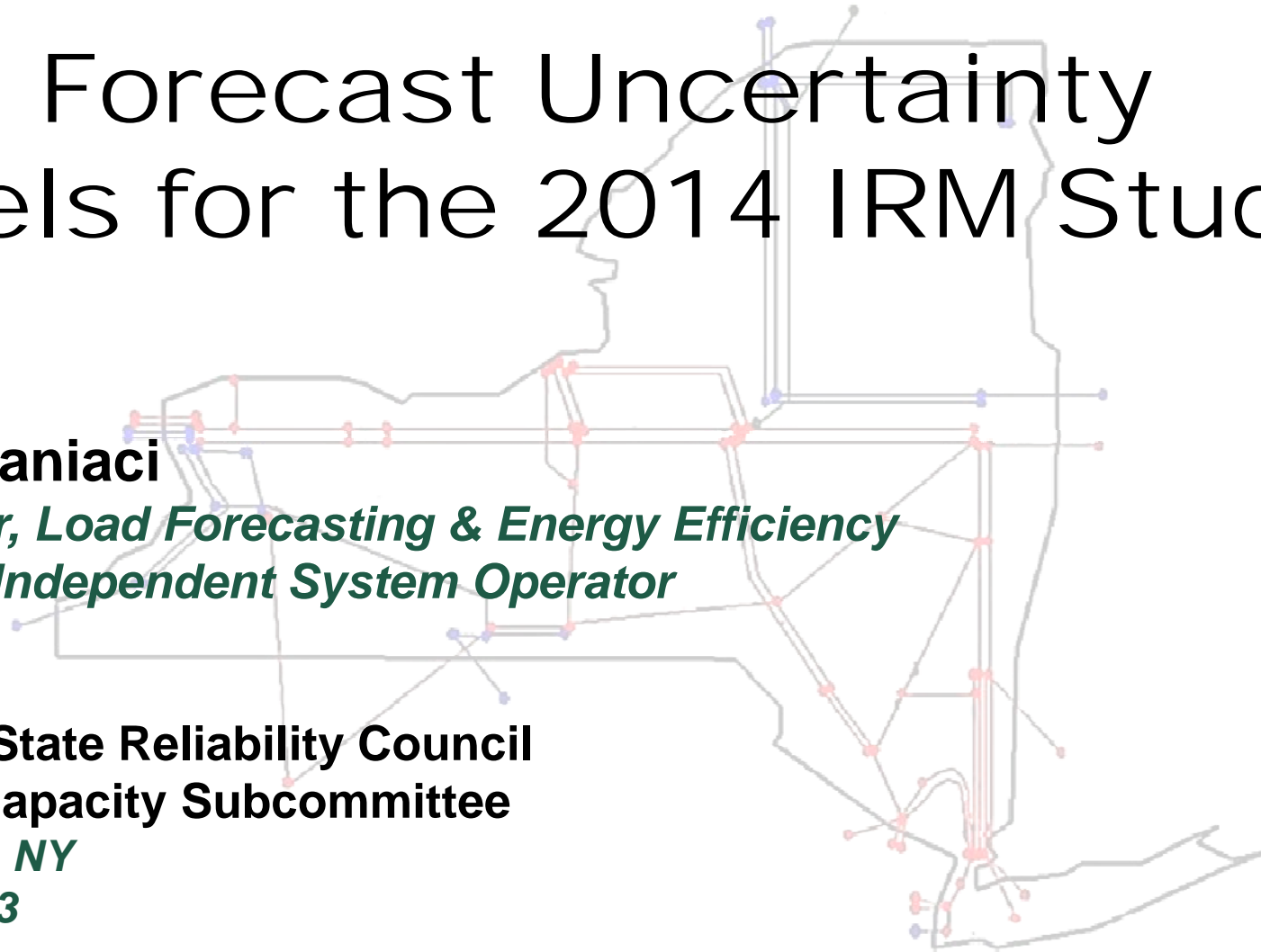


Load Forecast Uncertainty Models for the 2014 IRM Study

Arthur Maniaci

*Supervisor, Load Forecasting & Energy Efficiency
New York Independent System Operator*

**New York State Reliability Council
Installed Capacity Subcommittee
Rensselaer, NY
June 5, 2013**



Overview

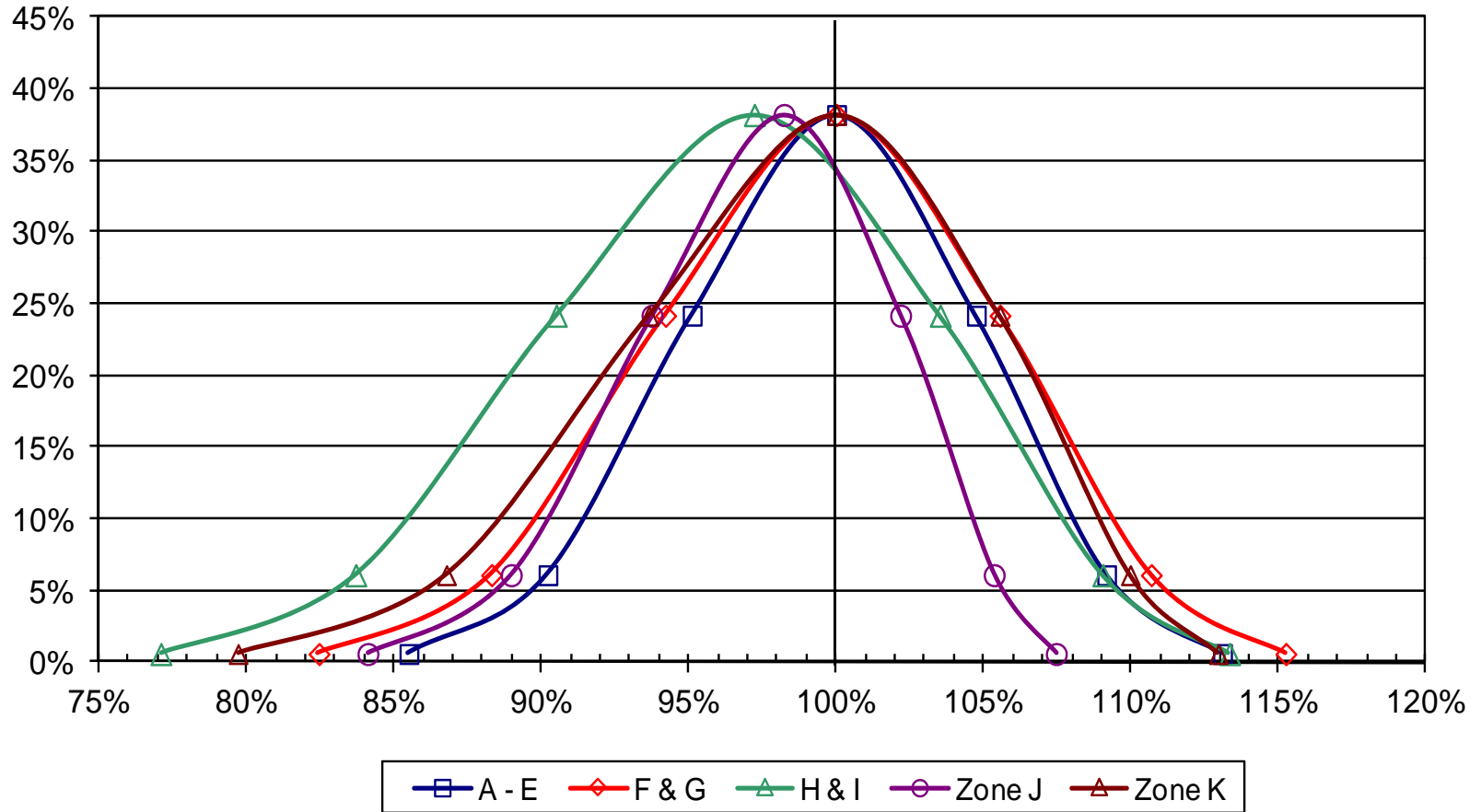
- 1. Summary of 2014 Load Forecast Uncertainty Models**
- 2. NYISO LFU Model for Zones A to E**
- 3. NYISO LFU Model for Zones F & G**
- 4. NYISO LFU Models for Zones H-I and J**
- 5. NYISO LFU Model for Zone K**

