Methodology for Calculating Long-term Peak Forecast with temperature sensitive loads

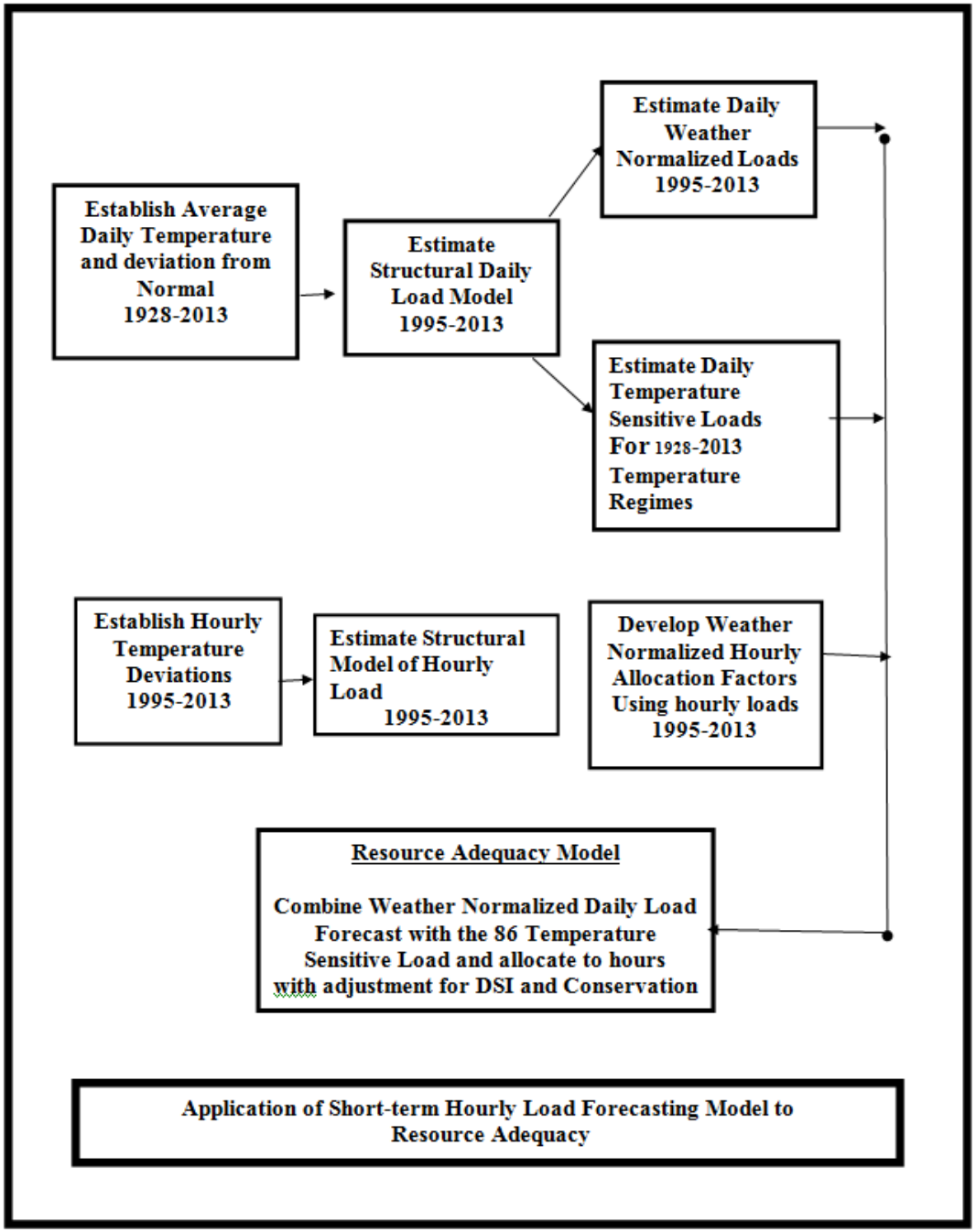
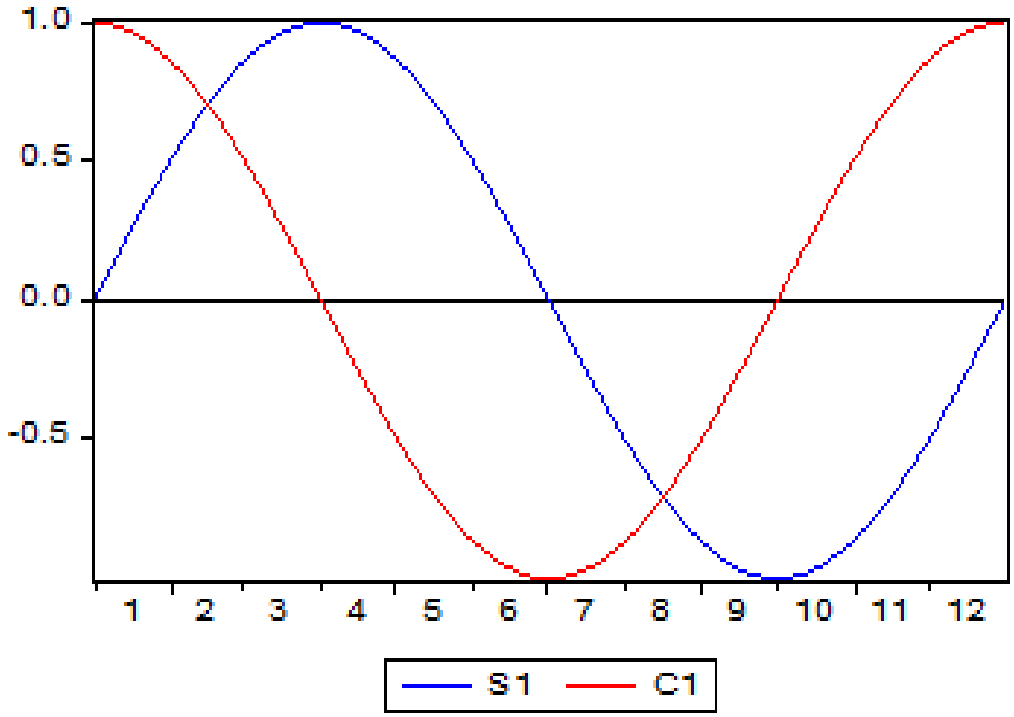

