HOW RELIABLE IS SAMPLING?

Results of the Home Energy Ratings of Ohio Batch Test Protocol Pilot

Prepared for:

RESNet Conference

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Evaluation Team

- Quantec, LLC
  - Consulting firm with offices in Portland, OR and Boulder, CO
  - Focused on energy efficiency program evaluation
    - *Impact analysis*
    - *Process evaluation*
- Indiana Community Action Association
  - Located in Indianapolis, IN
  - Accredited HERS Raters
  - Weatherization service providers

Background Information

- ENERGY STAR homes generally use 30% less energy than 93 MEC homes
  - Promotes environmental protection
  - Saves homeowners $$
  - Newly built homes verified to have met certain energy efficiency guidelines
- MEC is used by many states, including Ohio, as the energy standard to which homes must be built*
  - Compliance can be demonstrated a variety of ways, including use of the Home Energy Rating System (HERS)

*Ohio has since adopted IECC 2000 as the residential energy standard.

Background Information

- HERS is an objective standardized evaluation of the energy efficiency compared to a simulated reference house that meets minimum energy code requirements
  - Reference house is assigned a score of 80
  - For every 5% reduction in energy use (compared to the reference house) the HERS score increases by one point – a home with a HERS rating of 86 (30% more energy efficient than the reference house) would qualify for the ENERGY STAR label
- HERS process involves at least one on-site inspection of the home and includes:
  - Blower door and duct test
  - Computer simulation to calculate the score and estimate annual energy costs

Pilot Approach

Builders are recruited and "qualified" by raters

Basic "energy models" are identified for each builder

Raters review building plans to determine expected efficiency, performance and required "corrections"

Three of each energy model are constructed and rated using an intensified audit and the Home Energy Rating System (HERS)

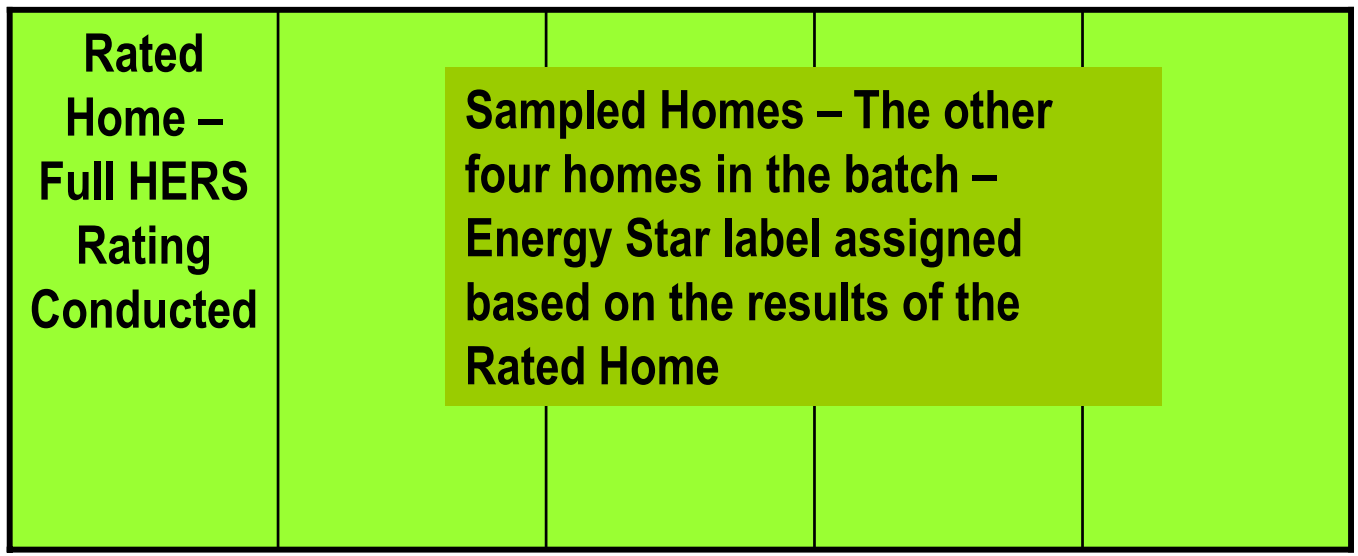
If all three homes "pass," (score 86 or above on the HERS), the builder can begin using the sampling protocol