(1) Summary of 2014 Load Forecast Uncertainty Models

Recommended 2014 LFU Models

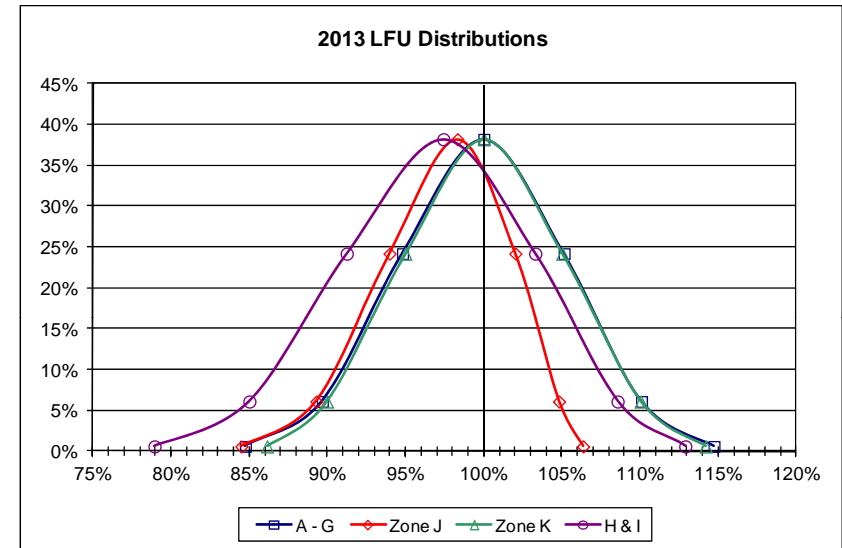
2014 Load Forecast Uncertainty Models						
Bin No.	Probability	A - E	F&G	H & I	Zone J	Zone K
1	0.62%	85.50%	82.45%	77.09%	84.11%	79.71%
2	6.06%	90.21%	88.30%	83.70%	88.97%	86.77%
3	24.17%	95.10%	94.20%	90.50%	93.74%	93.64%
4	38.30%	100.00%	100.00%	97.21%	98.22%	100.00%
5	24.17%	104.74%	105.54%	103.52%	102.17%	105.54%
6	6.06%	109.16%	110.67%	109.03%	105.34%	109.96%
7	0.62%	113.09%	115.24%	113.33%	107.45%	112.95%
	Low - Med	14.5%	17.5%	20.125%	14.1%	20.3%
	Hi-Med	13.1%	15.2%	16.115%	9.2%	12.9%
	Delta	27.6%	32.8%	36.240%	23.3%	33.2%

2014 LFU Distributions



2013 LFU Models for Comparison

2013 Load Forecast Uncertainty Models					
Bin No.	Probability	A - G	H & I	Zone J	Zone K
1	0.62%	84.75%	78.93%	84.49%	86.13%
2	6.06%	89.67%	85.00%	89.29%	89.96%
3	24.17%	94.80%	91.23%	93.97%	94.98%
4	38.30%	100.00%	97.41%	98.31%	100.00%
5	24.17%	105.14%	103.29%	102.02%	105.02%
6	6.06%	110.09%	108.56%	104.81%	110.04%
7	0.62%	114.73%	112.89%	106.35%	114.20%
Low - Med		15.3%	18.5%	13.8%	13.9%
Hi-Med		14.7%	15.5%	8.0%	14.2%
Delta		30.0%	34.0%	21.9%	28.1%



2014 vs 2013

Area	2013		2014	
	Low	High	Low	High
A-E	84.75%	114.73%	85.50%	113.09%
F&G	84.75%	114.73%	82.45%	115.24%
H-I	78.93%	112.89%	77.09%	113.33%
J	84.49%	106.35%	84.11%	107.45%
K	86.13%	114.20%	79.71%	112.95%

(2) Model Specifications for Zones A-E

- ◆ **Per-unit MW data & load-weighted CTHI from NYISO archives, including DR impacts**
- ◆ **Years: 2010, 2011, 2012**
- ◆ **Months – June to August**
- ◆ **Days – Monday-Friday, no Holidays**
- ◆ **3rd order polynomial**
- ◆ **Total observations - 194**

2014 LFU Model – Zones A-E

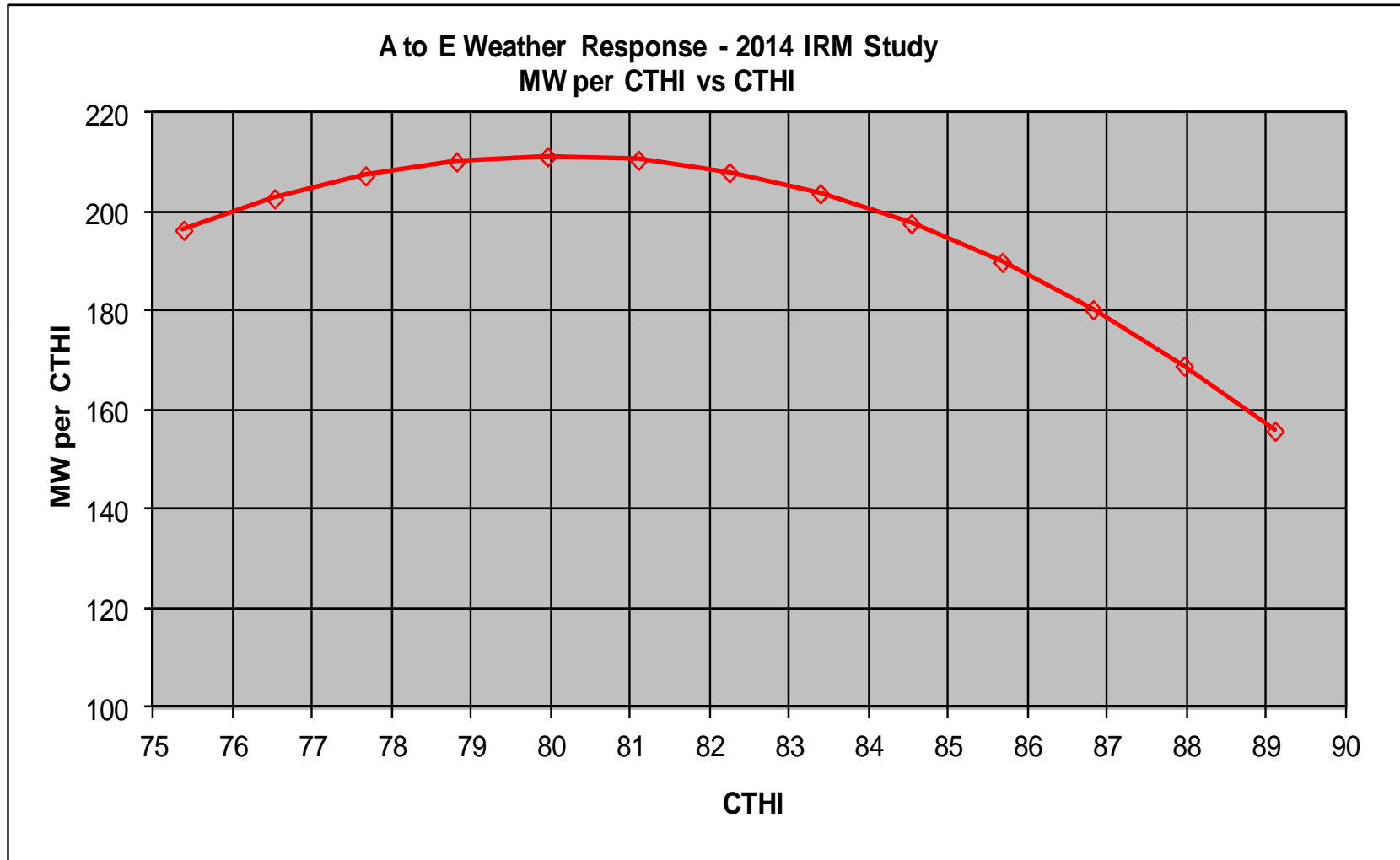
	Wtd CTHI
30-Year Mean	82.24
30-Year Std. Dev	2.29

