Welcome to the Machine: *Industrializing the Process of Producing Energy Savings*

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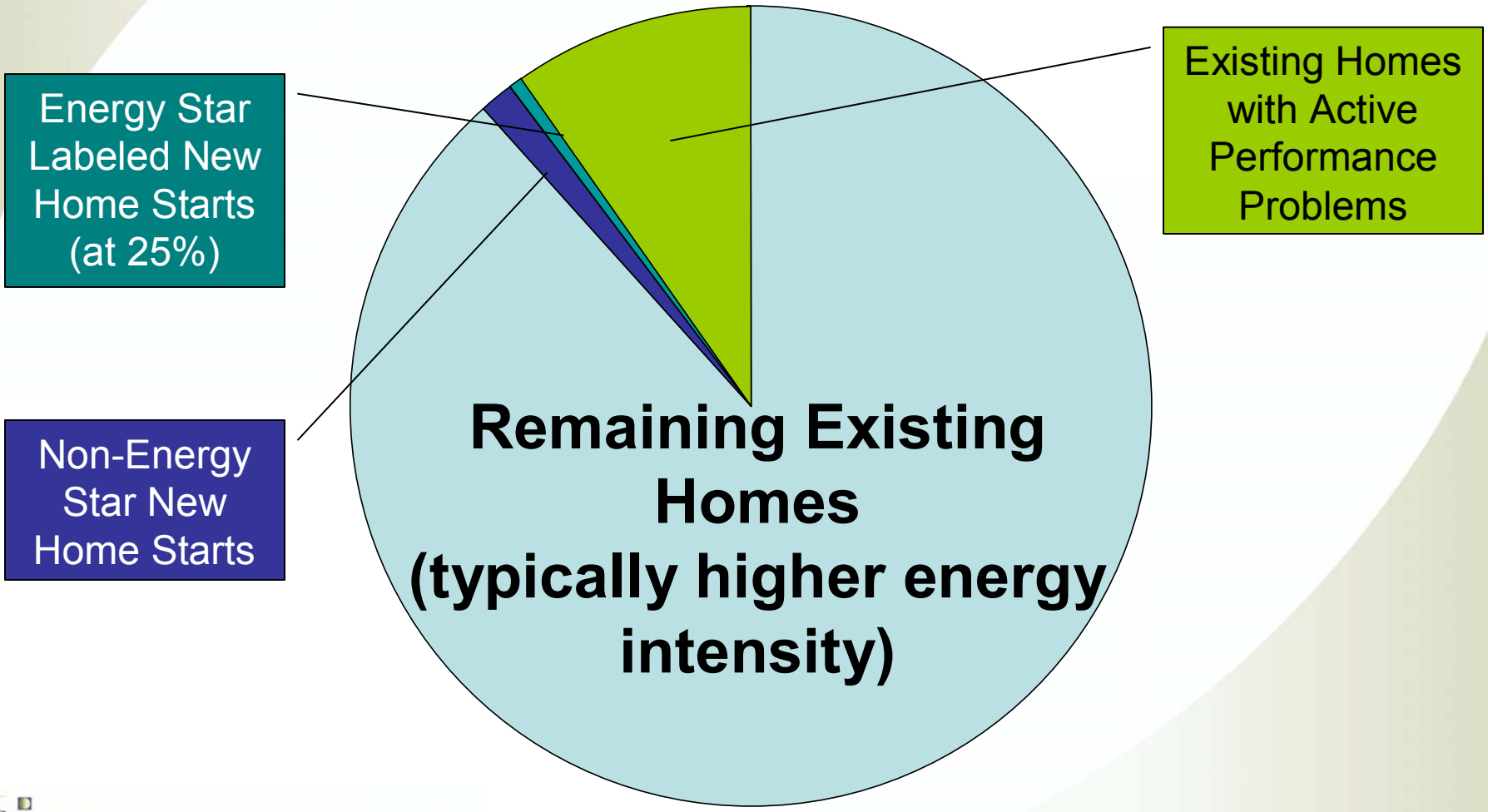
Issues addressed in this talk

- Should we worry about reliably producing savings for residential programs and customers?
- Do we currently reliably produce savings?
- If not, how do we get there?
- What new technologies will help us get there?
- Some recommendations on next steps

There's lots of energy savings in existing homes, if we can just solve a few problems

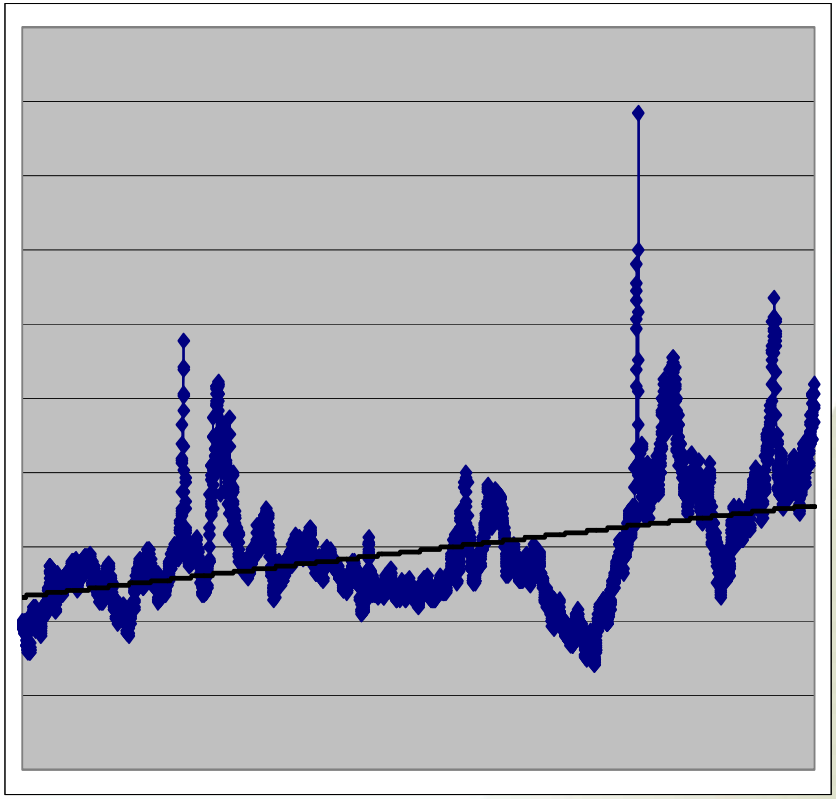
Existing homes have a lot of "potential" for energy savings