Homes with a HERS score of 86 or more are assigned the ENERGY STAR label

Homes are grouped into batches of 5 - 1 of the 5 is randomly selected and rated (with special attention paid to any issues identified in the audit of the first 3 homes) - if it receives a HERS score of 86 or above, all homes in the batch are labeled ENERGY STAR

Rated and Sampled Homes

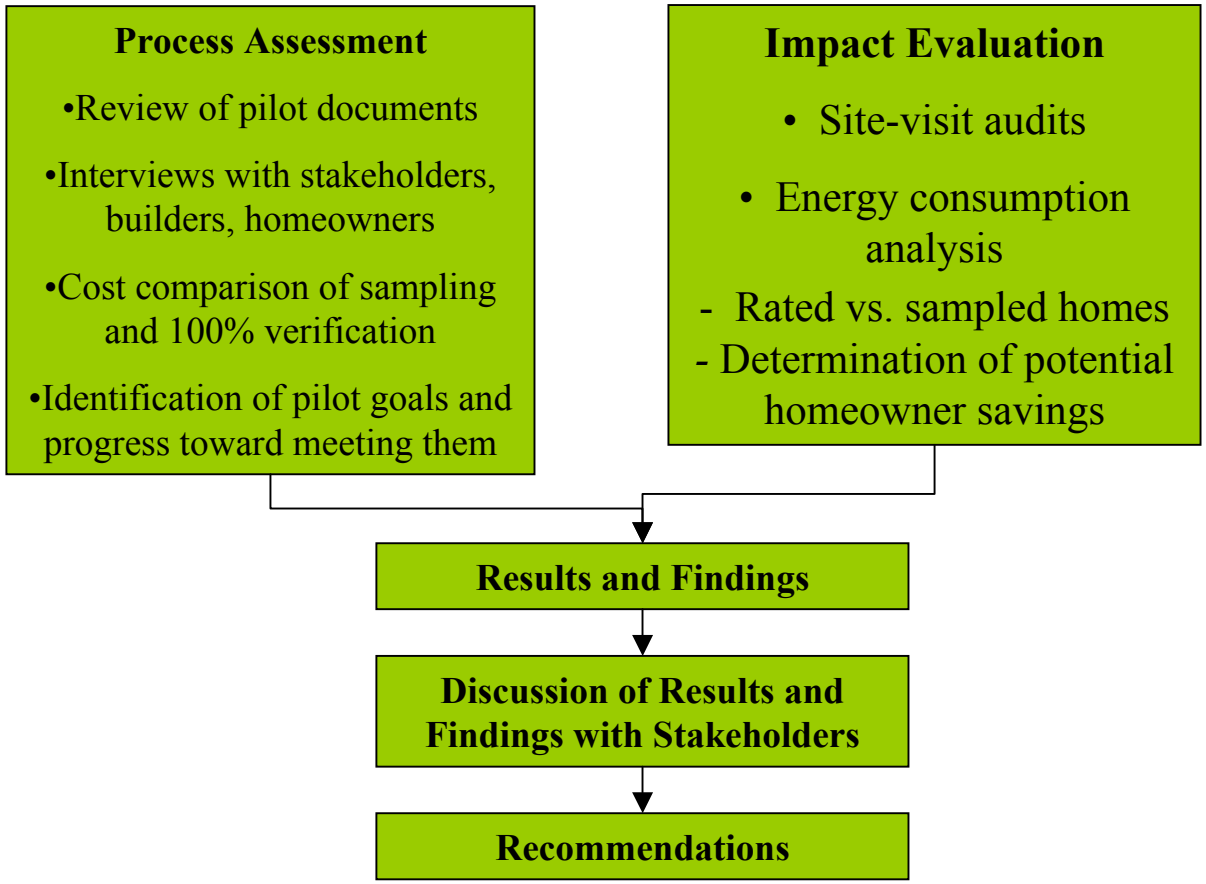
Batch – A group of five homes built by a single builder, are the same energy model, built in the same timeframe (~ 1 month, using same subcontractors)