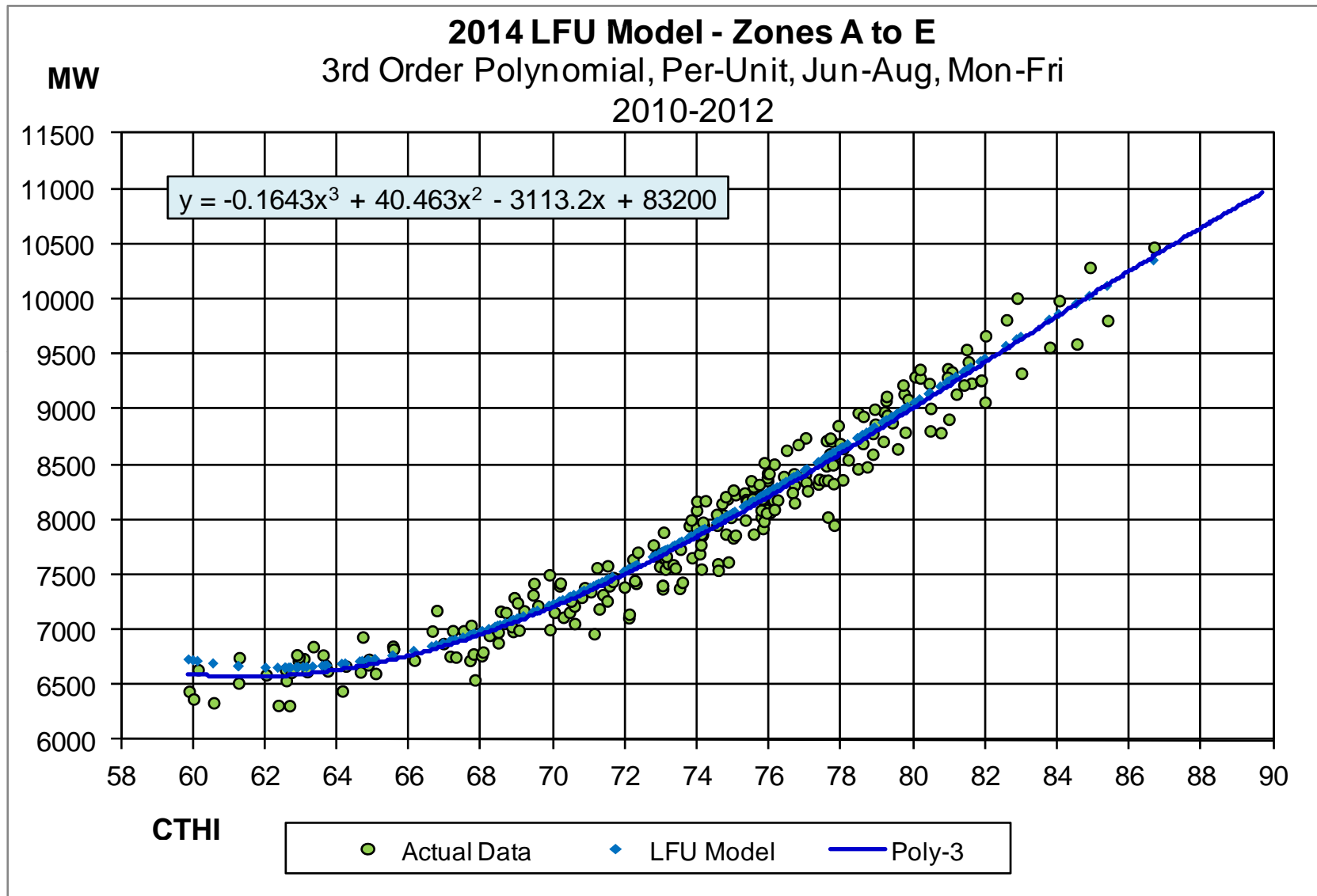
Ref MW at 78 CTHI	8048.0
Ref MW at 50th	9502.0
2014 NCP	9835.0

	Load Model	
A0	12.9772043	
A1	-0.4948350	
A2	0.0064976	
A3	-0.0000271	
2014 MW	9834.1	at 50th pct

Derivative
-4.95E-01
1.30E-02
-8.12E-05

Z'	Cum Prob	CTHI	Per Unit Model	2014 PU	dPU	dCTHI	MW/CTHI from Bins	MW/CTHI	PU @ 50th
-3.00	0.00135	75.37	1.0094	8408		1.15		196	0.8550
-2.50	0.00621	76.52	1.0368	8637	229	1.15	200	203	0.8782
-2.00	0.02275	77.66	1.0650	8872	235	1.15	205	207	0.9021
-1.50	0.06681	78.81	1.0938	9111	239	1.15	209	210	0.9265
-1.00	0.15866	79.95	1.1227	9353	242	1.15	211	211	0.9510
-0.50	0.30854	81.10	1.1518	9594	242	1.15	211	211	0.9756
0.00	0.50000	82.24	1.1806	9834	240	1.15	209	208	1.0000
0.50	0.69146	83.39	1.2089	10070	236	1.15	206	204	1.0240
1.00	0.84134	84.53	1.2365	10300	230	1.15	201	198	1.0474
1.50	0.93319	85.68	1.2632	10522	222	1.15	194	190	1.0700
2.00	0.97725	86.82	1.2887	10735	212	1.15	185	180	1.0916
2.50	0.99379	87.97	1.3127	10935	200	1.15	175	169	1.1119
3.00	0.99865	89.11	1.3351	11121	186	1.15	163	156	1.1309





Comparison of 2013 & 2014 A-E Models

2014 Load Forecast Uncertainty Distribution

			Zones A-E
LFU Bin	Cum Prob	Bin Prob	PU MW @ 50th
1	0.62%	0.62%	0.8550
2	6.68%	6.06%	0.9021
3	30.85%	24.17%	0.9510
4	69.15%	38.30%	1.0000
5	93.32%	24.17%	1.0474
6	99.38%	6.06%	1.0916
7	100.00%	0.62%	1.1309

2013 Load Forecast Uncertainty Distribution

			Zones A-G
LFU Bin	Cum Prob	Bin Prob	PU MW @ 50th
1	0.62%	0.62%	0.8475
2	6.68%	6.06%	0.8967
3	30.85%	24.17%	0.9480
4	69.15%	38.30%	1.0000
5	93.32%	24.17%	1.0514
6	99.38%	6.06%	1.1009
7	100.00%	0.62%	1.1473

(3) Model Specifications for Zones F-G

- ◆ **Per-unit MW data & Load-weighted CTHI from NYISO archives, including DR impacts**
- ◆ **Years: 2010, 2011, 2012**
- ◆ **Months – June to August**
- ◆ **Days – Monday-Friday, no Holidays**
- ◆ **3rd order polynomial**
- ◆ **Total observations - 194**

2014 LFU Model – Zones F&G

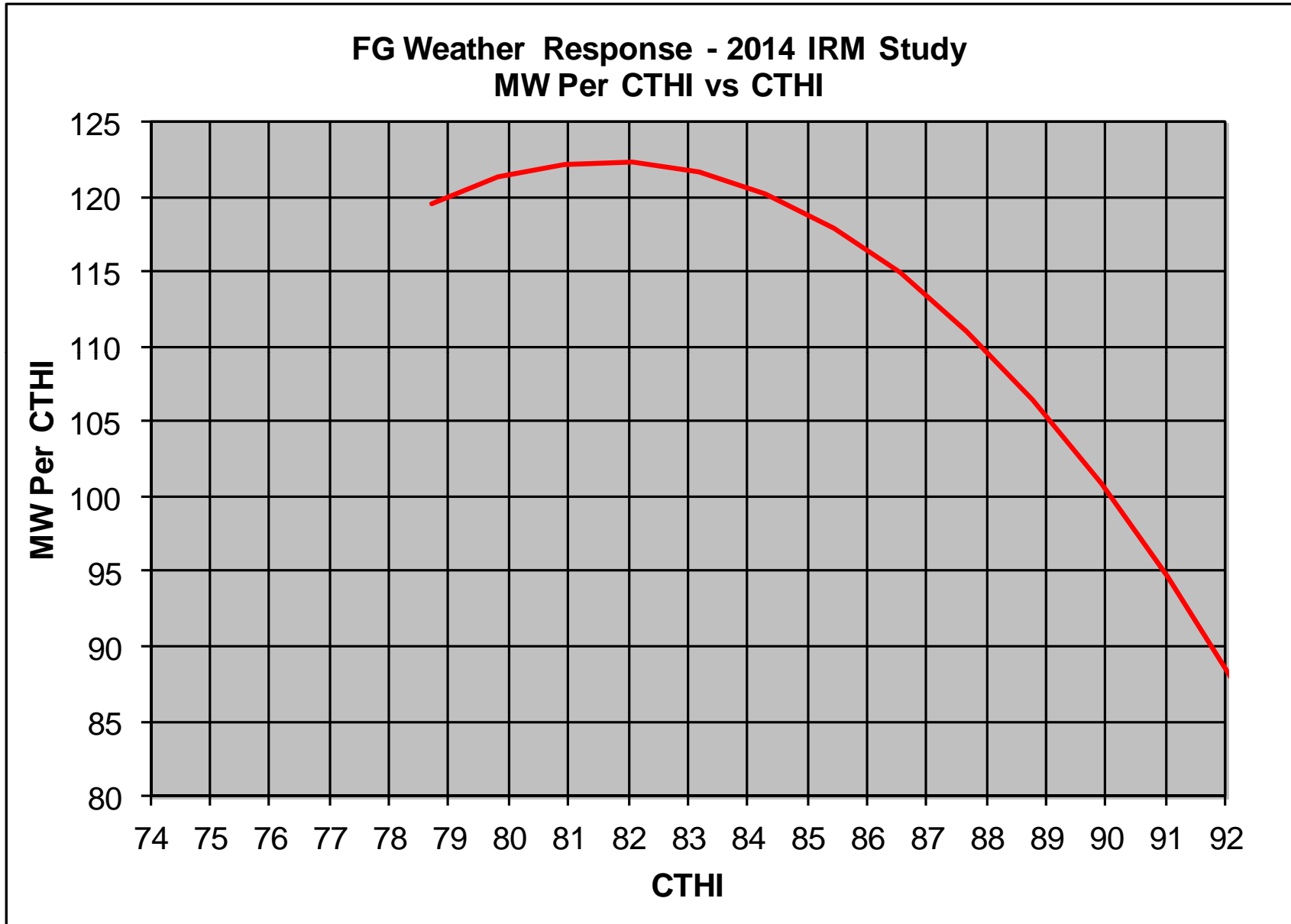
	Wtd CTHI
30-Year Mean	85.43
30-Year Std. Dev	2.24

