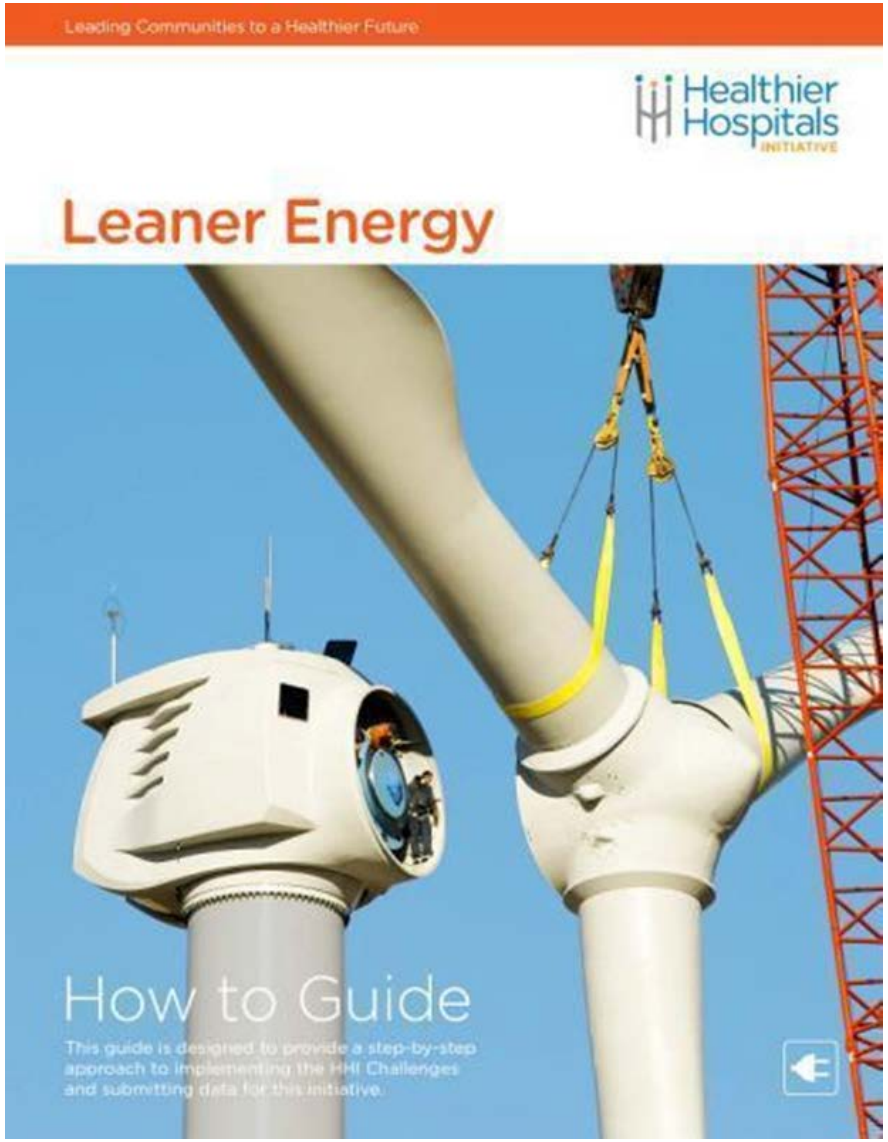


Healthier Hospitals INITIATIVE

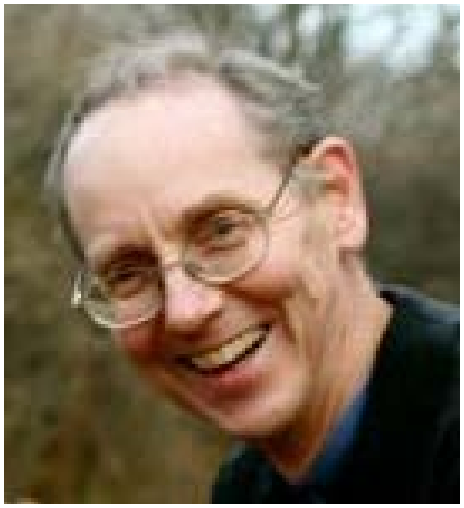
LINKING QUALITY IMPROVEMENT AND LEANER ENERGY USE

Sharing Call Series for Quality Community--Part 2

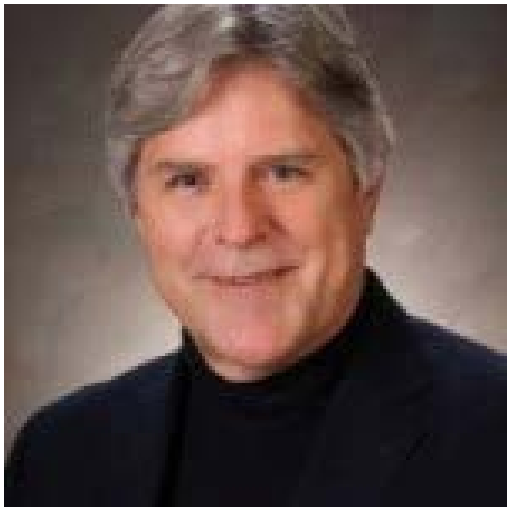
13 March 2014

Kevin Little, Ph.D.

Presenters



Kevin Little
Principal
Informing Ecological Design, LLC
IHI Improvement Advisor



Paul Linzmeyer
Sustainability Leader
ThedaCare

Agenda

1. Context for our call series
2. Assignments from week 1
3. ThedaCare Introduction
4. The Problem: Has energy use changed in our hospital?
5. A Refined Question and a Refined Answer
6. Your turn: data sets to try

Our premise

- The Leaner Energy challenge requires benchmarking, monitoring, and improvement
- Facilities and sustainability managers may be challenged by these "QI" fundamentals
- QI specialists have relevant skills and understanding
- Collaboration between groups can repay itself multiple times in better environmental performance

Healthier Hospitals INITIATIVE

Leaner Energy

Level 1	Level 2	Level 3
Reduce greenhouse gases by decreasing weather-adjusted energy intensity from metered energy use by three percent from baseline.	Reduce greenhouse gases by decreasing weather-adjusted energy intensity from metered energy use by five percent from baseline.	Reduce greenhouse gases by decreasing weather-adjusted energy intensity from metered energy use by ten percent from baseline OR if facility is already an ENERGY STAR rated facility (> 75), maintain ES status.

Baseline: Input energy data into ENERGY STAR Portfolio Manager to track energy use and GHG emissions

Level 1 – 3% reduction

Level 2 – 5% reduction

Level 3 – 10% reduction (or >75 ES)

This Webinar Series

Session	Date	Topics
1	27 Feb 2014	Healthier Hospitals Initiative; Gundersen Health Example; Leaner Energy Challenge explained; Assignments
2	13 Mar 2014	Modeling energy use in buildings using monthly data; Assignment: try your hand on practice data or your own building's data
3	27 Mar 2014	Review of Assignment; 15-minute energy use and daily energy use: applications; Partnering with facilities/sustainability colleagues

Two questions posed 27 Feb 2014

1. Is your organization taking part in HHI?

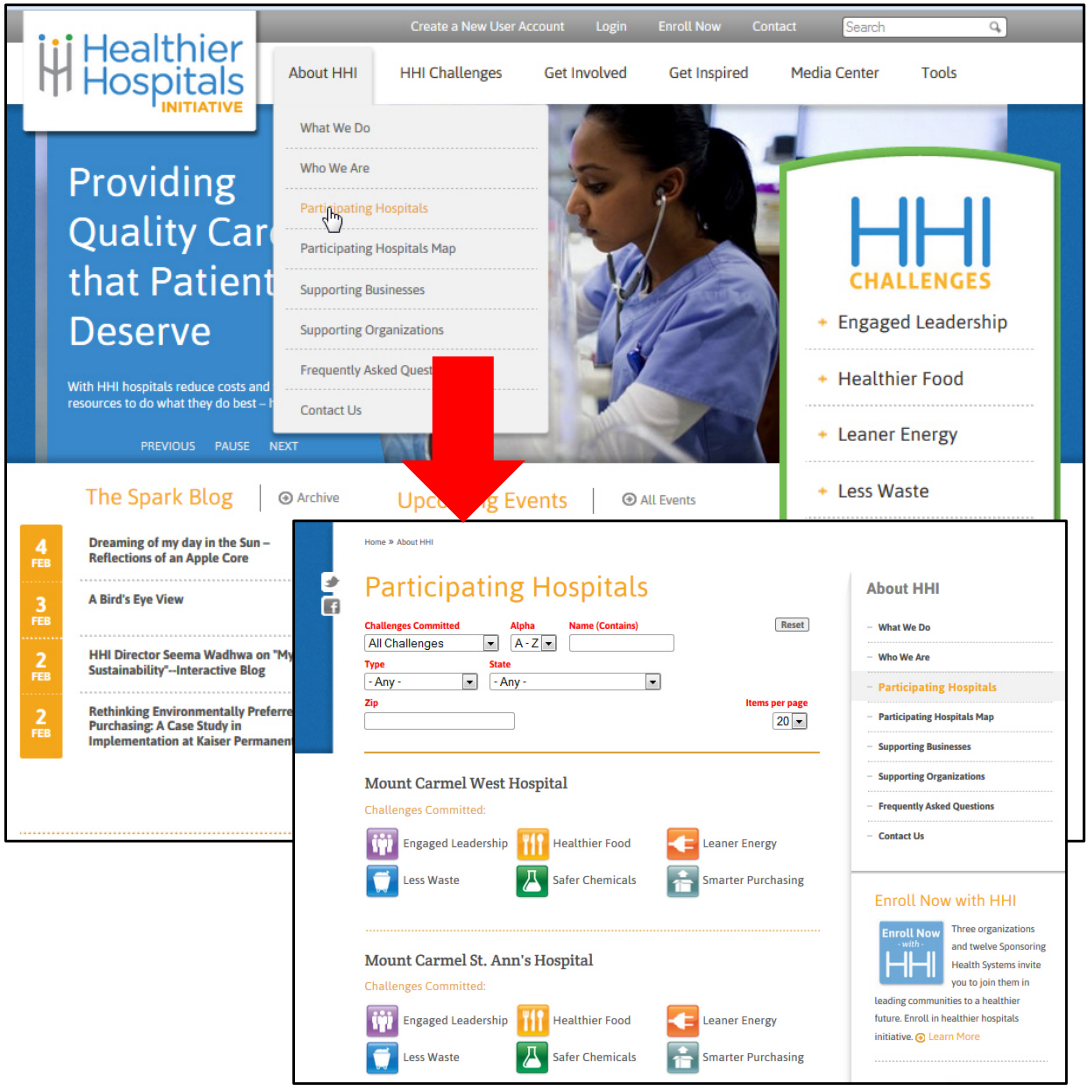
   You can find out from the HHI website.

2. Is your organization using Portfolio Manager*?

   You may have to hunt for the answer.