Pilot Objectives

- Determine the reliability of sampling as a method to verify performance of homes constructed by volume builders
- Demonstrate validity of sampling to the HERS industry
- Identify infrastructure requirements to support use of a sampling approach

Evaluation Approach



Pilot Stakeholders

- Ohio Office of Energy Efficiency
  - Environmental Protection Agency
- Residential Energy Network
  - Fannie Mae
- Raters (Energy Designed Homes)
  - Builders (Avenbury and M/I)

Process Assessment:
Interviews with Stakeholders

- Overall objectives
  - Increase market share of ENERGY STAR homes
  - Reduce the cost of verifying ENERGY STAR compliance
  - To build customer awareness of ENERGY STAR homes and the associated benefits of owning a labeled home
- Roles of the various stakeholders
  - Most of the work done by the participating builder and raters
  - OEE coordinated pilot and sponsored the evaluation
  - EPA and RESNet may take future actions based on Pilot results

Process Assessment:
Interviews with Stakeholders

- Issues
  - Home Energy Rating process yields value beyond the HERS score
  - Balance needs to be established between "brand equity" of ENERGY STAR and reducing barriers to participation
  - Energy Efficient Mortgages may be important key to promoting construction of high efficiency homes
    - *HERS rating has been used as quantifiable justification to lenders to accepts additional credit risk*
  - Benefits to participating builders need further quantification
    - *some builders see a distinction between building to the ENERGY STAR standard and going further to have the home labeled*

Process Assessment:
Non-Participating Builders

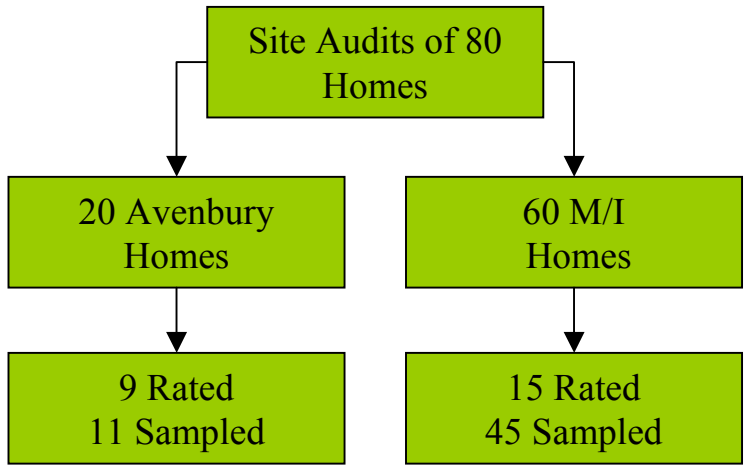
- Benefits to consumers come from the construction of ENERGY STAR homes
- Labeling provides assurance to the builder and to the homeowner
- Support from EPA
  - Marketing support and materials (use of the ES logo)
  - Opportunities for recognition important to builders
- Consumer knowledge and awareness of ENERGY STAR growing
- Some sentiment that the benefit of obtaining the ENERGY STAR label is outweighed by cost ($ and time)

Process Assessment:
Interviews with Homeowners

- General awareness, but limited understanding, of the ENERGY STAR status by the owners of the homes labeled in the pilot
  - 86% aware that their home was ENERGY STAR labeled
  - Unclear expectations regarding potential savings
- Energy efficiency considered "somewhat important" in selection of a particular home
- **Energy Efficiency = Quality Construction**
- Buyers of new homes expect that the "standard" new home is relatively energy efficient
- Some awareness of other ENERGY STAR products – lighting and appliances

Impact Evaluation: Site Audits

- Purpose of site audits:
  - To determine if Sampled homes met ENERGY STAR standards
  - To verify Rated and Sampled homes were similar
- Sites selected to provide mix of:
  - Builder
  - Energy Models
  - Vintage
  - Rated and Sampled homes



