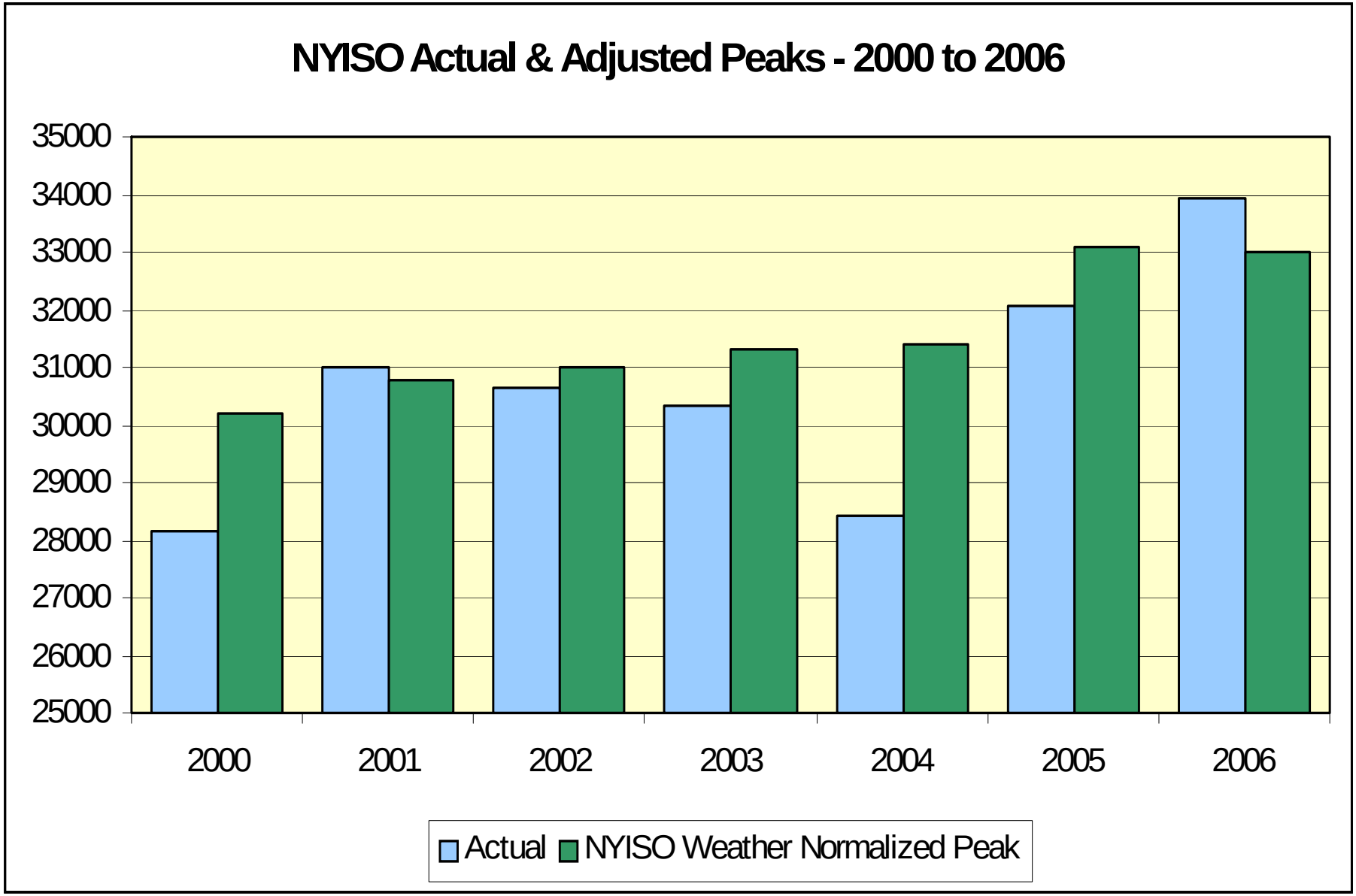
Review of NYISO Summer Peak Models – 2000 to 2006

NYISO
Resource & Load Adequacy
January 22, 2007

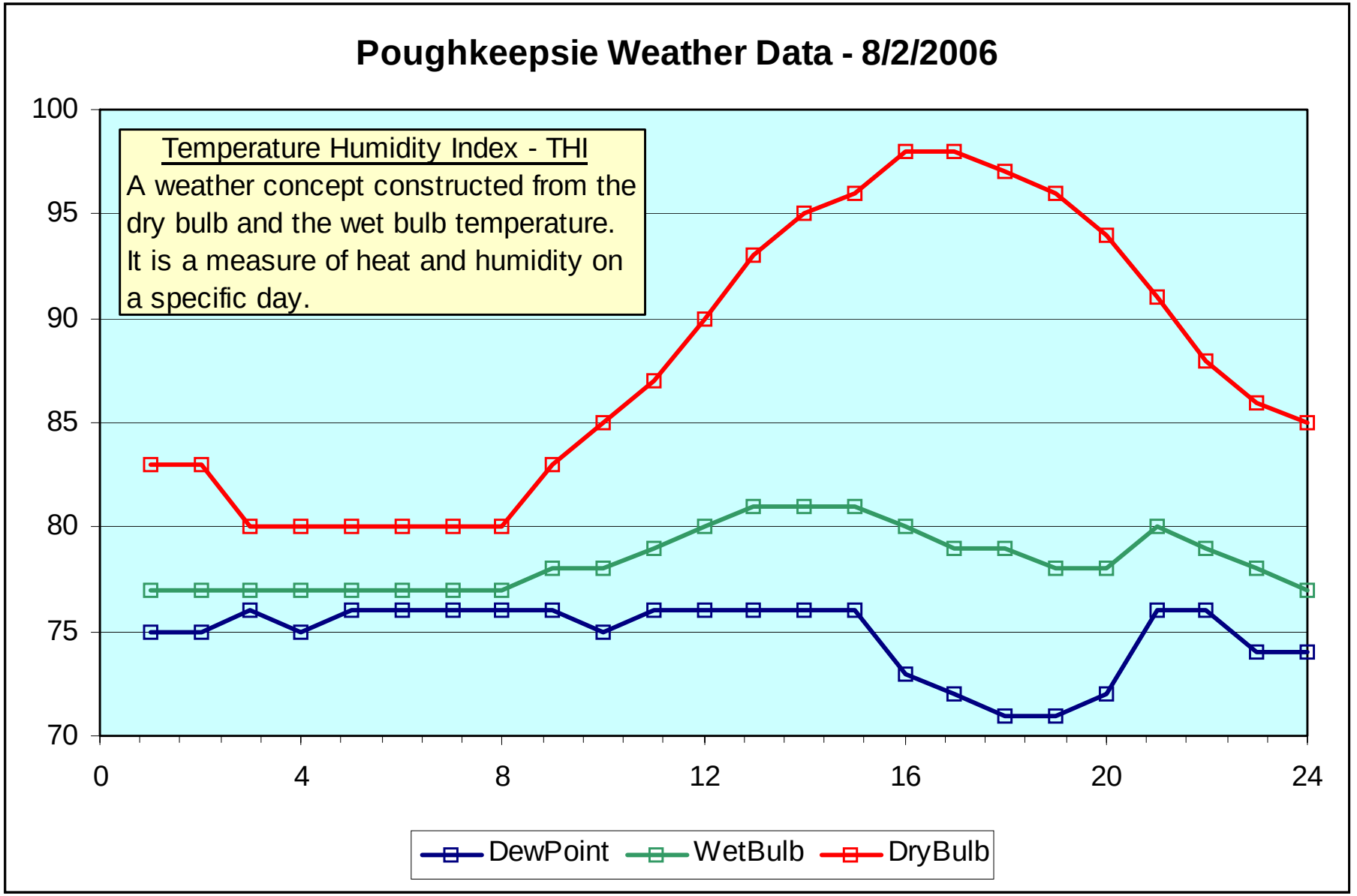

NYISO Actual & Adjusted Peaks - 2000 to 2006
35000
34000
33000
32000
31000
30000
29000
28000
27000
26000
25000
2000
2001
2002
2003
2004
2005
2006
Actual
NYISO Weather Normalized Peak

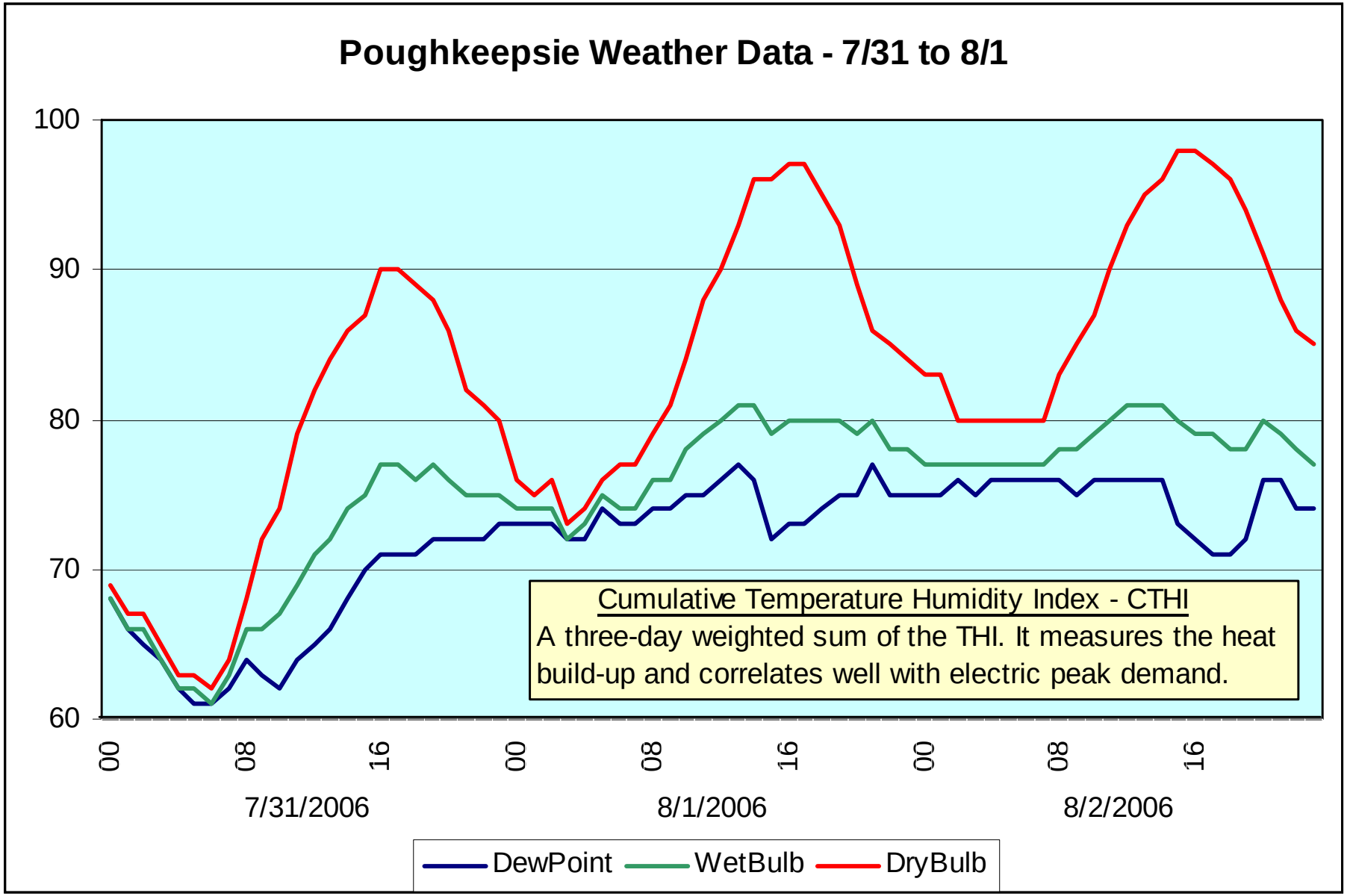
Summary of Review

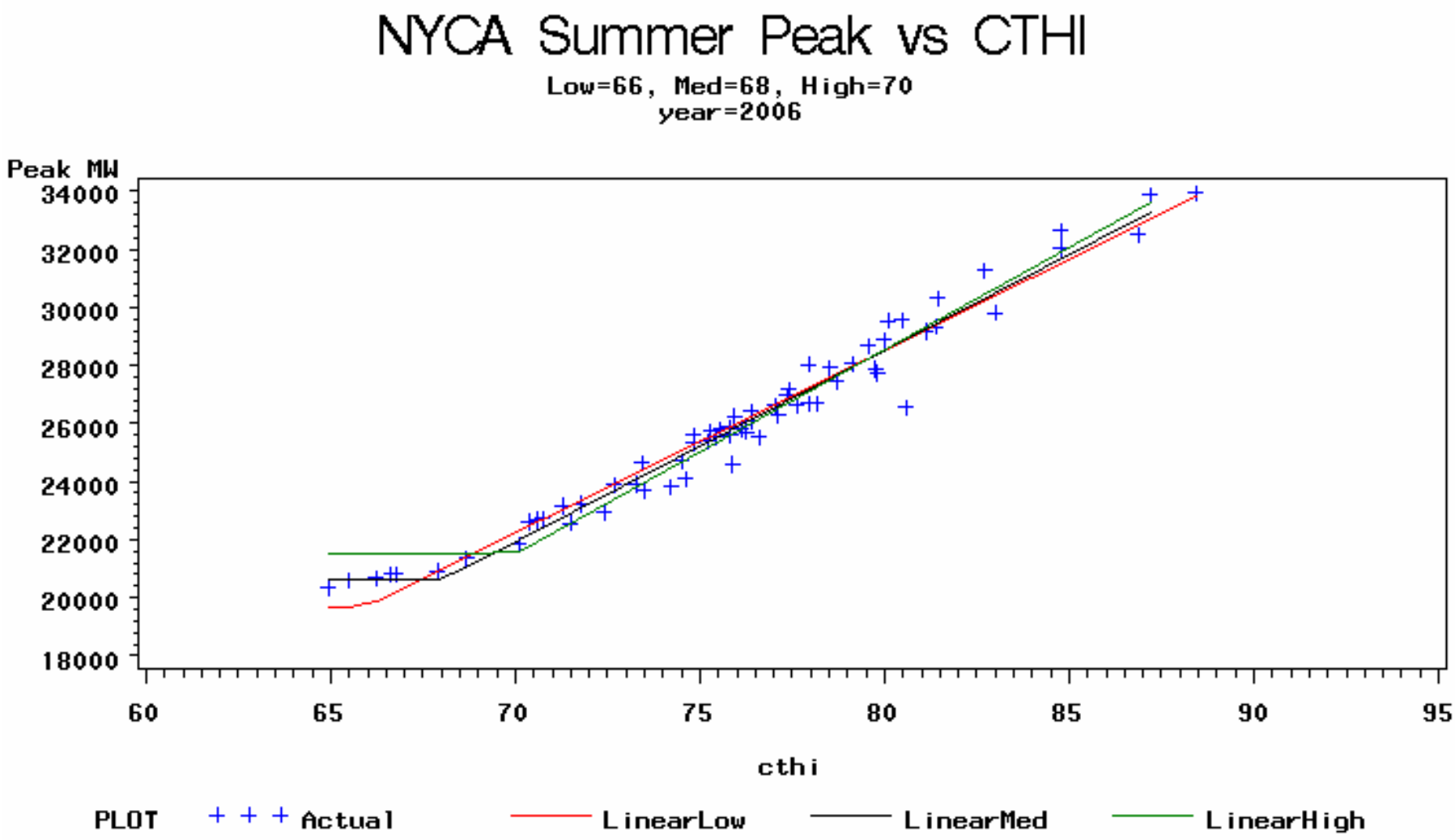
1. Trends in both base load & weather sensitivity are present in the time series of parameters from 2000 to 2006. However, it is not true that these trends must increase year after year in a steady or predictable manner.
2. In 2004, the peak was set on June 9th. The remainder of the summer was cool. Effect on weather normalization is real.
3. The NYISO methodology has better statistical behavior than using a parameter trend approach as was suggested by an MP.
4. NYISO's year-by-year method captures the effect of higher electric utilization, along with other reasons for changing peaks.
5. Every TO's model showed less weather response in 2004 than 2003 or 2005. Consequently, the 2004 WN peak was lower than the trend from 2000 to 2006.
6. A correction to account for an early peak ought to be considered in the future, since early peaks are rare.