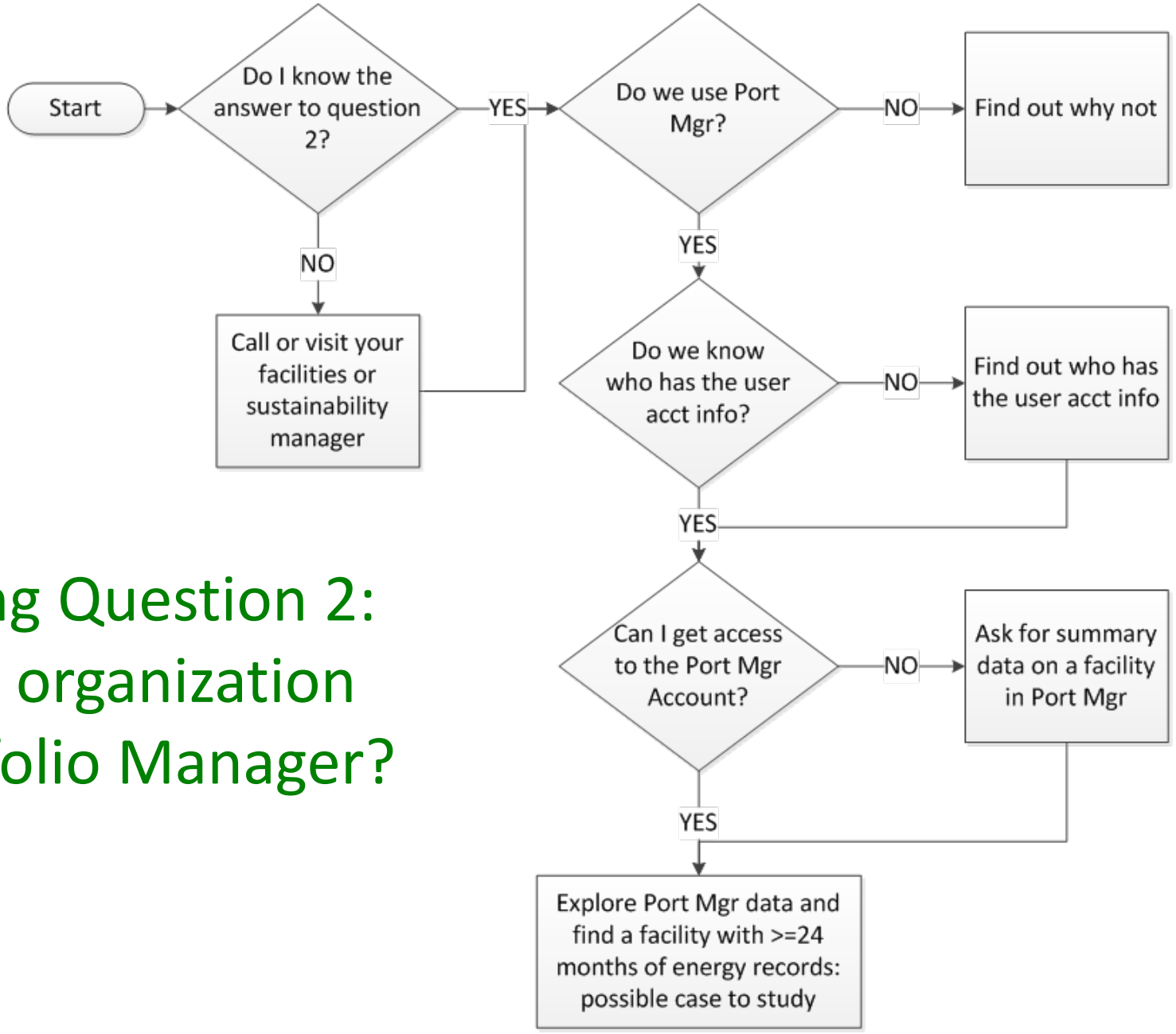
*If your organization uses Portfolio Manager and you have at least two years of monthly data for one facility, you have the option to use your own data to develop a weather-adjusted energy model after the next webinar.

Answering Question 1: HHI Participation



1. Go to HHI website http://healthierhospitals.org/
2. In the **About HHI** menu, choose **Participating Hospitals**
3. Search for a hospital that is part of your organization.
4. You can enroll as an individual and you can enroll your organization, too, if you're not already taking part.

Answering Question 2: Does our organization use Portfolio Manager?



Thanks to ThedaCare for sharing data used in our webinar!

3. THEDACARE INTRODUCTION

THEDACARE SUSTAINABILITY JOURNEY

OUR SUSTAINABILITY JOURNEY'S PURPOSE IS TO HELP REACH OUR MISSION OF CREATING HEALTHY COMMUNITIES BY GREATLY REDUCING OR ELIMINATING OUR ENERGY, WASTE AND WATER FOOTPRINT.

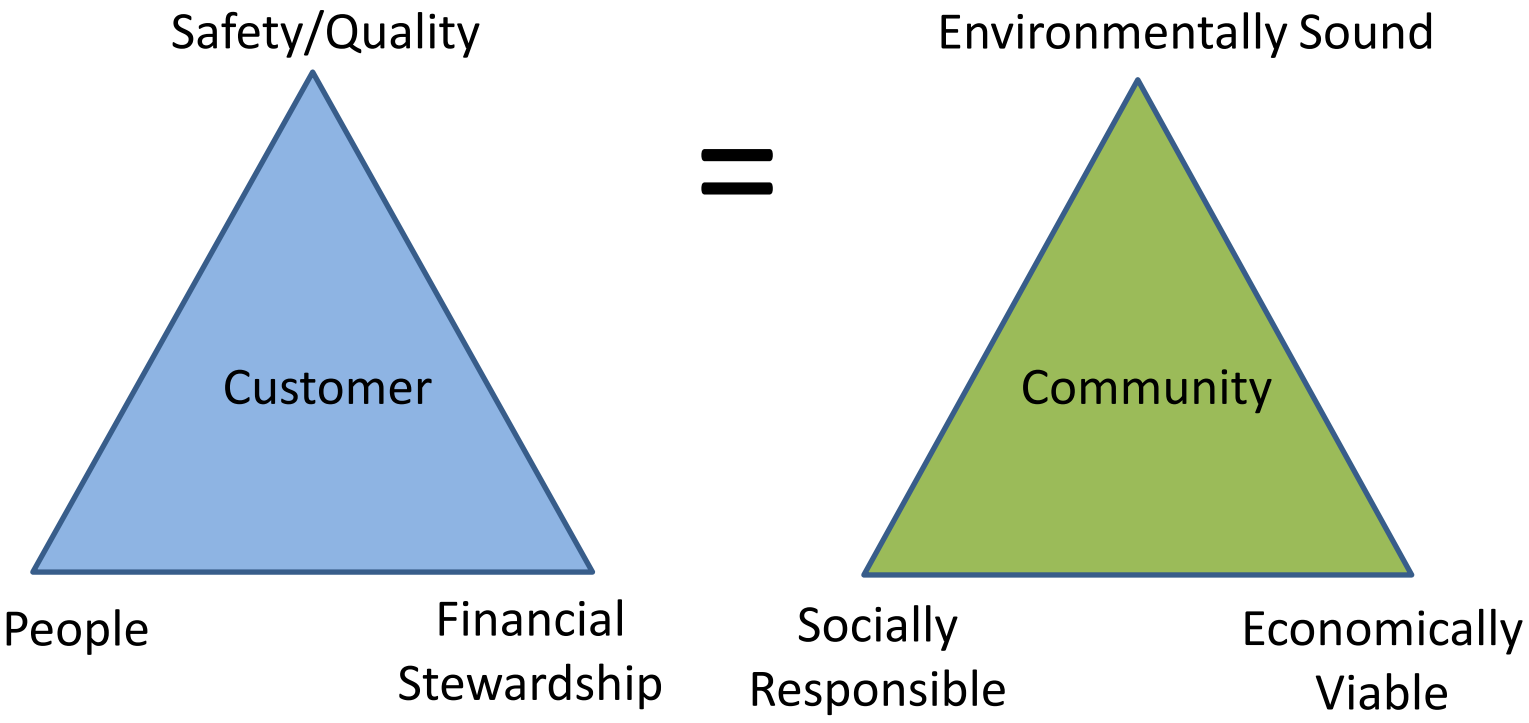
WHY SHOULD IT MATTER TO THEDACARE OR ANYONE ELSE

Similar to Lean, Sustainability is a cultural transformation that changes how an organization works. It requires new habits, new skills, and often a new attitude throughout the organization. It is not an additional burden, but rather an enhancement of who we currently are.

THEDACARE VALUES

Also, Sustainability practices support our Values and Behaviors:

- Love our work,
- be courageous, and
- have a thirst for knowledge.



ThedaCare True North

Triple Bottom Line

THEDACARE™

RESULTS

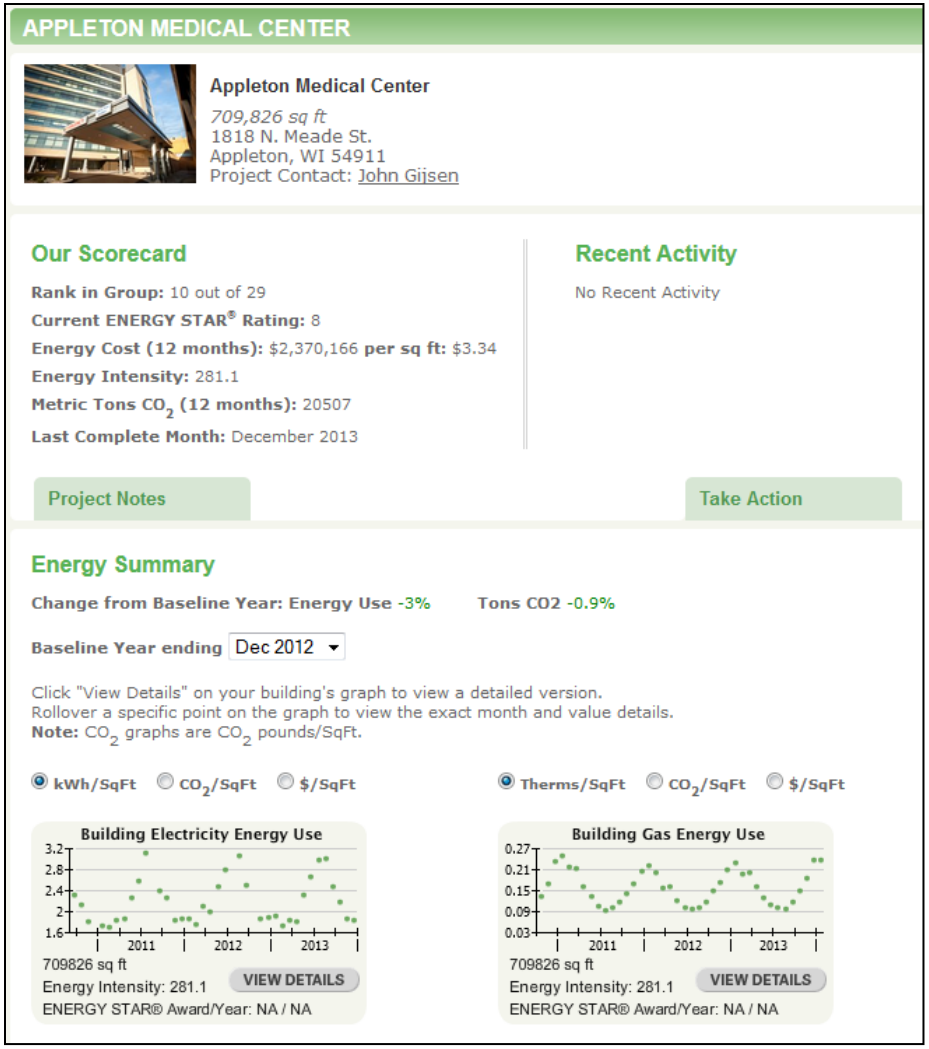
- $1.9M IN RCx PRODUCED SIGNIFICANT SAVINGS WITH ABOUT A 2 YEAR PAYBACK
  - CHANGED OUT ALL T12S
  - LED LIGHTING IN PARKING RAMP AND LOTS
  - STEAM TURBINE PROJECT
  - FEASIBILITY STUDIES FOR OR AHU OPTIMIZATION
  - FACILITIES OPERATIONS WERE TESTED FOR PERSISTENCE AND RESULTS WERE FAVORABLE

THEDACARE™

4. THE PROBLEM

Background

- ThedaCare Health System working on HHI challenges
- Have data in ENERGY STAR® Portfolio Manager and using 3rd party application Energy Stewards®
- Are we seeing changes in energy use after retro-commissioning?

