Phase II Report: Baseline Characterization
Market Effects Study of Investor-Owned Utility Multifamily Residential New Construction Programs in California

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Abstract

This document presents the Phase II findings of a prospective market effects and market characterization study focused on the California investor-owned utilities' (IOUs) new construction programs that target the multifamily market. The key objectives of Phase II are to establish the following:[1]

- Baseline measurements of 2010-2012 multifamily new construction (MFNC) building practices
- Baseline measurement of indicators of expected program outcomes and market effects

The evaluation team used a multi-pronged approach to conduct the second phase of this research effort: 51 interviews with various market actors involved with the construction and design of 15 case study sites, a survey of 33 developers, and on-site visits and accompanying energy simulation models for 28 MFNC projects.[2]

In this study we have focused on nonparticipant MFNC projects[3] in order to better understand the effects of the IOUs' program on the MFNC market outside of the program. By focusing on nonparticipant multifamily projects we are better able to understand the ways in which the IOU program has effects that spill over onto the rest of the market. [4]

It is important to note that the samples are over-represented by low-income projects, projects located in jurisdictions with mandatory above-code energy-efficiency requirements, and projects that participated in voluntary, non-IOU green programs, such as GreenPoint Rated. As a result, the findings are not fully representative of the market-rate MFNC market and are more applicable to the low-income market. With this caveat in mind, note that many of the energy experts interviewed for this project – about three-quarters[5] - worked in both low-income and market-rate sectors, allowing them to provide feedback about multiple segments of the multifamily new construction market. Further, over half of the developer survey respondents were active in market-rate sector (see Appendix E.2).

From our sample of 24 low-rise and four high-rise MFNC projects, we found that all of the sampled MFNC projects exceeded the applicable Title 24 energy code requirements, with the low-rise site averaging 23% more efficient than code and high-rise sites averaging 24% more efficient than code. In general, gas savings were substantially higher than electricity savings, and domestic hot

[1] The key objectives of Phase I of the evaluation, which preceded Phase II, included (1) developing a preliminary program and market and (2) conducting a market characterization and analysis of California MFNC market segments during the 2010 to 2012.

[2] The team attempted to exclude all IOU MFNC program participants from the case study and on-sites in an effort to reach the non-participating portion of the market (though one MFNC participant was included in the final on-site and case study sample).

[3] Nonparticipant MFNC projects are defined as MFNC projects that did not participate in the IOUs' MFNC programs

[4] Fourteen of fifteen case study sites and 27 of 28 the on-sites were nonparticipant MFNC projects. In the developer surveys, 30 of 33 developers were asked detailed questions about their experiences with nonparticipant projects.

[5] Of the 51 case study respondents, 76% had experience in both sectors, including the four code officials. Excluding the four code officials, 74% of respondents had this mixed sector experience.

water measures accounted for the bulk of the savings. It is important to note that 82% of the on-site projects (23 of 28) had either high-efficiency requirements or strong incentives to be highly efficient, including all of the high-rise sites, because they either received California Tax Credit Allocation Committee (CTCAC) awards or were built in reach code jurisdictions.

There is evidence suggesting that the IOU MFNC program has affected the practices and efficiency levels of non-participating MFNC projects. However, other market interventions (in particular CTCAC funding), other green building programs such as LEED and GPR, and other policies (such as reach codes) are having more substantial impacts on the efficiency levels of non-participating MFNC projects and are the primary drivers of market changes.

In addition, the case studies confirmed and emphasized the importance of a finding from the Phase I research regarding the role of local officials in encouraging developers to build to above-code standards. Respondents described the importance of “soft money” partners, including local agencies (such as the now-dissolved Redevelopment Agencies), municipalities, housing authorities, and other public officials that assist with the development of an MFNC project (such as providing financial support, zoning variances, marketing assistance, etc.) in exchange for the developer tailoring the project to meet those backers’ goals. In other words, the IOU programs are operating in a market that includes a particularly complex array of public programs and policies influencing the energy efficiency of the MFNC market, even after the dissolution of the Redevelopment Agencies. Further, it appears that the market-rate and low-income MFNC markets are relatively distinct, though interwoven, markets.

Despite the fact that other market factors, such as CTCAC, are driving market changes, the Phase II findings suggest that the program has affected the market through trainings, design assistance, and plan reviews, thus affecting the knowledge and practices of developers and their design teams (i.e., indications of potential market effects). In addition, the requirement to use Certified Energy Plans Examiners (CEPEs) to prepare Title 24 documentation and HERS Rater inspections creates further impacts by providing a level of quality control for energy efficiency measures, designs, and practices. CEPEs are commonly used outside the program because official Title 24 documentation encourages their use. While we did not find evidence that the programs led to increased marketing or consumer demand for efficiency, developers indicated that efficiency and green labels are important marketing tools, particularly for high-income buyers in the market rate sector, suggesting program elements that the programs could revisit.

Finally, the Phase II research confirms several Phase I findings, including that the developer is the key decision maker of a project’s energy efficiency level, financial considerations dominate developers’ energy-related decisions, and developer perspectives on the value of energy efficiency vary greatly; while some developers view efficiency as a hassle, others view it as a marketable feature or a core part of their mission.

Executive Summary

This document presents the Phase II findings of a prospective market effects and market characterization study focused on the California investor-owned utilities' (IOUs) new construction programs[6] that target the multifamily market (referred to jointly as "the program" throughout this report).

The key objectives of Phase II are to establish the following:[7]

- **Baseline measurements of 2010-2012 multifamily new construction (MFNC) building practices**
- **Baseline measurement of indicators of expected program outcomes and market effects**

The IOUs' new construction program seeks to transform California's residential and nonresidential new construction markets. The program aims to ensure that 1) home builders in California will be encouraged to construct homes that exceed California's Title 24 energy-efficiency standards and 2) residential new construction will move toward the CPUC's goal of achieving "zero net energy" (ZNE) performance for all single- and multifamily homes by 2020.[8]

The evaluation team used a multi-pronged approach to conduct the second phase of this research effort: 51 interviews with various market actors involved with the construction and design of 15 case study sites, a survey of 33 developers, and on-site visits and accompanying energy simulation models for 28 MFNC projects.

In this study we have focused on nonparticipant MFNC projects[9] in order to better understand the effects of the IOUs' program on the MFNC market outside of the program. By focusing on

[6] The California Advanced Homes Program (CAHP) is the core IOU new construction program addressing the MFNC market. Each California IOU implements CAHP in its own service territory; PG&E uses a third-party firm to implement the program under the California Multifamily New Homes Program (CMFNH) name (referred to jointly with CAHP as "the program"). In addition, the Savings By Design (SBD) program, designed for commercial construction, sometimes includes residential high-rise buildings and mixed-use buildings that are mostly commercial.

[7] The key objectives of Phase I of the evaluation, which preceded Phase II, included (1) developing a preliminary program and market model in order to identify the key market actors, market segments, and factors affecting energy efficiency in California's multifamily new construction (MFNC) market and (2) conducting a market characterization and analysis of California MFNC market segments during 2010 to 2012.

[8] Southern California Gas Program, Program Implementation Plans, 1) 2010-2012 Energy Efficiency Programs New Construction PIP.
http://eestats.cpuc.ca.gov/EEGA2010Files/SCG/PIP/Wave1/SCG%20SW%20New%20Construction%20PIP%20-%20Final.doc, p. 2.
2) Statewide Programs, Appendix B.2, Section A, April 23, 2013,
https://www.socalgas.com/regulatory/documents/A-12-07-003/Appendix%20B.2-_Section_A_Statewide_Programs_(Clean).pdf, accessed February 12, 2014, p. 209. Market transformation discussion for RNC program starts on page 202.

[9] Nonparticipant MFNC projects are defined as MFNC projects that did not participate in the IOUs' MFNC programs

nonparticipant multifamily projects we are better able to understand the ways in which the IOU program has effects that spill over onto the rest of the market.[10]

Baseline Measurement of 2010-2012 MFNC Building Practices

From our sample of 24 low-rise and four high-rise MFNC projects, **we found that all of the sampled MFNC projects exceeded the applicable Title 24 energy code requirements, ranging from slightly more efficient than code (1% annual energy savings compared to code) to much more efficient than code (66% annual energy savings)**. On average, we found low-rise sites to be 23% more efficient than code, while high-rise sites were 24% more efficient than code. In general, gas savings were substantially higher than electricity savings (Table ES-1).[11]

It is important to note that **82% of the on-site projects (23 of 28), including all of the high-rise sites, had either high-efficiency requirements or strong incentives to be highly efficient** because they either received California Tax Credit Allocation Committee (CTCAC) awards[12] or were built in reach code jurisdictions.[13] However, it also important to note that projects not subject to any above-code efficiency requirements were, on average, over 20% more efficient than code requirements.

Table ES-1: All On-Sites: Estimated Energy Savings Relative to Applicable Title 24 Codes by Efficiency Requirements

Type of MFNC Projects	# of Sites	Avg. # of Stories	Avg. # of Units	Avg. Annual kWH Savings	Avg. Annual Therm Savings	Avg. Annual Combined Energy Savings (kBTU)
Low-rise, Standard Title 24 (T24) Requirements	7	2.8	58.6	4.7%	24.2%	21.2%
Low-rise, Energy Efficiency (EE) Favored / Encouraged*	4	2.7	83.6	4.9%	28.3%	22.1%
Low-rise, Required EE	8	2.3	35.0	19.3%	29.1%	25.8%
All Low-rise	**24**	**2.6**	**58.8**	**11.5%**	**27.1%**	**23.3%**
All High-rise**	**4**	**7.3**	**106.5**	**4.5%**	**39.1%**	**24.1%**
Total	**28**	**3.3**	**65.6**	**10.5%**	**28.8%**	**23.4%**

[10] Fourteen of fifteen case study sites and 27 of 28 the on-sites were nonparticipant MFNC projects. In the developer surveys, 30 of 33 developers were asked detailed questions about their experiences with nonparticipant projects.
[11] Twenty-seven of the 28 on-site projects were nonparticipant projects.
[12] As discussed in more detail in the body of the report, prior to 2011, CTCAC awarded competitive points for building to above-code standards, but did not mandate above-code practices in all projects. While not required, the competitive points were critical to securing CTCAC awards. Interviewees viewed meeting those higher efficiency criteria as de facto requirements that greatly increased their competitiveness for the CTCAC award money.
[13] In comparison, 59% of the population of nonparticipating MFNC projects located within IOU territories were required or encouraged to be high efficiency (see Appendix A for more details).

*Prior to 2011, CTCAC did not require developers to build more efficiently than code, but did award competitive points for doing so.
** All high-rise sites had high-efficiency requirements or strong incentives to be high efficiency because they either received California Tax Credit Allocation Committee (CTCAC) awards or were built in reach code jurisdictions.

Table ES-2 reports the average energy savings for each measure type with projects grouped by their efficiency requirements and rise. The percentages indicate the effect of the specific measure on the annual energy savings of the entire project. **On average, the total savings appears to be heavily driven by DHW systems,** which, on average, result in MFNC projects that consume 19% less energy than required by Title 24 energy code; even low-rise projects subject to no above-code efficiency requirements or pressures have DHW systems that are 17% more efficient, on average.

Table ES-2: Low-Rise On-Sites: Estimated Energy Savings Relative to Applicable Title 24 Codes for Individual Measure Types, by Revised Strata

Efficiency Requirements	# of Sites	Avg. # of Units	Avg. Annual Energy Savings (kBTU)						
			Glazing / Fenestrat.	Envelope Insulat.	Cool Roof	HVAC	DHW	Other/ Interactive	Total
Standard T24 Requirements	7	80.8	-2.9%	5.6%	0.0%	1.0%	17.3%	0.2%	21.2%
Favored / Encouraged	4	39.0	2.4%	1.7%	0.0%	0.6%	17.7%	-0.3%	22.1%
Required EE	8	69.3	-1.7%	2.3%	0.0%	2.1%	20.9%	2.2%	25.8%
All Low-rise	**24**	**58.8**	**-0.2%**	**2.7%**	**0.0%**	**1.3%**	**18.8%**	**0.7%**	**23.3%**
All High-rise	**4**	**106.5**	**NA***	**0.4%**	**0.6%**	**0.4%**	**20.3%**	**2.4%**	**24.1%**
Total	**28**	**65.6**	**-0.2%***	**2.4%**	**0.1%**	**1.1%**	**19.0%**	**1.0%**	**23.4%**

* For high-rise sites, fenestration/glazing is included with the envelope insulation measure.

Baseline Measurement of Market Effects Indicators and Expected Outcomes

A key objective of this study is to collect baseline measurements of indicators of the market effects of the IOU MFNC program. While we do not yet expect to find clear or extensive evidence of market effects, we use the potential indicators of market effects to organize our findings and report on the current state of the market, as well as provide a theoretical framework for future monitoring of potential market effects due to program activity.

The CPUC Energy Efficiency Evaluation Protocol[14] follows the definition of market effects offered by Eto, Prahl, and Schlegel: "A change in the structure of a market or the behavior of

[14] California Public Utilities Commission. 2006. *California Energy Efficiency Evaluation Protocols: Technical, Methodological, and Reporting Requirements for Evaluation Professionals.* San Francisco: California Public Utilites Commission.

participants in a market that is reflective of an increase in the adoption of energy-efficient products, services, or practices and is causally related to market intervention(s)."[15] Further, the CPUC Evaluation Protocols specify that market effects encompass non-participant spillover, which are savings from those who are not directly participating in a utility program but who reduce their energy use after being influenced by a utility program.

The baseline measurements address market characteristics and market changes, such as changes in practices by market actors, including developers (i.e., supply-side changes) or changes in consumer preferences and demand (i.e., demand-side changes). We focus on baseline measurements of several key indicators (see Table ES-3) and found some suggestive evidence that the IOU MFNC programs have contributed to market changes and impacts outside of the program. However, other market interventions, such as CTCAC requirements, other voluntary programs such as LEED, and policies such as reach codes appear to be more significant drivers of market changes.[16] Examples of these indicators of broader impacts on the market by the IOU program include market actors implementing above-code practices even when not participating in the program, or lenders and investors making energy efficiency a construction requirement for developers seeking funding.

The key data sources for market effects indicators in this research effort include case study interviews, the survey of MFNC developers, and the on-site visits and energy modeling. It is important to note that the samples are over-represented by low-income projects, projects located in jurisdictions with mandatory above-code energy-efficiency requirements, and projects that participated in voluntary, non-IOU green programs, such as GreenPoint Rated; the sample is not, however, over-represented by LEED projects.

For example, all of the case study sites and 23 of 28 on-sites were either required to be high efficiency due to reach code or CTCAC requirements or were encouraged to be high efficiency to win competitive CTCAC awards. Further, nearly all of the case study sites (13 of 15) and on-site projects (24 of 28) were low-income sites, which commonly are either required or encouraged to be built to above-code energy efficiency standards in order to win CTCAC awards (note that not all low-income projects received CTCAC awards).[17] The developer survey sample is also overrepresented by low-income projects and projects with high-efficiency requirements, but not as much as the case study sample. As a result, the findings are not fully representative of the market-rate MFNC market and are more applicable to the low-income market. With this caveat in

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[15] Eto, J., Ralph Prahl, and Jeff Schlegel. 1996. A Scoping Study on Energy Efficiency Market Transformation by California Utility DSM Programs. Berkeley: Lawrence Berkeley National Laboratory.

[16] LEED, GPR and CTCAC represent substantial portions of the market. with LEED-registered products representing 27% of all MFNC projects and GreenPoint Rated representing 16% of projects started from 2010 through 2012. CTCAC, which accepts LEED and GreenPoint Rated certifications to satisfy its sustainability criteria, represent 45% of all MFNC starts. In addition, 26% of MFNC projects that were started from 2010 through 2012 took place in a city or county where advanced energy standards were approved.

[17] As discussed in more detail in the body of the report, prior to 2011, CTCAC awarded competitive points for building to above-code standards, but did not mandate above-code practices in all projects. While not required, the competitive points were critical to securing CTCAC awards.

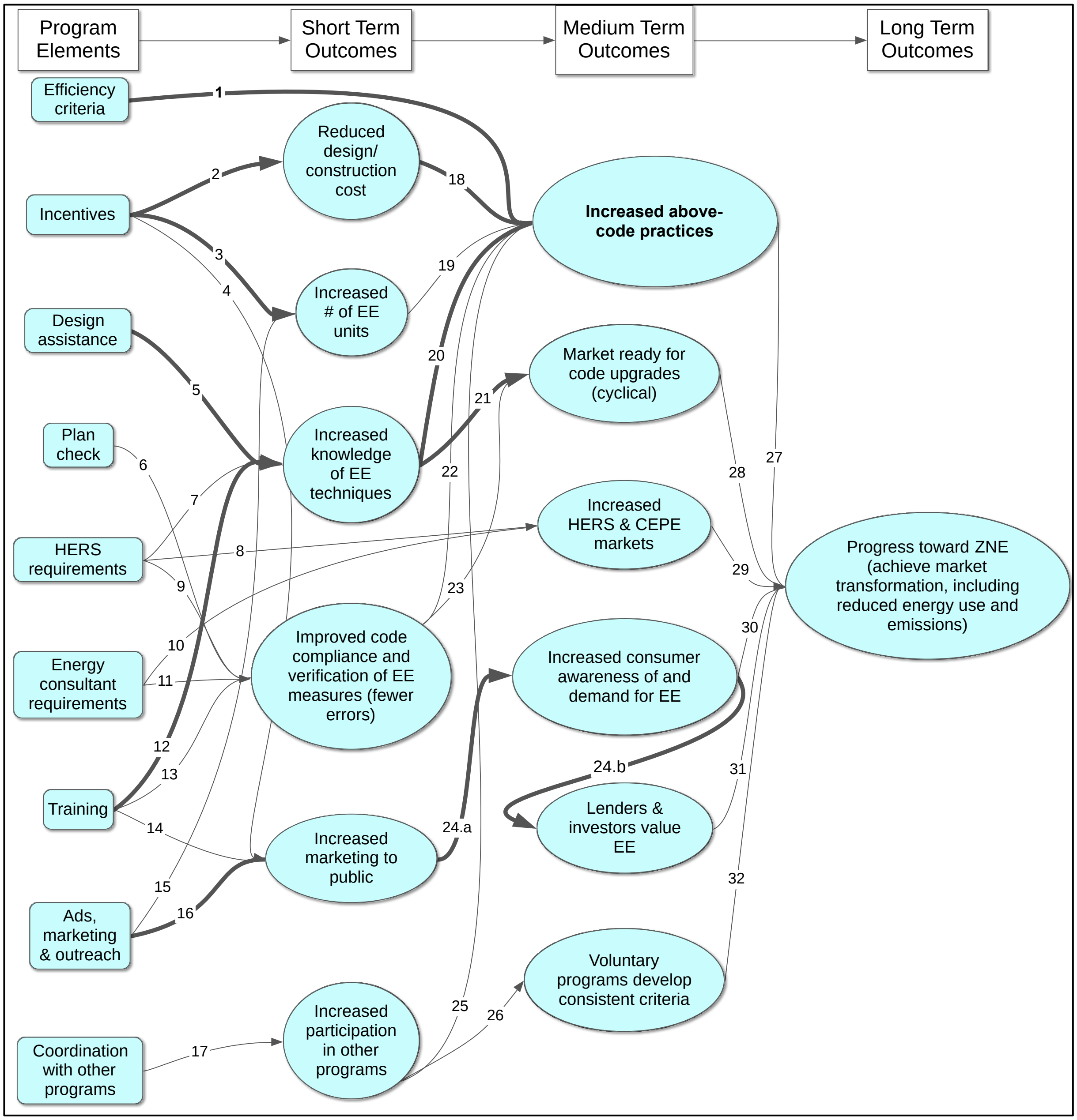
mind, it is important to note that the interviews and surveys asked respondents to assess market forces that impact the efficiency of both their case-study project and their non-case study projects and that many of the energy experts interviewed for this project worked in both low-income and market-rate sectors, allowing them to provide feedback about multiple segments of the multifamily new construction market. Of the 51 respondents interviewed for the case study research, 76% had experience in the low-income and market-rate sectors, allowing the team to create a picture of the behaviors in both market segments, even though the case study projects themselves were overrepresented by low-income projects.[18] Further, over half of the developer survey respondents were active in market-rate sector (see Appendix E.2).

Figure ES-1 depicts the IOUs' MFNC program logic model presented in the Phase I report. On the left side of the program portion of the model are the IOU program's key elements. Branching out to the right are the expected short-, medium-, and long-term outcomes of these program elements, along with the connections between intermediary steps toward the long-term outcomes.[19] The bold lines in the program model indicate the key links from program elements to outcomes indicating market effects.

[18] Of the 51 case study respondents, 76% had experience in both sectors, including the four code officials. Excluding the four code officials, 74% of respondents had this mixed sector experience.

[19] From left to right, the model moves from the specific program components to the broader, long-term effects on the market that the program is intended to achieve (i.e., market effects). A critical medium-term outcome in the model (indicated by its relatively large size) is the increase in above-code practices in the MFNC market; program elements consistently point toward this outcome. The sole long-term outcome of the program efforts would ultimately be progress toward California's goal of ZNE, which would indicate a market transformation and, of course, be accompanied by reduced energy use and greenhouse gas emissions.

Figure ES-1: IOU MFNC Program Model



*Key links from program elements to outcomes are shown in bold.

Our summary of findings focuses on eight key market outcomes that could potentially result from various IOU program activities (bold font in Table ES-3) as well as three additional outcomes.[20] The table below also summarizes whether or not the team found evidence of the theorized outcome being linked to an IOU program activity. Insufficient evidence does not necessarily mean that there is no link, but that this research project did not find evidence of such a link.

Table ES-3: Key Market Effects Outcomes Assessed by Research Team

Potential Market Effects Outcome	Evidence Supporting Outcome	Evidence of Outcome Linked to IOU Programs
Increased above-code practices in non-program MFNC projects	✓ / ✗	Evidence of above-code practices, but more evidence of effects attributable to other green (i.e., LEED) and affordable housing programs and policies (CTCAC).
Reduced design and construction costs	✗	Insufficient evidence.
Increased numbers of above-code units being constructed	✓ / ✗	Insufficient evidence from interviewees and survey respondents, but site visits provide evidence of above-code construction outside of the program.
Increased knowledge of efficient building practices	✓ / ✗	Evidence of increased knowledge from IOU MFNC program training and design assistance. Low levels of program awareness among developers and low training participation rates hinder the program's ability to affect the market.
Increased marketing of efficiency to the public	✓ / ✗	No evidence of increased marketing. However, evidence that at least some developers view efficiency and green labels as important marketing tools. Other programs, such as LEED, have much more market value, than the IOUs programs.
Enhanced readiness for code upgrades	✓ / ✗	Limited evidence that the program improved preparedness for future code cycles for a small number of developers.* Evidence from site visits of MFNC projects that are more efficient than code, suggesting at least some developers were ready for a more stringent code.
Increased consumer demand for efficient construction	✓ / ✗	Some evidence of consumer demand from the market-rate sector, particularly high-income buyers, but no evidence of increased demand.
Increased lender and investor demand for efficient construction	✗	No evidence of increased demand. Lenders and investors factor expected utility costs into their financial calculations, but do not require EE.
Improved compliance with code/above-code programs	✓	Some evidence that program elements helped improve compliance with program and code requirements.*
Expanded Certified Energy Plans Examiner (CEPE) market	✓	Limited evidence that IOU MFNC program and other programs have increased demand for CEPEs and Certified Energy Analysts (CEAs) and that CEPEs and CEAs offer helpful guidance.*
Voluntary "green" programs develop standards consistent with the IOU program standards	✓	Evidence of IOU planning efforts contributing to somewhat consistent standards, particularly reach code and CTCAC standards.

* Indicates evidence from the case studies but not the developer survey, suggesting limited evidence of this indicator in the market-rate MFNC sector (due to the sample disposition of the case studies).
✓ indicates evidence supporting the outcome; ✗ indicates lack of evidence; ✓ and ✗ indicates mixed evidence.

Expected Outcome: Increased above-code practices in non-program homes

Several program elements could contribute to increased above-code practices in non-program homes, including the two following measurable indicators linking IOU program elements and above-code practices:

- On-site inspections and energy modeling
- Increased stock and availability of high-efficiency equipment

Indicator of above-code practices:

- ***On-site inspections and energy modeling***

There is clear evidence that projects are being built outside of the IOU MFNC program to above-code standards, largely due to market forces and market interventions including reach code,[21] CTCAC requirements for low-income housing, other green programs such as LEED and GreenPoint Rated, and "soft money" sources.

- All 28 projects with on-site visits were at or above code (23.4% better than standard [BTS],[22] on average), though 82% of these sites were subject to pressure or requirements to build more efficiently than code due to CTCAC or reach code.

There is some evidence suggesting that IOU MFNC program practices were adopted into non-participating projects, thus signifying the potential presence of market effects. However, the IOU program appears to be secondary to other such market interventions driving this outcome.

- More than one-fifth of case study interviewees (22%) said that market effects were at least partly attributable to the IOU MFNC program, whereas about one-half (49%) attributed adoption of above-code practices to non-IOU programs. Interviewees and survey respondents emphasized that reach codes, California Tax Credit Allocation Committee (CTCAC) requirements, and LEED requirements had the greatest influence on developers, whether or not the developer was subject to those programs' criteria.
- CTCAC's sustainability criteria were identified as a key driver of efficiency for 12 of the 13 low-income case study projects.

[20] All of the expected outcomes were drawn from the Phase I report. For more details, see: NMR. 2014. *Final Phase I Report: Baseline Characterization Market Effects Study of Investor-Owned Utility Multifamily Residential New Construction Programs in California.* http://www.calmac.org/publications/WO54_MFNC_-_Phase_1_Report_Final_070814_.pdf

[21] It should be noted that whereas 46 localities, including five counties, adopted reach code requirements under the 2008 Title 24 standards, since the 2013 Title 24 energy code went into effect in July of 2014, only six municipalities (including one county) have adopted reach code requirements based on that most recent code version (as of June 18, 2015). http://www.energy.ca.gov/title24/2013standards/ordinances/

[22] Better than standard (BTS) is a common term used in discussing energy compliance margins relative to a baseline home built according to Title 24 energy code standards.