Estimate Daily Weather Normalized Loads 1995-2013
Establish Average Daily Temperature and deviation from Normal 1928-2013
Estimate Structural Daily Load Model 1995-2013
Estimate Daily Temperature Sensitive Loads For 1928-2013 Temperature Regimes
Establish Hourly Temperature Deviations 1995-2013
Estimate Structural Model of Hourly Load 1995-2013
Develop Weather Normalized Hourly Allocation Factors Using hourly loads 1995-2013
Resource Adequacy Model
Combine Weather Normalized Daily Load Forecast with the 86 Temperature Sensitive Load and allocate to hours with adjustment for DSI and Conservation
Application of Short-term Hourly Load Forecasting Model to Resource Adequacy

Figure 2. Fourier Series Sine and Cosine Harmonics with One Cyle Per Year



Method: Least Squares
Date: 09/15/14 Time: 15:47
Sample: 1/01/1928 12/31/2020 IF @YEAR>1994
Included observations: 6938
Convergence achieved after 8 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C1	0.089331	0.001506	59.33430	0.0000
C2	0.067614	0.001483	45.59589	0.0000
S1	0.016762	0.001503	11.15019	0.0000
S2	0.029529	0.001498	19.71680	0.0000
S3	-0.019945	0.001455	-13.70421	0.0000
C1_W	-0.038399	0.000335	-114.6754	0.0000
C2_W	-0.017436	0.000243	-71.76301	0.0000
S1_W	0.020180	0.000334	60.33051	0.0000
S2_W	0.017156	0.000245	69.94726	0.0000
C1_W*C1	0.010235	0.000474	21.58375	0.0000
C2_W*C1	0.005179	0.000344	15.04930	0.0000
S2_W*C1	-0.002925	0.000347	-8.422812	0.0000
C1_W*S1	0.001947	0.000473	4.112704	0.0000
S1_W*S1	-0.001513	0.000473	-3.197535	0.0014
D_JUL4	-0.082677	0.004083	-20.24948	0.0000
D_LBD	-0.067118	0.004136	-16.22935	0.0000
D_MEMD	-0.073460	0.004150	-17.70208	0.0000
D_NYD	-0.052855	0.004175	-12.65842	0.0000
D_TG	-0.075589	0.004151	-18.21139	0.0000
D_XMAS	-0.060912	0.004089	-14.89564	0.0000
RESILOG	-0.064568	0.004658	-13.86148	0.0000
RESILOG*C1	-0.353046	0.006429	-54.91454	0.0000
RESILOG*C2	0.139059	0.005360	25.94507	0.0000
RESILOG*S1	-0.158495	0.006080	-26.06818	0.0000
RESILOG*S2	0.165025	0.006217	26.54270	0.0000
RESILOG(-1)	-0.036034	0.004425	-8.143734	0.0000
RESILOG(-1)*C1	-0.078942	0.006047	-13.05414	0.0000
RESILOG(-1)*S2	0.016144	0.005879	2.746180	0.0060
RESILOG^2*S2	-0.099096	0.016250	-6.098009	0.0000
LOG(REGION_EMP)	0.440705	0.019668	22.40761	0.0000
@YEAR=1998	-0.028181	0.004619	-6.101422	0.0000
@YEAR=2001	-0.023738	0.004600	-5.160393	0.0000
C	6.066012	0.170675	35.54135	0.0000
AR(1)	0.451210	0.011622	38.82370	0.0000
AR(2)	0.320528	0.011568	27.70870	0.0000

R-squared	0.963865	Mean dependent var	9.883843
Adjusted R-squared	0.963687	S.D. dependent var	0.106320
S.E. of regression	0.020260	Akaike info criterion	-4.955279
Sum squared resid	2.833531	Schwarz criterion	-4.920749
Log likelihood	17224.86	Hannan-Quinn criter.	-4.943375
F-statistic	5415.673	Durbin-Watson stat	1.969198
Prob(F-statistic)	0.000000		

Inverted AR Roots	.84	-.38

Methodology for incorporating temperature sensitive loads

Year Mon Day Map	Actual Temp	Conditional Mean Temperature	Deviation from Mean	Temp Sensitive Load MW
1/1/1928	19.4	34	(15)	1.15
1				
1/1/1952	14.3	34	(20)	1.33
3				
1/1/2013	28.4	34	(6.1)	1.06
3				

Temperature sensitive loads are effected by degree of deviation in temperatu

in the day, and the preceeding two days.

Variable	Coefficient	Std. Error	t-Statistic
RESILOG*C1	-0.353046	0.006429	(55)
RESILOG*C2	0.139059	0.00536	26
RESILOG*S1	-0.158495	0.00608	(26)
RESILOG*S2	0.165025	0.006217	27
RESILOG(-1)	-0.036034	0.004425	(8)
RESILOG(-1)*C1	-0.078942	0.006047	(13)
RESILOG(-1)*S2	0.016144	0.005879	3
RESILOG^2*S2	-0.099096	0.01625	(6)