Impact Evaluation: Site Audits - Process

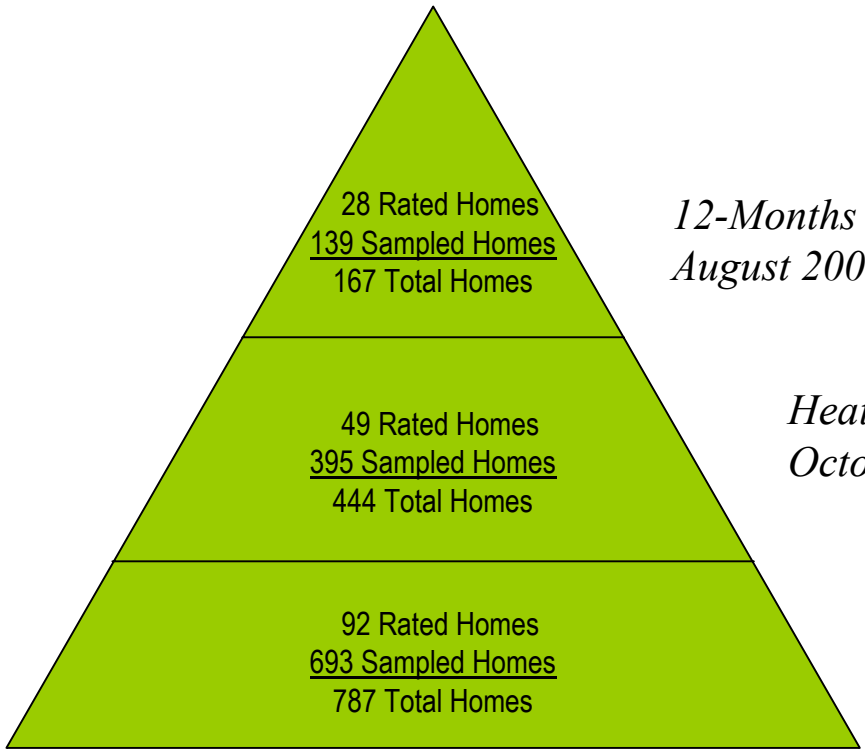
- Completed a Rating Inputs Form for each house selected for a site visit
- Verified/documented the key structural variables (dimensions; number, type, size & orientation of doors and windows; type & amount of insulation, etc.)
- Verified/documented the key mechanical variables (type, size & efficiency of furnace, water heater & air conditioner)
- Conducted Blower door tests
  - Whole house
  - With and without garage
  - With and without basement
- Conducted Pressure differential tests
  - PD to attic, basement and garage.
- Conducted a Duct leakage test
- Calculated HERS Score (REMRate)

Impact Evaluation: Site Audits – Results

- All audited homes met the ENERGY STAR standard (obtained an 86 or higher HERS rating)
- Average HERS score of 88.3 for Sampled homes and 88.1 for Rated homes

Impact Evaluation:
Consumption Analysis

- Compared natural gas consumption of Rated and Sampled homes with 12-months, heating season, or peak-month data



