

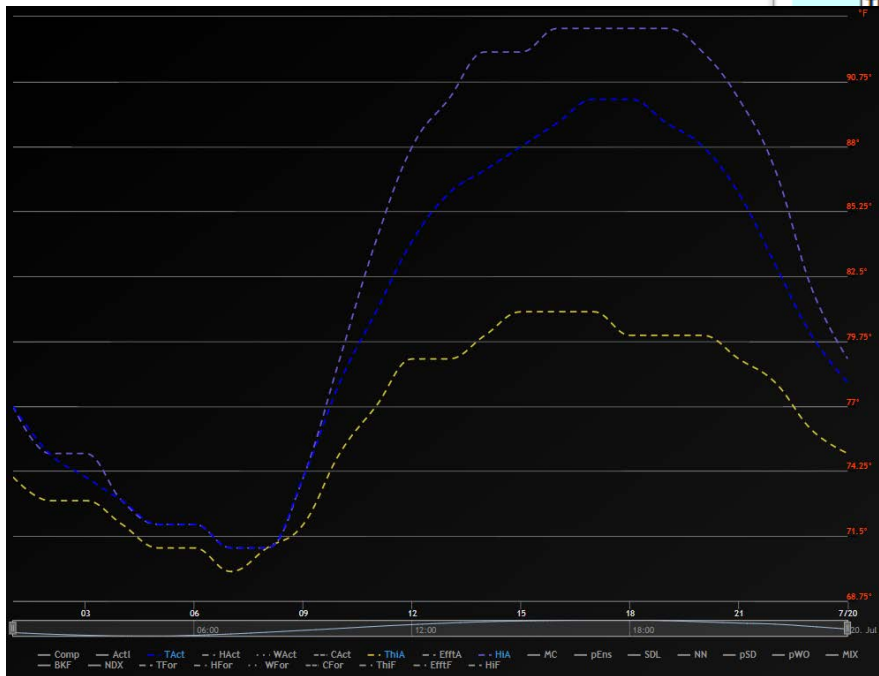
# Load Forecasting Overview

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SODRSTF  
March 9, 2018

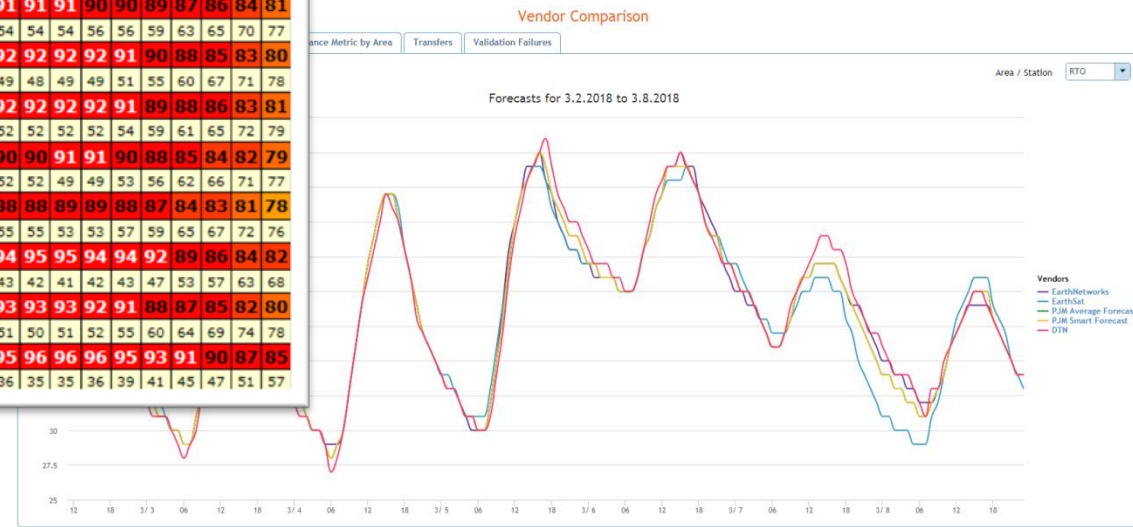
Inputs		
<b>Temporal</b> <ul style="list-style-type: none"><li>• Season</li><li>• Day of the week</li><li>• Time of day</li><li>• Holidays</li></ul>	<b>Weather</b> <ul style="list-style-type: none"><li>• Temperature</li><li>• Cloud cover</li><li>• Wind</li><li>• Humidity</li></ul>	<b>Load</b> <ul style="list-style-type: none"><li>• Historical loads</li><li>• Similar days</li></ul>