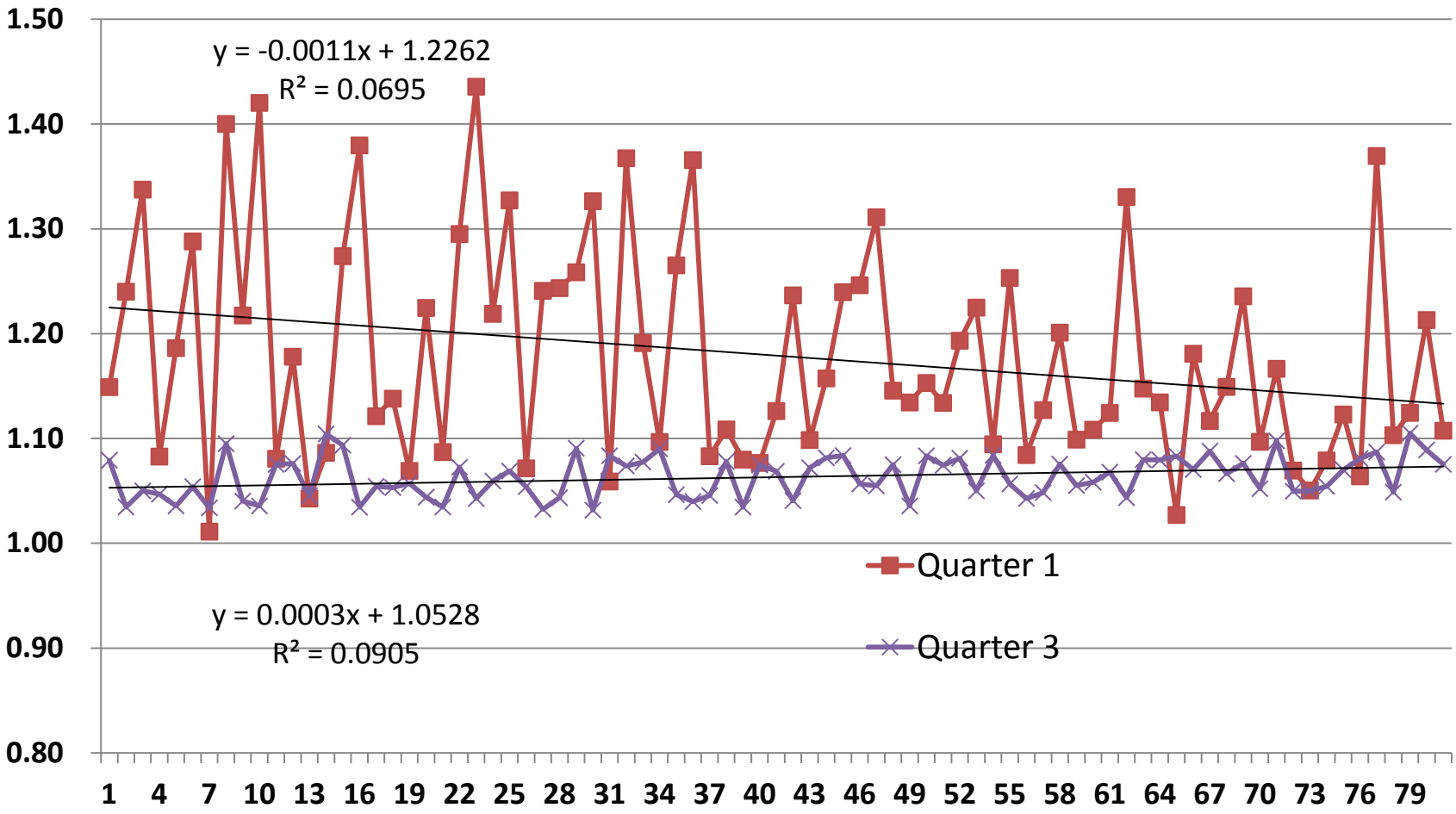
C1, C2, S1, S2 have different value for each day of the year.

Hour	Hourly Shape for the this Day	1928 Temp deviation Multiplier for Jan 1 Date	2015 Day 1 Daily WN load	DSI 2015	Jan 1/1/2015 with Jan 1/1928 temp overlay	1952 Temp deviation Multiplier for Jan 1 Date	Jan 1/1/2015 with Jan 1/1952 temp overlay	2013 Temp deviation Multiplier for Jan 1 Date	Jan 1/1/20 with Jan 1/2013tem overlay
1	3.42%	0.94	23,061	765	22,538	1.09	25,915	0.87	20,8
2	3.35%	0.92	23,061	765	22,065	1.07	25,369	0.85	20,3
3	3.33%	0.92	23,061	765	21,939	1.06	25,224	0.85	20,2
4	3.37%	0.93	23,061	765	22,172	1.07	25,493	0.85	20,4
5	3.50%	0.97	23,061	765	23,051	1.12	26,508	0.89	21,2
6	3.83%	1.06	23,061	765	25,129	1.22	28,908	0.97	23,1
7	4.31%	1.19	23,061	765	28,158	1.37	32,407	1.09	25,9
8	4.61%	1.27	23,061	765	30,093	1.47	34,642	1.17	27,7
9	4.65%	1.28	23,061	765	30,344	1.48	34,932	1.18	27,9