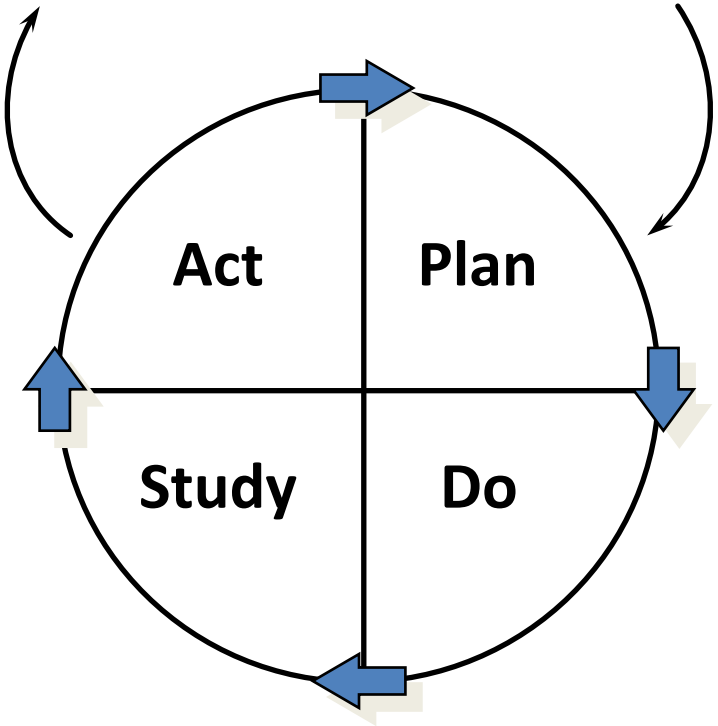


Model for Improvement

What are we trying to accomplish?

How will we know that a change is an improvement?

What change can we make that will result in improvement?



Framework to organize improvement

Developed by Associates in Process Improvement (API), used with permission
www.apiweb.org

Weather Normalized Energy Intensity--recap

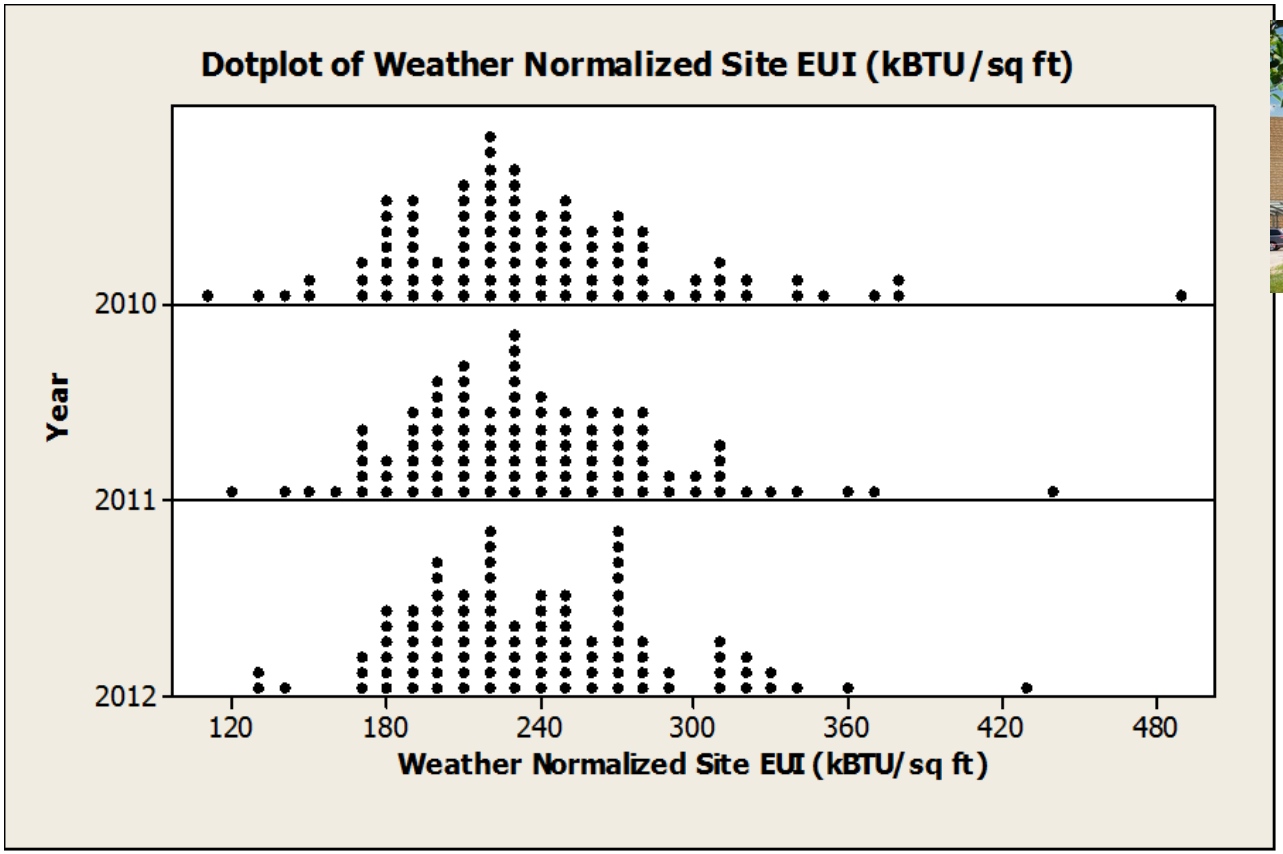
Inputs:

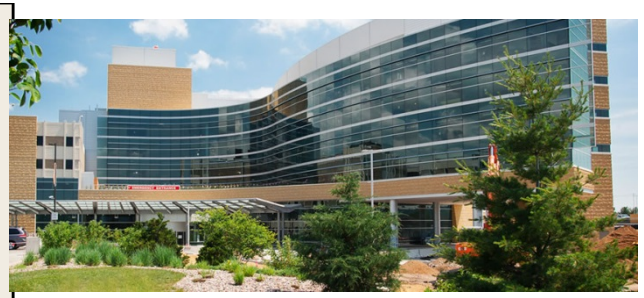
1. 12 months total energy use in kBtu
2. area of building in sq ft
3. zip code to find nearest National Weather Station

Output:

kBtu/sq ft/year adjusted to 30 year average weather conditions.

Hospital values kBtu/sq ft/yr



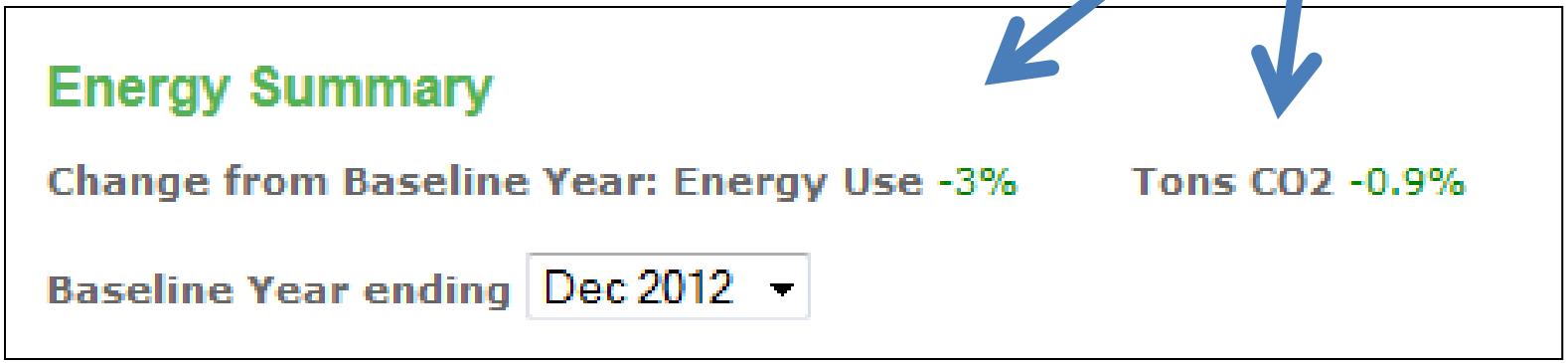


New Gundersen Health hospital (opened Jan 2014) aims for **115** kBtu/sq ft/yr

97 Hospitals from HHI Leaner Energy Challenge 2013
Median value 2012 ~ **233** kBtu/sq ft/yr

Details from Appleton Medical Center Home Page in Energy Stewards

Weather-normalized EI and CO_2 calculations from Portfolio Manager via automatic data exchange



We have an answer!

Using Portfolio Manager data* and arithmetic:

3% decrease in weather-normalized EI

12 mos. ending Dec 2013

vs

12 mos. ending Dec 2012

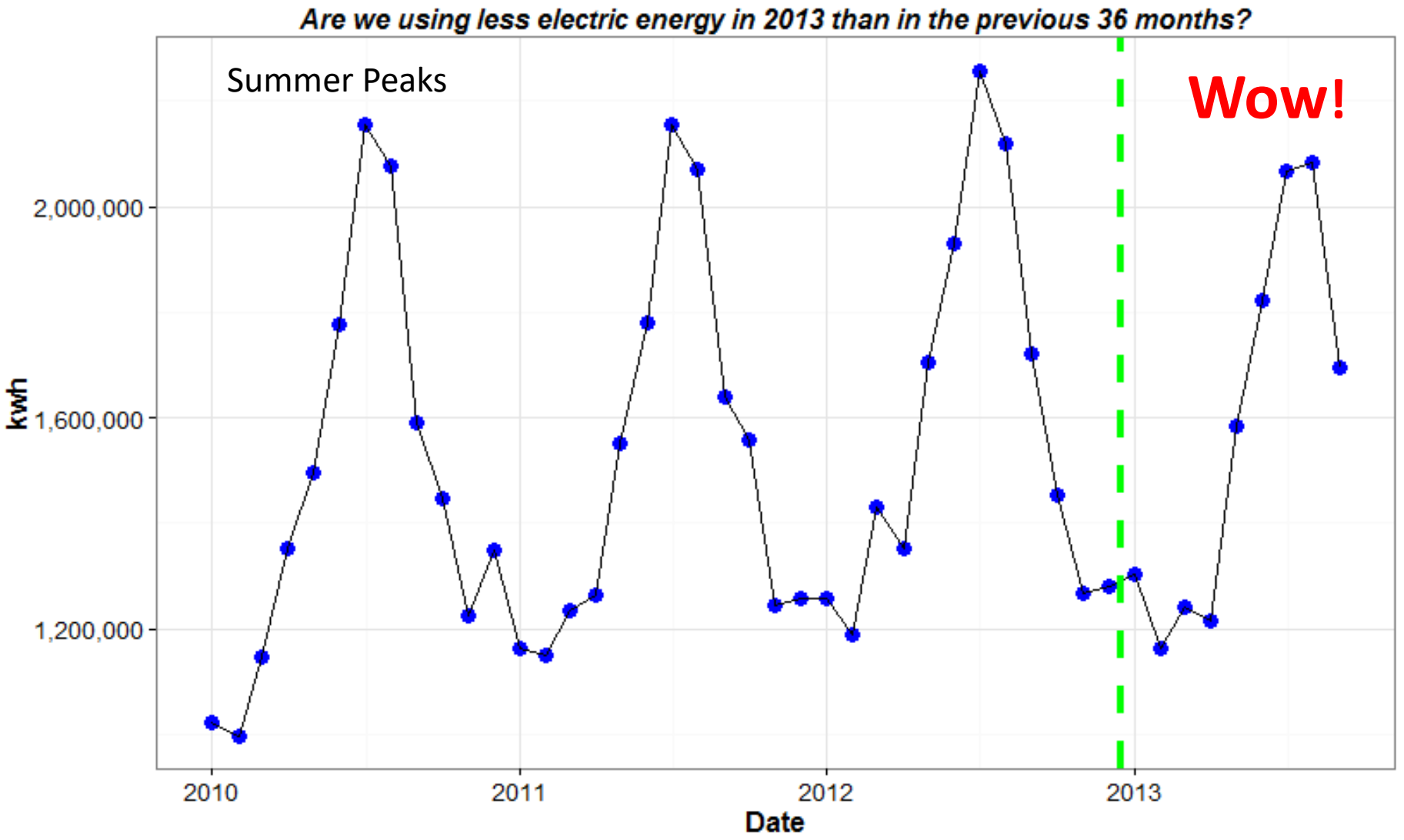
*Data detective story will continue in part 3 of webinar.

