Energy Exchange

Federal Sustainability for the Next Decade

U.S. Department of Energy

Performance Targets from Performance Data

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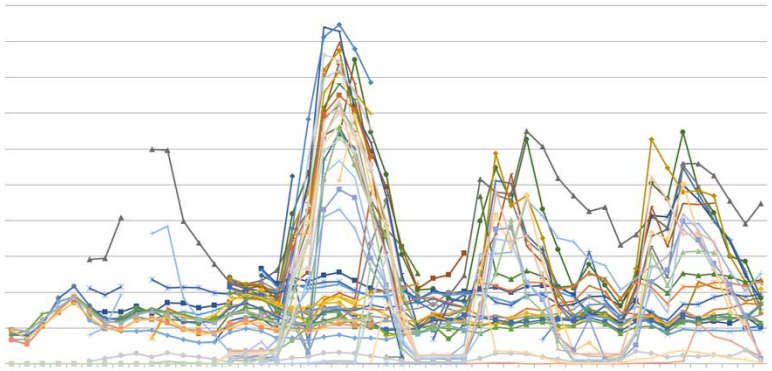
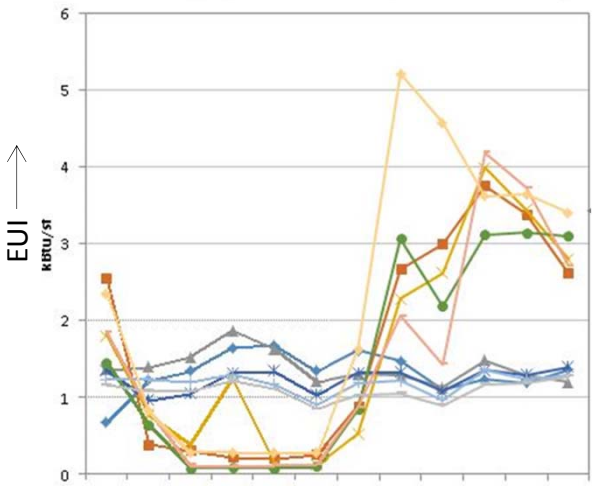
U.S. Army Corps of Engineers
August 10, 2016

Overview

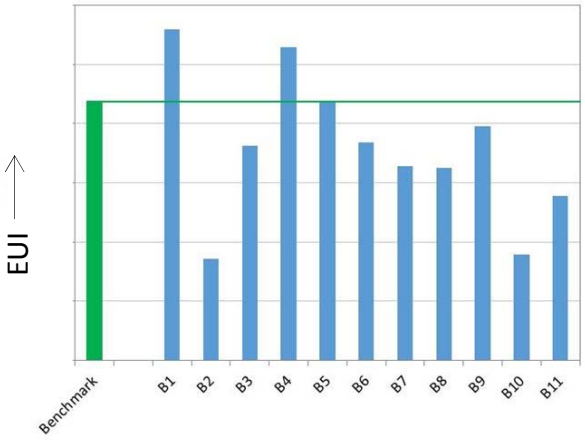
- Using meter data from real Army buildings to develop energy use targets



1. Data collection



2. Data Processing



3. Modeling and Target Development

Why do we need Targets?

- The Army needs to verify that its buildings are performing to their full potential

Commercial Buildings

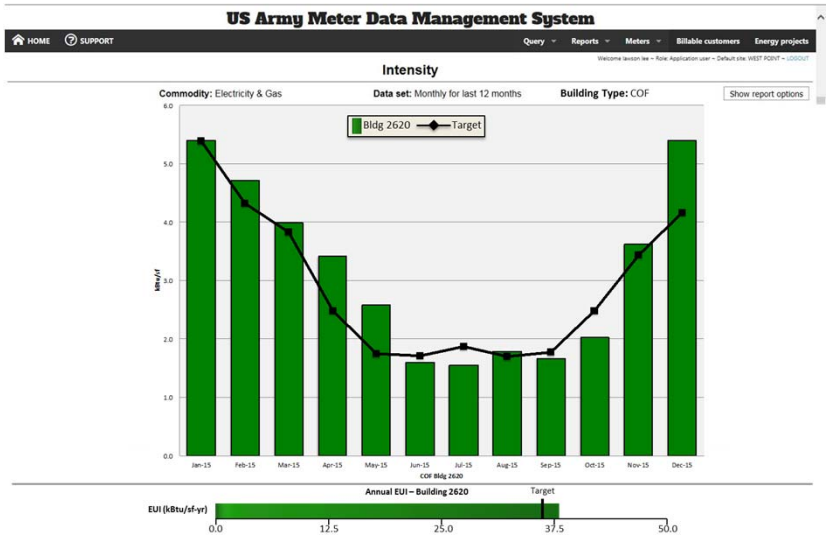
Office
Retail
Education
Healthcare
Storage