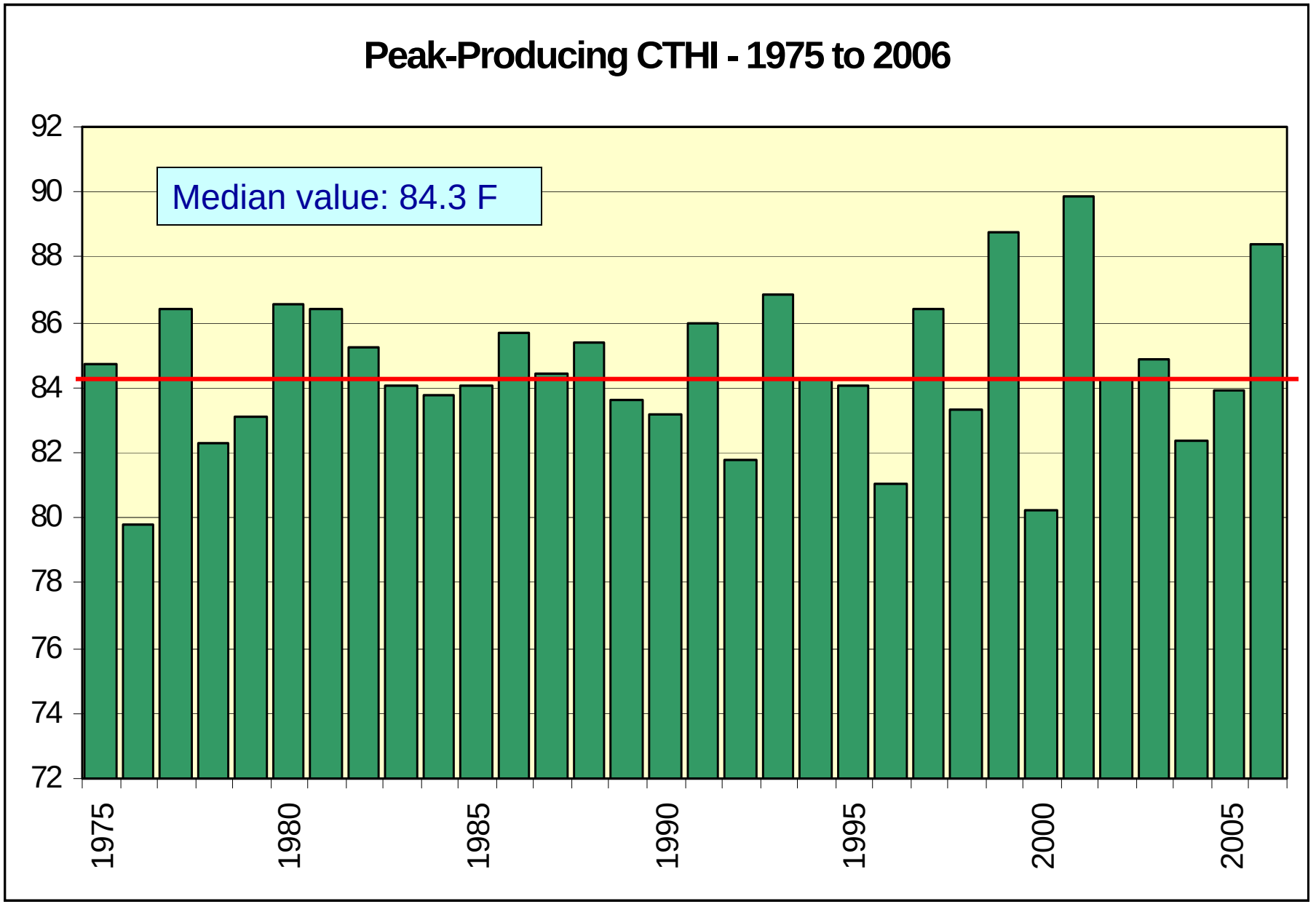
(1) NYISO Weather Normalization of Peak Demand

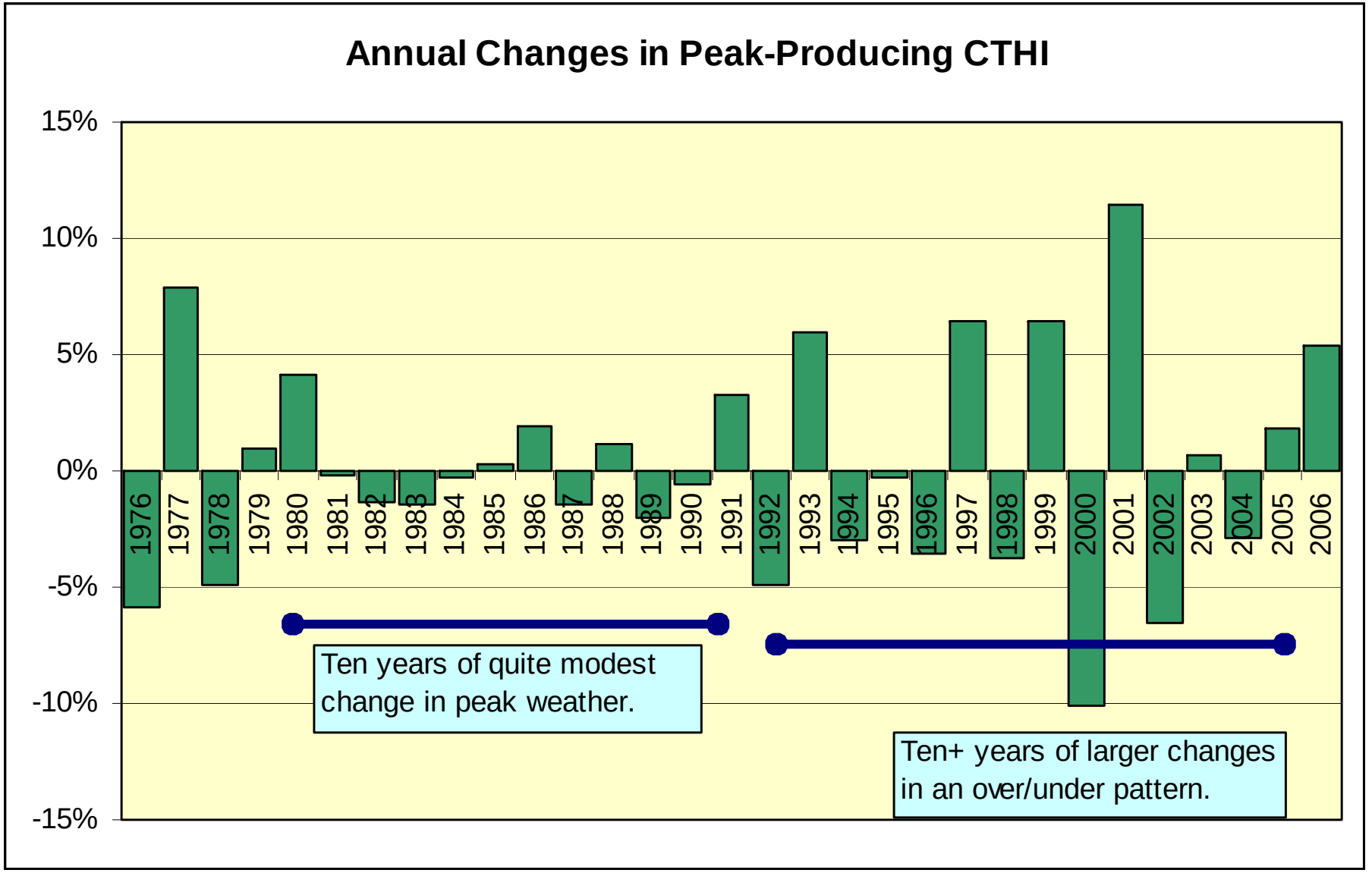
- NYISO models summer weekday peak demand for each transmission organization on a year-by-year basis.
- NYISO Method: Piecewise-Linear Regression
  - Independent model estimation performed each year
  - Estimates both weather-sensitive & non-weather-sensitive load
  - Evaluates weather response separately for each TO
  - Low/Medium/High weather response chosen based on best r-squared
- We compare our estimates of weather-adjusted peak and the size of the adjustment to those submitted by each TO.
- The NYISO normalizes weather conditions to a 30 year median peak-producing index of temperature & humidity.


Poughkeepsie Weather Data - 8/2/2006
Temperature Humidity Index - THI
A weather concept constructed from the dry bulb and the wet bulb temperature. It is a measure of heat and humidity on a specific day.
100
95
90
85
80
75
70
0
4
8
12
16
20
24
DewPoint
WetBulb
DryBulb

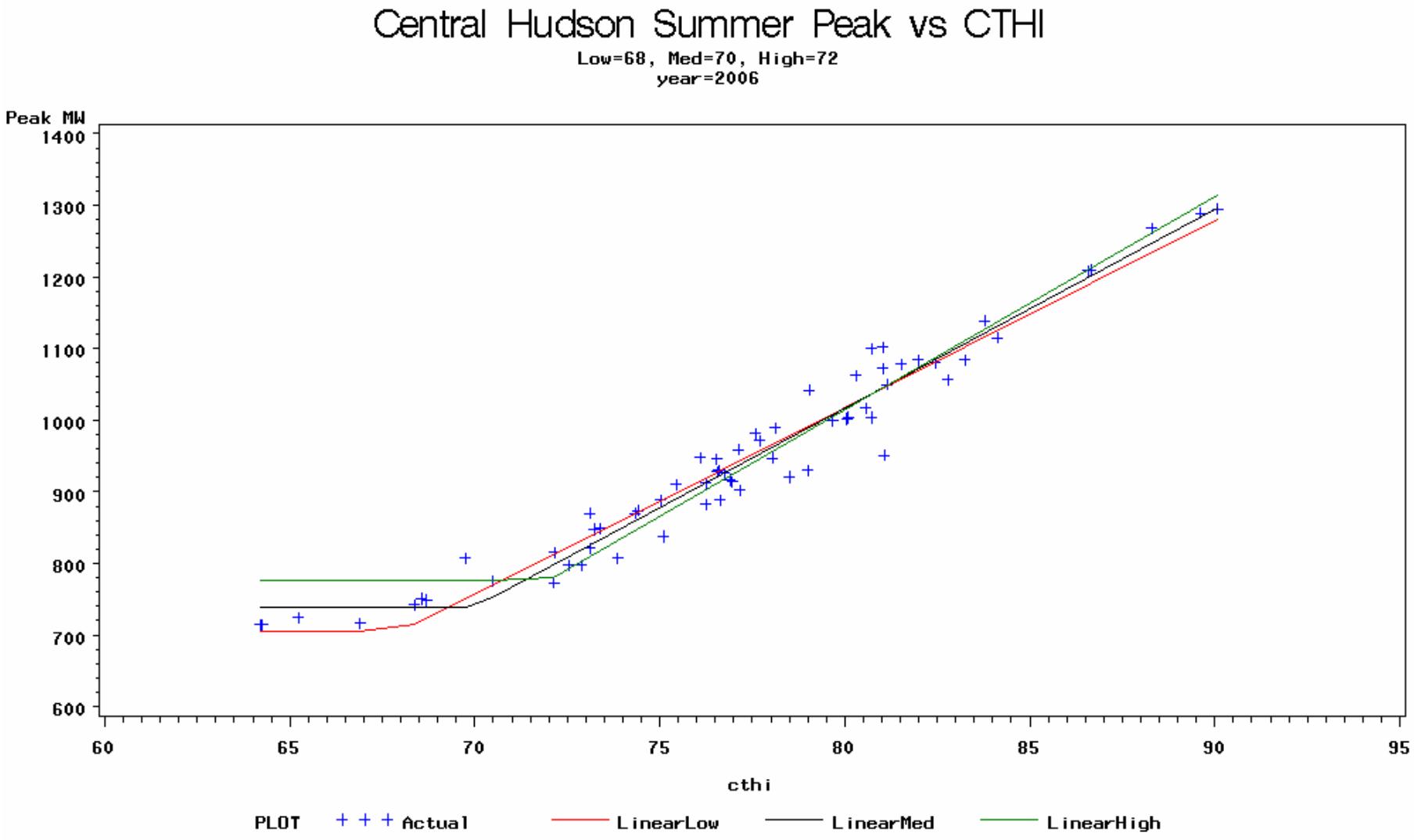

Poughkeepsie Weather Data - 7/31 to 8/1
100
90
80
70
60
00
08
16
00
08
16
00
08
16
7/31/2006
8/1/2006
8/2/2006
Cumulative Temperature Humidity Index - CTHI
A three-day weighted sum of the THI. It measures the heat build-up and correlates well with electric peak demand.
DewPoint
WetBulb
DryBulb

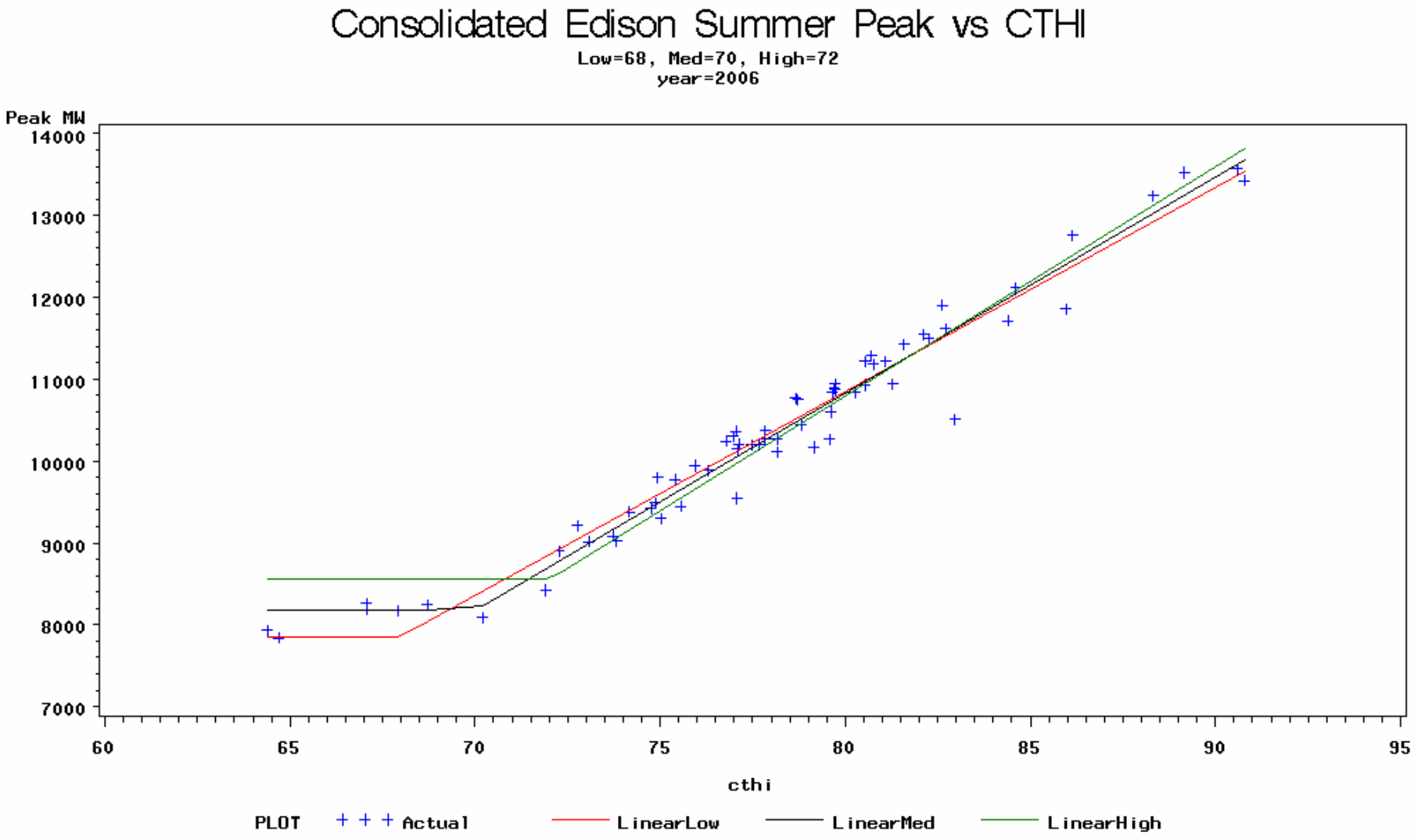

NYCA Summer Peak vs CTHI
Low=66, Med=68, High=70
year=2006
Peak MW
34000
32000
30000
28000
26000
24000
22000
20000
18000
60
65
70
75
80
85
90
95
cthi
PLOT
Actual
LinearLow
LinearMed
LinearHigh

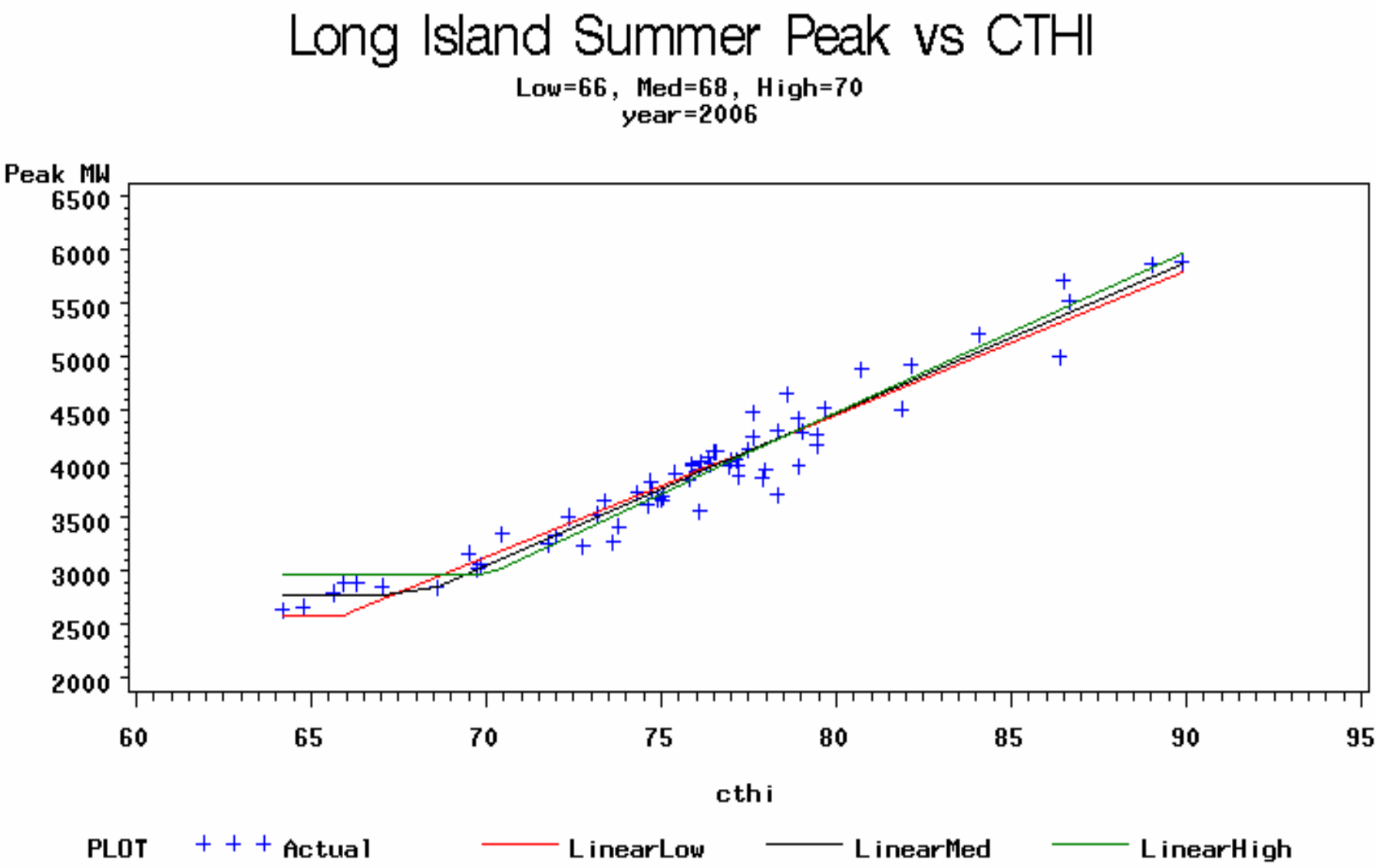

Peak-Producing CTHI - 1975 to 2006
Median value: 84.3 F
92
90
88
86
84
82
80
78
76
74
72
1975
1980
1985
1990
1995
2000
2005