Increased market demand for residential efficiency services

- Increase in energy prices
  - *Variable but increasing on the average*
- Cocooning for comfort
  - *Increased interest in health and comfort*
  - *Aging populace*
  - *Interest in home reinforced by perceptions of threats*
- Environmental concerns
  - *"Change a light, change the world"*

Fuel Oil Spot Pricing



Increased demand for effective residential programs

- Demand response programs and advanced metering pilots
- More efficiency funds
  - *More commodity delivery programs*
  - *Market based program design leveraging consumer investments*

Home Performance with Energy Star

How do we measure now?

Evaluation Approach	Issues
Billing analysis	Expensive, time lag
Run time meters	Expensive
Re-auditing	Expensive
Adjusted deemed savings	Counting widgets instead of performance
Diagnostics input to eng. models	Placeholders for actual performance
Proctor Engineering's Check-me	Effective TQM, but is a component approach

Limited by serious problems in energy information flow …

- Poor access to data
  - *Are energy bills useful?*
  - *Privacy and competition issues*
- Long time delays
  - *Monthly for consumers*
  - *Annual for contractors and programs*
- Just too expensive and time consuming to do it
  - *Obtaining signatures*
  - *Handling data*
  - *Analyzing data*

That result in programs operating without timely feedback

- Most programs have some information on savings, typically too late to be of real use for feedback
  - *Little or no connection to contractor or customer*
- Little or no program or contractor incentive to step outside the widget box
- Evaluation biases against whole house approaches

And contractors and consumers with

- Little understanding of energy use
- Little recognition of the impact of quality
- Lack of ability to control savings quality
  - *If you can't measure it….*

Disempowered despite their enthusiasm…….

Answer: Industrializing the energy savings process

- Goal: Low cost rapid feedback at the contractor and customer level that supports program evaluation
  - *Customers should get useful feedback on their behavior and installations*
  - *Contractors should get useful feedback on their work*
  - *Program evaluation should be integrated with program management functions*
    - Evaluation is a auditing function, and routine savings tracking is a bookkeeping function