CBECS
Energy Star Portfolio Manager

Army Buildings

Brigade HQ
Vehicle Maintenance
Dining
Company Operations
Barracks

MDMS + EUIs



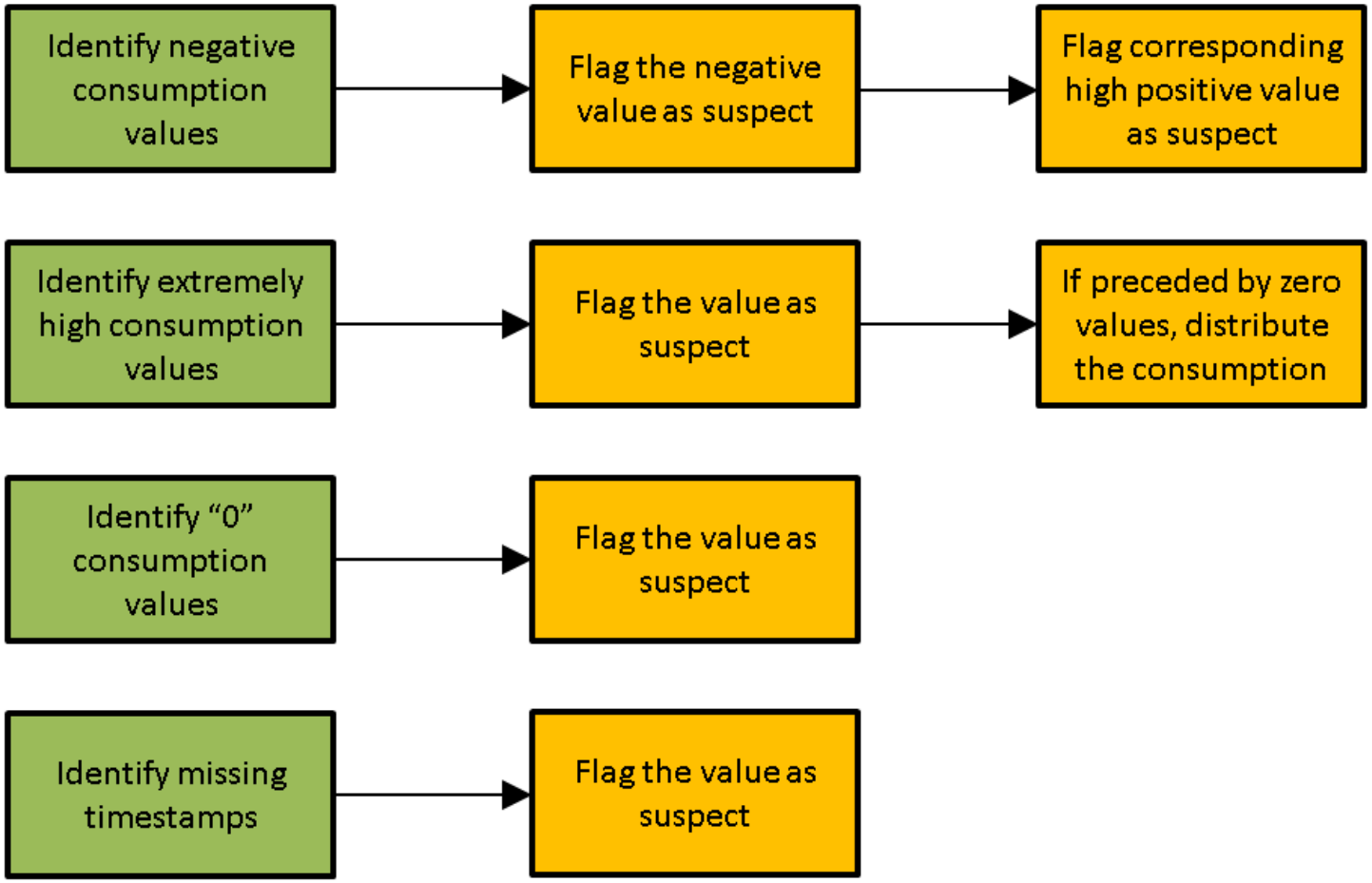
5 Army Building Types

- Building types selected based on previous studies – accounted for approximately 85% of all new construction projects