## Operator experience

- PJM uses forecasts from three weather vendors
- Lots of tools to help visualize data, identify trends and highlight anomalies



		Tuesday, 07-16-2013																							
Area	Hour:	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
TEMP		77	76	75	74	74	74	73	73	75	77	79	83	85	86	88	89	90	90	90	89	87	85	83	81
TEMP		77	76	75	74	73	73	74	76	80	83	87	89	91	91	92	92	92	91	90	88	86	83	79	
TEMP		84	84	85	87	90	90	92	89	85	76	70	63	58	55	53	53	53	53	55	60	65	73	81	
TEMP		76	75	74	73	72	72	74	76	79	82	85	87	89	89	90	90	89	89	87	85	83	80	77	
TEMP		85	86	89	89	90	92	93	90	87	80	73	67	62	59	58	57	56	57	58	61	66	70	78	84
TEMP		77	76	75	74	74	73	73	74	77	80	84	87	90	91	91	91	91	90	90	89	87	86	84	81
TEMP		79	82	84	88	88	90	94	91	85	76	67	61	56	54	54	54	54	56	56	59	63	65	70	77
TEMP		75	75	74	73	72	72	72	73	76	80	84	87	90	92	92	92	92	92	91	90	88	85	83	80
TEMP		82	84	86	87	88	88	89	91	83	75	66	60	53	51	49	48	49	49	51	55	60	67	71	78
TEMP		76	76	74	74	73	73	73	76	79	83	87	89	92	92	92	92	92	91	89	88	86	83	81	
TEMP		85	85	88	88	90	90	90	94	88	79	72	63	59	52	52	52	52	52	54	59	61	65	72	79
TEMP		76	75	74	73	72	71	72	72	75	78	81	85	87	88	90	90	91	91	90	88	85	84	82	79
TEMP		80	81	84	88	89	91	89	89	84	77	70	61	57	55	52	49	49	53	56	62	66	71	77	
TEMP		76	75	74	73	72	71	72	72	74	78	81	85	86	87	88	88	89	89	88	87	84	83	81	78
TEMP		79	82	82	87	87	90	87	91	85	76	69	61	59	57	55	55	53	53	57	59	65	67	72	76
TEMP		79	78	77	77	76	75	76	79	81	85	87	90	92	94	95	95	94	94	92	89	86	84	82	79
TEMP		76	81	81	81	84	84	83	81	74	68	58	53	49	46	43	42	41	42	43	47	53	57	63	68
TEMP		77	76	75	74	74	74	75	78	81	85	88	91	92	93	93	93	92	91	88	87	85	82	80	
TEMP		83	86	88	88	89	89	90	88	83	74	66	61	55	52	51	50	51	52	55	60	64	69	74	78
TEMP		82	80	78	77	76	75	76	79	82	84	88	91	94	95	96	96	96	95	93	91	90	87	85	
TEMP		65	69	71	74	74	76	79	77	69	60	55	48	42	37	36	35	35	36	39	41	45	47	51	57



- THI, or the Temperature-Humidity Index, is a measure of comfort.
- THI is *not* in degrees – it does not tell you what temperature it feels like, given the high humidity. The heat index does this.
- Some people begin to feel uncomfortable at values above 70, while most people are uncomfortable at values in the 80s.
- Used to select similar days in summer (May – September).

## Neural Nets

- **Neural Net:** uses historical load and temperature and temperature forecasts
- **Index:** a neural net using THI (in summer) and wind chill (in winter) instead of temperature
- **Weather Optimized:** a neural net optimized for sudden changes in weather patterns
- **Backfill:** PJM's configuration to handle sudden changes in weather patterns

## Similar Day Algorithms

- **Similar Day:** looks for similar historical days using weather pattern matching
- **Similar Day Lookup:** PJM's similar day lookup algorithm, suggests a number of similar days from which the PJM operator can choose

## Ensemble Models\*

- **Ensemble:** a “best weighted most” average of the NN, WO, and SD
- **Mix:** a “best weighted most” average of the Ens, NDX, BKF, and SDL

\* Ensemble models perform the best on average

Forecast Day: Thu, 8/10/2017    Forecast Area: RTO    Additional Days: 0    Submit    Print

Load Day    Similar Day Lookup    **Historic Data**

Forecast Horizon

Fixed     Relative    18

Load Metrics

Metric	Weight
<input type="checkbox"/> ActI	
<input checked="" type="checkbox"/> MC	
<input type="checkbox"/> Comp	100
<input checked="" type="checkbox"/> pEns	40
<input checked="" type="checkbox"/> SDL	20
<input checked="" type="checkbox"/> NN	0
<input checked="" type="checkbox"/> pSD	0
<input checked="" type="checkbox"/> pWO	0

