

What are the Likely Impacts of Recent Changes in California's Residential New Construction Standards on Construction/Compliance Practices and Utility RNC Programs

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ABSTRACT

Revisions to California's low-rise residential building standards had a large impact on two multi-year studies being conducted in California. The worksopes of these studies—the Statewide Residential New Construction Energy Efficiency Baselines (Baseline Study) and the Impacts of Recent Changes to Title 24 on Builder Practices and Compliance (Title 24 Impact Study)—were refined to support an analysis of issues related to the new requirements. In particular, this paper presents information from in-depth interviews and telephone surveys of energy consultants and builders on the likely impact of the new Standards on compliance-related building practices. The analysis was taken a step further by simulating these self-reported changes using MICROPAS, a compliance software (Enercomp 2001), to ascertain the effectiveness of these changes on compliance. A key element of the compliance analysis is the Residential New Construction (RNC) Interface, developed to translate on-site survey data into input files for MICROPAS and, ultimately, a set of flexible result reporting formats. In addition to the impact on builders and energy consultants, the new Standards will affect the state utilities' residential new construction energy efficiency programs. Data from interviews and surveys provide useful information that can be used by utility program planners to refocus RNC programs in light of the new standards.

Background

In California, the energy performance of low-rise (three floors or less) residential new construction (RNC) is covered by the Title 24 Residential Standards, which are administered by the California Energy Commission (CEC). These Standards apply to low-rise detached single family homes, attached single family homes, and multifamily residences less than three stories high. Compliance with these Standards is typically evaluated with CEC-approved software. MICROPAS is the most commonly used computer program for this purpose. The Standards are typically updated on a three-year cycle (e.g., 1995, 1998). However, the normal revision cycle was interrupted by the recent events resulting from deregulation of California's investor-owned utilities (IOUs).

In response to what the State of California describes as “growth trends in electricity peak demand that have strained the adequacy and reliability of California's electricity system,” the State passed Assembly Bill 970 (AB 970) in September 2000. One action of AB 970 was to direct the CEC to “adopt and implement updated and cost-effective standards...to ensure the maximum feasible reductions in wasteful, uneconomic, inefficient, or unnecessary consumption of electricity.” The CEC began to consider amendments to the current standards that could be “quickly analyzed and justified, and which would have a clear and significant impact on peak energy demand.” Because of this action, the AB 970 Standards were created and adopted in January 2001. Under these Standards, statewide annual source energy savings is estimated at 14% from the 1998 Standards, which includes a 39% or 155 MW reduction in cooling energy use on a statewide basis (CEC 2000).

This sudden and significant revision of the Standards had a large impact on the focus of two multi-year studies being conducted in California: the Statewide Residential New Construction Energy Efficiency Baseline Study (Baseline Study) and the Impacts of Recent Changes to Title 24 on Builder Practices and Compliance Study (Title 24 Impact Study). The Baseline Study focuses on developing baseline construction and compliance characteristics of newly constructed homes. To accomplish the study objectives, detailed compliance analyses were performed using MICROPAS and data from 800 on-site surveys of newly constructed California homes (RER 2000). An essential feature of the compliance analysis was the construction of an interface (RNC Interface) between the on-site data and MICROPAS. This interface allows data to be processed directly from the surveys into MICROPAS, batch processing of sites, and flexibility to run “what if” scenarios.

The Title 24 Impact Study is primarily concerned with identifying barriers to Title 24 compliance, changes in builder practices attributable to the Title 24 revisions, and measures and methods typically used by builders to meet Title 24 energy budgets. To accomplish the objectives of this study, a series of in-depth interviews was conducted, followed by telephone surveys of builders, Title 24 energy consultants, and utility program planners and administrators.

The major change to the Standards is that radiant barriers,¹ low solar heat gain fenestration,² duct sealing,³ and TXV valves⁴ for air conditioners (certified by a Home Energy Rating System (HERS) provider/rater) are now part of Prescriptive Package D for some climate zones. These added features will also affect the standard budgets used for performance method calculations and will make it much tougher to achieve compliance.

Another change is the addition of an alternative to Prescriptive Package D. This package is an alternative to HERS-certified measures (duct sealing and TXV valves for air conditioners) and requires higher performance windows and high efficiency HVAC equipment.

Due to the new AB 970 Standards, the scopes of the studies were changed mid-stream in order to assess the potential impact on energy usage caused by installing the four required measures and determine how builders will change their construction and compliance practices in response to the Title 24 revisions. The analysis design and approach used in the Baseline and Title 24 Impact Studies was sufficiently flexible to pursue the expanded workscope. In particular, the RNC Interface facilitated detailed impact analyses of the installation of measures covered by the revised standards. The in-depth interview guides and telephone surveys were revised to include questions relevant to the impact of AB 970.

The new standards also affect existing California RNC programs. Specifically, some measures integrated into the AB 970 baseline are integral parts of existing programs. For instance, PG&E’s Comfort Home Program offered incentives for duct sealing, while ComfortWise offers incentives for high performance windows. Therefore, RNC program planners are concerned about identifying ways to refocus their programs to account for the new requirements. The Title 24 Impact Study was expanded to collect suggestions from Title 24 consultants and builders on how the utilities could alter their RNC programs in light of AB 970.