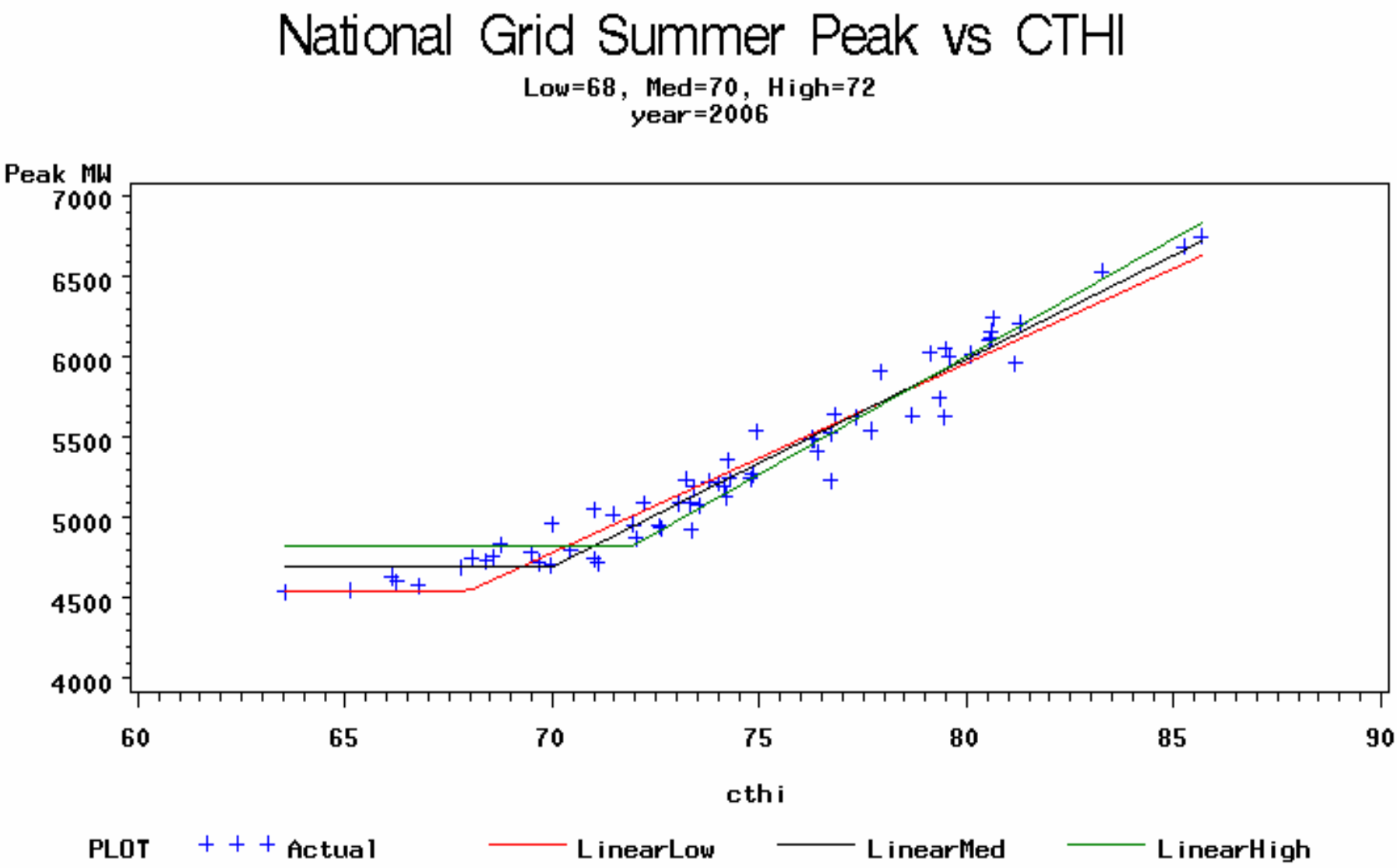

Annual Changes in Peak-Producing CTHI
15%
10%
5%
0%
-5%
-10%
-15%
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
Ten years of quite modest change in peak weather.
Ten+ years of larger changes in an over/under pattern.

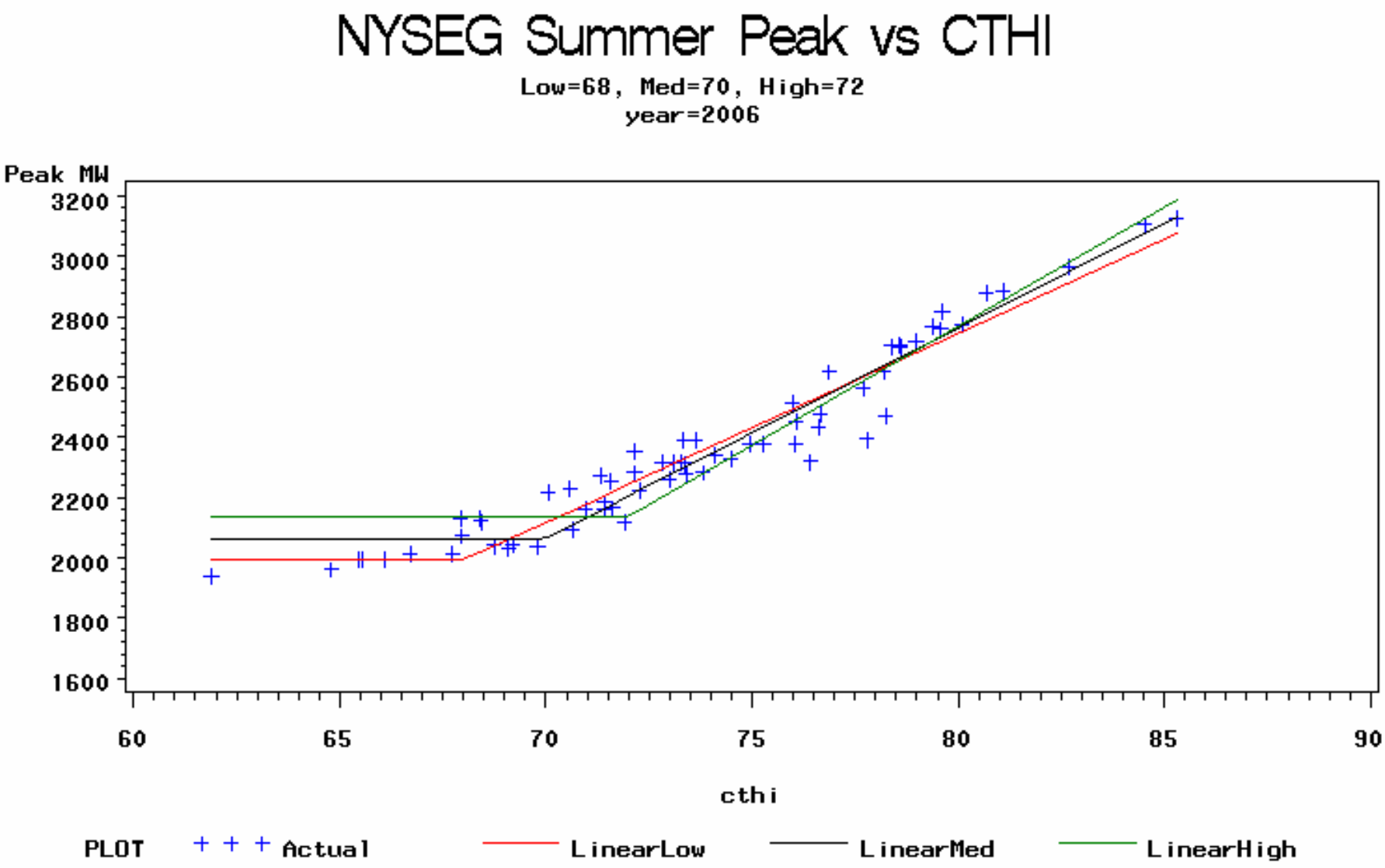
(2) Review of 2006 Weather Response of Each TO


Central Hudson Summer Peak vs CTHI
Low=68, Med=70, High=72
year=2006
Peak MW
1400
1300
1200
1100
1000
900
800
700
600
60
65
70
75
80
85
90
95
cthi
PLOT
Actual
LinearLow
LinearMed
LinearHigh


Consolidated Edison Summer Peak vs CTHI
Low=68, Med=70, High=72
year=2006
Peak MW
14000
13000
12000
11000
10000
9000
8000
7000
60
65
70
75
80
85
90
95
cthi
PLOT
Actual
LinearLow
LinearMed
LinearHigh

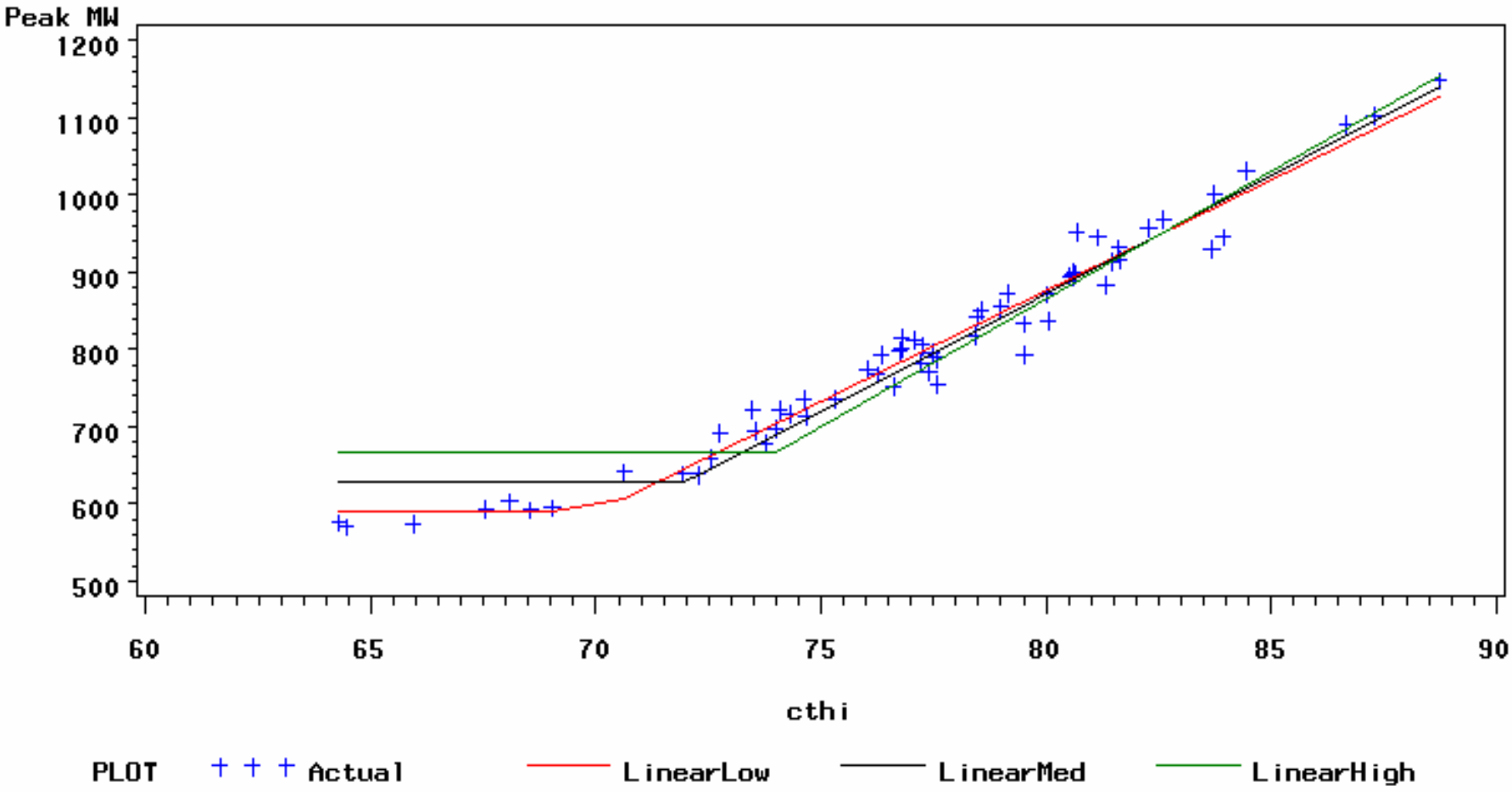

Long Island Summer Peak vs CTHI
Low=66, Med=68, High=70
year=2006
Peak MW
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
60
65
70
75
80
85
90
95
cthi
PLOT
Actual
LinearLow
LinearMed
LinearHigh

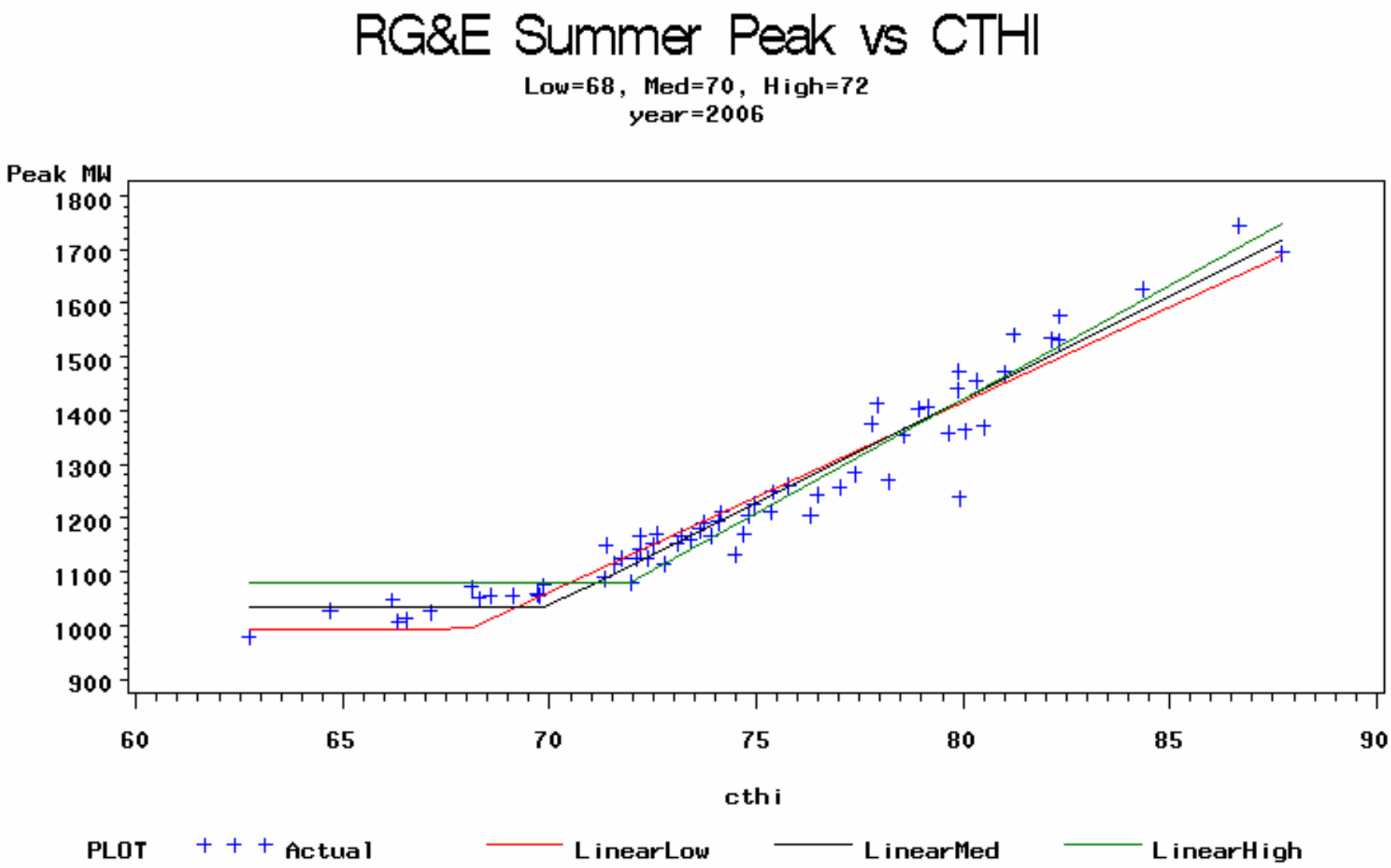

National Grid Summer Peak vs CTHI
Low=68, Med=70, High=72
year=2006
Peak MW
7000
6500
6000
5500
5000
4500
4000
60
65
70
75
80
85
90
cthi
PLOT
Actual
LinearLow
LinearMed
LinearHigh


NYSEG Summer Peak vs CTHI
Low=68, Med=70, High=72
year=2006
Peak MW
3200
3000
2800
2600
2400
2200
2000
1800
1600
60
65
70
75
80
85
90
cthi
PLOT
Actual
LinearLow
LinearMed
LinearHigh