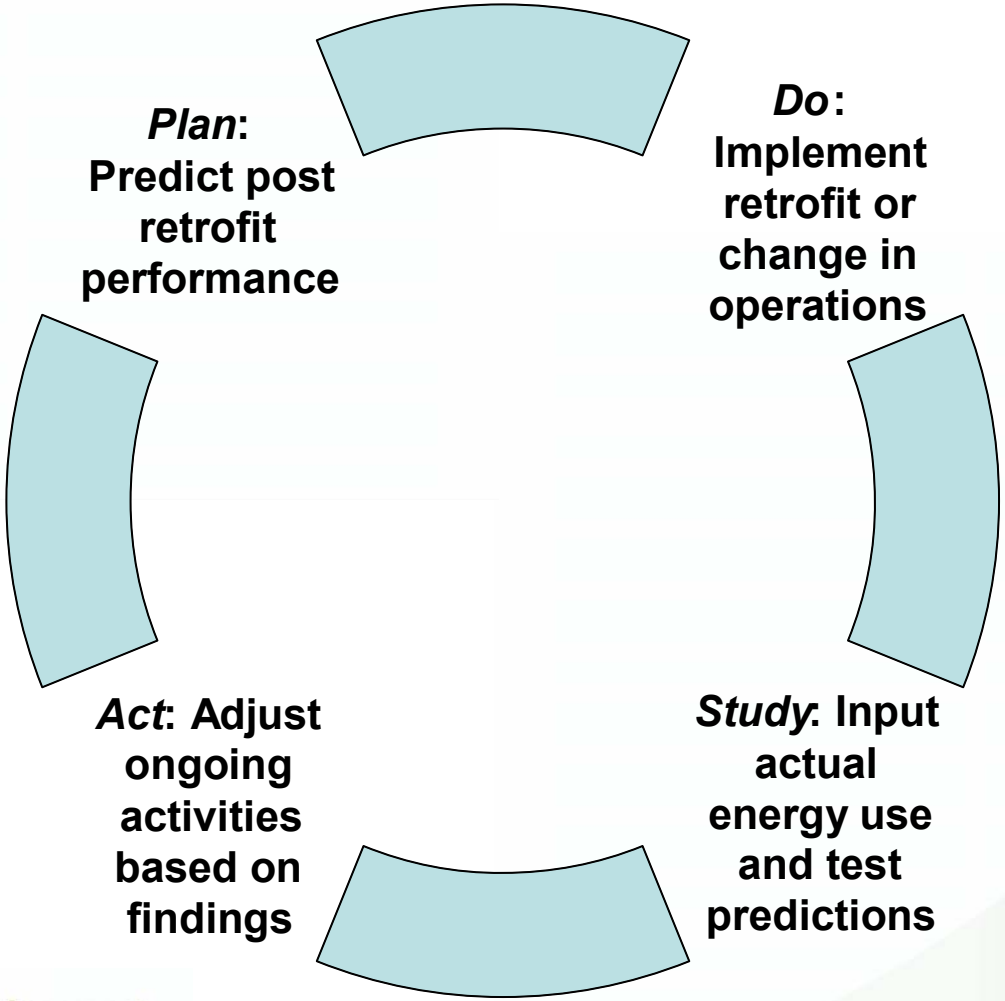
Benefits of feedback and measurement

- Increased consumer confidence
- Differentiation between high and low quality providers of savings
- Savings warrantees
- Increased regulator confidence
- More savings as practices and models are optimized
- Customer able to adjust behavior

Apply the basic principles of Total Quality Management

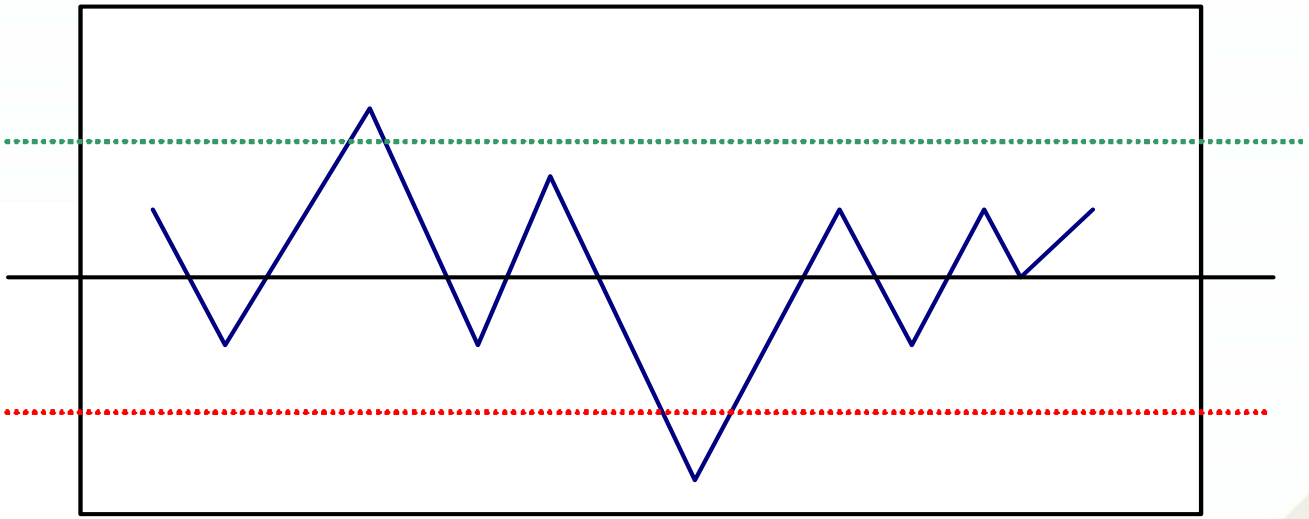
- Continuous feedback for process improvement
- History
  - *W. Edwards Deming (1900-1993)*
  - *Major influence on Japanese manufacturing*
  - *Malcolm Baldridge Award (NIST)*
  - *Systems approach = Whole house*

The Total Quality Management feedback cycle



Continuous process improvement

- Investigating outliers and trends
- Reducing variation and taking control



Improving feedback cycle time

- Faster feedback promotes a faster rate of evolution
- Examples of tracking variables in the retail industry
  - *Walmart*
  - *Disney*

The importance of defining the proper TQM control variable

- Normalized savings – The program
  - *Adjusted billing compared to adjusted billing*
- Actual savings – The customer
  - *Weather adjusted pre retrofit model or billing compared to actual post retrofit bills*
- Predicted performance – The contractor
  - *Weather adjusted post retrofit model compared to actual bills*

Advantages of predicted performance

- Tracking predicted performance allows for rapid feedback, days or weeks
- Predicted performance captures variation and trends in both modeling and installation
- Measures quality
  - *Taking control of the building*
  - *Energy is an indication of control of other flows important to the customer*

Is maximizing savings really in the interest of the customer?