Paper Objectives

Insofar as AB 970 does not become effective until January 2002,⁵ the main sources of information on how builders and Title 24 consultants plan to meet the new standards are self-reported data from

¹ A radiant barrier is a reflective foil or metal-coated surface usually placed on or against the underside of a roof.

² Low solar heat gain fenestration products are typified by a dual-paned, vinyl framed window with low solar/low emissivity (spectrally selective) glass.

³ Duct sealing involves actively testing and sealing a duct system with a “duct blaster” or equivalent apparatus.

⁴ Air conditioning system performance is dependent on proper refrigerant charge and air flow across the coil. TXVs mitigate the problems of improper refrigerant charge and airflow by making the system operate at its rated efficiency.

⁵ June 2001 is the official effective date. However, approved master plans are exempt until December 31, 2001.

in-depth interviews and telephone surveys with these professionals. The analysis discussed in this paper focuses on taking the self-reported information on likely changes in building practices and simulating these plans using the RNC Interface. The simulations will analyze whether builders and Title 24 consultants can meet the new standards using their planned approaches. Further, a summary of suggestions on how the utilities can alter their RNC programs to assist Title 24 consultants and builders in coping with the new standards is included.

This paper reviews compliance methods used to meet the revised Title 24 Standards, describes findings from the in-depth and telephone surveys of energy consultants and builders, discusses the RNC Interface development, examines the impacts on compliance from the various measures builders will likely use, and reviews suggestions from Title 24 consultants and builders regarding RNC programs.

Compliance Methods

Two methods can be used to show compliance with the Residential Standards: the prescriptive approach and the performance approach. For the prescriptive approach, compliance is achieved by building the home to meet or beat a pre-established “package” of building features (e.g., insulation, percent fenestration) and equipment (e.g., space heating, water heating, air conditioning). Within each package, the severity of energy efficiency level required for the features and equipment also varies by “CEC climate zone,” of which 16 are currently defined. The 1998 Standards had four such packages—A through D.

Under the performance method, heating and cooling energy usage for the residence as designed (design energy budget) is simulated and compared to that for a prototype “standard” home (standard energy budget). Prescriptive Package D is used as the basis for determining the standard home energy budget. Compliance is achieved when the design energy budget is lower than the standard energy budget. The difference between these values is called the “compliance margin.” Over 95% of compliance analysis is completed using the Performance method. Building energy use is simulated using one of four state-approved simulation models. MICROPAS is the model used for this analysis.

Title 24 Consultants and Builder Interviews

As AB 970 has yet to be implemented, there is much conjecture as to which measures will be used in the performance-based method to meet compliance requirements. Preliminary discussions with Title 24 consultants and others involved in analyzing the impacts of AB 970 suggest that the performance method will continue as the preferred method of compliance. However, builders will need to go beyond their usual methods (e.g., high performance windows, high efficiency equipment) and adopt some of these new measures to make homes comply. The Title 24 and builder surveys were designed to collect this information and address which combination of measures are most likely to be used to meet the new compliance requirements. This section discusses the data collected from the telephone surveys of Title 24 consultants and builders.

Thirteen in-depth interviews with Title 24 consultants were conducted. Following these interviews, a telephone survey was designed using knowledge gained from the in-depth interviews and 55 telephone surveys were conducted. In addition, 17 in-depth interviews with builders were completed. Surveys included builders of both single family and multifamily homes.

Title 24 consultants were asked questions to determine what measures builders will likely use to meet compliance once AB 970 Standards are in effect. First, consultants were asked how likely they believe builders are to use each measure required by Prescriptive Package D. The consultants were then asked how likely they were to use four other measures to meet compliance. This is important since the more stringent requirements call for builders to implement several energy efficient measures at once if they choose not to use both low solar heat gain fenestration and HERS-certified sealed ducts.

Use of Features Included in Prescriptive Package D

Each consultant was asked how likely he/she believes builders will be to use the four methods required under AB 970. Responses were given on a scale of 1 to 5, with one representing “Not at all Likely” and 5 representing “Very Likely.” As shown in Table 1, consultants feel that builders are more likely to use low solar heat gain fenestration (average 3.9) than other measures. In fact, Title 24 consultants feel that builders are more likely to install low solar heat gain fenestration than TXV valves, radiant barriers, or HERS-certified sealed ducts. Additionally, 20 consultants reported that builders would likely (rating of 3, 4, or 5) use both HERS-certified sealed ducts and high performance windows.

Table 1: Likelihood of Use for Compliance–Features in Prescriptive Package D

Feature	Average Likelihood ¹	Weighted Standard Errors
HERS-Certified Sealed Ducts	2.68	(0.17)
Thermostatic Expansion Valves (TXV)	2.27	(0.20)
Low Solar Heat Gain Fenestration	3.92	(0.13)
Radiant Barriers	3.18	(0.18)
All Four Measures	2.84	(0.18)

¹ Values are weighted means.

