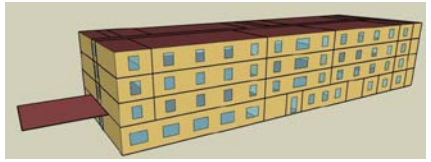


Outpatient Healthcare

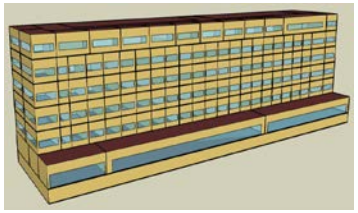
Hospital



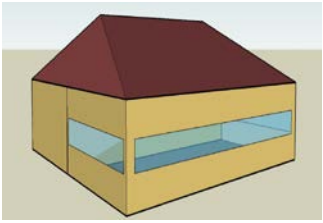
Small Hotel



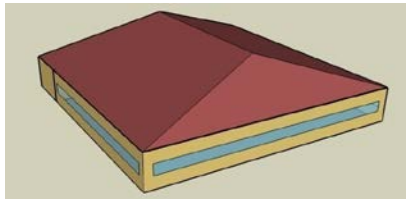
Large Hotel



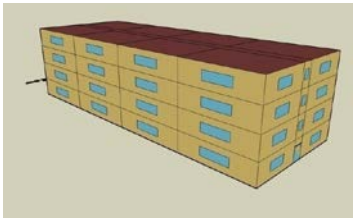
Quick-service Restaurant



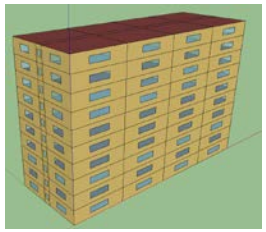
Full-service Restaurant



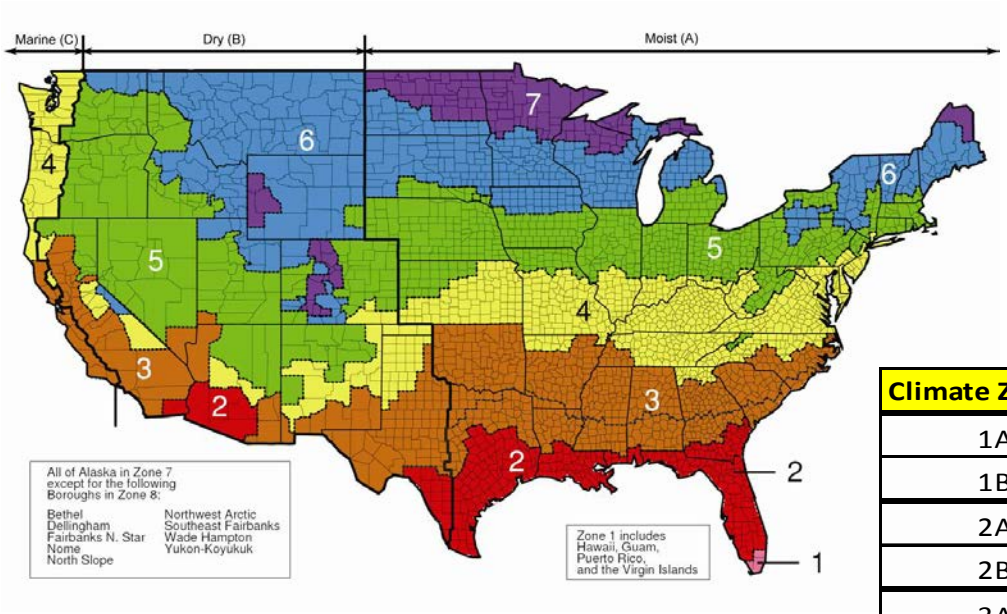
Mid-rise Apartment



High-rise Apartment



Climate Zones and Locations



Climate Zone	Climate Zone Type	Representative City
1A	Very Hot - Humid	Miami FL
1B	Very Hot - Dry	Riyadh, Saudi Arabia
2A	Hot - Humid	Houston, TX
2B	Hot - Dry	Phoenix AZ
3A	Warm - Humid	Memphis, TN
3B	Warm - Dry	El Paso, TX
3C	Warm - Marine	San Francisco, CA
4A	Mixed - Humid	Baltimore, MD
4B	Mixed - Dry	Albuquerque NM
4C	Mixed - Marine	Salem OR
5A	Cool - Humid	Chicago IL
5B	Cool - Dry	Boise ID
5C	Cool - Marine	Vancouver, BC
6A	Cool - Humid	Burlington VT
6B	Cool - Dry	Helena MT
7	Very Cold	Duluth, MN
8	Subarctic	Fairbanks, AK

New Construction Weighting Factors

Download PNNL report on new construction weights at:
http://www.pnl.gov/main/publications/external/technical_reports/PNNL-19116.pdf