Weather Metrics

<input type="checkbox"/> TAct	<input type="checkbox"/> TFor
<input type="checkbox"/> HAct	<input type="checkbox"/> HFor
<input type="checkbox"/> WAct	<input type="checkbox"/> WFor
<input type="checkbox"/> CAct	<input type="checkbox"/> CFor
<input type="checkbox"/> ThiA	<input type="checkbox"/> ThiF
<input type="checkbox"/> EfftA	<input type="checkbox"/> EfftF
<input type="checkbox"/> HiA	<input type="checkbox"/> HiF



	MC	Err MC	pEns	Err pEns
8/10/2017 01:00	89783	0.30	80067	-0.5
8/10/2017 02:00	76017	0.19	75292	-0.7
8/10/2017 03:00	73028	0.27	72291	-0.7
8/10/2017 04:00	71306	0.41	70571	-0.6
8/10/2017 05:00	71480	0.77	70742	-0.3
8/10/2017 06:00	74707	0.90	73846	-0.2
8/10/2017 07:00	88099	1.21	78932	-0.2
8/10/2017 08:00	103376	1.61	84283	0.3
8/10/2017 09:00	116534	1.46	89447	0.2
8/10/2017 10:00	129528	1.12	94276	-0.2
8/10/2017 11:00	118730	0.85	99301	-0.5
8/10/2017 12:00	105323	0.61	103798	-0.8
8/10/2017 13:00	119520	0.68	107784	-0.9
8/10/2017 14:00	113389	0.69	111578	-0.9
8/10/2017 15:00	116186	0.62	114214	-1.0
8/10/2017 16:00	118282	0.98	116163	-0.8
8/10/2017 17:00	119690	1.25	117494	-0.6
8/10/2017 18:00				
Error Average		0.94		0.53

[View Weather Report](#)

Show Data Points

— Comp — ActI — TAct — HAct — WAct — CAct — ThiA — EfftA — HiA — MC — pEns — SDL — NN — pSD — pWO — MIX  
 — BKF — NDX — TFor — HFor — WFor — CFor — ThiF — EfftF — HiF

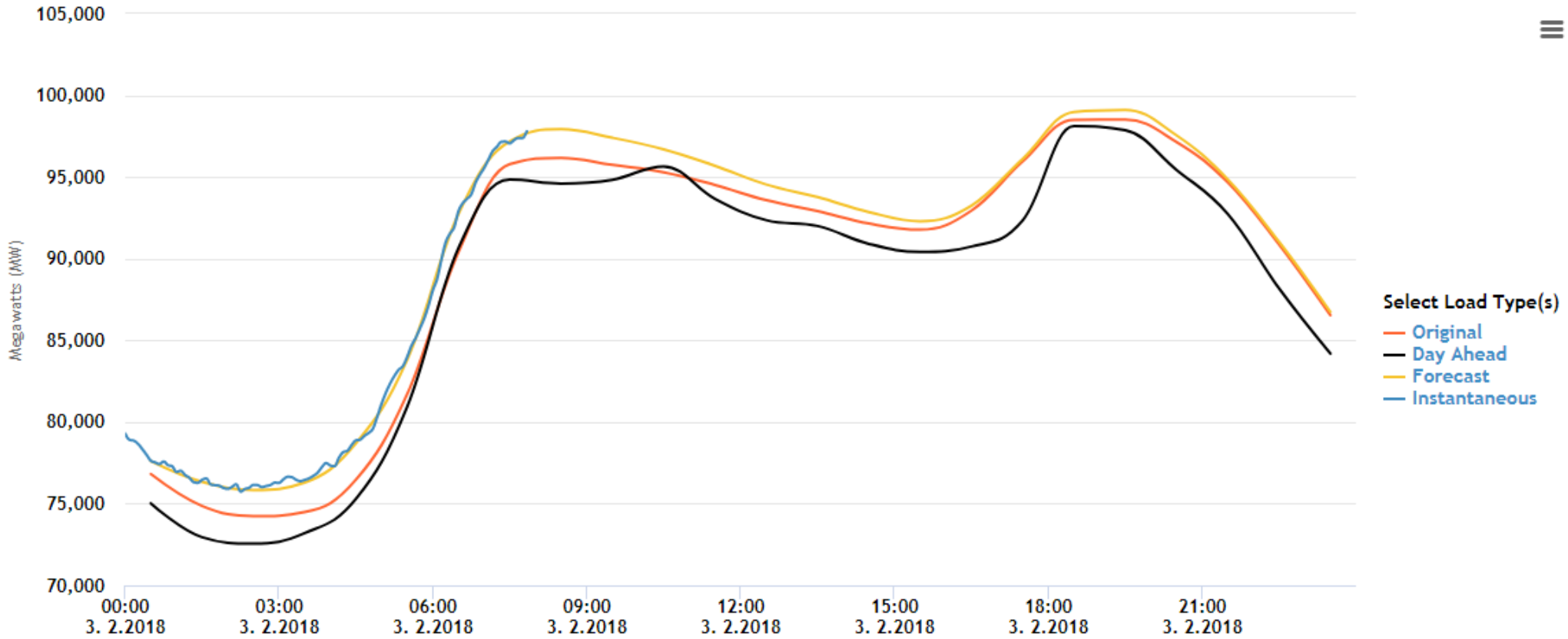
On average days, PJM operators often use the base-model Neural Net, the Ensemble, the Mix and the Similar Day Lookup. In certain situations, other models may perform better:

- **Significant changes in weather or extreme temperatures:** Weather Optimized or Backfill
- **Significant effects from humidity or wind expected:** Index
- **Holidays:** PJM's Similar Day Lookup

- PJM posts on its website load forecasts for **seven days** (including today) for **22 zones** plus a few aggregates, including the Mid-Atlantic zone and the RTO
- PJM dispatchers can update forecasts for any day, but will typically focus on the **intraday and day-ahead** forecasts
- PJM dispatchers can update forecasts at any time, and the forecasts are captured and posted online **twice an hour** (at XX:15 and XX:45)



3.1.2018 
  3.2.2018 
  3.3.2018 
 PJM RTO Total
Current Load Values



Click and drag in the plot area to zoom in. Click on a legend item to hide or show the series data.



# External Postings – Data Miner 2

Data updated as of FRI MAR 02 11:15:00 2018.

MID ATLANTIC REGION HOUR ENDING INTEGRATED FORECAST LOAD MW

Date		1	2	3	4	5	6	7	8	9	10	11	12
03/02/18	am	25251	24585	24387	24608	25521	27622	31154	33033	34015	34436	34651	34398
	pm	34041	33977	33935	34102	34833	36186	36744	35910	34892	33720	31992	30284
03/03/18	am	28139	27349	26987	26826	27100	27840	28896	29858	30802	31034	30870	30384
	pm	29715	29109	28753	28776	29214	30541	31936	31826	31543	30756	29562	28325
03/04/18	am	27124	26409	26054	26002	26237	26873	27751	28510	29300	29498	29272	28906
	pm	28546	28181	27948	28087	28828	30302	31893	32407	32409	31414	29911	28401
03/05/18	am	27766	27324	27312	27706	28809	31270	34810	36240	35593	34457	33466	32593
	pm	31883	31455	31076	31149	31795	33410	34891	35331	35199	33926	31875	29995
03/06/18	am	29145	28650	28522	28762	29720	32030	35621	36897	36091	34941	34073	33392
	pm	32898	32657	32478	32557	33240	34522	35490	35624	35160	33690	31400	29381
03/07/18	am	27884	27198	26940	27054	27865	30072	33531	35006	34701	34008	33501	33048
	pm	32632	32393	32129	32188	32888	34423	35774	35715	35281	33964	31897	30018
03/08/18	am	28482	27874	27713	27913	28827	31074	34450	35808	35295	34372	33700	33082
	pm	32479	32140	31867	31978	32776	34441	35754	35771	35483	34283	32262	30387

AP HOUR ENDING INTEGRATED FORECAST LOAD MW

Date		1	2	3	4	5	6	7	8	9	10	11	12
03/02/18	am	5263	5311	5302	5351	5602	5802	6383	6644	6674	6706	6630	6543
	pm	6423	6341	6256	6248	6327	6455	6722	6687	6531	6348	6089	5841
03/03/18	am	5718	5628	5608	5636	5729	5868	6081	6275	6403	6377	6274	6116
	pm	5947	5780	5662	5634	5713	5938	6202	6225	6205	6091	5909	5710
03/04/18	am	5530	5447	5419	5462	5526	5632	5819	6003	6135	6087	5950	5832
	pm	5727	5592	5483	5469	5580	5841	6114	6240	6282	6136	5949	5772
03/05/18	am	5667	5638	5684	5777	5976	6350	6892	7081	6947	6691	6482	6312
	pm	6132	5980	5836	5802	5875	6123	6400	6498	6510	6332	6056	5803
03/06/18	am	5551	5455	5433	5485	5652	5968	6480	6690	6627	6536	6476	6408
	pm	6337	6232	6175	6160	6217	6347	6537	6573	6517	6274	5936	5626
03/07/18	am	5551	5440	5414	5458	5607	5924	6459	6699	6640	6558	6520	6446
	pm	6340	6263	6175	6126	6182	6327	6543	6639	6666	6488	6184	5894
03/08/18	am	5759	5677	5664	5708	5863	6223	6778	6975	6911	6817	6744	6666
	pm	6564	6480	6400	6380	6441	6623	6846	6921	6910	6730	6403	6115