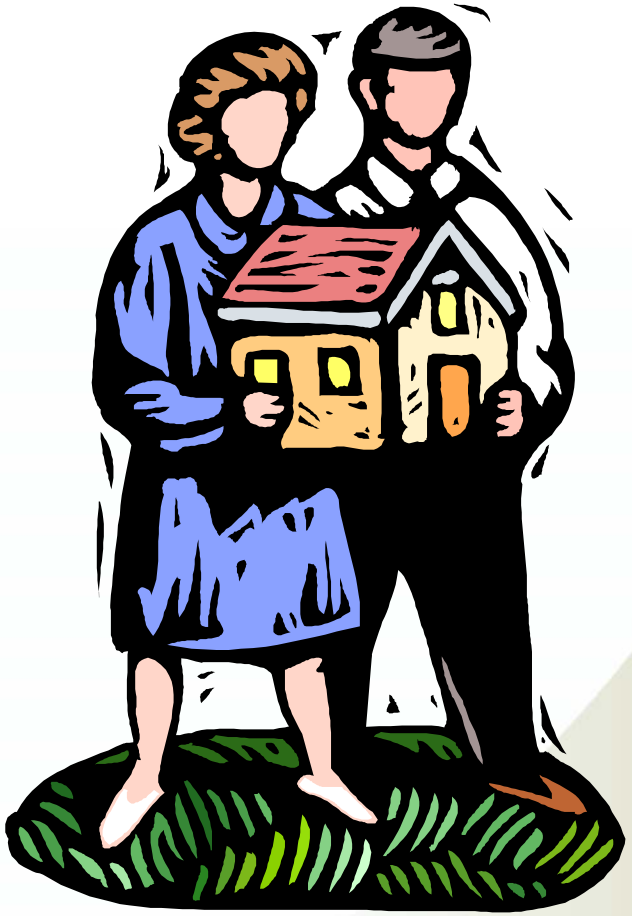
- Customer wants integration of energy work with non energy investments such as health impacts
  - *Example: Mechanical ventilation at odds with saving energy*
- Home Performance with Energy Star
  - *Customer centric, its their money*
  - *Remodeling plus energy improvements*
  - *IEQ first, energy second*

Approaches to reducing variation from prediction

- True up of pre-retrofit model to actual bills
- Flexible model that allows user to model what will actually be installed, not just limited measure set
- Whole house approach – taking control of building systems and influencing customer behavior
  - *Energy as a indicator of whole house performance*
  - *What is between the improvement and the meter?*
    - Shell improvement example – blower door
- Benchmarking as a bound for predicted performance

What about those unpredictable occupants?

- Taking control reduces post retrofit occupant impacts
  - *Setback example*
  - *No need for occupant to overcome poor performance*
- Random effects vs trends
  - *Trends are as important as reducing variation*

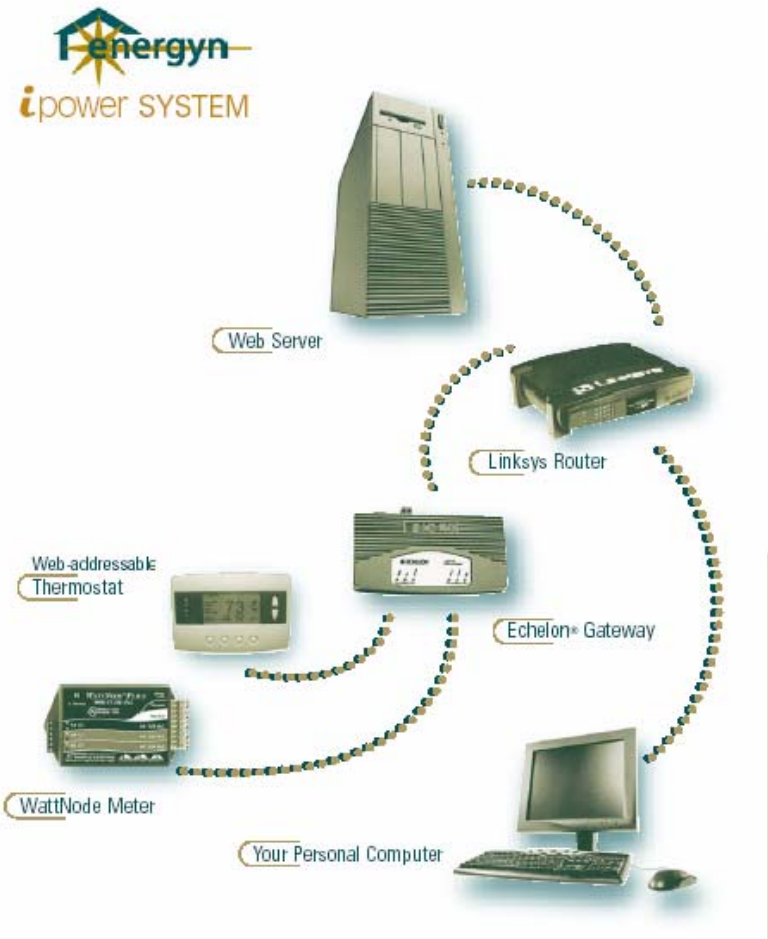


New technologies in feedback and measurement

- Advanced metering
- Web based viewing of energy bills
- Online databases
- Improved secure data exchange
- Residential hourly simulation tools
- Benchmarking