Building Type	Primary Activity	Area, ft^2 (m^2)	Number of Stories
Brigade Headquarters (BDEHQ)	Office, data center	39,600	2
Company Operations Facility (COF)	Administrative, training	114,000	2
Dining Facility (DFAC)	Cafeteria	23,400	1
Tactical Equipment Maintenance Facility (TEMF)	Vehicle maintenance, repair shop	33,000	2
Unaccompanied Enlisted Personnel Housing (UEPH)	Housing	54,800	3

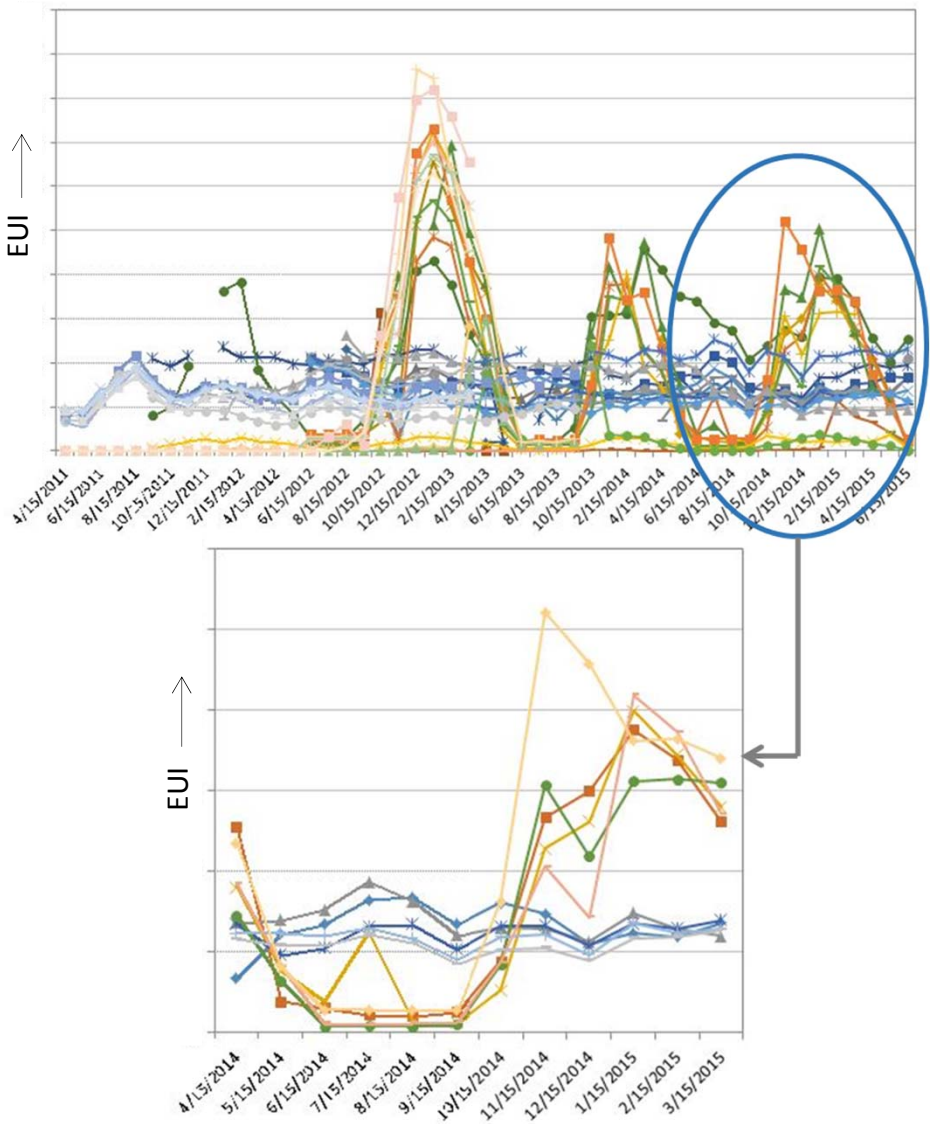
Filtering Through the Data

- Meter data is collected and processed before being used for calibration



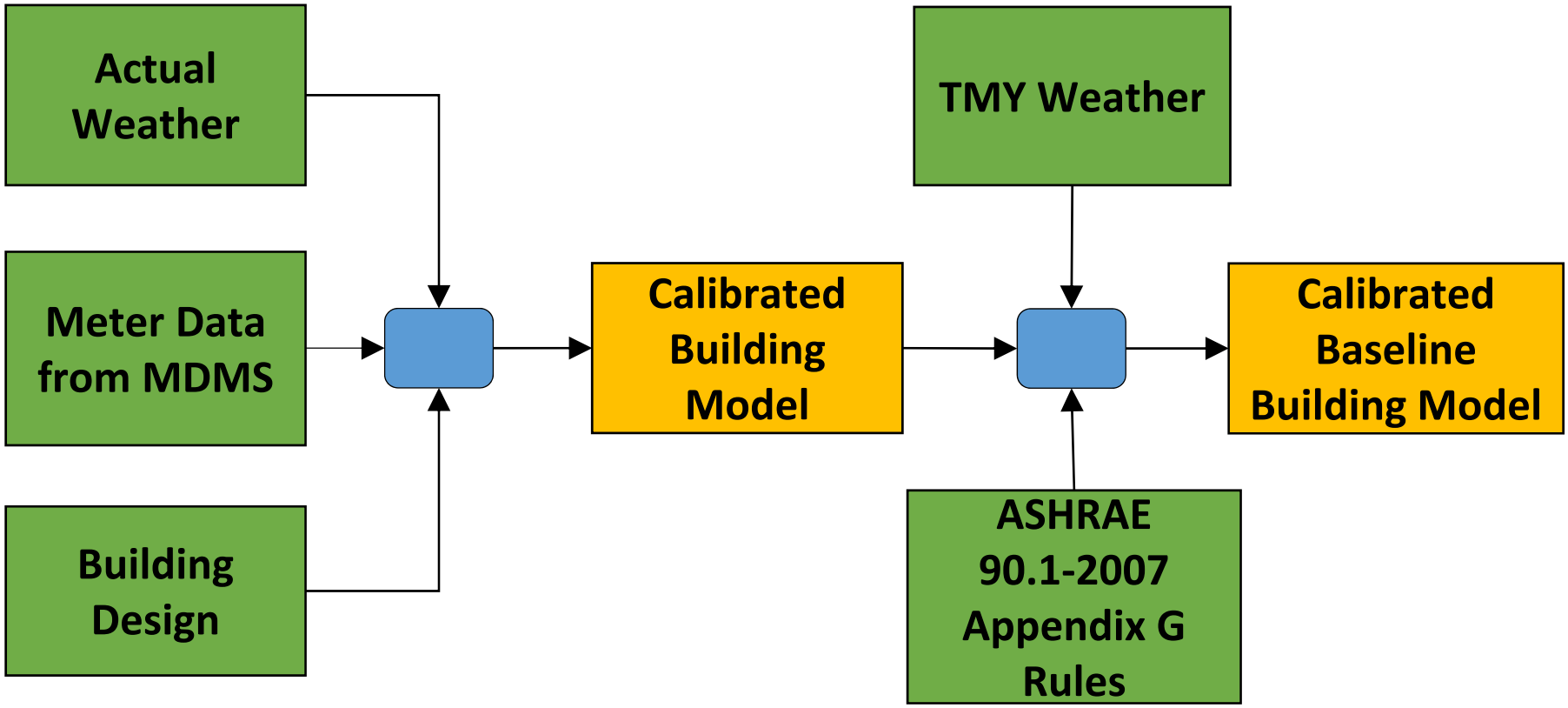
Data for Calibration

- Buildings with “best” monthly data are chosen for calibration—some judgement required