Indicator of above-code practices:

- ***Increased stock and availability of high-efficiency equipment***

Case study respondents did not indicate having any concerns about the availability of high-efficiency equipment, but concerns about the reliability and maintenance costs of the equipment were common.

Future research is needed to fully assess the effects of the IOU programs on the stock and availability of high-efficiency equipment, such as through analysis of supplier inventories.

Expected Outcome: Increased knowledge (from IOU design assistance and training)

The IOUs provide design assistance and training to market actors under the assumption that knowledgeable market actors are better able to comply with code, meet voluntary criteria, and incorporate efficiency into their standard practices.

Indicators of increased knowledge:

- ***Market actors learn from the IOUs' design assistance***
- ***Market actors report that they participated in and learned from trainings***

Phase II research showed that the IOU MFNC program training and design assistance influenced those who participated, but design team members also learn from other above-code programs and trainings. Low levels of program awareness among developers and lower rates of participation in training hinder the program's ability to influence the market.

- Nearly two-fifths (37%) of the 51 case study interviewees indicated that IOU MFNC program training and/or design assistance increased their knowledge about energy efficiency.
- Seventeen of 21 case study interviewees who received training (81%) said that it influenced the efficiency level of their non-program project practices; only five of the 14 interviewees who received the IOUs' design assistance on other, participating, projects (36%) reported finding it valuable.
- However, some case study interviewees did not view the training and design assistance as particularly influential, suggesting, among other things, that the IOUs should provide guidance on more advanced technologies and building techniques for more experienced developers and design teams.[23]
- Twenty-seven percent of the surveyed developers received IOU training. Overall, 15% of them, representing 19% of all units started, said that the training was somewhat or very

[23] Four of the 21 interviewees who attended trainings did not report finding them useful, while nine of the 14 interviewees who received design assistance did not report finding it useful.

influential on their design practices, while 9% rated the training as very influential on their construction practices.

Expected Outcome: Reduced design and construction costs

Financial incentives are a key IOU program mechanism designed to overcome barriers related to the cost and hassle of building to above-code standards.[24]

Indicator of reduced costs:

- ***Reduced incremental cost of energy-efficient design and construction***

Case study interviewees provided insufficient evidence to suggest that there were changes in the incremental costs of energy-efficient practices or technologies outside of the IOU MFNC program.[25]

Expected Outcome: Increased numbers of above-code, efficient units being constructed

The IOUs' incentives and program outreach to developers are designed to encourage participation in the IOU new construction programs, resulting in developers building more above-code units than they would have without that support.

Indicator of more energy-efficient units built:

- ***Developers attribute building above-code projects to the IOU program funding***

High levels of IOU MFNC program participation (38% of California units started from 2010 through 2012) suggest that the program could be positively impacting the number of units built, but Phase II interviews and surveys did not provide further evidence that the program was doing so.

Expected Outcome: Expanded market of licensed CEPEs

The IOU program requires Title 24 energy compliance documentation be completed by Certified Energy Plans Examiners[26] (CEPEs) in order to increase the quality of submissions to the program. The program theory posits that this program requirement could drive demand for CEPEs in the marketplace.

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[24] Incentives are also designed to help address the split-incentive barrier, whereby the project owners/developers have less incentive to build efficiently because they do not pay the residents' utility bills.

[25] Only two respondents, a market-rate developer and a HERS Rater, specifically mentioned the price of newer technologies decreasing in recent years, and they both attributed this to demand triggered by efficiency programs, but not the IOU program; the developer saw it driven by LEED, and the rater by CTCAC.

[26] Information on the CEPE certification is available at http://www.cabec.org/cepeinformation.php.

Indicator of expanded CEPE market:

- ***Market actors report an increase in demand for licensed energy consultants***

Case study findings suggest that the IOU MFNC program, along with other programs and requirements, have increased demand for CEPEs and Certified Energy Analysts (CEAs) to some extent. Market actors perceive that CEPEs and CEAs offer helpful guidance.

Our review of California Association of Building Energy Consultants (CABEC) certification lists found that CABEC discontinued the CEPE certification and changed the CEA certification for the 2013 Title 24 standards, leaving only a small pool of individuals certified under the most recent standards. This required programs to temporarily rely on the larger pool of CEPEs certified under previous Title 24 standards.

Expected Outcome: Improved compliance with base code and above-code programs

The IOU programs include program elements related to quality control, training, and measure verification that are intended to ensure compliance with program requirements, providing a level of quality control for energy efficiency measures beyond that provided for projects only subject to base code requirements. The program logic model theorizes that IOU program plan check, HERS inspections, usage of CEPEs, and training offerings lead to improved compliance metrics, fostering a market of developers and consultants better able to correctly implement above-code practices across their portfolios.

Indicators of code/above-code compliance:

- ***Market actors report that plan check catches modeling errors***
- ***T24 consultants report learning from the program's plan reviews***
- ***Building inspectors report that consultants who work with the program submit T24 compliance documents with fewer errors***

Case study interviewees provided feedback that was consistent with the theorized links between program elements and enhanced compliance code or other above-code programs, with some caveats.

- Case study interviewees found that the IOU program plan check helped identify problems with code compliance.
- Case study interviewees reported that HERS Raters (which are required by the program) were valuable in helping them navigate requirements of above-code programs.
    - Many interviewees thought that CEPE professionals (supported by the IOU program) did high quality work.

- The study also found evidence of barriers to adopting these positive influences, such as code officials paying less attention to energy efficiency than do IOU program plan checkers, and some developers preferring not to use HERS Raters due to associated costs and hassles.

Expected Outcome: Enhanced readiness for code upgrades

Due to program activities that result in increased knowledge of energy efficiency techniques (e.g., design assistance, HERS verifications, and training), the IOU program is designed to help market actors meet the requirements of future code cycles.

Indicator of readiness for code upgrades:

- ***Market actors are aware of and ready for upcoming code changes***

There is strong evidence that large numbers of non-program multifamily buildings were built during the period from 2010 to 2012 using above-code practices as a means of complying with the requirements or expectations of various energy efficiency programs, commonly including CTCAC and reach code. This suggests that at least some market actors were able to prepare prospectively for an upcoming code cycle. A small number of interviewees credited the IOU program with improving their preparedness for future code cycles.

Expected Outcome: Increased marketing of efficiency to the public

Through its own marketing and outreach efforts, the IOU MFNC program seeks to increase the amount of marketing that MFNC market actors conduct, with the expectation that it will stimulate consumer awareness and demand for energy efficiency.

Indicator of public marketing:

- ***Developers report increasing their marketing of energy efficiency***

While we did not find evidence that the IOU programs increased developers' marketing efforts, we did find that developers saw energy efficiency as an important component of their promotional efforts, particularly as a way to differentiate their development firms and projects, making their projects more attractive to investors, funders, municipalities, customers, and the general public. However, other programs, such as LEED, have much more marketable value than the IOUs' programs.

Nearly half (48%) of the developer survey respondents noted the cachet of green labeling programs for either renters or buyers. Respondents most often perceived that the LEED brand carried the most prestige among consumers and other stakeholders.[27] While the IOU program seeks to

[27] The marketing benefit and cachet of energy efficiency and programs such as LEED apply to the low-income market outside of consumer demand; developers of green affordable housing can build their prestige, donations, or future business based on successful marketing of green features.

leverage the ENERGY STAR Homes program, market actors did not point to ENERGY STAR Homes as carrying great weight for their target markets.

Expected Outcome: Increased consumer demand for efficient construction

The IOUs' marketing, outreach, and training are intended to lead to increased consumer demand for more above-code construction.

Indicator of consumer demand:

- ***Market actors report increasing consumer demand for energy efficiency, driving them to increase their adoption of above-code practices***

Our research did not find evidence of increased consumer demand, but suggests that there is consumer demand for energy efficiency, particularly among high-income buyers.

- Fifteen of twenty-five case study interviewees who discussed consumer demand indicated there was consumer demand in the market-rate segment, often identifying urban consumers (7 of 15) and high-income earners (3 of 15) as the demographic with the greatest interest in energy efficiency.
- Survey respondents reported higher levels of demand for energy efficiency in the market-rate sector (87% indicated moderate or high demand), particularly high-income buyers, but also indicated moderate levels of demand from the low-income market (55% indicated moderate or high demand).

Expected Outcome: Increased lender and investor demand for efficient construction

If lenders and investors perceive increased consumer demand for energy efficiency, they could respond by requiring developers to meet energy efficiency criteria as a condition of funding.

Indicator of demand from financiers:

- ***Lenders and investors require higher levels of energy efficiency in the projects in which they invest***

Case study respondents reported that private investors and lenders do not require above-code efficiency practices in multifamily projects other than ensuring that the developers adhere to any commitments that they made to their partners, such as obtaining CTCAC tax credits. Lenders and investors reported that they factor the developer's expected utility costs into their financial calculations, but that they do not demand above-code practices from their partners; they prioritize attracting clients over making specific demands of them. Further, one CTCAC investor described having to compete with other tax credit investors to get access to tax credit projects, giving them minimal leverage to request energy efficiency unless they have a strong relationship with the developer.

However, respondents reported that above-code efficiency requirements sometimes came from "soft money" partners such as local agencies (the now-dissolved Redevelopment Agencies, for example), municipalities, or other public officials that are willing to offer their assistance in helping with the development of a MFNC project. These "soft money" partners wield significant influence over projects, and can offer financial support, zoning variances, marketing assistance, and so forth in exchange for the developer meeting the goals of those backers, such as building to above-code standards or including affordable housing units.

Expected Outcome: Voluntary green programs develop consistent standards

The IOU programs include standards that are designed to complement other green programs, and other programs could mimic the IOU programs' standards. Green programs having complementary requirements would allow market actors to develop a consistent set of repeatable best practices.

Indicator of consistent standards:

- ***Market actors and staff from other programs report similar requirements across programs***

IOU planning efforts have contributed to the market effect of somewhat similar energy-efficiency requirements being implemented in multiple green construction programs. The IOUs played a key role in reach code adoption through their Codes and Standards Program,[28] and during the 2010 through 2012 IOU program cycle, CTCAC intentionally adopted efficiency standards that aligned with existing programs such as the IOU MFNC program. Case study respondents reported some overlap across various program standards and said that this should be resolved. However, differing program standards and verification requirements remained a challenge during the 2010 to 2012 IOU program cycle, and program standards appear to have become more fragmented since the rollout of the 2013 Title 24 energy code.

Drivers of and Barriers to Energy Efficiency in Multifamily New Construction

In the Phase II interviews and surveys, we attempted to verify and learn more about the drivers of and barriers to the implementation of energy-efficient building practices in the MFNC market, asking respondents to discuss their specific experiences on individual projects, as well as their experiences overall.

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[28] For more information on the IOUs' efforts to foster the adoption of reach code in California, see the Cadmus Group evaluation of the 2010-2012 Reach Code Subprogram within the Codes and Standards Program. The Cadmus Group, Inc., *Reach Code Subprogram 2010-2012 Process and Pilot Impact Evaluations*, prepared for the California Public Utilities Commission, October 2013. https://www.pge.com/regulation/EnergyEfficiency2015-BeyondRollingPortfolios/Other-Docs/ED/2014/EnergyEfficiency2015-BeyondRollingPortfolios_Other-Doc_ED_20140507_304180Atch01_304181.pdf

The research team asked case study respondents to describe drivers and barriers in the specific case study projects they worked on; the factors mentioned by the respondents are identified in Table ES-4.

Table ES-4: Case Study Interviewee Perceptions of Market Drivers and Barriers

Market Drivers and Barriers to Energy Efficiency		Number of Mentions	Percentage of Interviewees (n=50)*
Drivers	Favored by CTCAC	35	70%
	Return on investment	32	64%
	Reach code requirements	26	52%
	Developer mission/approach/type	24	48%
	Marketing tactic	20	40%
	Adequate market actor knowledge	18	36%
	Base code requirements	18	36%
	Consumer demand	15	30%
	Public officials/soft money expectations[29]	13	26%
	Attract lenders/investors/funders	13	26%
	Receive incentives	8	16%
	Improve non-energy benefits	7	14%
	Sufficient availability of equipment	6	12%
	Development process rapidity	6	12%
	Other drivers	3	6%
Barriers	Cost of equipment/maintenance	37	74%
	Conflicting developer mission/approach/type	19	38%
	Challenges with timing (e.g., consultants brought onto project too late to contribute)	14	28%
	Market actors' lack of knowledge	13	26%
	Hassle to implement	11	22%
	Limited technical feasibility	6	12%
	Lack of investor interest	5	10%
	Worsen aesthetics	4	8%
	Other barriers	5	10%

* One interviewee did not comment on the drivers or barriers; percentages total to greater than 100% because interviewees typically mentioned more than one barrier or driver.

CTCAC's sustainability criteria were identified as a key driver of efficiency for 12 of the 13 low-income projects' energy efficiency goals. Reach codes also drove several projects' efficiency goals (five projects). In addition, many case study projects pursued energy efficiency in order to reduce

[29] *Soft money* refers to money provided by investors and partners such as redevelopment authorities or cities investing in the projects.

operating costs (10), increase project marketability (7), and obtain "soft money" support (from public officials, public agencies, etc.; 6).[30]

Overall, **case study interviewees were most likely to point to CTCAC (70%) and returns on investment or long-term operating costs (64%) as drivers of energy efficiency for their projects**. Long-term operating costs are particularly important to developers who continue to own and operate their MFNC projects because they pay the common-space utility bills. Other important drivers include reach code requirements, the developer's level of commitment to energy-efficiency, and marketing benefits (particularly for LEED projects).

The cost of building efficiently was the greatest challenge for case study respondents; interviewees described it as a major hurdle for 11 of the case study projects and a minor problem for one. Timing was identified as a barrier for nine case study projects; interviewees pointed to decisions about efficiency being made too late in the development process and consultants having limited influence because they were hired when the project was too far into design or construction.

Individual **interviewees most commonly identified equipment/measure costs (74%) as a barrier, followed by lack of commitment to energy efficiency and timing (38%)**. In addition, program awareness in the developer community could pose a barrier to the program's ability to affect practices outside of the program**; while about three-fourths (76%) of case study interviewees were aware of the program, less than half (48%) of survey respondents were aware of the program**, including none of the market-rate project developers.

Other Market Dynamics

Key Decision Makers: Developers

Supporting the findings of the Phase I report, **case study interviewees and survey respondents identified the developer as the key decision maker of a project's energy efficiency level**. Nearly all of the survey respondents (97%) said the developer was the key decision maker, particularly given their control over financial decisions. Developers were described as the ultimate decision-makers, but they make decisions based on financial circumstances, guided by the influence of their various consultants and design team members. Case study respondents often identified architects and engineers as playing essential roles,[31] while energy consultants and financiers were very infrequently considered to be critical players affecting the energy efficiency of a project.

[30] The marketability of energy efficiency was associated with the marketability and cachet of the voluntary green program the project was participating in, such as LEED or GreenPoint Rated.
[31] Architects are commonly key decision makers in that they help to conceive and construct a project that meets the goals of the developer; they are involved in very early stages of the project's conception and design, often before many other consultants. Engineers are involved in energy-efficiency decisions most often in a technical capacity, making recommendations for the measures to install to reach previously set goals and offering suggestions to the developer (and architect) about measure cost and feasibility.

Key Project Stages: Conceptual/Schematic Design and Design Development

Case study interviewees indicated that the two earliest stages in the development process, **the *conceptual and schematic design* stage and the *design development* stage, were the most important phases in MFNC related to energy efficiency decision-making.**[32]

The conceptual and schematic design represents the start of the project. Developers outline the general design of a project with their architect, planning some of the elements that impact the energy-efficiency of the project, such as the orientation, layout, and, in some cases, mechanical systems. About one-fifth of all interviewees (11 of 51) reported that developers know at this point the level of energy efficiency that they are going to pursue because they normally have determined if they are going to pursue CTCAC funding or whether the project will be subject to reach codes. Some developers, but not all, determine at this early stage if they will pursue LEED or GreenPoint Rated certifications.

Design development is a critical phase and follows the schematic and conceptual design phase. At this stage, the developer's consultants (engineers, Title 24 consultants, etc.) become heavily involved in fleshing out the details of the project as initially conceived by the architect and developer, finalizing the design and mechanical specifications that will be used to create final construction documents.

Key decisions about energy efficiency may be made after this point—such as during the construction phase, for example—but interviewees indicated that this is often the result of unplanned circumstances with financial impacts on the project.

Conclusions and Recommendations

We note several key findings and conclusions from this Phase II report.

- **There is evidence suggesting that the IOU MFNC program has affected the practices and efficiency levels of non-participating MFNC projects, but that other market interventions (in particular, CTCAC funding), other green building programs (such as LEED and GPR), and other policies (such as reach codes) are having more substantial impacts** on the efficiency levels of non-participating MFNC projects. The IOU MFNC program appears to be a secondary factor compared to these other market factors and interventions, which appear to be more significant drivers of efficiency in the MFNC market.

- **The IOU programs are operating in a market that includes a particularly complex array of public programs and policies influencing the energy efficiency of the MFNC market, even after the dissolution of the Redevelopment Agencies.** The case studies confirmed and emphasized the importance of a finding from the Phase I research regarding

[32] The five key stages identified by case study interviewees are (1) Schematic and conceptual design, (2) Design development, (3) Construction documentation, (4) Bidding and negotiation, and (5) Construction.

the importance of the role of local officials in encouraging developers to build to above-code standards. Respondents described the importance of "soft money" partners, including local agencies (such as the now-dissolved Redevelopment Agencies), municipalities, housing authorities, and other public officials that assist with the development of a MFNC project (such as providing financial support, zoning variances, marketing assistance, etc.) in exchange for the developer tailoring the project to meet those backers' goals.

- Despite the importance of other market factors, such as CTCAC, the Phase II findings suggest that **the program has affected the market through trainings, design assistance and plan reviews, affecting the knowledge and practices of developers and their design teams.** In addition, the requirement to use CEPEs to prepare Title 24 documentation and HERS Rater inspections creates further impacts by providing a level of quality control for energy efficiency measures, designs, and practices. CEPEs are commonly used outside the program because official Title 24 documentation encourages their use. While we did not find evidence that the programs led to increased marketing or consumer demand for efficiency, developers indicated that efficiency and green labels are important marketing tools, particularly for high-income buyers in the market-rate sector. This suggests program elements that the programs could revisit.

- From our sample of 24 low-rise and four high-rise MFNC projects, we found that **all of the sampled MFNC projects exceeded the applicable Title 24 energy code requirements (an average of 23% BTS)**. Although the sampled projects from this assessment are overrepresented by low-income projects and projects with efficiency requirements, there is clear evidence that projects are being built outside of the IOU MFNC program to above-code standards.

- The Phase II research confirms the Phase I findings that **financial considerations dominate developers' energy-related decisions and that developer perspectives on the value of energy efficiency vary greatly**. For example, some developers view efficiency as a hassle, while others view it as a marketable feature or a core part of their mission.

Several recommendations for future research and IOU program design emerge from the findings of this study, many of which are premised on the assumption that increased program participation could lead to informed market actors being more willing and able to extend some program practices to their non-program projects.

- **Design assistance:**
  - **Speed up recommendations**
  - **Focus on upgrades other than higher mechanical system efficiencies**
  - **Provide data on maintenance costs**

- **Provide more advanced support for experienced teams, in addition to basic support for new participants**

Several case study interviewees reported that the design assistance was too basic, came too late, and was too focused on developers who are inexperienced with energy-efficient designs. This made it less useful for experienced developers who would be willing to participate and learn new strategies for efficient design. Design assistance must be a fast process targeted at the early development stages, such as conceptual/schematic design and design development, or developers cannot implement the suggestions cost-effectively.

Technical support should focus on cost-effective *practices* rather than expensive upgrades to mechanical systems. A mechanical system upgrade may not be an effective recommendation unless it comes not only with detailed explanations of upfront and long-term costs, but also with clear and accurate information on system reliability. This could in turn provide the information that might encourage developers to carry over these practices into their non-program projects.

- **Increase outreach beyond repeat participants to non-participating developers in order to expand the market of developers working on above-code projects.** While this recommendation may be limited by available program funding, awareness of and participation in the program's outreach and training efforts was low, even among program participants. Over one-half of survey respondents were unaware of the MFNC program, and participation in IOU training and design assistance was low among respondents. This outreach will be most effective if the IOUs can succinctly explain the following to developers:
    - Specific practices that meet program criteria
    - The upfront and long-term costs of those practices, *including maintenance*
    - Impacts on design/construction timelines
    - How the program can help simplify the design team's learning curve (design assistance)

- **Consider partnership with LEED or other green certification programs, such as GreenPoint Rated.** While the IOU program has strong measure verification requirements, LEED is a very powerful driver with a well-known name; investors care about this marketable label more than the actual energy savings. The IOUs should consider the costs and merits of creating a hybrid incentive or program structure that allows developers to follow the criteria of a program such as LEED, while retaining the quality control elements of the IOU program participation. This would be complicated by the use of the CAHP score in current IOU program standards. As it stands, developers have many options for green program participation, and some consolidation is likely to encourage above-code building.

- **Reconsider the timing and amount of IOU program incentives so as to increase participation.** While the IOU incentives can reduce the marginal cost of building to above-code standards, some developers find them not only too low, but also perceive barriers to program participation because the incentives are only received at project completion, well after developers have had to put together their project financing and capital, and because some developers do not view the IOU incentives as reliable enough to count on without making other provisions. IOUs should consider the feasibility of either providing the incentives earlier in the development process or enhancing the guarantees of financial payments to developers, along the lines of CTCAC tax credit awards that respondents felt absolutely confident in receiving, assuming they met their various commitments.

- **Demonstrate feasibility of energy efficiency via benchmarking of energy performance *and maintenance costs;* offer publicity and marketing support to developers who participate.** Developers, particularly those who continue to own and operate their MFNC projects, value the benefits of reduced operating expenses from investments in energy-efficient equipment and measures, while investors and lenders view utility expense as a critical component of their underwriting protocols. Demonstrating the performance of program participants could help drive increased interest in energy efficiency in MFNC, including outside of the program.

  Developers who own and operate their properties must factor long-term operating costs into their design specifications, but utility costs are only one factor. The IOUs should provide accurate data regarding the maintenance costs of efficient systems in order to demonstrate the feasibility of these systems to design teams. Respondents described choosing inefficient but reliable systems as one strategy for lowering operating costs.

  Both non-profit developers of low-income housing and for-profit developers of market-rate housing may view public recognition for their efficient projects as a significant incentive to participating in benchmarking efforts.

- **Increase marketing and advertising.** The IOUs should consider increasing their advertising and marketing of the IOU programs to potential renters and buyers in order to increase consumer demand for energy efficiency. Developers already perceive some consumer demand and have responded to demand for some projects. Stimulating consumer demand could increase developers' production of energy-efficient MFNC projects.

- **Continue coordinating with CTCAC.** CTCAC is a key driver of energy efficiency in the low-income MFNC market. By coordinating with CTCAC, the program can help expand the influence of both programs on the market. For example, CTCAC investors reported using their own consultants to verify that construction practices adhered to the developer's design commitments, serving as a quality assurance check to verify that the project would definitely receive the low-income tax credits that attracted the investors. The program's quality assurance practices could provide this service for investors and generate more market interest and confidence in energy efficiency.

- **Coordinate with the Codes and Standards Program to improve enforcement of and compliance with base and reach codes.** About three-quarters of case study interviewees who worked in reach code jurisdictions reported that reach codes were enforced either poorly or inconsistently across jurisdictions, similar to their experiences in non-reach-code jurisdictions.

1 Introduction

This document presents the Phase II findings of a prospective market effects and market characterization study focused on the California investor-owned utilities' (IOUs) new construction programs that target the multifamily market (together, referred to as "the IOU MFNC program"). In this study we have focused on nonparticipant MFNC projects[33] in order to better understand the effects of the IOUs' program on the MFNC market outside of the program. By focusing on nonparticipant multifamily projects we are better able to understand the ways in which the IOU program has effects that spill over onto the rest of the market. As identified in key literature on the topic—including Sebold et al.,[34] Prahl and Keating,[35] Keating,[36] and Rosenberg and Hoefgen[37]—successful market transformation programs often include several key practices:

1. Identifying target markets
2. Characterizing the market
3. Identifying the baseline against which market effects can be compared
4. Developing a market model
5. Developing a program theory and logic model
6. Developing a market transformation story
7. Establishing interim and long-term indicators of market effects
8. Planning for exit or transition from the market
9. Continuing to measure and monitor key indicators after transformation

The two phases of this study address the first seven items on the list. The first phase of this study included the results of interviews with industry experts and IOU program staff, surveys with builders and developers, a review of the multifamily new construction (MFNC) literature review, and other market research, including analysis of construction and permit data.

This second phase uses on-site visits to MFNC projects in California, case studies of specific projects, and an additional survey of developers to update and test the concepts presented in the Phase I report. The team uses these interviews, surveys, and on-site results to provide more context about drivers and barriers to efficient construction, how decisions regarding energy efficiency (EE)

[33] Nonparticipant MFNC projects are defined as MFNC projects that did not participate in the IOUs' MFNC programs
[34] Sebold, F. D., Fields, A., Skumatz, L., Feldman, S., Goldberg, M., Keating, K. and J. Peters. 2001. "A Framework for Planning and Assessing Publicly Funded Energy Efficiency." Study PG&E-SW040. Accessed July 9, 2013, from http://library.cee1.org/sites/default/files/library/1235/412.pdf.
[35] Prahl, R., and K. Keating. 2011. "Planning and Evaluating Market Transformation: What the Industry has Learned, and Possible Implications for California." Market Transformation Workshop, Consultant Whitepaper Draft, October 17.
[36] Keating, K. 2013. "Guidance on Designing and Implementing Energy Efficiency Market Transformation Initiatives." Draft, March 18.
[37] Rosenberg, M., and L. Hoefgen. 2009. "Market Effects and Market Transformation: Their Role in Energy Efficiency Program Design and Evaluation." California Institute for Energy and Environment. Accessed July 10, 2013, from http://www.calmac.org/publications/Market_Effects_and_Market_Transformation_White_Paper.pdf.

are made in the MFNC market, and how the IOU program interacts with the market, as well as to test the key theorized indicators of market effects presented in Phase I. In addition, this report includes preliminary baseline measurements of MFNC building practices for projects started from 2010 through 2012. The preliminary baseline measurements are based on the results of site visits and energy simulation models of a sample of four high-rise and 24 low-rise MFNC projects started from 2010 through 2012.[38] The energy modeling estimated the energy performance of these buildings relative to the Title 24 energy code requirements under which they were constructed and provides better understanding and characterization of the energy efficiency of MFNC construction practices in non-program projects started from 2010 through 2012.