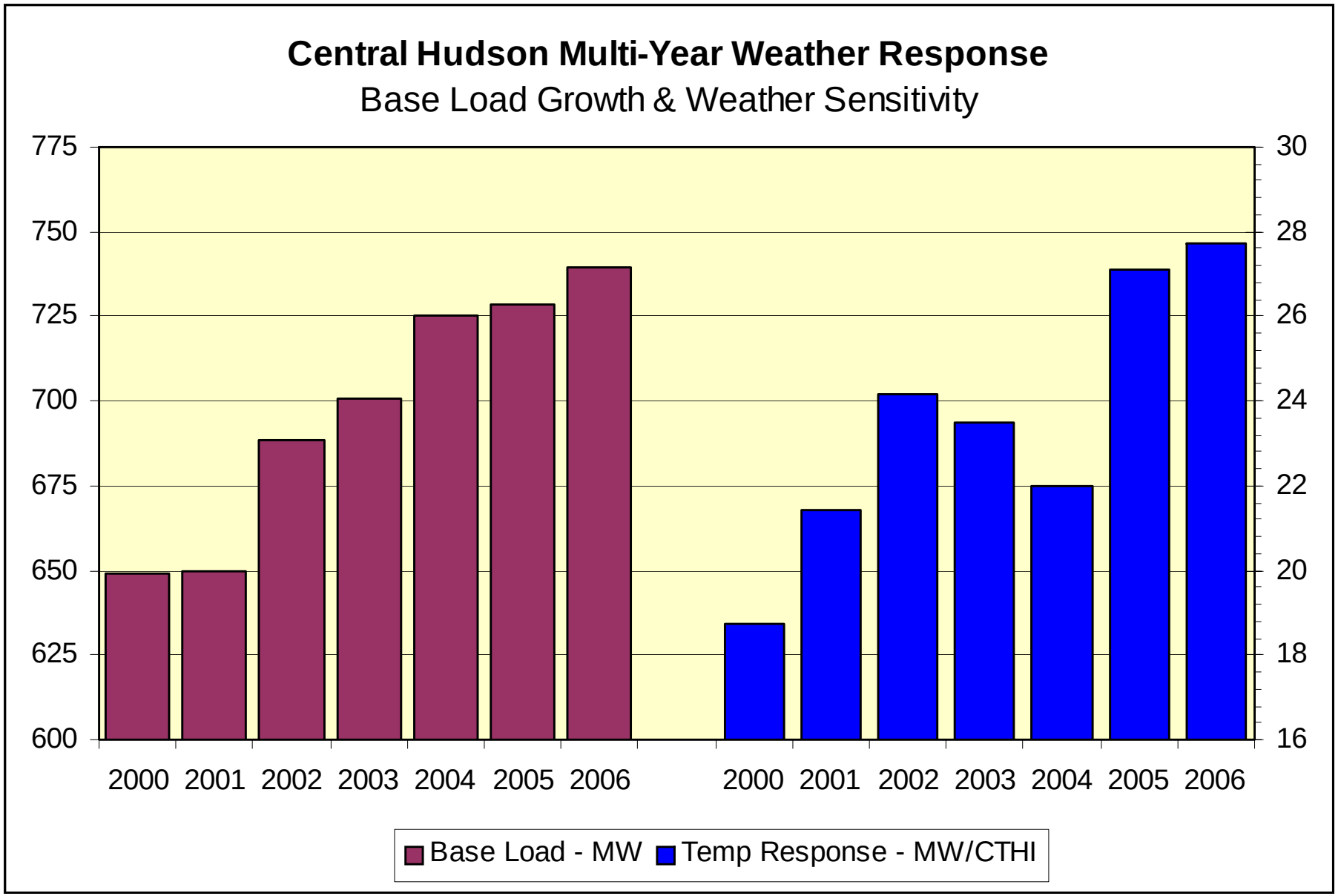
Orange & Rockland Summer Peak vs CTHI

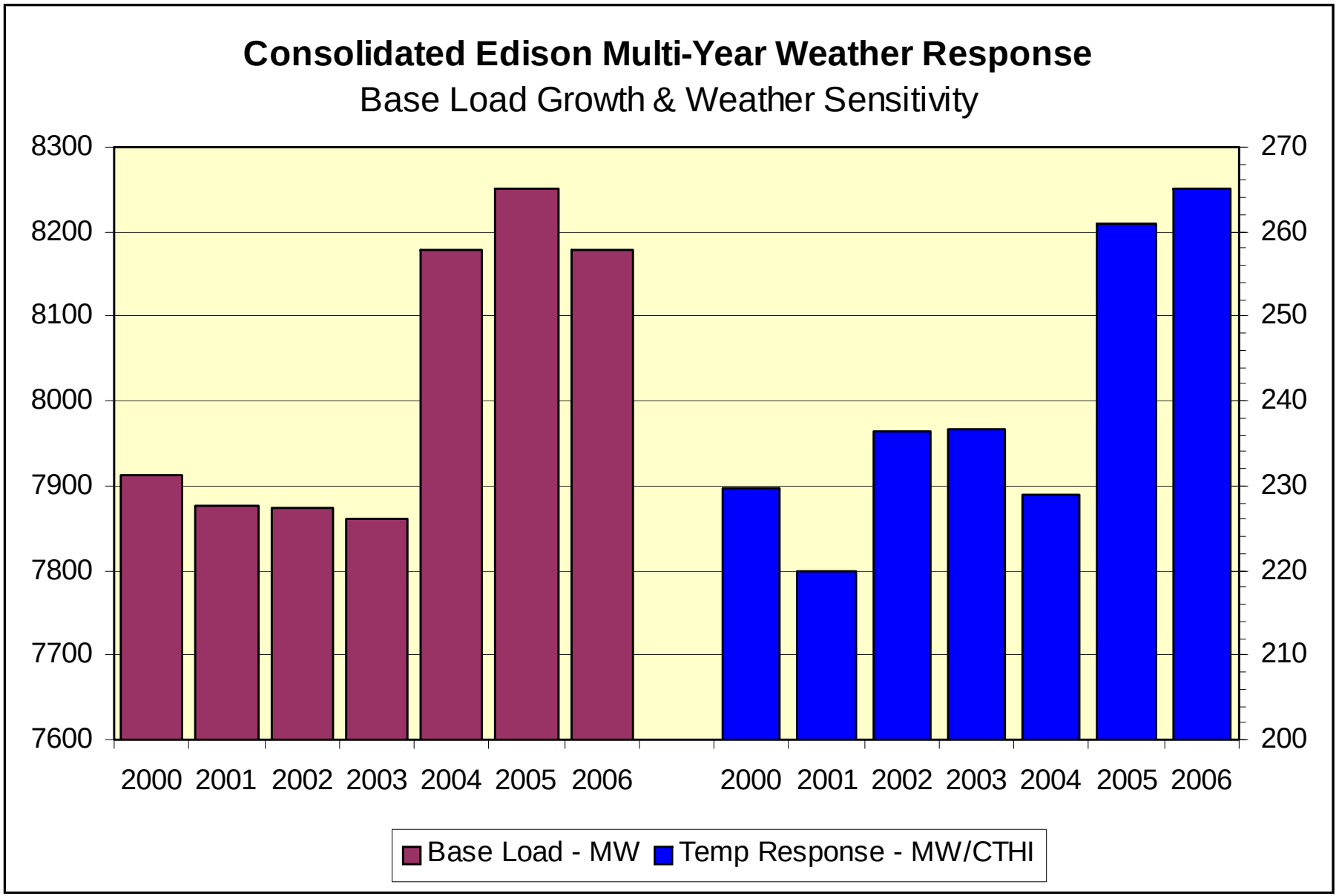
Low=70, Med=72, High=74
year=2006

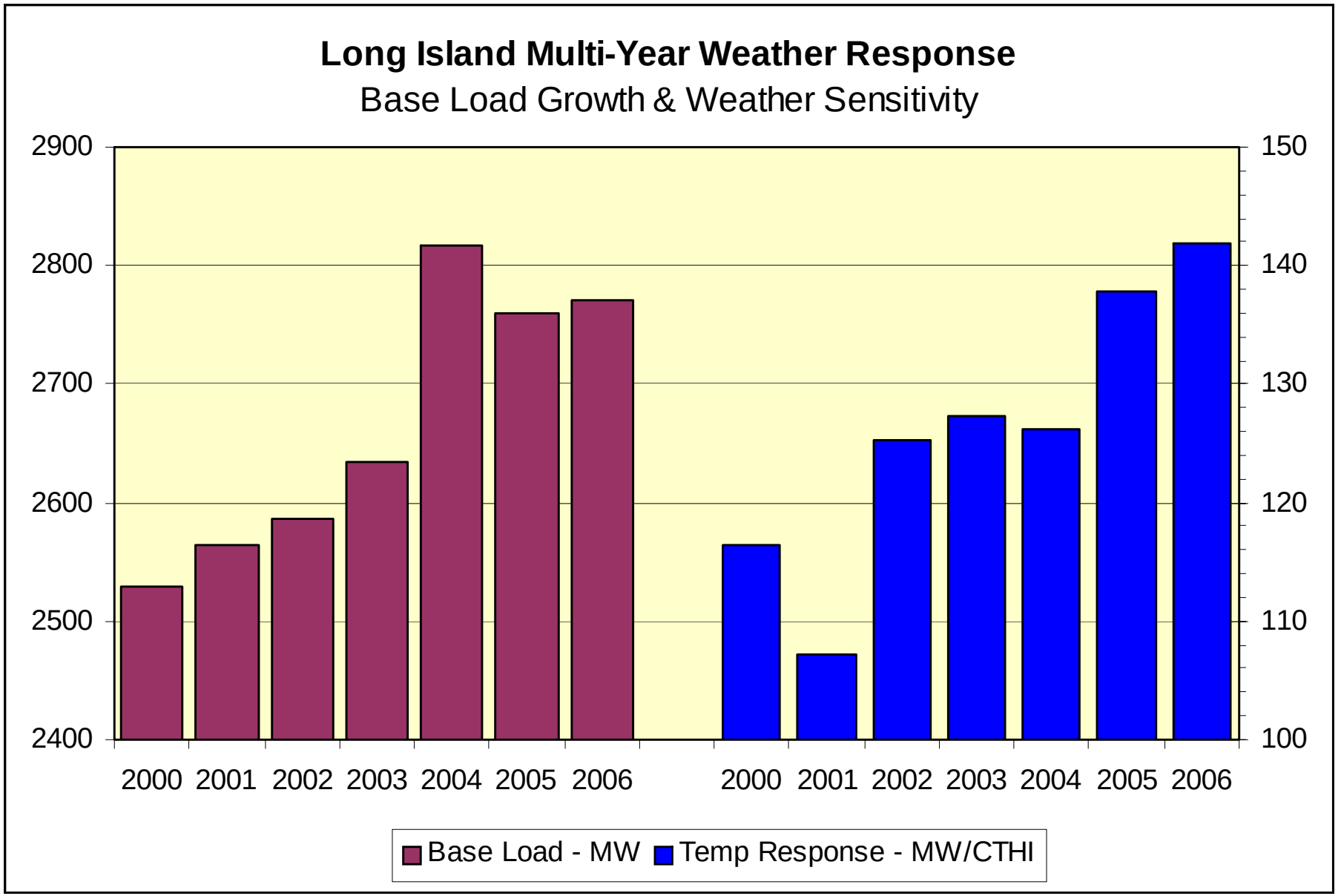


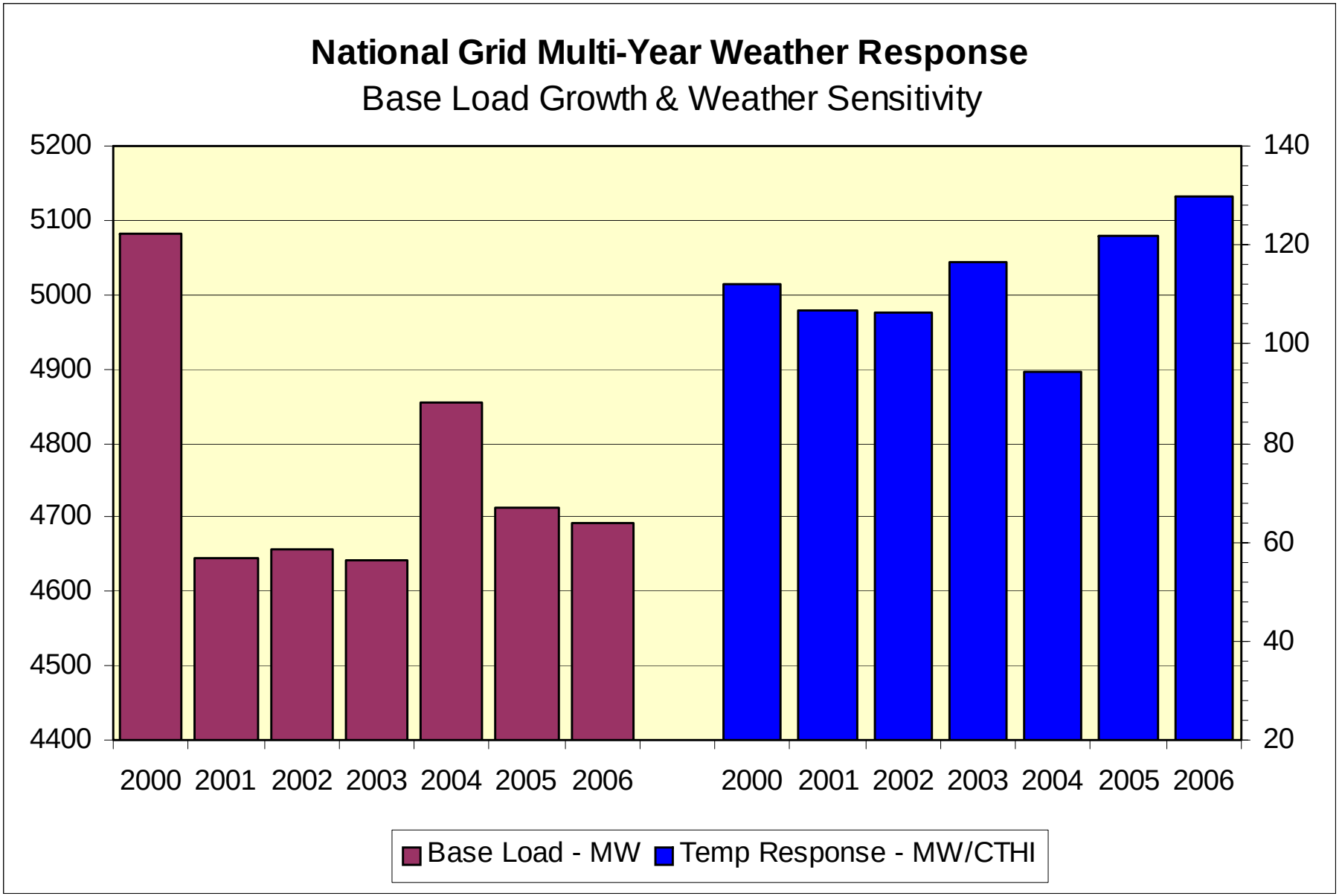

RG&E Summer Peak vs CTHI
Low=68, Med=70, High=72
year=2006
Peak MW
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
60
65
70
75
80
85
90
cthi
PLOT
Actual
LinearLow
LinearMed
LinearHigh

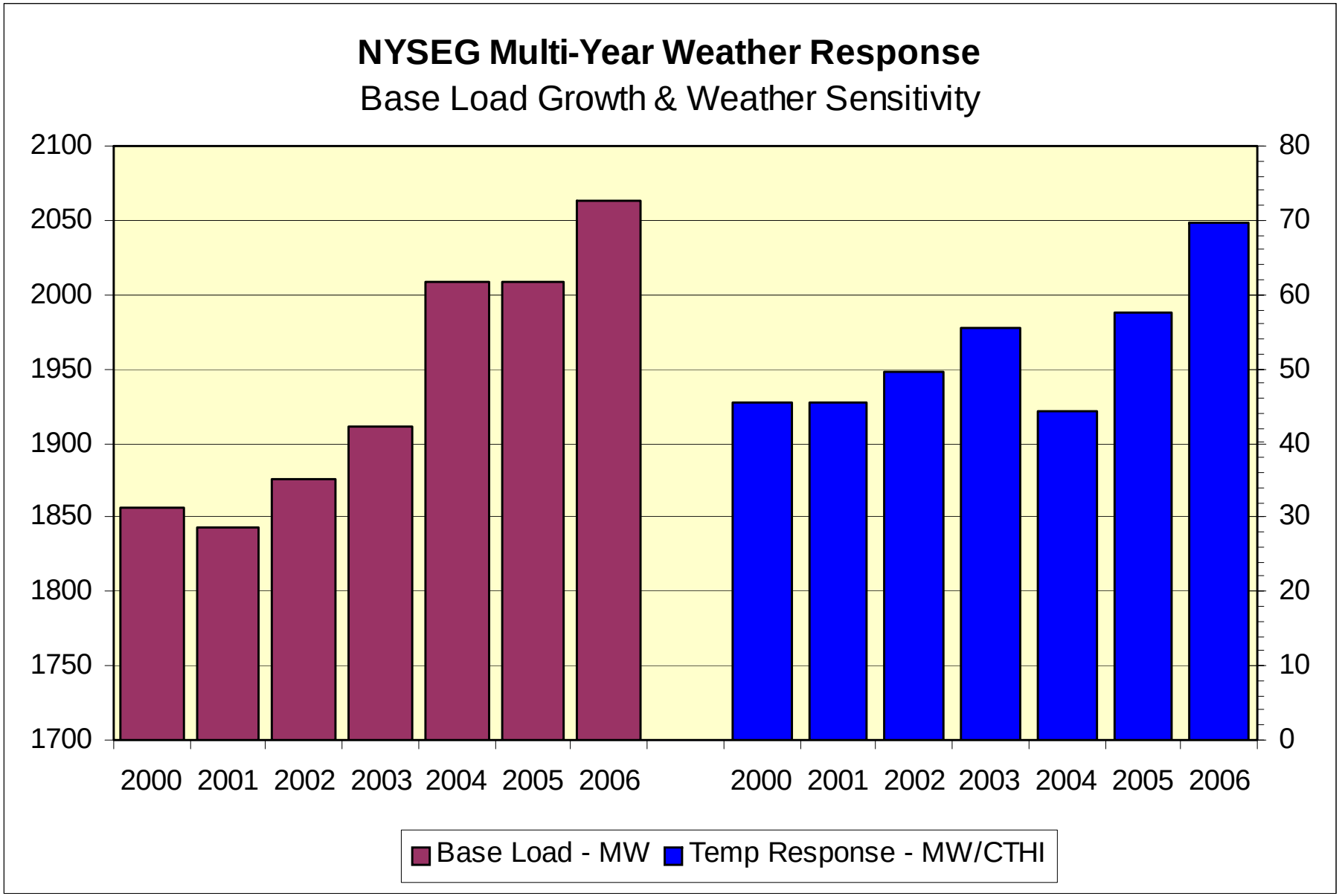
(3) Review of NYISO Estimates of TO Weather Response - 2000 to 2006

