

Cold Climate Region: Case Study #5

City of Boulder, SmartRegs Ordinance

Low-Rise Multi-Family, 1960's Vintage

Boulder, CO

Program	SmartRegs Ordinance
Location:	Boulder, Colorado
Building Type:	Low-Rise Multi-Family
Building Size:	35,000+ ft ² living space
Foundation:	Slab-on-grade
Configuration:	3 Stories, 69 Units,
SWA Contact:	Lois Arena

Built in 1966, this 35,000+ ft² apartment building was constructed on a slab-on-grade foundation with a flat, unvented roof. Due to height restrictions in the City of Boulder, most buildings, including multi-family buildings, are 3 stories or less in height. This 69 unit apartment complex fits that description.

The configuration of this building is somewhat unique in that it has a center courtyard for the residents' use. This configuration, sort of a square doughnut, results in at least 2 exterior walls for each apartment.

Efficiency levels in this property were consistent with its year and type of construction (see table at right). The apartments are heated with hot water base-board radiators that are fed from two gas-fired central boilers.

These boilers also provide the domestic hot water for the occupants. Each boiler heats 2-119 gallon indirect hot water storage tanks to meet the daily hot water needs of the residents.

Since no nameplate information could be obtained from these boilers, the efficiencies were assumed to be 65 AFUE. These values are based on age and RESNET's Home Energy Rating System (HERS) standards, Table 303.7.1(3) Default Values for Mechanical System Efficiencies. The water heating efficiency is based on this AFUE and then reduced slightly to account for standby losses from the tanks.

Of the 69 apartments, 5 offer 2 bedrooms while the rest are 1 bedroom units. Apartment sizes are 470, 600 and 800 ft², the majority (56) of which are the smaller 470 ft² apartments. Other than the outdoor courtyard, common spaces are limited to a small laundry room and a couple of entryways.



This 3-story, multi-family apartment building in Boulder, CO offers a central courtyard for tenant use.

Energy Efficient Features

Roof:	R-19 batts, unvented
Walls:	R-11
Windows:	Single metal
Foundation:	Slab-on-grade, R-0

Heating:	Central boilers (2), natural gas, 65 AFUE
Cooling:	Window Units, SEER 8
Hot Water:	Indirect tank off boiler, 0.60 EF

Air Leakage: 9.7 ACH@50 pascals, 0.52 ACHn

Additional SmartRegs Features

None

SmartRegs Checklist Score: from 92 to 104 points

(Score must be ≥ 100 points)

HERS Index: from 112 to 128

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

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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The manager of this property opted to use the prescriptive method of compliance and have the auditor fill out a checklist rather than perform energy modeling to determine if the property was in compliance. The checklist is quicker than modeling, provides answers right on site and does not require the additional time and expense of duct leakage testing. If compliance can be gained without modeling, the checklist is a more economical option.

Each apartment will be scored individually in the SmartRegs program to account for floor plan configuration differences. Differences in layout can result in different exposed wall areas, which in turn, can affect the SmartRegs score. Also depending on which level the apartment is located on, the unit may or may not have exposed ceilings or floors (slab). For example, a corner unit on the 1st floor will generally have a lower SmartRegs score than a center unit on the 2nd floor, because that second floor unit will have less wall exposed to the outside and will have neither a floor nor a ceiling exposed to the outside. These are both examples where the 2nd floor unit will gain more points than the 1st floor unit.

The following table lists the scores for a center unit and a corner unit on each floor of the building.

	As-Is SmartRegs Scores		
	1st Floor	2nd Floor	3rd Floor
Center	95	104	101
Corner	92	101	98

Because the minimum allowable score is 100 points, the property owner will have to improve the property by 2019 in order to maintain the rental permit required by the City of Boulder.

Based on the worse case scenario of 92 points for a 1st floor corner unit, 8 additional points would be needed to meet the SmartRegs threshold. Considering that the building is already getting substantial points for its walls, roof and infiltration, the areas of greatest opportunity are the windows and the heating system.

Facts about SmartRegs

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



All the windows in this apartment complex are single pane metal windows.

This owner has chosen to replace all the single pane metal windows with low-e, vinyl windows with efficiencies of U-0.29. This upgrade gains 14 points on the SmartRegs checklist. When applied to all the as-is scores, all units come into compliance as can be seen in the following table.

	SmartRegs w/ New Windows (U-0.29)		
	1st Floor	2nd Floor	3rd Floor
Center	109	118	115
Corner	106	115	112

For purposes of this case study, the small, center apartments were modeled using REM/Rate, a simulation program used to analyze the energy use of residential buildings. Small, center units were chosen because this is the configuration of the majority of the apartments in this building. The HERS Indices for this property as-is ranged from 112 for the 2nd floor center unit to 128 for the 1st floor center unit, showing very good agreement with the goals of program creators and administrators:

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

After the windows are upgraded, the HERS Indices for the center units on all three floors fall at or below 106.