MW @ Model 1.0 PU	3377.7
MW @ Model 50th Pctile	4551.7
2014 MW Forecast	4639.0

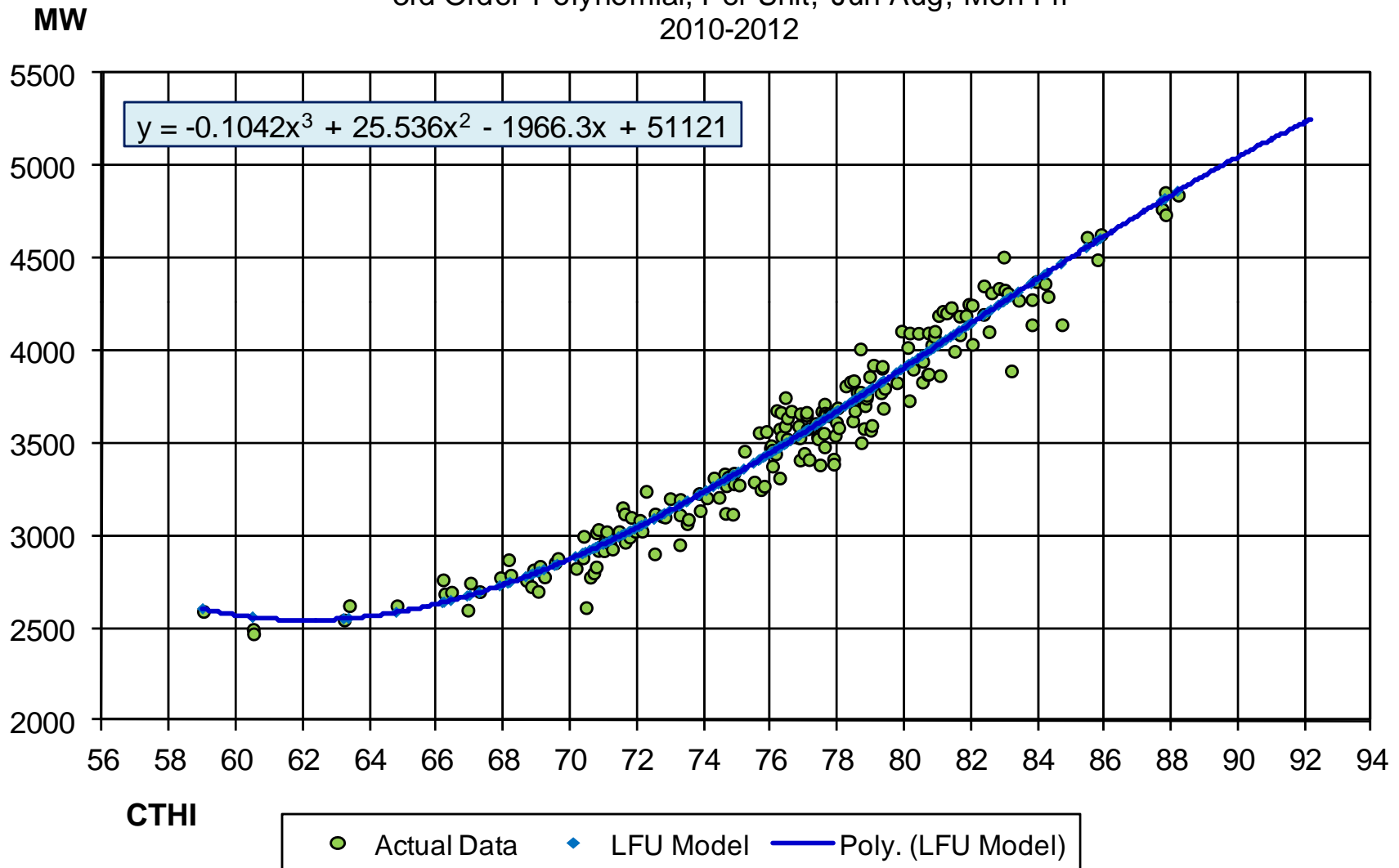
	Load Model	
A0	15.134993	
A1	-0.582143	
A2	0.007560	
A3	-0.000031	
2014 MW	4639	at 50th pct

Derivative
-5.82E-01
1.51E-02
-9.25E-05

Z'	Cum Prob	CTHI	2014 MW	2014 PU	dPU	dCTHI	MW/CTHI from Bins	MW/CTHI	PU @ 50th
-3.00	0.00135	78.71	1.1111	3825		1.12		120	0.8245
-2.50	0.00621	79.83	1.1503	3960	135	1.12	120	121	0.8536
-2.00	0.02275	80.95	1.1899	4096	136	1.12	122	122	0.8830
-1.50	0.06681	82.07	1.2297	4233	137	1.12	122	122	0.9125
-1.00	0.15866	83.19	1.2694	4370	137	1.12	122	122	0.9420
-0.50	0.30854	84.31	1.3088	4506	136	1.12	121	120	0.9712
0.00	0.50000	85.43	1.3476	4639	133	1.12	119	118	1.0000
0.50	0.69146	86.55	1.3855	4769	130	1.12	116	115	1.0281
1.00	0.84134	87.67	1.4223	4896	127	1.12	113	111	1.0554
1.50	0.93319	88.79	1.4576	5018	122	1.12	109	106	1.0817
2.00	0.97725	89.91	1.4914	5134	116	1.12	104	101	1.1067
2.50	0.99379	91.03	1.5232	5244	110	1.12	98	95	1.1304
3.00	0.99865	92.15	1.5529	5346	102	1.12	91	88	1.1524



2014 LFU Model - Zones F&G
 3rd Order Polynomial, Per-Unit, Jun-Aug, Mon-Fri
 2010-2012



Comparison of 2013 & 2014 Models

2014 Load Forecast Uncertainty Distribution

			Zones F-G
LFU Bin	Cum Prob	Bin Prob	PU MW @ 50th
1	0.62%	0.62%	0.8245
2	6.68%	6.06%	0.8830
3	30.85%	24.17%	0.9420
4	69.15%	38.30%	1.0000
5	93.32%	24.17%	1.0554
6	99.38%	6.06%	1.1067
7	100.00%	0.62%	1.1524

