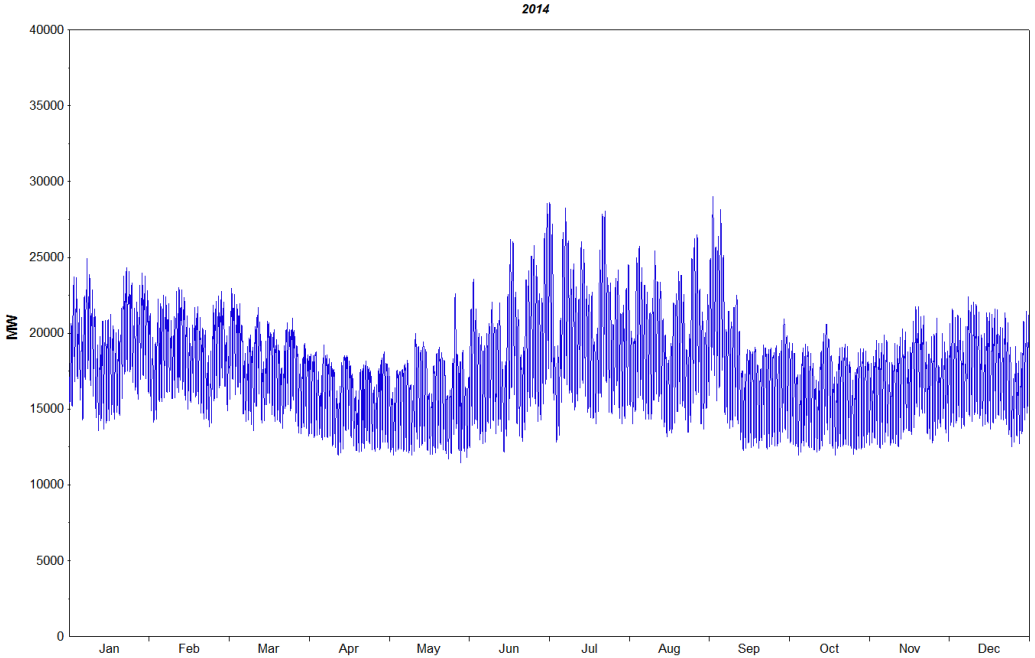
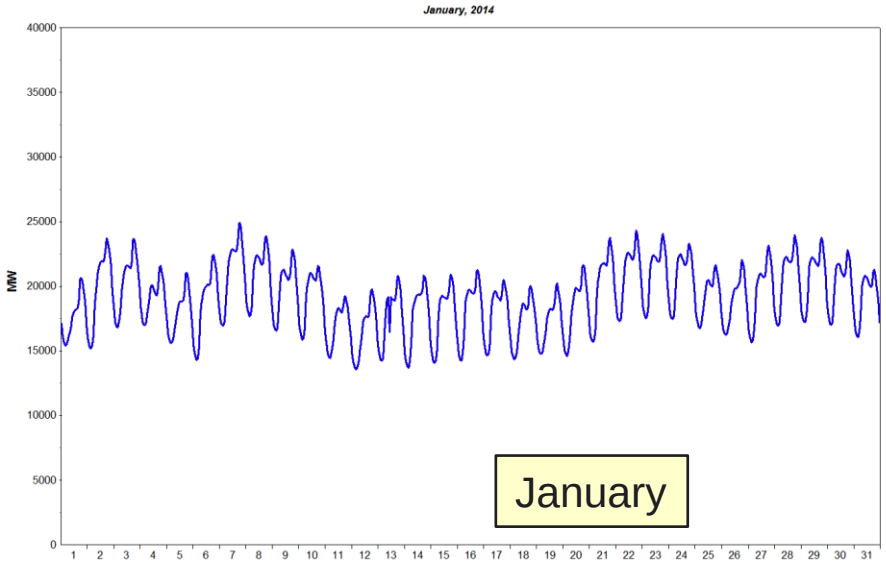
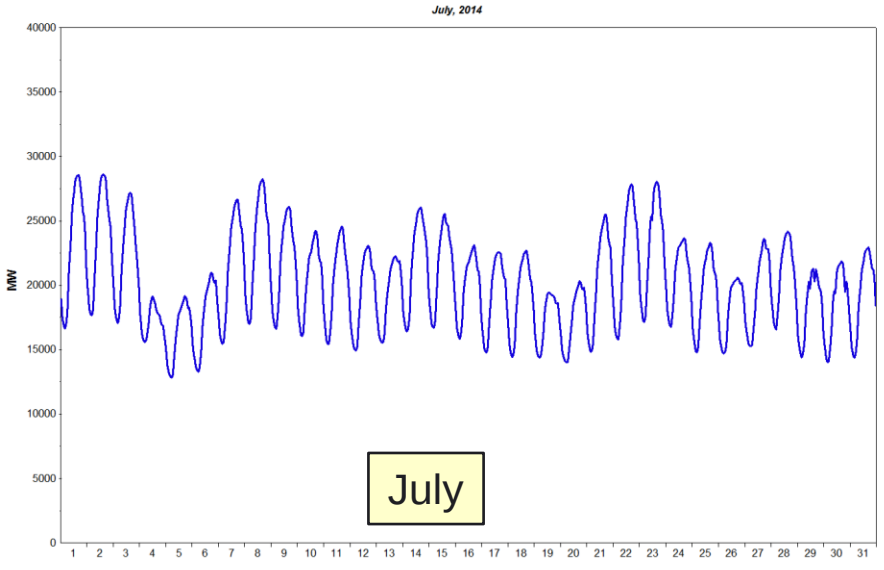
BUILDING A SYSTEM LEVEL SAE MODEL