Use of Features not Included in Prescriptive Package D

As mentioned earlier, builders will likely use low solar heat gain fenestration to meet the more stringent requirements of AB 970. However, it is likely that higher efficiency windows alone will be insufficient to make a home comply under the new standards. Therefore, the team examined the consultants’ opinions of what other features builders will use in combination with low solar heat gain fenestration. As shown in Table 2, the consultants believe that builders are most likely to use higher efficiency water heaters and/or air conditioners in combination with low solar heat gain fenestration.

Table 2: Likelihood of Use for Compliance–Given the use of Low Solar Heat Gain Fenestration

Feature	Average Likelihood ¹	Weighted Standard Errors
Higher Efficiency Water Heater	3.86	(0.18)
Higher Efficiency Air Conditioner	3.76	(0.19)
Higher Efficiency Furnace	3.50	(0.19)
Increase Insulation Levels	3.36	(0.19)

¹ Values are weighted means.

To meet the more stringent requirements of AB 970, builders will need to use both duct sealing and low solar heat gain fenestration, or one of these in combination with several other measures, to comply. Thus, the consultants’ opinions regarding other features that will be used along with duct sealing were examined. Similar to the results above, Table 3 shows that the consultants believe builders are most likely to use higher efficiency water heaters and/or air conditioners along with duct sealing.

Table 3: Likelihood of Use for Compliance—Given the use of HERS-Certified Sealed Ducts

Feature	Average Likelihood ¹	Weighted Standard Errors
Higher Efficiency Water Heater	3.69	(0.35)
Higher Efficiency Air Conditioner	3.69	(0.28)
Higher Efficiency Furnace	2.75	(0.30)
Increase Insulation Levels	3.38	(0.27)

¹ Values are weighted means.

Summary of Findings from Title 24 Consultant and Builder Surveys

Data from the telephone surveys suggest that builders will likely use low solar heat gain fenestration to comply with the new standards. However, since installing low solar heat gain fenestration alone will be insufficient to comply with the new Standards, Title 24 consultants added that builders will likely install higher efficiency water heaters and air conditioners. Also, Title 24 consultants feel that builders are less likely to use duct sealing and TXVs—measures that require HERS certification.

Compliance Analysis

The survey findings provided a good qualitative assessment about what measures and combinations of measures the respondents think would work in meeting the more stringent Standards. The next logical step was to test their opinions and quantitatively evaluate which approaches would most likely comply. In particular, the following approach was used to test which, if any, of the planned approaches would result in a large percentage of homes meeting the Standards. First, on-site survey data for 800 newly constructed homes were used to test if the homes, as-built, would comply with AB 970. Next, taking advantage of the RNC Interface’s flexibility, radiant barriers were globally implemented—meaning a radiant barrier was added to each home. After artificially adding this measure, the homes were again analyzed to determine if implementing this one measure would make the homes comply. This procedure was repeated for each remaining measure included in Prescriptive Package D: sealed ducts, low solar heat gain fenestration, and TXV valves. Next, using information collected during the Title 24 consultant interviews, a list of the most likely combinations of measures was developed. Each combination was globally implemented and the compliance results of each analyzed.

Development of the RNC Interface and the compliance results of each run are discussed below.

RNC Interface

The RNC Interface is a software tool that uses the data collected from the 800 on-site surveys to create MICROPAS⁶ input files and generate MICROPAS compliance runs from the RMST survey data. These runs were used to examine each building’s compliance status and to explore the energy conservation potential of some key energy saving technologies. The RNC Interface is designed to support batch processing of the compliance analysis and is capable of outputting the compliance energy use results and producing summary tables of energy use by end use and by site. This feature of the RNC Interface is especially important since it allows the user to run multiple sites simultaneously and to implement global changes such as including a radiant barrier in the input file for each home.

Considerable effort went into ensuring that the RNC Interface produced accurate MICROPAS simulation results given its design and the limitations of the available data. A testing procedure was developed to evaluate the RNC Interface’s default parameters and underlying algorithms and structure.

⁶ MICROPAS was chosen because it is the tool of choice of energy consultants for performing low-rise residential compliance analysis.

Based on the results of the testing procedure, a final error band was developed for use in analyzing the RMST surveyed sites.

Compliance Results – 1995 Standards

To accomplish the Baseline Study objectives, detailed compliance analyses were performed using MICROPAS and data from 800 on-site surveys of newly constructed homes. The initial compliance analysis performed on these homes used the 1995 low-rise residential standards, since these homes were built between July 1, 1998 and June 30, 1999—before the 1998 standards went into effect. As shown in Figure 1, RNC Interface compliance analysis results indicate that 15.6% of all homes built in the study period were non-compliant. Most homes, however, fell within the compliant group (51.0%) and 0.5% fell in the overly compliant group.