12-Months Data
August 2001 through July 2002

Heating Season Data
October 2001 through April 2002

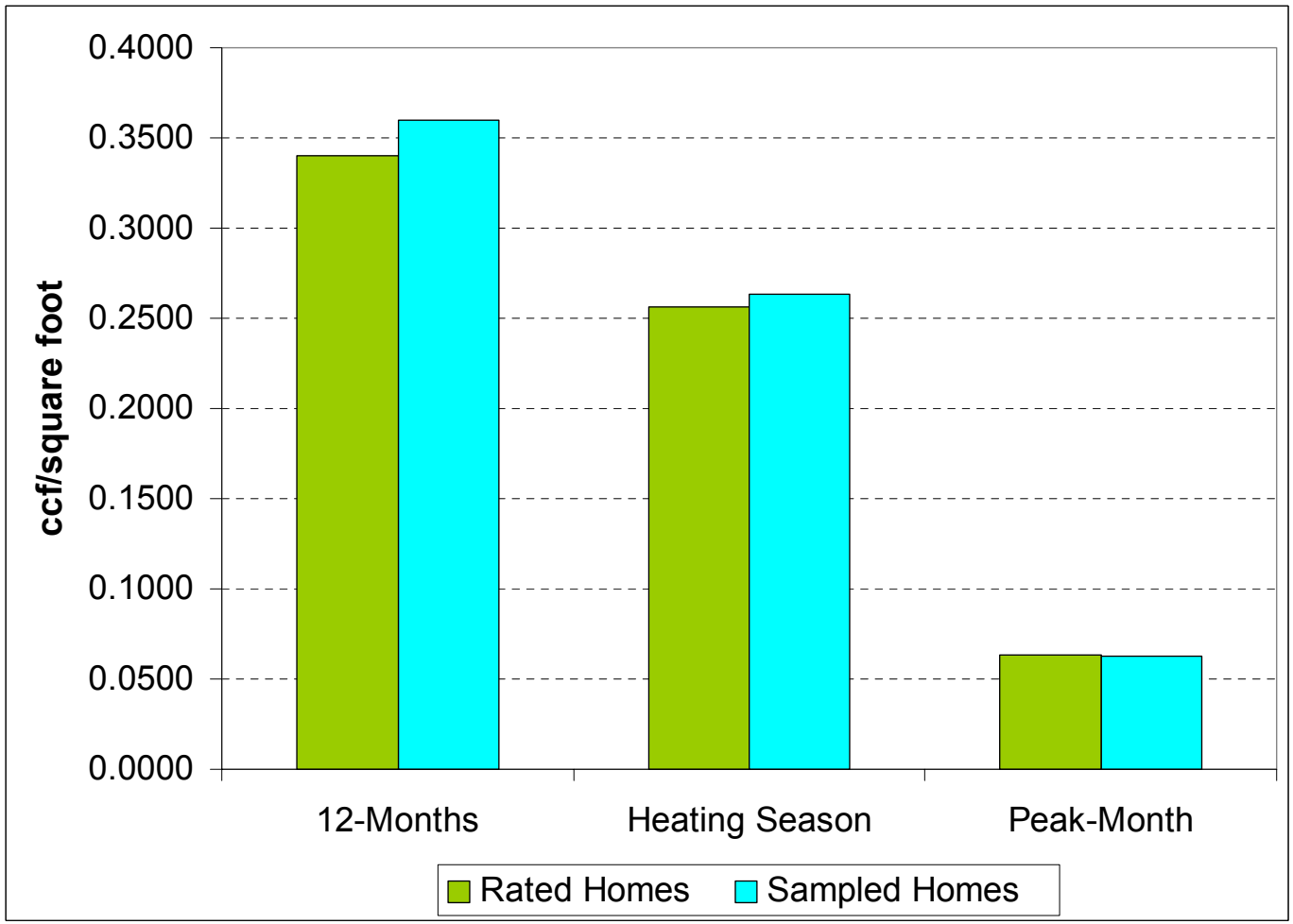
Peak-Month Data
January 2002

Impact Evaluation:
Consumption Analysis

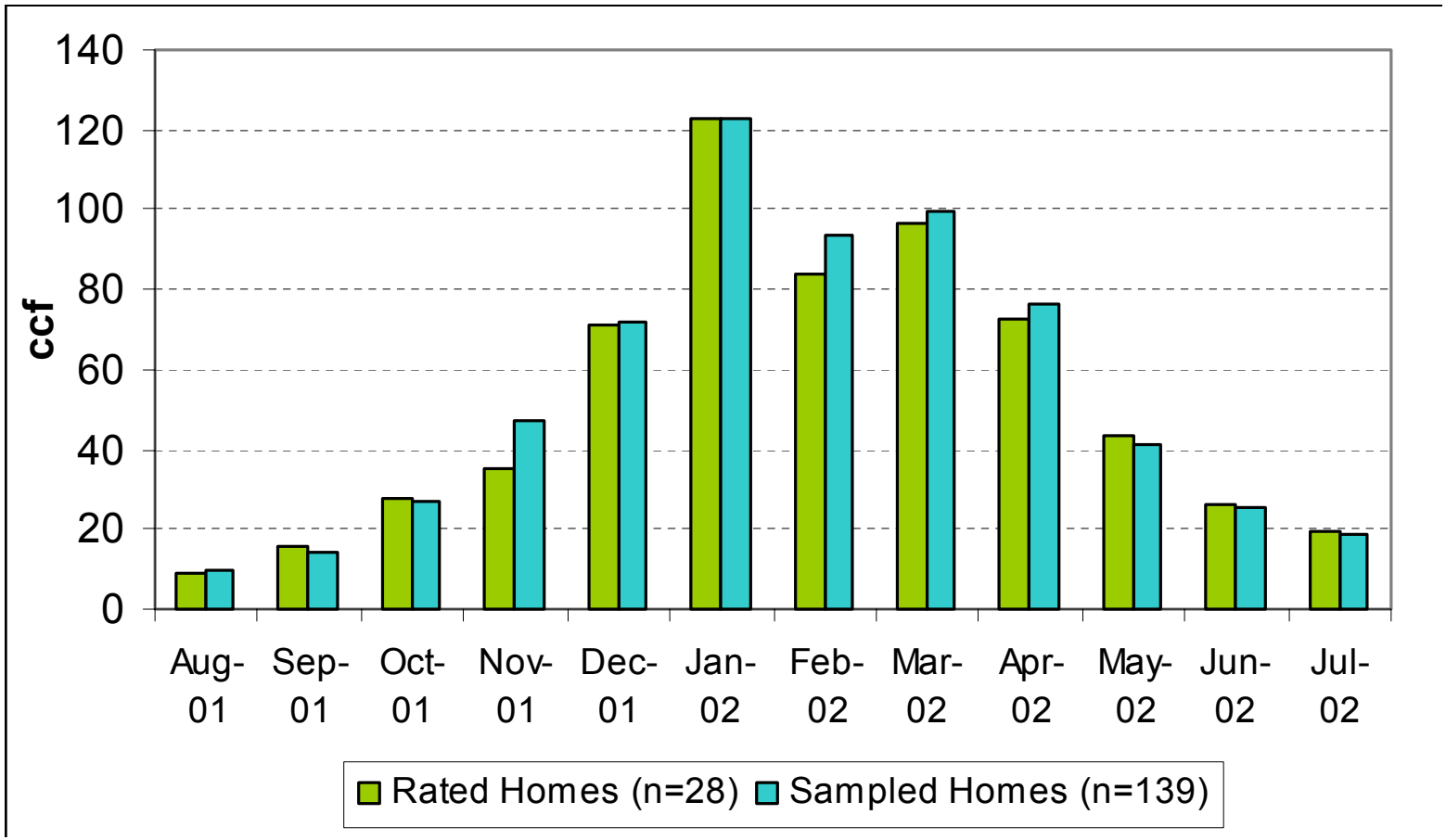
- Purpose of consumption analysis:
  - To determine if Rated homes and Sampled homes had similar levels of energy consumption (ccf/square foot)
- Results:
  - No statistical difference in consumption between Rated and Sampled homes

	Rated Homes ccf/square foot	Sampled Homes ccf/square foot
12-Months	0.3400	0.3598
Heating Season	0.2566	0.2634
Peak-Month	0.0633	0.0625