2013 Load Forecast Uncertainty Distribution

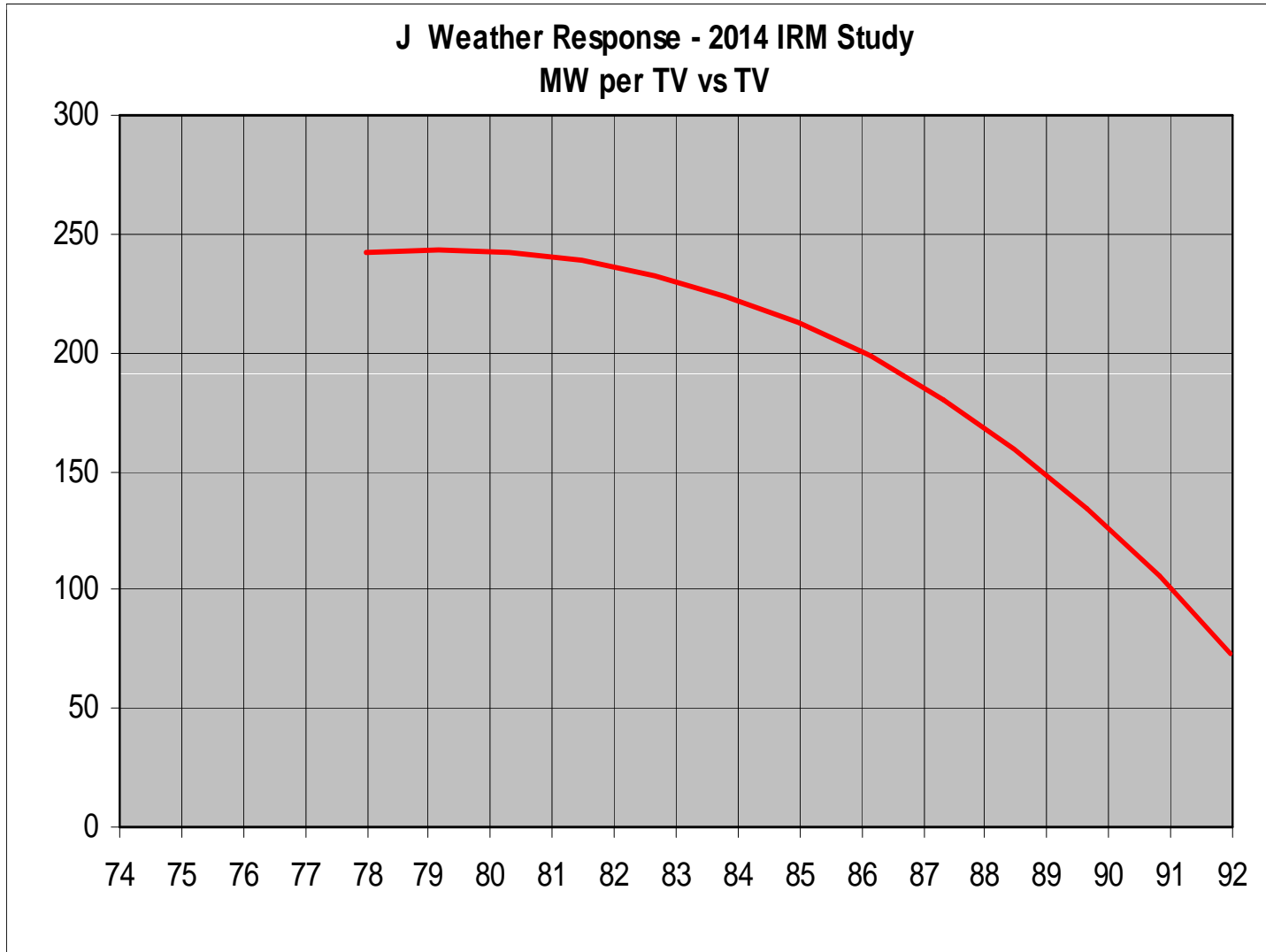
			Zones A-G
LFU Bin	Cum Prob	Bin Prob	PU MW @ 50th
1	0.62%	0.62%	0.8475
2	6.68%	6.06%	0.8967
3	30.85%	24.17%	0.9480
4	69.15%	38.30%	1.0000
5	93.32%	24.17%	1.0514
6	99.38%	6.06%	1.1009
7	100.00%	0.62%	1.1473

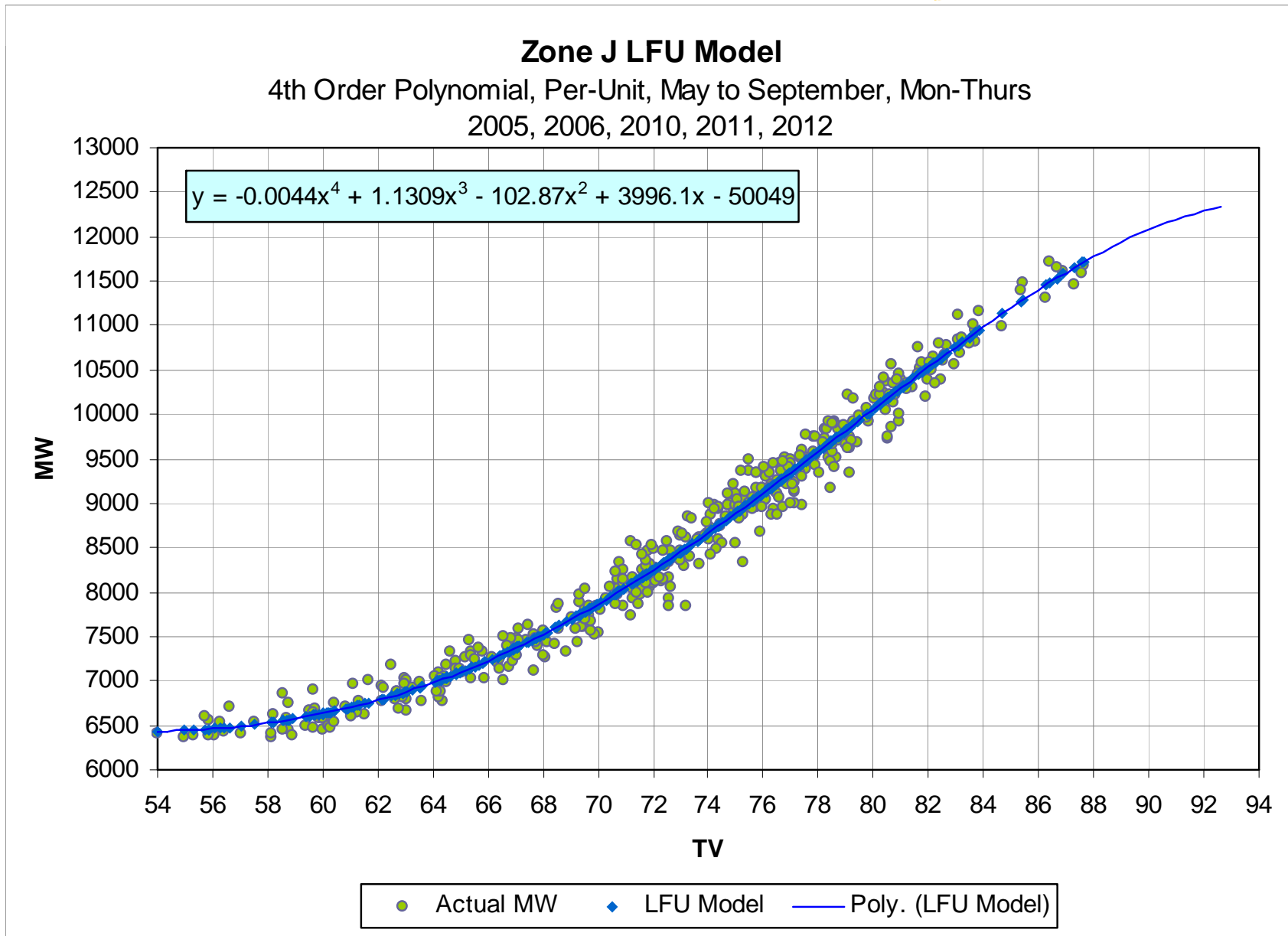
(4) Model Specifications for H-I and J

- ◆ **Per-unit MW data & TV data as provided by Con-Ed, including DR impacts**
- ◆ **Years: 2005, 2006, 2010, 2011, 2012**
- ◆ **Months – May through September**
- ◆ **Days – Monday-Thursday, no Holidays**
- ◆ **4th order polynomial**
- ◆ **Total observations - 424**