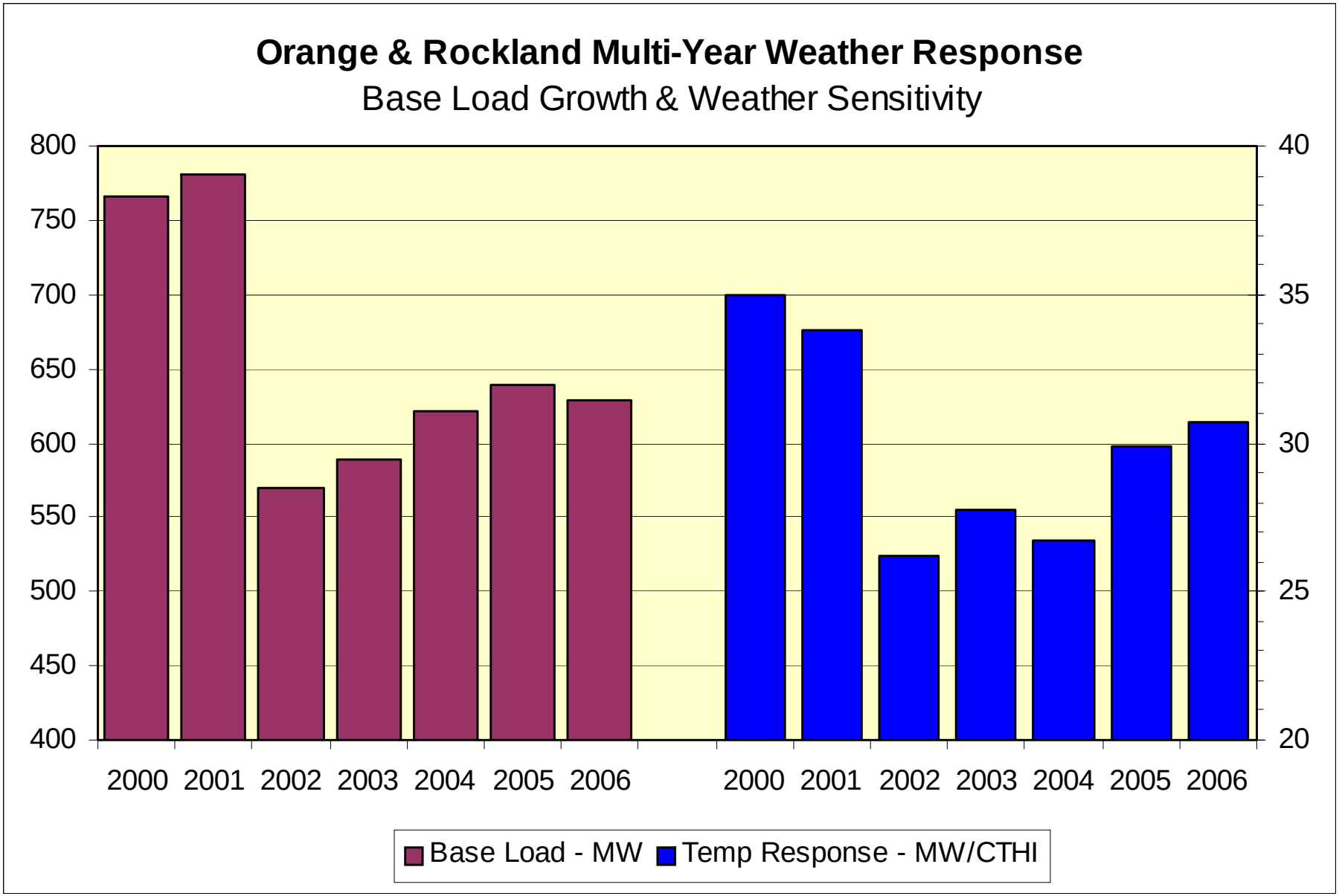

Central Hudson Multi-Year Weather Response
Base Load Growth & Weather Sensitivity
775
750
725
700
675
650
625
600
30
28
26
24
22
20
18
16
2000 2001 2002 2003 2004 2005 2006
2000 2001 2002 2003 2004 2005 2006
Base Load - MW
Temp Response - MW/CTHI

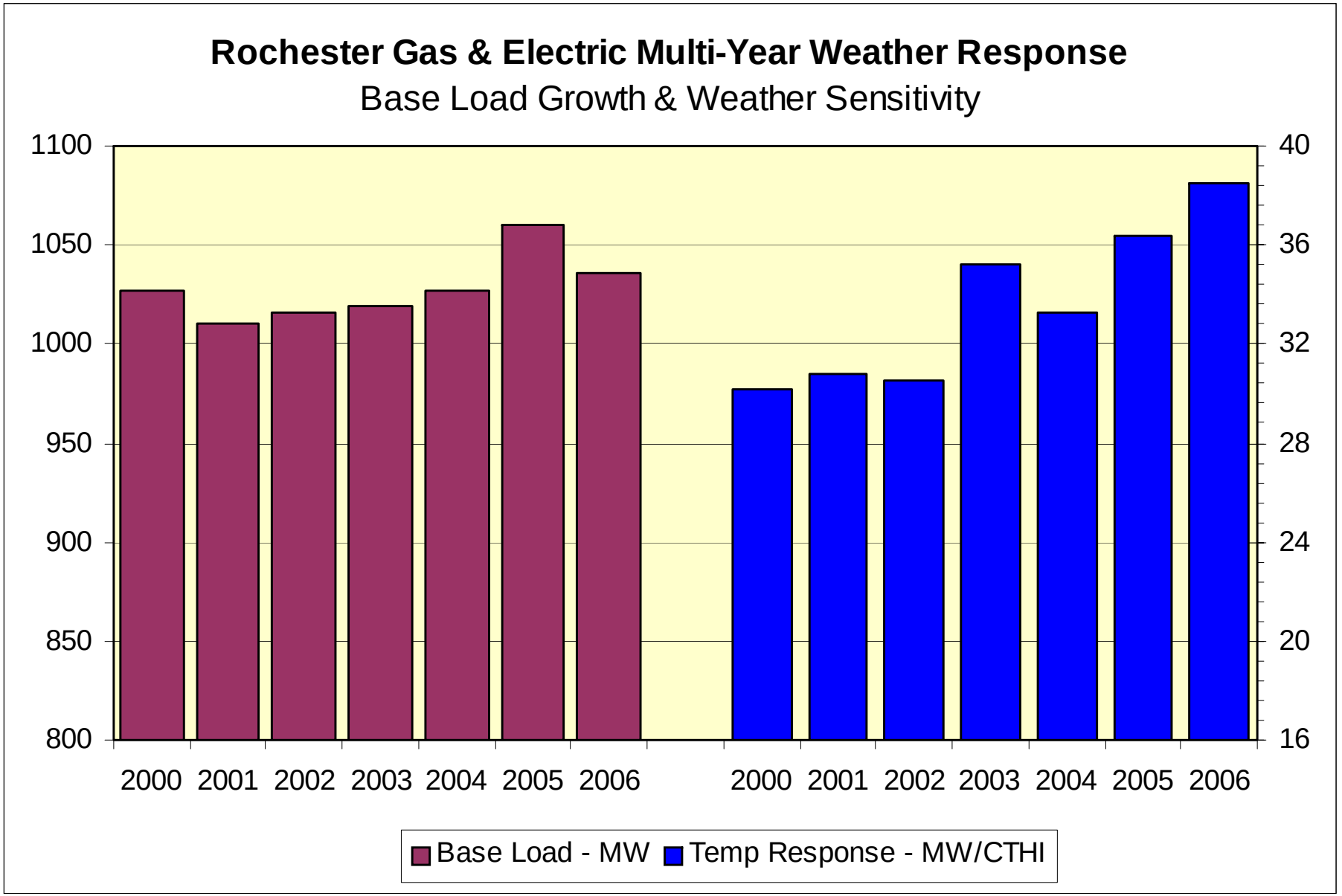

Consolidated Edison Multi-Year Weather Response
Base Load Growth & Weather Sensitivity
8300
8200
8100
8000
7900
7800
7700
7600
270
260
250
240
230
220
210
200
2000 2001 2002 2003 2004 2005 2006
2000 2001 2002 2003 2004 2005 2006
Base Load - MW
Temp Response - MW/CTHI


Long Island Multi-Year Weather Response
Base Load Growth & Weather Sensitivity
2900
2800
2700
2600
2500
2400
150
140
130
120
110
100
2000 2001 2002 2003 2004 2005 2006
2000 2001 2002 2003 2004 2005 2006
Base Load - MW
Temp Response - MW/CTHI

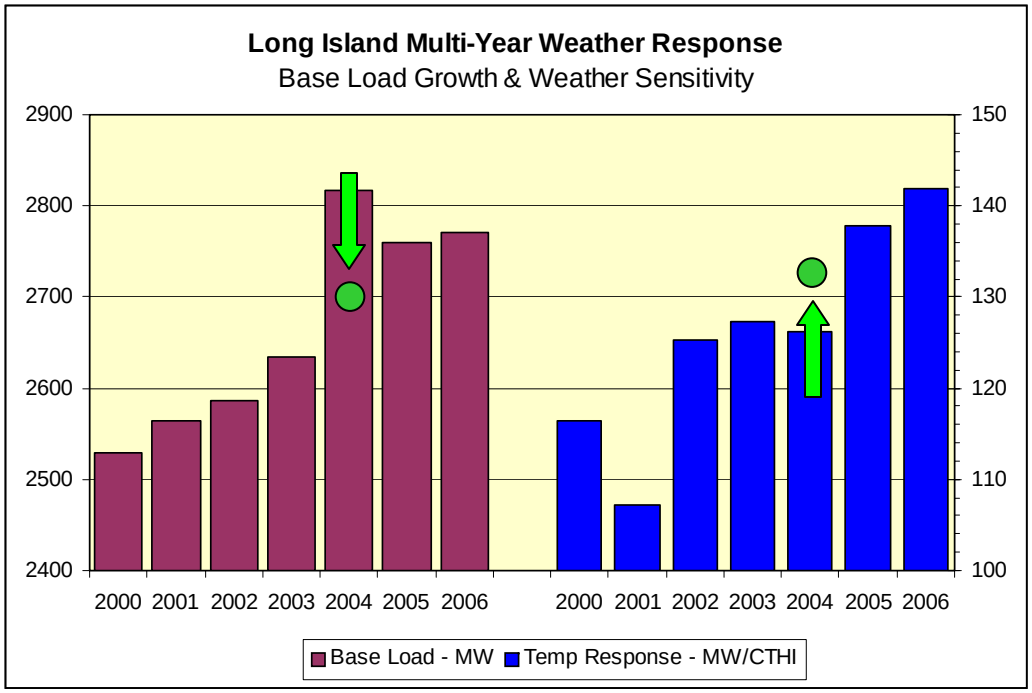

National Grid Multi-Year Weather Response
Base Load Growth & Weather Sensitivity
5200
5100
5000
4900
4800
4700
4600
4500
4400
140
120
100
80
60
40
20
2000 2001 2002 2003 2004 2005 2006
2000 2001 2002 2003 2004 2005 2006
Base Load - MW
Temp Response - MW/CTHI


NYSEG Multi-Year Weather Response
Base Load Growth & Weather Sensitivity
2100
2050
2000
1950
1900
1850
1800
1750
1700
80
70
60
50
40
30
20
10
0
2000 2001 2002 2003 2004 2005 2006
2000 2001 2002 2003 2004 2005 2006
Base Load - MW
Temp Response - MW/CTHI

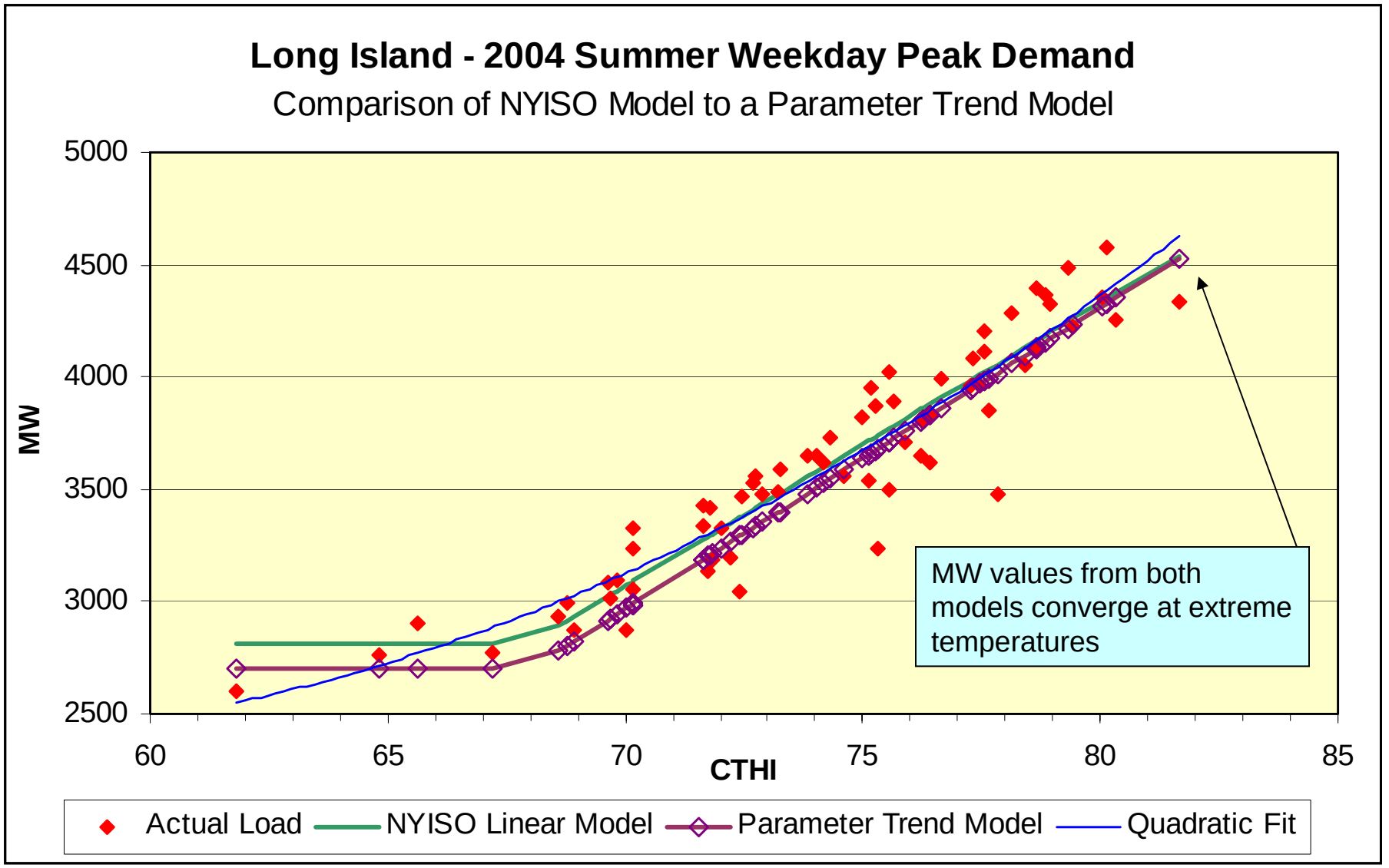

Orange & Rockland Multi-Year Weather Response
Base Load Growth & Weather Sensitivity
800
750
700
650
600
550
500
450
400
40
35
30
25
20
2000 2001 2002 2003 2004 2005 2006
2000 2001 2002 2003 2004 2005 2006
Base Load - MW
Temp Response - MW/CTHI

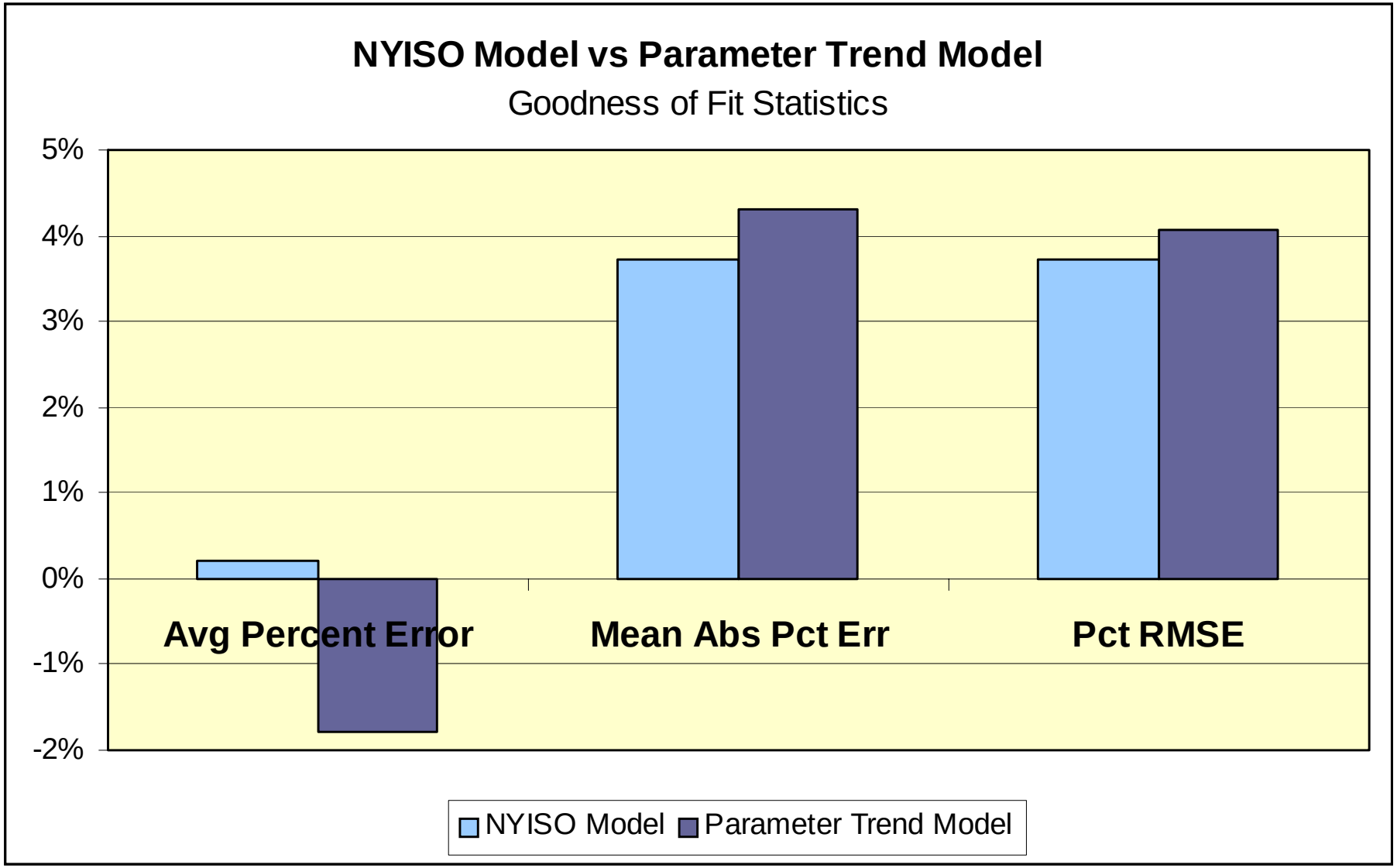

Rochester Gas & Electric Multi-Year Weather Response
Base Load Growth & Weather Sensitivity
1100
1050
1000
950
900
850
800
40
36
32
28
24
20
16
2000 2001 2002 2003 2004 2005 2006
2000 2001 2002 2003 2004 2005 2006
Base Load - MW
Temp Response - MW/CTHI

(4) Critique of NYISO Parameter Estimates for 2004



- NYISO models may seem to over-state base load & under-state weather-sensitivity in 2004, compared to 2003 & 2005.
- If 2004 weather-sensitivity were higher, then perhaps 2004 WN peak would be higher too.
- So what would happen if a NYISO 2004 model was replaced by one whose parameters trended between 2003 & 2005?
- We will consider the equation MW = 2700 + 134 * (CTHI – 68) for Long Island.....


