

APPENDIX 7-D. WEATHER DATA AND TEMPERATURE PARAMETERS

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APPENDIX 7-D. WEATHER DATA AND TEMPERATURE PARAMETERS

7-D.1 INTRODUCTION

The temperatures for water heater thermostat setpoint, inlet water temperature, and temperature of the air surrounding the water heater are based on the average annual outdoor air temperature, for each sample household. The outdoor air temperature for the households in the water heater RECS sample is not directly available. Similarly, the inlet water temperature is not available for the sample. This appendix describes DOE's approach to develop data for these two parameters.

7-D.2 OUTDOOR TEMPERATURE DERIVATION

RECS 2005 provides data on heating and cooling degree-days but not air temperatures for each household in the sample. To derive the outdoor air temperatures for the households in the RECS sample, DOE developed an approach to assign a physical location to each RECS household. The following steps were performed:

1. DOE assembled weather data from 282 weather stations that provide annual average outdoor air temperatures.^{1, 2} The annual average outdoor air temperatures represent 30-year averages. DOE also gathered the heating and cooling degree-days at base temperature 65°F for year 2005 for these weather stations.³ The 2005 heating and cooling degree days match the period used to determine the degree-days in RECS 2005.
2. RECS reports both heating degree-days (HDD) and cooling degree-days (CDD) to base temperature 65°F for each housing record. DOE assigned each RECS household to one of the 282 weather stations by calculating which weather station (within the appropriate census region or large state) gave the best linear least squares fit of the RECS data to the weather data.

Figure 7-D.2.1 and Figure 7-D.2.2 show the relationship between the gathered mean temperature values and the HDD and CDD values.