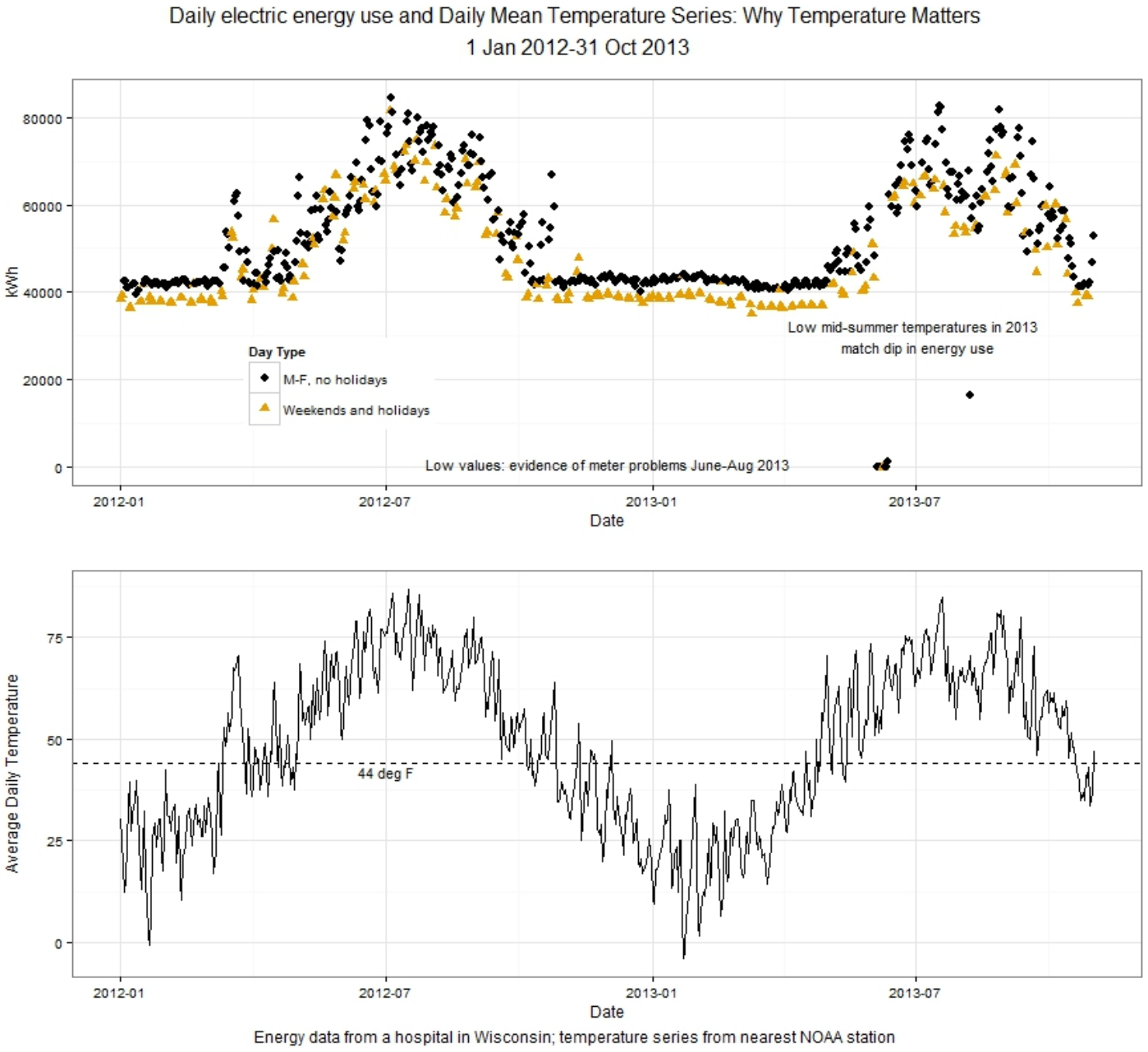
Limitations:

1. Did the change in energy use match your actions?
2. Was decrease in electricity? Natural gas? Both?
3. 12 month arithmetic is "slow" to detect impact

4. A REFINED QUESTION AND REFINED ANSWER

A Refined Question Posed in Oct 2013





Reminder: Energy use and temperature are related, so we better look at temperature effects

Method to Check Whole Building Changes in Energy Use

1. Get the right data.
2. Set a baseline period.
3. Plot the data to understand patterns and unusual values.
4. Model the energy use as a function of mean temperature or degree days.
5. Predict the energy use beyond the baseline period.
6. Compare the actual energy use and predicted use. Use a control chart to judge if there are savings.
7. If step 6 gives you a signal of savings, estimate avoided energy use and costs

1. Get the Right Data

Data Options

1. Use complete calendar months for energy

2. Work with "degree days" especially for heating. February is almost 10% shorter than January and energy use is therefore less

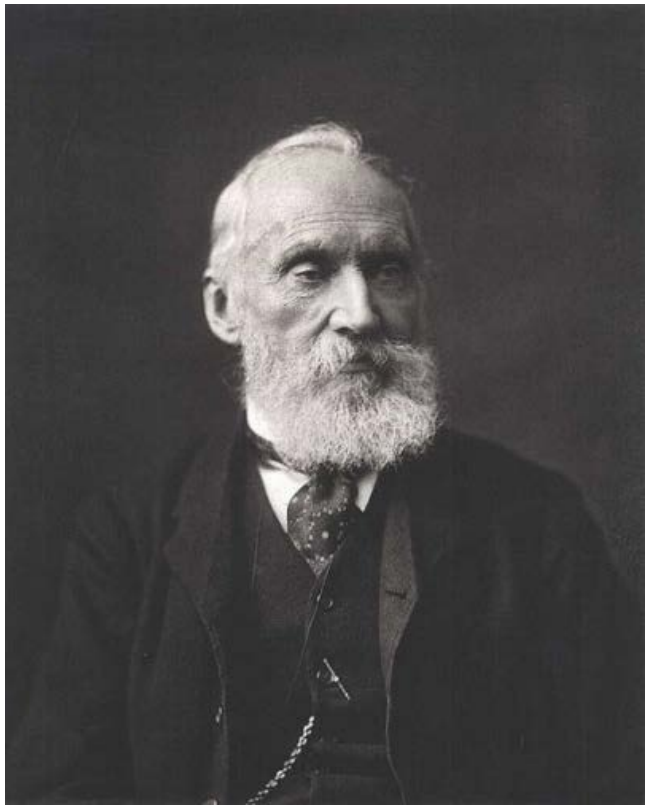
Alternative: work with energy/day, month by month

Getting started

1. Create complete months: energy use per day from bills; calculate calendar month by allocating energy per day from multiple bills

2. Calculate degree days for calendar months, varying the base

Reminder about data



Sir William Thomson, Baron Kelvin of Largs

"The more you understand what is wrong with a figure, the more valuable that figure becomes."

http://zapatopi.net/kelvin/quotes/

Months vary in length: Fewer Days, Lower energy use

Use "degree-day" calculation to compensate for varying lengths

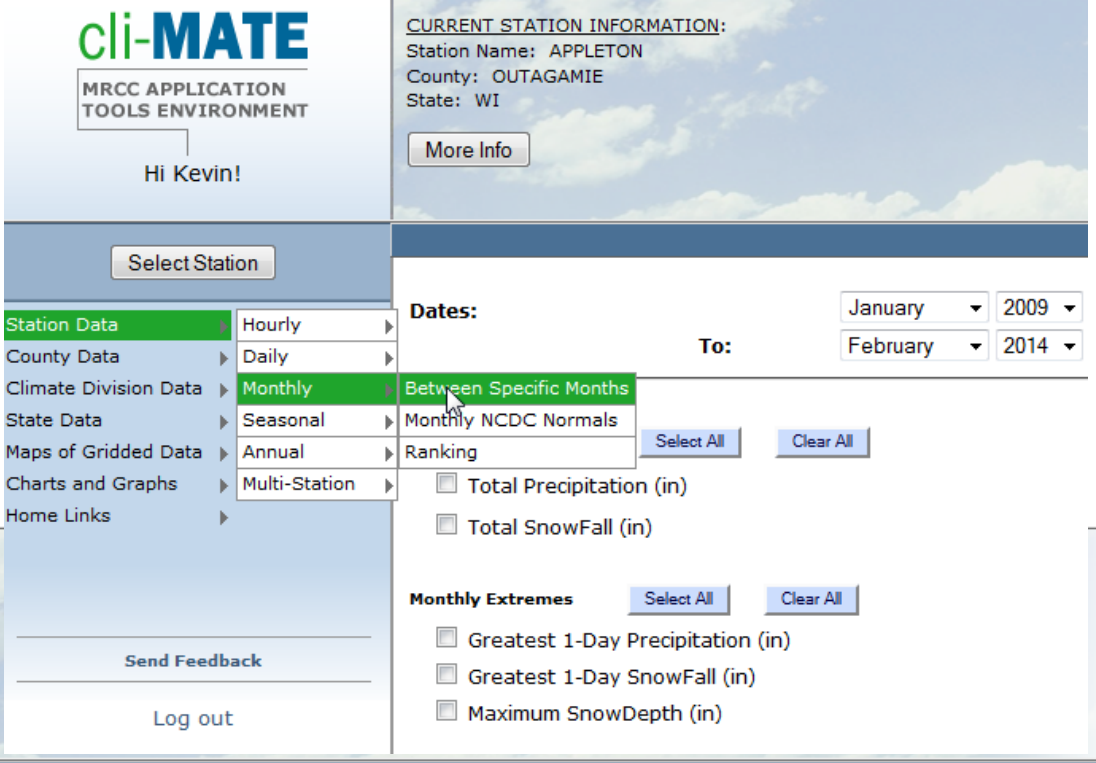
EXAMPLE

Mean Temperature 3/6/2014: 20° F

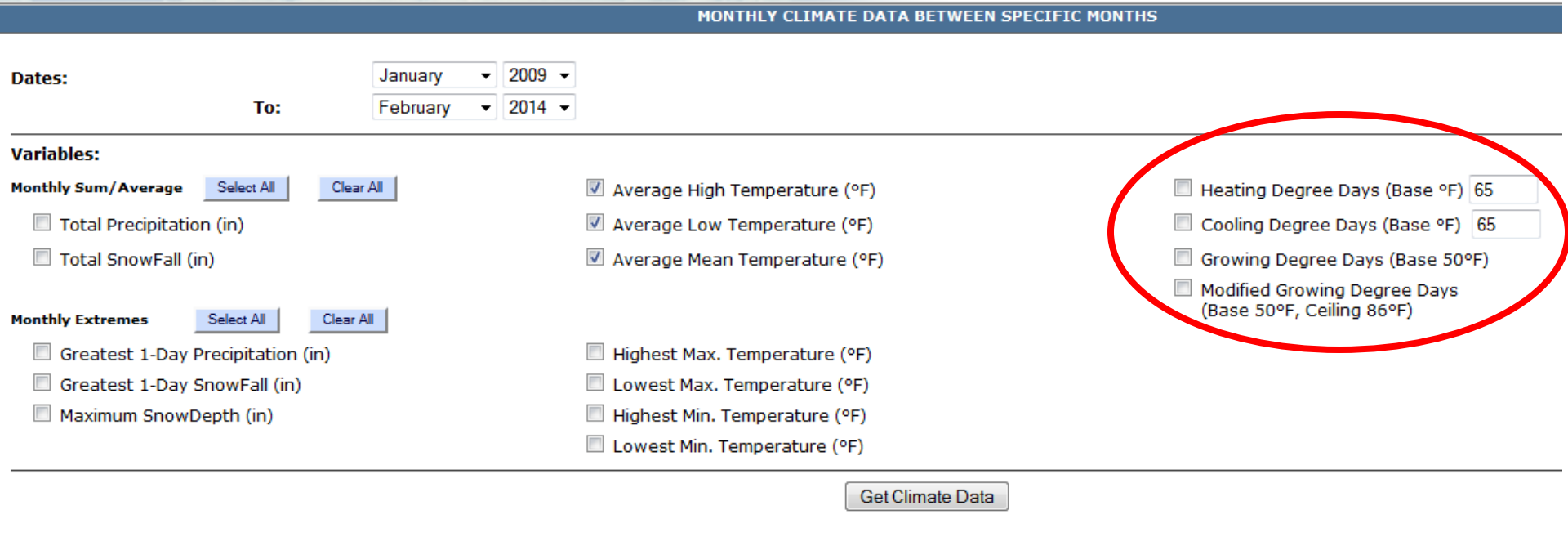
Mean Temperature 9/2/2013: 75° F

Using 65° F base (typical, but you can vary base)