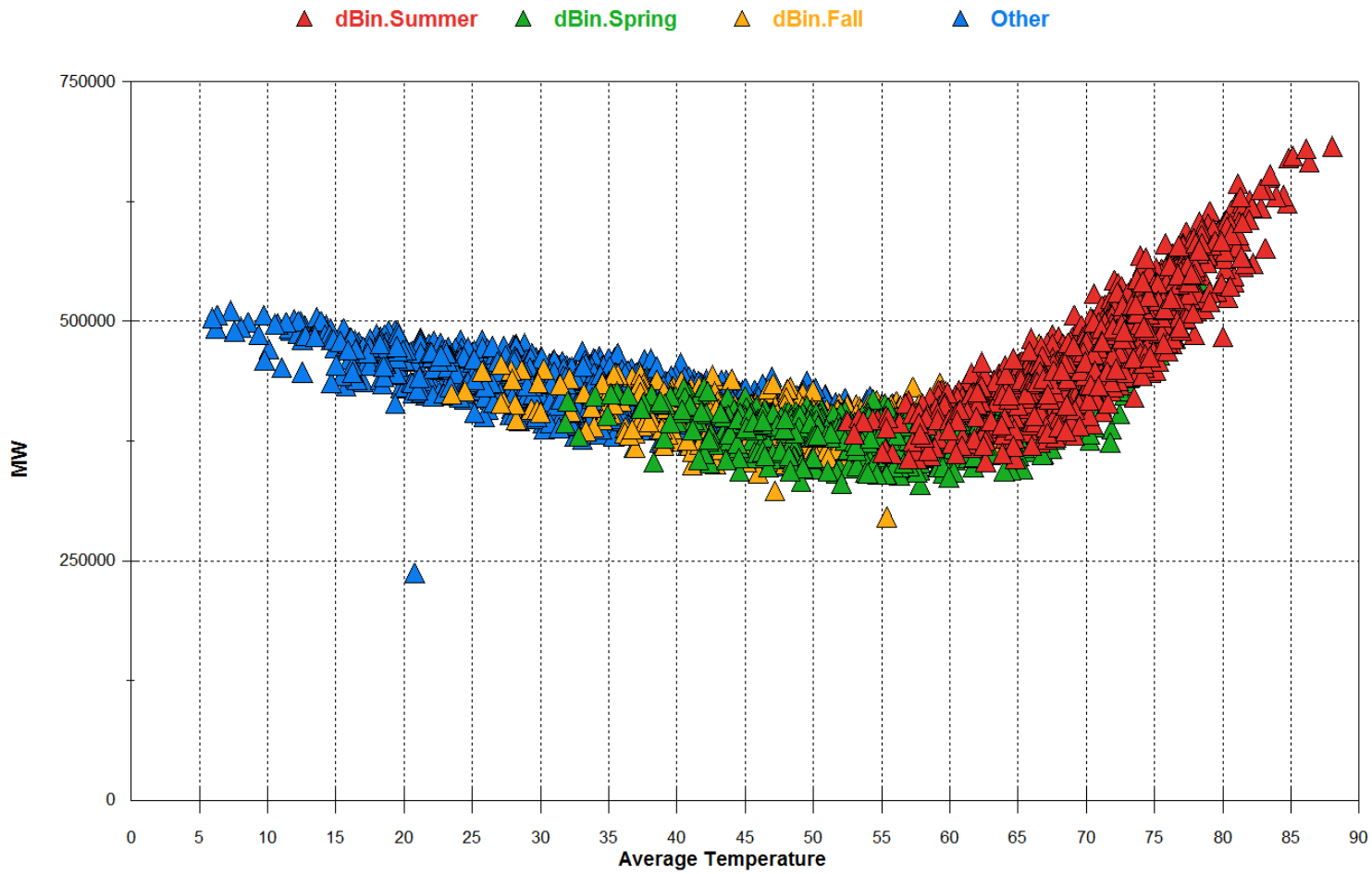
NEW YORK SYSTEM LOAD - 2014





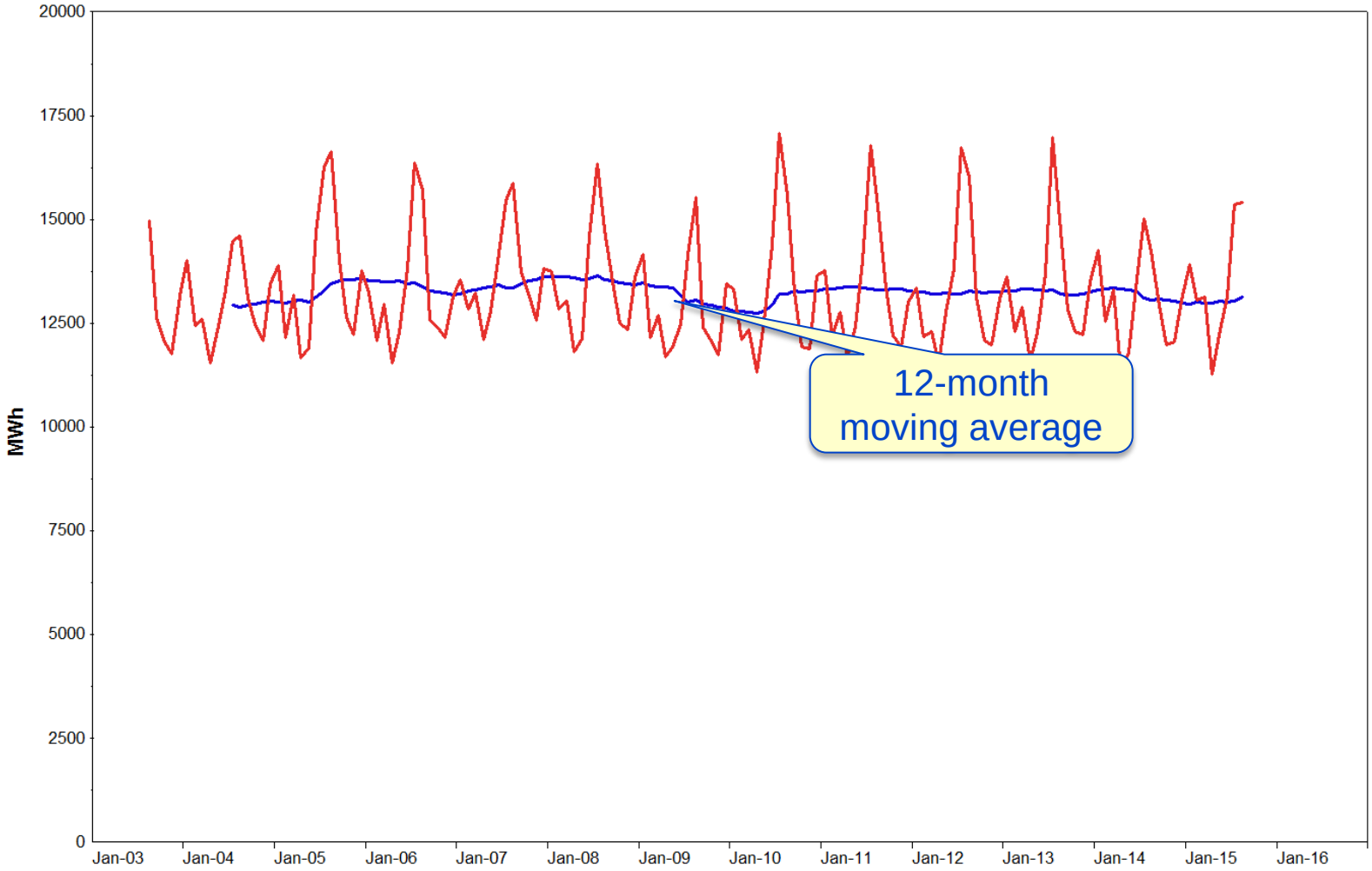


DAILY USE VS. AVERAGE TEMPERATURE



Relatively flat on the heating side

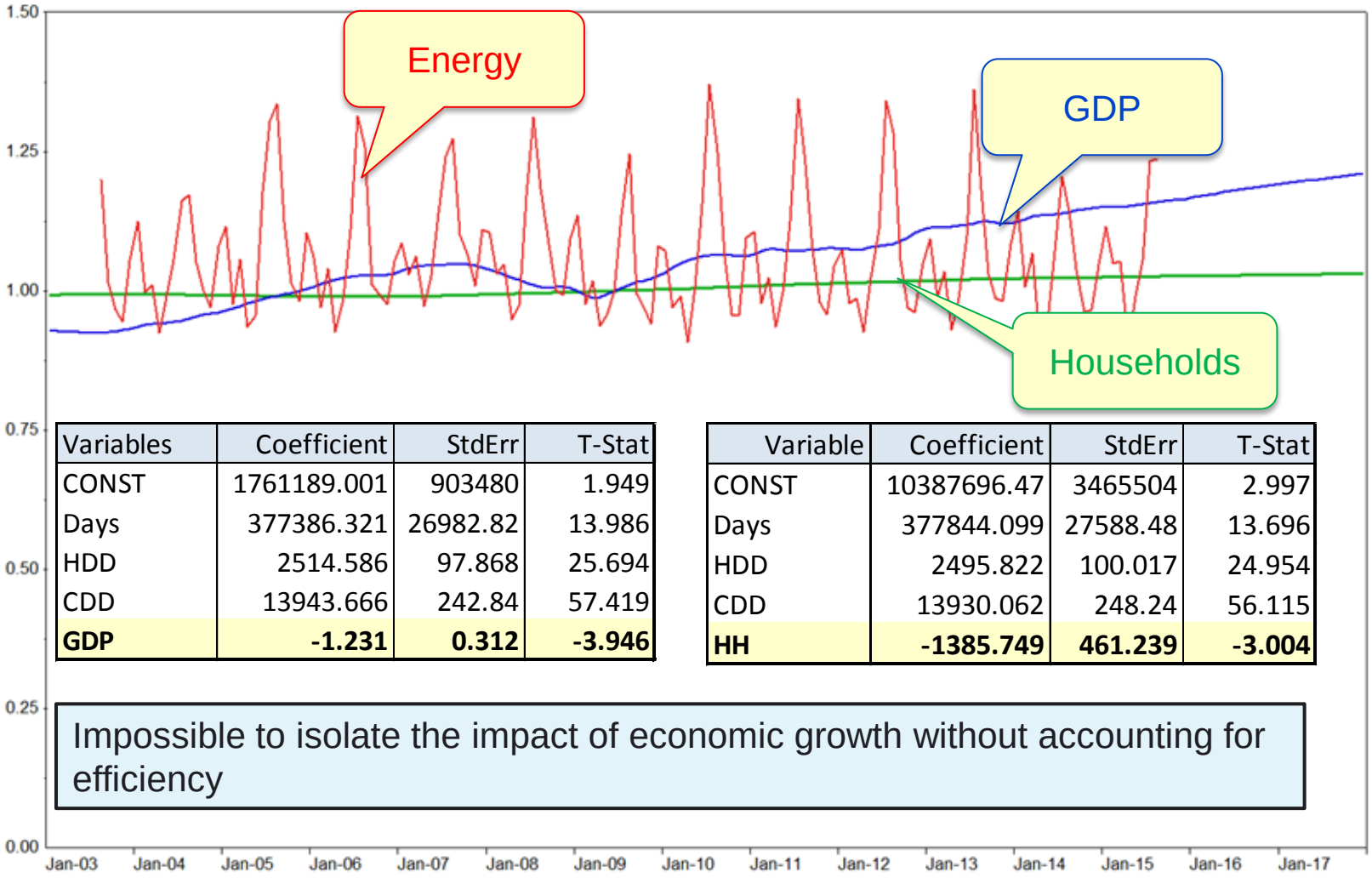
NEW YORK SYSTEM ENERGY



ENERGY VS. ECONOMIC GROWTH

Year	MWh	Chg	GDP	Chg	HseHlds	Chg
2003	155,633,423		1,038,067		7,166,889	0.4%
2004	156,264,563	0.4%	1,070,531	3.1%	7,194,071	0.4%
2005	162,998,316	4.3%	1,117,222	4.4%	7,210,329	0.2%