Long Island - 2004 Summer Weekday Peak Demand
Comparison of NYISO Model to a Parameter Trend Model
5000
4500
4000
3500
3000
2500
MW
60
65
70
75
80
85
CTHI
MW values from both models converge at extreme temperatures
Actual Load
NYISO Linear Model
Parameter Trend Model
Quadratic Fit

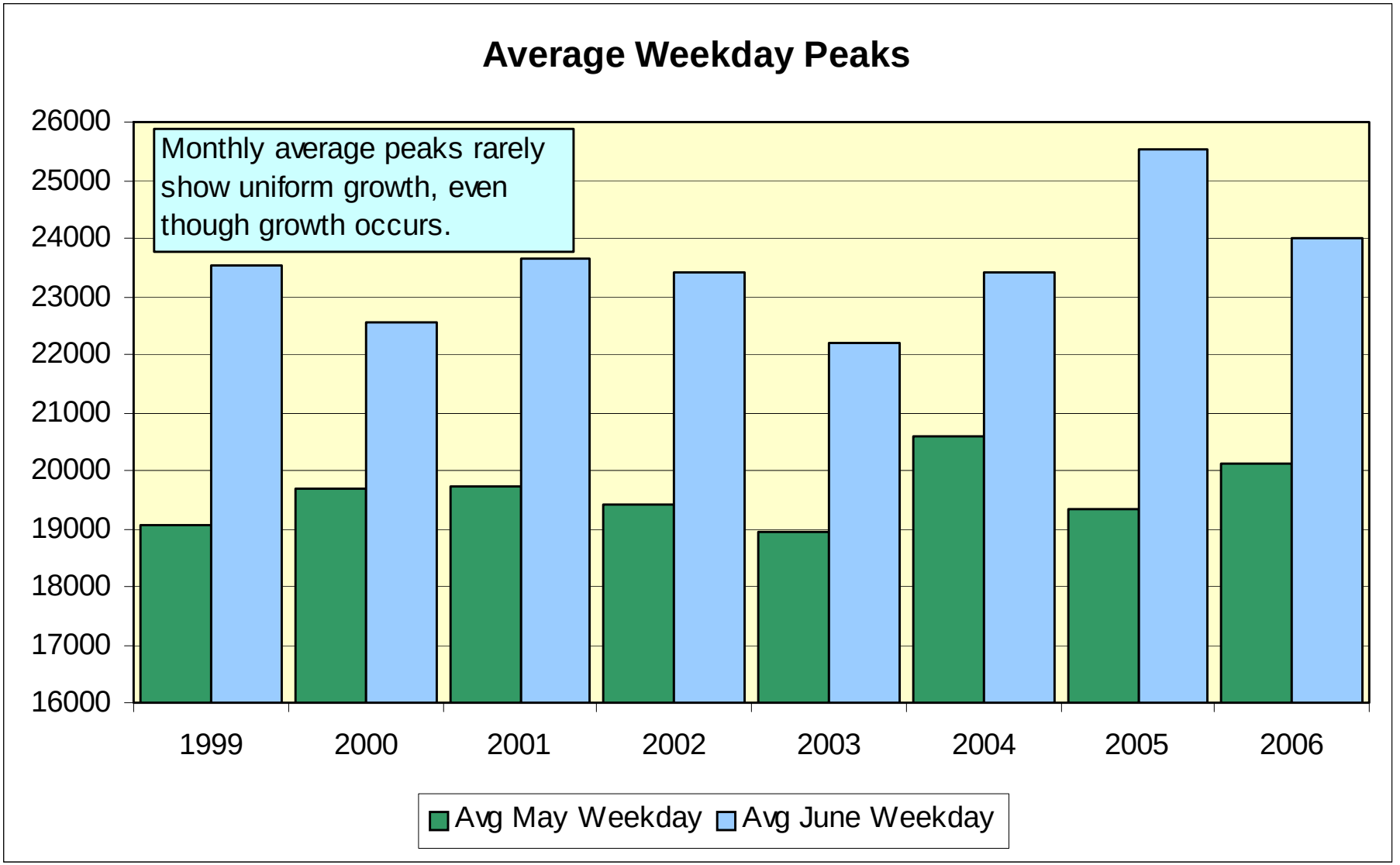

NYISO Model vs Parameter Trend Model
Goodness of Fit Statistics
5%
4%
3%
2%
1%
0%
-1%
-2%
Avg Percent Error
Mean Abs Pct Err
Pct RMSE
NYISO Model
Parameter Trend Model

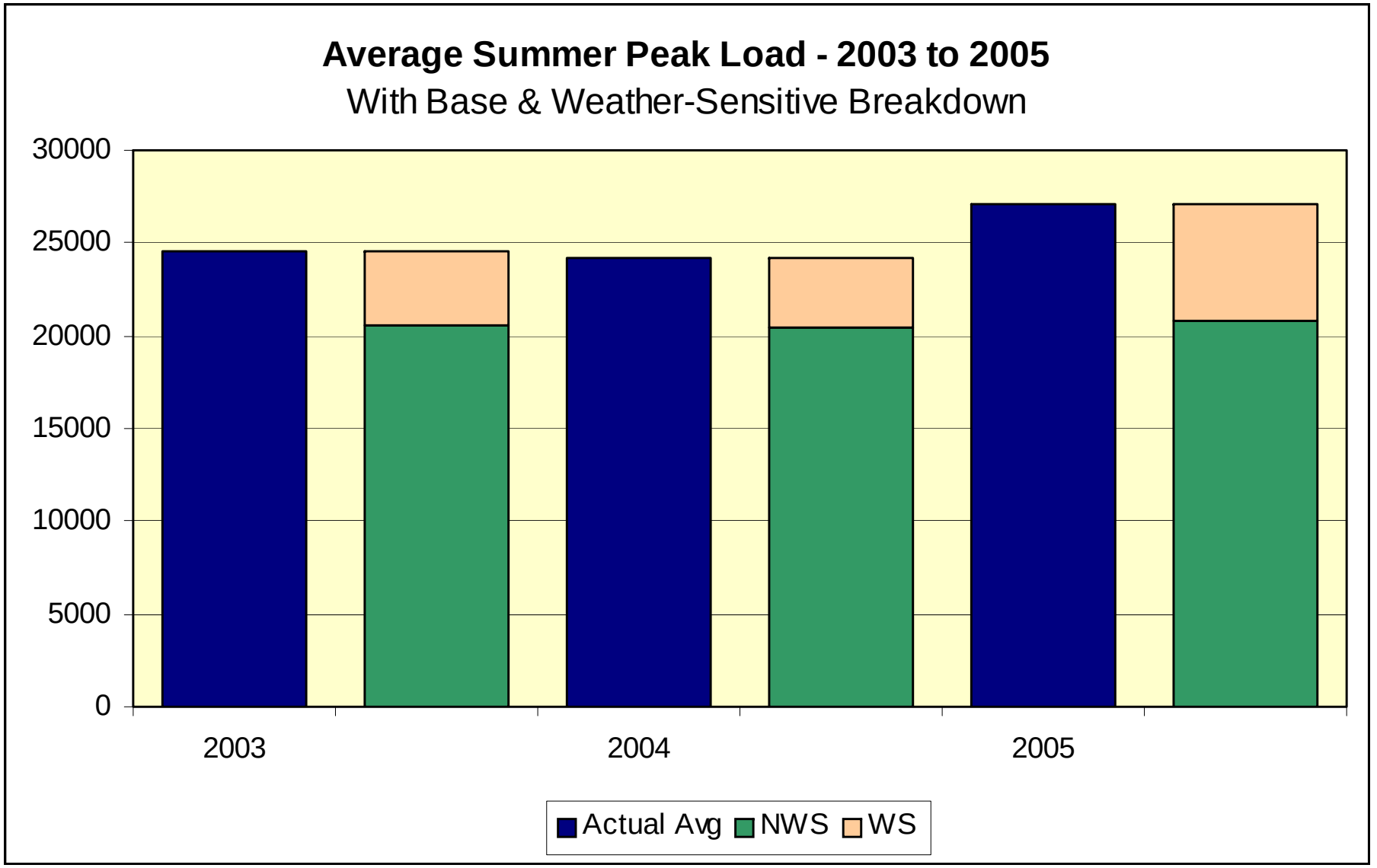
Results of Model Comparison

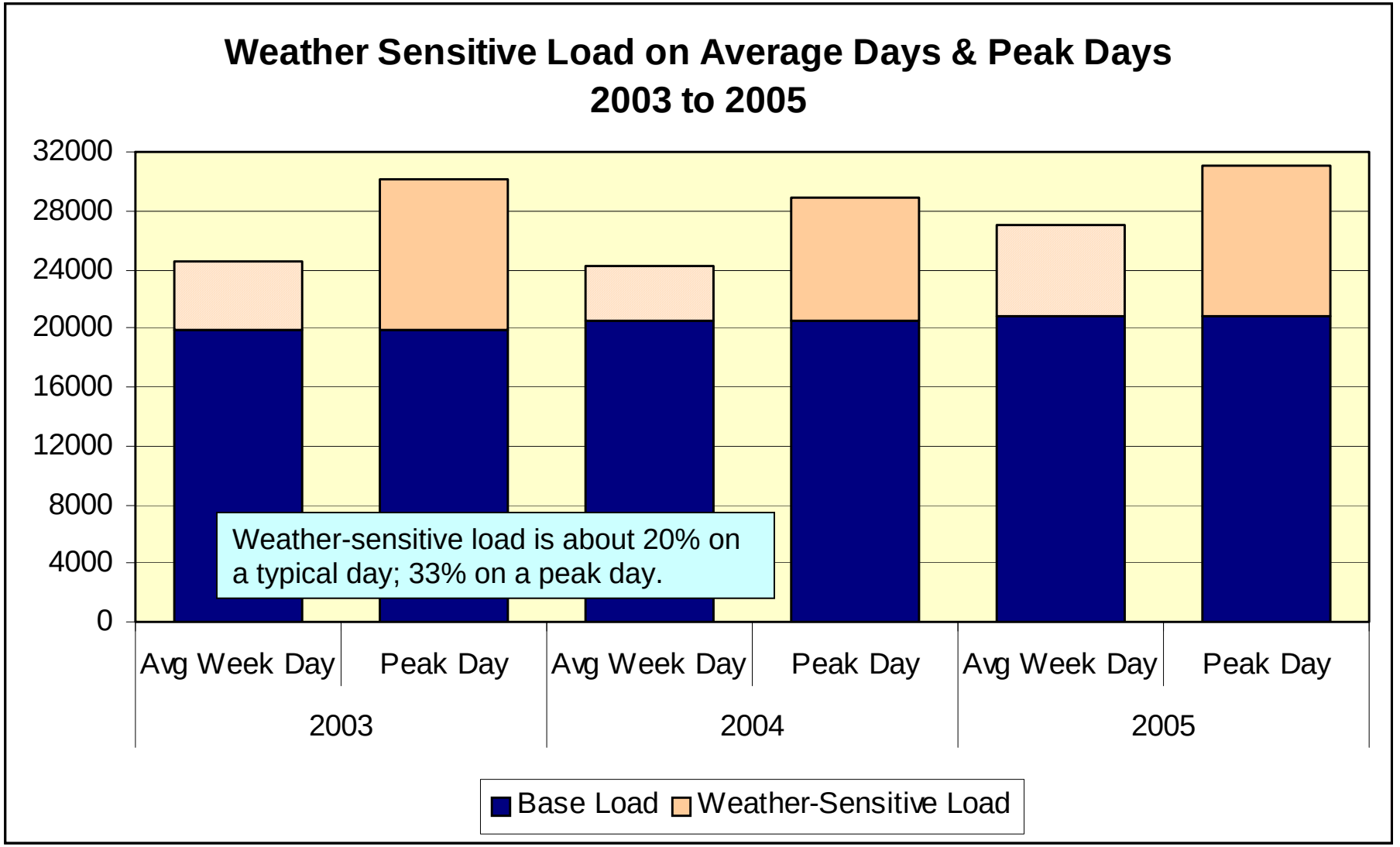
1. NYISO model is unbiased, while the parameter trend model under-predicts at most load levels.
2. NYISO model has slightly better mean absolute percent error (MAPE) and root mean square error (RMSE).
3. Both models predict essentially the same peak at high values of CTHI. Net effect of parameter changes is 0.
4. A parameter trend model is judgmental & of poorer quality and is therefore rejected.
5. The NYISO's statistical measure of weather response decreased from 2003 to 2004 for every TO, then increased in 2005. This is very difficult to explain away.
6. The result may be counter-intuitive, but it is statistically valid.

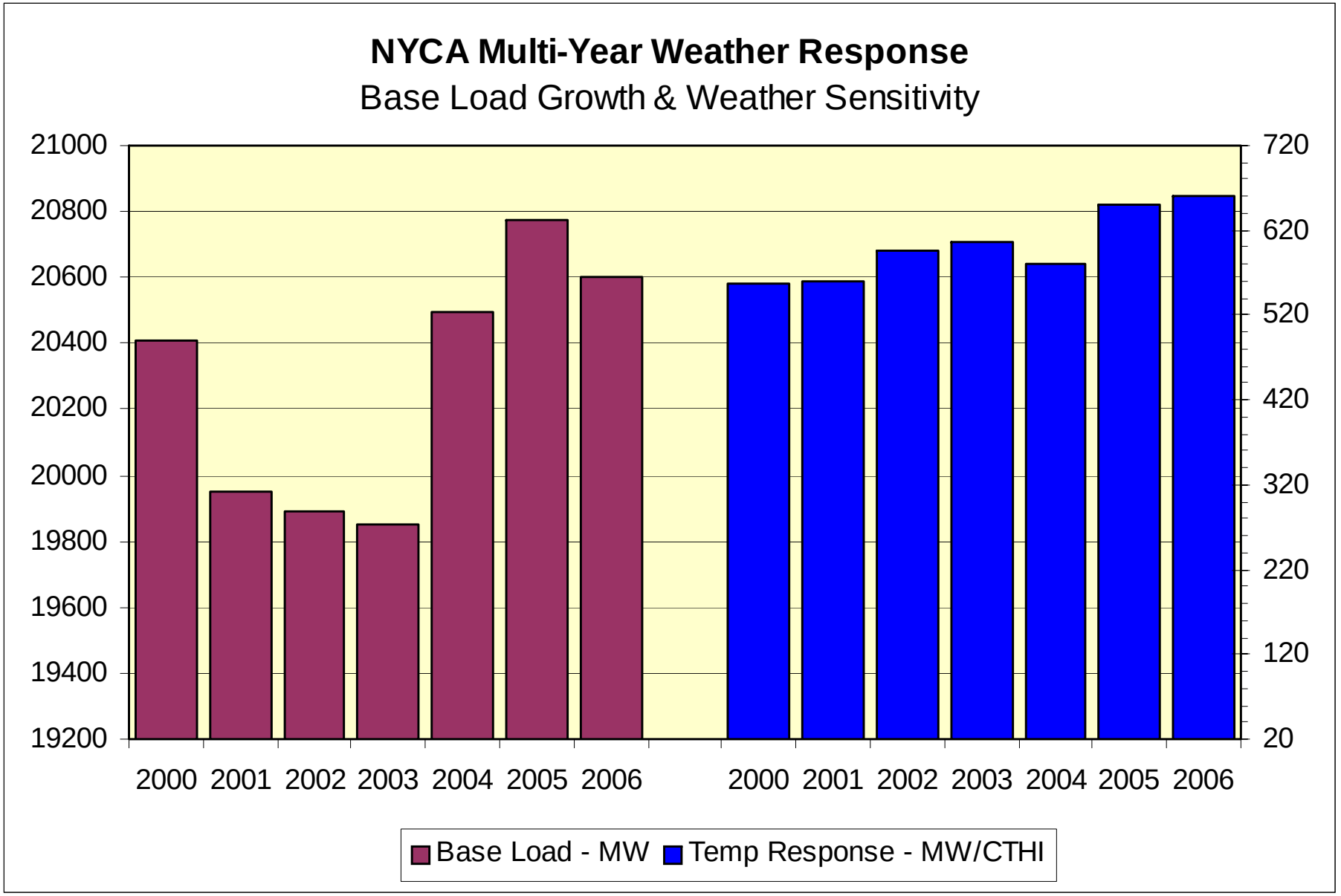
(5) Further Review of NYISO Results for 2000 to 2006