	9/2/2013	3/6/2014
Heating Degree Days	0	65 - 20 = 45
Cooling Degree Days	75-65 = 10	0

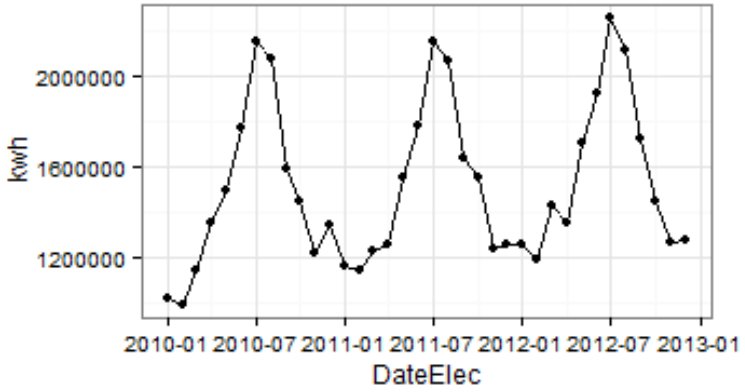


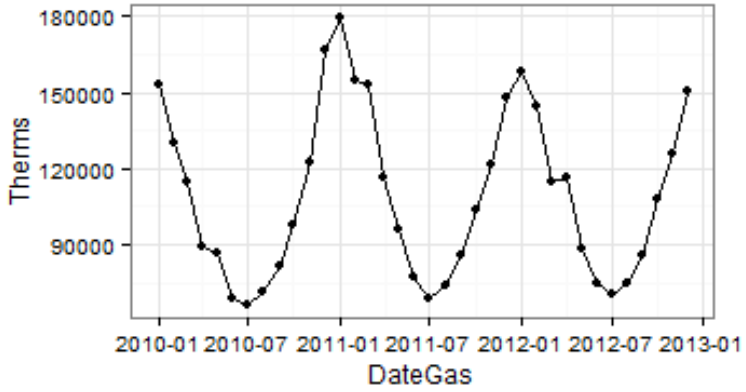
MRCC website allows you to specify degree days with different base settings as well as get monthly summary temperatures

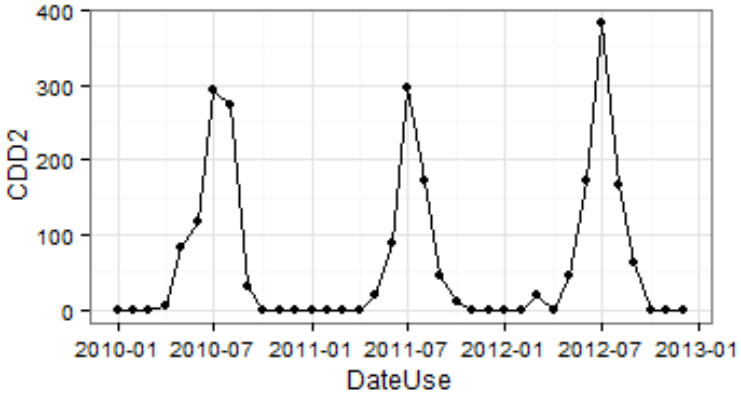


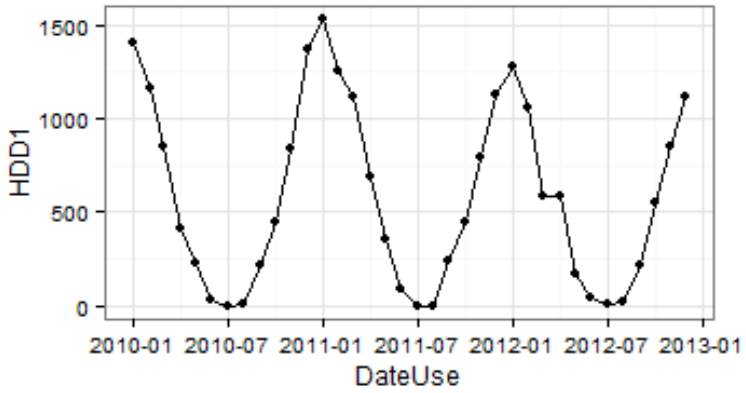
2. Set the Baseline Period

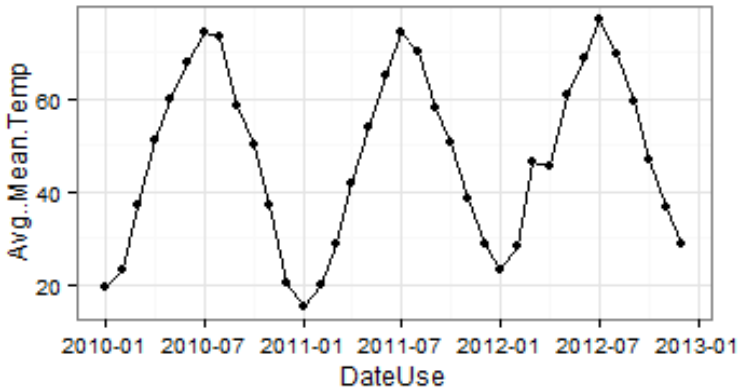
- Rational basis for comparison--relatively stable use (no major system changes, building additions, change in use)
- For monthly data modeling, 12 months is minimum.
- AMC: 36 months January 2010 - December 2012





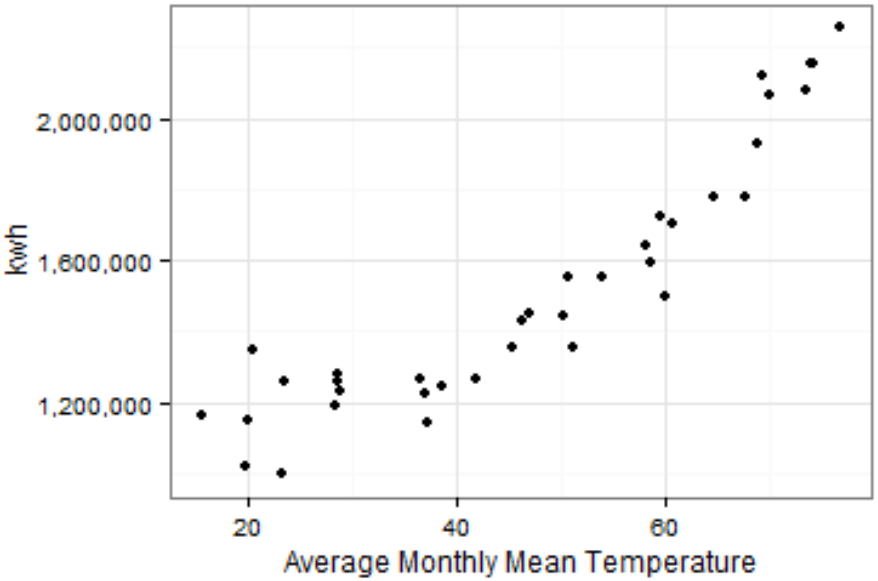


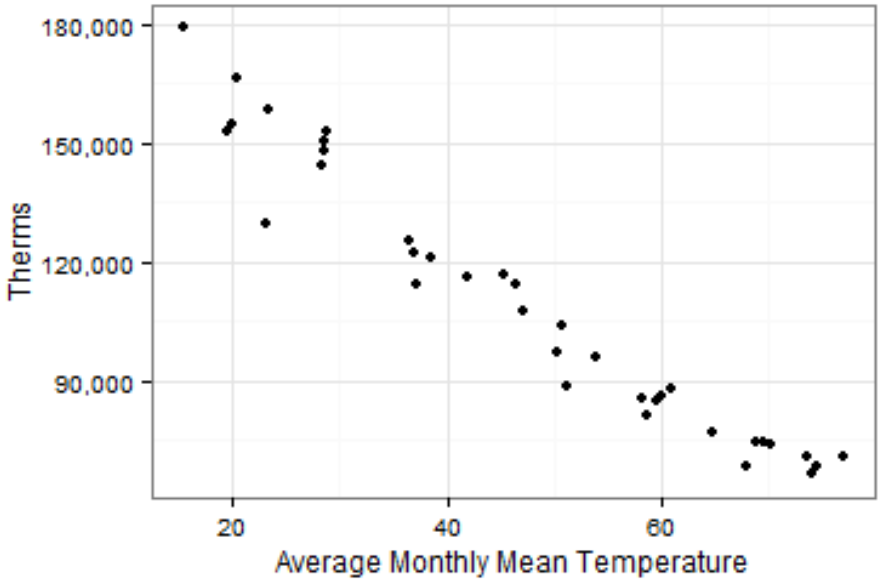


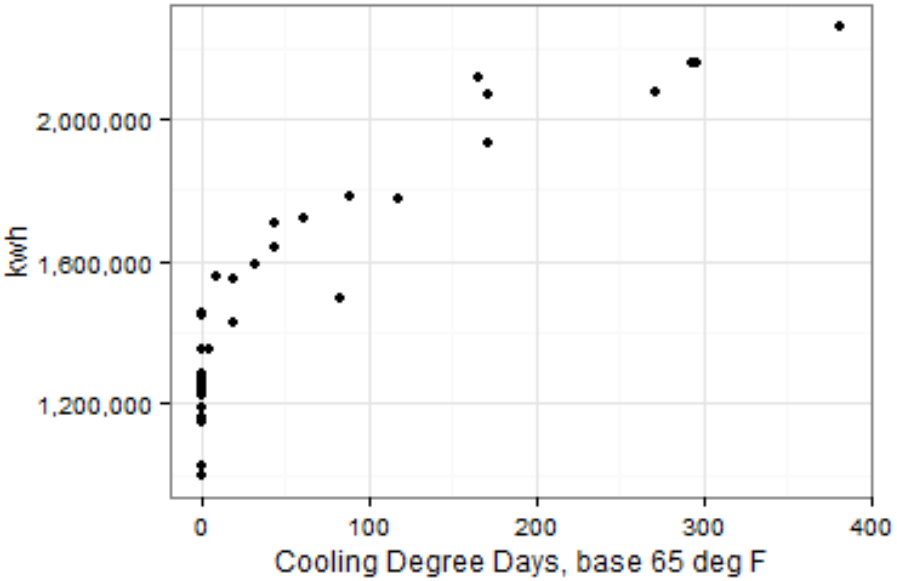


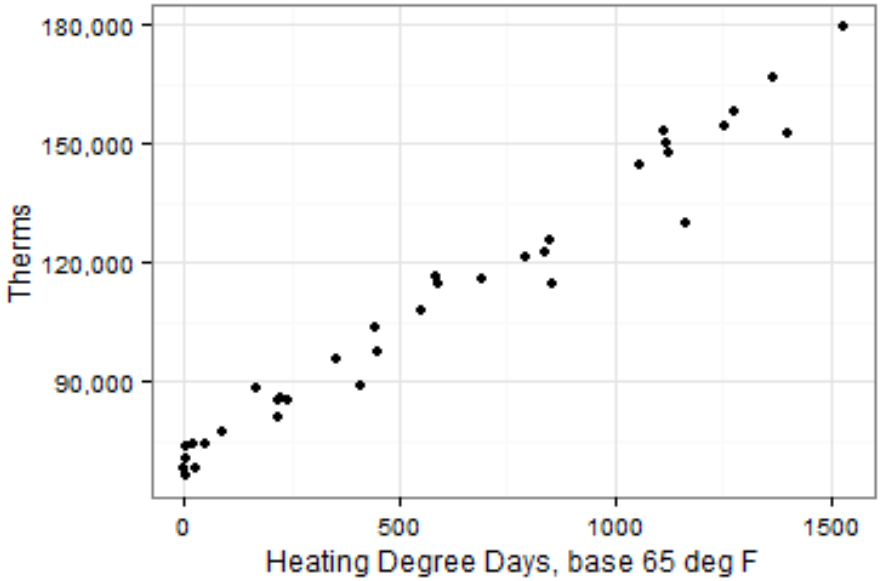
3. Plot the Data

Energy and Temperature relationships, Jan 2010-Dec 2012









4. Model the energy use

- Three year upward trend and variation related to temperature.
- Use "regression" to create an equation