Impact Evaluation:
Consumption Analysis
Consumption Per Square Foot



Impact Evaluation:
Consumption Analysis
Average Monthly Consumption

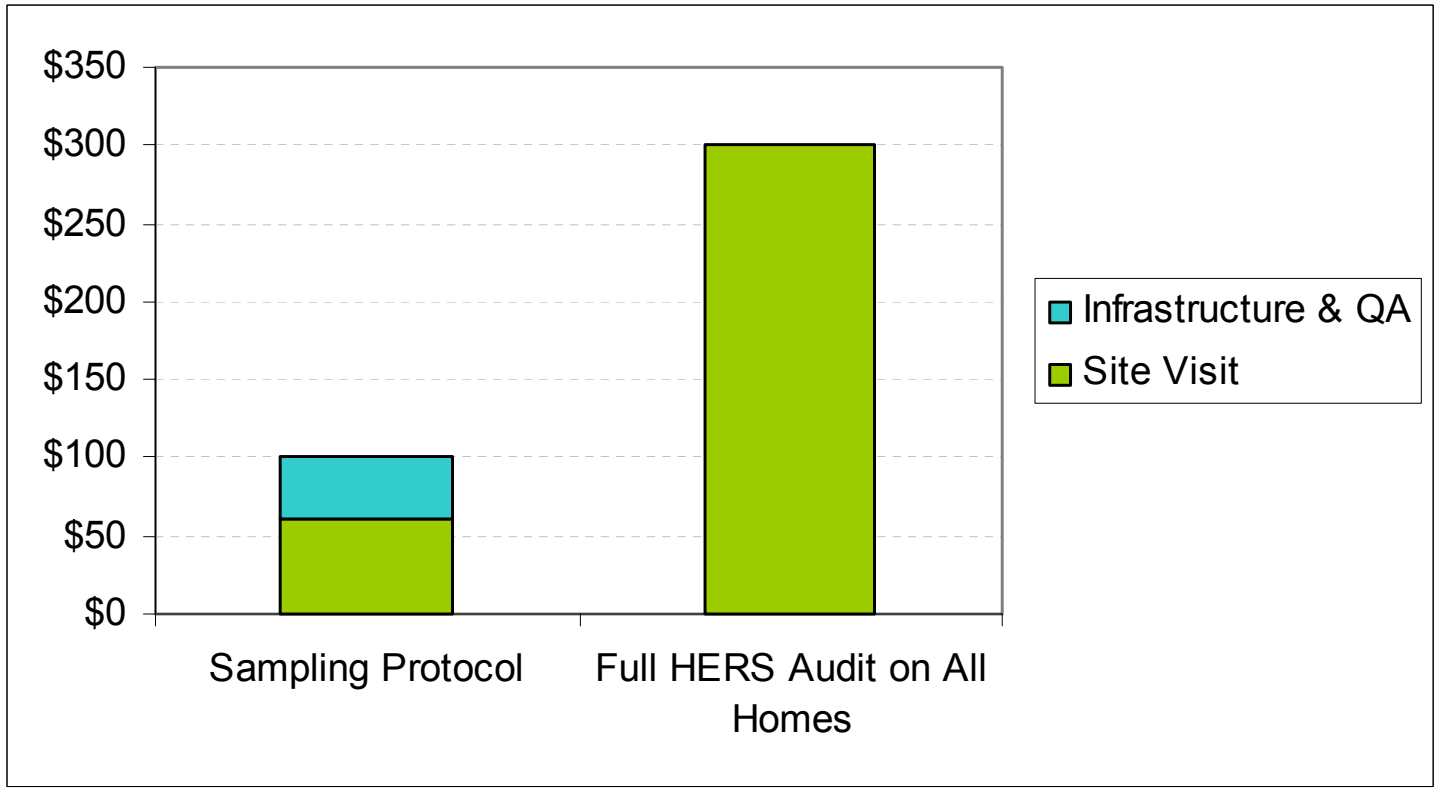


Cost Comparison

- Sampling Protocol or Sampling Program?
- How do you maintain the infrastructure required to ensure the reliability and success of sampling?
  - Builder Quality Control
  - Rater Training Qualifications (Senior rater accreditation)
  - Linking to Provider Services & Responsibilities and Other Programs
    - *Record Keeping*
    - *Quality Assurance*
    - *EEMs*
    - *Consumer Satisfaction*