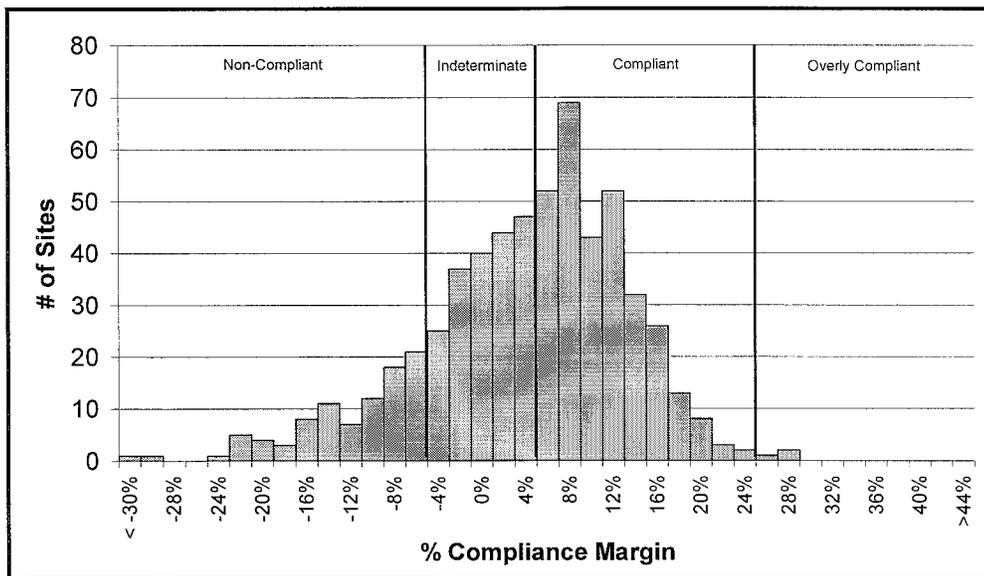


Figure 1: Compliance Results – 1995 Standards – As-Built

Compliance Results – AB 970 Baseline

To implement the measures required by Prescriptive Package D, the latest version of MICROPAS incorporating the new standards was used. Using the RNC Interface, compliance analysis was performed again for the as-built homes to provide a baseline. Table 4 and Figure 2 show that only 17% of homes built between July 1, 1998 and June 30, 1999 would comply with AB 970 as-built, while nearly 60% would not comply. Another 23% fell in the indeterminate group.

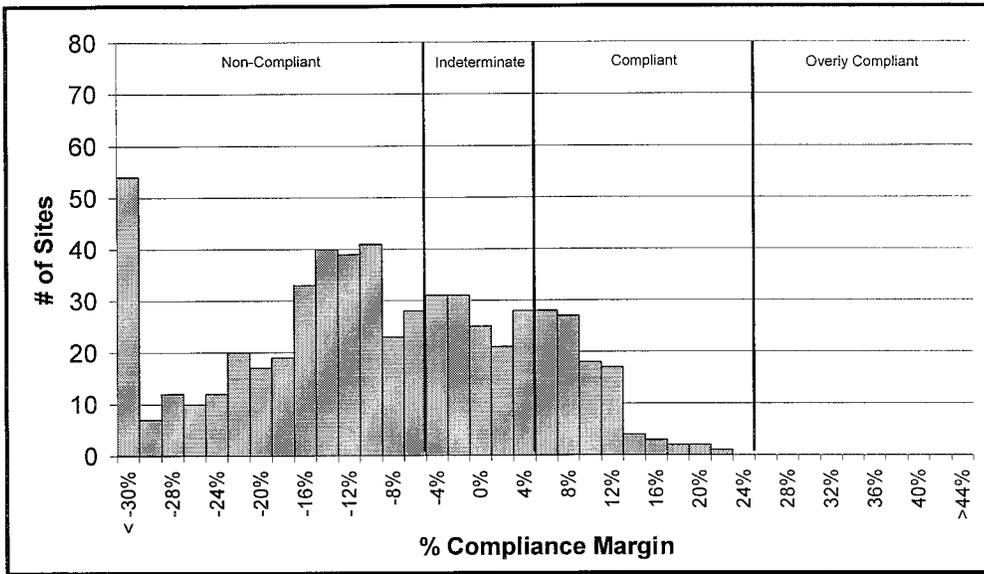


Figure 2: Compliance Results – AB 970 Standards – As-Built

Compliance Results – AB 970 – Implementing All Four Measures

Figure 3 illustrates the compliance results of implementing all four measures required by Prescriptive Package D in each home. As shown, nearly all homes comply (92.3%). Further, only 1.2% of detached single family homes fall in the non-compliant group, while an additional 6.6% are in the indeterminate group. Table 4 presents a breakout of the compliance results by measure.

Compliance Results – All Measures – Technical Potential

Technical potential savings were estimated for each of the four measures required by Prescriptive Package D for existing projects. Savings were also estimated for all four measures implemented together. Table 5 shows that on average a detached single family home with a cooling system would save approximately 1,750 kWh per year, while a home with a central gas furnace on average will save 33.5 therms per year. Table 6 shows the total estimated technical potential savings for California. As shown, the potential savings from implementing low solar heat gain fenestration accounts for most of the potential electric⁷ savings of the individual measures (54.2%). Conversely, the potential savings of duct sealing accounts for nearly all of the potential gas⁸ savings (92.4%).