For example:

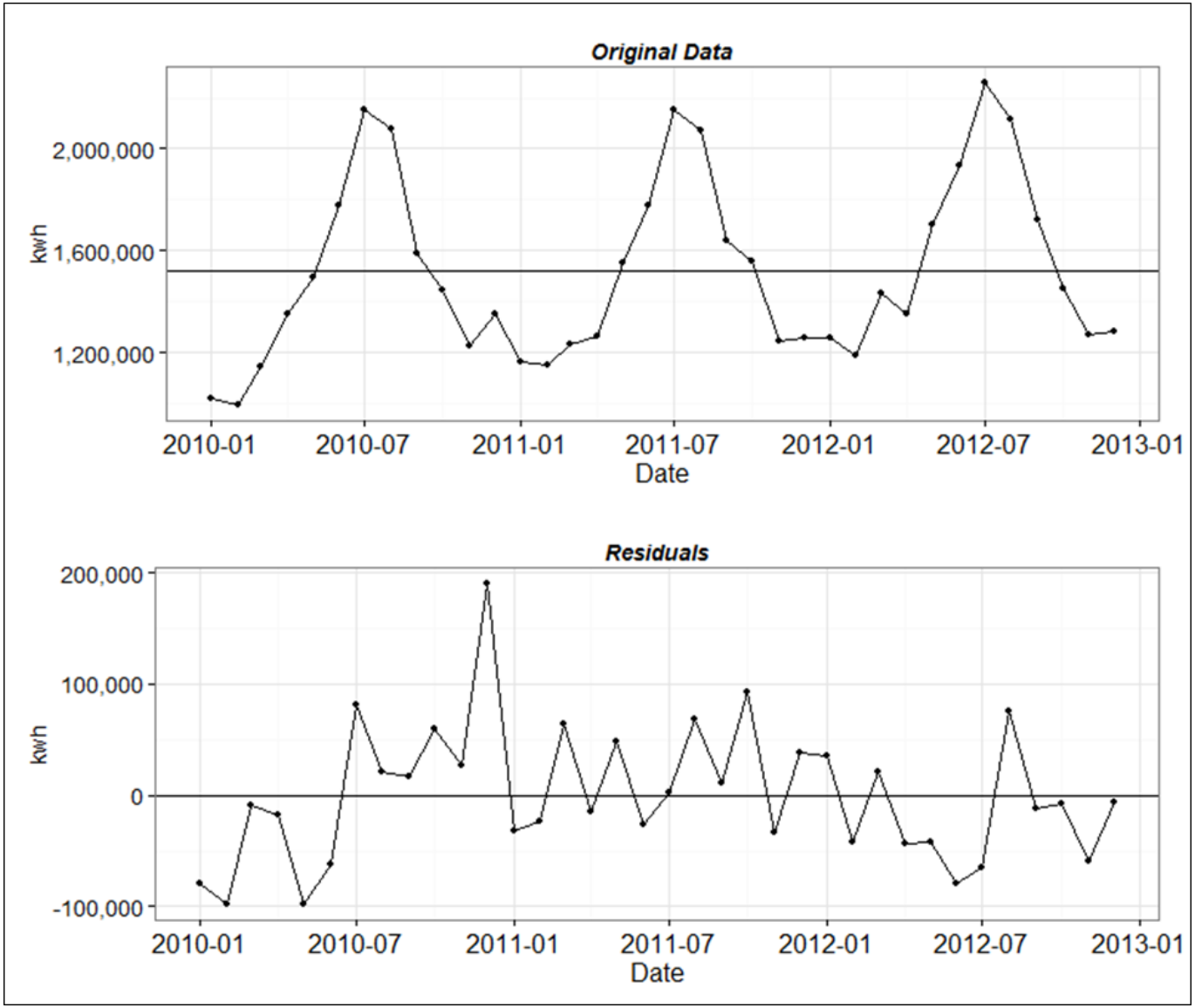
Predicted kwh =

1,341,783 + 5596 x Month Time Step

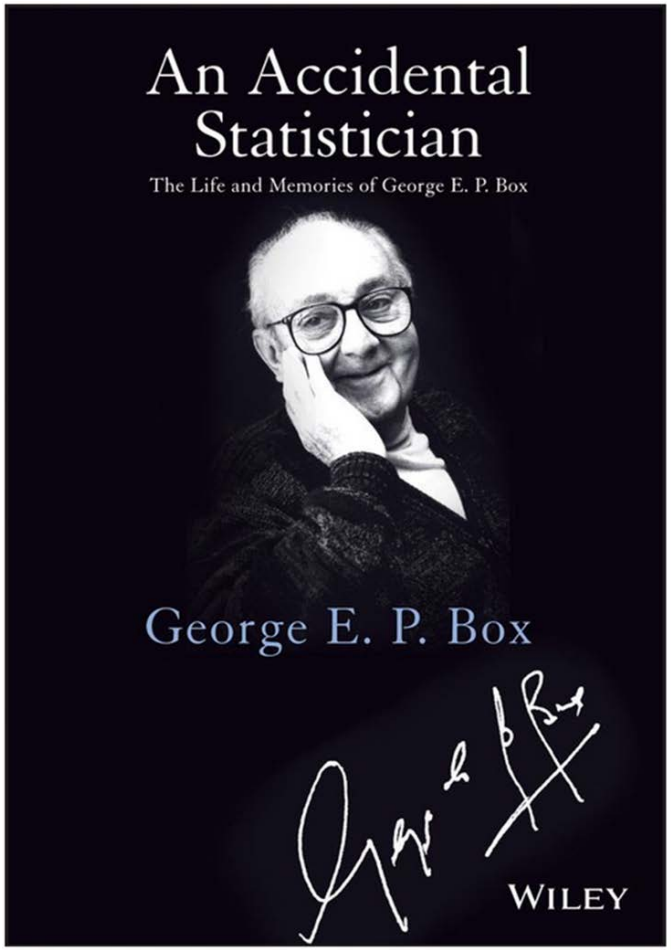
– 20455 x Average Monthly Mean Temperature +

402 x (Average Monthly Mean Temperature)^2

Check the Model



Is the Model useful?



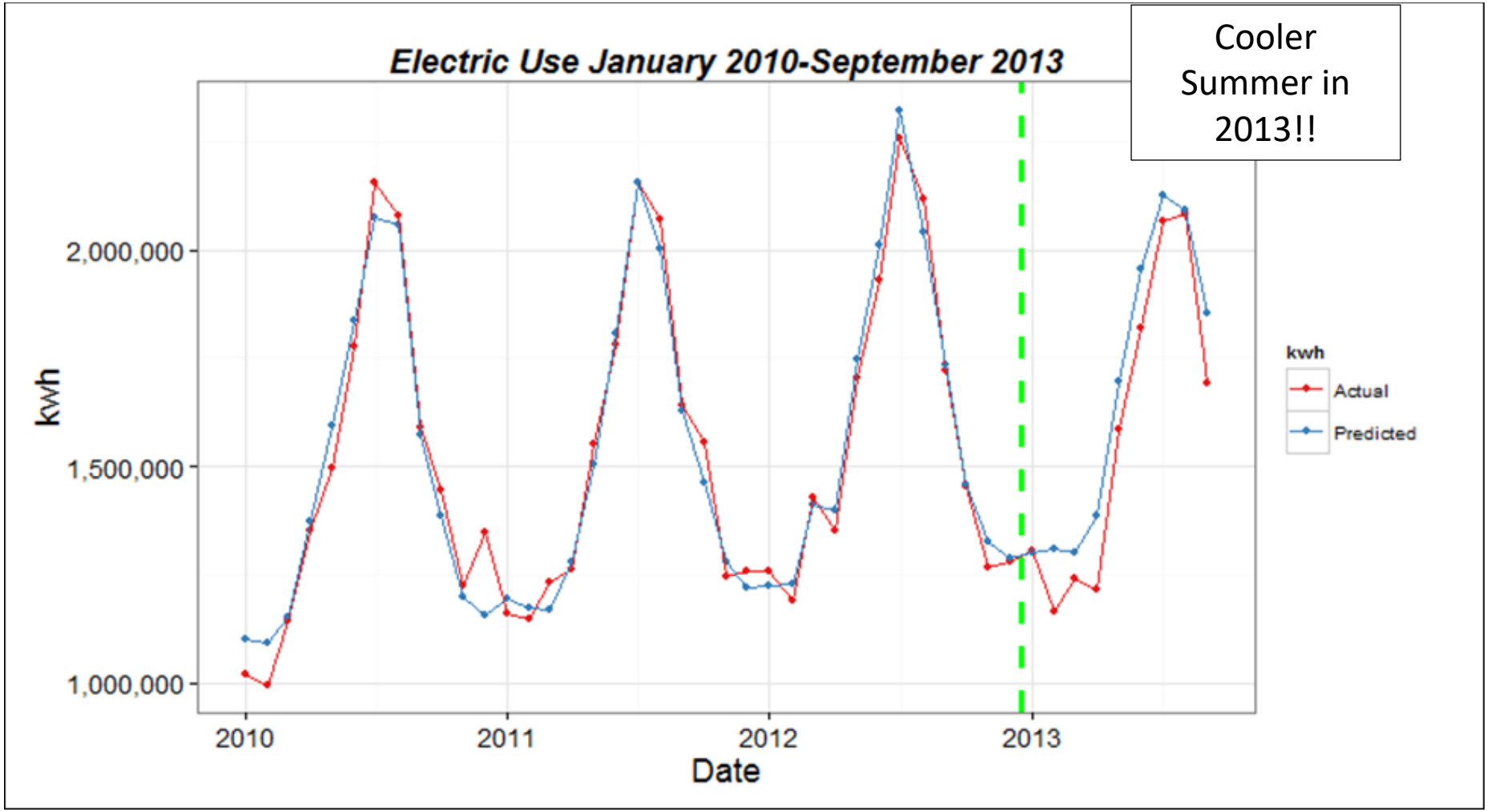
"The fact that the polynomial is an approximation does not necessarily detract from its usefulness because all models are approximations. Essentially, all models are wrong, but some are useful. However the approximate nature of the model must always be borne in mind."