2014 LFU Model – Zone J

	TV		Load Model	Adj Factor						
30-Year Mean	84.980	A0	-3.917344E+00	1.00064000					Derivative	
30-Year Std. Dev	2.334	A1	3.248047E-01						3.2480E-01	
		A2	-8.516908E-03						-1.7034E-02	
MW @ Model 1.0 PU	11360	A3	9.490273E-05						2.8471E-04	
MW @ Model 67th Pctile	11298	A4	-3.728184E-07						-1.4913E-06	
2014 MW Forecast	11658	2014 MW	11450	at 50th pct						
Ref MW	11722	2014 MW	11658	at 67th pct						
	Z'	Cum Prob	TV	2014 MW	2014 PU	dPU	dTV	MW/TV from Bins	MW/ TV	PU @ 67th
	-3.00	0.00135	77.98	9805	0.8411				242	0.8411
	-2.50	0.00621	79.15	10089	0.8654	0.02430	1.17	238	243	0.8654
	-2.00	0.02275	80.31	10372	0.8897	0.02431	1.17	239	242	0.8897
	-1.50	0.06681	81.48	10653	0.9138	0.02409	1.17	236	239	0.9138
	-1.00	0.15866	82.65	10928	0.9374	0.02362	1.17	232	233	0.9374
	-0.50	0.30854	83.81	11195	0.9603	0.02289	1.17	225	224	0.9603
	0.00	0.50000	84.98	11450	0.9822	0.02189	1.17	215	213	0.9822
	0.431	0.66667	85.99	11658	1.0000	0.01782	1.01	203	200	1.0000
	0.50	0.69146	86.15	11690	1.0028	0.02058	0.16	1457	198	1.0028
	1.00	0.84134	87.31	11911	1.0217	0.01896	1.17	186	180	1.0217
	1.50	0.93319	88.48	12109	1.0387	0.01701	1.17	167	159	1.0387
	2.00	0.97725	89.65	12281	1.0534	0.01471	1.17	144	134	1.0534
	2.50	0.99379	90.82	12422	1.0655	0.01205	1.17	118	106	1.0655
	3.00	0.99865	91.98	12527	1.0745	0.00901	1.17	88	74	1.0745