[38] The sample sizes are not sufficient to provide a representative baseline of MFNC building practices during the 2010 through 2012 period, but they do provide valuable insights into the energy efficiency of MFNC construction practices in non-program projects. Future MFNC data collection efforts could augment the data collected from this study to develop a baseline of 2010-2012 MFNC.

2 Methodology Summary

The evaluation team used a multi-pronged approach to conduct the second phase of this research effort: 51 interviews with various market actors involved with the construction and design of 15 case study sites, a survey with 33 developers, and on-site visits and accompanying energy simulation models for 28 MFNC projects. The case study-sites, developer survey sample and on-sites were sampled from the list of MFNC starts developed for the Phase I report.[39] Using lists of IOU MFNC program participants, the research team attempted to remove all program participants to create a list of nonparticipant MFNC projects.

As noted, we have focused on nonparticipant MFNC projects in this study in order to better understand the effects of the IOUs' program on the MFNC market outside of the program. Table 2-2 summarizes how the study treated IOU program participants during out data collection. For the case studies and on-sites, we tried to exclude all program participants. We learned that one case study and on-site project had participated in the IOU program after the bulk of our data collection and we retained the project in the study. For the developer surveys, we asked detailed questions about a developer's largest project started from 2010 through 2012 and their general experiences with their remaining MFNC projects during the same time period. We planned for a maximum of five program projects, and three IOU projects were included in the developer survey.

Table 2-1: Treatment of IOU Program Participants and Realized Sample for Case Studies, On-sites and Developer Survey

Data source	Sample size	Treatment of IOU program participants	Realized sample
Case study projects	15	Exclude	1 IOU program participant
On-sites	24	Exclude	1 IOU program participant
Developer survey	33	For Primary Project, maximum of 5 program projects if IOU project was developer's largest project*	3 IOU program participants

* Developers were asked detailed questions about their experiences on their largest project in our sample of MFNC as well as their general MFNC experiences from projects starting from 2010 through 2012.

[39] NMR. 2014. *Final Phase I Report: Baseline Characterization Market Effects Study of Investor-Owned Utility Multifamily Residential New Construction Programs in California.* http://www.calmac.org/publications/WO54_MFNC_-_Phase_1_Report_Final_070814_.pdf.

It is also important to point out that while we focused on nonparticipant MFNC projects, large percentages of our interviewees and survey respondents aware of the IOU program and participated in had participated in the program through other projects (Table 2-2). This allowed us to get a perspective on the program from those who had program experience, even if the particular project they were being asked about was not an IOU participant project.

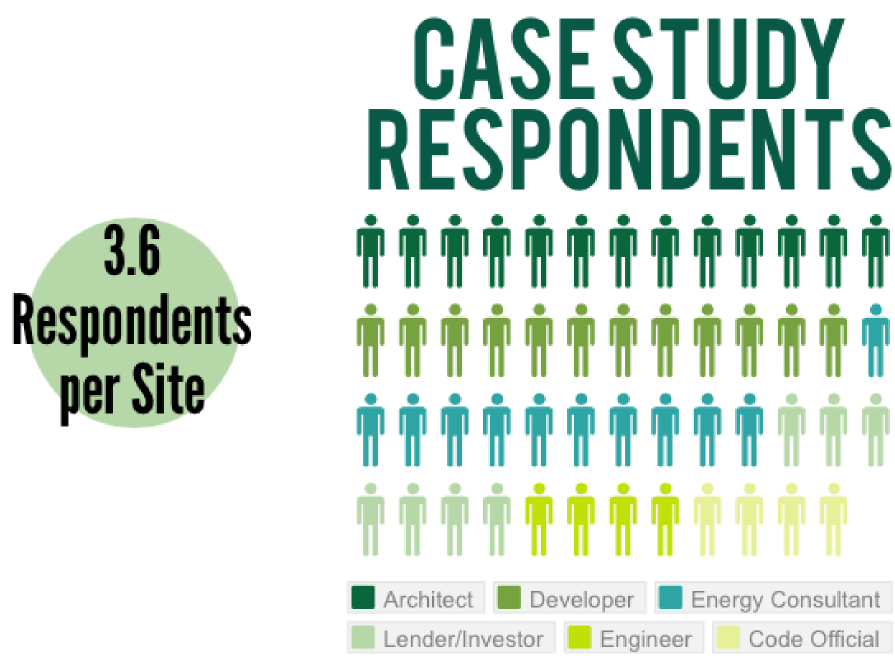
Table 2-2: Participation in and Awareness of IOU MFNC Program for Case Study Interviewees and Developer Survey Respondents

Data Source	Sample size	Case study or primary project, participated in IOU program		Have participated in IOU MFNC program		Aware of IOU program	
		n	%	n	%	n	%
Case study, developer IDIs	12	1	8%	6	50%	9	75%
Case study, all interviewees (excluding code officials)	47	4	9%	31	66%	38	81%
Developer survey*	33	3	9%	10	30%	16	48%

* Developers were asked detailed questions about their experiences on their largest project in our sample of MFNC as well as their general MFNC experiences from projects starting from 2010 through 2012.

2.1 Case Study Methodology

Figure 2-1: Case Study Interview Respondents – Role with the Case Study



The research team selected 15 case study sites and conducted a total of 51 interviews with key professionals associated with those projects, including architects, developers, energy consultants

(HERS Raters, GreenPoint Raters, Title 24 consultants, etc.), mechanical engineers, lenders and investors, and code officials working in the relevant jurisdictions.[40]

The team completed interviews with 3.6 respondents per site, on average (a few respondents were involved with multiple case study projects and gave perspectives on more than one site). We conducted between two and six interviews per site and at least three interviews for 80% of the 15 sites, speaking with at least four respondents for 60% of the sites.

The team prioritized the selection of case study sites from the sites included in the on-site sample (13 of 15 case study sites were included in the on-site sample). We took several parameters into account when selecting the case study sites, including the rise of the buildings in the project (i.e., high-rise and low-rise), high-efficiency requirements (i.e., the project was located in a reach code locality or received a CTCAC tax credit), IOU service territory, and climate region. Section 2.6 compares the sample site characteristics with the broader project population;[41] the bullets below summarize key sample characteristics and compare them with the broader population.

- **Rise:** The case study sample included six high-rise and nine low-rise sites; this distribution is fairly representative of the project population: For example, 62% of the broader project population included low-rise buildings, while 60% of the case study sample included low-rise buildings.
- **Income:** A larger-than-planned portion of the sites included in the final case study sample were low-income housing, partly because several sites that were thought to be market-rate sites were discovered to be low-income sites after recruiting them for the study. In addition, affordable housing developers, some of which were nonprofit organizations, may have been more willing to participate in interviews than their for-profit, market-rate counterparts.[42] As a result, 13 of 15 case study sites (80%) were low-income sites, while 52% of the projects in the broader population were low-income. That said, many of case study respondents involved with low-income projects—such as the various HERS Raters, GreenPoint Raters, Title 24 consultants, and engineers—worked on both market-rate and affordable housing and were able to comment on both sides of the MFNC market in California.
- **Efficiency requirements:** Because low-income projects commonly have efficiency requirements associated with their funding, the findings from the case studies may not be fully representative of the market-rate MFNC market. All of the case study sites were either required to be high efficiency due to reach code or CTCAC requirements (10 of 15 sites)

[40] Two interviews included two respondents participating collaboratively. Our analysis treats their responses as single interviews because they were providing a combined perspective on their firms' experience with the respective project.
[41] Here, when we refer to the project population, we are referring to projects that were started within IOU service territory between 2010 and 2012 did not participate in the IOU MFNC program.
[42] It is possible that affordable housing developers were more interested in responding to interviews because of the $150 incentive for each completed interview that the team was able to offer as remuneration for their completion of the interviews. Generally, affordable housing developers donated this incentive to their organizations, which likely have a greater need for financial support than market-rate housing developer firms, thus encouraging their participation.

or were encouraged to be high efficiency to win competitive CTCAC awards (see Section 2.5 for more details).

Figure 2-2 illustrates the case study sample projects' income category and reach code status by building rise.

Figure 2-2: Case Study Site Characteristics – Rise, Reach Code, and Income Category

Due to the importance of gaining varied perspectives on the specific case study projects, researchers underwent significant efforts to obtain interviews with multiple key professionals associated with the selected case study sites. The research team used the construction databases gathered during Phase I research[43] to identify key people or firms involved with these projects and supplemented these lists with exhaustive internet research about the projects and firms involved. The team contacted the various firms via e-mail and telephone calls to identify the key actors on the project most knowledgeable about the energy efficiency decisions made on the project. The telephone interviews lasted between half an hour and two hours.[44] We offered interviewees a $150 incentive for completing the interview.

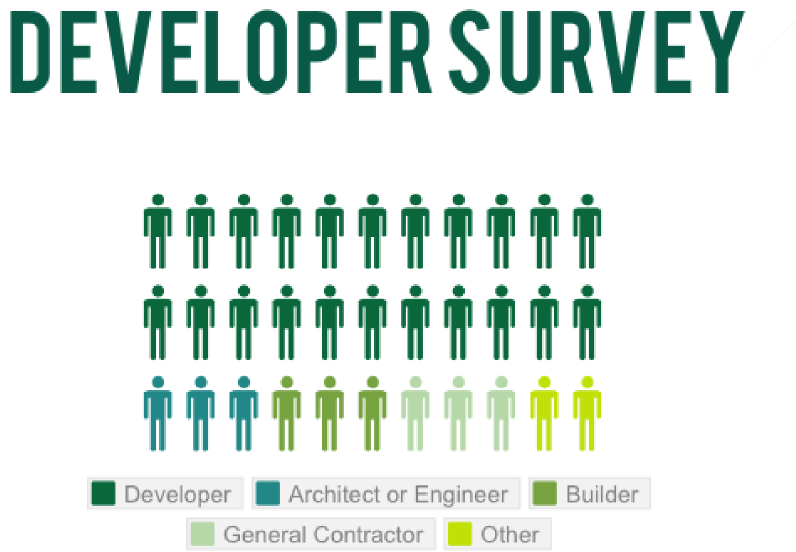
[43] These data came from CTCAC records, IOU program records, McGraw Hill construction start data, and quantitative CATI surveys. For further explanation on the database development, see the Phase I report.
[44] One respondent provided answers in writing.

The interviews focused on the respondents' experiences working on the selected case study project, what factors and which people determined the energy efficiency performance of the project, and general market forces that impact the efficiency of MFNC projects in California.

2.2 Developer Survey Methodology[45]

The research team conducted 33 telephone and online surveys with respondents who represented developers of MFNC projects not included in the case studies.

Figure 2-3: Developer Survey Respondent Roles



Respondents were asked to discuss their general MFNC experiences from projects starting from 2010 through 2012 and about their experiences on a specific project. Before fielding the surveys, we selected specific projects about which to ask by choosing the largest one with which the respondent was associated that had started construction during that timeframe. Survey questions included topics similar to those addressed in the case studies, such as the following:

- Awareness of the IOU MFNC program
- Awareness and adoption of energy-efficient building practices
- Awareness of ZNE building practices
- Key decision-makers and decision-making criteria for energy efficiency decisions
- Market demand for energy efficiency among various market segments
- Training received on energy-efficient practices
- Barriers to IOU MFNC program participation
- Relative importance of the other green programs and certifications

[45] For additional details on the methodology used to gather and analyze the developer survey data, see Appendix E.

- Similar to the case study sampling approach, the research team developed the survey sample frame from the data set that we compiled for the Phase I Report based on the population of MFNC projects started in California from 2010 through 2012.[46]

From a population of 763 multifamily new construction projects started from 2010 through 2012, the team constructed a sample frame of the 385 developers responsible for the projects. We followed quotas to ensure that the targeted respondents could speak about low-rise, high-rise, and IOU MFNC participating projects. The team performed various statistical analyses to characterize the survey results: we integrated the key findings into the main body of the report where we use those results to corroborate case study and/or on-site visit findings, and we present additional findings and methodology details in Appendix E.

[46] These data came from CTCAC records, IOU program records, McGraw Hill construction start data, and quantitative CATI surveys. For further explanation on the database development see the Phase I report.

2.3 On-Site Visits[47]

During the second-half of 2014, the evaluation team conducted on-site visits at 29 MFNC projects in California, including 24 eligible low-rise and four eligible high-rise sites.[48]

Figure 2-4: Breakdown of Site Visits*

*Three of the affordable sites were not CTCAC award sites. In our analysis, we did not categorize them as sites likely to have energy efficiency requirements associated with their construction.

The team gathered extensive measurements of the physical construction and mechanical equipment of the residential portions of those projects that would impact the projects' energy consumption. We also created detailed energy models to determine the projects' compliance margin relative to Title 24 energy code and offer insight into the energy savings (or lack of savings) associated with specific construction practices. The site visits were also informed by discussions with property managers or staff and a review of all available code compliance documentation that was gathered by researchers at local building departments prior to site visits or provided to the field researchers by the site contacts.

For both the high-rise and low-rise sites, Energy Soft developed unique EnergyPro software versions with add-ons specifically built for this research effort. These versions provided measure-specific parametric run outputs for the proposed energy simulation models that isolated the impacts

[47] A more detailed methodology for the on-site visits and energy modeling is available in Appendix D.
[48] The evaluation team visited a 25th low-rise site, but it was ineligible for the study and thus not included in the analysis.

of the proposed structural features or mechanical equipment apart from the other components of the energy model.[49] A key difference between the results of the parametric runs and the whole-building performance results of the overall Title 24 compliance margins is that the measure-specific results come in isolation from the other characteristics of the development. As with the developer survey, the evaluation team selected the on-site sample from the four data sources used in the Phase I market characterization report.[50]

The team used several key parameters to stratify the sample of qualifying sites, including the rise of the buildings in the project (i.e., high-rise and low-rise), high-efficiency requirements (i.e., the project was located in a reach code locality or received a CTCAC tax credit), and IOU service territory, as described in more detail below.

2.3.1 Low-Rise Sites

Using the construction start data from the Phase I report, the evaluation team compiled a sample frame of 303 qualifying low-rise, newly constructed multifamily developments that had broken ground between 2010 and 2012 and also fell within PG&E, SCE, or SDG&E service territories. The team attempted to follow quotas based on the IOU service territory (a 40/40/20 percent split between the three IOUs) and whether or not the sites were subject to the standard energy efficiency requirements of Title 24 or above-code requirements. In the case of the latter, according to the best available information, the developments were likely required to be more efficient than a comparable code-compliant project (typically by 15%) due to receipt of a CTCAC tax credit award for affordable housing or its location in a reach code jurisdiction. Fulfilling these quotas was limited by participant willingness and the ability to reach a site contact with sufficient authority to grant site access.

[49] The measure-specific parametric runs included fenestration/glazing, envelope insulation, cool roof, HVAC efficiency, and domestic hot water. For high-rise sites, fenestration/glazing is included with the envelope insulation measure.
[50] These data came from CTCAC records, IOU program records, McGraw Hill construction start data, and quantitative CATI surveys. For further explanation on the database development, see the Phase I report.

The team fulfilled its on-site quotas for all but one stratum of the low-rise sites, as shown in Table 2-3.

Table 2-3: Low-Rise On-site Strata

IOU	Standard Title 24 / EE Required	Targeted Number of Sites	Completed Sites
PG&E	Standard	4	4
	Required	6	6
SCE	Standard	5	5
	Required	5	5
SDG&E	Standard	2	1
	Required	3	3
CA Total	**Standard**	***11***	***10***
CA Total	**Required**	***14***	***14***

*A project was defined as being required or likely to have high-efficiency requirements if it received a CTCAC tax credit or started construction in a reach code community after the reach code was approved.

DNV GL engineers created EnergyPro models for the 24 eligible sites, comparing the performance to a baseline project built to the relevant code cycle. Thirteen of the low-rise developments included in the low-rise sample were approved under the 2005 Title 24 Standards (prior to the 2008 Title 24 Standards first effective date of January 1, 2010), while the remainder were modeled against the 2008 Title 24 energy standards. Compliance margins were calculated by comparing the annual energy consumption of the as-built models to the annual energy consumption of the same building if it were built to just meet the code.

DNV GL engineers spent a significant amount of time testing the results of the contracted "measure isolating parametric run" version of EnergyPro that the team received. Several iterations of the software were required to effectively remove the various simulation errors the DNV GL team encountered when testing the initial versions received. Additional details on the methodology are presented in Appendix D.

2.3.2 High-Rise Sites

Drawing a subset of projects from the same database as the other research efforts, the team recruited four new construction high-rise (four or more stories) projects to conduct site visits and collect detailed data, and created energy simulation models for each building using these primary data. Two of the sites were located in the PG&E service territory (the city of San Francisco) and two were located in the SCE service territory (Orange and Los Angeles Counties).[51] The two sites in SCE territory were subject to high-efficiency requirements due to their participation in CTCAC.

As with the low-rise site visits, the team estimated the energy performance of these buildings relative to the 2008 Title 24 energy code requirements under which they were constructed. The

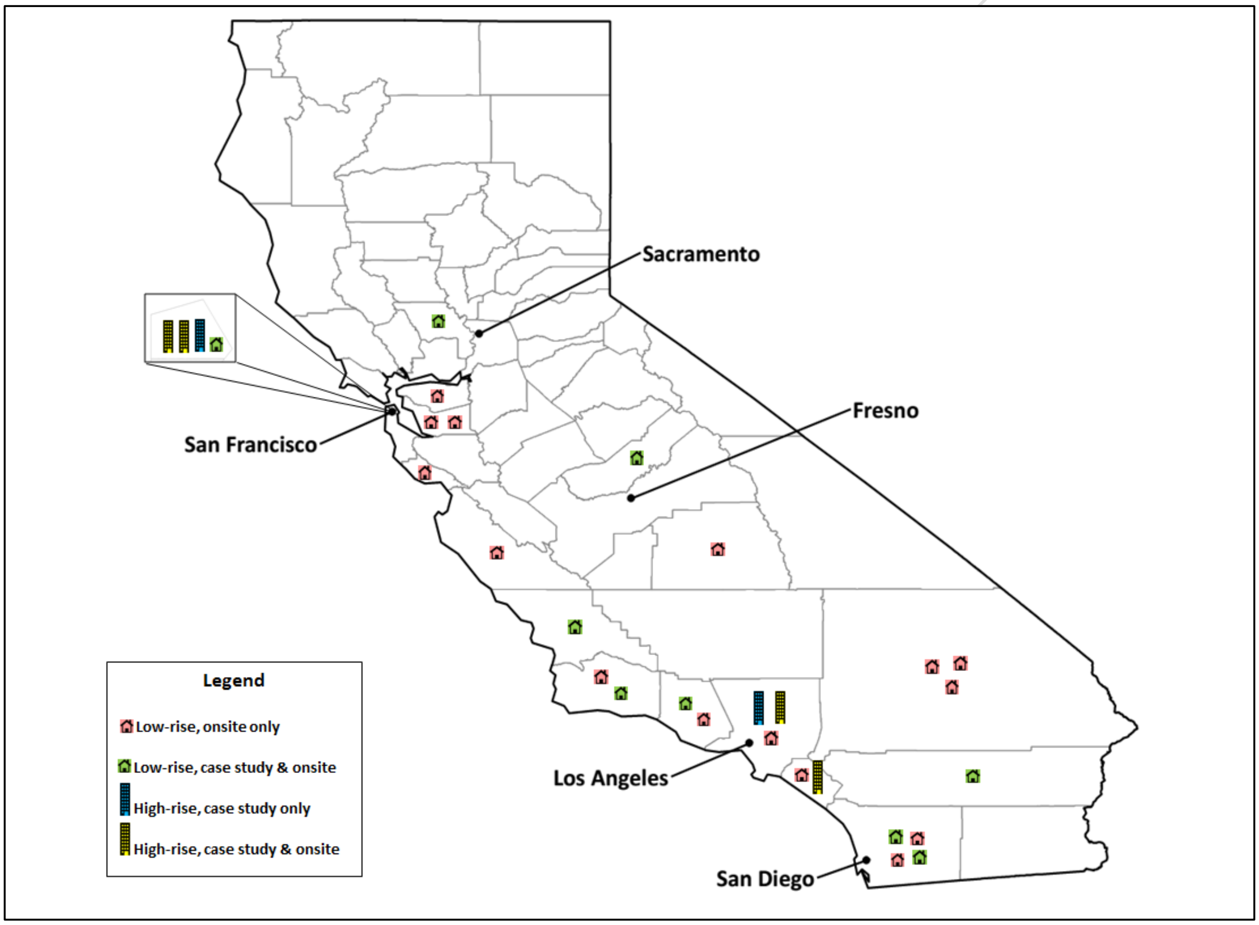
[51] No high-rise sites from the SDG&E service territory were willing to participate in the study.

evaluation team verified whether the applicable energy-related measures (1) were in compliance with the 2008 Title 24 code, (2) exceeded the code requirements, or (3) did not meet the code requirements. Additional details on the methodology are presented in Appendix D.

2.4 Location of Case Study and On-Sites

Figure 2-5 presents the approximate locations of the MFNC projects selected for the case studies and on-site visits. The icons are placed in the center of the county in which the projects are located in order to protect the anonymity of the sites and interview respondents. The projects are clustered along the coast and in California's major urban areas, reflecting similar patterns found in the population of MFNC projects started from 2010 through 2012.

Figure 2-5: Location of Case Study Projects and Site Visits*



* In order to preserve the anonymity of the MFNC projects and interview respondents, the icons in the map represent the approximate location of the MFNC projects selected for the case studies and on-site visits.

2.5 Re-Categorizing Efficiency Requirement Categories from Case Studies and On-Sites

Based on further research during the course of the project (online research about projects, follow-up discussions with site contacts, additional reviews of CTCAC reports, etc.), the evaluation team uncovered additional information about some of the 30 projects included in the on-sites and case studies that required reclassifying them into different strata than those originally identified. Researchers determined that five sites originally thought to be subject to the base Title 24 efficiency requirements were actually likely to have pursued high-efficiency criteria due to a previously unknown affiliation with CTCAC or similar programs. In addition, contrary to Phase I interviewee reports, researchers learned during Phase II research that prior to 2011, CTCAC encouraged energy efficiency by awarding CTCAC sustainability points for above-code project designs, but it did not require high-efficiency in its participant projects; therefore, of the final 25 sites that were subject to high-efficiency criteria, 14 were required to be high efficiency due to CTCAC, reach codes, or similar programs/codes, and 11 were encouraged (but not mandated) to be high efficiency in an effort to win CTCAC awards.[52] Respondents often discussed CTCAC "requirements," even if their projects were not subject to actual CTCAC efficiency mandates, because they appeared to view meeting those higher efficiency criteria as de facto requirements that greatly increased their competitiveness for the CTCAC award money.[53] For example, a developer for one case study project described the sustainability criteria and role of CTCAC in energy-efficiency decisions as follows:

> *The dominant force has to be CTCAC. When CTCAC made the sustainable practices part of the 9% scoring, there was no question that the industry was going to follow suit. That's a huge piece of capital.*[54]

An architect quantified the economic importance of earning the sustainability points:

> *On buildings of these types, a point [on the CTCAC competitive scoring scale] in energy efficiency can translate into millions of dollars.*

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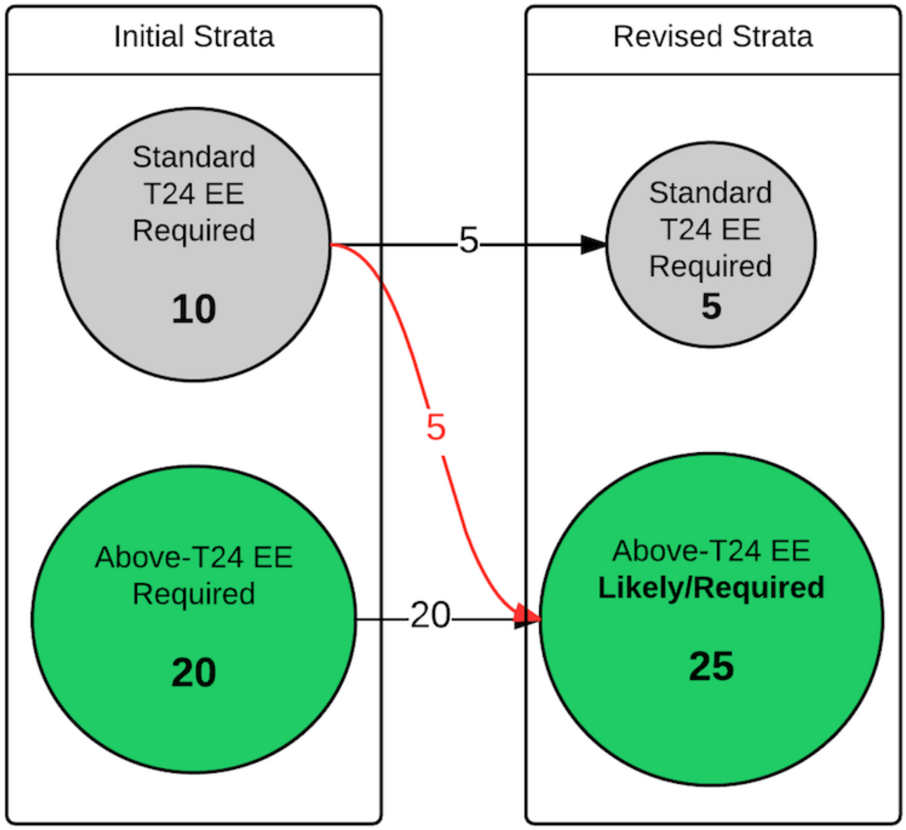
[52] Beginning in 2011, CTCAC *required* participating projects to be 15% more efficient than Title 24 requirements. See the 2011 CTCAC Annual Report for more details: California Tax Credit Allocation Committee. *2011 Annual Report*, 2012; http://www.treasurer.ca.gov/ctcac/2011/annualreport.pdf.