	1	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	6A	6B	7	8	weights by bldg type
Large office	0.102	0.326	0.061	0.445	0.285	0.117	1.132	0.000	0.154	0.442	0.121	0.133	0.000	0.011	0.000	**3.33**
Medium office	0.129	0.813	0.292	0.766	0.715	0.136	1.190	0.036	0.196	1.060	0.342	0.298	0.035	0.033	0.007	**6.05**
Small office	0.084	1.064	0.289	0.963	0.475	0.078	0.936	0.047	0.123	0.920	0.322	0.241	0.030	0.032	0.005	**5.61**
Standalone retail	0.224	2.220	0.507	2.386	1.250	0.191	2.545	0.119	0.428	3.429	0.792	0.948	0.091	0.109	0.014	**15.25**
Strip mall retail	0.137	0.991	0.254	1.021	0.626	0.103	1.008	0.023	0.107	1.023	0.201	0.153	0.016	0.007	0.001	**5.67**
Primary school	0.064	0.933	0.164	0.944	0.446	0.048	0.895	0.030	0.094	0.920	0.224	0.168	0.037	0.023	0.003	**4.99**
Secondary school	0.160	1.523	0.230	1.893	0.819	0.109	2.013	0.063	0.243	2.282	0.438	0.415	0.086	0.075	0.012	**10.36**
Hospital	0.040	0.479	0.096	0.468	0.273	0.039	0.615	0.022	0.106	0.812	0.218	0.221	0.024	0.034	0.001	**3.45**
Outpatient health care	0.037	0.567	0.134	0.581	0.275	0.061	0.818	0.023	0.181	1.058	0.218	0.342	0.033	0.039	0.002	**4.37**
Full-service restaurant	0.009	0.106	0.025	0.111	0.047	0.006	0.127	0.006	0.010	0.143	0.031	0.031	0.004	0.004	0.000	**0.66**
Quick-service restaurant	0.008	0.092	0.020	0.102	0.063	0.007	0.089	0.005	0.014	0.128	0.026	0.025	0.003	0.004	0.000	**0.59**
Large hotel	0.109	0.621	0.125	0.635	0.793	0.106	0.958	0.037	0.123	0.919	0.200	0.227	0.058	0.038	0.004	**4.95**
Small hotel	0.010	0.288	0.030	0.268	0.114	0.022	0.315	0.020	0.039	0.365	0.089	0.107	0.031	0.020	0.004	**1.72**
Warehouse	0.349	2.590	0.580	2.966	2.298	0.154	2.446	0.068	0.435	3.580	0.688	0.466	0.049	0.043	0.002	**16.72**
High-rise apartment	1.521	1.512	0.076	0.652	0.741	0.173	2.506	0.000	0.358	1.163	0.115	0.125	0.016	0.008	0.000	**8.97**
Mid-rise apartment	0.257	1.094	0.093	0.825	0.862	0.260	1.694	0.022	0.371	1.122	0.318	0.313	0.056	0.032	0.000	**7.32**
weights by zone	**3.24**	**15.22**	**2.98**	**15.03**	**10.08**	**1.61**	**19.29**	**0.52**	**2.98**	**19.37**	**4.34**	**4.21**	**0.57**	**0.51**	**0.06**	**100.00**

Weighted EUI Comparison

Building Type	Prototype	90.1-2010	189.1-2009		Site EUI Savings	Net EUI Savings
		Site EUI kBtu/ft²-yr	Site EUI kBtu/ft²-yr	Net EUI kBtu/ft²-yr		
Office	Small office	32.6	31.9	27.9	2.2%	14.5%
	Medium office	37.3	39.9	35.9	-6.8%	3.9%
	Large office	33.4	34.7	30.7	-4.0%	8.0%
Retail	Standalone retail	49.4	45.0	41.1	8.7%	16.8%
	Strip mall	55.9	54.0	50.0	3.4%	10.5%
Education	Primary school	50.3	53.4	49.4	-6.2%	1.7%
	Secondary school	41.3	41.1	37.2	0.3%	10.0%
Health Care	Outpatient healthcare	124.3	133.8	129.8	-7.6%	-4.4%
	Hospital	118.5	142.9	138.9	-20.6%	-17.2%
Lodging	Small hotel	66.4	58.8	54.9	11.4%	17.4%
	Large hotel	124.4	125.6	121.6	-1.0%	2.2%
Warehouse	Warehouse	19.0	15.6	11.6	17.9%	38.9%
Food Service	Quick-service restaurant	519.4	512.0	508.1	1.4%	2.2%
	Full-service restaurant	330.3	347.3	343.3	-5.1%	-3.9%
Apartment	Mid-rise apartment	41.1	37.1	33.1	9.7%	19.4%
	High-rise apartment	43.7	39.2	35.2	10.3%	19.4%
National-weighted average		**54.8**	**54.4**	**50.4**	**0.9%**	**8.1%**