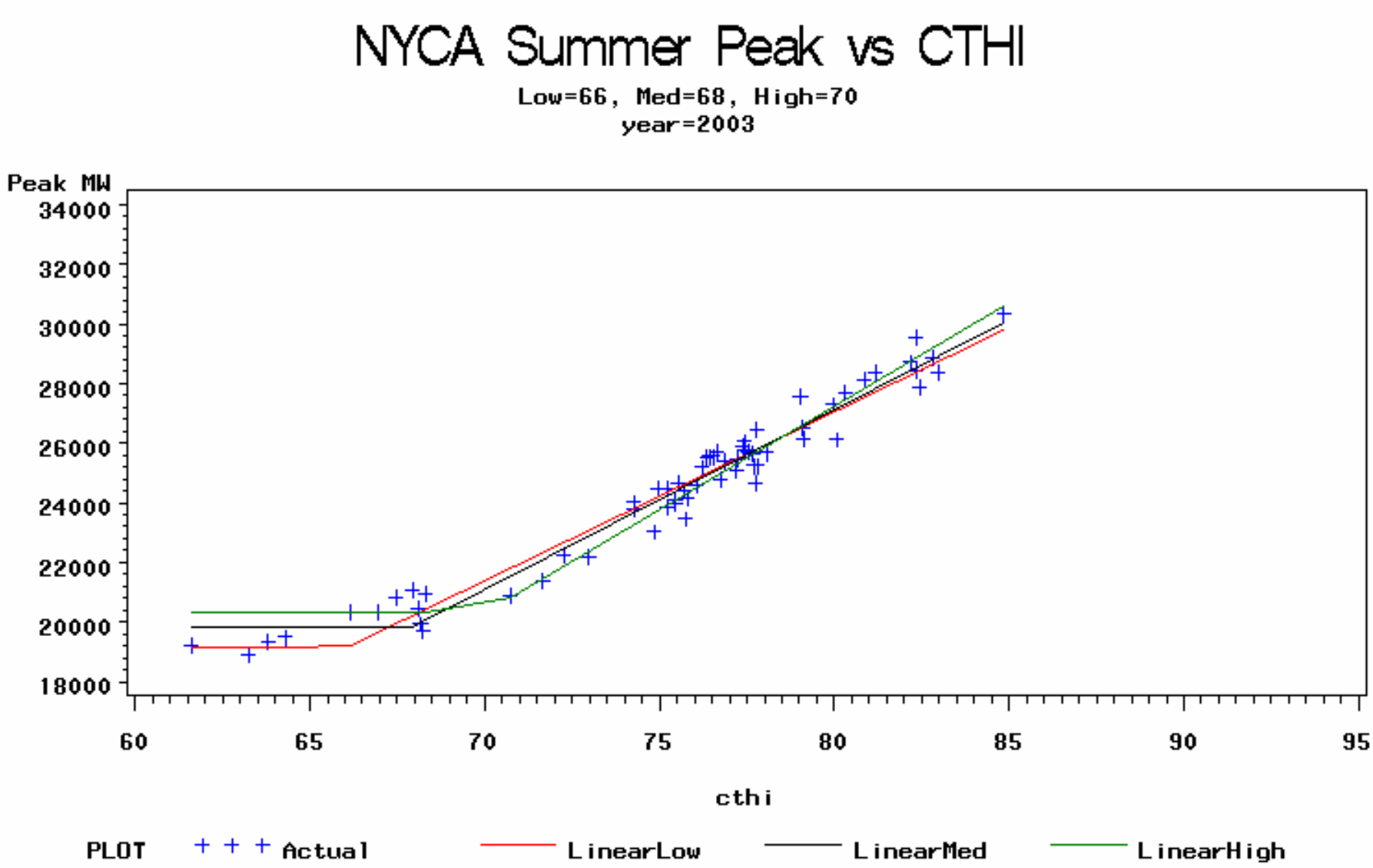
1. NYISO model tracks daily pattern of peak loads each summer.
2. NYISO model finds same behavior in 2004 as was found in each TO: lower weather response in 2004.
3. NYISO model is +/-2.5% accurate on peak day from 2000 to 2006, which is appropriate for a screening tool.
4. NYISO's day-ahead forecasting model is more accurate but also much more complex.
5. A more complex model must specify peak-producing conditions for each variable in the model, and is therefore less desirable as a screening tool.


Average Weekday Peaks
Monthly average peaks rarely show uniform growth, even though growth occurs.
26000
25000
24000
23000
22000
21000
20000
19000
18000
17000
16000
1999
2000
2001
2002
2003
2004
2005
2006
Avg May Weekday
Avg June Weekday


Average Summer Peak Load - 2003 to 2005
With Base & Weather-Sensitive Breakdown
30000
25000
20000
15000
10000
5000
0
2003
2004
2005
Actual Avg
NWS
WS

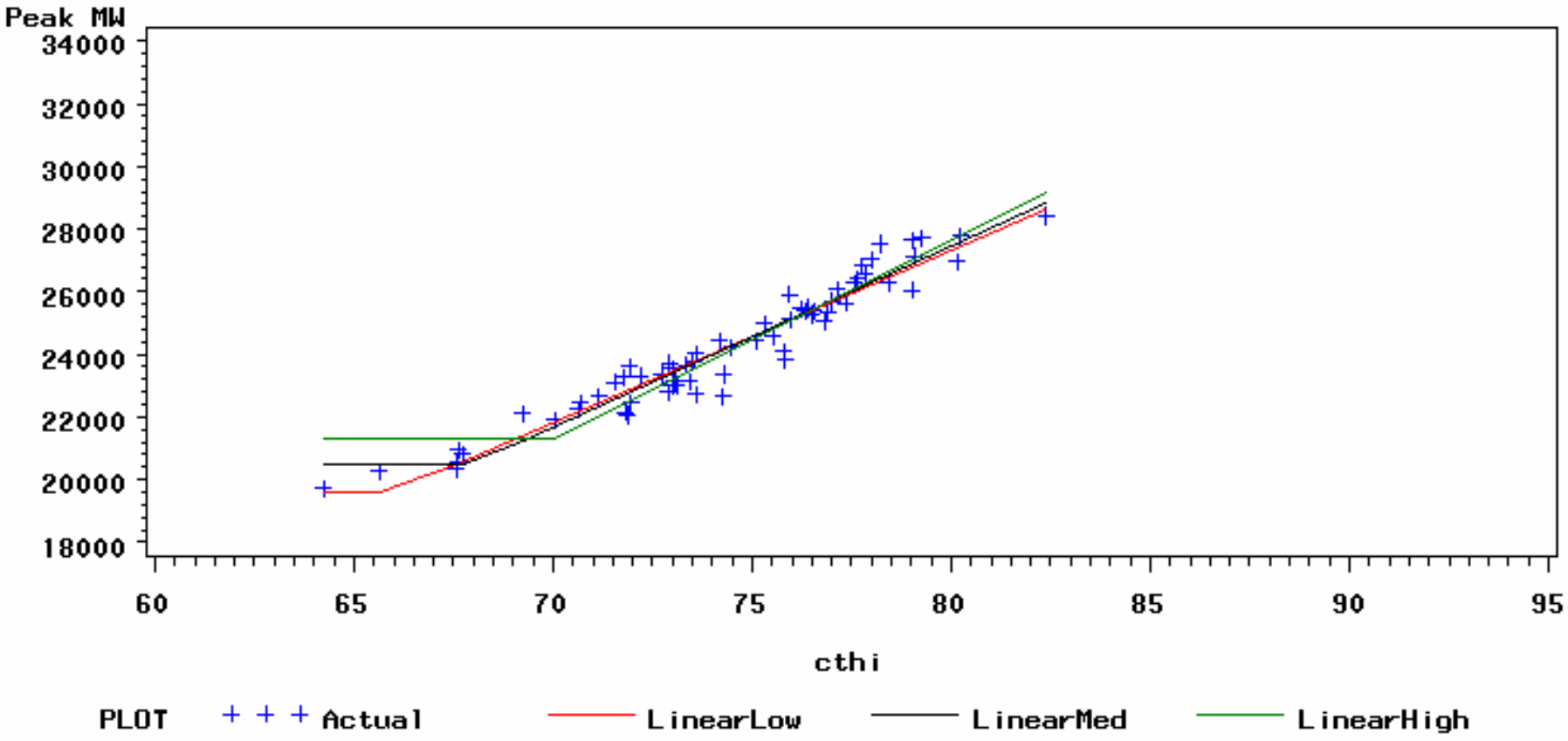

Weather Sensitive Load on Average Days & Peak Days
2003 to 2005
32000
28000
24000
20000
16000
12000
8000
4000
0
Weather-sensitive load is about 20% on a typical day; 33% on a peak day.
Avg Week Day
Peak Day
Avg Week Day
Peak Day
Avg Week Day
Peak Day
2003
2004
2005
Base Load
Weather-Sensitive Load

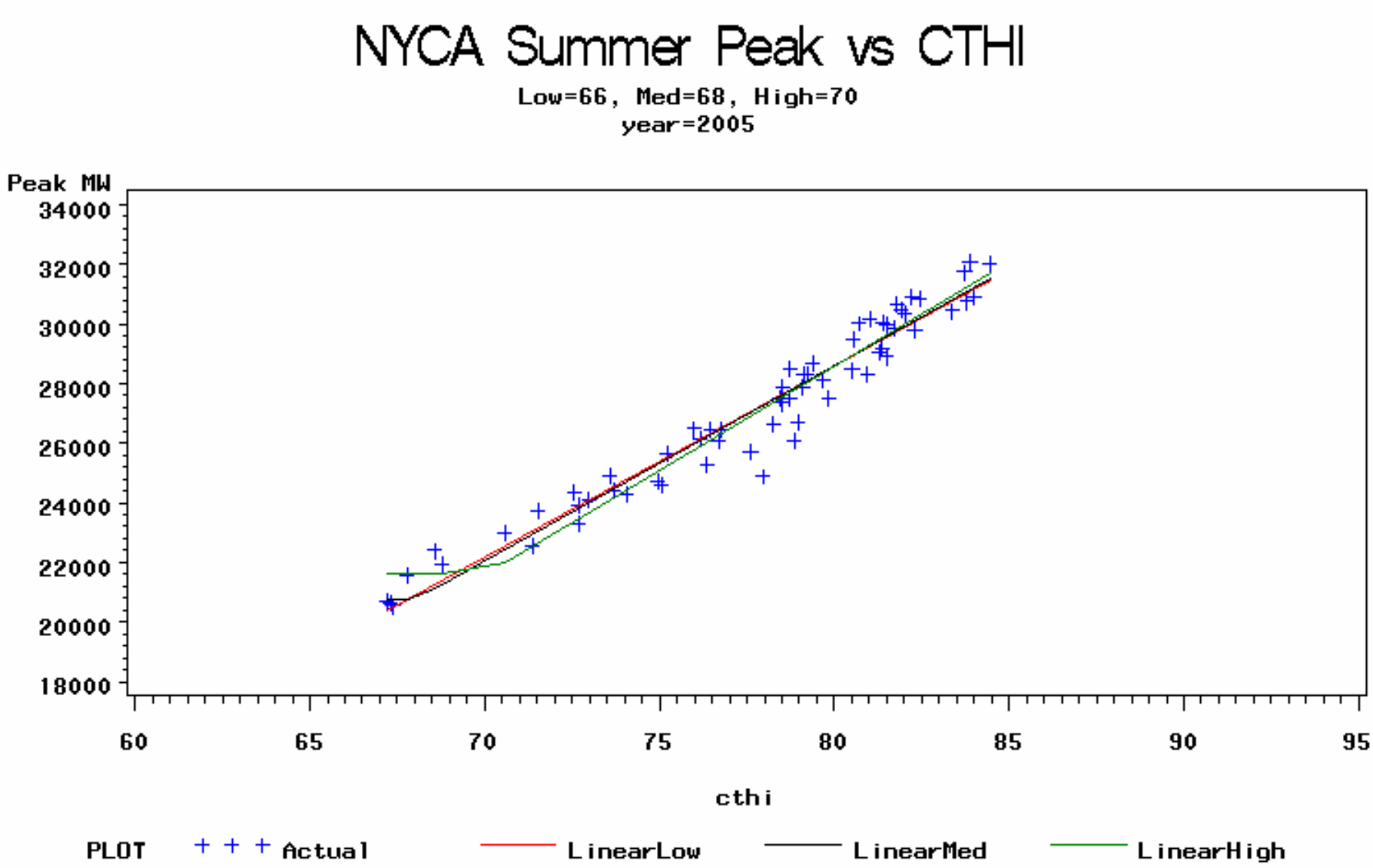

NYCA Multi-Year Weather Response
Base Load Growth & Weather Sensitivity
21000
20800
20600
20400
20200
20000
19800
19600
19400
19200
720
620
520
420
320
220
120
20
2000 2001 2002 2003 2004 2005 2006
2000 2001 2002 2003 2004 2005 2006
Base Load - MW
Temp Response - MW/CTHI

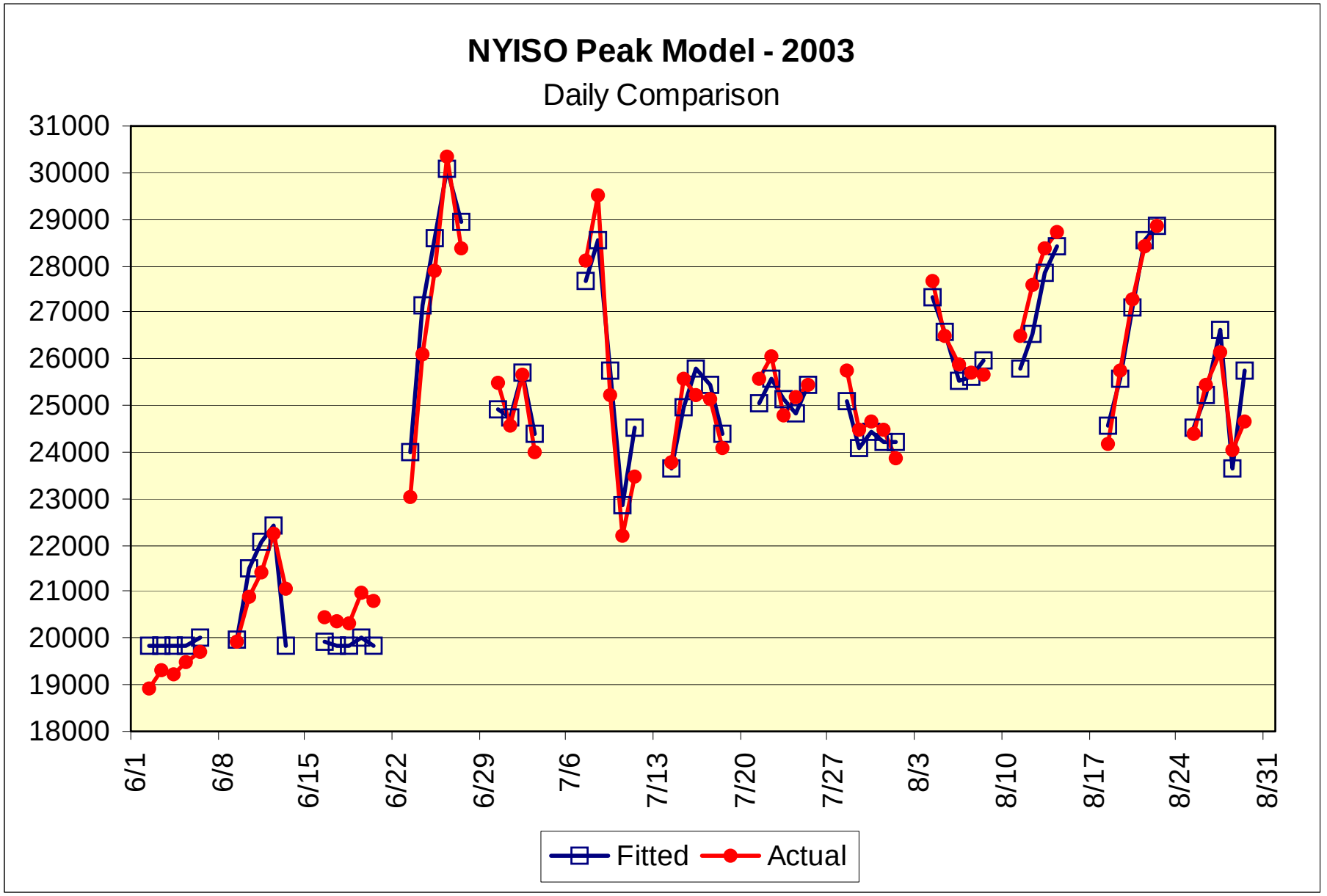

NYCA Summer Peak vs CTHI
Low=66, Med=68, High=70
year=2003
Peak MW
34000
32000
30000
28000
26000
24000
22000
20000
18000
60
65
70
75
80
85
90
95
cthi
PLOT
Actual
LinearLow
LinearMed
LinearHigh