[53] Interviewees often emphasized that their projects were reliant on CTCAC funding.

[54] The 9% scoring refers to the 9% tax credit awards. The 9% awards represent the approximate percentage of a project's income-restricted value that investors may annually deduct from their federal taxes. The 9% credits are awarded through competitive scoring, and market actors indicated that attaining the full points for sustainability was critical to winning the highly competitive 9% tax credits. Market actors reported that the 9% credits require a project to attain GreenPoint Rated, LEED, or Enterprise Green Communities certification. One expert reported that successful 9% applicants must go beyond the minimum thresholds and build to even higher efficiency tiers, such as the LEED Gold. For more details, see: NMR 2014. *Final Phase I Report: Baseline Characterization Market Effects Study of Investor-Owned Utility Multifamily Residential New Construction Programs in California.* http://www.calmac.org/publications/WO54_MFNC_-_Phase_1_Report_Final_070814_.pdf

Because of the importance of high-efficiency compliance points in winning CTCAC awards, throughout the report we generally refer to all projects that received CTCAC awards as having high-efficiency requirements.

Figure 2-6: Revisions to Initial Energy Efficiency Requirements Strata, Case Study and On-sites



Note: The *initial* strata were based on Phase I research involving a large database and limited opportunity to research individual sites. During our Phase II research, we were able to further refine strata based on energy efficiency requirements.

2.6 Sample Disposition and Representativeness

This section provides additional analysis of the case study, on-site, and developer survey sample dispositions, particularly focusing on comparing the samples to the population in regard to the energy efficiency requirements and rates of participation in voluntary, non-IOU, MFNC green programs.

Overall, the samples are over-represented by low-income projects (mostly CTCAC), projects subject to energy efficiency requirements, and projects that participated in voluntary, non-IOU, MFNC green programs, such as GreenPoint Rated, but LEED projects are not over-represented. It is important to note that the prevalence of low-income projects is not due to low-income projects representing a disproportionately large portion of the nonparticipant population as 52% of nonparticipating projects were low-income compared to 45% of participating projects.[55]

For example, all of the case study sites and 23 of 28 on-sites were either required to be high efficiency due to reach code or CTCAC requirements or were encouraged to be high efficiency to win competitive CTCAC awards, while 73% of the developer survey projects were required to be high efficiency compared to 59% of the nonparticipating MFNC population located within IOU territories (Table 2-5). Further, nearly all of the case study sites (13 of 15) and on-sites (24 of 28) were low-income sites, which commonly have efficiency requirements or strong incentives to be highly efficient due to CTCAC awards (see Table 2-4; note that not all low-income projects received CTCAC awards). The developer survey, while over-represented by low-income projects, had a larger percentage of market rate projects (36%).

As a result, despite the fact that many respondents worked in both the low-income and market-rate markets, the findings from this study are not fully representative of the market-rate MFNC market. Of the 51 respondents interviewed for the case study research, 76% had experience in the low-income and market-rate sectors, allowing the team to create a picture of the behaviors in both market segments, even though the case study projects themselves oversampled low-income projects.[56]

2.6.1 Comparison of Case Study, On-Site, Developer Survey Samples to the Population

This section provides additional details on the characteristics of the case study, on-site, and developer survey samples. The first set of tables compares the characteristics of the samples with those of the MFNC population of projects started from 2010 through 2012 that did not participate in the IOU MFNC program and were located within IOU service territories.

[55] For more details, see: NMR 2014. *Final Phase I Report: Baseline Characterization Market Effects Study of Investor-Owned Utility Multifamily Residential New Construction Programs in California.* http://www.calmac.org/publications/WO54_MFNC_-_Phase_1_Report_Final_070814_.pdf

[56] Of the 51 case study respondents, 76% had experience in both sectors, including the four code officials. Excluding the four code officials, 74% of respondents had this mixed sector experience.

As mentioned earlier in the methodology description, while this was unplanned, the sample is overrepresented by low-income projects:[57] 13 of 15 case study sites (80%) were low-income sites, whereas 52% of the nonparticipant project population included low-income housing (Table 2-4). The on-site sample was similarly overrepresented by low-income projects (86% of on-site projects); the developer survey sample was closer to the nonparticipant population, though still overrepresented by low-income projects (67%).

Table 2-4: Income Category of Case Study, On-site and Nonparticipating Projects

Income Category* **	**Case Study Projects**		**On-site Projects**		**Developer Survey ********	**Nonparticipating Project Population* (2010-2012)**	
	Number of Projects	**Percentage of Projects**	**Number of Projects**	**Percentage of Projects**	**Percentage of Projects (n = 33)**	**Percentage of Projects (n=494)**	**Percentage of Units** (n=36,383)**
Market rate	3	20%	4	14%	36%	48%	52%
Low-income	12	80%	24	86%	67%	52%	48%
Total	**15**	**100%**	**28**	**100%**	**100%**	**100%**	**100%**

* Population includes projects located within IOU territories that did not participate in the IOU MFNC program.
** We estimated the number of units if necessary and possible; some estimates were revised based on case study findings.
*** Projects labeled as *low-income* may not have had exclusively low-income housing units; for the purposes of analysis, we considered these projects low-income. Further, although we labeled projects that had not been specifically identified as low-income or did not appear in CTCAC data as *market-rate*, it may be possible that some of them were low-income projects; in fact, two case study projects that had not been identified during Phase I as low-income were determined to be low-income projects during our Phase II research. (The population data in the table reflect the updated income category.)
**** Developers were asked detailed questions about their largest multifamily project started from 2010 through 2012. One project included both market-rate and low-income units, and another developer did not identify the income category of their project.

[57] Several sites were originally thought to be market-rate projects but, after additional research and recruitment discussions, we learned that they were low-income sites; additionally, developers from non-profit organizations may have been more willing to participate in interviews than their for-profit, market-rate counterparts. However, many of the case study respondents involved with low-income projects worked on market-rate and affordable housing and were able to comment on both sectors of the MFNC market in California.

As presented in Table 2-5, case study sites were far more likely to be subject to high-efficiency requirements than the population of projects (60% and 35%, respectively); they were also much more likely to be encouraged to be high-efficiency than the project population (40% vs. 24%).[58] This difference is largely due to the fact that case study projects were mostly affordable housing projects. Similarly, 82% of the on-site projects were either required or encouraged to be high-efficiency. We provide further explanation of these efficiency categories and the oversampling of high-efficiency sites in Section 2.5. As with income category, the developer survey sample, while overrepresented by required or encouraged high-efficiency projects (73% combined), was closer to the nonparticipant population (59% combined).

Table 2-5: Energy Efficiency Requirements of Case Study, On-site and Nonparticipating Projects

Energy Efficiency Requirements***	Case Study Projects		On-site Projects		Developer Survey ****	Nonparticipating Project Population* (2010-2012)	
	Number of Projects	Percentage of Projects	Number of Projects	Percentage of Projects	Percentage of Projects (n = 33)	Percentage of Projects (n=494)	Percentage of Units** (n=36,383)
Standard Title 24	0	0%	5	18%	27%	41%	41%
High-efficiency required	9	60%	12	43%	45%	35%	37%
High-efficiency encouraged	6	40%	11	39%	27%	24%	22%
Total	**15**	**100%**	**28**	**100%**	**100%**	**100%**	**100%**

* Population includes projects located within IOU territories that did not participate in the IOU MFNC program.
** We estimated the number of units if necessary and possible; some estimates were revised based on case study findings.
*** We categorized projects using these criteria: *high-efficiency-required* projects are 2011 or 2012 CTCAC projects or within reach code areas; *high-efficiency-encouraged* projects are 2009 and 2010 CTCAC projects outside of reach code areas.
**** Developers were asked detailed questions about their largest multifamily project started from 2010 through 2012.

[58] We considered projects to be high-efficiency required if they were CTCAC projects started in 2012 or if they were within reach code areas. Projects that started outside of reach code areas, received CTCAC funding, and started before 2012 were labeled high-efficiency encouraged. All other projects were likely subject to base Title 24 energy efficiency requirements (standard).

The case study and developer sites' building rises were fairly representative of the project population, with 62% of the nonparticipant population including low-rise buildings compared to 60% of the case study sample and 70% of the developer survey sample including low-rise buildings. A substantially larger portion of the on-site projects were low-rise projects (86%) compared to the nonparticipant population (Table 2-6**Error! Reference source not found.**).

Table 2-6: Building Rise of Case Study, On-site and Nonparticipating Projects

Rise***	Case Study Projects		On-site Projects		Developer Survey ****	Nonparticipating Project Population* (2010-2012)	
	Number of Projects	Percentage of Projects	Number of Projects	Percentage of Projects	Percentage of Projects	Percentage of Projects (n=494)	Percentage of Units** (n=36,383)
High-rise	6	40%	4	14%	36%	32%	52%
Low-rise	9	60%	24	86%	70%	62%	43%
Unknown	-	-	-	-	3%	6%	5%
Total	**15**	**100%**	**28**	**100%**	**100%**	**100%**	**100%**

* The nonparticipating project population includes projects located within the IOU territories that did not participate in the IOU MFNC program. One case study project that unexpectedly participated in the IOU MFNC program is excluded from the nonparticipating population statistics but is included in the case study project statistics.
** Using the mean number of square feet per unit for projects with square footage and unit data, the team estimated the number of units for projects with square footage data but without unit data. Phase II research revealed that the number of units for three case study sites was different from the Phase I figures; these revised figures are incorporated into the data above. The projects where we could not obtain or estimate number of units are excluded from this column.
*** High-rise buildings are those with four or more habitable floors. Two non-case study projects had both high- and low-rise buildings; we count them twice (once in the high-rise figures and once in the low-rise figures).
**** Developers were asked detailed questions about their largest multifamily project started from 2010 through 2012. Three projects included both high-rise and low-rise buildings.

Next, we compare the rates of participation in voluntary green MFNC programs of the case study, on-site, and developer survey samples to statewide participation rates (Table 2-7).[59] It is worth noting that voluntary green MFNC program participants represent a substantial portion of the market from 2010 through 2012, with LEED-registered products representing 27% of all MFNC projects and GreenPoint Rated representing 16% of projects (CTCAC, which accepts LEED and GreenPoint Rated as certifications for meeting their efficiency requirements, represents 45% of all MFNC starts). The case study, on-site, and developer survey samples had comparable or lower rates of LEED-registered projects compared to the statewide population but higher rates of participation in the GreenPoint Rated and CTCAC programs.

Table 2-7: Voluntary Green MFNC Program Participation of Case Study, On-site and Nonparticipating Projects

Voluntary Green MFNC Program	Case Study Projects		On-site Projects		Developer Survey ****	Statewide MFNC Projects (2010-2012)	
	Number of Projects	Percentage of Projects	Number of Projects	Percentage of Projects	Percentage of Projects (n = 33)	Number of Projects	Percentage of Projects
LEED*	4	27%	5	18%	27%	208	27%
GreenPoint Rated**	8	53%	9	32%	30%	119	16%
CTCAC***	12	80%	20	71%	52%	341	45%
Total	**15**	**100%**	**28**	**100%**	**100%**	**763**	**100%**

* Counts of MFNC projects registered under LEED for Homes, Build, Design and Construction (BD&C), Neighborhood Development ratings systems. Data source: LEED Project Directory and data provided by LEED staff.
** Counts of projects that filed initial applications for GPR with Build It Green. Data provided by Build It Green, GreenPoint Rated Department, Projects Initially Approved from 2010 through 2012, received from GreenPoint Rated staff on August 7, 2013.
*** Data source: CTCAC, 2009-2011 Annual Reports
**** Developers were asked detailed questions about their largest multifamily project started from 2010 through 2012.

[59] We use the statewide counts and rates as the basis of comparison rather than non-IOU program participants within IOU territories because we only have statewide counts for GreenPoint Rated projects and because we are not able to identify and remove IOU program participants from the LEED data.

Last, we compare the IOU service territories and climate zones of the case study, on-site, and developer survey samples to the MFNC population of projects started from 2010 through 2012 that did not participate in the IOU MFNC program and were within IOU service territories.

The project population (62%) was more likely to be located in SCG service territory than was the case study project sample (47%), on-site sample (50%), and developer survey sample (42%). In addition, our case study, on-site, and developer survey samples were more likely to be located in PG&E territory than the project population, while the developer survey sample had lower percentages of projects located in SCE and SDG&E service territories (Table 2-8).

Table 2-8: IOU Territory of Case Study, On-site and Nonparticipating Projects

IOU Territory***	Case Study Projects		On-site Projects		Developer Survey ****	Nonparticipating Project Population* (2010-2012)	
	Number of Projects	Percentage of Projects	Number of Projects	Percentage of Projects	Percentage of Projects (n = 33)	Percentage of Projects (n=494)	Percentage of Units** (n=36,383)
PG&E	7	47%	12	43%	61%	34%	34%
SCE	6	40%	12	43%	12%	30%	25%
SDG&E	2	13%	4	14%	3%	10%	9%
SCG	7	47%	14	50%	42%	62%	60%
Total	**15**	**147%**	**28**	**150%**	**118%**	**135%**	**129%**

* Population includes projects located within IOU territories that did not participate in the IOU MFNC program.
** We estimated the number of units if necessary and possible; some estimates were revised based on case study findings.
*** Because SCG territory overlaps with electric utility providers' territories, percentages total to greater than 100%. For the case studies, six SCG sites were located in SCE territory and one site was in PG&E territory; twelve on-sites were in SCE territory and two were located in PG&E territory; four of the developer survey projects were located in SCE territory, two were in PG&E territory and eight were in LADWP territory.
**** Developers were asked detailed questions about their largest multifamily project started from 2010 through 2012.

As shown in Table 2-9, a larger percentage of case study projects (33%), on-site projects (32%) and developer survey projects (52%) were located in Climate Region 1 compared to the project population (24%), whereas a smaller percentage of case study and developer survey projects were located in Climate Region 3 (27% and 30%, respectively) compared to the project population (39%). A much smaller percentage of the developer survey projects were located in Climate Region 2 (3%) compared to the project population (21%).

Table 2-9: Climate Region of Case Study, On-site and Nonparticipating Projects

Climate Region (and Climate Zones)***	Case Study Projects		On-site Projects		Developer Survey *****	Nonparticipating Project Population* (2010-2012)	
	Number of Projects	Percentage of Projects	Number of Projects	Percentage of Projects	Percentage of Projects (n = 33)	Percentage of Projects (n=494)	Percentage of Units** (n=36,383)
Region 1 (Zone 1-5)	5	33%	9	32%	52%	24%	28%
Region 2 (Zone 6-7)	3	20%	4	14%	3%	21%	21%
Region 3 (Zone 8-10)	4	27%	10	36%	30%	39%	40%
Region 4 & 5 (Zone 11 - 16)****	3	20%	5	18%	15%	16%	11%
Total	**15**	**100%**	**28**	**100%**	**100%**	**100%**	**100%**

* Population includes projects located within IOU territories that did not participate in the IOU MFNC program.
** We estimated the number of units if necessary and possible; some estimates were revised based on case study findings.
*** Climate zones refer to those established in Title 24 documentation. To develop climate regions, we aggregated the 16 climate zones by matching those that had the same Title 24 requirements or that differed by up to one component. For more details, see: KEMA, Nexus Market Research, Summit Blue Consulting, Itron and the Cadmus Group. 2009. Phase I Report Residential New Construction (Single Family Home) Market Effects Study, prepared for the California Public Utilities Commission Energy Division Study ID: CPU0030.08.
**** Climate Regions 4 and 5 were combined because Region 5 only had one representing site.
***** Developers were asked detailed questions about their largest multifamily project started from 2010 through 2012.

3 On-Site Visits: Baseline Measurements of 2010-2012 MFNC Building Practices

In this section, we report the energy performance of 28 MFNC projects in California, including 24 eligible low-rise and four eligible high-rise sites. The team created energy models based on data collected during site visits to measure the projects' energy performance relative to the requirements of Title 24 energy code.

$$\text{Percentage annual savings} = \frac{(\text{T24 baseline energy usage} - \text{Modeled energy usage})}{\text{T24 baseline energy usage}}$$

Each site's overall savings percentage was calculated by subtracting the modeled site's annual combined electric and natural gas energy usage from the energy usage of a hypothetical baseline home built to the minimum efficiency requirements of the applicable Title 24 code version and dividing the result by the standard efficiency site's energy usage.

In addition, the energy models estimated the energy performance of the key structural features and mechanical equipment of each project, including fenestration/glazing, envelope insulation, cool roof, HVAC efficiency, and domestic hot water.[60]

Across the state, all of the sampled projects exceeded the applicable Title 24 energy code requirements, ranging from slightly more efficient than code (1% annual energy savings compared to code) to much more efficient than code (66% annual energy savings). On average, low-rise sites were found to be 23% more efficient than code, while high-rise sites were 24% more efficient than code. In general, gas savings were substantially higher than electricity savings.

It is important to note that 82% of the on-site projects (23 of 28), including all of the high-rise sites, had either high-efficiency requirements or strong incentives to be high-efficiency because they had received CTCAC awards or were built in reach code jurisdictions.[61] Of those 23 sites, 12 were mandated to be high efficiency and 11 were encouraged to be high efficiency because they were projects that won CTCAC funding before CTCAC required above-code practices in all of its participating projects.[62] However, projects not subject to any above-code efficiency requirements were, on average, over 20% more efficient than code requirements (Table 3-1).

In the following sections, we report the results of the low-rise MFNC projects by several parameters, including by efficiency requirements, climate region, and version of Title 24 under which the project was permitted. More detailed findings for individual sites can be found in

[60] For high-rise sites, fenestration/glazing is included with the envelope insulation measure.

[61] In comparison, 59% of the population of nonparticipating MFNC projects located within IOU territories were required or encouraged to be high-efficiency (see Section 2.6.1 for more details).

[62] As previously discussed, prior to 2011, CTCAC awarded competitive points for building to above-code standards, but did not mandate above-code practices in all projects. It is important to note that the competitive points were critical to securing CTCAC awards. Interviewees viewed meeting those higher efficiency criteria as de facto requirements that greatly increased their competitiveness for the CTCAC award money.

Appendix D. Because of the limited number of high-rise sites, we present the findings for each individual high-rise site in this chapter, with more detailed findings available in Appendix D.

3.1 Low-Rise On-Sites' Energy Performance

In this section, we report the energy performance of the 24 low-rise on-site projects visited by the research team. The team created energy models based on data collected during site visits to measure the projects' energy performance relative to the requirements of Title 24 energy code. The following tables display the annual electric, gas, and total energy savings percentage relative to the relevant Title 24 energy code version for the twenty-four modeled low-rise sites based on the analysis and site visits performed by DNV GL.

On average, the low-rise on-site projects were 23.3% more efficient than the applicable baseline code overall; they were 11.5% more efficient in terms of electricity usage and 27.1% more efficient in terms of natural gas consumption (Table 3-1). In addition, for each stratum, all of the projects, on average, were built to exceed Title 24 code requirements. (The differences between the strata are not statistically significant at the 90% confidence level.) Across the state, the modeled sites' gas consumption was also substantially more efficient than the average electrical consumption.

Table 3-1: Low-Rise On-Sites – Estimated Energy Savings Relative to Applicable Title 24 Codes by Efficiency Requirements

Efficiency Requirements	# of Sites	Avg. # of Stories	Avg. # of Units	Avg. Annual kWH Savings	Avg. Annual Therm Savings	Avg. Annual Combined Energy Savings (kBTU)
Standard T24 Requirements	5	2.8	58.6	4.7%	24.2%	21.2%**
Favored / Encouraged*	10	2.7	83.6	8.0%	26.6%	22.1%
Required EE	9	2.3	35.0	19.3%	29.1%	25.8%
Total	**24**	**2.6**	**58.8**	**11.5%**	**27.1%**	**23.3%**

*As previously discussed, prior to 2011, CTCAC did not require developers to build more efficiently than code, but did award competitive points for doing so.

**Of the five sites, one site was over 60% more efficient than code requirements, two sites were between 12% and 26% more efficient, and two sites were less than 5% more efficient.

Table 3-2 provides the average annual energy savings for sites within the five California Climate Regions.[63] In the savings columns, projects found to be more efficient than Title 24 requirements (i.e., have annual energy savings) are shaded green, while projects found to be less efficient than Title 24 requirements are shaded red. The sites in Climate Regions 1 and 3 had the highest overall energy savings, while Climate Regions 4 and 5 had the lowest energy savings. The sites in Climate Regions 2 and 3 had the highest average savings for electricity and gas usage, respectively. The energy savings for sites in Climate Regions 4 and 5 were lower compared to Climate Region 1. In addition, sites in Climate Regions 3, 4, and 5 used slightly more electricity than a comparable minimally code-compliant project but had substantial gas savings, resulting in projects that are more efficient than code overall.

Table 3-2: Low-Rise On-Sites – Estimated Energy Savings Relative to Applicable Title 24 Codes by Climate Region

Climate Region	# of Sites	Avg. # of Units	Avg. Annual kWH Savings	Avg. Annual Therm Savings	Avg. Annual Combined Energy Savings (kBTU)
1	7	80.8	18.4%	27.8%	26.5%†
2	4	39.0	39.9%	20.9%	21.7%
3	8	69.3	-0.2%	33.9%	27.1%
4 & 5*	5	50.0	-2.0%	20.0%	14.0%†
Total	**24**	**58.8**	**11.5%**	**27.1%**	**23.3%**

† Denotes a statistically significant difference between Climate Region 1 and Climate Regions 4 and 5 at the 90% confidence level.

* Climate Regions 4 and 5 were combined because Region 5 only had one representing site.

Table 3-3 reports the average annual energy savings for low-rise on-sites, grouped by the version of Title 24 energy code under which they were permitted. Sites built to the 2008 standards had higher compliance margins than those built to 2005 standards, but this is not a perfect comparison of performance because 2008 Title 24 energy code accounts for certain measures that the 2005 version did not.

[63] Climate Regions are composed of Climate Zones (CZs) established in Title 24 documentation. We aggregated Climate Zones by matching those that had the same Title 24 requirements or differed by up to one component. Region 1 includes CZs one through five, Region 2 includes CZs six and seven, Region 3 includes CZs eight through ten, Region 4 includes CZs 11 through 13, and Region 5 includes CZs 14 through 16. For more details, see: KEMA, Nexus Market Research, Summit Blue Consulting, Itron and the Cadmus Group. 2009. *Phase I Report Residential New Construction (Single Family Home) Market Effects Study*, prepared for the California Public Utilities Commission Energy Division, Study ID: CPU0030.08.

Table 3-3: Low-Rise On-Sites – Estimated Energy Savings Relative to Applicable Title 24 Codes by Title 24 Code Version

Permitted Code Year	# of Sites	Avg. # of Units	Avg. Annual kWH Savings	Avg. Annual Therm Savings	Avg. Annual Combined Energy Savings (kBTU)
2005 T24	13	49.7	4.6%	28.3%	23.7%
2008 T24	11	77.0	19.7%	25.6%	22.9%
Total	**24**	**58.8**	**11.5%**	**27.1%**	**23.3%**

Table 3-4 through Table 3-6 display the impact of several key measure categories on annual energy savings based on the measure-specific parametric runs.[64] The percentages indicate the effect of the specific measure on the annual energy savings, assuming all other measures are specified to minimum compliance with Title 24. The domestic hot water (DHW) measures account for the bulk of the energy savings in the low-rise sites, resulting in sites that are nearly 19% more efficient than code requirements alone. Envelope insulation and HVAC measures account for the bulk of the remaining savings, while fenestration and glazing are slightly less efficient than code requirements, on average. There are relatively small differences in measure-level savings across the sites subject to the three different levels of efficiency requirements (Table 3-4).

Table 3-4: Low-Rise On-Sites – Estimated Annual Energy Savings Attributable to Individual Measure Types, by Efficiency Requirements

Efficiency Requirements	# of Sites	Avg. # of Units	Avg. Annual Energy Savings (kBTU)						
			Glazing / Fenestrat.	Envelope Insulat.	Cool Roof	HVAC	DHW	Other / Interactive	Total
Standard T24 Requirements	5	80.8	-2.9%	5.6%	0.0%	1.0%	17.3%	0.2%	21.2%
Favored / Encouraged*	10	39.0	2.4%	1.7%	0.0%	0.6%	17.7%	-0.3%	22.1%
Required EE	9	69.3	-1.7%	2.3%	0.0%	2.1%	20.9%	2.2%	25.8%
Total	**24**	**58.8**	-0.2%	2.7%	0.0%	1.3%	18.8%	0.7%	**23.3%**

*As previously discussed, prior to 2011, CTCAC did not require developers to build more efficiently than code, but did award competitive points for doing so.

[64] The glazing/fenestration measure takes into account external shading devices, and the HVAC measure takes into account the distribution system. The "other/interactive" measure represents the difference between the sum of savings of the five independent, measure-specific parametric runs and the whole-building annual energy savings. Measures and building characteristics included in "other/interactive" include fans, pumps, and other features not captured in the measure-specific parametric runs.

DHW measures account for the bulk of the savings across the Climate Regions, though there appears to be great variation, ranging from a low of 11.3% savings in Climate Regions four and five to 23.5% savings in Climate Region three (Table 3-5).