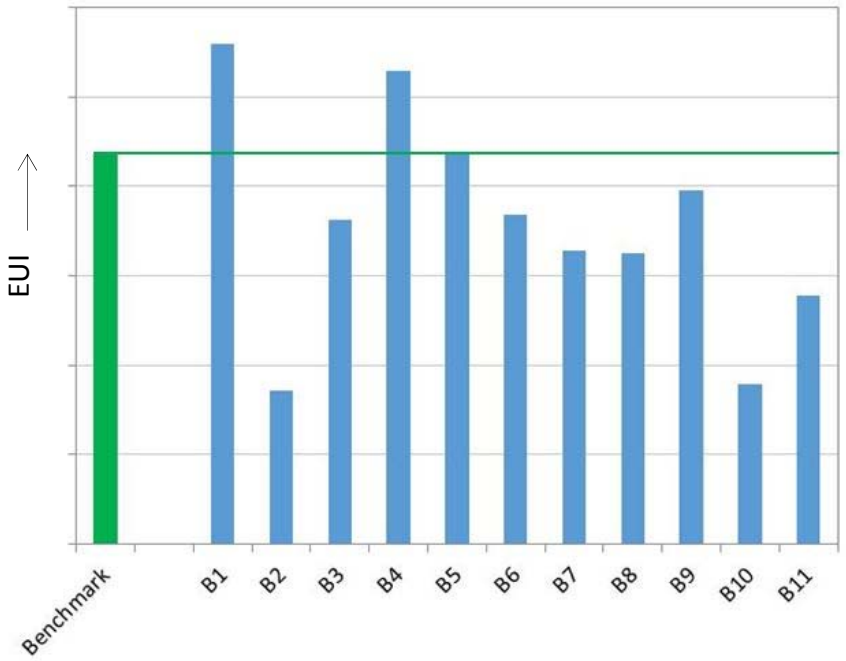
Recalibrating Building Models

- Building operation is taken into account when creating the baseline

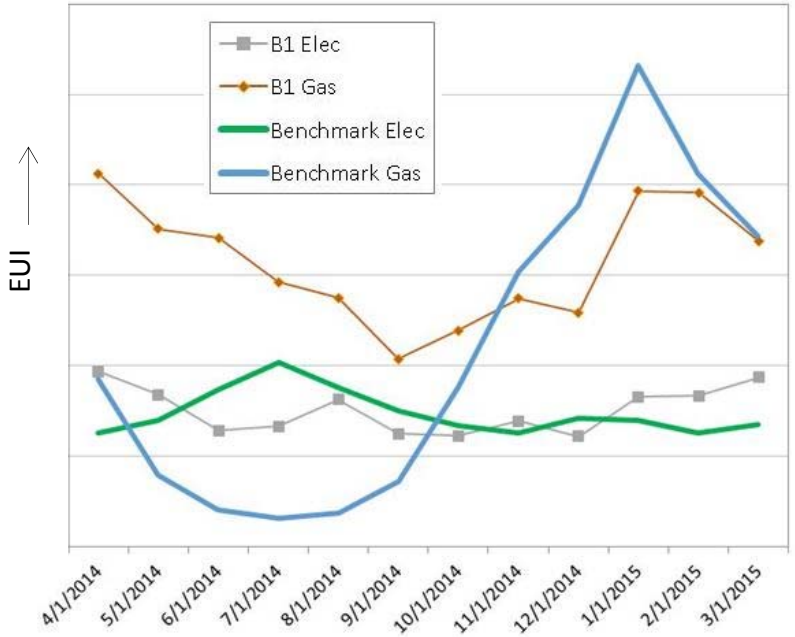


Calibrated vs Actual Consumption

- The “calibrated” baseline can be compared against actual building consumption to determine buildings requiring further inspection