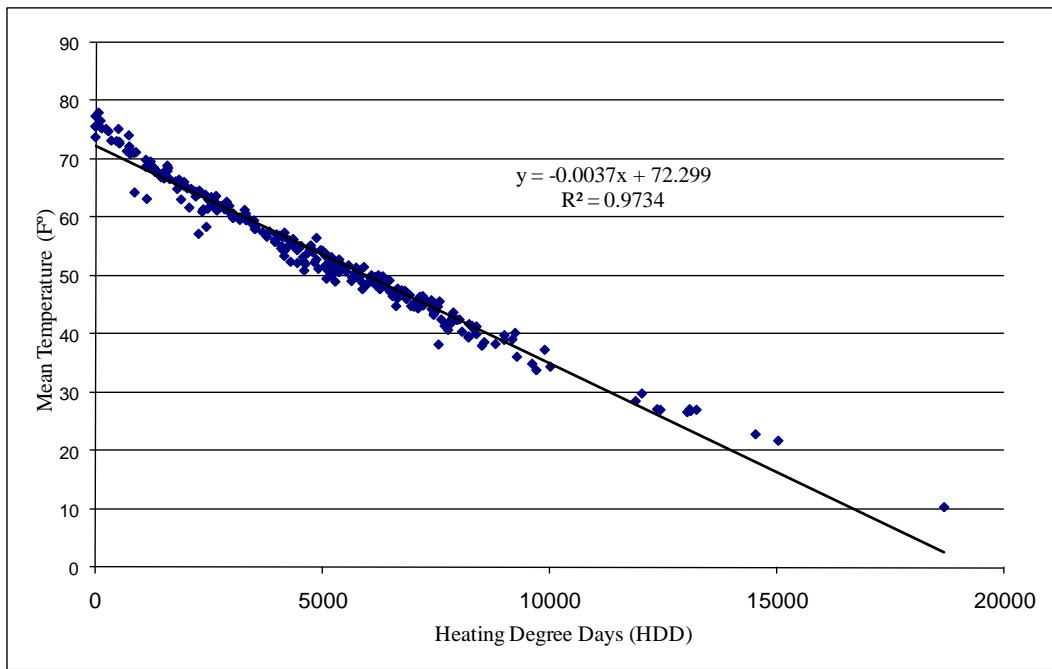


Figure 7-D.2.1 Heating Degree Days (HDD) Versus Mean Temperature

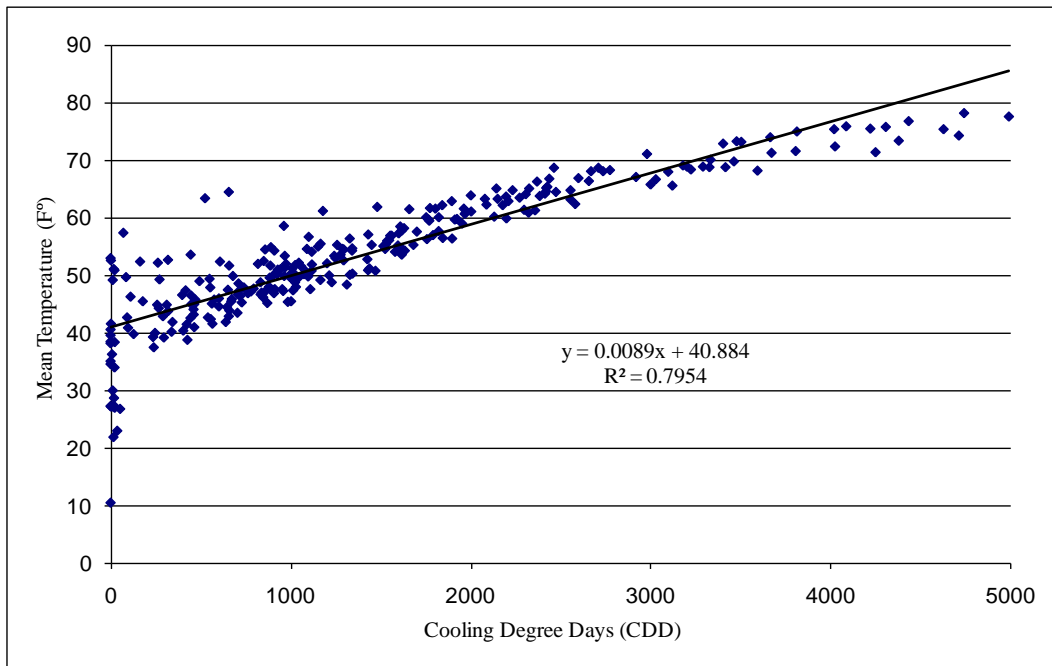


Figure 7-D.2.2 Cooling Degree Days (CDD) Versus Mean Temperature

7-D.2.2 Imputation Method

To calculate the mean outdoor air temperature, DOE matched the RECS 2005 combinations (255 individual combinations of census divisions plus 4 large states, together with the HDD and CDD data) to U.S. weather data. DOE used the U.S. weather station closest (or with minimum “distance”) from the RECS 2005 data combination. The following equation calculates the “distance” between the U.S. weather data and RECS 2005 data:

$$\text{Distance} = \sqrt{(HDD_2 - HDD_1)^2 + (CDD_2 - CDD_1)^2}$$

Where:

- HDD_1 = heating degree days from U.S. weather data,
- HDD_2 = heating degree days from RECS 2005 data,
- CDD_1 = cooling degree days from U.S. weather data, and
- CDD_2 = cooling degree days from RECS 2005 data.

Figure 7-D.2.3 and Figure 7-D.2.4 show the relationship between the imputed mean outdoor air temperature values and the RECS 2005 HDD values.