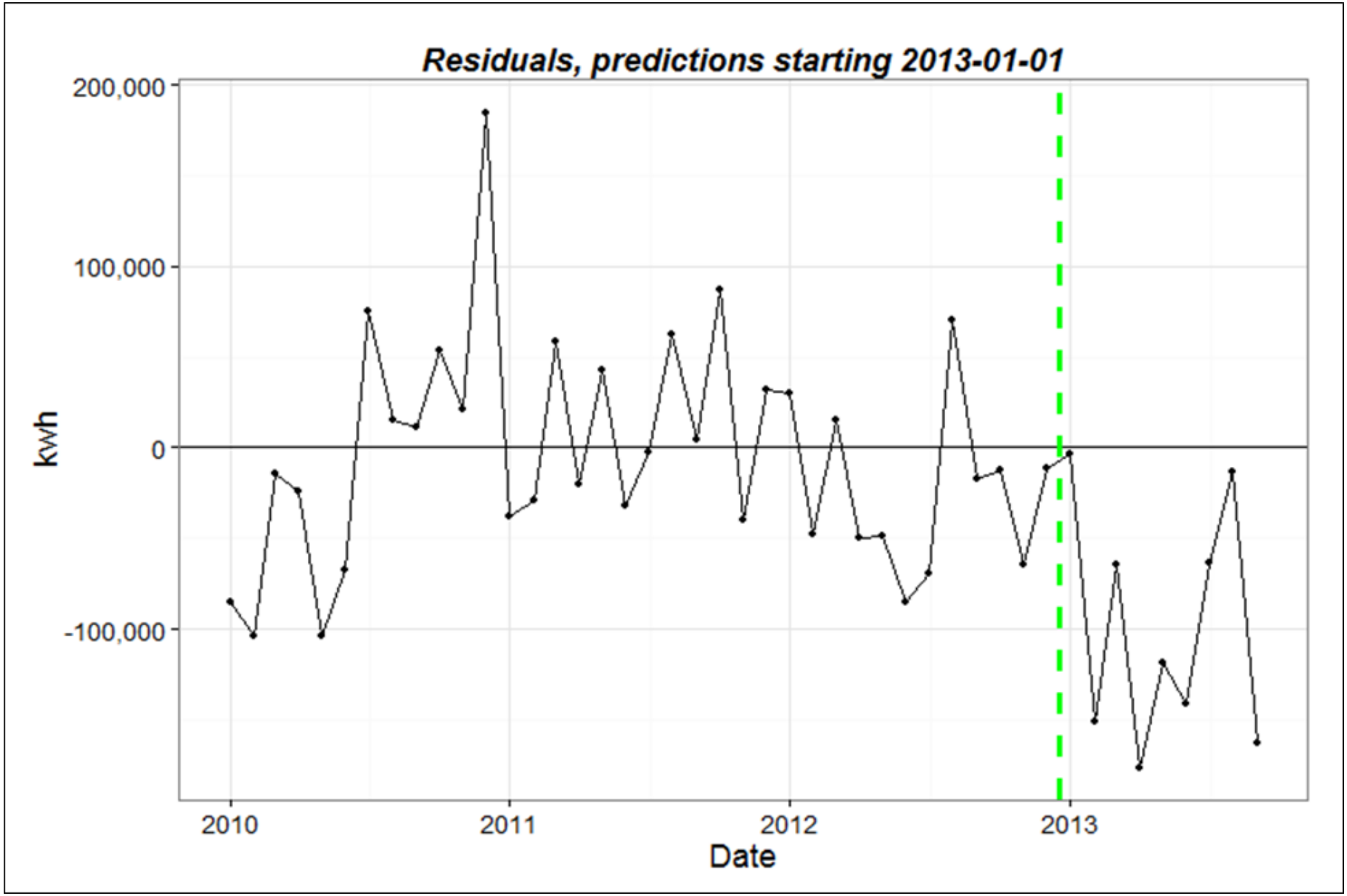
Box and Draper (1987), *Empirical Model Building and Response Surfaces* (1987) Wiley, p. 424

5. Predict Energy Use for 2013

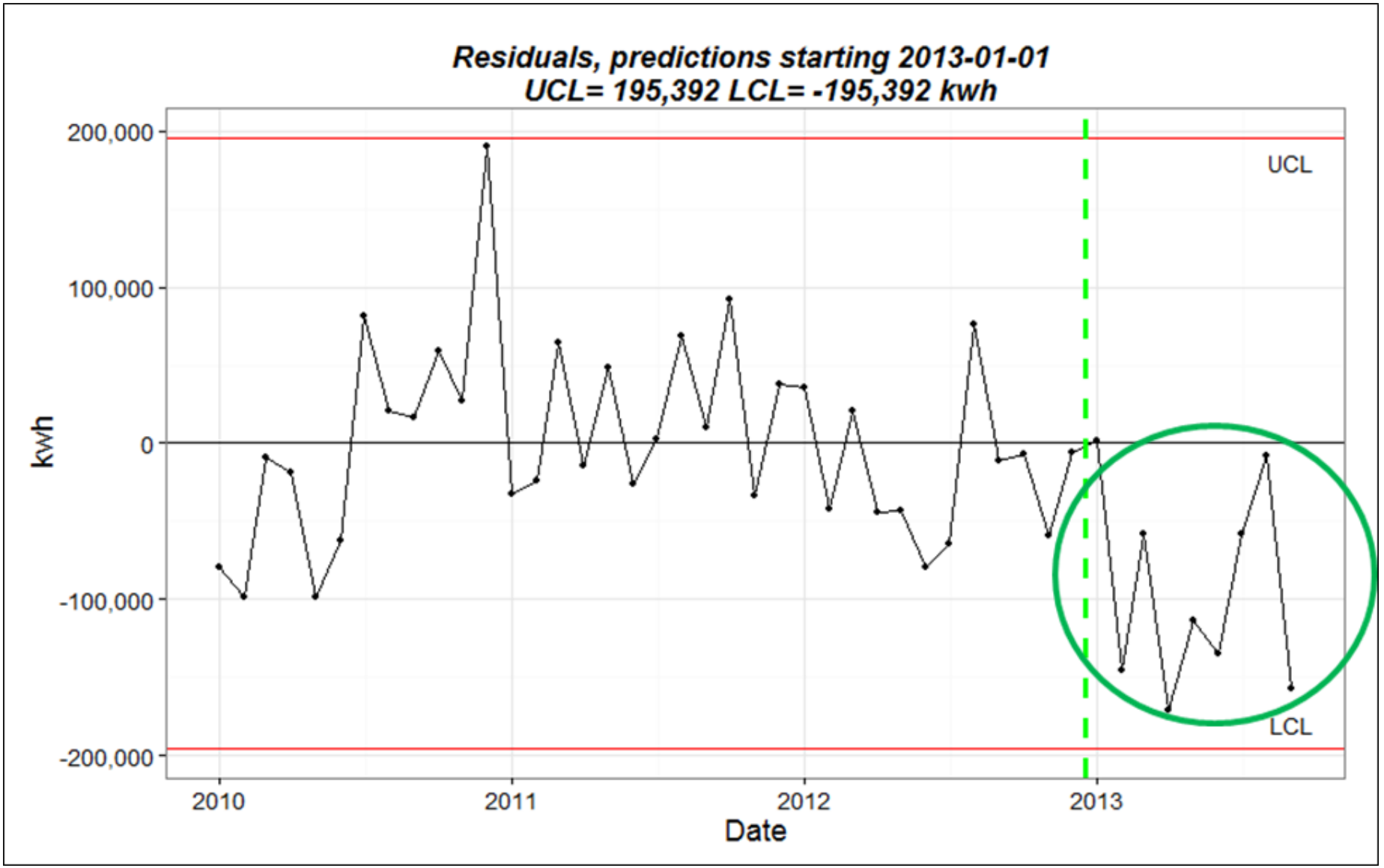
Get monthly temperature values for 2013 and use the model equation to generate predictions, month by month

6. Compare Actual to Predicted

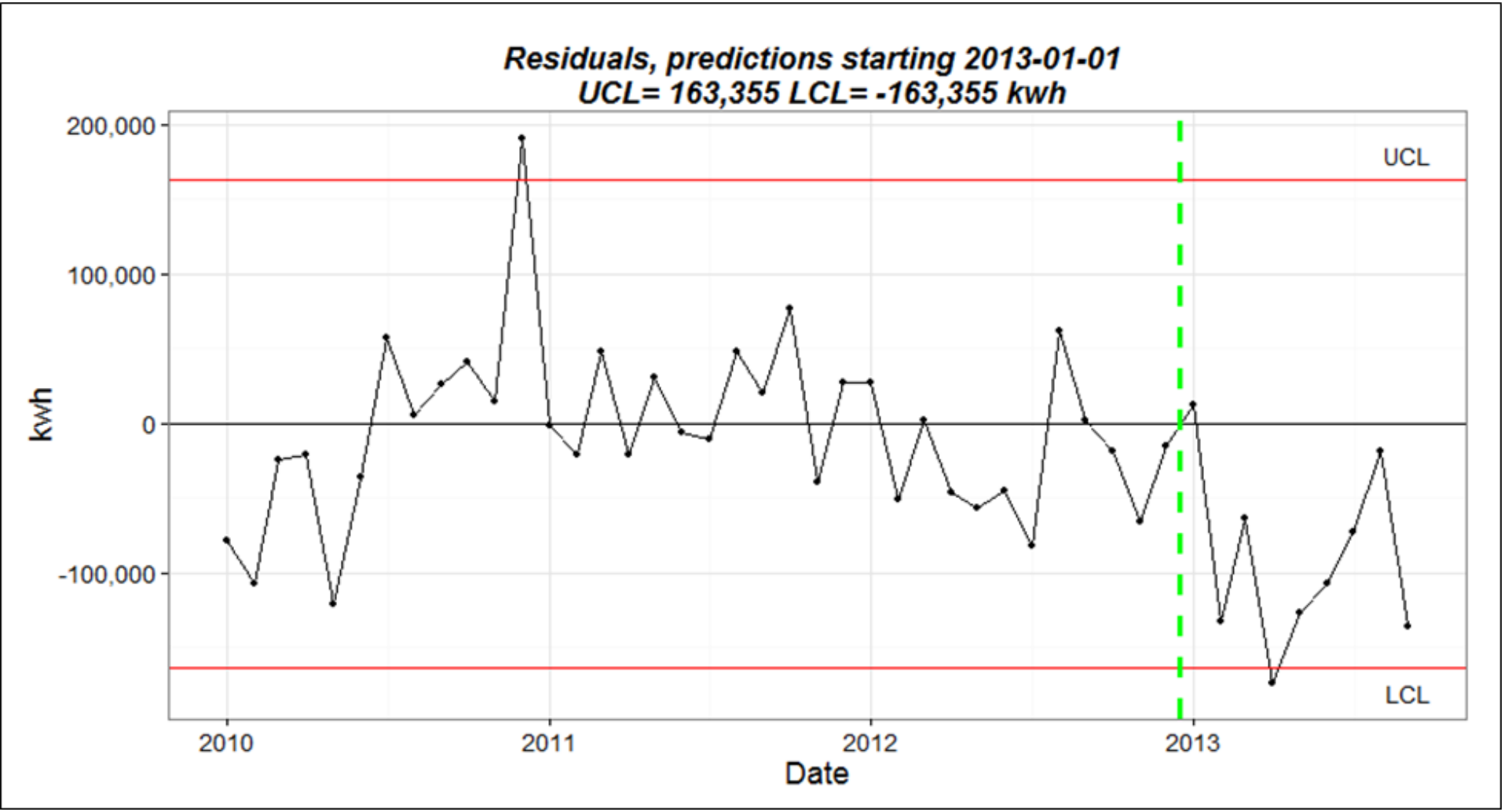



Residuals, predictions starting 2013-01-01
200,000
100,000
0
-100,000
kwh
2010
2011
2012
2013
Date