10	4.61%	1.27	23,061	765	30,080	1.47	34,626	1.17	27,7
11	4.53%	1.25	23,061	765	29,571	1.44	34,039	1.15	27,2
12	4.42%	1.22	23,061	765	28,862	1.41	33,220	1.12	26,6
13	4.32%	1.19	23,061	765	28,230	1.38	32,490	1.10	26,0
14	4.24%	1.17	23,061	765	27,701	1.35	31,879	1.08	25,5
15	4.19%	1.15	23,061	765	27,383	1.33	31,512	1.06	25,2
16	4.24%	1.17	23,061	765	27,706	1.35	31,885	1.08	25,5
17	4.49%	1.24	23,061	765	29,337	1.43	33,769	1.14	27,0
18	4.79%	1.32	23,061	765	31,216	1.53	35,940	1.22	28,7
19	4.80%	1.32	23,061	765	31,293	1.53	36,028	1.22	28,8
20	4.67%	1.29	23,061	765	30,441	1.49	35,044	1.18	28,0
21	4.50%	1.24	23,061	765	29,371	1.43	33,808	1.14	27,0
22	4.27%	1.18	23,061	765	27,913	1.36	32,124	1.08	25,7
23	3.95%	1.09	23,061	765	25,864	1.26	29,757	1.00	23,8
24	3.63%	1.00	23,061	765	23,832	1.16	27,409	0.92	21,9
	100.00%	**1.15**							
	Sum	**Average**							