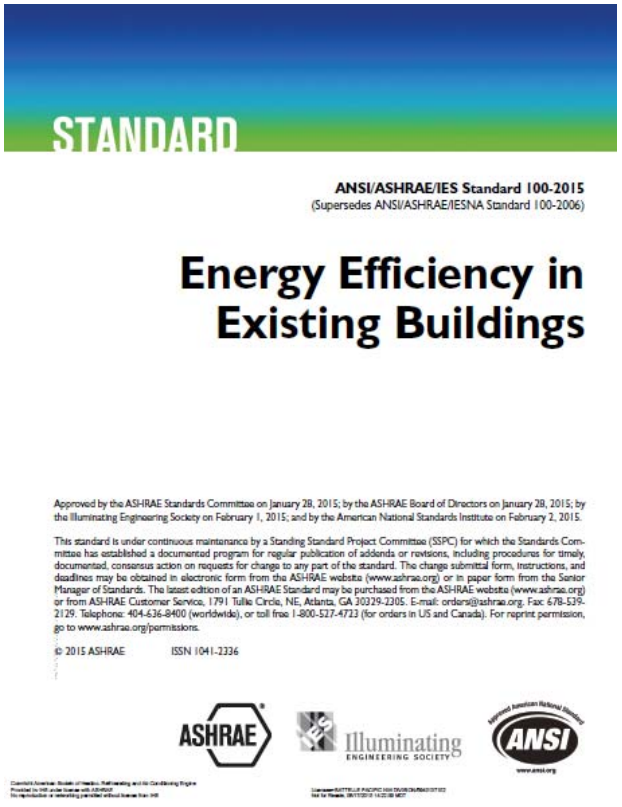
(a) Annual EUI Comparison



(b) Monthly EUI Comparison

ASHRAE Standard 100

- ASHRAE Standard 100 targets are used for buildings *not* included in the study


STANDARD

ANSI/ASHRAE/IES Standard 100-2015
(Supersedes ANSI/ASHRAE/IESNA Standard 100-2006)

Energy Efficiency in Existing Buildings

Approved by the ASHRAE Standards Committee on January 28, 2015; by the ASHRAE Board of Directors on January 28, 2015; by the Illuminating Engineering Society on February 1, 2015; and by the American National Standards Institute on February 2, 2015.

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ASHRAE Illuminating Engineering Society ANSI

Table 7-2

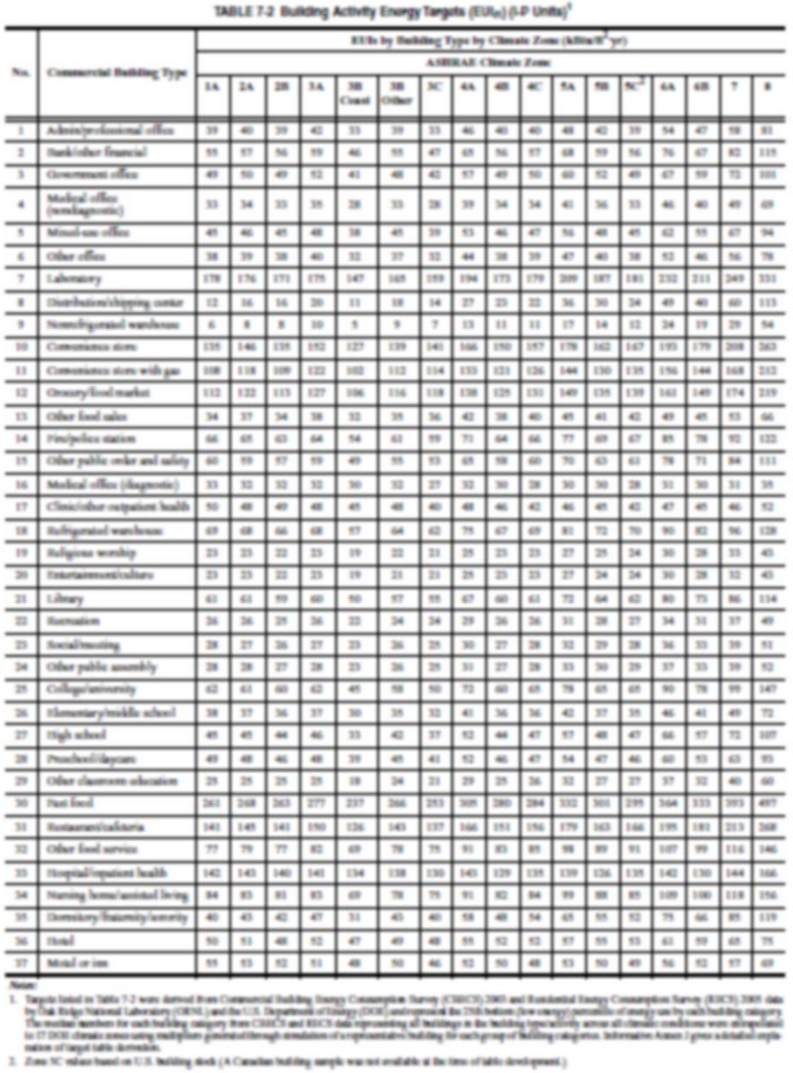


TABLE 7-2 Building Activity Energy Targets (EUI_{BA}) (I-P Units)[1]

