Cold Climate Region
Case Study #9: 2427 7th Street
City of Boulder, SmartRegs Ordinance
Multi-Family, Early 1900's Vintage

Boulder, CO

Program:	SmartRegs Ordinance
Location:	Boulder, Colorado
Building Type:	Multi-Family
Number of units:	2
Building Size:	493 ft^2 2nd Floor/611 ft^2 1st Floor
Foundation:	Basement/Crawlspace: Unconditioned
Configuration:	2 bedrooms, 2 baths
SWA Contact:	Lois Arena

Due to their proximity to the University of Colorado, there are several older neighborhoods in Boulder that are dominated by rental properties. Many of these old, single family homes, such as this bungalow built in 1900, have been divided into more than one unit. Each floor of this two story home has been converted into an individual apartment.

According to Boulder's SmartRegs requirements, each rental unit in a building must be tested and scored separately. Unusual layouts, common walls and floors, shared equipment, and occupant use of the space can make this quite challenging. Efficiency levels and testing results for each unit in this home are shown in the table at right.

It is common when rating a multi-family building that some units will score better than others. Contributing factors include whether the unit is on the bottom, middle or top floor of the building, the amount of exposed surface to outside, and differences in lighting and appliances in each space. Differences in the HERS Index can also be the result of the affects of solar exposure and the amount of window area. In the case of this home, where percentage of above grade walls and efficiency levels are fairly similar between the two apartments, the resulting SmartRegs scores and HERS Indices are also fairly similar.

The 1st floor unit in this building only scores 3 points lower on the SmartRegs checklist than the 2nd floor unit. While the 1st floor gained several more points for lights and appliances than the 2nd, it scored significantly worse in the foundation insulation category. The 2nd floor gained 15 points for being located over conditioned space, but the 1st gets zero for being over an uninsulated basement/crawlspace.

This home has been divided into two rental units. At this time, neither unit achieves 100 points on the SmartRegs checklist, therefore, efficiency improvements must be made.

Energy Efficient Features

Attic:	R-19 blown cellulose
Walls:	Uninsulated brick
Windows:	Predominantly single pane wood + storms
Foundation:	Crawlspace R-0, Basement R-0
Heating:	Central system - forced air, natural gas, 90 AFUE, in unconditioned basement
Cooling:	None
Ductwork:	Uninsulated & in unconditioned space
Hot Water:	Atmospheric, natural gas, unconditioned space, 0.59 EF
Air Leakage:	2nd Fl: 25.23 ACH@50 pascals, 1.14 ACHn 1st Fl: 32.29 ACH@50 pascals, 1.45 ACHn

Additional SmartRegs Features

Low-flow faucets and showerheads, programmable thermostat

SmartRegs Checklist Score*: 88 points 2nd Fl
85 points 1st Fl

(The final score must be ≥ 100)

HERS Index: 139 2nd Fl/150 1st Fl

*100 points on the SmartRegs checklist should approximately equate to a HERS index of 120.

Steven Winter Associates, Inc.

www.swinter.com
61 Washington St. 6th Fl, Norwalk, CT 06854 tel 203-857-0200 fax 203-852-0741
307 7th Ave. Ste. 1701, New York, NY 10001 tel 212-564-5800 fax 212-741-8673
1112 16th St., NW Ste. 240, Washington, DC 20036 tel 202-628-6100 fax 202-393-5043

Boulder, CO

The minimum allowable score when using the prescriptive method for compliance with Boulder's SmartRegs ordinance is 100 points. The lower unit of this property scored 85 points and the upper 88, therefore, the owner will have to improve both by 2019 in order to maintain their rental license.

When developing the SmartRegs checklist, program creators intended that 100 points should approximately equate to a HERS Index of 120. Given this assumption, both apartments should have a HERS Index above 120 (the higher the HERS index the less efficient the home).

To validate this assumption, SWA modeled both units in this home using REM/Rate, a simulation program used to analyze the energy use of residential buildings. As anticipated, both units scored above 120: the upper unit received a HERS Index of 139, and the lower an index of 150.