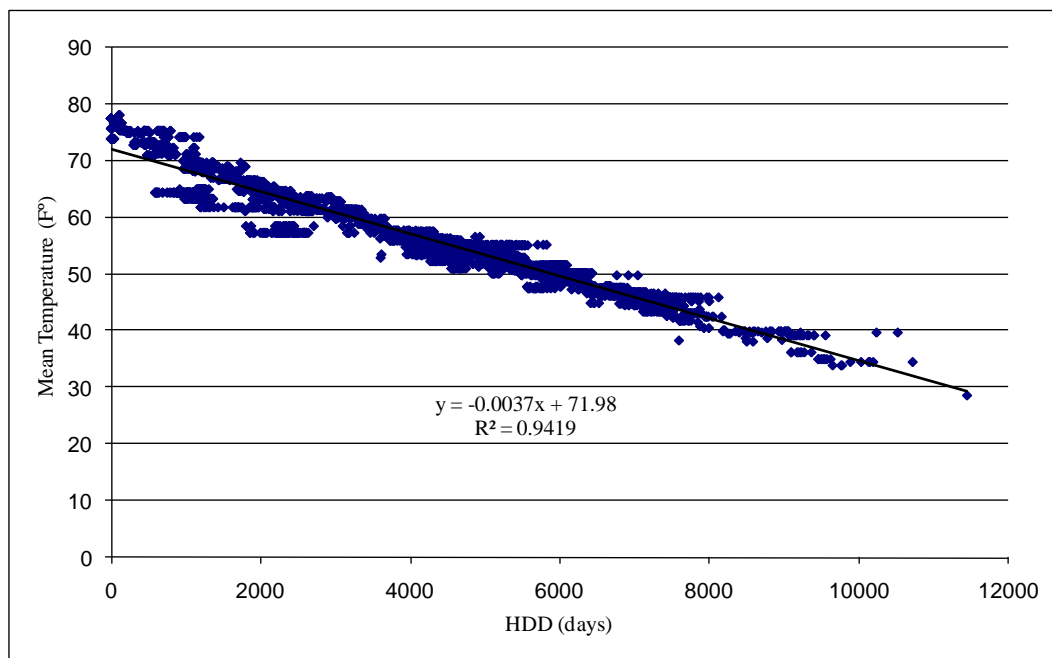


Figure 7-D.2.3 Heating Degree Days (HDD) Versus Imputed Mean Temperature Values

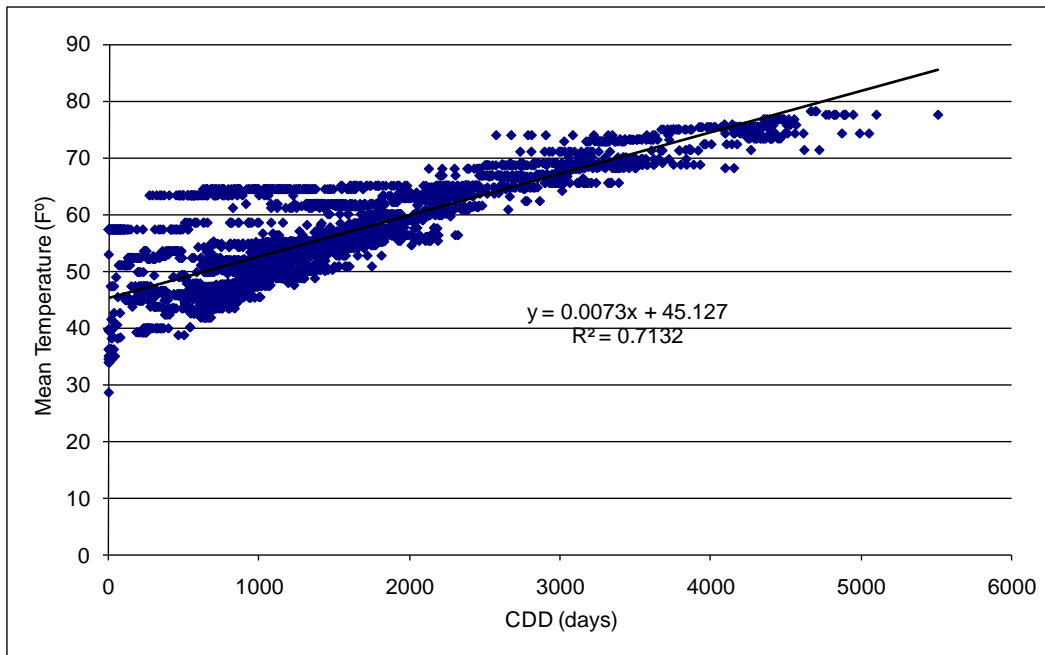


Figure 7-D.2.4 Cooling Degree Days (CDD) Versus Imputed Mean Temperature Values

Table 7-D.2.1 shows the imputation results for all RECS locations. Note that some weather station data matches with several of the RECS 2005 255 HDD & CDD combinations. Table 7-D.2.2 shows a subset of the data matches.

Table 7-D.2.1 Weather Station Data

Station Location		Code	Mean Temp	HDD (2005)	CDD (2005)
State	City				
AK	KODIAK	BDL	50.2	6219	1003
AK	KING SALMON	BDR	52.1	5361	1046
AK	ANCHORAGE	BOS	51.6	5902	888
AK	BETHEL	ORH	47.2	6670	714
AK	BIG DELTA	CAR	39.2	9166	236
AK	BARROW	HUL	39.9	8989	247
AK	BETTLES	PWM	45.7	7218	471
AK	COLD BAY	CON	45.9	7385	602
AK	FAIRBANKS	MWN	27.2	13063	0
AK	GULKANA	PVD	51.1	5824	1010
AK	HOMER	BTB	45.2	7425	729
AK	JUNEAU	ACY	53.5	5109	1278
AK	MCGRATH	EWR	54.5	4949	1526
AK	NOME	ABE	50.6	5704	1085
AK	KOTZEBUE	CXY	53.3	5187	1243
AK	ST PAUL ISLAND	ERI	50.0	6318	907
AK	TALKEETNA	IPT	49.8	6038	965