Site EUI: total annual site energy use intensity
Net EUI: net annual energy use intensity with renewable

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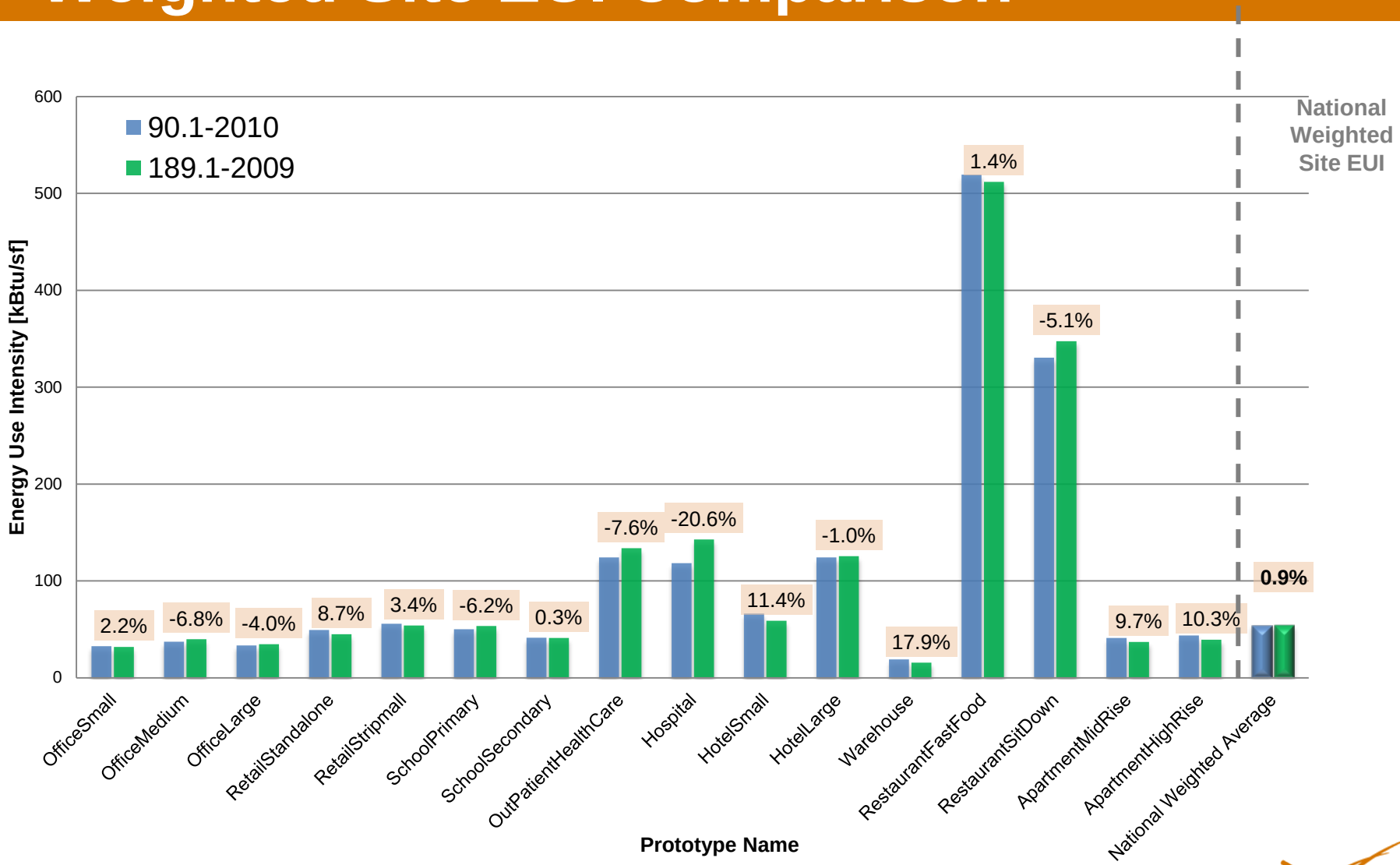
Weighted Site EUI Comparison