Upon initial review of the audit results, it would appear that the owner has several options for improving the efficiency of this home. But, as is often the case when retrofitting an existing home, before energy improvements can be made other upgrades must be implemented for health or safety reasons. Since this extra work does not contribute to energy savings, the overall cost-effectiveness of the improvement can be significantly reduced.

For example, adding insulation to this attic would generally be a cost-effective upgrade. But, given the age of this home, it could very well have knob and tube wiring. If it does, the wiring would have to be upgraded before any additional insulation could be added.

Likewise, insulating the foundation would be problematic. This space is currently being used for storage and is quite packed with belongings. A good majority of these items would have to be taken out to properly insulate the walls and install a vapor barrier over the exposed dirt of the crawlspace area. On top of this, the crawl space is under 2' tall toward the front of the home making improvements to that area very difficult.

Facts about SmartRegs

2 Compliance Paths: Prescriptive or Performance
- Prescriptive: ≥ 100 points on Checklist
- Performance: HERS Index <= 120

Uninsulated, partially sealed ductwork in the uninsulated basement/crawlspace

Basement and crawlspace are being used as storage making any retrofits in this area difficult and more costly.

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Cold Climate Region: Case Study #9 SmartRegs Compliance (cont.)

Boulder, CO

One option for owners of these hard to improve older buildings is installing a minimum of 1 kW of PV (photovoltaics) on the roof. Because this upgrade gains 44 points on the SmartRegs checklist, no other improvements would have to be made to this home. The only stipulation is that the home score at least 70 points on the checklist before this option can be used. Both of these units pass that criteria.

But again, house configuration and existing circumstances make installing PV on this house challenging. The image at the right shows this home's complicated roof configuration; hardly ideal for a PV installation. Also, large trees to the east, south and west will shade a good portion of this roof for much of the year. Both of these issues make installing an efficient PV system difficult at best.

With the above considerations in mind, the following improvement options for this property were analyzed:

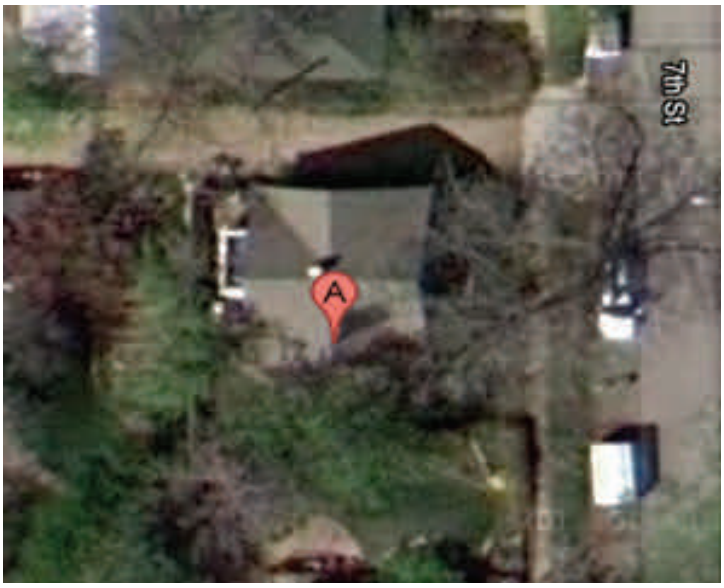
- Replace the water heater with an instantaneous, 0.82 EF model (5 points);
- Reduce the air leakage in both apartments to 0.75 ACHn (4 points);
- Reduce the duct leakage by 50% (9 points).

While some extra cost will be incurred to perform these improvements in this home as compared to a new or newer home, they should be more cost-effective than some of the other options discussed. The affects of these upgrades on the SmartRegs and HERS Indices for both apartments are shown in the following table.