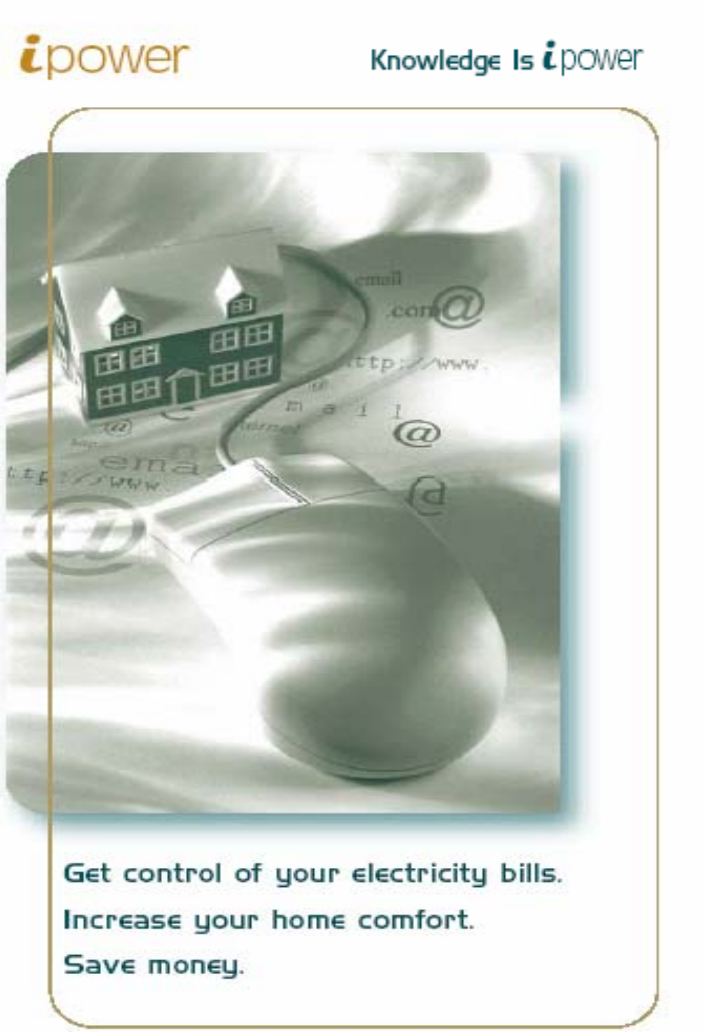
Hardware based approaches to enhancing feedback

- Advanced metering, with or without the utility involved
- Web based interfaces for energy information, thermostat and appliance control, demand response
- Real time access to information



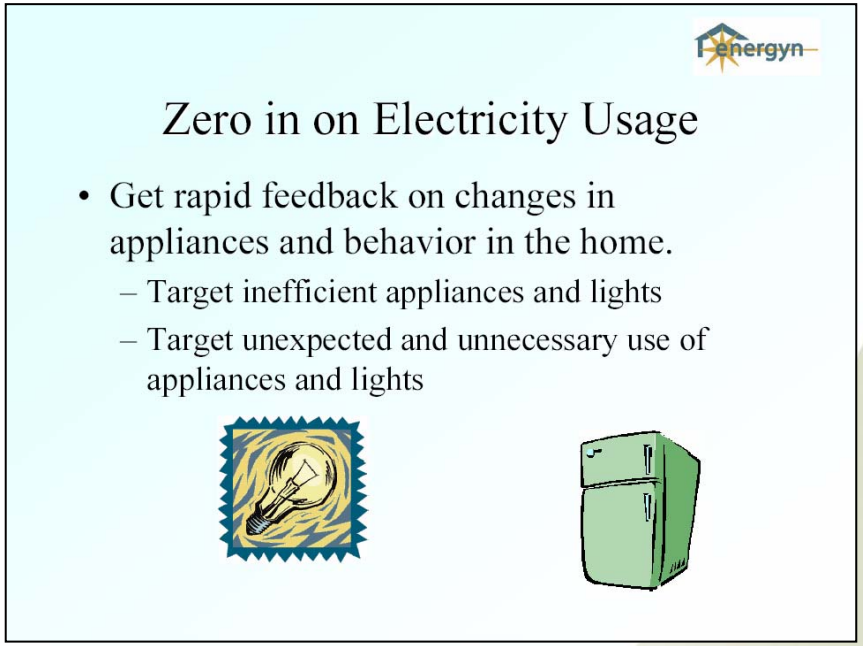
Sample pilot project

- Energyn - California Energy Commission demand response funding
- 80 home pilot
- Emphasis on customer education combined with enabling tech
- NYSERDA and Gulf Power pilots also



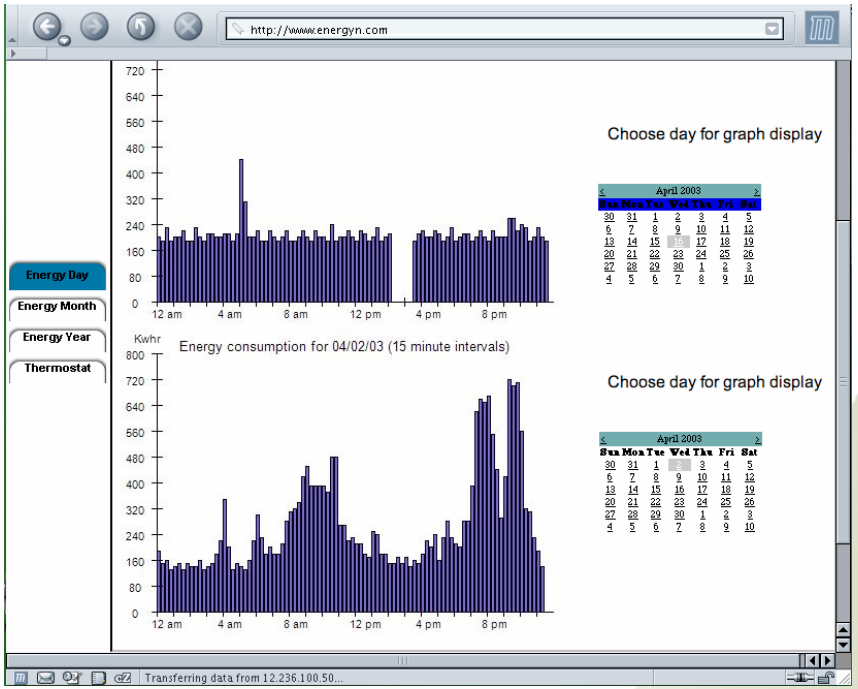
Teaching continuous improvement to customers