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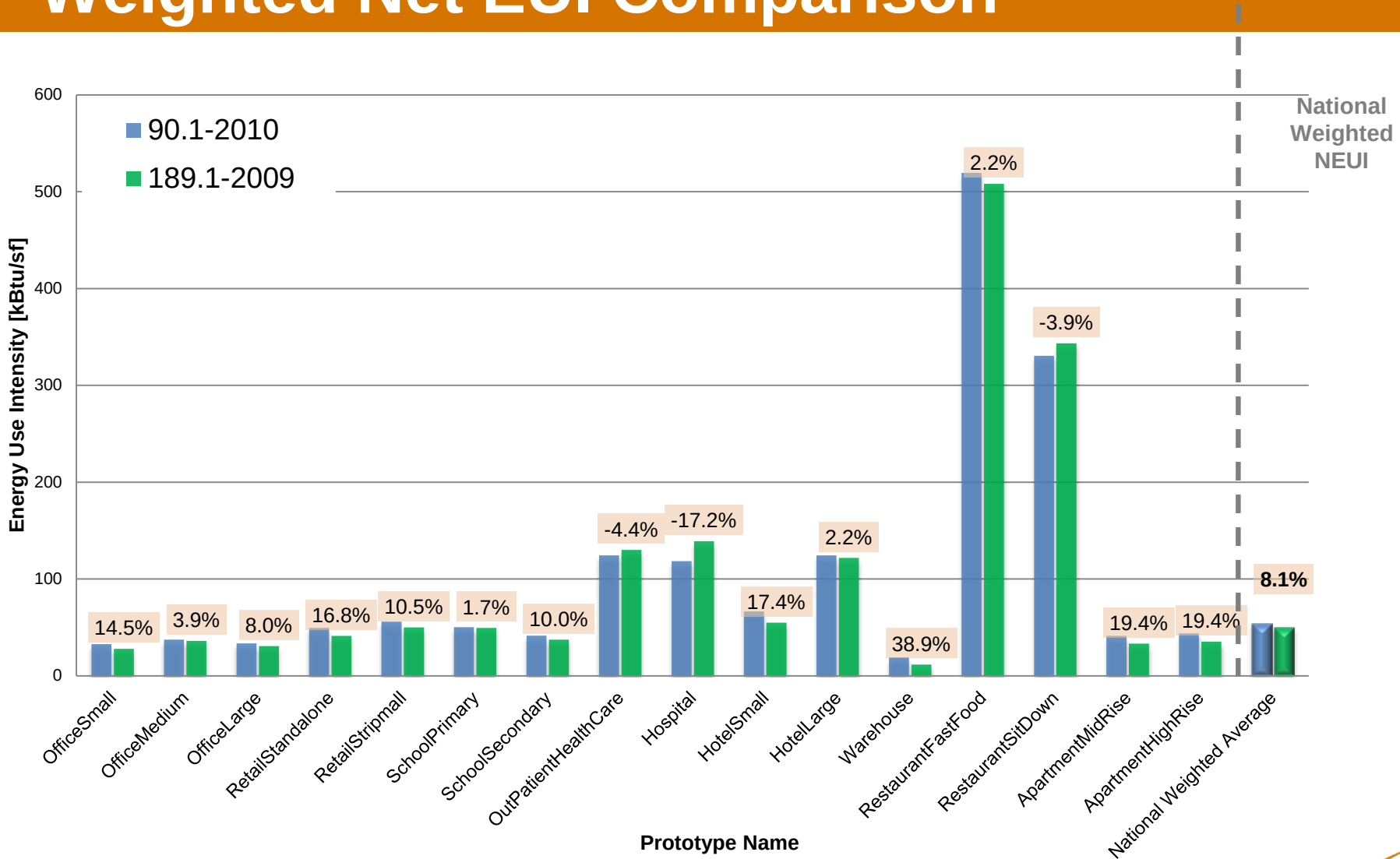
Weighted Net EUI Comparison