Table 3-5: Low-Rise On-Sites – Estimated Annual Energy Savings Attributable to Individual Measure Types, by Climate Region

Climate Region	# of Sites	Avg. # of Units	Avg. Annual Energy Savings (kBTU)						
			Glazing / Fenestration	Envelope Insulation	Cool Roof	HVAC	DHW	Other / Interactive	Total
1	7	80.8	-3.0%	7.2%	0.0%	1.1%	18.8%	2.5%	26.5%
2	4	39.0	1.4%	1.1%	0.0%	<0.1%	18.8%	0.4%	21.7%
3	8	69.3	-0.4%	0.6%	0.0%	2.1%	23.5%	1.3%	27.1%
4 & 5	5	50.0	2.6%	1.1%	0.0%	1.2%	11.3%	-2.2%	14.0%
Total	**24**	**58.8**	-0.2%	2.7%	0.0%	1.3%	18.8%	0.7%	**23.3%**

Table 3-6 displays the same savings for each measure type, comparing low-rise on-sites permitted under the 2005 and 2008 Title 24 energy code versions.

Table 3-6: Estimated Energy Savings Relative to Applicable Title 24 Codes for Individual Measure Types, by Title 24 Energy Code Version

Code Version	# of Sites	Avg. # of Units	Avg. Annual Energy Savings (kBTU)						
			Glazing / Fenestrat.	Envelope Insulation	Cool Roof	HVAC	DHW	Other / Interactive	Total
2005 T24	13	53.3	0.9%	1.3%	0.0%	1.4%	20.0%	0.2%	23.7%
2008 T24	11	65.2	-1.5%	4.4%	0.0%	1.1%	17.4%	1.4%	22.9%
Total	**24**	**58.8**	-0.2%	2.7%	0.0%	1.3%	18.8%	0.7%	**23.3%**

3.2 High-Rise On-Sites' Energy Performance

The following section presents the energy savings results based on the four high-rise on-site visits conducted by Cadmus. All four sites were built subject to 2008 Title 24 energy efficiency requirements, all were subject to above-code requirements or pressures, and all exceeded the Title 24 energy code. The evaluation team found that all significant measure categories (glazing/fenestration, envelope insulation, cool roof expansion, HVAC, and domestic hot water) were verified to meet or exceed the 2008 Title 24 code requirements on each project, with no incident of a measure falling out of code compliance (more details about each of the four high-rise sites are available in Appendix D).

Table 3-7 presents the overall estimated energy savings (electricity, natural gas, and both combined) for each site compared to the 2008 Title 24 energy codes that applied to the four high-rise sites, along with basic characteristics of each site.

Table 3-7: High-Rise On-Sites – Estimated Energy Savings Relative to 2008 Title 24 Codes

Site No.	Climate Zone	Efficiency Requirements	# of Stories	# of Units	Annual kWH Savings	Annual Therm Savings	Annual Combined Energy Savings (kBTU)
Case Study Site One	3	Required EE (Market-Rate+Reach)	<10	5 to 19	1.5%	41.4%	20.9%
Case Study Site Two	3	Required EE (Market-Rate+Reach)	10+	200+	0.4%	55.9%	29.2%
Case Study Site Five	9	Favored / Encouraged (CTCAC) *	<10	60 to 79	7.2%	19.8%	20.5%
Case Study Site Six	8	Required EE (CTCAC)	<10	60 to 79	8.9%	39.2%	25.9%
Total (Mean)	**N/A**	**N/A**	**7.3**	**106.5**	**4.5%**	**39.1%**	**24.1%**

*As previously discussed, prior to 2011, CTCAC did not require developers to build more efficiently than code, but did award competitive points for doing so.

In terms of electric usage, the overall estimated electric Energy Use Intensity (EUI) for the residential portion ranged from 4.10 to 5.30 kWh/sq. ft per site.

Table 3-8 presents the estimated energy performance for significant measure types compared to the applicable 2008 Title 24 energy codes. As with the low-rise sites, the DHW measures accounted for the bulk of the savings for the high-rise sites.

Table 3-8: High-Rise On-Sites - Estimated Energy Savings Relative to 2008 Title 24 Codes for Individual Measure Types

Site No.	Efficiency Requirements	# of Stories	# of Units	Avg. Annual Energy Savings (kBTU)					
				Glazing & Envelope Insulation*	Cool Roof	HVAC	DHW	Other / Interactive	Total
Case Study Site One	Required EE	<10	5 to 19	-1.7%	0.0%	0.0%	22.1%	0.5%	20.9%
Case Study Site Two	Required EE	10+	200+	0.1%	0.0%	0.0%	29.4%	-0.4%	29.2%
Case Study Site Five	Favored / Encouraged	<10	60 to 79	0.8%	0.6%	1.3%	11.2%	6.7%	20.5%
Case Study Site Six	Required EE	<10	60 to 79	2.5%	1.9%	0.1%	18.4%	3.0%	25.9%
Total (Mean)	**N/A**	**7.3**	**106.5**	**0.4%**	**0.6%**	**0.4%**	**20.3%**	**2.4%**	**24.1%**

* For high-rise sites, fenestration/glazing is included with the envelope insulation measure.

4 Case Study Summaries

This section presents the main drivers and barriers reported by respondents affiliated with the 15 case study sites, reports the compliance margins of each site relative to Title 24, and summarizes the characteristics of the sites. More detailed information on the individual sites, with a focus on how efficiency-related decisions were made, is included in Appendix C. Those longer narratives include an in-depth discussion of key actors and their relationships, factors that determined the efficiency of the project, interesting site features, and so forth.

Additionally, Section 5 includes analyses of the case study interviews and other data sources that inform the baseline measurements of key market effects outcomes and indicators posited to be associated with the MFNC program.

In Table 4-1 and Table 4-2, we summarize the major and minor drivers and barriers associated with each case study project; later in this section we provide site-by-site summaries, including the key drivers and barriers of energy efficiency that interviewees associated with the particular case study project.[65, 66]

CTCAC expectations or requirements were identified as a driving factor for the largest number of projects; interviewees consistently described them as a major determinant to advancing the energy efficiency of a project and a major factor for 12 of the 13 low-income projects' energy efficiency goals. Reach codes acted as a major driver for many projects as well (5 projects). Either as minor or primary drivers, many case study projects pursued energy efficiency in order to reduce operating costs (10), increase project marketability (7), and attain soft money[67] or public officials/agency support (6).[68]

The cost of equipment was the greatest challenge for projects to achieve energy efficiency: interviewees described it as a major hurdle for 11 of the projects and a minor problem for one project. Timing often presented a barrier, identified by nine projects as a minor reason that the projects were not as energy-efficient as they might have been. Interviewees pointed to problems with hiring and/or involving their consultants or making decisions about equipment too late.

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[65] In some cases interviewees emphasized specific elements, and in other cases they may have only touched on certain elements that may have contributed but were not major factors.

[66] Section 6 reports interviewees' general assessment of drivers and barriers; in that section, we analyze the percentages of *interviewees* that pointed to particular drivers and barriers.

[67] Case study respondents described "soft money" partners as local agencies (the now-dissolved Redevelopment Agencies, for example), municipalities, or other public officials that are willing to offer their assistance in helping with the development of a MFNC project (such as financial support, zoning variances, marketing assistance, and so forth), in exchange for the developer tailoring the project to meet certain goals of those backers, such as building to above-code standards or including affordable housing units, or similar goals.

[68] The marketability of energy efficiency was associated with the marketability and cachet of the voluntary green program the project was participating in, such as LEED or GreenPoint Rated.

Table 4-1: Case Study Site Summary of Key Drivers to Energy Efficiency

Driver	**Case Study Site**														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CTCAC			●	●	●	●		●	●	●	●	●	●	●	●
Reduce operating costs	○	○		○	○	○	○			○		●	●	●	
Marketability of energy efficiency	○	○			○	○			○				○	●	
Soft money/public agency encouragement		○				○	○	●				●	○		
Knowledgeable design team									○	○		●	○	○	
Mission-driven developer						○				○		●	○	●	
Reach code	●	●	●				●			●					
Standard design practices					●	●			○	○			●		
Economic downturn lowered costs					●	●				○					
Green-minded design team	○	○													
Marketability of GreenPoint Rated	○											●			
NSHP incentives										○			○		
Other	○												○	○	○

● denotes that interviewees described the element as a major or primary energy efficiency driver for the site.

○ denotes that interviewees described the element as only a minor or secondary energy efficiency driver for the site.

Table 4-2: Case Study Site Summary of Key Barriers from Energy Efficiency

Barriers	**Case Study Site**														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Costs	●		○	●	●	●	●	●	●	●		●	●	●	●
Timing	○		○	○			○	○	○	○		○	○		
Hassle of green program participation					○					○		○	○	○	○
Limited interest among key actors				○						○		○	○		
Equipment reliability concerns					○					●				○	
Non-energy efficiency code requirements		○	●							○					
Difficulty with equipment installation					○	●								○	
Other										○	○	○			

● denotes that interviewees described the element as a major or primary energy efficiency barrier for the site.

○ denotes that interviewees described the element as only a minor or secondary energy efficiency barrier for the site.

The research team was able to conduct on-site visits at 13 of the 15 case study sites. The team calculated that nine of those sites had compliance margins that were within ten percentage points of the average compliance margin estimated by the case study respondents during in-depth interviews (Table 4-3).[69] In the "Difference" column in Table 4-3, projects found to have higher compliance margins (i.e., are more efficient) in the on-site analysis are shaded green, and projects found to have lower compliance margins are shaded red. Three of the sites were calculated to have much higher compliance margins than respondents estimated; only four were lower than respondents estimated, and only one was much lower than respondents thought. It is important to note that this comparison is meant to be illustrative only; respondents were not always able to recall the exact compliance margins. In addition, the respondents might have been thinking in terms of TDV-based compliance margins (whereas the on-site analysis is based on total annual energy usage) or, despite the instructions of interviewers, thinking of the building as a whole rather than just the residential areas (as was done for this on-site analysis).

Table 4-3: Case Study Compliance Margins: Respondents vs. On-Sites

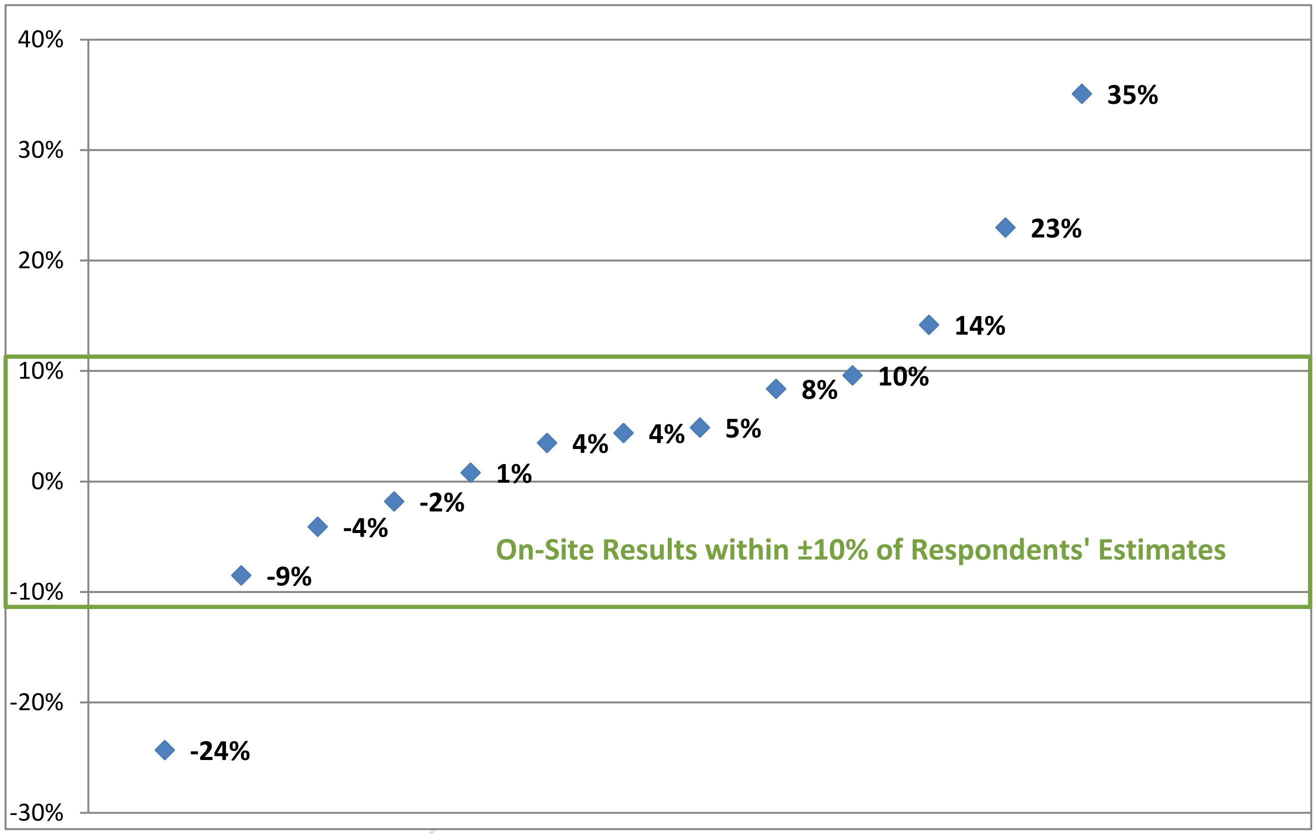
(Sorted from least to most efficient, according to respondents; values rounded)

Case Study Site No.	Respondents' Avg. Compliance Margin	On-Site Compliance Margin	Difference
Site 9	10%	18%	8%
Site 12	14%	12%	-2%
Site 7	15%	19%	4%
Site 2	15%	29%	14%
Site 3	15%	N/A	N/A
Site 13	17%	21%	4%
Site 8	20%	21%	1%
Site 6	21%	26%	5%
Site 4	21%	N/A	N/A
Site 15	25%	1%	-24%
Site 1	25%	21%	-4%
Site 11	25%	48%	23%
Site 5	29%	21%	-9%
Site 14	31%	66%	35%
Site 10	41%	51%	10%

[69] In some cases, respondents provided differing estimates of the energy efficiency of the case study projects. This could be explained by differences in memory, or because they were remembering different compliance reports—for example, residential and common spaces, or just residential areas, or even compliance documentation that was not the final version. The figures provided are thus the average compliance margins of all respondents who were able to provide a numerical estimate of the site's performance relative to code.

Figure 4-1 plots the difference between the respondents' estimates and the on-site modeling results for each of the case study sites where on-sites were conducted. The green box shows sites where the differences are within 10%.

Figure 4-1: Difference Between On-Site Results and Respondent Estimates



4.1 Case Study Site One: Interviews and On-Site

Site One is a relatively small high-rise project built in the San Francisco area for market-rate renters (under 10 stories and with fewer than 20 units). The developer attained GreenPoint Rated certification to comply with San Francisco's local energy ordinance (reach code) that requires greater energy efficiency than required by Title 24. Interviewees said that the IOU MFNC program had no direct impact on the project.

Respondents described an environmentally conscious design team that had to scale back its initial plans for a particularly efficient project due to budget restrictions in the wake of the economic downturn. Ultimately, they sought to comply with the local reach code with a bit of margin. Respondents estimated it was between 20% and 30% better than standard (BTS)[70] (25%, on average), which aligns with the compliance calculations performed by the research team, who

[70] Better than standard (BTS) is a common term used in discussing energy compliance margins relative to a baseline home built according to Title 24 energy code standards.

estimated that it was 21% more efficient than 2008 Title 24 energy code, based on our on-site visit and compliance calculations.

This was a typical project for the design team in terms of energy efficiency: "No one was looking to break any new ground." The interviewed consultants described their role as providing the guidance necessary to help the developer meet its obligations under San Francisco's reach code.

The key drivers and barriers to the energy-efficiency level of Site One that interviewees described are presented below in Table 4-4.

Table 4-4: Case Study Site One - Key Drivers and Barriers

Drivers	Major	Minor
Reach code	✓	
Green-minded design team		✓
Marketability of GreenPoint Rated brand and energy efficiency		✓
Reduce operating costs		✓
Non-energy benefits of efficiency measures (noise reduction)		✓
Barriers	**Major**	**Minor**
Costs	✓	
Timing (GreenPoint Rater brought on late)		✓

4.2 Case Study Site Two: Interviews and On-Site

Site Two is a large high-rise building in the San Francisco area consisting of market-rate rental units (10+ stories, 200+ units, 200,000+ square feet). The design team decided to attain LEED certification during project conception as a means of complying with San Francisco's reach code. Respondents did not know why this project did not go through the IOU MFNC program, nor were they able to speak to the IOU MFNC program's impact on construction practices in the MFNC market.

Respondents estimated that the energy compliance margin was around 15% BTS (near the San Francisco minimum threshold); the on-site team estimated its performance to be substantially higher, at 29% BTS. The design team viewed LEED as their baseline from the outset, and thus incorporated energy efficiency features earlier than on projects for which they do not have to meet such specific criteria. The whole design team had similar ideas about energy efficiency and how to meet those goals, and it was "part of the DNA" of the design process, given its pursuit of LEED.

Table 4-5 presents the drivers and barriers that interviewees mentioned impacted the energy efficiency level of Site Two.

Table 4-5: Case Study Site Two - Key Drivers and Barriers

Drivers	**Major**	**Minor**
Reach code (drove to LEED)	✓	
Green-minded design team		✓
Marketability of energy efficiency		✓
Reduce operating costs		✓
Expedited permitting		✓
Barriers	**Major**	**Minor**
Non-energy efficiency code requirements		✓

4.3 Case Study Site Three: Interviews

Site Three is a high-rise building in the San Francisco area that is under 10 stories, with between 60 and 79 affordable housing units, and was built by a non-profit developer. This project sought GreenPoint Rated certification in an effort to meet San Francisco reach code requirements and achieve competitive points for CTCAC, and respondents estimated that it was around 15% more efficient than Title 24. The design team, led by a non-profit developer, had a limited budget and was just targeting the minimum requirements of the jurisdiction and the CTCAC program. The IOU program did not directly influence this project in any way, according to interviewees.

Respondents had mixed perspectives on the energy efficiency decisions made by the design team; some thought they prioritized efficiency early on, but others thought that decisions were made on an ad-hoc basis, and that things were quite "fluid." The drivers and barriers to the energy-efficiency level of Site Three, as cited by interviewees, are presented below in Table 4-6.

Table 4-6: Case Study Site Three - Key Drivers and Barriers

Drivers	**Major**	**Minor**
Reach code	✓	
CTCAC	✓	
Barriers	**Major**	**Minor**
Historic preservation	✓	
Costs		✓
Timing (Rater brought on late)		✓

4.4 Case Study Site Four: Interviews

Site Four is a high-rise building in Los Angeles County that is under 10 stories, with between 60 and 79 units for low-income tenants, built by a for-profit developer. In an effort to receive funding from CTCAC as well as public funding, this developer pursued and obtained GreenPoint Rated certification. It was constructed outside of a reach code area and was not directly influenced by the IOU program, according to the interviewees.

Respondents estimated that the project was between 15% and 25% more efficient than Title 24 code required (21%, on average), employing a solar-assisted DHW system for common space water usage. The design team reported that meeting CTCAC guidelines was critical for this project and that without the CTCAC efficiency requirements, efficiency would not have been a priority; the engineers on the project were also less interested in efficiency than the designer, which created some hurdles in implementing an efficient design. Table 4-7 summarizes the drivers and barriers to the energy efficiency level of Site Four that the interviewees described.

Table 4-7: Case Study Site Four - Key Drivers and Barriers

Drivers	**Major**	**Minor**
CTCAC	✓	
Reduce operating costs		✓
Barriers	**Major**	**Minor**
Costs	✓	
Engineering consultant not interested in energy efficiency		✓
Timing (energy consultant brought on late)		✓

4.5 Case Study Site Five: Interviews and On-Site

Site Five is an affordable, high-rise housing project built by a for-profit developer in the Los Angeles area (under 10 stories, with 60 to 79 units, and between 40,000 and 65,000 square feet). The design team used LEED certification to meet CTCAC energy efficiency guidelines and was able to upgrade the energy efficiency and reach a higher LEED tier than they had initially planned because construction bids were lower than expected after the economic downturn. All four respondents were familiar with the IOU MFNC program, but reported that it did not have a direct impact on the project.

Respondents estimated that the project was between 24% and 50% better than standard (29%, on average); based on an on-site visit, the research team estimates that it was approximately 21% BTS. Solar PV panels were installed to offset the owner's operating costs on the common areas, and the design team clearly saw energy efficiency as a means of marketing their work; the green-minded developer and design team marketed the project's efficiency and were encouraged to obtain LEED by public officials.

Table 4-8 summarizes interviewees' descriptions of the drivers and barriers to the energy efficiency level of Site Five.

Table 4-8: Case Study Site Five - Key Drivers and Barriers

Drivers	**Major**	**Minor**
CTCAC	✓	
Standard design practices	✓	
Economic downturn lowered costs	✓	
Reduce operating costs		✓
Marketability of energy efficiency		✓
Barriers	**Major**	**Minor**
Costs	✓	
Hassle of LEED certification		✓
Equipment reliability concerns		✓
Limits to modeling software capabilities		✓

4.6 Case Study Site Six: Interviews and On-Site

Site Six is a high-rise building (under 10 stories) with between 60 and 79 affordable units. It was constructed in Orange County in a non-reach-code area by a non-profit developer. It attained LEED certification as a means of meeting CTCAC sustainability guidelines, and respondents thought that they did not use any particularly "exotic" methods to achieve this. Respondents estimated that it was about 21% BTS, and calculations based on the team's on-site results showed that its compliance margin was higher, at 26% BTS. The developer had applied to participate in the IOU MFNC program, but had not been able to participate,[71] though the developer does frequently participate in the program since it is already building to elevated efficiency standards to comply with CTCAC guidelines. None of the interviewees attributed the program with impacting the efficiency level of the project.

The non-profit developer normally targeted LEED certification on its projects and would adjust the final efficiency performance based on available budget once nearing the construction phase. Like with Site Five, the design team was able to achieve a higher-than-planned level of efficiency because construction bids were lower than the developer thought they would be, as contractors offered lower bids to stay competitive during the economic downturn.

[71] Respondents could not recall why they were not able to participate in the IOU program.

Table 4-9 lists all of the drivers and barriers to the energy efficiency level of Site Six, as cited by interviewees.

Table 4-9: Case Study Site Six - Key Drivers and Barriers

Drivers	**Major**	**Minor**
CTCAC	✓	
Standard design practices	✓	
Economic downturn lowered costs	✓	
Reduce operating costs		✓
Marketability of energy efficiency		✓
Mission-driven developer		✓
City partners encouraged energy efficiency		✓
Barriers	**Major**	**Minor**
Costs	✓	
Hassle and timing impacts of adding energy efficiency	✓	

4.7 Case Study Site Seven: Interviews and On-Site

Site Seven is a low-rise project (fewer than four stories) in the San Francisco area, with between 20 and 39 affordable housing units, built by a for-profit developer. The now-dissolved San Francisco Redevelopment Agency (RDA) provided financial support for the project, and the units were intended for low-income families. To comply with the city's reach code, the project participated in GreenPoint Rated; additionally, the RDA encouraged energy efficiency on the project. The IOU program did not directly affect the efficiency level of the project, in large part because the developer was unfamiliar with the program.

The developer did not participate in the IOU MFNC program, but did receive IOU incentives from NSHP for inclusion of solar DHW and PV systems. The team focused on "tried and true" measures to comply with the city's reach code as cost-effectively as possible; cost was the ultimate determinant of the achieved energy efficiency. Respondents estimated it was about 15% BTS (to comply with the minimum reach code requirements), and the on-site research team calculated it to be 19% BTS based on information they collected.

Table 4-10 presents the drivers and barriers to the energy efficiency level of Site Seven that the interviewees reported.

Table 4-10: Case Study Site Seven - Key Drivers and Barriers

Drivers	Major	Minor
Reach code	✓	
Reduce operating costs for future homeowners		✓
Encouragement from Redevelopment Agency		✓
Barriers	**Major**	**Minor**
Costs (split-incentive)	✓	
Timing (energy efficiency not incorporated early enough)		✓

4.8 Case Study Site Eight: Interviews and On-Site

Site Eight consists of low-rise buildings housing between 40 and 59 units for low-income residents. It was a higher-tier LEED project located in southern California, not within a reach code jurisdiction. It was developed by a non-profit organization and supported by CTCAC and other public and private funds. Interviewees could not assess the impact of the IOU program on the energy efficiency level of the project.

A website for the project estimates that the site was about 20% BTS, and the research team's on-site visit reports a compliance margin of 21% BTS. Respondents described focusing on passive design elements to maximize shading and reduce demand for air conditioning in the hot climate. The energy efficiency achieved was "based on economics," according to the respondents. At the time, CTCAC provided points to projects building to above-code standards, and "all they wanted to do is maximize their CTCAC points" to increase their chances of winning tax credit funding.

Table 4-11 lists the drivers and barriers to the energy efficiency level of Site Eight that the interviewees mentioned.

Table 4-11: Case Study Site Eight - Key Drivers and Barriers

Drivers	Major	Minor
CTCAC	✓	
Encouragement from Redevelopment Agency	✓	
Barriers	**Major**	**Minor**
Costs	✓	
Timing (some energy efficiency measures added later)		✓

4.9 Case Study Site Nine: Interviews and On-Site

Site Nine is an affordable, low-rise housing project, with between 40 and 59 units, built by a for-profit developer in the Central Coast region. The project met CTCAC sustainability guidelines (not mandatory at that time), but did not participate in any green certification programs, and was not subject to reach code. The IOU program was not attributed with any direct influence on the project.

Respondents described the project as being around 10% more efficient than 2005 Title 24 code, though an on-site visit conducted for this evaluation estimated its performance to be 18% better than standard. The developer was "looking for the best value" to guide the selection of measures to install; the team used an efficient central DHW system paired with inefficient (but reliable) electric resistance heating, anticipating that the heating system would not be used much during the mild winters. The developer left a planned solar PV array off the project due to budget constraints, and did not install air conditioning.