AK	UNALAKLEET	PHL	55.3	4735	1530
AK	VALDEZ	PIT	50.9	5765	929
AK	YAKUTAT	MLI	50.2	5750	1344
AL	BIRMINGHAM	ORD	49.1	6076	1166
AL	HUNTSVILLE	PIA	50.8	5514	1431
AL	MONTGOMERY	RFD	47.9	6421	1030
AL	MOBILE	SPI	52.7	5168	1427
AL	MUSCLE SHOALS	EVV	56.0	4317	1548
AL	TUSCALOOSA	FWA	49.9	6153	1008
AR	FORT SMITH	IND	52.5	5263	1295
AR	FAYETTEVILLE	SBN	49.5	6243	1044
AR	LITTLE ROCK	ANJ	40.1	8375	339
AZ	DOUGLAS	APN	42.5	7941	444
AZ	FLAGSTAFF	DTW	49.7	6189	1098
AZ	WINSLOW	FNT	46.8	6906	763
AZ	PHOENIX	GRR	47.6	6642	891
AZ	TUCSON	HTL	43.1	7858	462
AZ	YUMA	LAN	46.8	6585	908
CA	BAKERSFIELD	MKG	47.1	6583	780
CA	BLYTHE	SAW	38.7	8548	427
CA	EUREKA	CAK	49.5	6215	884
CA	FRESNO	CLE	49.6	6067	997
CA	LOS ANGELES	CMH	52.9	5355	1250
CA	MT SHASTA	CVG	54.2	4981	1342
CA	PASO ROBLES	DAY	51.5	5730	1059
CA	REDDING	FDY	50.2	6067	1020
CA	SACRAMENTO	MFD	48.7	6320	833
CA	SAN DIEGO	TOL	49.5	6210	1031
CA	STOCKTON	YNG	48.5	6328	711
CA	SAN FRANCISCO	GRB	44.4	7392	647
CO	ALAMOSA	LSE	47.3	6754	1014
CO	COLORADO SPRINGS	MKE	47.5	6612	954
CO	DENVER	MSN	46.1	6837	848
CO	GRAND JUNCTION	ALO	47.2	6845	862
CO	PUEBLO	DBQ	46.9	6791	839
CO	TRINIDAD	DSM	50.0	5817	1330
CT	HARTFORD	SUX	48.3	6189	1313
CT	BRIDGEPORT	CNK	53.5	5057	1618
DC	WASHINGTON	DDC	55.2	4488	1683
DE	WILMINGTON	GLD	50.7	5353	1117
FL	DAYTONA BEACH	ICT	56.4	4342	1846
FL	KEY WEST	TOP	54.3	4803	1627
FL	FT LAUDERDALE	DLH	39.1	8985	296
FL	FORT MYERS	INL	37.4	9876	240

FL	GAINESVILLE	MSP	45.4	7003	1003
FL	JACKSONVILLE	RST	43.4	7434	705
FL	ORLANDO	STC	41.8	7797	640
FL	MIAMI	COU	54.0	4663	1581
FL	WEST PALM BEACH	MCI	54.2	4777	1635
FL	PENSACOLA	SGF	56.2	4254	1758
FL	TALLAHASSEE	STL	56.3	4352	1898
FL	TAMPA	BIS	42.3	7795	557
FL	VERO BEACH	DIK	41.8	8215	344
GA	ALBANY	FAR	41.5	8283	566
GA	AUGUSTA	GFK	40.3	9227	404
GA	ATHENS	ISN	40.9	8326	465
GA	ATLANTA	JMS	41.4	8376	423
GA	WAYCROSS	BFF	47.8	6254	741
GA	BRUNSWICK	GRI	49.9	5748	1215
GA	COLUMBUS	LBF	48.7	6228	1025
GA	MACON	LNK	51.1	5762	1439
GA	SAVANNAH	OFK	48.7	5979	1229
HI	HONOLULU-OAHU	OMA	50.7	5749	1472
HI	HILO-HAWAII	VTN	47.2	6558	959
HI	LIHUE-KAUAI	ABR	43.8	7868	660
HI	KAHULUI-MAUI	ATY	42.8	7847	657
IA	WATERLOO	FSD	45.1	6999	871
IA	DUBUQUE	HON	45.3	7173	985
IA	DES MOINES	PIR	47.5	6802	1110
IA	SIOUX CITY	RAP	46.6	6533	834
ID	BOISE	DCA	57.5	4154	1702
ID	LEWISTON	ILG	54.4	4991	1296
ID	POCATELLO	ABY	66.3	1763	2658
IL	MOLINE	AGS	63.2	2475	2151
IL	CHICAGO	AHN	61.5	2841	1805
IL	PEORIA	ATL	62.1	2754	1843
IL	ROCKFORD	AYS	66.7	1630	2438
IL	SPRINGFIELD	BQK	68.6	1596	2464
IN	EVANSVILLE	CSG	65.1	2019	2421
IN	FORT WAYNE	MCN	63.7	2202	2385
IN	INDIANAPOLIS	SAV	66.2	1948	2370
IN	SOUTH BEND	BWI	54.6	4714	1343
KS	CONCORDIA	SBY	56.6	4858	1101
KS	DODGE CITY	AVL	54.8	4083	891
KS	GOODLAND	CLT	61.4	3279	1660
KS	WICHITA	GSO	58.1	3504	1631
KS	TOPEKA	HAT	62.8	2884	1896
KY	BOWLING GREEN	ILM	63.8	2650	2002