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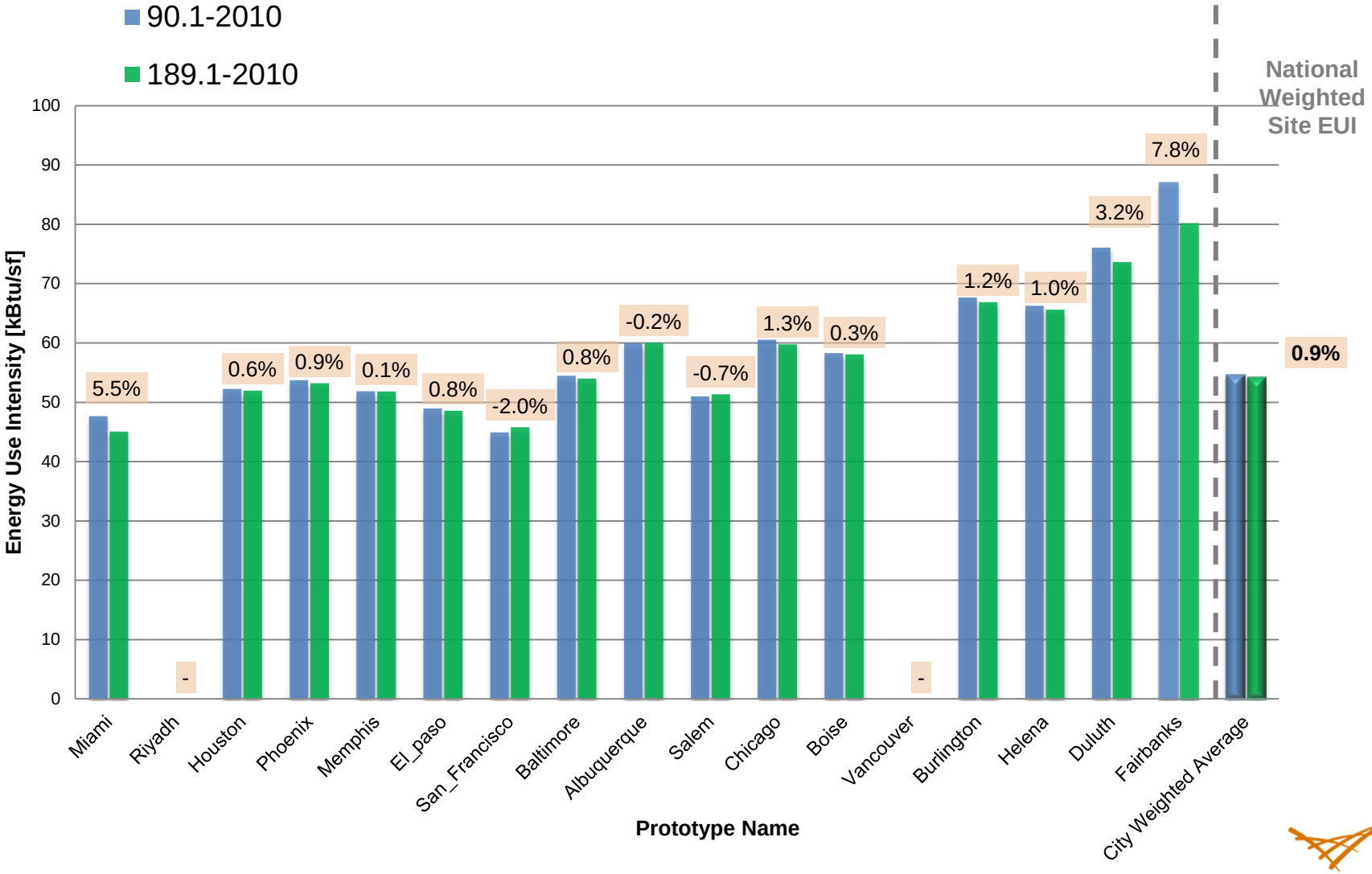
Weighted Site EUI Comparison by Location



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Weighted Site EUI by End Use

Prototype Name	Site Energy Use Intensity, kBtu/ft²-yr							
	Interior Lights		Exterior Lights		Plug and Process Loads		Refrigeration	
	90.1-2010	189.1-2009	90.1-2010	189.1-2009	90.1-2010	189.1-2009	90.1-2010	189.1-2009
Small office	10.19	10.47	1.64	1.58	8.44	9.10	0.00	0.00
Medium office	6.77	7.12	1.44	1.48	13.48	15.01	0.00	0.00
Large office	7.25	7.50	1.04	1.11	14.10	15.61	0.00	0.00
Standalone retail	17.01	15.96	1.83	1.69	7.47	7.49	0.00	0.00
Strip mall	18.85	20.54	2.32	2.60	5.42	5.42	0.00	0.00
Primary school	10.43	10.65	0.45	0.40	20.93	21.31	0.99	0.98
Secondary school	9.69	9.95	0.40	0.35	14.05	14.43	0.72	0.72
Outpatient healthcare	12.33	12.34	3.05	3.05	46.46	47.28	0.00	0.00
Hospital	14.22	14.77	0.81	0.81	48.98	49.57	0.76	0.76
Small hotel	9.00	7.10	1.44	1.44	22.22	21.76	0.00	0.00
Large hotel	10.57	7.78	1.82	1.82	35.01	34.79	0.59	0.56
Warehouse	6.14	5.91	1.16	0.91	2.44	2.54	0.00	0.00
Quick-service restaurant	13.55	22.27	4.40	5.28	274.48	274.61	24.59	24.67
Full-service restaurant	13.50	26.11	4.28	5.08	157.07	157.62	10.94	10.92
Mid-rise apartment	2.94	1.98	1.13	1.13	14.37	14.54	0.00	0.00
High-rise apartment	2.70	1.81	1.83	1.83	12.96	13.20	0.00	0.00
National Weighted Average	**9.8**	**9.6**	**1.5**	**1.4**	**16.8**	**17.1**	**0.4**	**0.4**

Weighted Site EUI by End Use (cont'd)