⁷ Electric savings are primarily cooling savings. Electric heating accounts for a small percentage of electric savings.

⁸ Gas savings are exclusively heating savings.

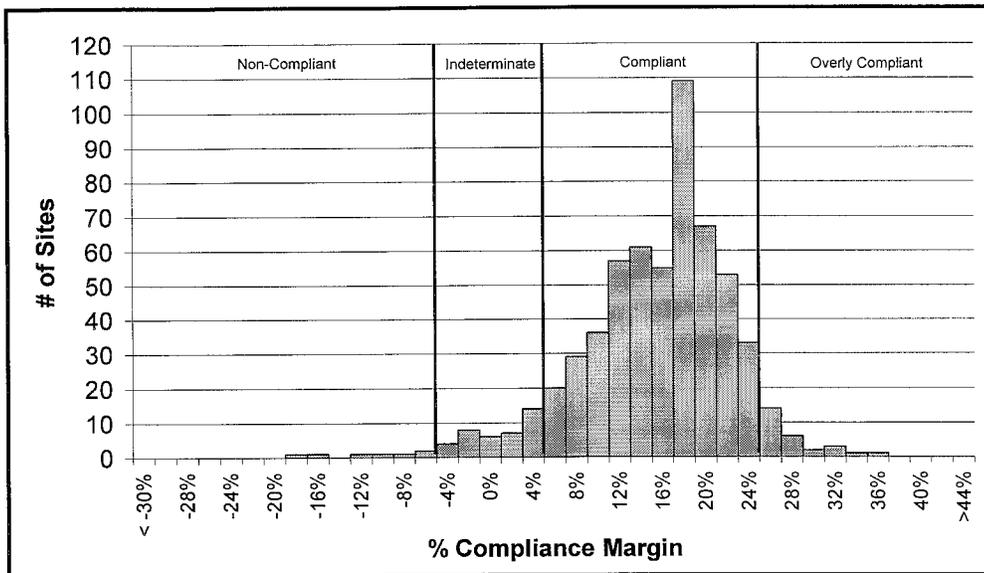


Figure 3: Compliance Results – AB 970 Standards – With All Four Technical Potential Measures

Table 4: Compliance Results – Using Measures Required by Prescriptive Package D

	Non-Compliant	Indeterminate	Compliant	Overly Compliant
Baseline	59.9%	22.9%	17.2%	0.0%
Radiant Barriers	51.4%	25.3%	23.3%	0.0%
Duct Sealing	38.6%	34.1%	27.3%	0.0%
Low Solar Heat Gain Fenestration (0.40)	15.2%	29.0%	55.3%	0.5%
Thermostatic Expansion Valves (TXV)	53.0%	25.8%	21.2%	0.0%
All Four Measures	1.2%	6.6%	87.7%	4.6%

Table 5: Technical Potential Savings of AB 970 Measures – per Home

Measure/Scenario Description	Cooling Savings ⁹ (kWh)		Gas Heating Savings ¹⁰ (therms)		Electric Heating Savings ¹¹ (kWh)	
	Per Home	Per 1,000 ft ²	Per Home	Per 1,000 ft ²	Per Home	Per 1,000 ft ²
Radiant Barriers	341	150	2.5	1.1	39	16
Duct Sealing	390	172	21.9	9.8	231	95
Low Solar Heat Gain Fenestration	1,062	467	10.5	4.7	194	80
Thermostatic Expansion Valves	344	151	0.0	0.0	0	0
All Measures Implemented¹²	1,749	770	33.5	15.0	435	179

⁹ The basis for per home and per 1000 ft² savings estimates is limited to those homes with cooling equipment.

¹⁰ The basis for per home and per 1000 ft² savings estimates is limited to those homes with gas (natural gas and propane) heating equipment.

¹¹ The basis for per home and per 1000 ft² savings estimates is limited to only those homes with electric heating equipment.

¹² Please note that the sum of the potential savings for the individual measures does not total the potential savings when all four measures are implemented simultaneously because the measures are not additive.

Table 6: Technical Potential Savings of AB 970 Measures – Total

Measure/Scenario Description	Electric Savings		Gas Savings	
	MWh	% of Sum	Therms	% of Sum
All Measures Implemented	143,121		2,166,610	
Radiant Barriers	22,742	14.2%	203,573	10.2%
Duct Sealing	26,948	16.8%	1,841,889	92.4%
Low Solar Heat Gain Fenestration	86,805	54.2%	-51,324	-2.6%
Thermostatic Expansion Valves	23,568	14.7%	0	0.0%
Sum of Individual Measures	160,063		1,994,138	

Compliance Results – AB 970 – Implementing Low Solar Heat Gain Fenestration

As mentioned above, Title 24 consultants believe that builders are most likely to use low solar heat gain fenestration. When told that installing this alone was not enough for a home to comply, they added that builders were also likely to use high efficiency water heaters and air conditioners. Table 7 presents a breakout of compliance results by measure combination. Figure 4 illustrates the compliance results with all homes receiving low solar gain fenestration. These results suggest that many homes will not pass with low solar heat gain fenestration (SHGC=0.40) alone. In particular, approximately 44% of detached single family homes are either in the non-compliant or indeterminate groups and only 0.5% are in the overly compliant group. However, when both high efficiency air conditioning and water heating systems are added along with high performance fenestration (SHGC=0.35), over 77% of homes comply and only 7% of homes do not. Figure 5 shows the compliance distribution for homes with low solar heat gain fenestration (SHGC=0.35) and high efficiency air conditioning and water heating systems artificially implemented.