Data Miner 2 - http://dataminer2.pjm.com/ - Google Chrome

dataminer2.pjm.com/feed/load\_frctest\_7\_day

### Seven-Day Load Forecast

Export: [CSV](#)

Evaluated At UTC	Evaluated At EPT	Datetime Beginning UTC	Datetime Beginning EPT	Datetime Ending UTC	Datetime Ending EPT	Forecast
3/2/2018 16:17	3/2/2018 11:17	3/2/2018 05:00	3/2/2018 00:00	3/2/2018 06:00	3/2/2018 01:00	AE/M
3/2/2018 16:17	3/2/2018 11:17	3/2/2018 06:00	3/2/2018 01:00	3/2/2018 07:00	3/2/2018 02:00	AE/M
3/2/2018 16:17	3/2/2018 11:17	3/2/2018 07:00	3/2/2018 02:00	3/2/2018 08:00	3/2/2018 03:00	AE/M
3/2/2018 16:17	3/2/2018 11:17	3/2/2018 08:00	3/2/2018 03:00	3/2/2018 09:00	3/2/2018 04:00	AE/M
3/2/2018 16:17	3/2/2018 11:17	3/2/2018 09:00	3/2/2018 04:00	3/2/2018 10:00	3/2/2018 05:00	AE/M
3/2/2018 16:17	3/2/2018 11:17	3/2/2018 10:00	3/2/2018 05:00	3/2/2018 11:00	3/2/2018 06:00	AE/M
3/2/2018 16:17	3/2/2018 11:17	3/2/2018 11:00	3/2/2018 06:00	3/2/2018 12:00	3/2/2018 07:00	AE/M
3/2/2018 16:17	3/2/2018 11:17	3/2/2018 12:00	3/2/2018 07:00	3/2/2018 13:00	3/2/2018 08:00	AE/M
3/2/2018 16:17	3/2/2018 11:17	3/2/2018 13:00	3/2/2018 08:00	3/2/2018 14:00	3/2/2018 09:00	AE/M
3/2/2018 16:17	3/2/2018 11:17	3/2/2018 14:00	3/2/2018 09:00	3/2/2018 15:00	3/2/2018 10:00	AE/M
3/2/2018 16:17	3/2/2018 11:17	3/2/2018 15:00	3/2/2018 10:00	3/2/2018 16:00	3/2/2018 11:00	AE/M
3/2/2018 16:17	3/2/2018 11:17	3/2/2018 16:00	3/2/2018 11:00	3/2/2018 17:00	3/2/2018 12:00	AE/M
3/2/2018 16:17	3/2/2018 11:17	3/2/2018 17:00	3/2/2018 12:00	3/2/2018 18:00	3/2/2018 13:00	AE/M
3/2/2018 16:17	3/2/2018 11:17	3/2/2018 18:00	3/2/2018 13:00	3/2/2018 19:00	3/2/2018 14:00	AE/M
3/2/2018 16:17	3/2/2018 11:17	3/2/2018 19:00	3/2/2018 14:00	3/2/2018 20:00	3/2/2018 15:00	AE/M
3/2/2018 16:17	3/2/2018 11:17	3/2/2018 20:00	3/2/2018 15:00	3/2/2018 21:00	3/2/2018 16:00	AE/M
3/2/2018 16:17	3/2/2018 11:17	3/2/2018 21:00	3/2/2018 16:00	3/2/2018 22:00	3/2/2018 17:00	AE/M

Close

10:00 A.M.

**Initial Load Forecast is completed**

**9:45 a.m.:** Most, if not all, updates will be captured and posted externally

**10:30 a.m.:** Day-Ahead Market closes

1:30 P.M.

**Updates made to Load Forecast**

**1:30-2:15 p.m.:** Re-Bid Period

**2:15 p.m.:** Run RAC with updated forecast, posted in time for Intraday 2

6:00 P.M.

**Becomes “Original” forecast in Dataviewer**

Final Load Forecast updates made

**6:00 p.m.:** RAC re-run if inputs have changed, posted in time for Intraday 3

Questions?