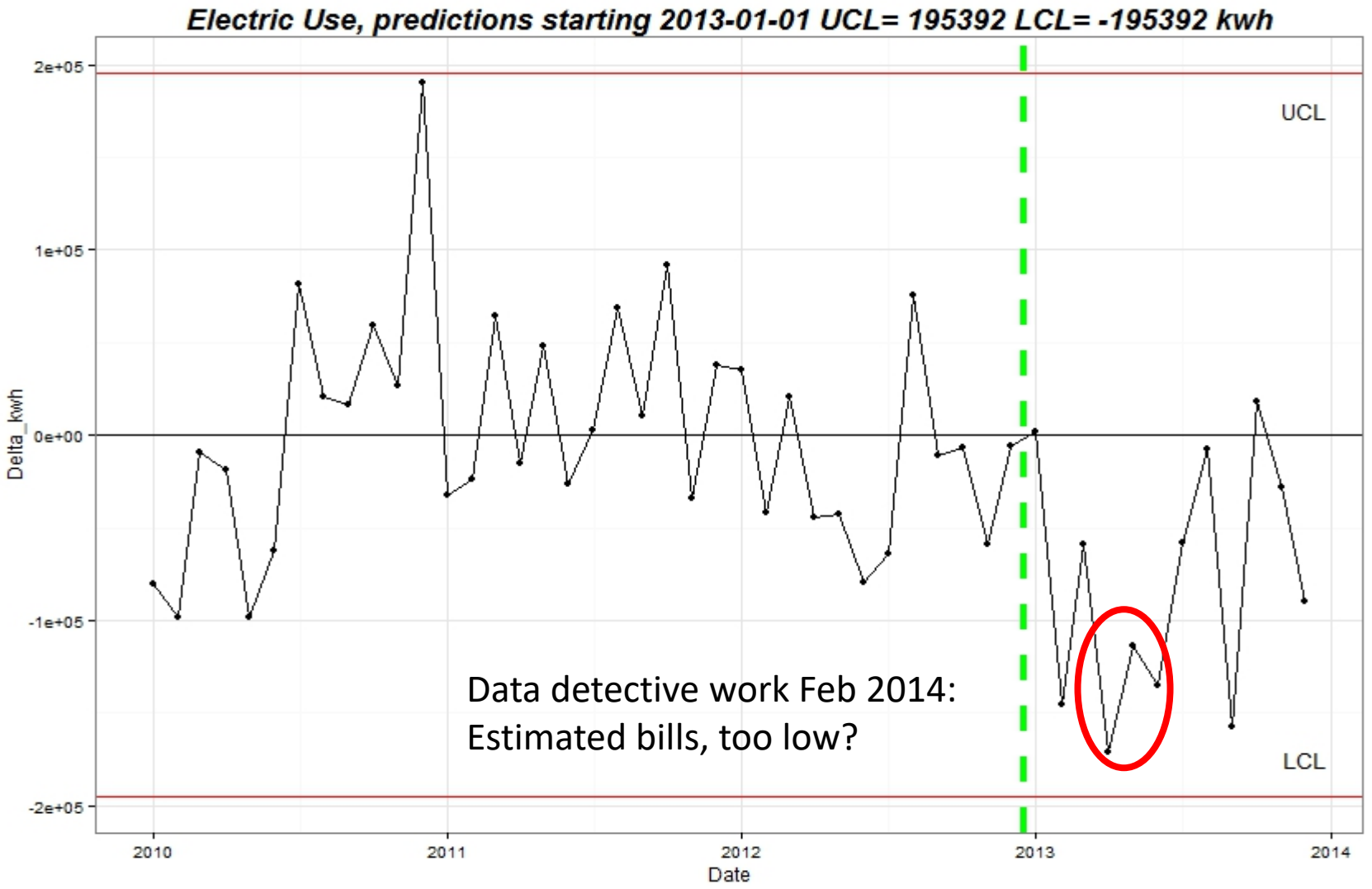
Control Chart Signal of Special Cause: 8 consecutive values below center line



Refined model--uses cooling degree days base 25° F, removes ~3 % variability from varying days in summer months



Update Through December 2013



7. Estimate avoided energy use and costs

2013 Summary Electric Energy Table

month	kwh	estimated kwh savings	kwh cost (cents)	estimated $ savings
2013-01-01	1,304,700	-11,952	8.2	-978
2013-02-01	1,164,564	132,494	8.4	11,097
2013-03-01	1,241,590	63,949	8.2	5,219
2013-04-01	1,215,566	173,885	8.3	14,462
2013-05-01	1,584,208	126,562	8.4	10,646
2013-06-01	1,821,561	107,779	8.5	9,124
2013-07-01	2,067,926	72,441	8.4	6,052
2013-08-01	2,084,851	18,468	8.3	1,530
2013-09-01	1,694,425	136,364	9.0	12,239

Technical notes

1. Model issues
2. Control chart issues
3. Uncertainty in estimating savings

See discussion in blog post

https://www.iecodesign.com/blog/2013/11/15/is-our-building-using-less-energy-this-year-part-2

5. YOUR TURN: MODEL ENERGY USE, LOOK FOR CHANGES FROM BASELINE

Energy Model Practice Options

1. Hospital Gas Use, Appleton WI
2. Garvey School Electricity Use, Chicago IL
3. Your own building

Hospital Gas Model Data Set

- 48 months Jan 2010 - Dec 2013
- Data Fields: Date, Therms, Avg Monthly Mean Temp, Heating Degree Days (base 65° F).
- Potential Baseline: 2010-2012, predict use in 2013.
- Data file: available as attachment and

www.iecodesign.com/HospitalGasExercise.xlsx

School Electric Model

- 48 month record
- Data Fields: Date, kWh, Avg Monthly Mean Temp, Heating Degree Days (base 65° F).
- Baseline: Sept 2004 - Aug 2006
- School uses only electricity (yes, electricity for heating!)
- Data file: available as attachment and

http://www.iecodesign.com/SchoolElecData.xlsx

Your own building

1. Follow the seven steps on the "Method" slide
2. Easiest to start with a building in Portfolio Manager.
3. Want help? Email me, we'll find a time to have a web meeting to go thru details.

References

Degree-day blog post

http://www.energystewards.net/useful-ideas/what-are-degree-days/

Summary of AMC Electricity case:

http://www.iecodesign.com/index.php/our-blog/181-is-our-building-using-less-energy-this-year-part-1

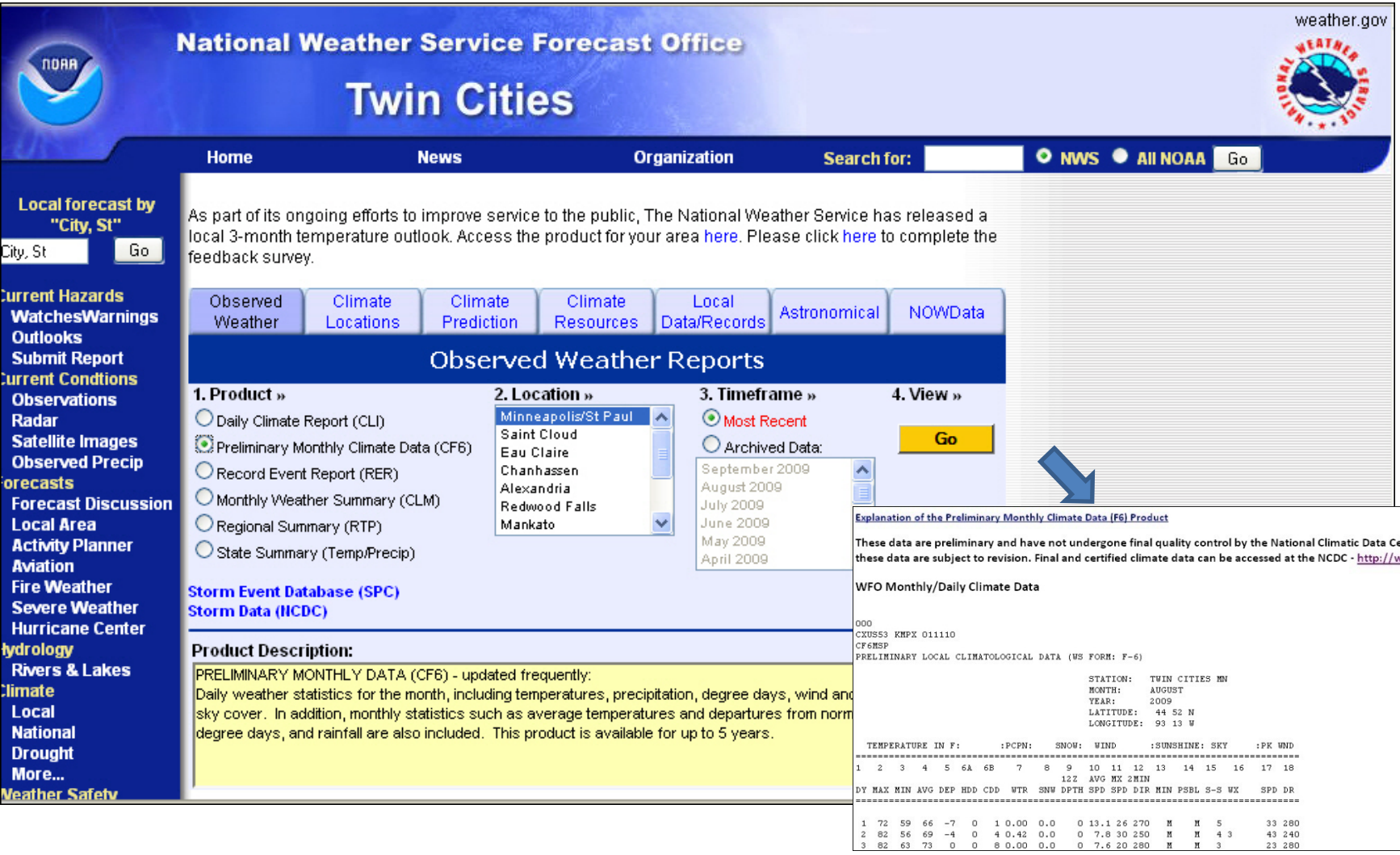
http://www.iecodesign.com/index.php/our-blog/183-is-our-building-using-less-energy-this-year-part-2

APPENDIX: TEMPERATURE DATA SOURCES

Temperature Data Sources

Sources	Barriers to Use
Outside air sensors – tied to building automation system	Extracting data; maintenance of sensors; data quality
Stand-alone temperature sensors	Extracting data; maintenance of sensors; data quality
U.S. NOAA data (public domain) Canada: http://climate.weather.gc.ca/	No cost for simple searches; cumbersome to access multiple locations; location effect?
Weather data services	Fee-based vs free; location effect?

Example of Free NOAA Data



Free comprehensive data source for U.S.

cli-MATE
MRCC APPLICATION TOOLS ENVIRONMENT
WELCOME TO THE cli-MATE DATABASE

LOOK! A NEW SYSTEM WITH NEW LOG IN

PLEASE LOG IN:
Email:
Password:
Log In

New to cli-MATE?
Register Here

PLEASE NOTE: For best results on this site, you must have Javascript enabled on your browser.

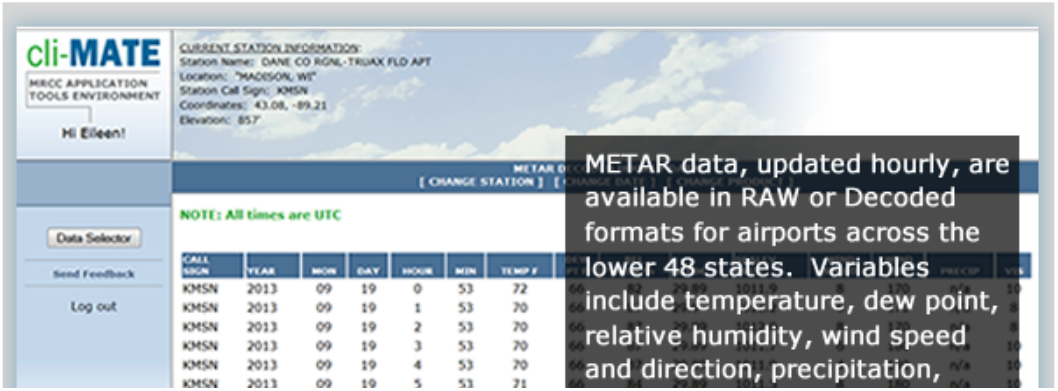
Return to MRCC Midwestern Regional Climate Center

Announcing cli-MATE: the MRCC's Application Tools Environment for accessing climate data and value-added tools. cli-MATE is replacing our previous subscription data tool, MACS. The best part of cli-MATE is that it is now FREE!

If you are a new user, register for free access to cli-MATE using the registration button near the top of the page. For users that would like to download and access large amounts of climate data, the MRCC is still offering services to help you with those needs.

Use cli-MATE to look up such information as raw climate data, rankings of climate information, thresholds, growing season tools, maps, graphs, and much, much more.

HIGHLIGHTED PRODUCTS
(mouse over to pause scrolling)



http://mrcc.isws.illinois.edu/CLIMATE/

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CleanMed2014
Creating Healing Environments

CleanMed 2014

GLOBAL CENTER FOR HEALTH INNOVATION

Cleveland, Ohio | June 2-5

INSPIRATION. EDUCATION. INNOVATION.

This Webinar Series

Session	Date	Topics
1	27 Feb 2014	Healthier Hospitals Initiative; Gundersen Health Example; Leaner Energy Challenge explained; Assignments
2	13 Mar 2014	Modeling energy use in buildings using monthly data; Assignment: try your hand on practice data or your own building's data
3	27 Mar 2014	Review of Assignment; 15-minute energy use and daily energy use: applications; Partnering with facilities/sustainability colleagues

http://healthierhospitals.org/hhi-challenges/leaner-energy/webinars-and-sharing-calls