This was one of the developer's last non-LEED projects and was built when the developer was transitioning to green certifications as standard practice; in addition to the goal of pursuing CTCAC, the developer explained that they incorporated this approach as a standard practice because "we wanted to stand above our competitors." Table 4-12 lists the drivers and barriers to the energy efficiency level of Site Nine that the developer and the other interviewees mentioned.

Table 4-12: Case Study Site Nine - Key Drivers and Barriers

Drivers	**Major**	**Minor**
CTCAC	✓	
Standard design team practices		✓
Marketability of energy efficiency		✓
Differentiation from other projects		✓
Knowledgeable design team		✓
Barriers	**Major**	**Minor**
Costs	✓	
Timing (energy efficiency requires early planning)		✓

4.10 Case Study Site Ten: Interviews and On-Site

Site Ten is a low-rise affordable housing project including between 40 and 59 units. Constructed by a non-profit developer in a reach code location in the southern Central Coast of California, this project received CTCAC funding and participated in the NSHP. It was built with a focus on simplicity and low maintenance costs. The IOU program did not directly affect the energy efficiency level of this project because the developer respondent and the architect were unaware of the IOU program.

As with other case study sites, construction bids were lower than expected due to the economic recession, helping to lower site costs and allowing the developer to put extra money toward energy efficiency. The design team described a highly efficiency project, just over 40% BTS, which corresponds to the on-site team's slightly higher estimate of about 51% BTS. The design team thought that, due to the mild climate, they were able to achieve high energy savings with minimal effort (forgoing air conditioning and using efficient DHW systems and passive cooling/shading measures), but that the mild climate also reduced the relative priority of energy efficiency (they would have been more concerned about energy efficiency if the climate had been more harsh).

Table 4-13 presents the drivers and barriers to the energy efficiency level of Site Ten, as cited by interviewees.

Table 4-13: Case Study Site Ten - Key Drivers and Barriers

Drivers	**Major**	**Minor**
Reach Code	✓	
CTCAC	✓	
Economic downturn lowered costs		✓
Reduce operating costs		✓
Standard design practices		✓
Mission-driven developer		✓
NSHP incentives		✓
Mild climate (e.g., no AC)		✓
Knowledgeable design team		✓
Barriers	**Major**	**Minor**
Costs	✓	
Reliability concerns	✓	
Timing (HERS Rater hired and inspections done too late)		✓
Public/zoning officials prioritize aesthetics		✓
Low investor interest in energy efficiency		✓
Mild climate makes energy efficiency less critical		✓
NSHP participation hassles		✓

4.11 Case Study Site Eleven: Interviews and On-Site

Site Eleven was a low-rise project in the Los Angeles area including between 20 and 39 affordable units for low-income tenants. It was constructed outside of a reach code area, and respondents estimated that it was about 25% BTS, on average. The research team calculated a compliance margin of 48% BTS. The non-profit developer obtained GreenPoint Rated certification to boost its application for CTCAC funding (CTCAC did not require efficiency at the time). Obtaining CTCAC funding was a critical—and typical—goal of the developer. It made energy efficiency commitments to CTCAC at the outset of the project's conception, and then attempted to balance the fact that the size of the building and the lot put some limits on the technologies it could use on the site (Table 4-14). The MFNC program did not appear to affect the energy efficiency of this project because the developer was unaware of the MFNC program.

Table 4-14: Case Study Site Eleven - Key Drivers and Barriers

Drivers	**Major**	**Minor**
CTCAC	✓	
Barriers	**Major**	**Minor**
Project layout/size limited possible energy efficiency measures		✓

4.12 Case Study Site Twelve: Interviews and On-Site

Site Twelve is an affordable, low-rise housing project with between 40 and 59 units built in the San Diego area. It was built by a for-profit developer who obtained the property at a discounted price under a partnership with a public agency. Built under the 2005 Title 24 requirements and not subject to reach code, the project used GreenPoint Rated to gain CTCAC competitive scoring points and qualify for NSHP incentives for the solar panels added to the common spaces to offset the developer's operating costs.

Respondents thought that it was around 15% BTS (14%, on average), and the on-site visit confirmed a similar 12% BTS. The interviewed design team members reported that the IOU program did not impact the project, but they were unable to pinpoint why they had not participated, given that the project did participate in the similar NSHP program.

Table 4-15 summarizes the drivers and barriers to the energy efficiency level of Site Twelve that interviewees described.

Table 4-15: Case Study Site Twelve - Key Drivers and Barriers

Drivers	Major	Minor
CTCAC	✓	
Mission-driven developer	✓	
Public funding sources	✓	
Reduce operating costs	✓	
Knowledgeable design team	✓	
Marketability of GreenPoint Rated	✓	
Barriers	**Major**	**Minor**
Costs	✓	
Hassle of GreenPoint Rated		✓
Too many decision makers at developer firm		✓
Timing (GreenPoint Rater hired too late)		✓
Disinterest from engineer		✓

4.13 Case Study Site Thirteen: Interviews + On-Site

Site Thirteen was a low-rise project with between 60 and 79 affordable housing units set in central California, outside of a reach code jurisdiction. Developed by a for-profit developer, this CTCAC project[72] achieved GreenPoint Rated certification and received incentives from the NSHP and USDA MFNC programs. The developer applied to participate in the IOU MFNC program, but respondents said that the application was denied because the project was too far into the design and construction to be able to meet all of the program criteria.

Interviewees estimated that Site Thirteen was around 15% BTS (17% BTS, on average), and on-site analysts estimated that it was 21% BTS. The developer installed solar PV systems on the common spaces as a means of lowering the operating costs. The Housing Authority representative described how, as the investor rather than the developer on this project, he was “the passenger,” could not drive or substantially impact the developer’s goals, and would have built to an even higher level of efficiency if he had been the developer.[73]

[72] CTCAC required energy efficiency at the time.
[73] The Housing Authority could also purchase the property from the developer in the future, and thus reported that he would have liked to see even greater efficiency in the common spaces because the associated energy costs of the common spaces could potentially become his responsibility in the future.

Table 4-16 presents the drivers and barriers influencing the energy efficiency level of Site Thirteen.

Table 4-16: Case Study Site Thirteen - Key Drivers and Barriers

Drivers	**Major**	**Minor**
CTCAC	✓	
Standard design practices	✓	
Reduce operating costs	✓	
Mission-driven developer		✓
NSHP and USDA energy efficiency incentives		✓
Knowledgeable design team		✓
HERS verification		✓
Marketability of energy efficiency to investors		✓
Barriers	**Major**	**Minor**
Costs	✓	
Developer only somewhat mission-driven		✓
Hassles (HERS verification)		✓
Timing (HERS Rater hired too late)		✓

4.14 Case Study Site Fourteen: Interviews and On-Site – IOU Program Participant

Site Fourteen is the only confirmed IOU MFNC program participant among the fifteen case study projects. It is an affordable housing project with between 20 and 39 units in low-rise buildings. It was built in San Diego County in a non-reach code jurisdiction by a non-profit developer with a focus on above-code projects as a part of its mission, and it participated in the GreenPoint Rated program as a means of obtaining competitive CTCAC funding (CTCAC required above-code efficiency at the time).

The developer had no specific numeric target for efficiency, but wanted to surpass CTCAC's minimum threshold (15% BTS) as much as possible within the budget; energy efficiency lowered the operating expenses, but also contributed to the prestige of the non-profit, helping it attract investors and donors. Despite participating in the IOU MFNC program, three key respondents—the architect, developer, and HERS/GreenPoint Rater, all with CAHP program experience—said that the program had virtually no impact[74] on the efficiency of the project because it was already being built to efficiency levels far beyond CAHP requirements in order to be competitive for CTCAC.

Respondents estimated that the project was somewhere between 20% and 40% BTS (31%, on average), and the on-site visit estimated an even higher compliance margin of 66% BTS. Though it was an IOU MFNC program participant, respondents said it was CTCAC, not the IOU program,

[74] The city investor noted that the IOU asked the design team to benchmark the project's energy performance over time to monitor its real-world energy consumption, but did not otherwise impact the actual efficiency of the project.

that drove the efficiency of the project: "CAHP is just the whipped cream," i.e., an unnecessary but welcome funding source.

Table 4-17 presents the drivers and barriers to the energy efficiency level of Site Fourteen.

Table 4-17: Case Study Site Fourteen - Key Drivers and Barriers

Drivers	Major	Minor
CTCAC	✓	
Marketability of energy efficiency to investors/donors	✓	
Reduce operating costs	✓	
Mission-driven developer	✓	
Small design team		✓
Knowledgeable design team		✓
Willingness to undergo IOU program hassles		✓
Barriers	**Major**	**Minor**
Costs	✓	
Equipment reliability concerns		✓
Installation problems		✓
Hassles/costs of working with multiple programs		✓

4.15 Case Study Site Fifteen: Interviews + On-Site

Site Fifteen includes between 40 and 59 units for low-income tenants in low-rise buildings. This low-rise project, built in the greater Sacramento region, was built by a non-profit developer outside of reach code jurisdiction. In pursuit of meeting CTCAC minimum requirements (which required above-code efficiency at the time), this project received EGC certification. While the developer interviewee reported that Site Fifteen was 25% higher than Title 24 requirements, our research team's modeling estimates that it was right at code, about 1% above 2008 Title 24 requirements. The developer and HERS Rater/engineer reported that the IOU MFNC program did not influence the project.

The developer reported that meeting these above-code targets "is pretty much what you have to hit" to secure CTCAC financing. For affordable housing, CTCAC's energy efficiency requirements are "just a fact of life you have to deal with."

Table 4-18 lists the drivers and barriers impacting the energy efficiency level of Site Fifteen that the developer and other interviewees cited.

Table 4-18: Case Study Site Fifteen – Key Drivers and Barriers

Drivers	**Major**	**Minor**
CTCAC	✓	
Utility allowances overcome split-incentive*		✓
Barriers	**Major**	**Minor**
Costs	✓	
Hassles of CTCAC		✓

* The rent paid to the developer/owner can be increased if the developer has lowered the occupant's utility bills by building to above-code standards.

5 Baseline Measurement of Market Effects Indicators and Expected Outcomes

A key objective of this study is to collect baseline measurements of indicators of market effects of the IOU MFNC program. While we do not yet expect to find extensive evidence of market effects, we use the indicators of potential market effects to organize our findings within a theoretical framework and report on the current state of the market.

The CPUC Energy Efficiency Evaluation Protocol[75] follows the definition of market effects offered by Eto, Prahl, and Schlegel: “A change in the structure of a market or the behavior of participants in a market that is reflective of an increase in the adoption of energy-efficient products, services, or practices and is causally related to market intervention(s).”[76] Further, the CPUC Evaluation Protocols specify that market effects encompass non-participant spillover, which are savings from those who are not directly participating in a utility program but reduce their energy use after being influenced by a utility program.

The research topics included in this chapter focus on market changes, such as changes in practices by market actors, including developers (i.e., supply-side changes), or changes in consumer preferences and demand (i.e., demand-side changes). In this chapter, we directly focus on baseline measurements of the extent to which the IOU MFNC program resulted in market changes and impacts outside of the program, such as influencing market actors to implement above-code practices even when not participating in the program, or increased availability of high-efficiency equipment in the marketplace in general (Figure 5-1 shows this relationship within the program theory logic model). We also compare the relative level of influence between the IOU program and other market drivers, including other programs, policies, and regulations.

The key data sources for this chapter include the case study interviews, the survey of MFNC developers, and the on-site visits and energy modeling. It is important to note that all of the samples are overrepresented by low-income projects and projects with high-efficiency requirements. For example, nearly all of the case study sites (13 of 15) were low-income sites, which commonly have efficiency requirements associated with their funding, and all of the case study sites faced high-efficiency requirements or encouragement to receive funding. As a result, the findings from the case studies are not fully representative of the market-rate MFNC market.

We present the summary of our findings in this chapter and provide the detailed findings in Appendix B.

[75] California Public Utilities Commission. 2006. *California Energy Efficiency Evaluation Protocols: Technical, Methodological, and Reporting Requirements for Evaluation Professionals.* San Francisco: California Public Utilites Commission

[76] Eto, J., R. Prahl, and J. Schlegel. 1996. A Scoping Study on Energy Efficiency Market Transformation by California Utility DSM Programs. Berkeley: Lawrence Berkeley National Laboratory.

5.1 Program Theory and Logic

As discussed in the first phase of this evaluation, the IOU MFNC program places considerable emphasis on a long-term goal of transforming the MFNC market toward widespread Zero Net Energy (ZNE) construction practices.[77]

Figure 5-1 depicts the IOUs' MFNC program logic model presented in the Phase I report. It is based on the evaluation team's review of program materials, market research, and interviews with program staff and market actors from the first phase of this research study. The outcomes and market transformation indicators were thus based on informed theory, and information related to key outcomes and indicators was collected in this second phase (Phase II) of the evaluation.

On the left side of the program portion of the model are the IOU program's key elements. Branching out to the right are the expected short-, medium-, and long-term outcomes of these program elements, along with the connections between intermediary steps toward the long-term outcomes.[78] The bold lines in the program model indicate the key links from program elements to outcomes indicating market effects.

Key IOU program elements that could eventually lead to market transformation include the following:[79]

- **Efficiency criteria.** IOU program criteria could drive demand for high-efficiency products and could serve as standards that other voluntary efficiency programs (LEED, ENERGY STAR, etc.) or municipalities (in the form of "reach code"[80]) might decide to adopt.
- **Incentives.** Incentives should help to overcome increased costs of energy-efficiency equipment, design and construction costs, and split-incentives barriers. By decreasing the extra cost for higher levels of efficiency, incentives can help lead to greater acceptance from builders and also increased economies of scale.

[77] Southern California Gas Program, Program Implementation Plans: Statewide Programs, Appendix B.2, Section A, April 23, 2013, http://www.socalgas.com/regulatory/documents/A-12-07-003/Appendix%20B.2%20Section%20A%20Statewide%20Programs.pdf, accessed May 1, 2015, p. 207. Market transformation discussion for RNC program starts on page 202.

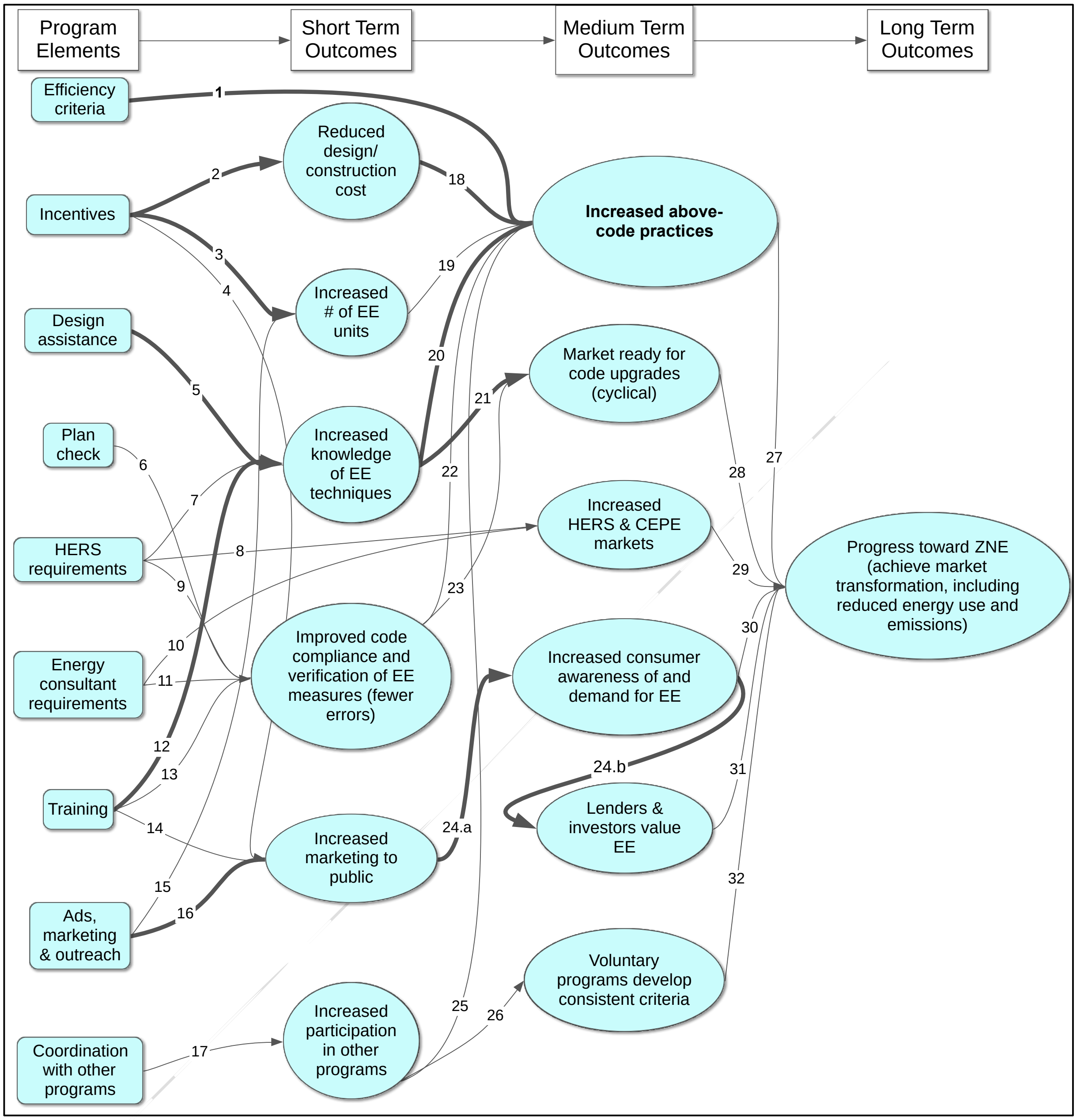
[78] From left to right, the model moves from the specific program components to the broader, long-term effects on the market that the program is intended to achieve (i.e., market effects). A critical medium-term outcome in the model (indicated by its relatively large size) is the increase in above-code practices in the MFNC market; program elements consistently point toward this outcome. The sole long-term outcome of the program efforts would ultimately be progress toward California's goal of ZNE, which would indicate a market transformation and, of course, be accompanied by reduced energy use and greenhouse gas emissions.

[79] The remaining program elements, such as plan check, can also affect the market but not to the same extent as the key elements identified.

[80] The IOUs' Reach Code Subprogram of the Codes and Standards Program contributes directly to this adoption of consistent criteria. "IOUs have and will continue to promote regionally consistent ordinances where possible to reduce the duplication of efforts that results when individual government entities develop the language and technical supporting documentation independently." Source: Southern California Gas Program, Program Implementation Plans: Statewide Programs, Appendix B.2, Section A, April 23, 2013, http://www.socalgas.com/regulatory/documents/A-12-07-003/Appendix%20B.2%20Section%20A%20Statewide%20Programs.pdf, accessed January 28, 2014.

- **Design assistance.** Design assistance offers an educational opportunity for market actors, teaching them about advanced building practices to mitigate barriers related to builder knowledge, information, or willingness to build efficiently.
- **Training.** IOU training should result in increased knowledge among market actors as well as improved designs and construction processes. Marketing-focused trainings can lead developers to improve or increase their marketing of energy-efficient construction, ideally leading to increased consumer demand for more above-code construction.
- **Advertising, marketing, and outreach.** IOUs market the program to developers and encourage developers to market efficiency to homebuyers. If lenders and investors perceive a growing demand for energy-efficient construction, they may begin to value energy efficiency as an important characteristic of the buildings in which they invest.

Figure 5-1: IOU MFNC Program Model



*Key links from program elements to outcomes are shown in bold.

5.2 Summary of Findings of Individual Market Effects Indicators and Expected Outcomes

In the Phase I report, the evaluation team identified a wide variety of theorized market effects associated with the IOU new construction programs. This list was informed by market actors, program staff, and additional market characterization research. The team traced the links between specific program elements and market outcomes and suggested indicators that could be monitored over time to evaluate whether or not those outcomes occurred and whether the IOU programs contributed to their occurrence (recognizing the difficulty of attribution in a complex market environment where the IOU programs are not the sole market intervention).

Of the more comprehensive list of theorized outcomes, the evaluation team proposed eight key market outcomes that could potentially result from IOU program activities. In the Phase II research, the evaluation team used on-site visits, case studies involving in-depth interviews with market actors, and CATI surveys with developers to collect data on these outcomes, which are as follows:

- Increased above-code practices in non-program homes
- Reduced design and construction costs
- Increased numbers of above-code, efficient units being constructed
- Increased knowledge of efficiency building practices
- Increased marketing of efficiency to the public
- Enhanced readiness for code upgrades
- Increased consumer demand for efficient construction
- Increased lender and investor demand for efficient construction

The team also collected data on the following three additional outcomes:

- Expanded Certified Energy Plans Examiner (CEPE) market
- Baseline measurement of non-program MFNC energy performance
- Voluntary "green" programs develop standards consistent with the IOU program standards

Table 5-1 summarizes the IOU program elements and associated outcomes that the team investigated in the Phase II study. The table identifies program elements, their associated outcomes, indicators for the outcomes, numbered links in the program model, the timing of the expected outcome, and recommended timing of data collection for the expected outcome. Key indicators are identified in bold, but the evaluation team also collected data on additional indicators in this study.

Table 5-1: Program Elements, Expected Outcomes and Indicators

Program Element	Outcome	Indicator	Link	Timing of Outcome	Timing of Data Collection
Incentives	Reduced design and construction costs	**Market actors report that incentives lower the incremental costs for above-code, energy-efficient design and construction.**	2	Short-term	Ongoing
	Increased numbers of above-code, efficient units being constructed	**Developers report that they would not be able to build the same quantity without IOU funding.**	3	Short-term	Ongoing
	Increased above-code practices	**Market actors report decreasing incremental costs of energy-efficient technologies and practices as a factor encouraging their use.**	18	Med.-term	Ongoing
Efficiency Criteria	Increased above-code practices	**On-site inspections confirm increased above-code practices in non-program homes.**	1	Med.-term	Every three to four years
		Increased stock/availability of high-efficiency equipment reported by market actors.	1	Med.-term	Ongoing
Design Assistance & Training	Increased above-code practices	**Market actors report increased awareness of EE practices (including integrated design) from program efforts has changed practices in non-program homes.**	20	Med.-term	Ongoing
	Increased knowledge	**Market actors report they learned from the IOUs' design assistance offerings, including the value of integrated design.**	5	Short-term	Ongoing
		Market actors report that they participated in and learned from trainings.	12	Short-term	Ongoing
	Readiness for code upgrades	**Market actors are aware of and ready for coming code changes as a result of the program.**	21	Med.-term	Up to one year before every code cycle change
Advertising, Marketing, and Outreach	Increased marketing of efficiency	**Developers report increasing their marketing of energy efficiency.**	16	Short-term	Ongoing
	Increased consumer demand	**Market actors report increasing homebuyer and renter demand for energy efficiency, thus encouraging developers to increase their adoption of above-code practices.**	24.a	Med.-term	Ongoing
	Increased demand for efficient construction by	**Lenders and investors require EE measures/criteria in the projects in which they invest.**	24.b	Med.-term	Every three to four years

Program Element	Outcome	Indicator	Link	Timing of Outcome	Timing of Data Collection
	lenders and investors				
Plan Check	Improved code/above-code compliance	Market actors report that program plan check catches modeling errors that would not be corrected otherwise.	6	Short-term	Ongoing
HERS Requirements	Improved code/above-code compliance	HERS Raters report that they ensure that installed measures meet Title 24, program, or manufacturer standards.	9	Short-term	Ongoing
Energy Consultant Requirements	Expanded CEPE market	Energy consultants or other market actors report an increase in demand or supply for licensed energy consultants (due to the program).	10	Med.-term	Every three to four years
	Improved code/above-code compliance	Market actors report that licensed consultants produce higher quality Title 24 documents with fewer errors than their non-certified counterparts.	11	Short-term	Ongoing if possible, but likely only every three to four years
Coordination with Other Programs	Consistent "green" program criteria	Consistent "green" program criteria	26	Med.-term	Every three to four years, or time with code or program cycle changes

In the Phase I report, we uncovered a few dynamics that demonstrate the IOUs' relationship to and influence on reach codes and CTCAC. We suggest that the reader keep these in mind when considering this section's assessment of the IOU MFNC program indicators.

- **The IOUs have played a key role in reach code adoption and implementation.** The IOUs' Codes and Standards Program includes a Reach Code Subprogram element that provided both policy guidance and technical support to local municipalities regarding the adoption and implementation of reach code. An important aspect of this assistance came in the form of performing climate-specific studies on the cost-effectiveness of implementing reach code, which municipalities could use in their applications to the CEC.[81]

[81] For more information on the IOUs' efforts to foster the adoption of reach code in California, see the Cadmus Group evaluation of the 2010-2012 Reach Code Subprogram within the Codes and Standards Program. The Cadmus Group, Inc., *Reach Code Subprogram 2010-2012 Process and Pilot Impact Evaluations*, prepared for the California Public Utilities Commission, October 2013. https://www.pge.com/regulation/EnergyEfficiency2015-BeyondRollingPortfolios/Other-Docs/ED/2014/EnergyEfficiency2015-BeyondRollingPortfolios_Other-Doc_ED_20140507_304180Atch01_304181.pdf

- **CTCAC aligned its standards with other programs, including the IOU MFNC program.** CTCAC intentionally chose to adopt efficiency standards that aligned with the efficiency requirements of existing programs such as the IOU MFNC program during the course of the 2010 through 2012 IOU program cycle. (The CTCAC standards have since been revised to measure energy compliance relative to the 2008 Title 24 code version, while the IOU MFNC program's 2014-2015 cycle measures compliance relative to the 2013 Title 24 code version.)
- **The IOU program incentives facilitated CTCAC standards.** One Phase I interviewee involved in the creation of the original CTCAC efficiency standards reported that CTCAC would not have adopted the above-code requirements if the IOUs' programs were not available to help cover the costs of building 15% more efficiently than code.