KY	JACKSON	RDU	59.6	3314	1913
KY	LEXINGTON	CAE	63.6	2545	2198
KY	PADUCAH	CHS	65.3	2003	2427
KY	LOUISVILLE	GSP	60.0	3024	1754
LA	BATON ROUGE	LYH	55.4	4375	1167
LA	LAKE CHARLES	ORF	59.6	3484	1767
LA	LAFAYETTE	RIC	57.6	3674	1823
LA	NEW ORLEANS	ROA	56.3	3948	1329
LA	SHREVEPORT	BKW	51.6	5360	659
MA	BOSTON	CRW	54.5	4436	1289
MA	WORCESTER	EKN	49.8	5644	680
MD	BALTIMORE	HTS	55.0	4375	1516
MD	SALISBURY	MRB	54.0	5044	1118
ME	CARIBOU	BHM	62.2	2587	2089
ME	HOULTON	HSV	60.6	3007	1968
ME	PORTLAND	MGM	65.0	2104	2326
MI	SAULT ST MARIE	MOB	66.8	1507	2600
MI	ALPENA	MSL	61.0	2956	2004
MI	DETROIT	TCL	64.0	2416	2307
MI	FLINT	BWG	57.2	3980	1601
MI	GRAND RAPIDS	JKL	55.9	3946	1537
MI	HOUGHTON LAKE	LEX	55.2	4525	1451
MI	LANSING	PAH	56.8	4145	1554
MI	MUSKEGON	SDF	56.9	4085	1792
MI	MARQUETTE	JAN	64.1	2257	2414
MN	DULUTH	MEI	64.7	2283	2234
MN	INT'L FALLS	TUP	61.3	2669	2298
MN	MINNEAPOLIS	BNA	58.9	3459	1954
MN	ROCHESTER	CHA	60.0	3140	1824
MN	SAINT CLOUD	CSV	54.5	4166	1091
MO	COLUMBIA	MEM	62.3	2629	2582
MO	KANSAS CITY	MKL	59.4	3443	1771
MO	SPRINGFIELD	TRI	54.9	4201	1153
MO	SAINT LOUIS	TYS	58.4	3517	1610
MS	JACKSON	FSM	61.2	2920	2359
MS	MERIDIAN	FYV	57.7	3825	1619
MS	TUPELO	LIT	62.1	2941	2179
MT	BILLINGS	BTR	67.0	1443	2920
MT	CUT BANK	LCH	67.9	1312	3099
MT	KALISPELL	LFT	68.3	1292	3225
MT	GLASGOW	MSY	68.8	1102	3203
MT	GREAT FALLS	SHV	65.7	1868	3001
MT	HELENA	HBR	59.8	3379	2200
MT	MILES CITY	OKC	60.1	3178	2132

MT	MISSOULA	TUL	60.8	3303	2323
NC	ASHEVILLE	DUG	61.5	2369	1963
NC	CHARLOTTE	FLG	46.2	6634	111
NC	GREENSBORO	INW	55.2	4096	1259
NC	CAPE HATTERAS	PHX	74.2	732	4714
NC	WILMINGTON	TUS	68.7	1207	3417
NC	RALEIGH DURHAM	YUM	75.3	504	4629
ND	BISMARCK	ALS	40.8	7751	97
ND	DICKINSON	COS	47.8	5870	554
ND	FARGO	DEN	50.1	5730	925
ND	GRAND FORKS	GJT	51.8	5047	1119
ND	WILLISTON	PUB	51.7	5217	1026
ND	JAMESTOWN	TAD	51.0	5110	945
NE	SCOTTSBLUFF	BOI	51.9	5424	975
NE	GRAND ISLAND	LWS	52.4	4814	851
NE	NORTH PLATTE	PIH	46.5	7131	398
NE	LINCOLN	BIL	47.4	6560	652
NE	NORFOLK	CTB	39.7	8206	128
NE	OMAHA	FCA	42.6	7603	92
NE	VALENTINE	GGW	42.6	8000	541
NH	CONCORD	GTF	43.7	7443	320
NH	MT WASHINGTON	HLN	44.0	7478	461
NJ	ATLANTIC CITY	MLS	46.3	7217	720
NJ	NEWARK	MSO	44.8	7527	312
NM	ALBUQUERQUE	ABQ	56.8	3767	1562
NM	CLAYTON	CAO	53.3	4563	968
NM	CARLSBAD	CNM	62.8	2619	2211
NM	ROSWELL	ROW	60.8	3028	1974
NV	ELKO	EKO	46.4	7169	448
NV	ELY	ELY	44.8	7001	259
NV	LAS VEGAS	LAS	68.1	1582	3595
NV	LOVELOCK	LOL	50.1	5181	1075
NV	RENO	RNO	51.3	4900	970
NV	WINNEMUCCA	WMC	49.3	6464	550
NY	ALBANY	SLC	52.0	5321	1203
NY	WATERTOWN	CPR	44.9	6939	465
NY	BINGHAMTON	CYS	44.9	6610	449
NY	BUFFALO	LND	45.0	7203	563
NY	NEW YORK	RKS	42.8	7849	291
NY	ROCHESTER	SHR	44.5	7091	602
NY	SYRACUSE	WRL	45.4	7214	671
NY	UTICA	ADQ	40.5	8058	0
OH	AKRON CANTON	AKN	34.5	10001	0
OH	CLEVELAND	ANC	36.2	9265	8