Table 7: Compliance Results – Using Measures not Included by Prescriptive Package D with Low Solar Heat Gain Fenestration

	Non-Compliant	Indeterminate	Compliant	Overly Compliant
Baseline	59.9%	22.9%	17.2%	0.0%
Low Solar Heat Gain Fenestration (0.40)	15.2%	29.0%	55.3%	0.5%
Low Solar Heat Gain Fenestration (0.35) and High Efficiency Water Heaters	10.6%	18.9%	69.1%	1.3%
Low Solar Heat Gain Fenestration (0.35) and High Efficiency Water Heaters and High Efficiency Air Conditioners	7.4%	15.3%	75.7%	1.5%

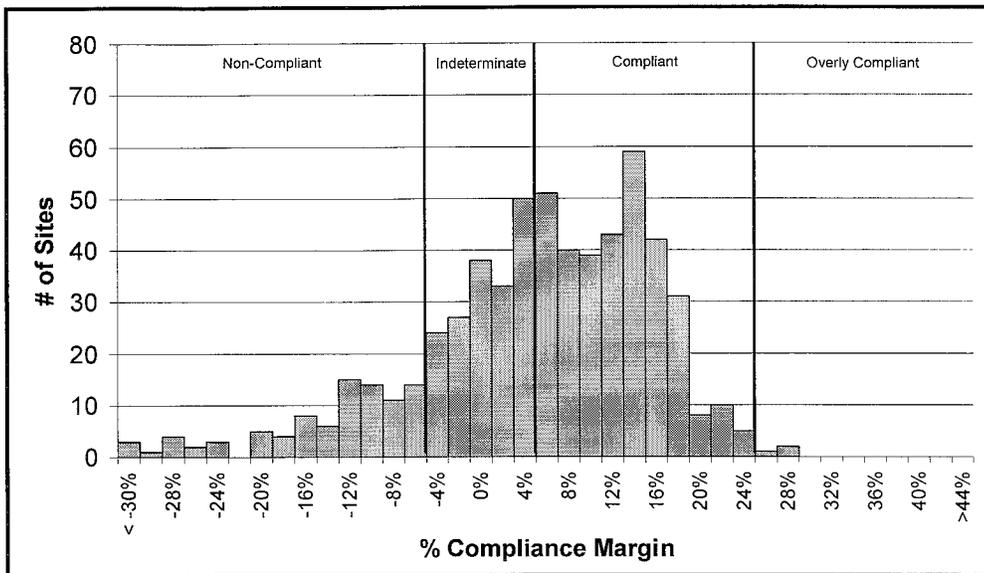


Figure 4: Compliance Results – AB 970 Standards – Low Solar Heat Gain Fenestration (0.40)

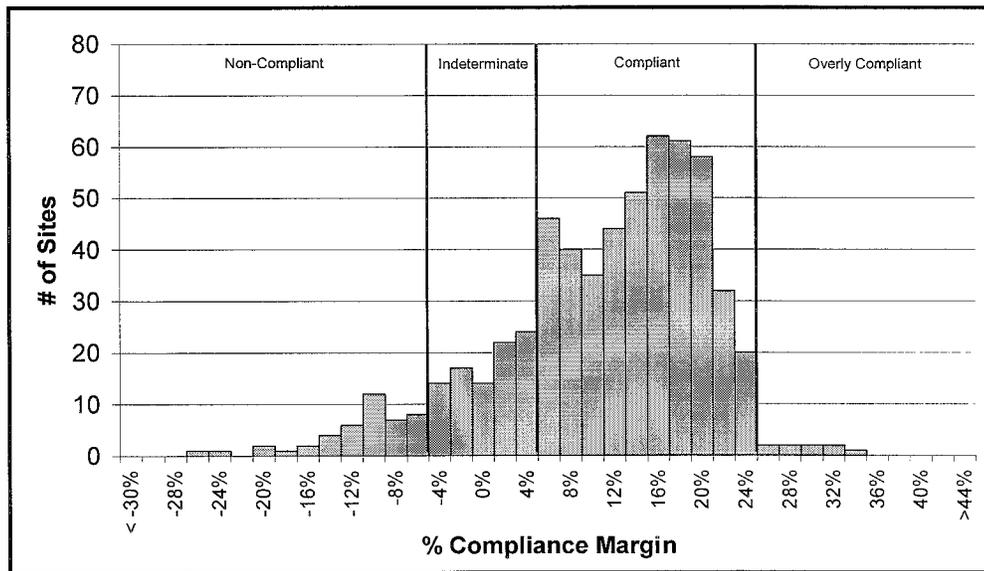


Figure 5: Compliance Results – AB 970 Standards – Low Solar Heat Gain Fenestration (0.35) and High Efficiency Air Conditioning and High Efficiency Water Heating