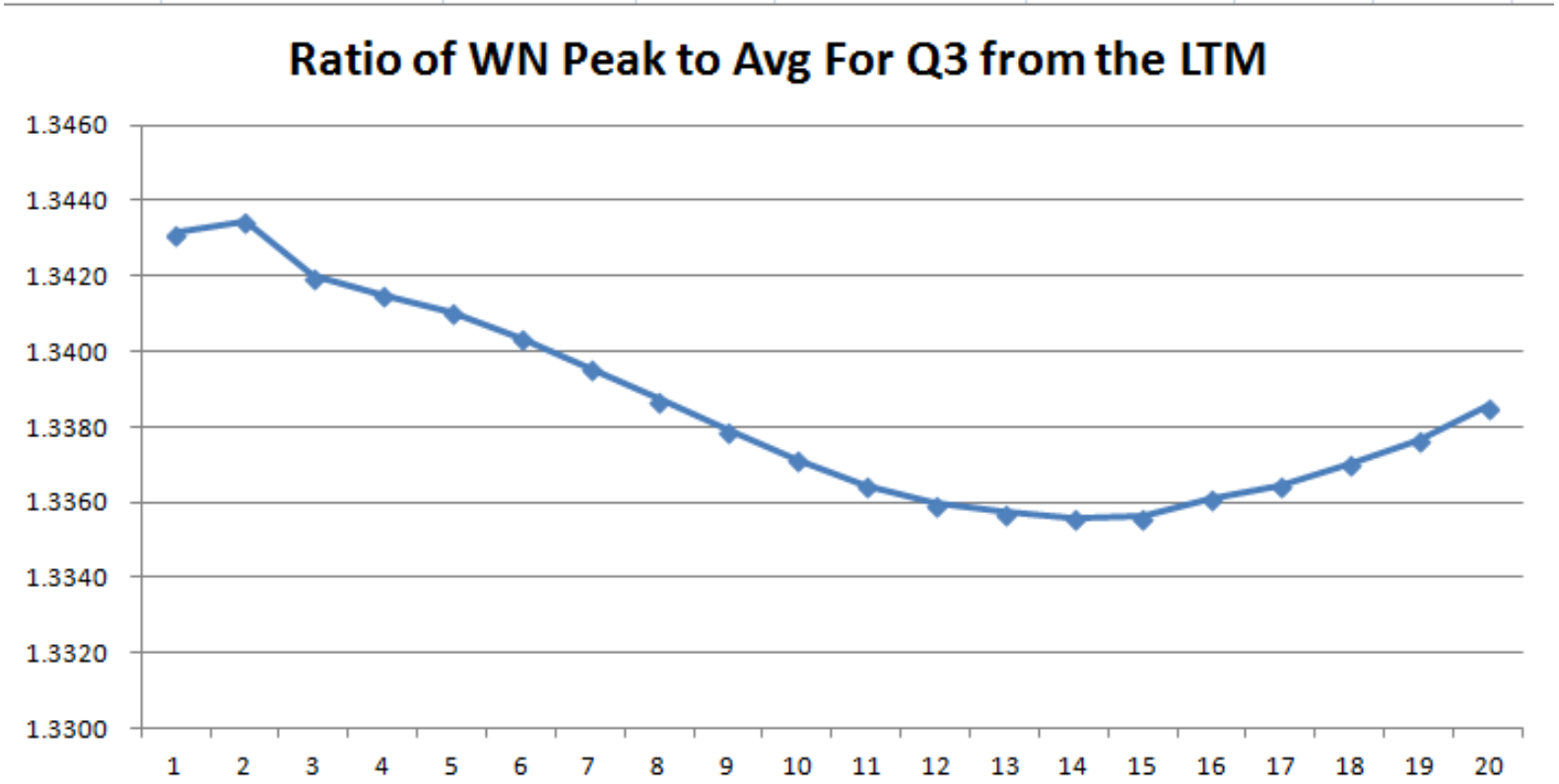
Extreme weather events

Year	Month	Day		Actual temp	Normal te	Deviation in temp	Multiplier value minus 0.3
1950	1	3	1950_1_3	12.53	34.32	(21.79)	1.11
1955	11	12	1955_11_12	23.43	45.66	(22.23)	1.08
1955	11	13	1955_11_13	24.30	45.37	(21.07)	1.10
1955	11	14	1955_11_14	21.11	45.07	(23.96)	1.19
1955	11	15	1955_11_15	18.71	44.77	(26.06)	1.31
1955	11	16	1955_11_16	24.75	44.47	(19.72)	1.11
1964	12	16	1964_12_16	17.95	36.32	(18.37)	1.01
1964	12	17	1964_12_17	13.84	36.14	(22.30)	1.25
1964	12	18	1964_12_18	18.19	35.97	(17.78)	1.12
1968	12	30	1968_12_30	11.01	34.54	(23.53)	1.20
1968	12	31	1968_12_31	17.72	34.47	(16.75)	1.07
1972	12	5	1972_12_5	22.51	38.83	(16.32)	1.01
1972	12	6	1972_12_6	22.96	38.57	(15.61)	1.01
1972	12	7	1972_12_7	19.43	38.31	(18.88)	1.10