Prototype Name	Site Energy Use Intensity, kBtu/ft²-yr							
	Fans		Pumps		Heat Recovery		Cooling	
	90.1-2010	189.1-2009	90.1-2010	189.1-2009	90.1-2010	189.1-2009	90.1-2010	189.1-2009
Small office	3.87	3.07	0.00	0.00	0.00	0.00	3.65	3.21
Medium office	1.49	1.15	0.00	0.00	0.00	0.01	5.95	5.95
Large office	1.59	1.23	1.07	1.63	0.02	0.51	3.87	3.98
Standalone retail	8.23	6.70	0.00	0.00	0.58	0.72	6.10	5.34
Strip mall	8.05	6.72	0.00	0.00	0.00	0.00	7.57	5.92
Primary school	4.55	3.84	0.01	0.01	0.73	1.09	7.49	6.17
Secondary school	4.48	4.02	0.17	0.41	0.81	1.17	7.99	7.83
Outpatient healthcare	9.35	9.90	0.44	0.46	0.00	0.00	18.59	20.45
Hospital	11.40	14.43	3.41	5.45	0.47	1.24	11.66	15.06
Small hotel	7.95	7.29	0.02	0.02	0.00	0.51	7.28	6.50
Large hotel	5.15	4.78	0.75	1.75	1.35	1.90	16.42	16.32
Warehouse	0.84	0.56	0.00	0.00	0.00	0.00	0.47	0.35
Quick-service restaurant	32.86	27.30	0.00	0.00	0.00	0.00	25.32	19.27
Full-service restaurant	15.99	14.94	0.00	0.00	0.00	0.00	18.38	17.77
Mid-rise apartment	5.05	4.08	0.00	0.00	0.00	0.00	3.97	3.35
High-rise apartment	4.91	3.83	0.55	0.61	0.00	0.00	8.88	7.76
National Weighted Average	**5.2**	**4.6**	**0.3**	**0.4**	**0.3**	**0.4**	**6.8**	**6.5**

Weighted Site EUI by End Use (cont'd)

Prototype Name	Site Energy Use Intensity, kBtu/ft²-yr							
	Heating		Service Hot Water		Humidifier		Total	
	90.1-2010	189.1-2009	90.1-2010	189.1-2009	90.1-2010	189.1-2009	90.1-2010	189.1-2009
Small office	3.19	2.84	1.59	1.59	0.00	0.00	32.57	31.85
Medium office	4.73	5.68	3.49	3.49	0.00	0.00	37.35	39.89
Large office	3.77	2.46	0.65	0.65	0.00	0.00	33.35	34.69
Standalone retail	6.95	6.13	1.19	1.02	0.00	0.00	49.36	45.05
Strip mall	11.41	11.12	2.25	1.67	0.00	0.00	55.87	53.99
Primary school	3.68	7.93	1.02	1.02	0.00	0.00	50.27	53.41
Secondary school	2.46	1.76	0.51	0.51	0.00	0.00	41.27	41.15
Outpatient healthcare	29.65	34.80	1.52	1.52	2.93	4.02	124.31	133.81
Hospital	25.57	39.57	1.17	1.17	0.02	0.02	118.46	142.85
Small hotel	7.53	3.24	10.98	10.98	0.00	0.00	66.42	58.84
Large hotel	6.10	9.26	46.65	46.65	0.00	0.00	124.41	125.61
Warehouse	7.80	5.18	0.14	0.14	0.00	0.00	18.99	15.59
Quick-service restaurant	120.56	115.05	23.59	23.59	0.00	0.00	519.36	512.05
Full-service restaurant	77.45	82.16	32.74	32.74	0.00	0.00	330.35	347.34
Mid-rise apartment	6.53	4.92	7.14	7.14	0.00	0.00	41.14	37.14
High-rise apartment	4.87	3.15	7.04	7.04	0.00	0.00	43.74	39.24
National Weighted Average	**8.8**	**8.9**	**4.9**	**4.8**	**0.1**	**0.2**	**54.8**	**54.4**

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Summary of Requirement Difference 189.1-2009 vs. 90.1-2010