OH	COLUMBUS	BET	29.9	12013	12
OH	CINCINNATI	BIG	28.6	11876	19
OH	DAYTON	BRW	10.4	18659	0
OH	FINDLAY	BTT	22.9	14513	37
OH	MANSFIELD	CDB	38.4	8794	0
OH	TOLEDO	FAI	26.7	13011	53
OH	YOUNGSTOWN	GKN	27.1	12420	2
OK	HOBART	HOM	38.1	8496	0
OK	OKLAHOMA CITY	JNU	41.5	7676	2
OK	TULSA	MCG	26.9	13086	23
OR	ASTORIA	OME	27.1	13214	12
OR	BAKER	OTZ	21.8	15012	16
OR	BURNS	SNP	35.0	9601	0
OR	EUGENE	TKA	33.9	9692	22
OR	MEDFORD	UNK	27.2	12349	21
OR	NORTH BEND	VWS	38.3	7542	23
OR	PENDLETON	YAK	39.5	8201	0
OR	PORTLAND	HNL	77.5	0	4992
OR	SALEM	ITO	73.9	0	3666
PA	ALLENTOWN	LIH	75.7	0	4308
PA	HARRISBURG	OGG	75.8	0	4088
PA	ERIE	AST	51.0	4588	18
PA	WILLIAMSPORT	BKE	45.4	7453	179
PA	PHILADELPHIA	BNO	44.2	7450	268
PA	PITTSBURGH	EUG	52.1	4612	263
RI	PROVIDENCE	MFR	54.4	4133	859
SC	COLUMBIA	OTH	52.5	4288	2
SC	CHARLESTON	PDT	52.3	5258	608
SC	GREENVILLE	PDX	53.5	4150	445
SD	ABERDEEN	SLE	52.6	4574	319
SD	WATERTOWN	ALW	54.2	4770	910
SD	SIOUX FALLS	BLI	50.8	5269	22
SD	HURON	EAT	51.9	5562	819
SD	PIERRE	GEG	47.3	6485	417
SD	RAPID CITY	OLM	49.6	5078	86
TN	NASHVILLE	SEA	52.3	4437	164
TN	CHATTANOOGA	UIL	49.1	5272	12
TN	CROSSVILLE	YKM	48.9	5867	494
TN	MEMPHIS	ALB	47.5	6607	913
TN	JACKSON	ART	45.7	7565	576
TN	BRISTOL	BGM	45.8	7089	674
TN	KNOXVILLE	BUF	47.9	6644	880
TX	ABILENE	LGA	55.1	4707	1597
TX	WACO	ROC	47.6	6735	795

TX	ALICE	SYR	47.4	6636	909
TX	AMARILLO	UCA	46.6	7195	709
TX	AUSTIN	BFL	65.0	1797	2144
TX	BROWNSVILLE	BLH	71.3	889	4251
TX	CORPUS CHRISTI	EKA	52.9	4857	0
TX	DALLAS FT WORTH	FAT	63.2	1881	2080
TX	DEL RIO	LAX	63.3	1128	525
TX	EL PASO	MHS	49.2	5629	272
TX	GALVESTON	PRB	58.5	2437	963
TX	HOUSTON	RDD	61.6	2466	1775
TX	LUBBOCK	SAC	61.1	2345	1180
TX	MIDLAND ODESSA	SAN	64.4	858	657
TX	SAN ANTONIO	SCK	61.8	2061	1482
TX	SAN ANGELO	SFO	57.3	2267	71
TX	WICHITA FALLS	ABI	64.4	2316	2475
TX	VICTORIA	ACT	66.6	1837	3030
UT	SALT LAKE CITY	ALI	72.3	743	4026
VA	LYNCHBURG	AMA	57.0	4045	1432
VA	NORFOLK	AUS	69.0	1578	3181
VA	RICHMOND	BRO	73.3	346	4380
VA	ROANOKE	CRP	71.5	690	3807
VT	BURLINGTON	DFW	65.5	1953	3122
WA	WALLA WALLA	DRT	69.7	1210	3464
WA	BELLINGHAM	ELP	64.7	2146	2556
WA	WENATCHEE	GLS	71.2	848	3673
WA	SPOKANE	IAH	68.8	1221	3292
WA	OLYMPIA	LBB	59.7	3173	1925
WA	SEATTLE TACOMA	MAF	63.4	2604	2273
WA	QUILLAYUTE	SAT	68.7	1277	3328
WA	YAKIMA	SJT	64.5	2209	2420
WI	GREEN BAY	SPS	63.1	2597	2556
WI	LACROSSE	VCT	70.0	1108	3334
WI	MILWAUKEE	DAB	71.0	763	2981
WI	MADISON	EYW	78.1	68	4743
WV	BECKLEY	FLL	75.4	135	4222
WV	CHARLESTON	FMY	74.9	284	3814
WV	ELKINS	GNV	68.6	1193	2711
WV	HUNTINGTON	JAX	68.0	1358	2670
WV	MARTINSBURG	MCO	72.8	527	3404
WY	CASPER	MIA	76.7	109	4435
WY	CHEYENNE	PBI	75.3	232	4021
WY	LANDER	PNS	68.2	1305	2775
WY	ROCK SPRINGS	TLH	68.0	1520	2737
WY	SHERIDAN	TPA	73.1	522	3505