1972	12	8	1972_12_8	17.25	38.06	(20.81)	1.19
1972	12	9	1972_12_9	19.30	37.82	(18.52)	1.13
1972	12	10	1972_12_10	19.05	37.58	(18.53)	1.11
1972	12	11	1972_12_11	20.76	37.35	(16.59)	1.05
1979	1	1	1979_1_1	11.83	34.42	(22.59)	1.17
1979	1	2	1979_1_2	19.90	34.37	(14.47)	1.01
1982	1	6	1982_1_6	12.40	34.24	(21.84)	1.06
1983	12	21	1983_12_21	17.44	35.50	(18.06)	1.04
1983	12	22	1983_12_22	15.47	35.36	(19.89)	1.13
1983	12	23	1983_12_23	13.99	35.23	(21.24)	1.19
1983	12	24	1983_12_24	17.08	35.10	(18.02)	1.10
1985	11	22	1985_11_22	23.11	42.65	(19.54)	1.07
1985	11	23	1985_11_23	19.38	42.34	(22.96)	1.22
1985	11	24	1985_11_24	22.08	42.04	(19.96)	1.14
1985	12	1	1985_12_1	20.36	39.96	(19.60)	1.09
1990	12	20	1990_12_20	16.46	35.65	(19.19)	1.08
1990	12	21	1990_12_21	14.71	35.50	(20.79)	1.18
1990	12	22	1990_12_22	15.77	35.36	(19.59)	1.15