2006	158,197,943	-2.9%	1,148,597	2.8%	7,225,060	0.2%
2007	163,332,737	3.2%	1,161,022	1.1%	7,252,805	0.4%
2008	161,229,223	-1.3%	1,120,041	-3.5%	7,275,415	0.3%
2009	154,416,156	-4.2%	1,142,771	2.0%	7,301,429	0.4%
2010	159,380,328	3.2%	1,183,352	3.6%	7,326,277	0.3%
2011	159,348,823	0.0%	1,198,667	1.3%	7,329,890	0.0%
2012	158,948,197	-0.3%	1,236,172	3.1%	7,323,250	-0.1%
2013	158,924,755	0.0%	1,248,273	1.0%	7,319,236	-0.1%
2014	155,919,228	-1.9%	1,279,978	2.5%	7,304,501	-0.2%
2003 - 2014		0.0%		1.9%		0.2%

INDEXED ENERGY AND ECONOMIC DRIVERS



Variables	Coefficient	StdErr	T-Stat
CONST	1761189.001	903480	1.949
Days	377386.321	26982.82	13.986
HDD	2514.586	97.868	25.694
CDD	13943.666	242.84	57.419
GDP	**-1.231**	**0.312**	**-3.946**

Variable	Coefficient	StdErr	T-Stat
CONST	10387696.47	3465504	2.997
Days	377844.099	27588.48	13.696
HDD	2495.822	100.017	24.954
CDD	13930.062	248.24	56.115
HH	**-1385.749**	**461.239**	**-3.004**