- Customers were given simple presentation on using system as a tool for feedback
- Looking for ways to change behavior and equipment



Pilot conclusions

- Customers are empowered by access to even simple data comparisons
- Real time data makes the information interesting and useful
- Demand control works



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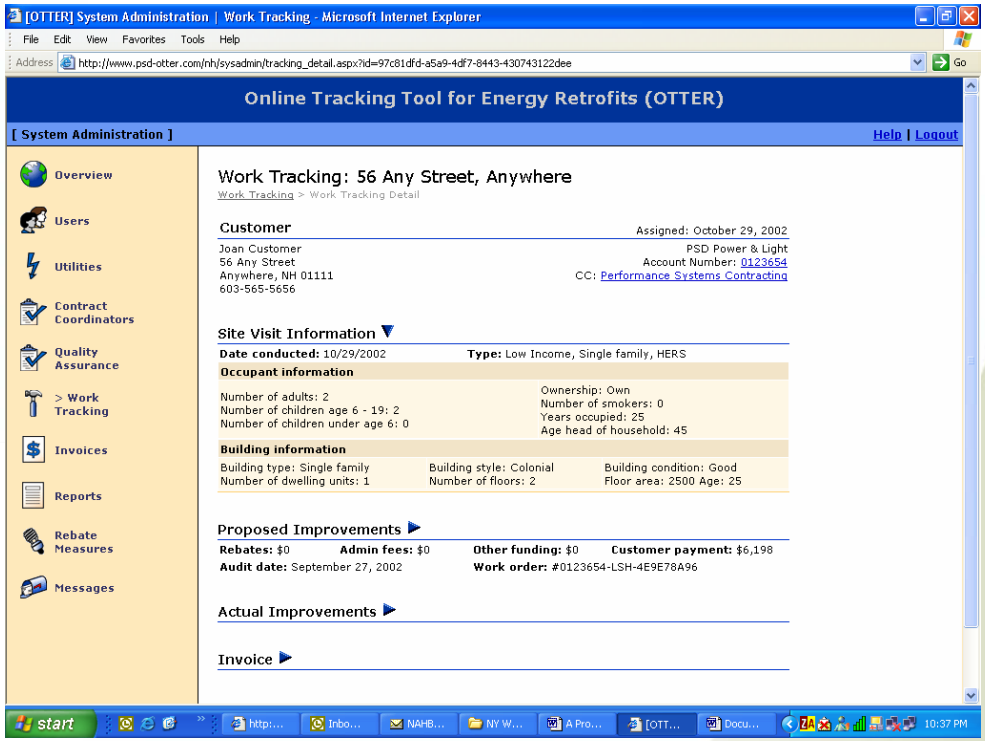
Future enhancements to hardware and interface

- Intelligent agents and event detection
- Equipment integration with home networks
- Automated device control
- Next markets
  - *Solar and Zero Energy Homes*

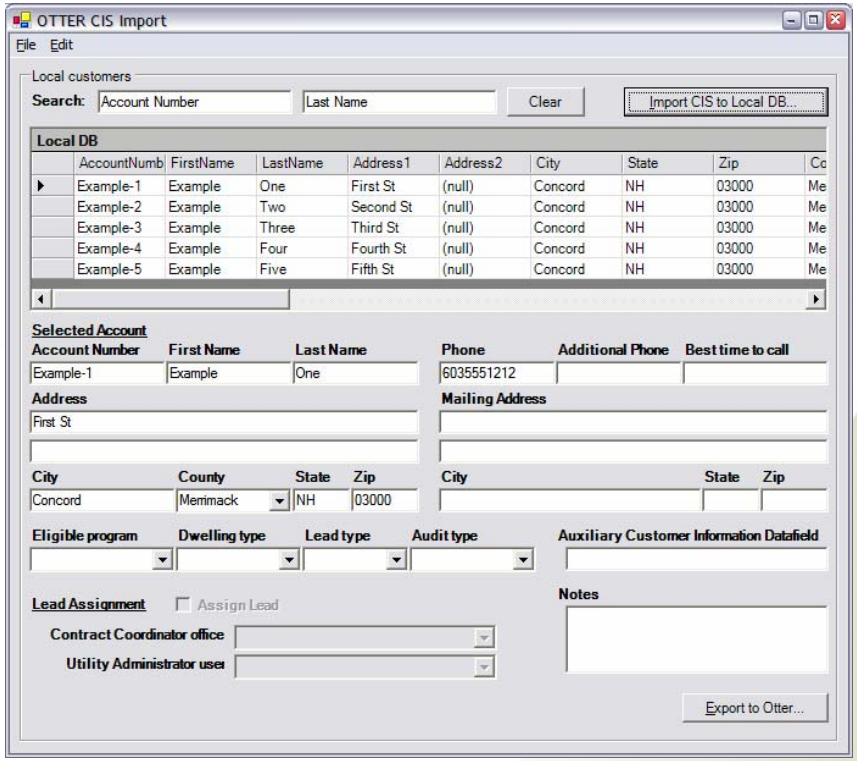
Software: Tracking to support a TQM model

- Online browser based applications with any time any where access to data and reports
  - *Client tracking*
  - *Work tracking*
  - *Savings tracking*
  - *Benchmarking*
- Beginning to be used by weatherization, home performance, utility programs