Cost Comparison

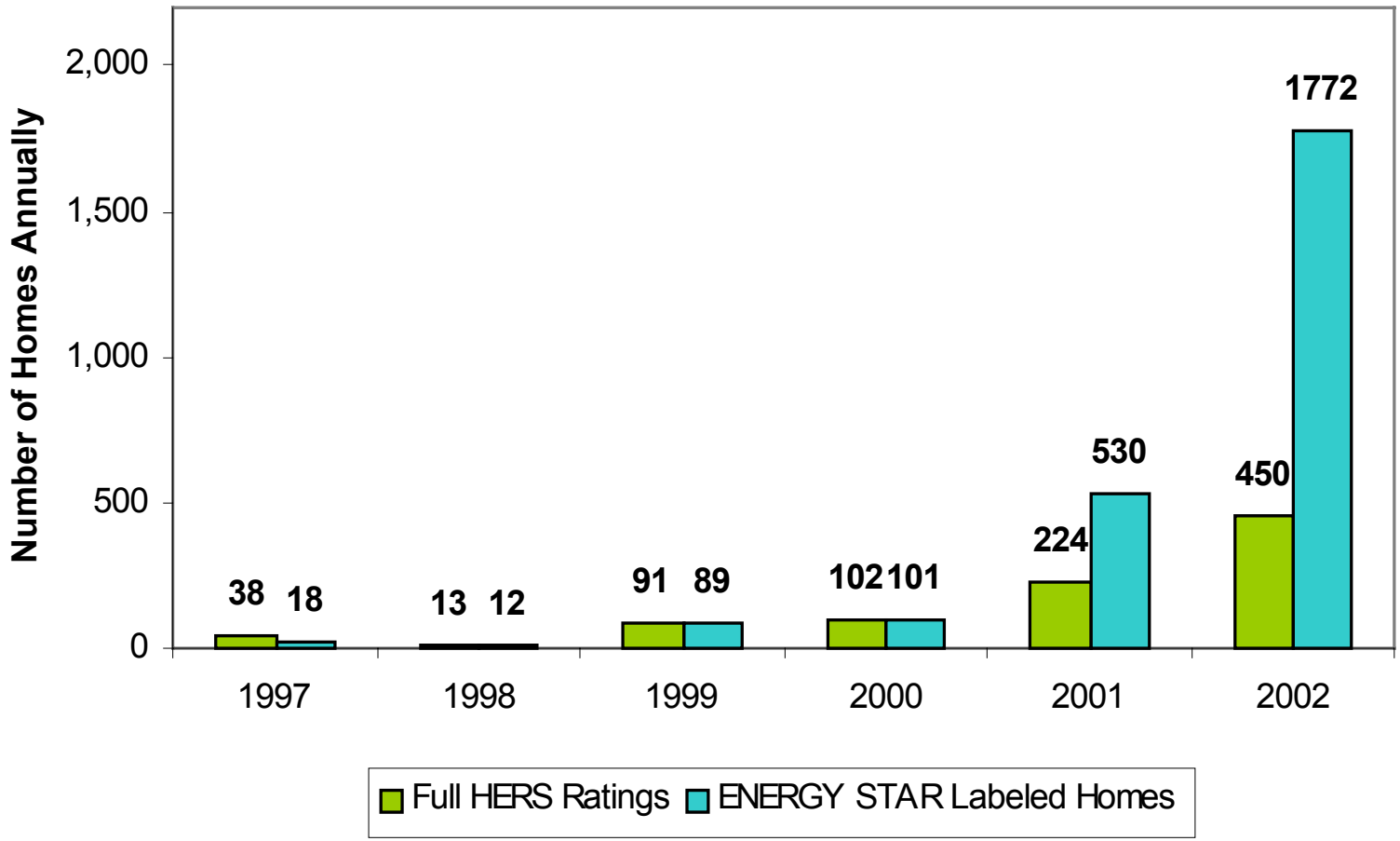
- Potential savings from sampling exists – some infrastructure costs (training, administration, etc.) will be incurred



Findings

- Sampling can provide reliable verification of home efficiency and performance
- Builder concerns about costs and time requirements of verification supports sampling approach
- Sampling option may help to tap potential for increased market share for ENERGY STAR labeled homes exists
  - Interest and commitment of builders
  - Growing consumer awareness

Impact on Market for ENERGY STAR Homes



Findings, cont.

- Sampling will likely reduce the overall cost of verification
- Infrastructure is required to support sampling
  - Builder & Rater training
  - Oversight of sampling process
  - Process for corrective action

Recommendations

- Promote sampling as an option for consideration by local Rating providers
  - National protocol could be adopted and customized to meet local or state needs
- Establish criteria for builders to "qualify" for sampling approach
  - Number of homes constructed annually
  - Baseline analysis of home designs that predicts performance exceeding the ENERGY STAR standard
  - Training of crews and subcontractors

Recommendations, Cont.

- Establish a protocol for sample selection
  - Rating providers should demonstrate a basic understanding of statistical analysis
  - Protocols for selection of homes to be Rated
- Explicit policies for handing failures
- Clear policy on eligibility for Energy Efficient Mortgages