Compliance Results – AB 970 – Implementing HERS-certified Duct Sealing

As in low solar heat gain fenestration, duct sealing alone would make a home not meet the Standards. However, duct sealing along with other measures will make the home closer to reaching compliance. As mentioned above, Title 24 consultants believe builders will use high efficiency water heaters and air conditioners along with duct sealing. Many consultants added that if builders went through the “hassle” of having the duct sealing certified by a HERS rater, they would also install a TXV valve since this device is inexpensive. Table 8 presents a breakout of compliance results by measure combination. Figure 6 illustrates compliance results with all homes receiving HERS-certified duct sealing. Results suggest that many homes will not pass with duct sealing alone. As shown, approximately 73% of detached single family homes are either non-compliant or indeterminate and no homes are overly compliant. However, when TXVs and high efficiency air conditioning and water heating systems are added,

approximately 58% of homes comply and just under 13% of homes do not. Figure 7 shows the compliance distribution for homes with duct sealing, TXV, and high efficiency air conditioning and water heating systems artificially implemented.

Table 8: Compliance Results – Using Measures not Included by Prescriptive Package D with Duct Sealing and Thermostatic Expansion Valves

	Non-Compliant	Indeterminate	Compliant	Overly Compliant
Baseline	59.9%	22.9%	17.2%	0.0%
Duct Sealing	38.6%	34.1%	27.3%	0.0%
Thermostatic Expansion Valves (TXV)	53.0%	25.8%	21.2%	0.0%
Duct Sealing, TXV, and High Efficiency Water Heaters	19.7%	37.4%	42.7%	0.2%
Duct Sealing, TXV, and High Efficiency Water Heaters and High Efficiency Air Conditioners	12.5%	29.7%	57.3%	0.5%