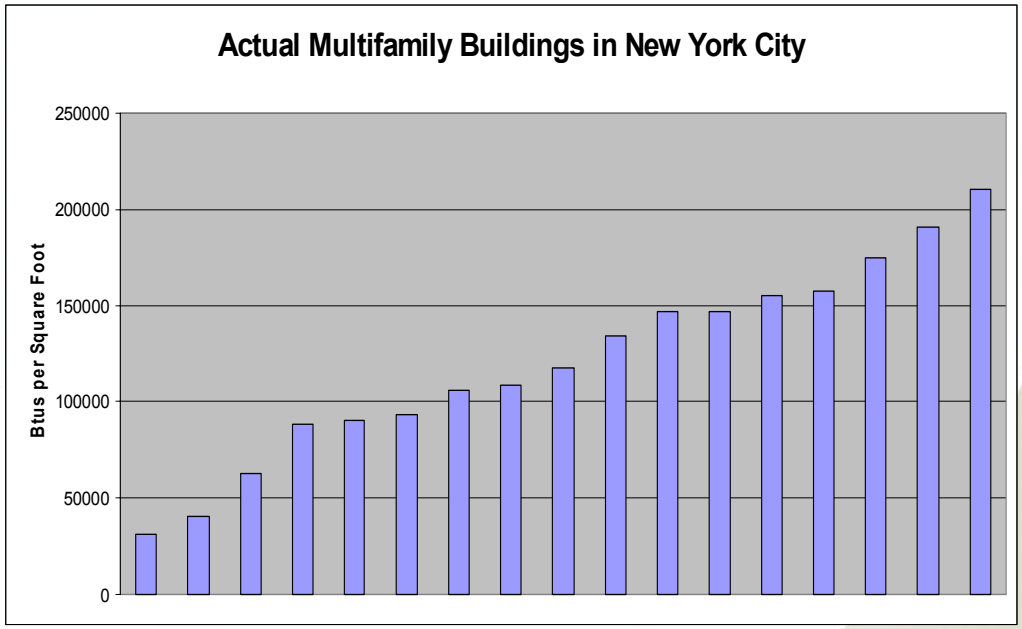
Getting access to fuel data

- Big barrier
- Requirements
  - *Automated import, lots of data handled repeatedly*
  - *Utility control over connection*
  - *Easy on the IT department*



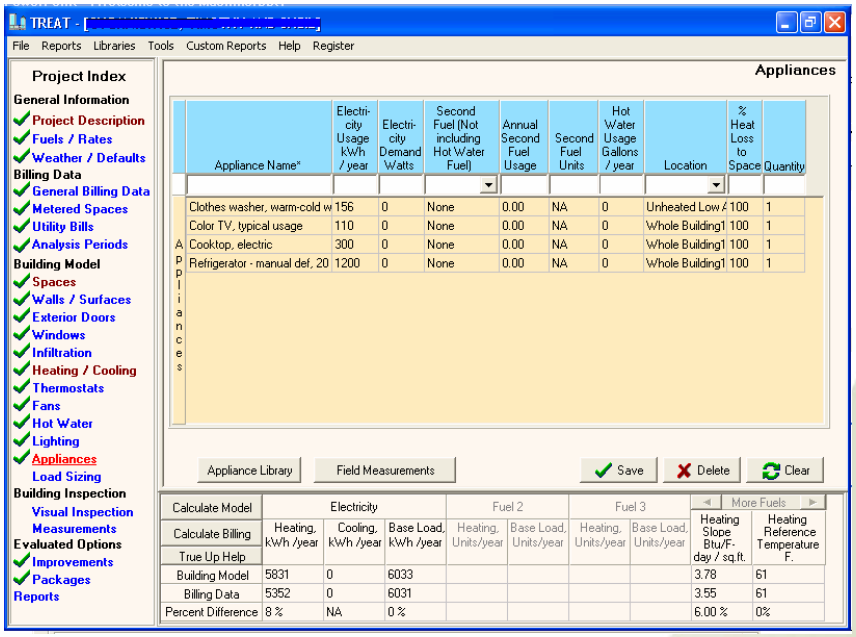
Benchmarking

- Comparing buildings to improved and unimproved equivalents
- Understand the potential for savings
- Set standards for post retrofit performance