5.2.1 Expected outcome: Increased above-code practices in non-program homes

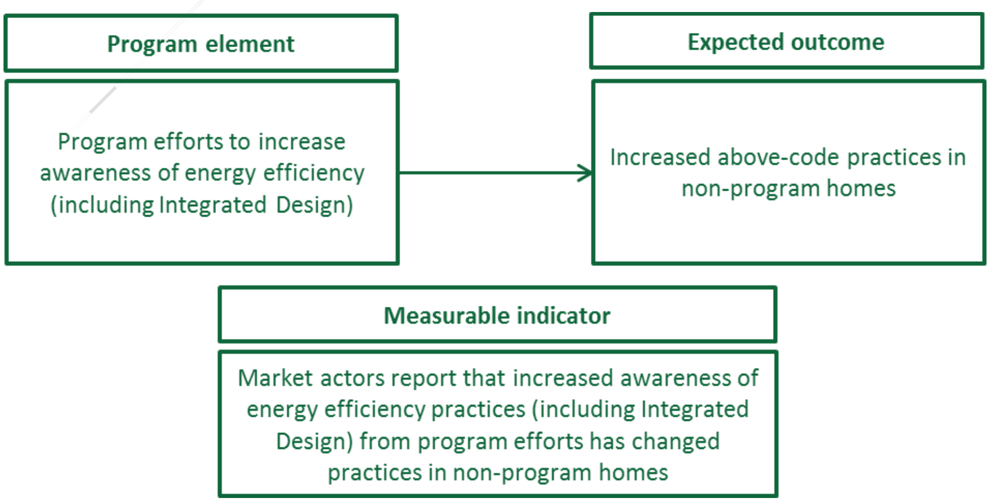
Several program elements could contribute to the outcome of increased above-code practices in non-program homes. In this section, we present findings associated with the following measurable indicators of a link between IOU program elements and that expected outcome:

- *Increased awareness of energy efficiency practices*
- *On-site inspections and energy modeling*
- *Increased stock and availability of high-efficiency equipment*

We present the findings associated with other indicators of the link between program elements and above-code practices, such as *increased knowledge* (due to IOU trainings and program design assistance), later in this chapter.

5.2.1.1 Increased awareness of energy efficiency practices

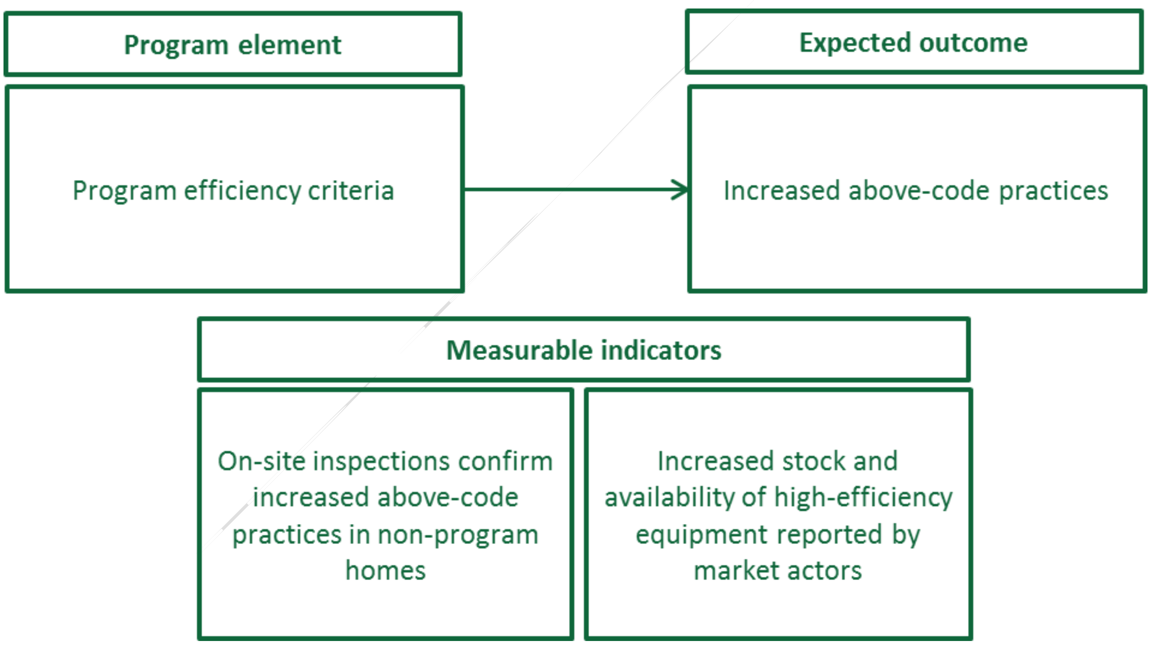
The figure below shows the link between the program element and the expected outcome. It also shows the measurable indicator assessing how increased awareness influenced building practices, as presented in the logic model (Table 5-1).



Summary of Findings: Some evidence suggests that IOU MFNC program practices were adopted into non-participating projects, signifying the potential presence of market effects. However, various voluntary green and affordable housing programs and policies, such as CTCAC and LEED, were reported to be the key driver of this indicator, substantially increasing market actor knowledge and impacting their practices. The IOU program appears to be a secondary market intervention driving this outcome in comparison to other programs. Interviewees explained that practices learned through the IOU program—and from other similar programs—became standard practices, resulting in the implementation of new measures into non-program projects (especially if they were cost-effective). Case study interviewees and survey respondents more often emphasized that reach codes, CTCAC, and LEED requirements had the greatest influence on developers' standard practices, both when they were and when they were not participating in non-IOU programs or subject to the requirements of reach codes or CTCAC funding.

5.2.1.2 Program efficiency criteria driving above-code practices and equipment availability

Program efficiency criteria are expected to lead to above-code practices. The indicators linking efficiency criteria and above code practices include on-site inspections and increased stock and availability of high-efficiency equipment (see the figure below and Table 5-1).



Increased Above-Code Practices – On-site Inspections and Energy Modeling

The first indicator shown above—on-site inspections confirm increased above-code practices in non-program homes—was addressed in Phase II research through on-site visits and contextualized through case study interviews.

***Summary of Findings*:** While the sampled projects from this assessment are overrepresented by low-income projects and those with efficiency requirements, there is clear evidence that projects are being built outside of the IOU MFNC program to above-code standards due to market forces and various market interventions, including reach code, CTCAC requirements, “soft money” sources, and so forth.

The research team calculated that all 28 projects with on-site visits were at or above code (24.6% BTS, on average), though 82% of these sites were subject to pressure or requirements to build more efficiently than code due to CTCAC or reach code. However, projects not subject to any above-code efficiency requirements were, on average, over 20% more efficient than code requirements. Case study respondents were also experienced with above-code building practices (all of the case study sites were designed to be at least 10% BTS), and 79% of surveyed developers reported that the biggest project they worked on from 2010 through 2012 was an above-code project.

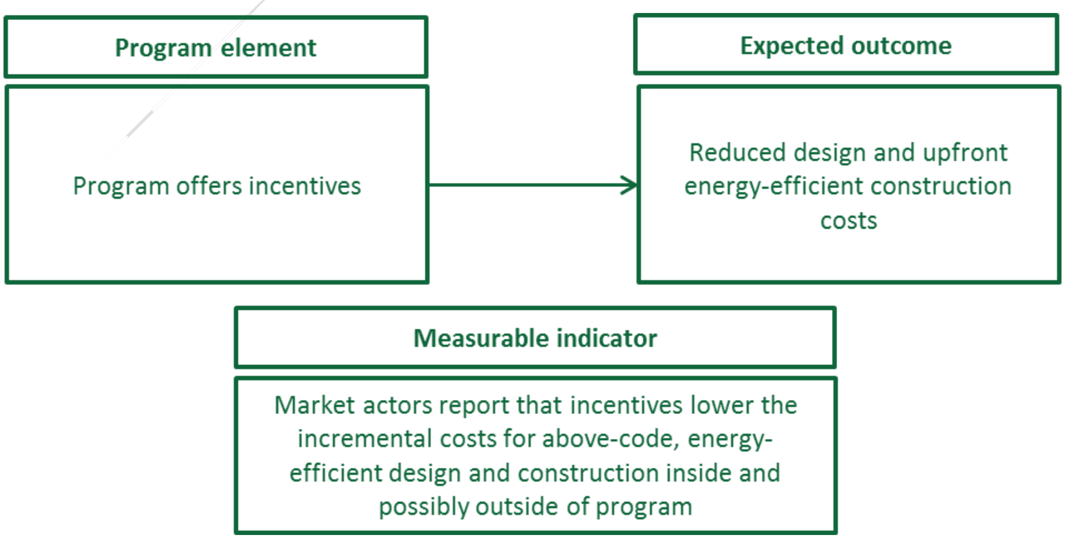
Increased Stock and Availability of High-efficiency Equipment

The second indicator in the above illustration that is related to this program element is the increased stock and availability of high-efficiency equipment.

Summary of Findings**:** Further research is needed to shed light on the effects of the IOU programs on the stock and availability of high-efficiency equipment, such as through analysis of supplier inventories. In general, case study respondents did not point to concerns about lack of equipment availability. However, they did express a common concern that the available high-efficiency equipment either was not—or was perceived not to be—as reliable as standard efficiency equipment.

5.2.2 Expected outcome: Reduced design and construction costs

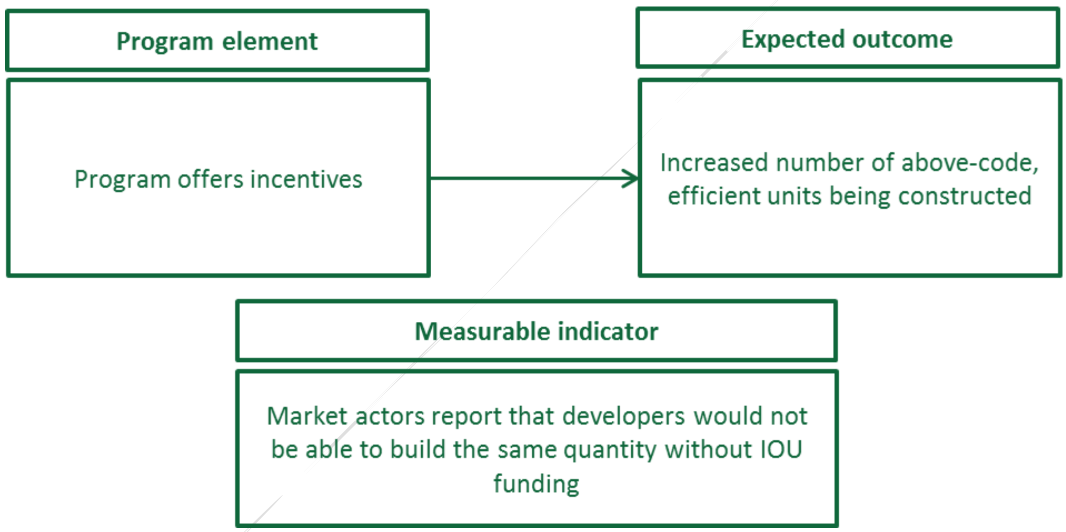
Financial incentives are a key IOU program mechanism designed to overcome barriers related to the cost and hassle of building to above-code standards and are designed to help address the split-incentive barrier, whereby the project owners/developers have less incentive to build efficiently because they do not pay the residents’ utility bills. This program element, linked outcome, and measurable indicator of that linkage are illustrated below.



***Summary of Findings*:** Case study interviewees provided insufficient evidence to suggest that there were changes in the incremental costs of energy-efficient practices or technologies outside of the IOU MFNC program.[82] IOU incentives can reduce the marginal cost of building to above-code standards, but some developers perceive barriers to program participation, such as the amount or timing of the incentives that are only received at project completion, well after developers have had to put together their project financing and capital.

5.2.3 Expected outcome: Increased numbers of above-code, efficient units being constructed

The IOUs' incentives and program outreach to developers are designed to encourage participation in the IOU new construction programs and could potentially encourage developers to build more above-code units than they would without that financial or informational support. This program element, linked outcome, and indicator of that linkage are illustrated below.



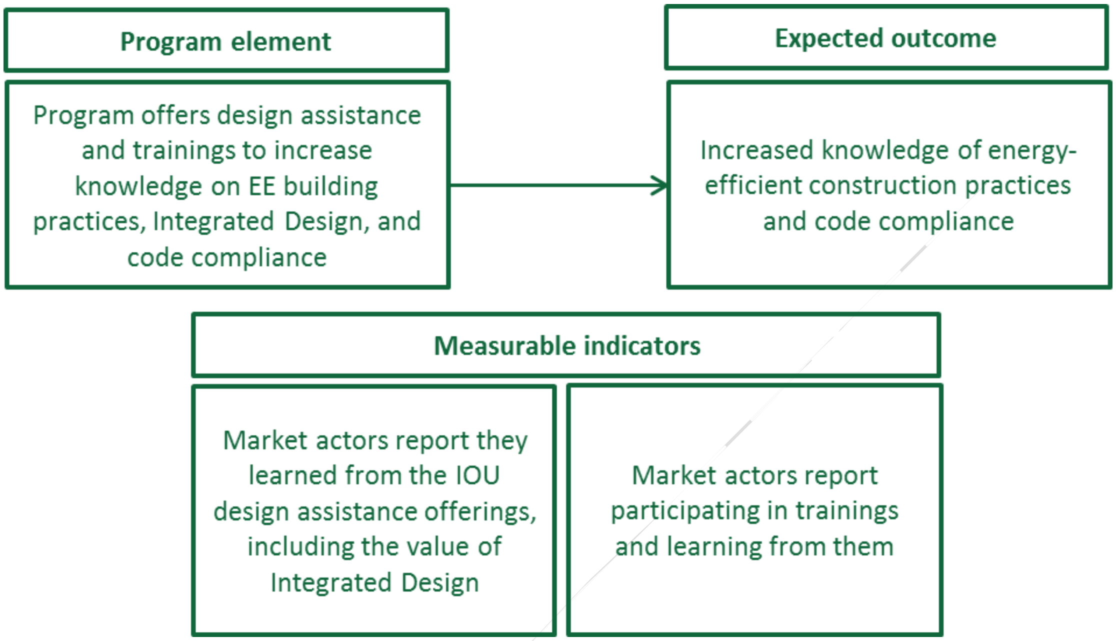
Summary of Findings: High levels of IOU MFNC program participation (38% of California units started from 2010 through 2012) suggest that the program could positively impact the number of units built, but Phase II interviews and surveys did not uncover evidence that the program was doing so.

5.2.4 Expected outcome: Increased knowledge

The IOUs offer design assistance and training to market actors under the assumption that knowledgeable market actors are also better able to comply with code, meet voluntary criteria, and carry this knowledge into future projects (both program and non-program projects). The IOU MFNC program design assistance teaches market actors about advanced building practices and the value of Integrated Design practices by providing feedback on specific projects going through the

[82] Only two respondents, a market-rate developer and a HERS Rater, specifically mentioned the price of newer technologies decreasing in recent years, and they both attributed this to demand triggered by efficiency programs, but not the IOU program; the developer saw it driven by LEED, and the rater by CTCAC. Developers were not asked about changes to incremental pricing for efficiency measures.

IOU program. The trainings seek to increase market actors' ability to meet advanced building requirements cost-effectively through improving their designs and construction processes. Together, program design assistance and trainings strive to overcome barriers related to market actor knowledge, information, and willingness to build efficiently. The program element, theorized outcome, and measurable indicators of that link illustrated below summarize these dynamics as included in the program theory logic model.



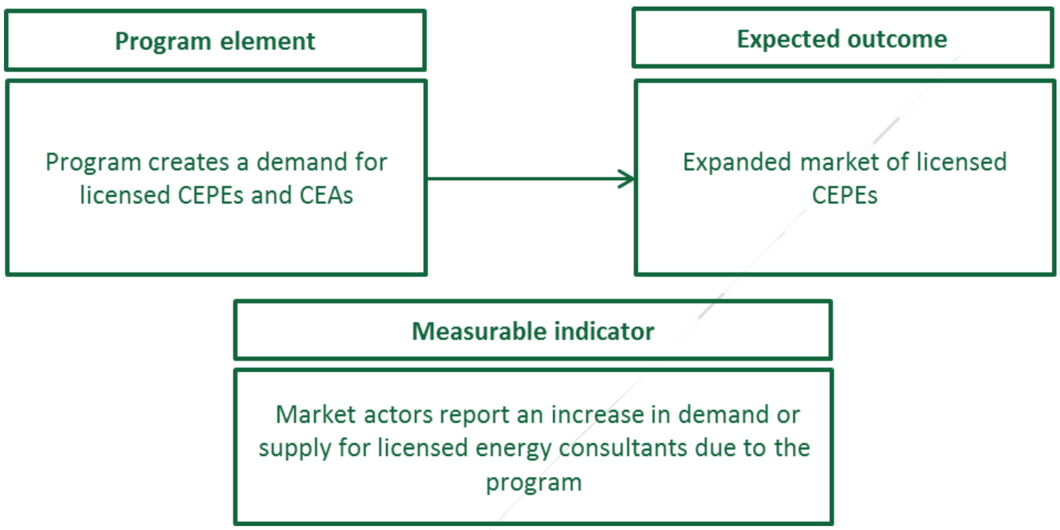
Summary of Findings: Phase II case study interviews and developer surveys showed that the IOU MFNC program training and design assistance influenced those who participated, but, as mentioned previously, the IOU program offerings serve as one of several market interventions in California (CTCAC, LEED, GreenPoint Rated, etc.) that offer trainings to help MFNC market actors to improve their design and construction. In addition, relatively low levels of program awareness and lower rates of participation in training hinder the program's ability to affect the market.

Case study respondents reported that these informational IOU MFNC program elements had increased attendee/recipient knowledge and also impacted their energy efficiency practices outside of IOU program projects: Nearly two-fifths of case study interviewees indicated that IOU MFNC program training and/or design assistance increased their knowledge about energy efficiency, and sizable shares of developers who had received training said that it influenced the efficiency level of their non-program project practices. Some interviewees did not view the training and design assistance as particularly influential, suggesting, among other things, that the IOUs increase the specificity of their guidance.

Twenty-seven percent of the 33 developer survey respondents received IOU training. Overall, 15% of respondents, representing 19% of all units started among respondents, said that the training was somewhat or very influential on their design practices, while 9% rated the training as very influential on their construction practices.

5.2.5 Expected outcome: Expanded market of licensed CEPEs

Authors of Title 24 energy compliance documentation are not required to be Certified Energy Plans Examiners[83] (CEPEs), but the IOU program does require this of documentation authors in order to increase the quality of submissions to the program. The program theory logic model posits that this program requirement could drive demand for CEPEs in the marketplace, as shown below.



Summary of Findings: Case studies revealed that the IOU MFNC program, along with other programs and requirements, have increased demand for CEPEs and CEAs to some extent.[84] Outside of the IOU program, the use of CEPEs is not required in the construction market in California, but it is encouraged by Title 24 compliance manuals and required by multiple above-code programs. Market actors perceive that CEPEs and CEAs offer helpful guidance, and the certifications themselves offer credibility to those attaining them. Our review of CABEC certification lists found that CABEC discontinued the CEPE certification and changed the CEA certification for the 2013 Title 24 standards, leaving only a small pool of individuals certified under the most recent standards. This required programs to temporarily rely on the larger pool of CEPEs certified under previous Title 24 standards.

5.2.6 Expected outcome: Improved compliance with base code and above-code programs

The IOU programs include various program elements related to quality control, training, and measure verification that are intended to ensure compliance with program requirements. This provides a level of quality control for energy efficiency measures beyond that provided for projects

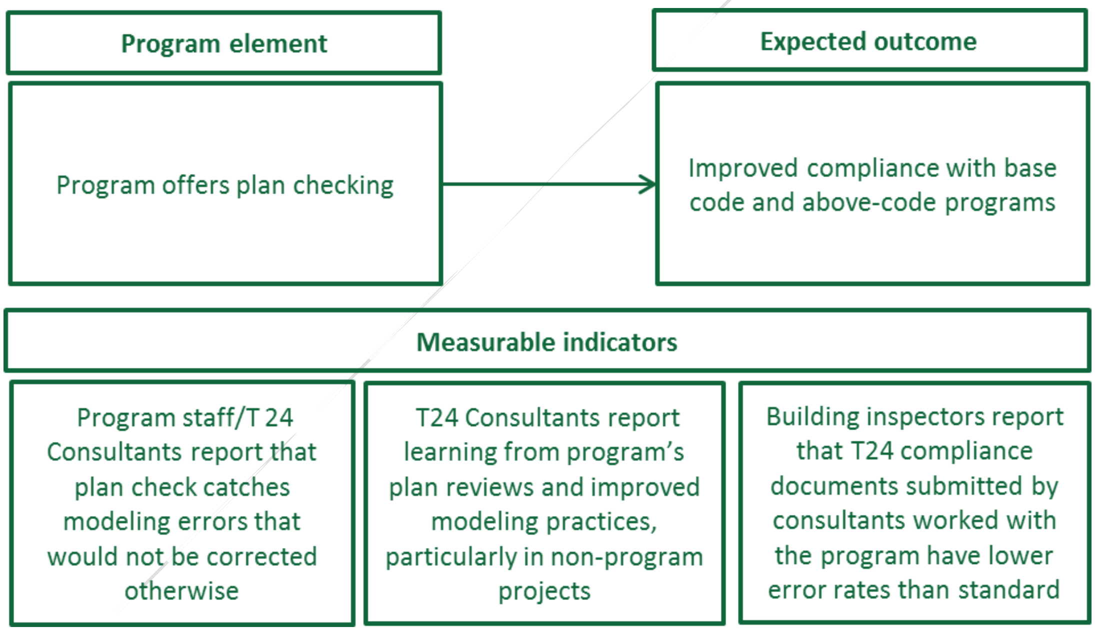
[83] Information on the CEPE certification is available at: http://www.cabec.org/cepeinformation.php.
[84] The developer CATI survey did not explore the size of the CEPE market.

only subject to base code requirements. There are severable measurable indicators of a link between IOU program elements and improved compliance:

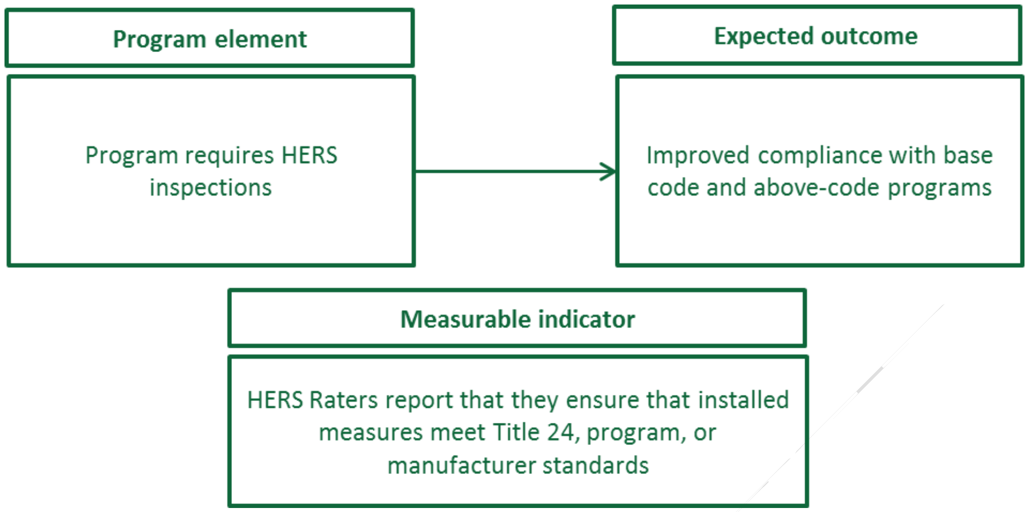
- *Market actors report that program plan check catches modeling errors that would not be corrected otherwise.*
- *HERS Raters report that they ensure that installed measures meet Title 24, program, or manufacturer standards.*
- *Market actors report that licensed consultants produce higher quality Title 24 documents with fewer errors than their non-certified counterparts.*

In this section, we describe the program elements and indicators that could lead to improved compliance and discuss the measurable indicators of those linkages between the program elements and that outcome. The program logic model theorizes that IOU program plan check, HERS inspections, usage of CEPEs, and training offerings lead to improved compliance metrics.

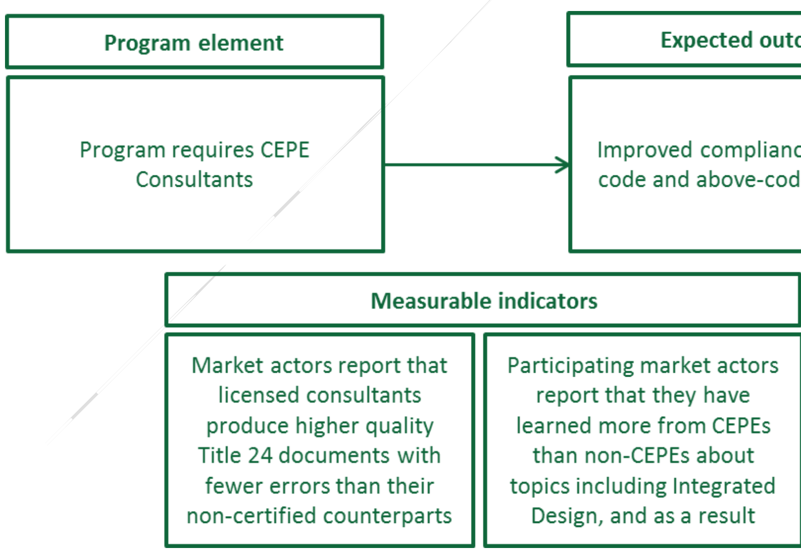
The program logic model theorizes that IOU program plan checks lead to improvements in modeling and documentation. The illustration below shows this and includes the measurable indicators.



The program logic model theorizes that mandatory IOU program HERS inspections result in improved compliance and practices as well.