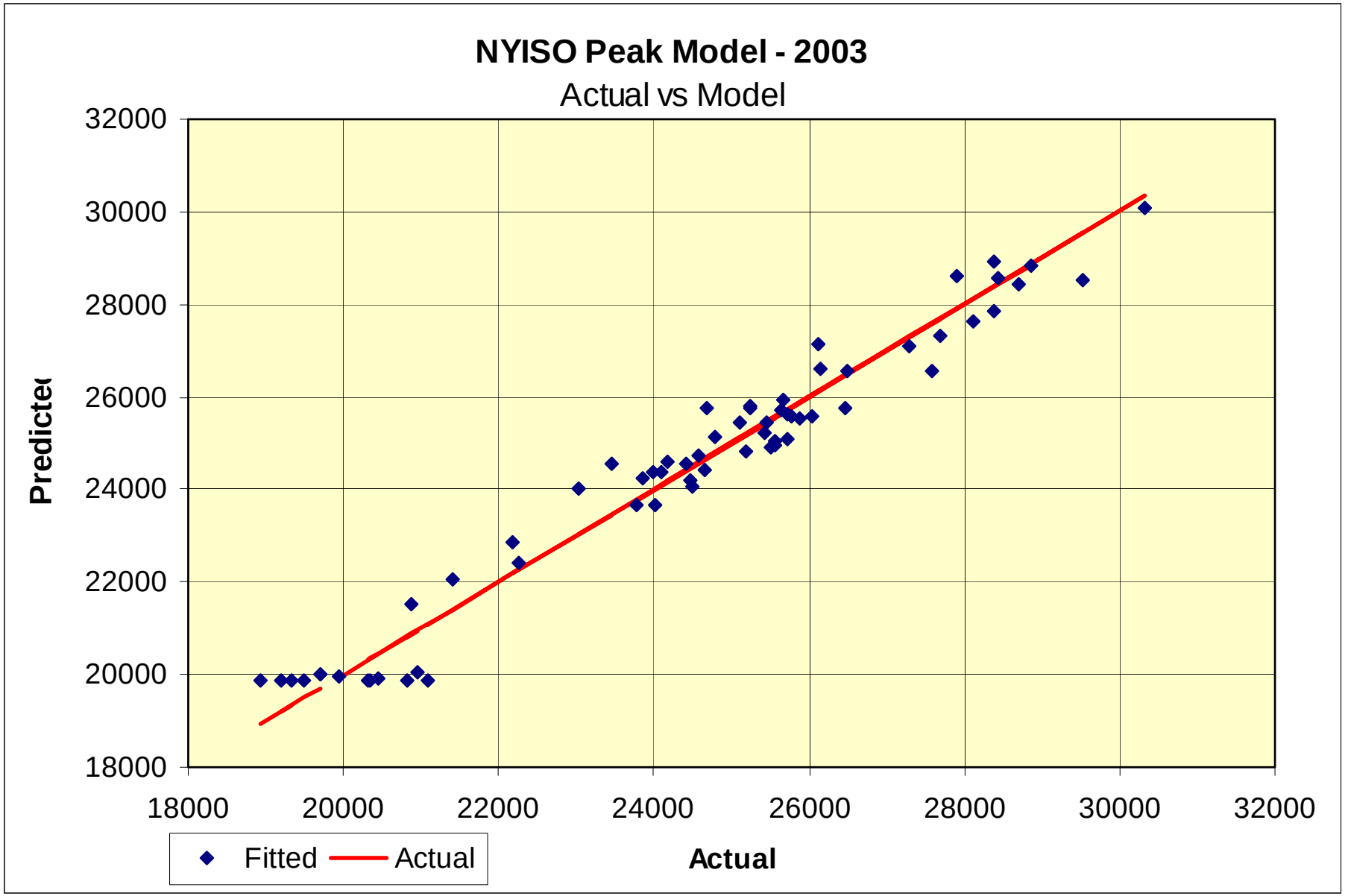
NYCA Summer Peak vs CTHI

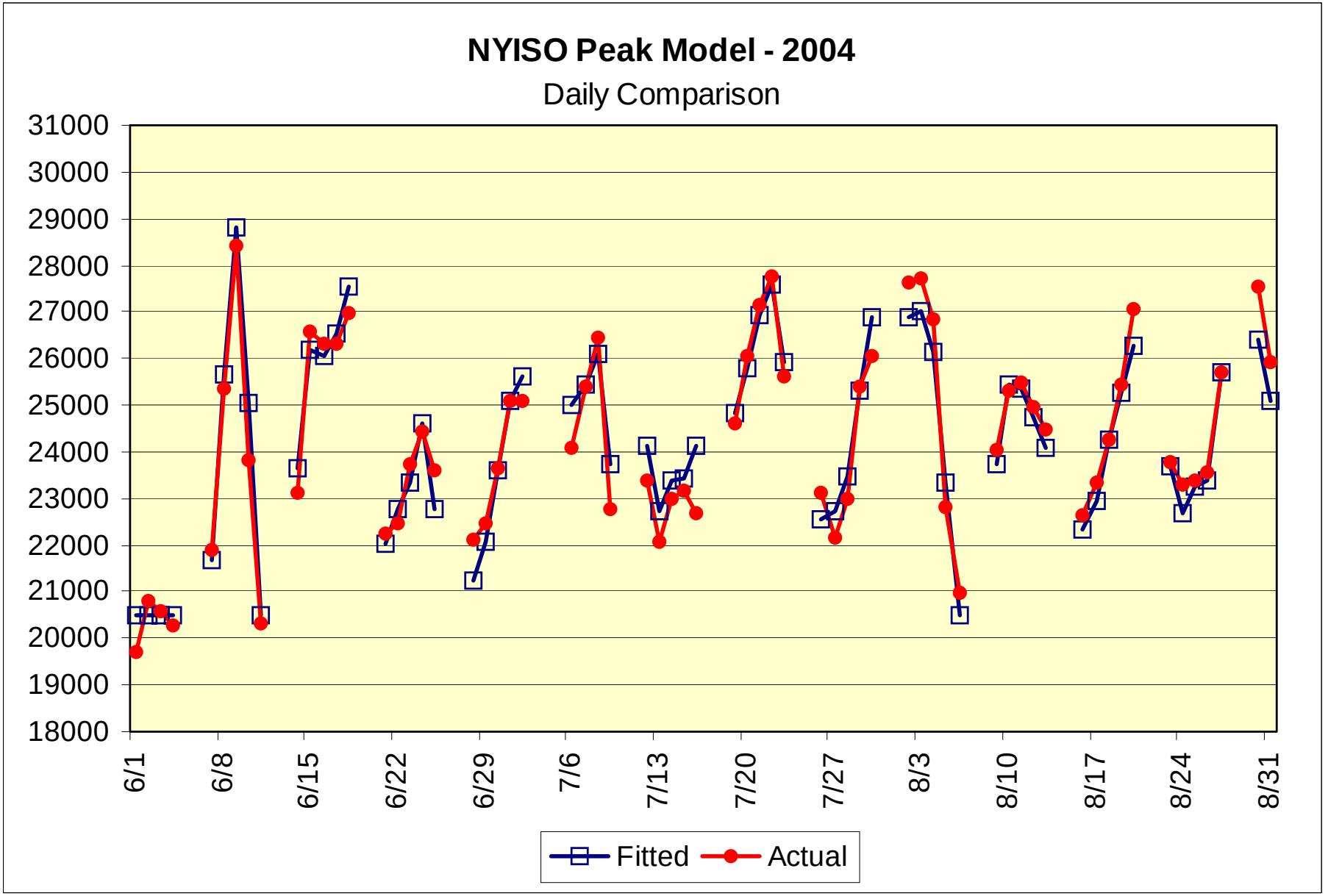
Low=66, Med=68, High=70
year=2004




NYCA Summer Peak vs CTHI
Low=66, Med=68, High=70
year=2005
Peak MW
34000
32000
30000
28000
26000
24000
22000
20000
18000
60
65
70
75
80
85
90
95
cthi
PLOT
Actual
LinearLow
LinearMed
LinearHigh


NYISO Peak Model - 2003
Daily Comparison
31000
30000
29000
28000
27000
26000
25000
24000
23000
22000
21000
20000
19000
18000
6/1
6/8
6/15
6/22
6/29
7/6
7/13
7/20
7/27
8/3
8/10
8/17
8/24
8/31
Fitted
Actual


NYISO Peak Model - 2003
Actual vs Model
Predicted
32000
30000
28000
26000
24000
22000
20000
18000
18000
20000
22000
24000
26000
28000
30000
32000
Actual
Fitted
Actual


NYISO Peak Model - 2004
Daily Comparison
31000
30000
29000
28000
27000
26000
25000
24000
23000
22000
21000
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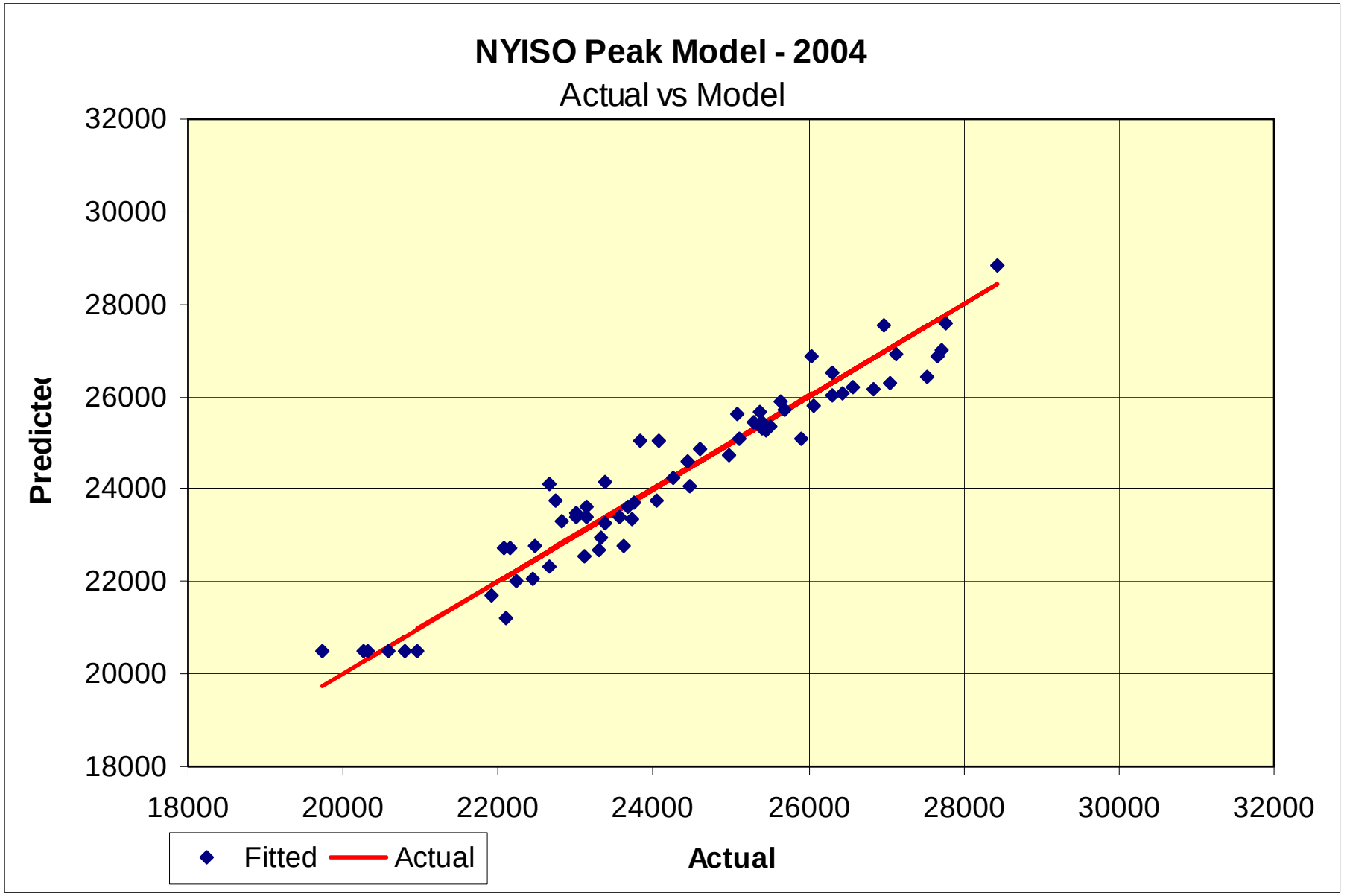
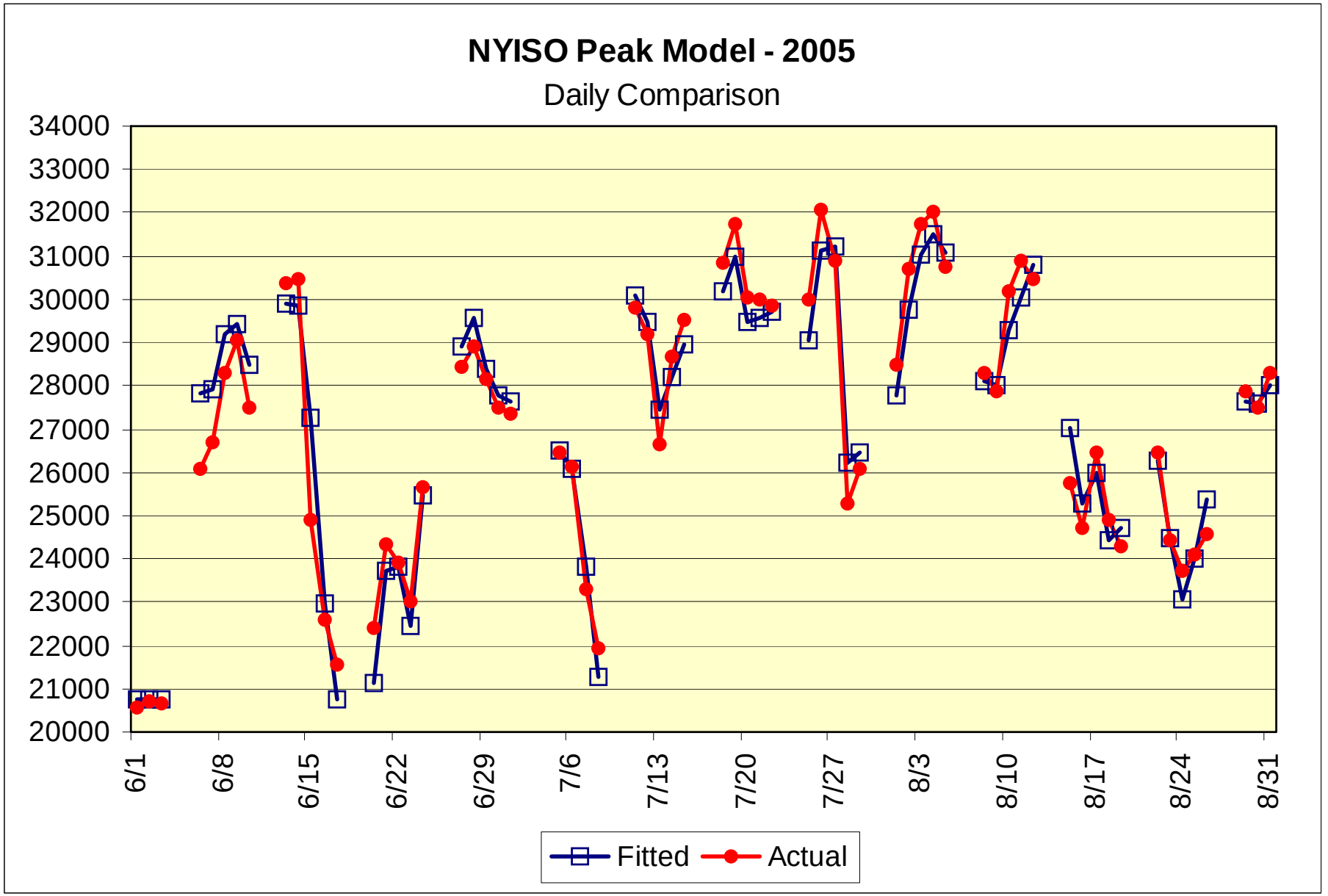
19000
18000
6/1
6/8
6/15
6/22
6/29
7/6
7/13
7/20
7/27
8/3
8/10
8/17
8/24
8/31
Fitted
Actual


NYISO Peak Model - 2004
Actual vs Model
Predicted
32000
30000
28000
26000
24000
22000
20000
18000
18000
20000
22000
24000
26000
28000
30000
32000
Actual
Fitted
Actual


NYISO Peak Model - 2005
Daily Comparison
34000
33000
32000
31000
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28000
27000
26000
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24000
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21000
20000
6/1
6/8
6/15
6/22
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7/13
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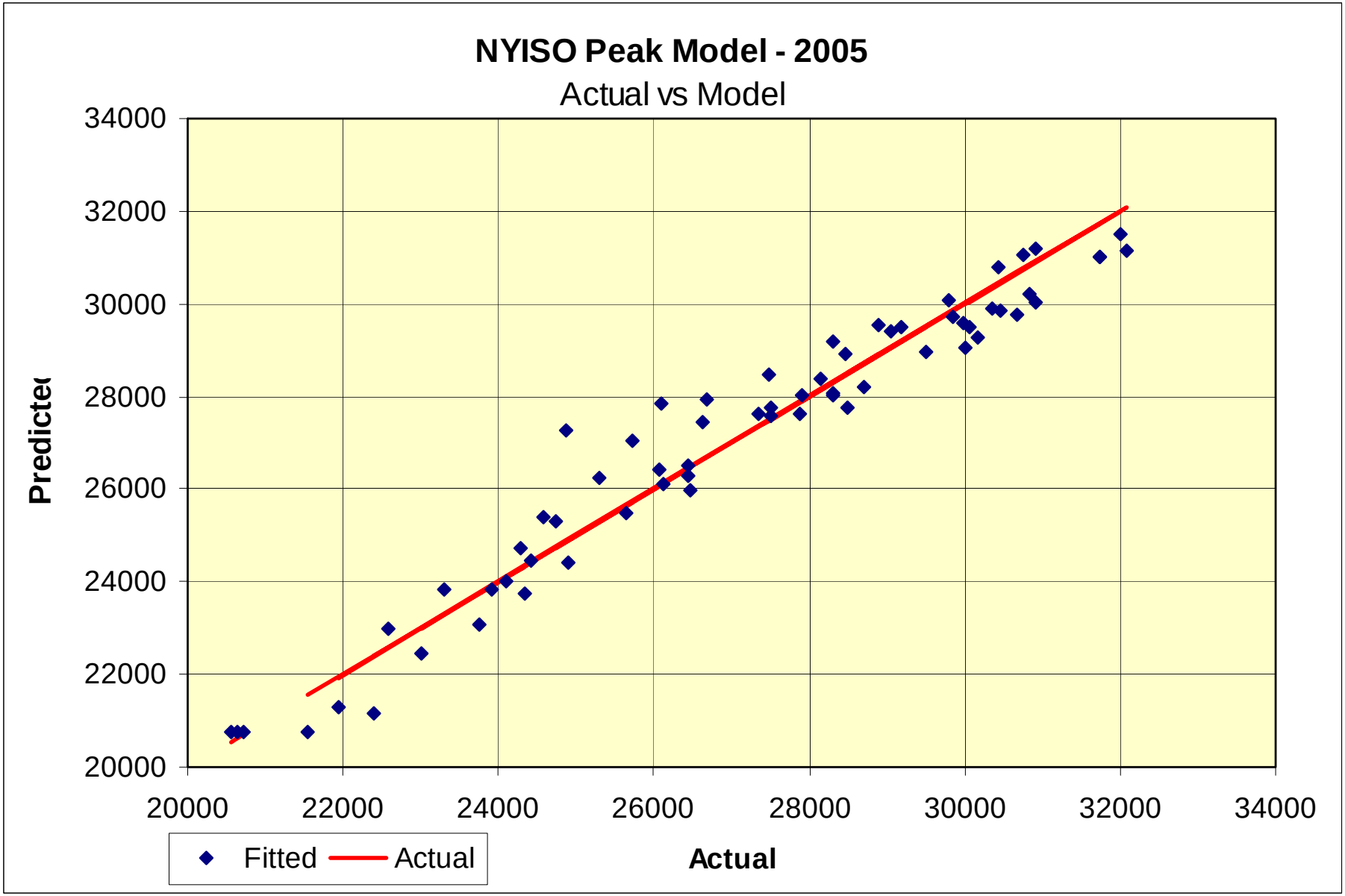
8/3
8/10
8/17
8/24
8/31
Fitted
Actual


NYISO Peak Model - 2005
Actual vs Model
Predicted
34000
32000
30000
28000
26000
24000
22000
20000
20000
22000
24000
26000
28000
30000
32000
34000
Fitted
Actual
Actual