Building component affected		90.1-2010		189.1-2009	
		Addenda	Key difference of modeled requirements	Sections	Key difference of modeled requirements
Renewable	Onsite renewable installation	N/A	No Requirement (NR)	7.4.1.1	4.0 kBtu/ft2
Envelope	Building envelope criteria	90.1-07g	Only improved requirement on metal buildings by comparing to 90.1-2007	7.4.2.1	Improved requirements on all building envelope components by comparing to 90.1-2007
Envelope	Cool roof	90.1-07f	SRI = 0.55 thermal emittance = 0.75	7.4.2.2	SRI = 0.64
Envelope	Permanent projection	N/A	NR	7.4.2.5	PF of 0.5 for CZ 1-5 on W, S, and E sides.
Envelope	Vestibule	90.1-07q	No difference	7.4.2.7	No difference
Envelope	Limits poorly oriented fenestration	90.1-07bn	As ≥ Aw and As ≥ Ae Implemented through building rotation	7.4.2.9	a. For climate zones 1-4: (An x SHGCn + As x SHGCs) >= 1.1 x (Ae x SHGCe + Aw x SHGCw) b. For climate zones 5-6: 1/3 x (An x SHGCn + As x SHGCs + Ae x SHGCe) >= 1.1 x (Aw x SHGCw) Implemented through extended overhang
Envelope	Continuous air barrier	90.1-07am 90.1-07bf	Requirements are at component level. modeled effective whole building infiltration rate at 1.0 cfm/ft² at 0.3 in. w.c.	7.4.2.10	whole building air leakage testing modeled effective infiltration rate at 0.4 cfm/ft² at 0.3 in. w.c.
HVAC	Equipment Efficiency (PTAC and PTHP)	90.1-07bw	See Table 6.8.1D	7.4.3.1 (PTAC and PTHP)	See Table C-4
HVAC	Chiller performance	90.1-07m	Mostly the same except for air-cooled chiller EER=9.562	7.4.3.1 (chiller)	Mostly the same except for air-cooled chiller EER 10
HVAC	Equipment Efficiency (others)	N/A	See Table 6.8.1	7.4.3.1 (Others)	More efficient equipment requirements See Appendix C
HVAC	Threshold for DCV	N/A	40 people per 1000 ft²	7.4.3.2	25 people per 1000 ft²
HVAC	Economizer	90.1-07cy	Cooling capacity of 54 kBtu/h as the threshold. Zone 2A is included	7.4.3.4	Cooling capacity of 33 kBtu/h as the threshold. Zone 2A is excluded

Summary of Requirement Difference between 189.1-2009 and 90.1-2010

Building component affected		90.1-2010		189.1-2009	
		Addenda	Key difference of modeled requirements	Sections	Key difference of modeled requirements
HVAC	VAV reheat controls	90.1-07h	dual-maximum control sequence Cooling 20% and Heating 50%	7.4.3.5	single-maximum control sequence as 15% of the zone design peak supply rate
HVAC	Fan power limitation	N/A	Same as 90.1-2007	7.4.3.6	10% lower than 90.1-2007
HVAC	Single Zone VAV for DX system	90.1-07n	Standard requires VAV for DX system over 110 KBtu/h. It is modeled as VAV and two-stage DX.	7.4.3.7 (DX over 110 kBtu/h)	Standard requires VAV and Staged DX for DX system over 110 KBtu/h. It is modeled as required.
HVAC	Two-Stage DX cooling coil	N/A	NR	7.4.3.7 (DX over 65 kBtu/h)	DX system with cooling capacity of 65 to 110 KBtu/h
HVAC	ERV	90.1-07e	Minimum OA fraction down to 30%	7.4.3.8	Minimum OA fraction down to 10%
HVAC	Kitchen Exhaust Hoods	90.1-07ax	Transfer air Efficient hood design VAV exhaust hood.	7.4.3.9	Variable-speed fan control for individual kitchen hoods larger than 5000 cfm. Saving is not captured in PNNL prototypes as no individual kitchen hoods meet this threshold
HVAC and Lighting	Automatic control in hotel/motel guest rooms	90.1-07aw	Bathroom lights only	7.4.3.12	HVAC (thermostat reset) and all lights
HVAC	Open cooling towers with centrifugal fan units over 1,100 gpm	90.1-07u	Meet the energy efficiency requirements for axial fan units	N/A	Same as 90.1-2007
HVAC	Chilled Water and Condenser Water Pipe Sizing	90.1-07af	Prescribes maximum flow rates through chilled water and condenser water piping.	N/A	Same as 90.1-2007