No.	Commercial Building Type	EUIs by Building Type by Climate Zone (kBtu/ft²·yr)															
		ASHRAE Climate Zone															
		1A	2A	2B	3A	3B Coast	3B Other	3C	4A	4B	4C	5A	5B	5C[2]	6A	6B	7	8
1	Admin/professional office	39	40	39	42	33	39	33	46	40	40	48	42	39	54	47	58	81
2	Bank/other financial	55	57	56	59	46	55	47	65	56	57	68	59	56	76	67	82	115
3	Government office	49	50	49	52	41	48	42	57	49	50	60	52	49	67	59	72	101
4	Medical office (nondiagnostic)	33	34	33	35	28	33	28	39	34	34	41	36	33	46	40	49	69
5	Mixed-use office	45	46	45	48	38	45	39	53	46	47	56	48	45	62	55	67	94
6	Other office	38	39	38	40	32	37	32	44	38	39	47	40	38	52	46	56	79
7	Laboratory	178	176	171	175	147	165	159	194	173	179	209	187	181	232	211	249	351
8	Distribution/shipping center	12	16	16	20	11	18	14	27	23	22	36	30	24	49	40	60	113
9	Nonrefrigerated warehouse	6	8	8	10	5	9	7	13	11	11	17	14	12	24	19	29	54
10	Convenience store	135	140	135	152	127	139	140	166	150	157	178	162	147	193	179	208	263
11	Convenience store with gas	108	118	109	122	102	112	114	133	121	126	144	130	135	156	144	168	212
12	Grocery/food market	132	132	133	127	106	116	118	138	125	131	149	135	139	161	149	174	219
13	Other food sales	34	37	34	38	32	35	36	42	38	40	45	41	42	49	45	53	66
14	Fire/police station	66	65	63	64	54	61	59	71	64	66	77	69	67	85	78	92	122
15	Other public order and safety	60	59	57	59	49	55	53	65	59	60	70	63	61	78	71	84	111
16	Medical office (diagnostic)	33	32	32	32	30	32	27	32	30	28	30	30	28	31	30	31	35
17	Clinic/other outpatient health	50	48	49	48	45	48	40	48	46	42	46	45	42	47	45	46	52
18	Refrigerated warehouse	69	68	66	68	57	64	62	75	67	69	81	72	70	90	82	96	128
19	Religious worship	23	23	22	23	19	22	21	25	23	23	27	25	24	30	28	33	45
20	Entertainment/culture	23	23	22	23	19	21	21	25	23	23	27	24	24	30	28	32	43
21	Library	61	61	59	60	50	57	55	67	60	61	72	64	62	80	73	86	114
22	Recreation	26	26	25	26	22	24	24	29	26	26	31	28	27	34	31	37	49
23	Social/meeting	28	27	26	27	23	26	25	30	27	28	32	29	28	36	33	39	51
24	Other public assembly	28	28	27	28	23	26	25	31	27	28	33	30	29	37	33	39	52
25	College/university	62	61	60	62	48	58	50	72	60	65	78	65	65	90	78	99	147
26	Elementary/middle school	38	37	36	37	30	35	32	41	36	36	42	37	35	46	41	49	72
27	High school	45	45	44	46	33	42	37	52	44	47	57	48	47	66	57	72	107
28	Preschool/daycare	49	48	46	48	39	45	41	52	46	47	54	47	46	60	53	63	93
29	Other classroom education	25	25	25	25	18	24	21	29	25	26	32	27	27	37	32	40	60
30	Fast food	261	268	263	277	237	266	253	305	280	284	332	301	295	364	333	393	497
31	Restaurant/cafeteria	141	145	141	150	126	143	137	166	151	156	179	163	166	195	181	213	268
32	Other food service	77	79	77	82	69	78	75	91	83	85	98	89	91	107	99	116	146
33	Hospital/inpatient health	142	143	140	141	134	138	130	143	129	135	139	126	135	142	130	144	166
34	Nursing home/assisted living	84	85	83	85	69	78	75	91	82	84	99	88	89	109	100	118	156
35	Dormitory/fraternity/sorority	40	43	42	47	31	40	40	58	48	54	65	55	52	75	66	85	119
36	Hotel	50	51	48	52	47	49	48	55	52	52	57	55	53	61	59	65	75
37	Motel or inn	55	53	52	51	48	50	46	52	50	48	53	50	49	56	52	57	69

Notes:
1. Targets listed in Table 7-2 were derived from Commercial Building Energy Consumption Survey (CBECS) 2003 and Residential Energy Consumption Survey (RECS) 2005 data by Oak Ridge National Laboratory (ORNL) and the U.S. Department of Energy (DOE) and represent the 25th bottom (low energy) percentile of energy use by each building category. The median numbers for each building category from CBECS and RECS data representing all buildings in the building type/activity across all climatic conditions were extrapolated to 17 DOE climate zones using multipliers generated through simulation of a representative building for each group of building categories. Informative Annex J gives a detailed explanation of target table derivation.
2. Zone 5C values based on U.S. building stock (A Canadian building sample was not available at the time of table development.)