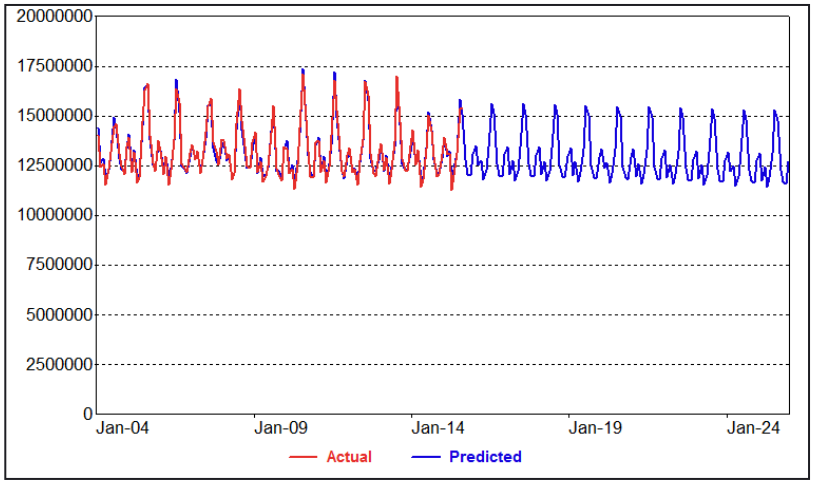
Impossible to isolate the impact of economic growth without accounting for efficiency

MODEL WITH TREND

One simple approach is to allow the slope on GDP to change over time

Variable	Coefficient	StdErr	T-Stat
Days	366519.408	14795.82	24.772
HDD	2442.767	109.587	22.291
CDD	13669.666	270.736	50.491
GDP	**0.754**	**0.419**	**1.799**
GDP_Trend	**-0.031**	**0.009**	**-3.33**
MA(1)	0.504	0.078	6.486