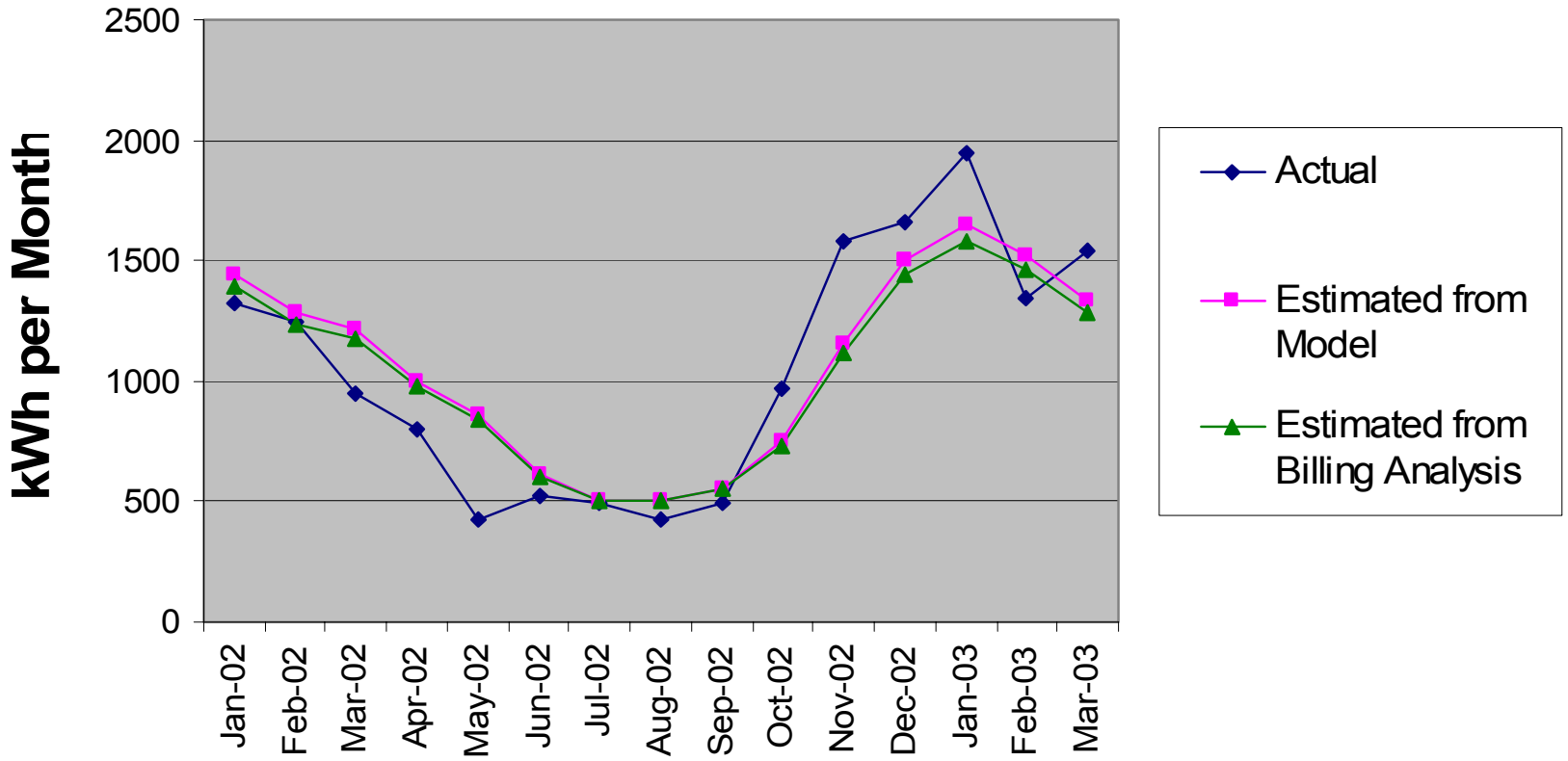


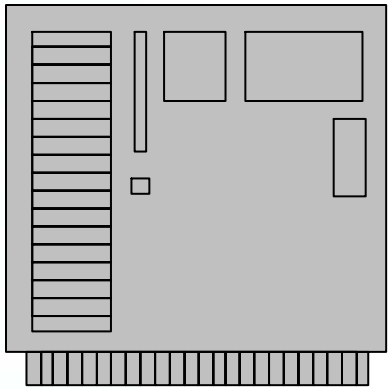
Simulation modeling

- TQM requires simulations
  - *Needs more than measure specific engineering calculations*
- Hard to model out of control buildings
- Quality assurance issues
- Path to improvements of the simulation tool

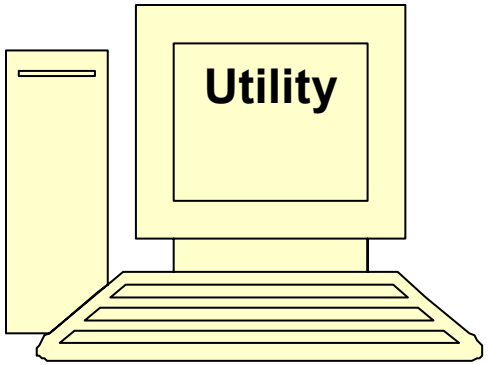


Make comparisons routine





Web Server



1. Client and billing data upload, job assigned.
2. Message to contractor generated
3. Download billing data to TREAT
4. Modeling and workscope development
5. XML upload
6. Workscope approval

Customer

7. Preliminary eval and progress reports
8. Post retrofit billing data upload
9. Email to client
10. Client data input and review
11. Messaging and data download
12. Report to client

Transition issues

- Moving from prescriptive savings to modeling
  - *Training contractors*
  - *Educating policy and eval staff on path forward*
- Interaction drives changes to SIR and expected improvement mix
  - *Realization rate impacts*

New uses for feedback

- Evolve into performance warranties
  - *Already available in new construction*
- Target training based on installation activities and metered performance
  - *Focus on performance should increase attention to baseload measures*
  - *Secure low cost source of savings*
- Residential monitoring services

Recommendations

- Contractor and program quality rankings based on control over predicted performance
  - *Reward the use of feedback and measurement – Baldrige type award for energy programs*
- Limit the use of deemed savings
- Integrate evaluation with feedback

Recommendations 2

- Open the flow of information by requiring utilities to offer customers access to a standardized energy use data file
  - *Access to information through the customer addresses privacy issue*
  - *Standardized data file forwarded to service provider*
    - Contractors
    - Third party programs
    - Monitoring services
    - ???

Contact info

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