Multiplier from STM 1928-2008

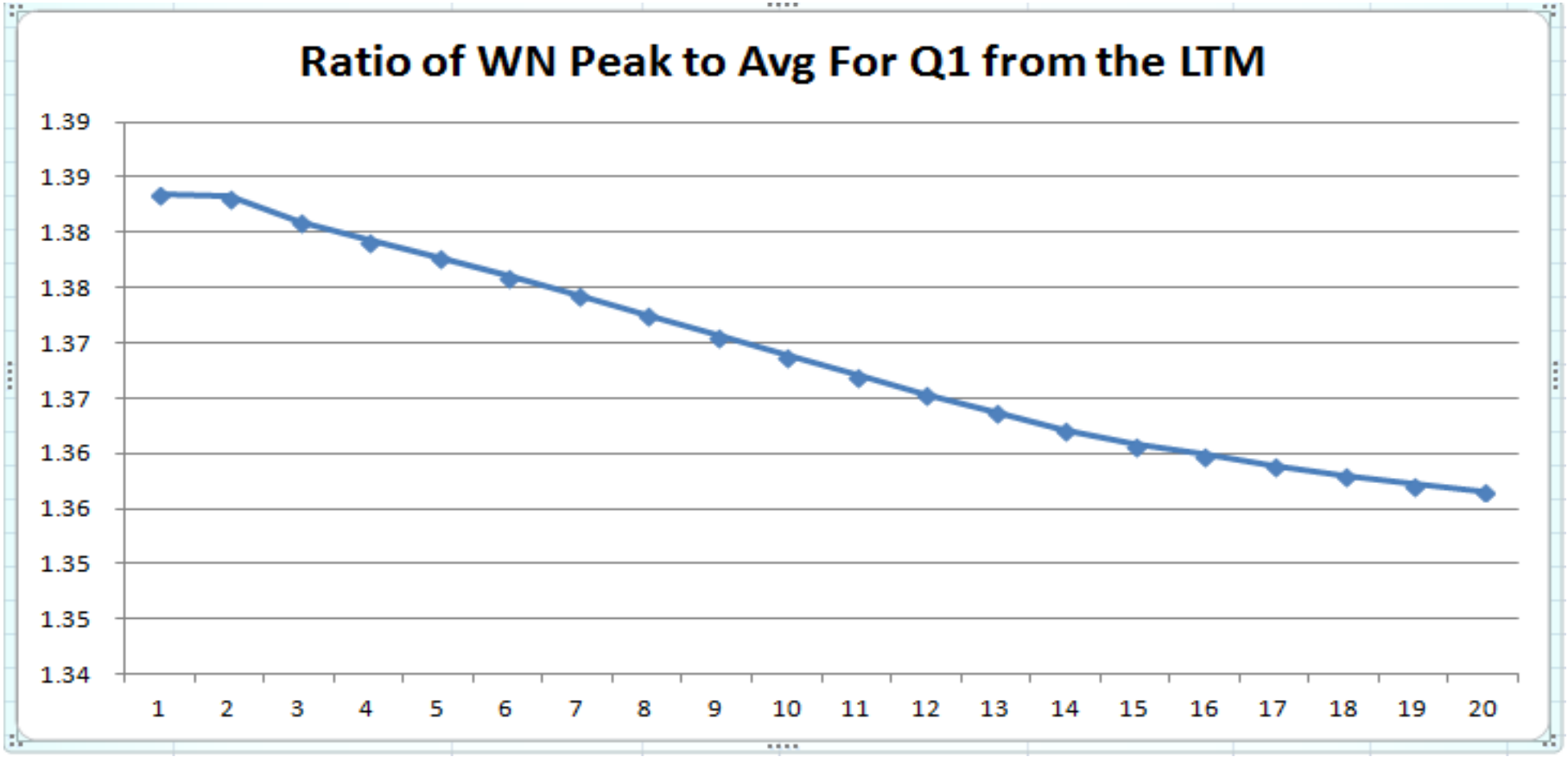


Very little change in Q3 Multiplier



Rooftop solar expansion and its impact of summer peak loads explains the drop (slight) drop in relationship between Peak and Energy

Decline in Winter multiplier



Should we use more recent data from more recent Period

Statistical presentation of Daily Temperatures in Winter and Summer for two periods suggest?

Quarter 1	Average	Max	Min	STDEV	Variance
1928-2014	39.3	59.6	3.3	7.2	51.7
1993-2014	40.0	59.6	13.4	6.2	38.7
Quarter 3					
1928-2014	65.9	82.8	46.7	5.1	26.2
1993-2014	66.9	82.8	50.8	5.1	25.7