As-Is vs. Upgraded Scores		
	SmartRegs	Hers Index
1st Floor		
As-Is	85	150
Upgraded	103	116
2nd Floor		
As-Is	88	139
Upgraded	106	109

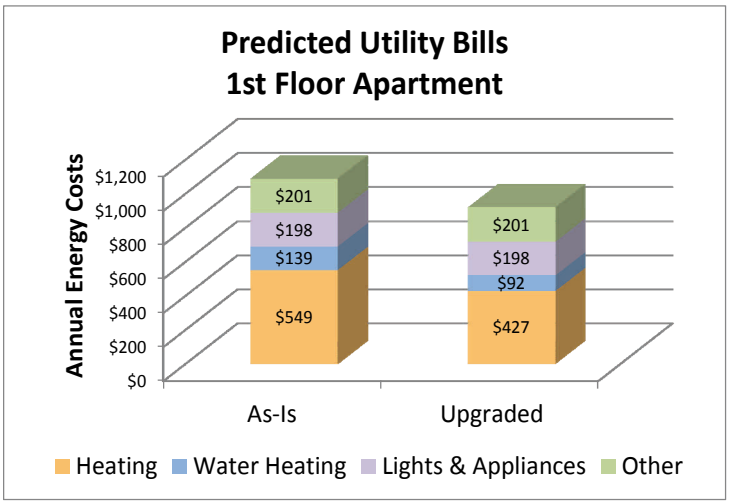
The analysis on both of these units shows good agreement with the goal of SmartRegs developers that 100 points should approximately equate to a HERS Index of 120. The scores both behaved in a consistent manner as well: when the SmartRegs score was below 100, the HERS Index was above 120, and visa versa.

Improvement Analysis



Satellite image showing complicated roof configuration and large trees to the east, south and west blocking solar exposure.

Predicted monthly utility bills for the first floor apartment are displayed in the graph below. REM/Rate predicts an annual utility bill of approximately $1000 for the units As-Is (slightly more for the 1st floor, and slightly less for the 2nd). For each apartment, the upgrades result in predicted utility bill savings of about 16% (approximately $160/yr) and reductions in emissions of about 15%.



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Boulder, CO

This property owner was interviewed to determine her feelings and concerns about Boulder's new SmartRegs ordinance. A summary of her opinions and suggestions for improvements are below.

Q. Why did you decide to participate now and not wait till later in the process?

A: The owner of this property chose to participate now to take advantage of free inspections and to start the planning process in the case that improvements would need to be made. This owner is very concerned with energy efficiency in general and had performed many enhancements before SmartRegs was passed.

Q. How long has the owner owned this property?

A: This property has been owned for approximately 25 years. She owns 2 properties with a total of 7 units.

Q. Are you educating the occupants about what and why renovations are taking place and how it will benefit them?

A: This owner actively educates students on environmental issues and energy efficiency. She recommended that the city create a "Tips for Tenants" worksheet to aid in the education process.

Q. What is your normal maintenance routine – i.e., every few months, once a year, on occupant turn over?

A: She provides enough furnace filters to her tenants every year for a monthly replacement . When there are no other expenses that year, the owner uses that opportunity to upgrade something. There have been no comfort complaints from her tenants.

Q: What has been the biggest challenge for you throughout this process?

A: The biggest challenge for this landlord has been improving such an old property. Often there are not cost-effective upgrade opportunities – brick walls, knob and tube wiring, plaster interiors, etc.

Q: What would you like other property owners to know?

A: As with most rental property owners interviewed during this process, this owner expressed that the process wasn't as difficult, and reaching compliance wasn't as hard as originally anticipated. She also felt that the EnergySmart advisors were very helpful.

Q: Concerns?

A: The owners biggest concern with the SmartRegs ordinance was having the local government make decisions over what she feels is her personal business.

Steven Winter Associates, Inc. is the lead for the Department of Energy's Building America team called the Consortium for Advanced Residential Buildings (CARB).

CARB would like to thank Populus, LLC , a sustainable design consulting firm and the program administrator for the City of Boulder's SmartRegs program, for their expertise, time and assistance in creating these case studies.

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