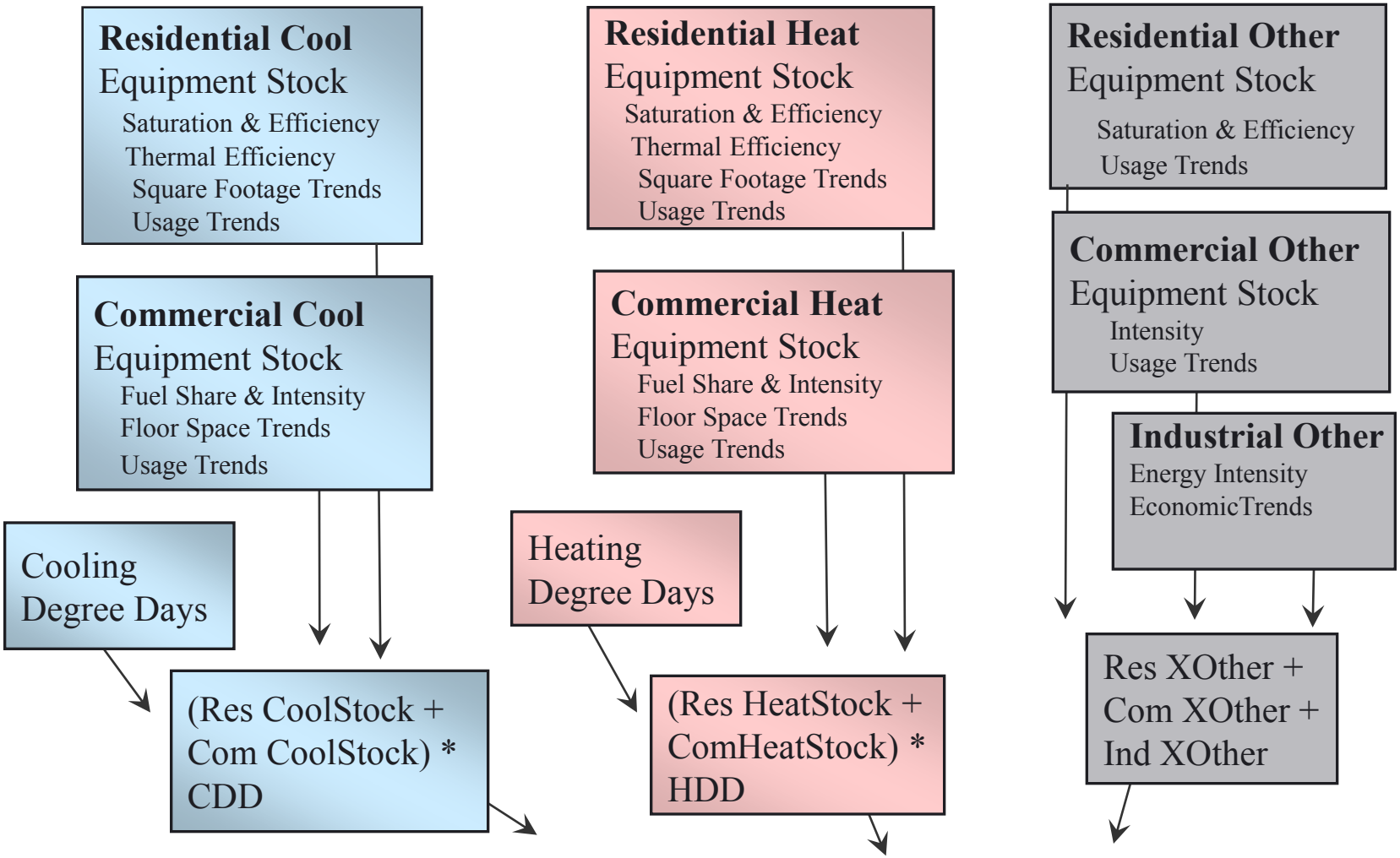
Model Statistics	
Iterations	14
Adjusted Observations	140
Deg. of Freedom for Error	134
R-Squared	0.974
Adjusted R-Squared	0.973
AIC	24.676
BIC	24.802
Mean Abs. % Err. (MAPE)	1.32%
Durbin-Watson Statistic	1.895



System energy declines 0.4% per year. (probably too strong of a decline)

We want to replace the trend variable with something that has a little more structure ?

SYSTEM SAE MODEL SPECIFICATION



$$Energy_m = a + b_c \times XCool_m + b_h \times XHeat_m + b_o \times XOther_m + e_m$$

COOLING VARIABLE

» For Revenue Class SAE Models:

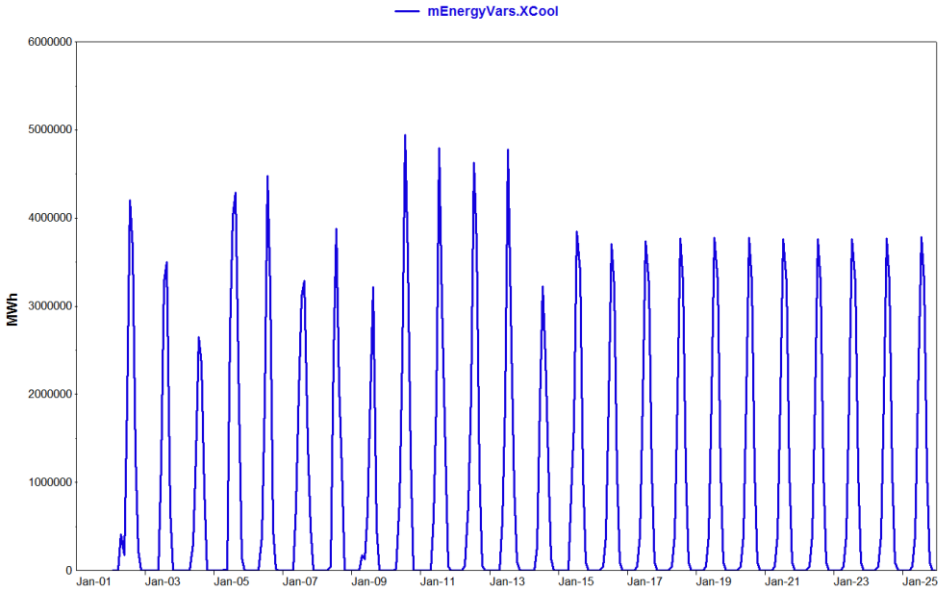
$$ResCool_{y,m} = HH_{y,m} \times ResCoolIndex_{y} \times ResCoolUse_{y,m}$$

$$ComCool_{y,m} = FloorSpace_{y,m} \times ComCoolIndex_{y} \times ComCoolUse_{y,m}$$

» For system level model:

$$WtCoolIdx_{y,m} = \mathrm{Re}\,sWt * ResCoolIdx_{y} + ComWt * ComCoolIdx_{y,m}$$

$$XCool_{y,m} = WtCooIdx_{y,m} \times EconVar_{y} \times CDD_{y,m} \times BaseCoolMWh$$



Index weights = annual class cooling load estimates
res = 0.5
com = 0.5

HEATING VARIABLE

- For Revenue Class SAE Models:

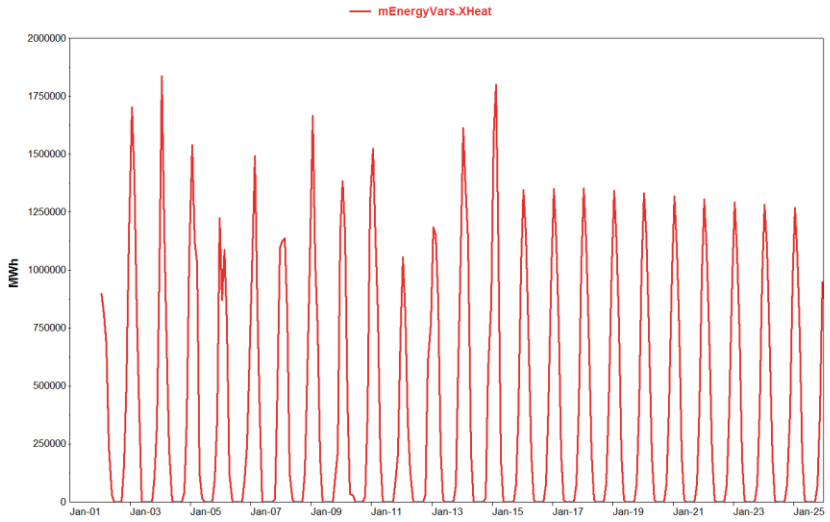
$$ResHeat_{y,m} = HH_{y,m} \times ResHeatIndex_{y} \times ResHeatUse_{y,m}$$

$$ComHeat_{y,m} = FloorSpace_{y,m} \times ComHeatIdx_{y} \times ComHeatUse_{y,m}$$

- For system level model:

$$WtHeatIdx_{y,m} = \mathrm{Re}\,sWt * ResHeatIdx_{y} + ComWt * ComHeatIdx_{y,m}$$

$$XHeat_{y,m} = WtHeatIdx_{y,m} \times EconVar_{y} \times CDD_{y,m} \times BaseHeatMWh$$



Index weights = annual class heating load estimates
res = 0.8
com = 0.2

OTHER USE VARIABLE

- For Revenue Class SAE Models:

$$ResOther_{y,m} = HH_{y,m} \times ResOtherIndex_{y} \times ResOtherUse_{y,m}$$

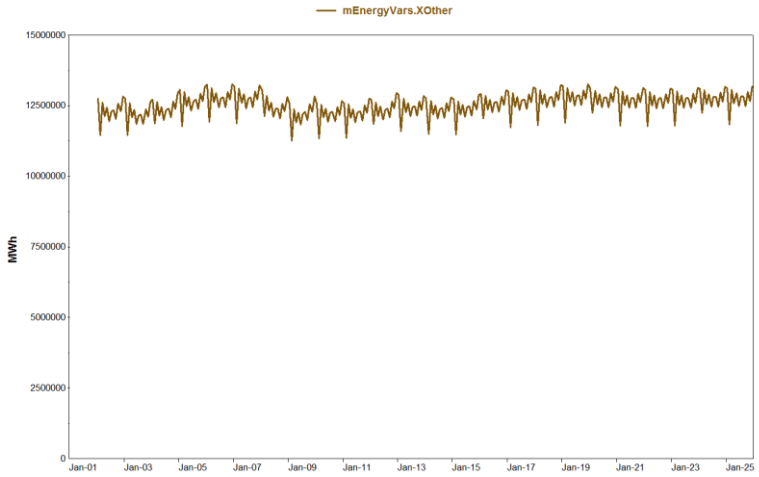
$$ComOther_{y,m} = FloorSpace_{y,m} \times ComOtherIdx_{y} \times ComOtherUse_{y,m}$$

$$IndOther_{y,m} = ManufEmp_{y,m} \times IndIdx_{y} \times IndUse_{y,m}$$

- For system level model:

$$WtOtherIdx_{y,m} = \mathrm{Re}\,sWt * ResOthIdx_{y} + ComWt * ComOthIdx_{y,m} + IndWt * IndIdx_{y,m}$$

$$XOther_{y,m} = WtOtherIdx_{y,m} \times EconIdx_{y} \times DaysIdx_{y,m} \times BaseOtherMWh$$

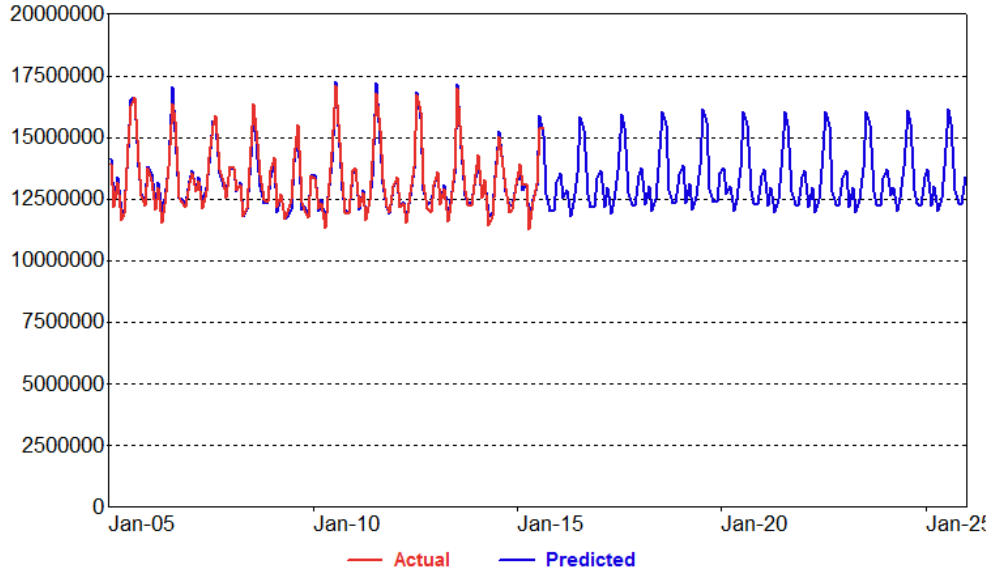


Index weights = annual class other load estimates
res = 0.4
com = 0.4
ind = 0.2

ESTIMATED SYSTEM SAE MODEL

Variables	Coefficient	StdErr	T-Stat
XOther	0.95	0.004	237.1
XHeat	1.113	0.060	18.5
XCool	1.091	0.022	49.2
Yr2015Plus	-205287.243	123279.752	-1.7
MA(1)	0.535	0.079	6.7

Model Statistics	
Iterations	11
Adjusted Observations	128
Deg. of Freedom for Error	123
R-Squared	0.973
Adjusted R-Squared	0.972
AIC	24.751
BIC	24.863
Mean Abs. % Err. (MAPE)	1.34%
Durbin-Watson Statistic	1.854



SUMMARY

- A well constructed SAE model can explain historical system energy trends well and generate a long-term energy forecast that captures end-use efficiency trends as well as economic and population growth.

- The SAE model allows to construct long-term scenarios that may include alternative economic growth and population projections, price projections, new standards and the adoption of more efficient technologies, and alternative EE investment strategies.