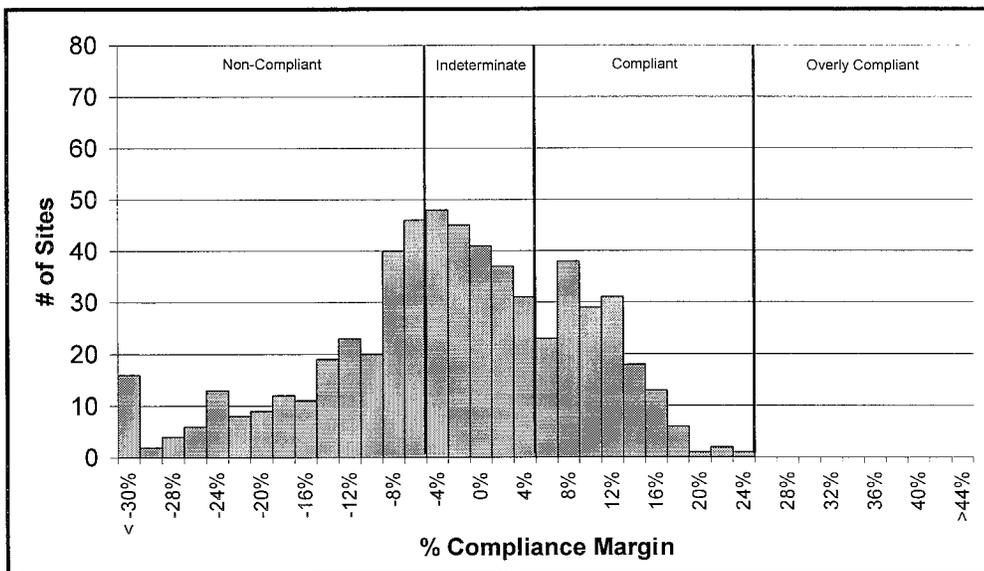


Figure 6: Compliance Results – AB 970 Standards – HERS-Certified Duct Sealing

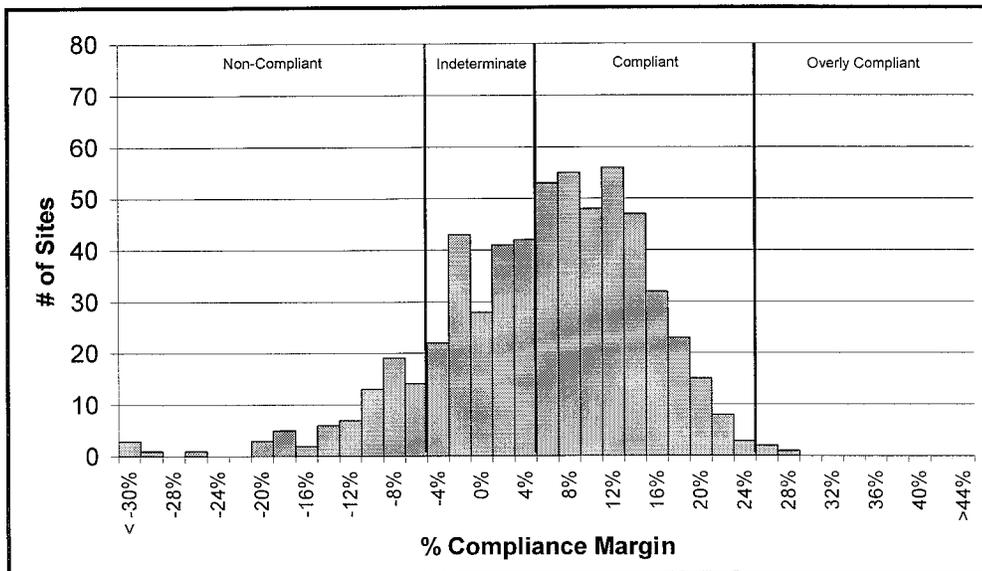


Figure 7: Compliance Results – AB 970 Standards – HERS-Certified Duct Sealing and TXV Valves and High Efficiency Air Conditioning and High Efficiency Water Heating

Summary of Compliance Analysis Findings

The compliance analysis results show that nearly 39% of homes will not comply if duct sealing is the only measure implemented. However, if builders also installed high efficiency air conditioners and water heaters, only 15.0 % would be non-compliant. Likewise, only implementing low solar heat gain fenestration would cause approximately 15% to be non-compliant. If builders also installed high efficiency air conditioners and water heaters, only 7.4% would be non-compliant. Also interesting is if builders were to implement all four measures required by Prescriptive Package D, as shown in Figure 3, most homes more than comply. In fact, 4.6% would fall in the overly compliant group.

Impacts on RNC Programs

The new Standards also affect existing RNC programs in the state. Elements now required under AB 970 were integral parts of existing programs. Therefore, RNC program planners are concerned about identifying ways to refocus their programs to account for the new requirements. The impact of the Title 24 Impact Study was expanded to collect suggestions from Title 24 consultants and builders on how the utilities could alter their RNC programs in light of AB 970.

Some issues and recommendations relating to RNC energy efficiency program design are discussed below. These issues and recommendations result from compliance analysis, builder and Title 24 consultant interviews, and discussions with industry experts.

- **Provide Training to Builders.** The Title 24 consultants interviewed believe the most effective way for utilities to assist builders in meeting AB 970 requirements is to offer more training and education. In fact, 31 consultants believe that offering more training is the only effective way for utilities to assist builders. In addition, the builders themselves perceive lack of information and training to be the largest barriers to meeting the new standards.
- **New Opportunities from AB 970 Environment.** AB 970 may encourage builders to participate in a program because, once the new standards are met, the additional measures needed to meet program requirements are relatively insignificant. Due to lack of knowledge about AB 970, most

Title 24 consultants and builders were uncomfortable answering questions relating to the impact of AB 970 on existing RNC programs, but of the responses received this was the most common.

Summary and Conclusions

The evaluation design and approach used in the existing Baseline and Title 24 Impact Studies was sufficiently flexible to accommodate a first-look analysis of the impacts of the changes to the residential low-rise building standards. In particular, the RNC Interface facilitated detailed impact analyses of the installation of measures covered by the revised standards. The in-depth interview guides and telephone surveys were revised to include questions relevant to the impact of AB 970.

Results from the analysis indicate that as predicted, implementing either low solar heat gain fenestration or duct sealing alone will not be enough for many homes to comply with the new Standards. However, implementing one of these measures along with other high efficiency measures causes nearly all detached single family homes to comply. Other key findings are summarized below:

- **Of the measures required by Prescriptive Package D, builders are most likely use low solar heat gain fenestration.** Title 24 consultants felt that builders are most likely to install low solar heat gain fenestration. On a scale of 1 to 5, with 5 meaning Very Likely, the average ranking for low solar heat gain fenestration was 3.9, compared to 3.2 and less for the other three measures.
- **Of the other high efficiency measures, builders are most likely to install high efficiency water heaters and air conditioners.** The average ranking of these two measures was higher than that for increased insulation levels and high efficiency furnaces.
- **Installing low solar heat gain fenestration brings homes closer to complying with AB 970 than using duct sealing.** When globally implementing low solar heat gain fenestration, nearly 56% of homes were compliant and only 15% were non-compliant. However, nearly 39% were non-compliant when duct sealing was globally implemented and only 27% were compliant.
- **If builders were to implement all four measures required by AB 970 Prescriptive Package D, at least 92.3% of detached single family homes would comply.** Furthermore, only 1.2% of the homes would be in the non-compliant group.
- **Utilities should provide more training to builders.** Over half the Title 24 consultants believe more builder training is the only way for utilities to assist builders. Also, builders themselves perceive lack of information and training as the largest barriers to meeting the new standards.

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