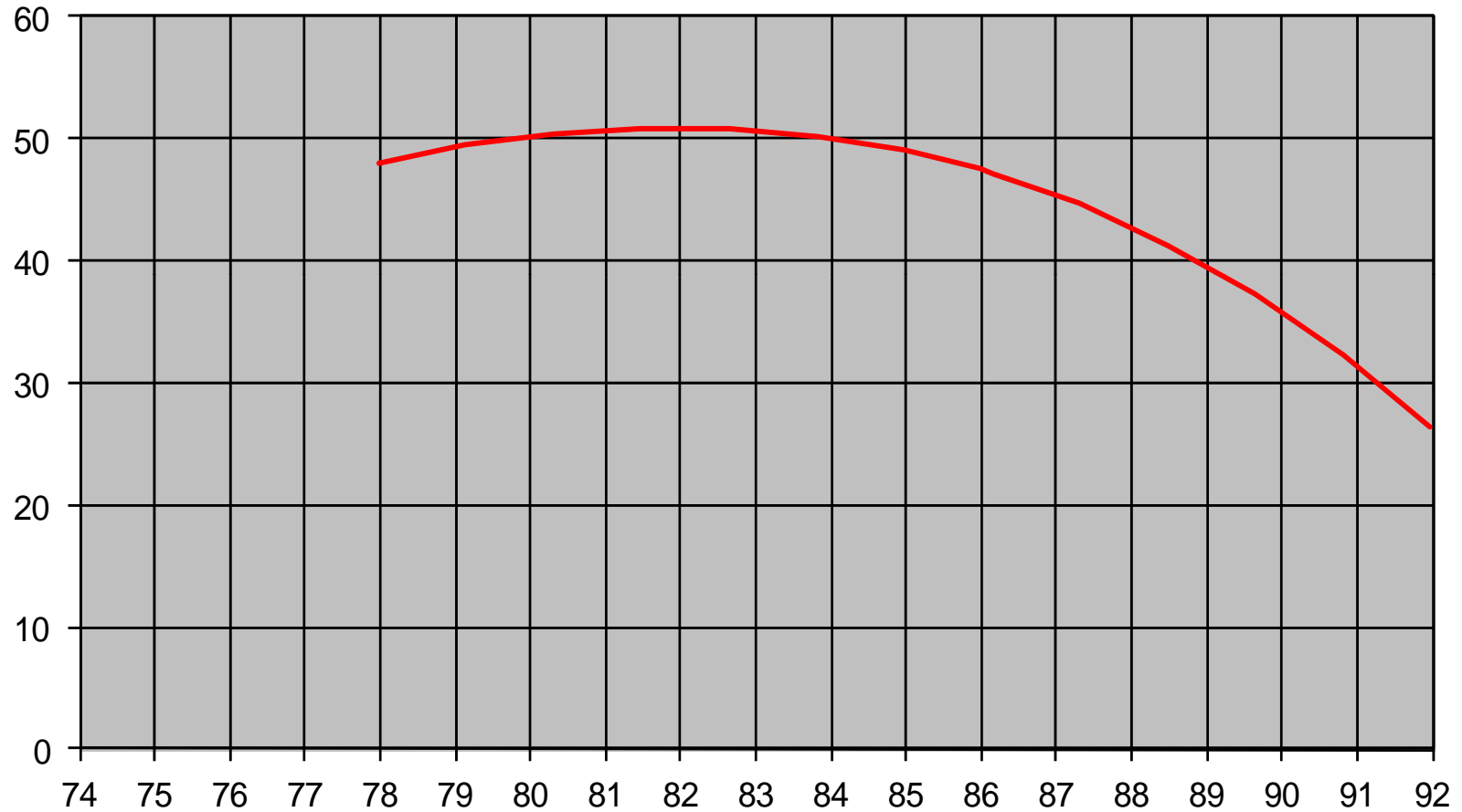




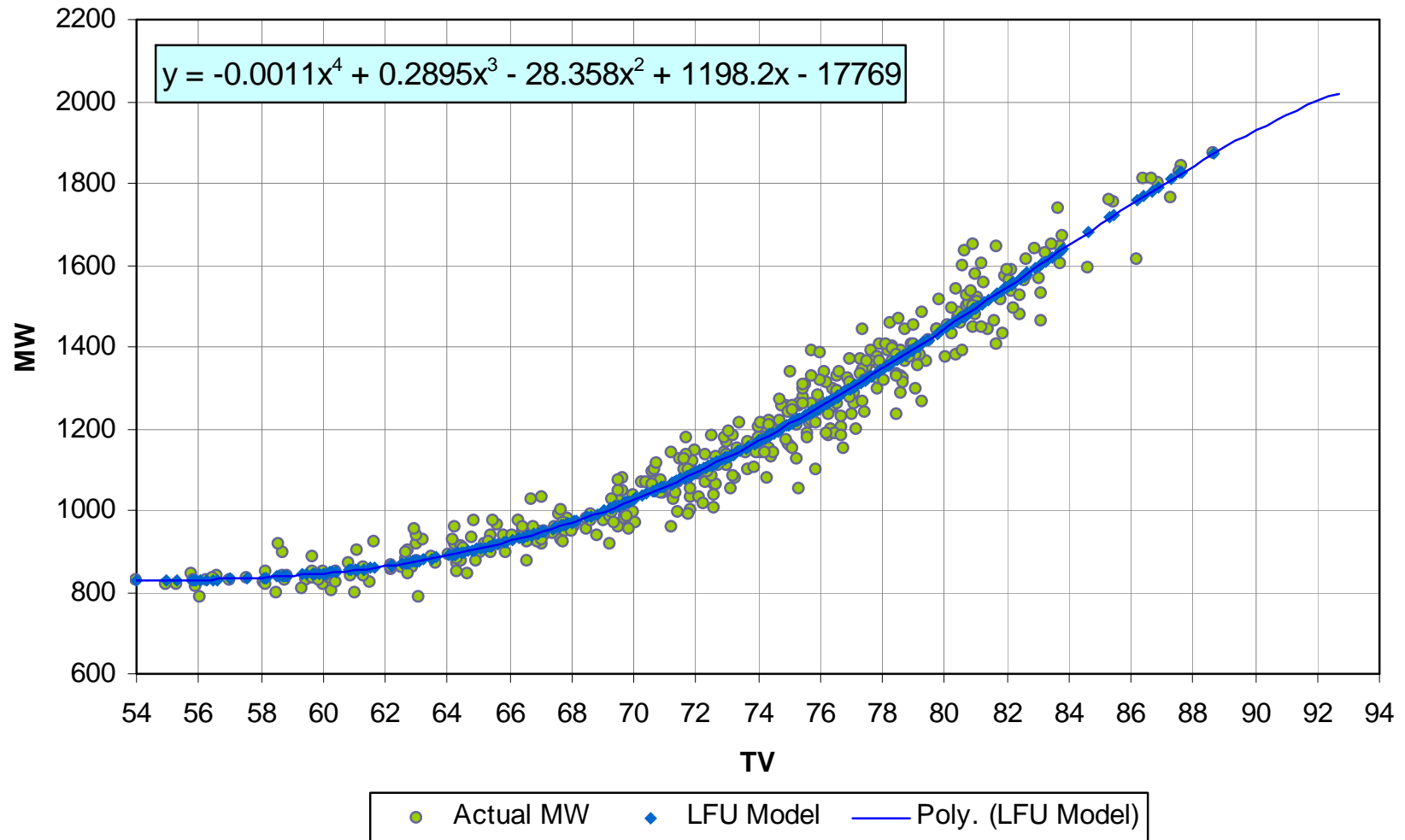
2014 LFU Model – Zones H&I

		TV		Load Model	Adj Factor					
30-Year Mean		84.98	A0	-1.17044E+01	1.00020500				Derivative	
30-Year Std. Dev		2.334	A1	7.78750E-01					7.7875E-01	
			A2	-1.83213E-02					-3.6643E-02	
MW @ Model 1.0 PU		1740	A3	1.86382E-04					5.5915E-04	
MW @ Model 67th Pctile		1719	A4	-6.82342E-07					-2.7294E-06	
2014 MW Forecast		1743	2014 MW	1694	at 50th pct					
Ref MW		1764	2014 MW	1743	at 67th pct					
	Z'	Cum Prob	TV	2014 MW	2014 PU	dPU	dTV	MW/TV from Bins	MW/ TV	PU @ 67th
	-3.00	0.00135	77.98	1344	0.7709				48	0.7709
	-2.50	0.00621	79.15	1401	0.8035	0.03265	1.1670	47	49	0.8035
	-2.00	0.02275	80.31	1459	0.8370	0.03344	1.1670	49	50	0.8370
	-1.50	0.06681	81.48	1518	0.8709	0.03393	1.1670	49	51	0.8709
	-1.00	0.15866	82.65	1577	0.9050	0.03408	1.1670	49	51	0.9050
	-0.50	0.30854	83.81	1636	0.9389	0.03388	1.1670	49	50	0.9389
	0.00	0.50000	84.98	1694	0.9721	0.03328	1.1670	48	49	0.9721
	0.431	0.66667	85.99	1743	1.0000	0.02786	1.0053	47	47	1.0000
	0.50	0.69146	86.15	1751	1.0044	0.03225	0.1617	338	47	1.0044
	1.00	0.84134	87.31	1804	1.0352	0.03077	1.1670	45	45	1.0352
	1.50	0.93319	88.48	1854	1.0640	0.02881	1.1670	42	41	1.0640
	2.00	0.97725	89.65	1900	1.0903	0.02633	1.1670	38	37	1.0903
	2.50	0.99379	90.82	1941	1.1136	0.02330	1.1670	34	32	1.1136
	3.00	0.99865	91.98	1975	1.1333	0.01969	1.1670	29	26	1.1333

HI Weather Response - 2014 IRM Study
MW per TV vs TV



Zones H&I LFU Model
 4th Order Polynomial, Per Unit, May to September, Mon-Thurs
 2005, 2006, 2010, 2011, 2012



Comparison of 2013 & 2014 Models

2014 Load Forecast Uncertainty Distribution

LFU Bin	Cum Prob	Bin Prob	Zone J	Zones H&I
			PU MW @ 67th	PU MW @ 67th
1	0.62%	0.62%	0.8411	0.7709
2	6.68%	6.06%	0.8897	0.8370
3	30.85%	24.17%	0.9374	0.9050
4	69.15%	38.30%	0.9822	0.9721
5	93.32%	24.17%	1.0217	1.0352
6	99.38%	6.06%	1.0534	1.0903
7	100.00%	0.62%	1.0745	1.1333

2013 Load Forecast Uncertainty Distribution

LFU Bin	Cum Prob	Bin Prob	Zone J	Zones H&I
			PU MW @ 67th	PU MW @ 67th
1	0.62%	0.62%	0.8449	0.7893
2	6.68%	6.06%	0.8929	0.8500
3	30.85%	24.17%	0.9397	0.9123
4	69.15%	38.30%	0.9831	0.9741
5	93.32%	24.17%	1.0202	1.0329
6	99.38%	6.06%	1.0481	1.0856
7	100.00%	0.62%	1.0635	1.1289

(5) Model Specifications for Zone K

- ◆ **Per-unit MW data & Islip CTHI from NYISO archives, including DR impacts**
- ◆ **Years: 2005, 2006, 2010, 2011, 2012**
- ◆ **Months – June to August**
- ◆ **Days – Monday-Friday, no Holidays**
- ◆ **3rd order polynomial**
- ◆ **Total observations - 312**

2014 LFU Model – Zone K

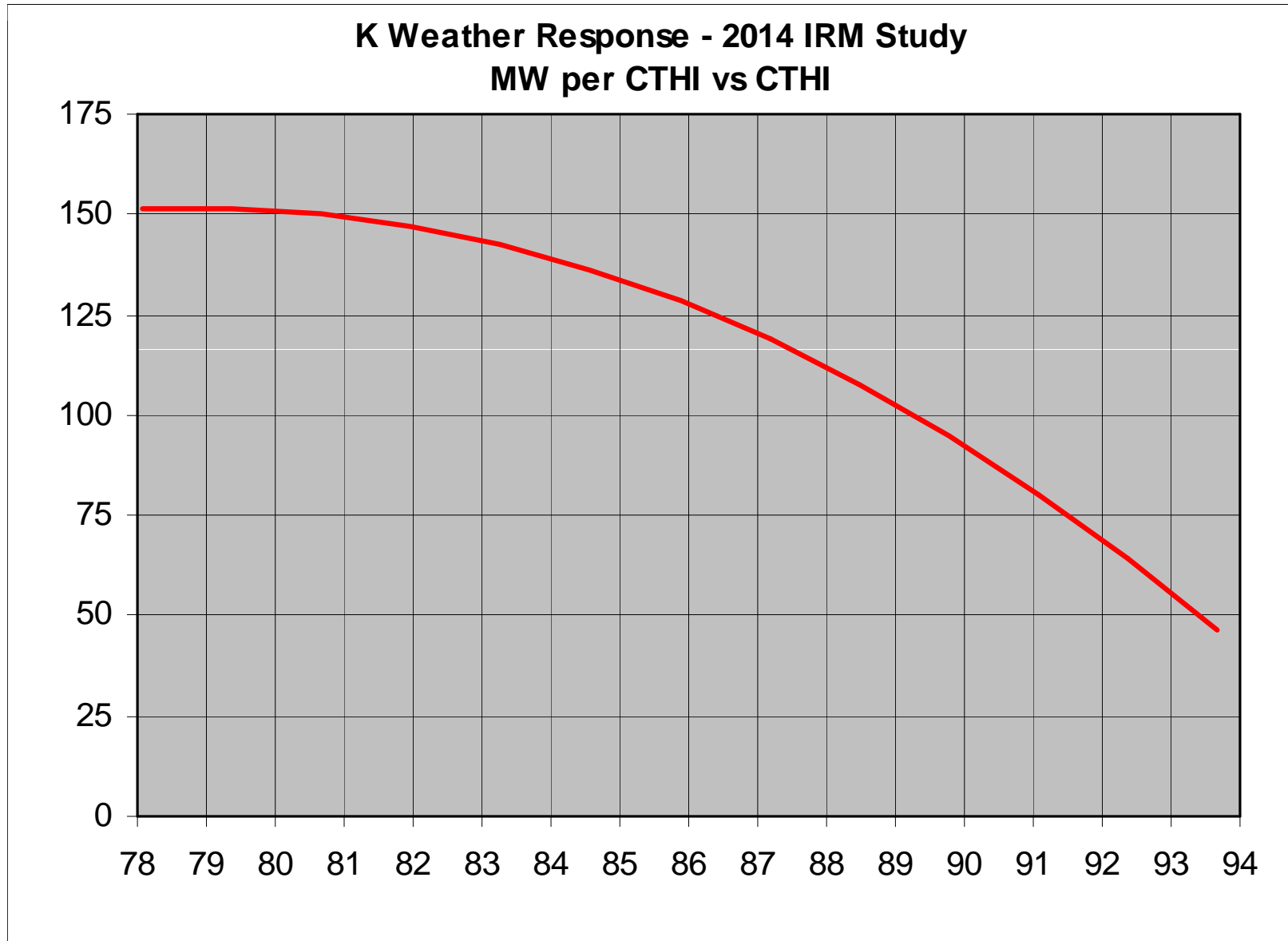
	Islip CTHI
30-Year Mean	85.8731
30-Year Std. Dev	2.6000