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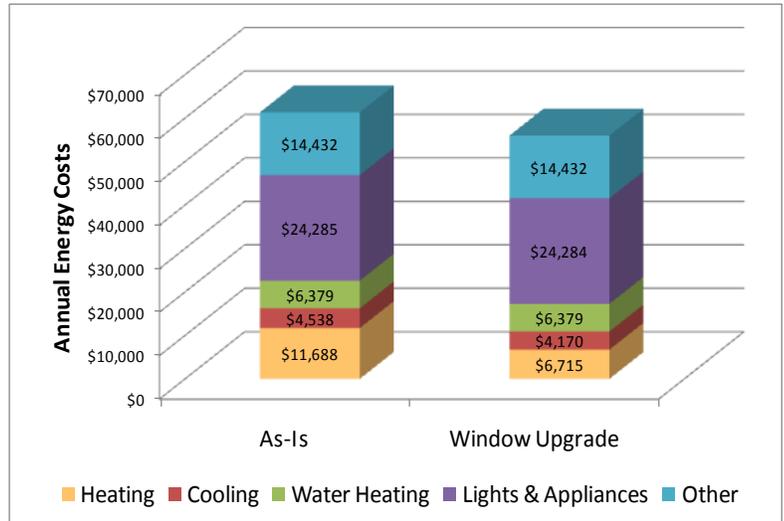
SmartRegs requirements were adopted to meet the city's sustainability objectives including environmental health, economic vitality and social equity. According to current statistics, rental properties comprise approximately 50 percent of Boulder's housing stock¹. Therefore, by requiring property owners to upgrade rental properties, the SmartRegs program aids in advancing Boulder's community sustainability objectives, and will hopefully result in lower energy bills for tenants.

Predicted monthly utility bills for this property as it existed at the time of the initial inspection are displayed in the graphs to the right. The top graph shows the predicted annual utility bills for all 69 apartments. The bottom graph shows the annual bills for one 1st floor, center unit. Modeling this building either way—as one entire building or individual units—predicts an energy savings of just under \$80 per apartment per year after the metal windows are replaced with the low-e vinyl windows (U-0.29).

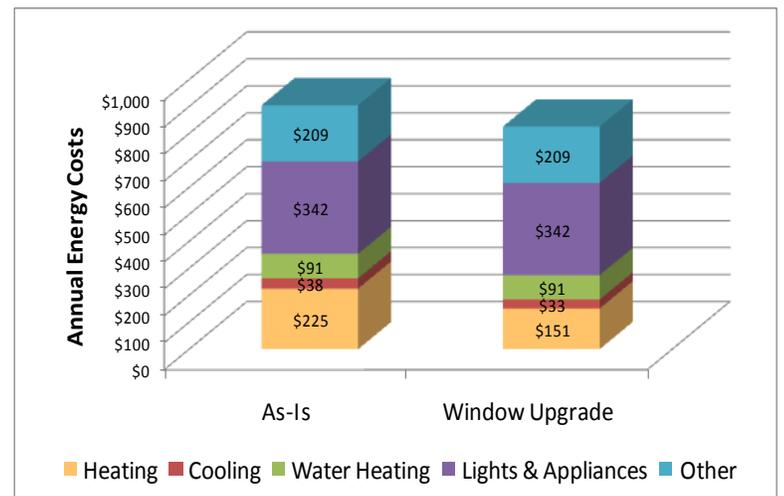
Compared to the single family case studies conducted, the majority of the predicted energy bills for this building are associated with the lights and appliances. This is understandable considering that many of the surfaces in each apartment border another apartment, therefore, little heat is lost. On a square foot basis, multi-family homes and apartments use much less energy for heating and cooling given the same efficiency values and conditioned square footage of detached homes.

This is not to say that upgrades that reduce heating and cooling loads should be overlooked in multi-family buildings. It should just be noted that the same improvements that may have been cost-effective on a detached home, won't necessarily be cost-effective on a multi-family unit of the same size.

To better analyze programs like SmartRegs, comparisons to actual utility bills are critical. Unfortunately, obtaining utility bills from major providers has been and remains incredibly difficult, even with signed consent forms from homeowners or renters. While this is not necessarily a barrier to



Predicted utility bills for all apartments from REM/Rate.



Predicted utility bills for one 1st floor, center unit.

program implementation, it is a huge barrier to improving these programs and ensuring that the upgrades being recommended are effective from an energy reduction and a cost-effectiveness standpoint. Removing this barrier is essential in meeting long term program goals.

¹2011 SmartRegs Handbook, City of Boulder