WY	WORLAND	VRB	73.2	463	3479
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Table 7-D.2.2 Subset of Data Matches

Location	DOE ID	HDD	CDD	Division
BOS	2977	5771	839	1
BOS	43	5788	900	1
BOS	396	5791	834	1
BOS	703	5796	833	1
BOS	2389	5817	828	1
BOS	1470	5874	894	1
BOS	385	5874	894	1
BOS	4354	5879	902	1
BOS	3952	5885	876	1
BOS	1529	5899	888	1
BOS	2381	5911	885	1
BOS	825	5913	894	1
BOS	2005	5922	880	1
BOS	2064	5931	801	1
BOS	4040	5933	879	1
BOS	1428	5933	879	1
BOS	535	5951	884	1
BOS	894	5956	873	1
BOS	2211	5958	873	1
BOS	1548	5959	873	1
BOS	3239	5965	871	1
BOS	620	5968	864	1
BOS	2533	5975	853	1
BOS	697	5979	865	1
BOS	4067	5980	865	1
BOS	3506	5983	866	1
BOS	1369	5994	864	1
BOS	4113	5994	932	1
BOS	1726	5997	861	1
BOS	1671	5998	861	1
BOS	328	6012	918	1
BOS	3790	6018	856	1
BOS	3890	6020	841	1
BOS	2587	6024	854	1
BOS	281	6028	839	1
BOS	87	6028	855	1
BOS	1440	6052	847	1
BOS	2152	6057	832	1
BOS	4140	6059	831	1
BOS	2949	6061	845	1
BOS	675	6062	876	1
BOS	1079	6071	843	1
BOS	178	6072	801	1
BOS	2487	6072	842	1
BOS	3111	6084	825	1
BOS	1797	6097	821	1
BOS	3333	6107	694	1

7-D.3 INLET WATER TEMPERATURE

The daily hot water use and the water heater energy use depend on average inlet water temperature. The inlet water comes to the water heater either from a municipal treatment plant or from ground well sources. DOE determined the water source using RECS 2005, which provides information about households in the sample with a well. Households without a well presumably use water from municipal treatment plants.

DOE derived the inlet water temperature using an approach developed by the National Renewable Energy Laboratory.^{4, 5}

$$T_{mains} = (T_{air,avg} + offset) + ratio * \left(\frac{\Delta T_{air,max}}{2} \right) * \sin(0.986 * (30 * month\# - 30 - lag) - 90)$$

Where:

T_{mains} =	mains (supply) temperature to domestic hot water tank, °F,
$T_{air,avg}$ =	annual average outdoor air temperature, °F,
$\Delta T_{air,max}$ =	maximum difference between monthly average outdoor air temperatures (i.e. $\text{MAX}(T_{air,month}) - \text{MIN}(T_{air,month})$), °F,
0.986 =	degrees/day (360/365),
$month\#$ =	number of month of the year (e.g. January = 1),
$offset$ =	given by a distribution of values as shown below, °F,
$ratio$ =	$0.4 + 0.01 \times (T_{amb,avg} - 44)$, and
lag =	$35 - 1.0 \times (T_{amb,avg} - 44)$, °F.

DOE calculated the offset term separately for the households using municipal treatment plants and ground well sources.

For households with wells DOE calculated offset value using a triangular distribution with min value of 0, average value of 2, and maximum value of 4.

The municipal plants offset was calculated using typical long-term water temperature average values for households with water coming from municipal treatment plants, as well as annual air temperature data, and population by state for 75 cities.^{1,2,6,7} The difference between these two averages was then calculated. The average population weighted average offset was calculated to be 3.72 with a standard deviation of 5.94. These values were used in the LCC spreadsheet to create a normal distribution for the offset (See Table 7-D.3.1).