Army EUIs – An Example

- Draft EUI tables developed for design requirements for Army facilities
- Develop EUI data to adapt to MDMS format to show targets on screen.
  - Currently working on mock-ups for implementation
  - Live demo “soon”

Buildings Pre-2008 - *Example*

ASHRAE Std 100 Values Table 7-2 Building Activity Energy Targets

“A” for Army Specific values by CAT Code

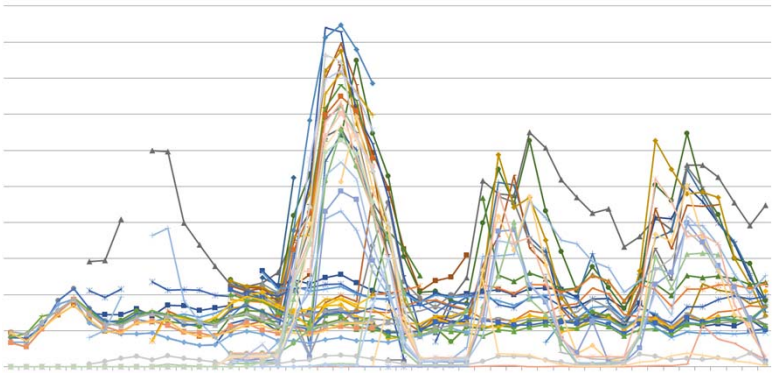
Calibrated Baseline

EUIs by Building Type by C
ASHRAE Clir

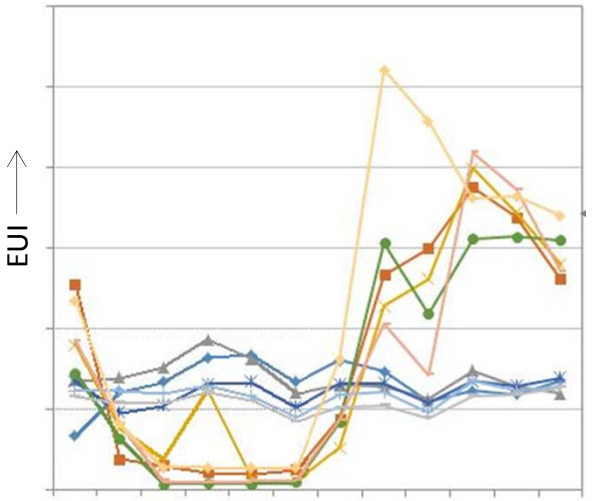
ASHRAE 100 No.	Commercial/Army Building Type	Army Category Code	1A	2A	2B	3A	3 Co
1	Admin/professional office		39	40	39	42	3
1A	Company Operations Facility	14185	35	39	36	41	
3	Government Office		49	50	49	52	4
3A	Brigade Headquarters	14182	74	72	69	71	6
5	Mixed-use office		45	46	45	48	3
6	Other Office		38	39	38	40	3
30	Fast Food		261	268	263	277	23
30A	Dining Facility	72210	390	401	390	402	34
31	Restaurant/cafeteria		141	145	141	150	12
32	Other food services		77	79	77	82	6
35	Dormitory/fraternity/sorority		40	43	42	47	3

Summary

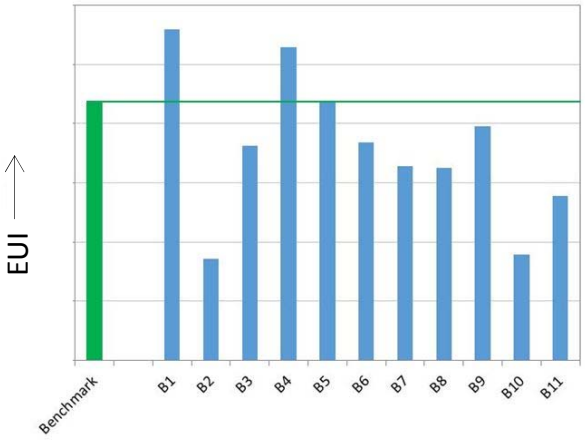
- Used performance data to develop performance targets



Data collection



Data Processing



Modeling and Target Development

Questions?

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