Summary of Requirement Difference between 189.1-2009 and 90.1-2010

Building component affected		90.1-2010		189.1-2009	
		Addenda	Key difference of modeled requirements	Sections	Key difference of modeled requirements
HVAC	Hydronic Variable Flow Control	90.1-07ak	1. Removes the requirement for VFDs on variable flow heating water systems and lowers the threshold for VFDs from 50 to 5 hp for chilled water systems; 2. Limits differential pressure setpoint and requires setpoint reset with DDC; 3. Adds water cooled air conditioners to systems requiring isolation valves; 4. Adds VFD pumping requirement to hydronic heat pumps and water cooled ac loops.	N/A	Same as 90.1-2007
HVAC	Laboratory Fan Systems	90.1-07as	Removes exception for VAV turndown requirements for zones with special pressurization requirements. Reduces laboratory threshold where VAV or heat recovery is required.	N/A	Same as 90.1-2007
HVAC	Supply Air Temperature Reset	90.1-07bh	Requires supply air temperature to be reset for multizone HVAC system.	N/A	Same as 90.1-2007
HVAC	SZVAV fan power	90.1-07ca	Requires that single zone VAV systems meet the fan power requirements for constant volume systems.	NR	modeled the same as in 90.1-2010
HVAC	Outdoor Air Damper Requirements	90.1-07cb	Removes exception for automatic damper requirements for buildings < 3 stories in height.	N/A	Same as 90.1-2007
HVAC	Chilled Water and Condenser Water Pipe Sizing	90.1-07cc	Modifies pipe sizing table for 8" pipe.	N/A	Same as 90.1-2007
HVAC	Outdoor Air Ventilation Optimization Control	90.1-07ck	Requires multi-zone VAV systems to have controls that optimize ventilation.	N/A	Same as 90.1-2007
HVAC	ERV pressure drop	90.1-07dj	Provides limits on the pressure drop of energy recovery devices.	NR	modeled the same as in 90.1-2010
Water heating	Water heater efficiency	N/A	See Table 7.8	7.4.4.1	Higher efficiency. Potential savings due to low-flow fixture are not captured.

Summary of Requirement Difference between 189.1-2009 and 90.1-2010

Building component affected		90.1-2010		189.1-2009	
		Addenda	Key difference of modeled requirements	Sections	Key difference of modeled requirements
Lighting	Exterior lights	90.1-07i	No difference	7.4.6	No difference
Lighting	LPD reduction	90.1-07by	LPD reduction	7.4.6.1	Reduce LPD by 10% from 90.1-2007
Lighting	Occupancy sensor control	90.1-07x	More space types	7.4.6.2	Less space types
Lighting	Manual on occupancy sensor	90.1-07aa bp	No difference	7.4.6.3	No difference
Lighting	Auto control for egress and security lighting	N/A	NR	7.4.6.4	PNNL prototype building models do not have clear definition for lights serving building security or emergency egress. Saving is not captured.
Lighting	Daylighting and dimming control	90.1-07d, ab, al, dd, ct	Requires automatic daylighting controls for primary sidelighted areas equals or exceeds 250 ft². Requires automatic daylighting controls when daylight area from toplighting exceeds 900 ft². Requires skylights in large spaces over 5,000 ft².	7.4.6.5	Requires automatic daylighting controls when daylight area from toplighting or sidelighting is greater than 250 ft². Toplighting requirement more stringent than 90.1-2010; sidelighting requirement is the same.
				8.3.4	Skylights are required in enclosed spaces greater than 20,000 ft². Less stringent than 90.1-2010.
				8.4.1	Minimum effective aperture requirements for office spaces and classrooms. No such requirement in 90.1-2010.
Lighting	Exterior Lighting Control	90.1-07cd	Turn off façade lights at night Reduce other lights to 30% of peak level at night.	7.4.6.7	Reduce most exterior lights (building facades, parking lots, garages, canopies, and all outdoor sales areas) to 50% of peak level at night.

Summary of Requirement Difference between 189.1-2009 and 90.1-2010

Building component affected		90.1-2010		189.1-2009	
		Addenda	Key difference of modeled requirements	Sections	Key difference of modeled requirements
Lighting	Additional lighting power allowance for retail display	90.1-07bq	Reduces additional lighting power allowance for retail display comparing to 90.1-07	N/A	NR (Same as 90.1-2007)
Lighting	Stairwell lighting control	90.1-07cf	Requires stairwell lighting to be controlled automatically using control devices such that the lighting power is reduced by at least 50% within 30 min of all occupants leaving that controlled zone.	N/A	NR (Same as 90.1-2007)
Lighting	Reduces lighting power allowance for some lobbies	90.1-07de	Reduces lighting power allowance for some lobbies in 90.1 to reflect advances in lighting technology.	N/A	NR (Same as 90.1-2007)
Lighting	Elevator ventilation and lights	90.1-07df	Adds requirements for elevator ventilation and lighting.	N/A	NR (Same as 90.1-2007)
Power	Motor efficiency	90.1-07aj	No difference (Table 10.8B)	7.4.7.1	No difference (Table C-13)
Power	Energy Star Equipment	N/A	NR	7.4.7.3	Saving is not captured. PNNL needs to refine its prototype buildings to breakdown the plug loads at the individual appliance and equipment level to implement this requirement
Power	Commercial refrigerators, freezers, and clothes washer	N/A	NR	7.4.7.4	Saving is not captured. PNNL needs to refine its prototype buildings to have detailed individual refrigeration equipment modeling inputs in order to implement this requirement
Power	Transformer efficiency	90.1-07o	Table 8.1	N/A	NR (Same as 90.1-2007)
Power	Plug Receptacle Control	90.1-07bs	Requires non-critical receptacle loads to be automatically controlled (turned off) based on occupancy or scheduling.	N/A	NR (Same as 90.1-2007)