Table 7-D.3.1 Calculation of Water Inlet Offset for Municipal Treatment Plants

Site	Average Water Inlet Temp (°F)	Average Annual Air Temp (°F)	Difference (Offset), Temp (°F)	Population by State (Census 2007 Est)
Anchorage, AK	38.6	36.2	2.4	683,478
Birmingham, AL	71.7	62.2	9.5	4,627,851
Montgomery, AL	66.4	65	1.4	
Little Rock, AR	63.9	62.1	1.8	2,834,797
Phoenix, AZ	82.3	72.8	9.5	6,338,755
Los Angeles, CA	72.8	63.3	9.5	36,553,215
San Diego, CA	76.2	64.4	11.8	
San Francisco, CA	67.7	57.3	10.4	
Denver, CO	61.3	50.1	11.2	4,861,515
Hartford, CT	56.6	50.2	6.4	3,502,309
Washington, DC	63.9	57.5	6.4	588,292
Dover, DE	61.9	56.8	5.1	864,764
Wilmington, DE	59.6	54.4	5.2	864,764
Miami, FL	75	76.7	-1.7	18,251,243
Tallahassee, FL	76.7	68	8.7	
Atlanta, GA	62	62.1	-0.1	9,544,750
Savannah, GA	68.1	66.2	1.9	
Honolulu, HI	76.8	77.5	-0.7	1,283,388
Des Moines, IA	60.3	50	10.3	2,988,046
Boise, ID	45.3	51.9	-6.6	1,499,402
Chicago, IL	53.9	49.1	4.8	12,852,548
Indianapolis, IN	49	52.5	-3.5	6,345,289
Topeka, KS	59	54.3	4.7	2,775,997
Louisville, KY	56.3	56.9	-0.6	4,241,474
New Orleans, LA	64.9	68.8	-3.9	4,293,204
Boston, MA	59.3	51.6	7.7	6,449,755
Baltimore, MD	56.8	54.6	2.2	5,618,344
Portland, ME	63.5	45.7	17.8	1,317,207
Detroit, MI	49.9	49.7	0.2	10,071,822
Minneapolis, MN	45.8	45.4	0.4	5,197,621
Kansas City, MO	51.1	54.2	-3.1	5,878,415
St. Louis, MO	61.3	56.3	5	
Biloxi, MS	64.9	67.4	-2.5	2,918,785
Jackson, MS	67.8	64.1	3.7	
Helena, MT	41.8	44	-2.2	957,861
Raliegh, NC	71.8	59.6	12.2	9,061,032
Bismark, ND	51	42.3	8.7	639,715
Lincoln, NE	53.5	51.1	2.4	1,774,571
Concord, NH	65.6	45.9	19.7	1,315,828
Trenton, NJ	55.3	52.9	2.4	8,685,920
Albuquerque, NM	76.2	56.8	19.4	1,969,915
Carson City, NV	58	50.6	7.4	2,565,382

Albany, NY	51.5	47.5	4	19,297,729
Binghamton, NY	59.9	45.8	14.1	
Buffalo, NY	49.2	47.9	1.3	
Long Island, NY	53	52.4	0.6	
New York, NY	57.6	55.1	2.5	
Plattsburgh, NY	50.6	44.5	6.1	
Potsdam, NY	48.5	43.3	5.2	
Poughkeepsie, NY	56.8	48.8	8	
Rochester, NY	57	47.6	9.4	
Rome, NY	51.3	46.6	4.7	
Syracuse, NY	54.7	47.4	7.3	
Watertown, NY	51.7	44.7	7	
Columbus, OH	54.8	52.9	1.9	11,466,917
Oklahoma City, OK	58.8	60.1	-1.3	3,617,316
Portland, OR	51.6	53.5	-1.9	3,747,455
Philadelphia, PA	56	55.3	0.7	12,432,792
Pittsburgh, PA	58	50.9	7.1	
Providence, RI	49.7	51.1	-1.4	1,057,832
Columbia, SC	59.2	63.6	-4.4	4,407,709
Sioux Falls, SD	55.3	45.1	10.2	796,214
Chattanooga, TN	67.7	60	7.7	6,156,719
Knoxville, TN	55	58.4	-3.4	
Memphis, TN	55	62.3	-7.3	
Dallas, TX	68.3	65.5	2.8	23,904,380
Houston, TX	65.9	70.5	-4.6	
Salt Lake City, UT	70.5	52	18.5	2,645,330
Richmond, VA	59.1	57.6	1.5	7,712,091
Montpelier, VT	47.8	42.9	4.9	621,254
Seattle, WA	41.1	52.3	-11.2	6,468,424
Greenbay, WI	44.7	44.4	0.3	5,601,640
Milwaukee, WI	46	47.5	-1.5	
Charleston, WV	62.8	54.5	8.3	1,812,035
Cheyenne, WY	51.7	44.9	6.8	522,830

Mean **3.72**
Standard Deviation 5.94

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