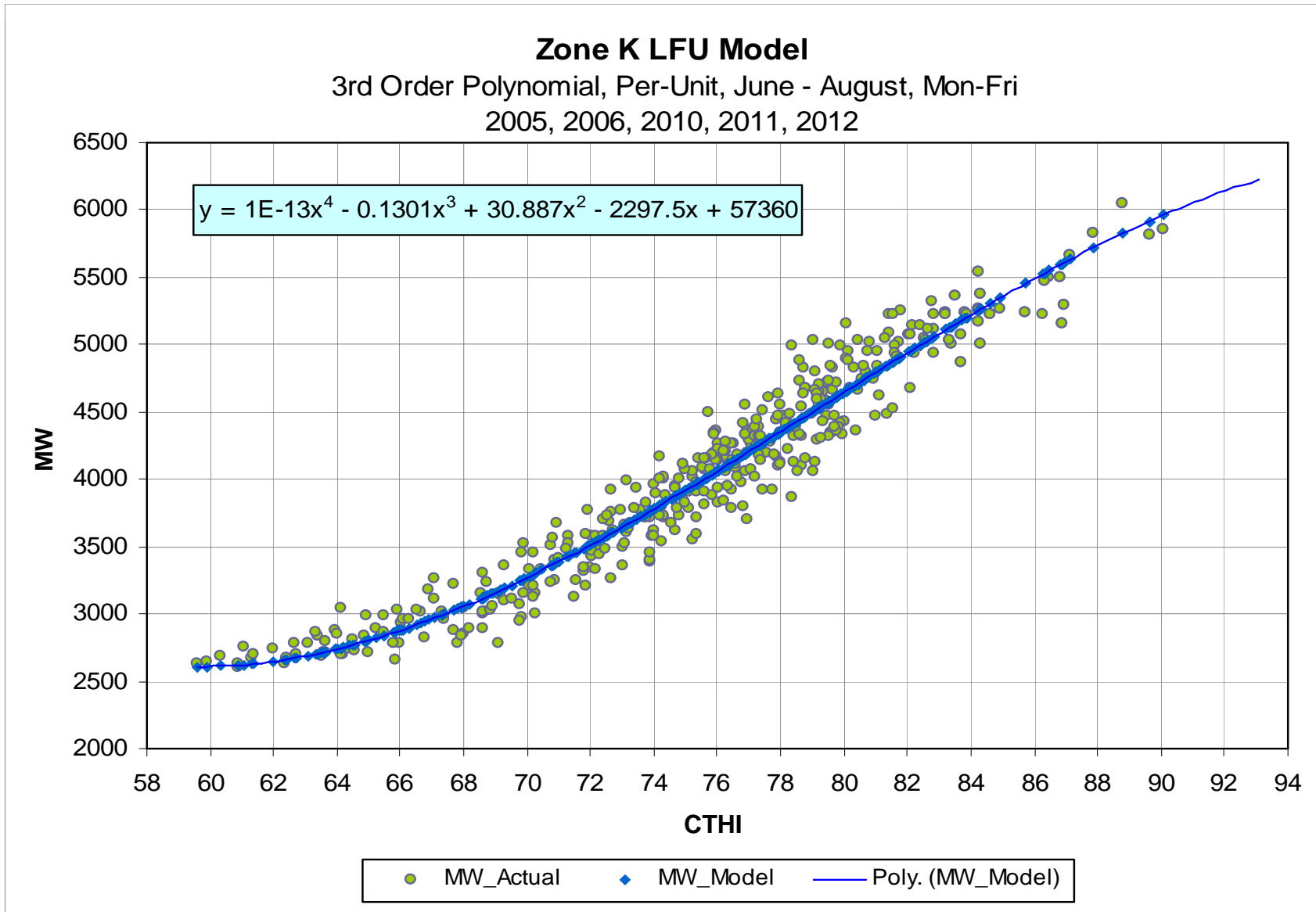
	Load Model	
A0	17.15188	
A1	-6.8171E-01	
A2	9.0797E-03	
A3	-3.8309E-05	
2014 MW	5566.0	at 50th pct at 50th pct

Derivative
-6.82E-01
1.82E-02
-1.15E-04

Ref MW at 78 CTHI	4336.0
Ref MW at 50th	5669.0
2014 NCP	5566.0

Z'	Cum Prob	CTHI	Per Unit Model	2014 MW	dMW	dCTHI	MW/CTHI from Bins	MW/CTHI Rollup	LFU, PU @ 50th
-3.00	0.00135	78.07	1.0421	4436	197	1.30	152	151	0.7970
-2.50	0.00621	79.37	1.0883	4633	196	1.30	151	152	0.8324
-2.00	0.02275	80.67	1.1345	4830	194	1.30	149	150	0.8677
-1.50	0.06681	81.97	1.1799	5023	189	1.30	145	147	0.9025
-1.00	0.15866	83.27	1.2243	5212	182	1.30	140	143	0.9364
-0.50	0.30854	84.57	1.2669	5394	172	1.30	133	136	0.9690
0.00	0.50000	85.87	1.3074	5566	161	1.30	124	129	1.0000
0.50	0.69146	87.17	1.3453	5727	161	1.30	124	119	1.0289
1.00	0.84134	88.47	1.3799	5875	148	1.30	113	108	1.0554
1.50	0.93319	89.77	1.4109	6006	132	1.30	101	95	1.0791
2.00	0.97725	91.07	1.4377	6121	114	1.30	88	80	1.0996
2.50	0.99379	92.37	1.4598	6215	94	1.30	72	64	1.1165
3.00	0.99865	93.67	1.4767	6287	72	1.30	55	46	1.1295





Comparison of 2013 & 2014 Models

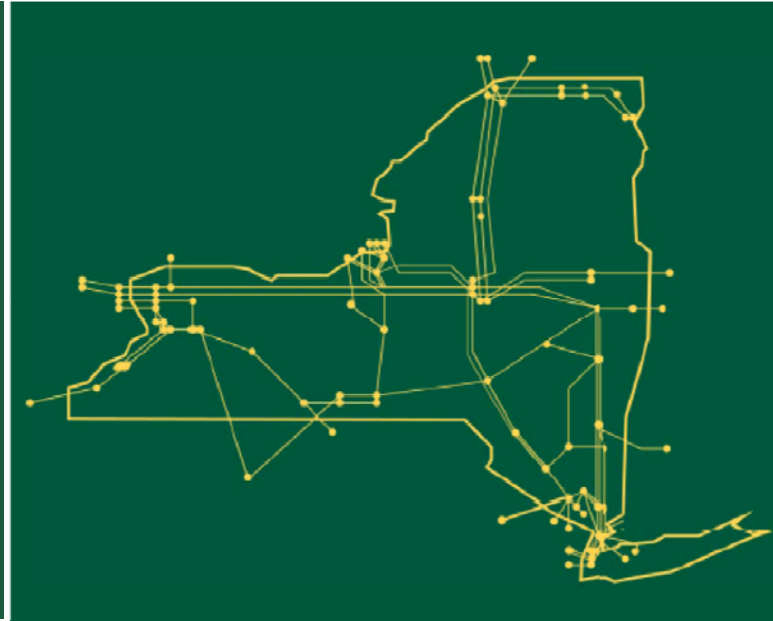
2014 Load Forecast Uncertainty Distribution

			Zone K
LFU Bin	Cum Prob	Bin Prob	PU MW @ 67th
1	0.62%	0.62%	0.7970
2	6.68%	6.06%	0.8677
3	30.85%	24.17%	0.9364
4	69.15%	38.30%	1.0000
5	93.32%	24.17%	1.0554
6	99.38%	6.06%	1.0996
7	100.00%	0.62%	1.1295

2013 Load Forecast Uncertainty Distribution

			Zone K
LFU Bin	Cum Prob	Bin Prob	PU MW @ 67th
1	0.62%	0.62%	0.8613
2	6.68%	6.06%	0.8996
3	30.85%	24.17%	0.9498
4	69.15%	38.30%	1.0000
5	93.32%	24.17%	1.0502
6	99.38%	6.06%	1.1004
7	100.00%	0.62%	1.1420

The New York Independent System Operator (NYISO) is a not-for-profit corporation responsible for operating the state's bulk electricity grid, administering New York's competitive wholesale electricity markets, conducting comprehensive long-term planning for the state's electric power system, and advancing the technological infrastructure of the electric system serving the Empire State.



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