Finally, the program's requirement of CEPE-certified Title 24 consultants is theorized to lead to improvements in Title 24 compliance. The indicators shown in the figure below (Indicators 11B and 11C) serve as measurement of this outcome.[85]



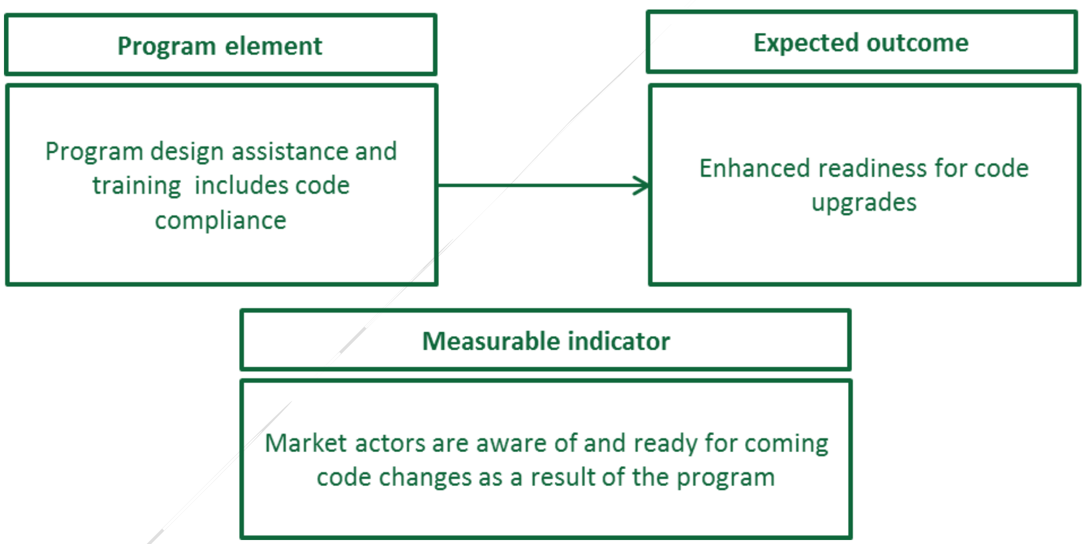
Summary of Findings: A small number of case study interviewees provided feedback that was consistent with the theorized links from the Phase I report between program elements promoting enhanced compliance with various relevant energy efficiency requirements, with some caveats. By fostering adherence to strict quality control standards, the IOU program potentially contributed

[85] Indicator 11A, "On-site inspections confirm above-code practices," is already assessed in the Link and Indicator 1 discussion (Section 5.2.1).

to market effects due to fostering a market of developers and consultants that were better able to correctly implement above-code practices in their non-program projects, as discussed in Section 5.2.1.1. Four case study interviewees found that the IOU program plan check's thoroughness was useful in identifying problems with code compliance; twelve case study respondents reported that HERS Raters (which are required by the program) were valuable in helping them navigate requirements of various above-code programs. In addition, many thought that CEPE professionals (supported by the IOU program) did high quality work. Barriers to adopting these positive influences exist, such as code officials paying less attention to energy efficiency than do IOU program plan checkers and some developers preferring not to use HERS Raters when not required to do so due to associated costs and hassles.

5.2.7 Expected outcome: Enhanced readiness for code upgrades

Due to program activities that result in increased knowledge of energy efficiency techniques (e.g., design assistance, HERS verifications, and training), the IOU program is designed to assist market actors in meeting the requirements of future code cycles. The illustration below shows this relationship and its measurable indicator.

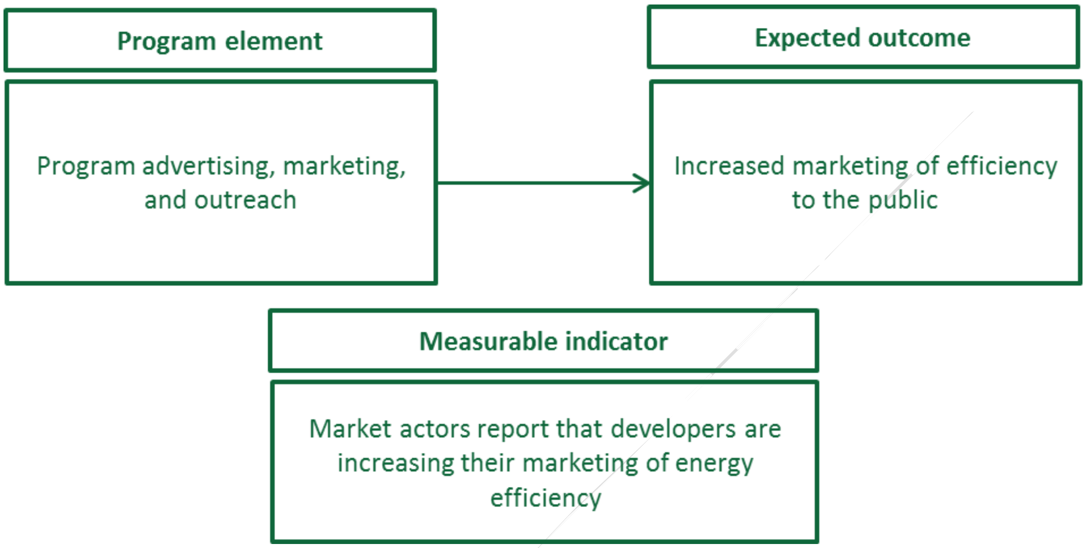


Summary of Findings: Meeting the requirements of changing energy code appears to be a challenge for many market actors. However, based on findings from this study, there is strong evidence that significant numbers of non-program multifamily homes were built in the 2010 through 2012 period using above-code practices as a means of complying with the requirements or expectations of various energy efficiency programs, such as the IOU MFNC program, CTCAC, and reach code. This suggests that at least some market actors were able to prepare beforehand for an upcoming code cycle.[86] A small number of case study interviewees credited the IOU program with improving their preparedness for future code cycles.

[86] Most of the case study respondents built projects under the 2008 Title 24 energy efficiency standards, but as of 2014, the 2013 Title 24 standards have come into effect.

5.2.8 Expected outcome: Increased marketing of efficiency to the public

Through its own marketing and outreach efforts, the IOU MFNC program seeks to increase the amount of marketing that MFNC market actors conduct. The program encourages developers to market efficiency to homebuyers with the expectation that it will stimulate consumer awareness and demand for energy efficiency. (We discuss consumer awareness and demand specifically in Section 5.2.9.) The figure below shows this dynamic as it exists in the program theory logic model.

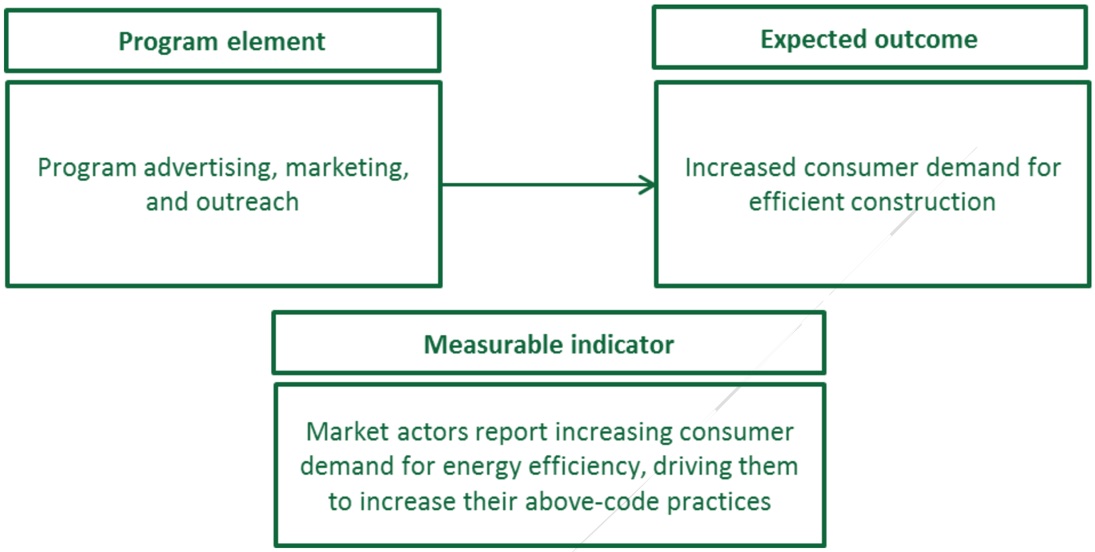


***Summary of Findings*:** While we did not find evidence of the IOU program directly increasing developers' marketing efforts, we did find that developers saw energy efficiency as an important component of their promotional efforts—particularly as a way to differentiate their projects and make them more attractive to and more likely to be supported by investors, funders, municipalities, customers, and the general public. In addition, many interviewees (15) noted the importance of green labeling programs in their marketing of energy efficiency. Most often, developers and other market actors, market experts, and IOU program representatives perceived that the LEED "brand" carried the most prestige among consumers and other stakeholders.[87] While the IOU program seeks to leverage the ENERGY STAR Homes program, market actors did not frequently point to ENERGY STAR Homes as carrying great weight for their target markets.

[87] The marketing benefit and cachet of energy efficiency and programs such as LEED apply to the low-income market outside of consumer demand; developers of green affordable housing can build their prestige, donations, or future business based on successful marketing of green features.

5.2.9 Expected outcome: Increased consumer demand for efficient construction

The IOUs' marketing, outreach, and training are intended to result in effective marketing of energy efficiency that would ideally lead to increased consumer demand for more above-code construction. (Marketing findings are described specifically in Section 5.2.8.) This relationship and its measurable indicator as presented in the program theory logic model are shown below.



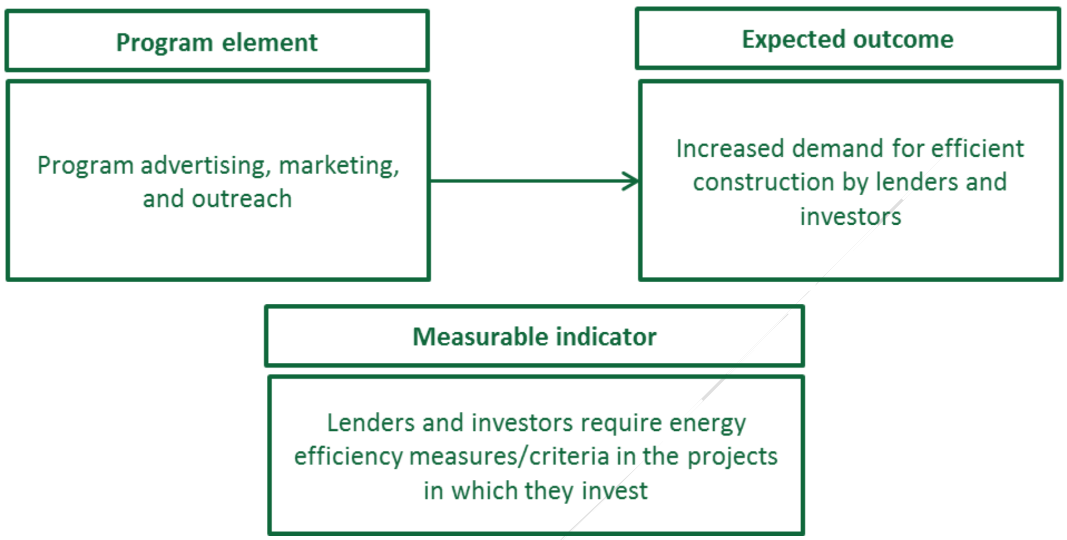
Note: This measurable indicator was accompanied by another in the program theory logic model that was not included as a task within this research effort: *Home buyers and renters report increased importance of energy efficiency as a feature and report hearing about it from marketing by the program, builders, and developers.*

Summary of Findings: The Phases I and II research activities offered evidence that consumer demand for energy efficiency exists. In particular, our findings suggest that high-income buyers possessed the highest demand for energy efficiency, and low-income customers and renters were least likely to seek energy efficiency. Interviewees attributed a lack of concern for energy efficiency among low-income customers to the fact that low-income customers had limited housing options due to affordable housing demand far exceeding the supply;[88] market actors observed that the low-income consumer segment found energy efficiency to be an added bonus, but not a critical housing feature. Case study interviewees often associated customers who were concerned with energy efficiency with being market rate and living in urban environments. We provide details on these and other findings in Appendix B. Survey respondents also attribute higher levels of demand for energy efficiency to the market-rate sector, particularly high-income buyers, but also attribute moderate levels of demand to the low-income market.

[88] CTCAC, CDLAC, HCD, and CALHFA. *Affordable Housing Cost Study: Analysis of the Factors that Influence the Cost of Building Multi-Family Affordable Housing in California*. October 2014. http://www.hcd.ca.gov/hpd/docs/FinalAffordableHousingCostStudyReport-with-coverv2.pdf, last accessed May 14, 2015.

5.2.10 Expected outcome: Increased lender and investor demand for efficient construction

To the extent that the IOU program offers successful advertising, marketing, and outreach efforts to developers and the public, its efforts could drive consumer demand for energy efficiency (as discussed in Section 5.2.9). In turn, as lenders and investors perceive this demand, they could respond by requiring developers to meet energy efficiency criteria as a condition of funding. The illustration below captures this theory.



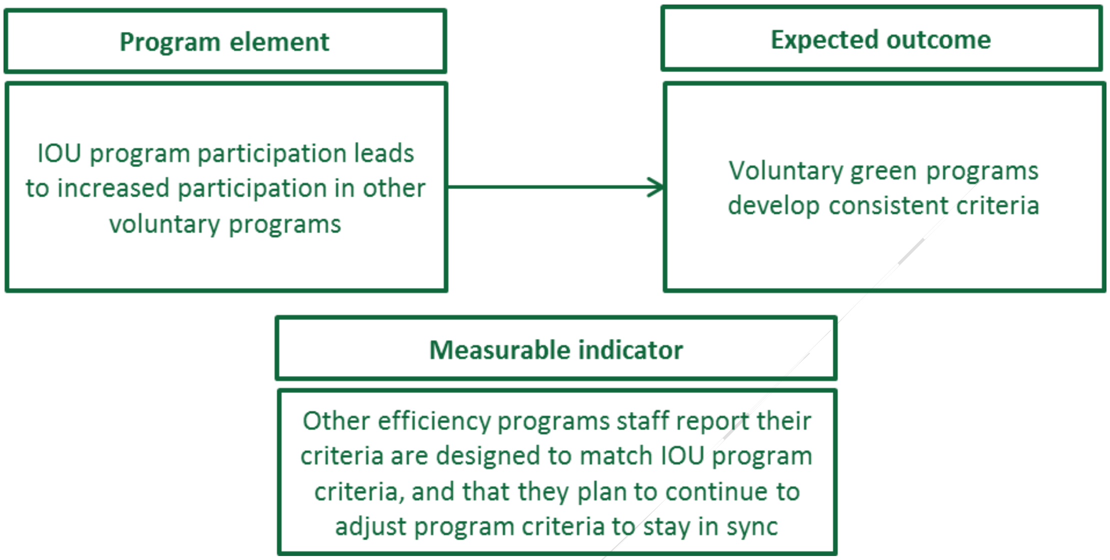
Note: This measurable indicator was accompanied by another in the program theory logic model that was not included as a task within this research effort: *Lenders to homebuyers increasingly offer and market energy-efficient mortgage products.*

Summary of Findings: Investors and lenders could have a large influence on the multifamily market should they see that consumers are demanding energy efficiency and that energy-efficient buildings can allow for greater debt service through higher rents or sales prices. However, respondents (largely focused on affordable housing) consistently reported that private investors and lenders do not require above-code efficiency practices in multifamily projects other than ensuring that the developers adhere to any commitments that they made to their various partners, such as obtaining CTCAC tax credits. While lenders and investors reported factoring expected utility costs into their financial calculations, it was not something that they would typically seek to improve, emphasizing that they prioritize attracting clients over energy efficiency.

In addition, case study respondents identified "soft money" partners—typically local agencies (such as the now-dissolved Redevelopment Agencies), municipalities, or other public officials—as occasionally requiring energy efficiency in MFNC projects within their jurisdictions. Soft money partners offer their assistance in helping with the development of a MFNC project (such as financial support, zoning variances, marketing assistance, and so forth) in exchange for the developer tailoring the project to meet certain goals of those backers, such as building to above-code standards or including affordable housing units or similar goals.

5.2.11 Expected outcome: Voluntary green programs develop consistent standards

The IOU program includes standards that are designed to complement the requirements of other green programs. The program logic model suggests that by promoting consistent green program practices, market actors could develop consistent best practices, making it easier to build above-code projects. The figure below presents these concepts as captured in the program theory logic model.



Summary of Findings: IOU planning efforts have contributed to the market effect of somewhat consistent energy-efficient construction practices that can be implemented in multiple green construction programs, particularly through the IOUs' support of developing consistent reach codes throughout California. However, differing program standards remained a challenge during the 2010 through 2012 IOU program cycle, and program standards appear to have become more fragmented since the rollout of the 2013 Title 24 energy code.

6 Drivers and Barriers

The following section first presents our findings on the general drivers and barriers of the implementation of energy efficiency building practices in the MFNC market. It then examines the drivers and barriers from participation in the IOU MFNC program and other green programs and initiatives—specifically, LEED, GreenPoint Rated, and ZNE. The reader should note that previous sections assessed the value that green programs carry for marketing efforts (Sections 5.2.8 and 5.2.10) and consumer demand (Section 5.2.9).

6.1 General Drivers and Barriers to Energy Efficiency

In our Phase I research, we collected market actor and program staff perspectives on the energy efficiency barriers and drivers or mitigating factors present in the MFNC market; we then mapped those to program efforts, linking the program's efforts to address the barriers. In the Phase II interviews and surveys, we attempted to verify and learn more about the drivers and barriers.

The Phase II research confirms the Phase I findings that financial considerations dominate developers' energy-related decisions and that developers' perspectives on the value of energy efficiency vary greatly. For example, some developers view efficiency as a hassle, while others view it as a marketable feature or a core part of their mission. A nonprofit developer of affordable housing might be motivated by altruism and a desire to attract future donors by touting advanced projects. Motivations certainly vary, but case study interviewees did indicate that it was common for for-profit developers to spend only what they had to in order to meet their internal targets, whether that was code, reach code, LEED, or CTCAC requirements. In contrast, some nonprofit, affordable housing developers might have more leeway to maximize a project's efficiency rather than reduce costs, depending on their mission and funding restrictions.

Case study interviewees were most likely to point to CTCAC (70%) and returns on investment (64%) as drivers to energy efficiency (Table 6-1). Other important drivers included reach code requirements, the developer's green approach, and marketing benefits. Interviewees most commonly identified equipment/measure costs (74%) as a barrier, followed by lack of commitment to energy efficiency and timing. After the summary of drivers and barriers presented in Table 6-1, we relate the Phase I program and market theories to the Phase II results. Some Phase II results reinforced Phase I factors, and some findings contradicted them.

Table 6-1: Case Study Interviewee Perceptions of Market Drivers and Barriers

Market Drivers and Barriers to Energy Efficiency		Number of Mentions	Percentage of Interviewees (n=50)*
Drivers	Favored by CTCAC	35	70%
	Return on investment	32	64%
	Reach code requirements	26	52%
	Developer mission/approach/type	24	48%
	Marketing tactic	20	40%
	Adequate market actor knowledge	18	36%
	Base code requirements	18	36%
	Consumer demand	15	30%
	Public officials/soft money expectations[89]	13	26%
	Attract lenders/investors/funders	13	26%
	Receive incentives	8	16%
	Improve non-energy benefits	7	14%
	Sufficient availability of equipment	6	12%
	Development process rapidity	6	12%
	Other drivers	3	6%
Barriers	Cost of equipment/maintenance	37	74%
	Conflicting developer mission/approach/type	19	38%
	Challenges with timing (e.g., consultants brought onto project too late to contribute)	14	28%
	Market actors' lack of knowledge	13	26%
	Hassle to implement	11	22%
	Limited technical feasibility	6	12%
	Lack of investor interest	5	10%
	Worsen aesthetics	4	8%
	Other barriers	5	10%

* One interviewee did not comment on the drivers or barriers; percentages total to greater than 100% because interviewees typically mentioned more than one barrier or driver.

Split incentives: Return on investment is valuable, but cost still presents a challenge. [90]

Theorized barrier: Developers pay for efficiency measures, but occupants reap the benefits.

Theorized driver/mitigating factors: Developers receive returns on investment by charging higher rents and increasing sale prices. Developers can offset costs through incentives, tax credits, etc., and receipt of innovative financing.

- *Phase II evidence*: Nearly two-thirds of case study interviewees (64%) described the attractiveness of return on investments resulting from reductions in operating expenses from investments in energy-efficient equipment and measures in their MFNC projects. This

[89] *Soft money* refers to money provided by investors and partners such as redevelopment authorities or cities investing in the projects.
[90] All of the statements in bold are the team's summaries of market actors' responses and do not reflect our opinions.

is particularly important to developers who continue to own and operate their MFNC projects and are responsible for the common space utility bills. However, a larger share of case study interviewees (74%) asserted that the cost of equipment is a barrier, with one engineer saying that developers apply pressure to keep costs low, so if the engineer himself uses a "gold plate" design approach (i.e., highly energy-efficient and expensive) then developers are unlikely to choose him for future projects. An investor added that "utility expense is a critical component of our underwriting protocol," so the returns on investment are important when seeking funding; investors/lenders may not require efficiency, but it does factor into debt service/return on investment (ROI) calculations (see Section 5.2.10 and Appendix B).

Equipment costs: Regulations and funding prerequisites trump high equipment costs.

Theorized barrier: Developers have limited access to capital for upfront costs.

Theorized driver/mitigating factors: Developers receive return on investments. Developers are required to build to efficient levels because of affordable housing regulations, lender/investor requirements, and reach codes.

- *Phase II evidence*: While case study interviewees were highly likely to consider equipment costs as a barrier, they often reported that CTCAC expectations (70%), reach code requirements (52%), statewide requirements (36%), soft money expectations (26%), and lender/investor requirements (26%) drove energy efficiency. Similarly, the majority of Phase II developer CATI survey respondents said that the most common drivers were reach codes (70%) and CTCAC requirements (55%), and nearly one-fifth (18%) pointed to lender/investor requirements. A developer called CTCAC expectations "the dominant force":

  > *When CTCAC made the sustainable practices part of the 9% scoring, there was no question that the industry was going to follow suit. That's a huge piece of capital.*

  An architect summarized that if a developer of affordable housing had made commitments to CTCAC tax credit investors, but then failed to obtain the CTCAC funding, the project would be a "catastrophic failure." We devote more discussion to the roles of other programs and regulations in Section 5.2.11 and the impact of investor requirements in Section 5.2.10 as well as Appendix B.

Risks and feasibility: Company missions and requisites outweigh hassles and feasibility doubts.

Theorized barrier: Developers face the difficulty and risk of adopting new equipment/ practices and have doubts about the feasibility of incorporating them into current practices.

Theorized driver/mitigating factors: Developers receive return on investments. They are also required to build to efficient levels because of increasingly stringent codes. Additionally, some builders are committed to green practices. Further, affordable housing projects demonstrate feasibility for the market-rate sector.

- *Phase II evidence*: In addition to identifying return on investment and other requirements as drivers, case study interviewees commonly reported that developer company goals and attitudes (48%) drove energy efficiency, particularly those that incorporated it into their company mission, where, as an interviewee put it, "the developer wants to do the right thing." Interviewees infrequently reported that implementation hassles (22%) and concern about technical feasibility (11%) presented an issue for incorporating energy efficiency into their projects.

Performance uncertainties: Equipment reliability is of limited concern.

Theorized barrier: Developers have concerns about the effectiveness of new equipment/practices and the equipment's reliability and potential maintenance.

Theorized driver/mitigating factors: Energy professionals can quantify efficiency performance. IOUs and trade organizations offer trainings.

- *Phase II evidence*: Five case study interviewees (10%) mentioned that developer skepticism about reliability of energy-efficient equipment/measures and the potential cost involved in maintenance were barriers.

Consumer demand: Energy efficiency is a marketing tool and consumer demand exists.

Theorized barrier: Developers have concerns about consumer demand, with market-rate consumers being more interested in location, price, amenities, and other features, while affordable housing tenants are typically most concerned with the availability of the housing itself rather than its energy efficiency.

Theorized driver/mitigating factors: Market-rate demand, particularly in luxury units and among buyers, is increasing. CTCAC requires energy efficiency. Energy efficiency offers market differentiation and the opportunity to market non-energy benefits.

- *Phase II evidence*: Case study interviewees often pointed to the benefits of marketing energy efficiency (40%)—with some specifically describing perceived non-energy benefits, such as increased comfort (14%)—as a driver to energy efficiency. Nearly one-third (30%) thought that consumer demand for energy efficiency exists. Survey respondents most often identified high-income customers (49%) as the market segment seeking out energy efficiency, and 87% of developers of market-rate projects estimated moderate to high levels of demand from their prospective occupants. We discuss marketing in greater detail in Section 5.2.8 and consumer demand in Section 5.2.9 as well as Appendix B.

Values and decision making: Developer commitments to energy efficiency are inconsistent.

Theorized barrier: Commitments to green building are inconsistent across developers.

Theorized driver/mitigating factors: Some builders are committed to green practices. Consumer demand may be increasing. Developers are required to build to efficient levels because of increasingly stringent codes. Key industry leaders and benchmarking data convince uncommitted builders.

- *Phase II evidence*: As mentioned above, case study interviewees commonly named developers' commitment to energy efficiency as a driver, with nearly one-half (48%)[91] mentioning it—in fact, one developer said that he selects the members of his design team based on their enthusiasm for energy efficiency, saying that he and his staff are "believers in energy efficiency, and surround ourselves with people who believe in it." However, more than one-third of interviewees (38%) thought that developers' attitudes/company missions could pose a barrier. Two of the mitigating factors identified in Phase I that are listed here were reinforced (increasing consumer demand and code requirements), but the case study interviewees did not indicate that industry leaders and benchmarking data were stimulating factors.

Market actors: Knowledgeable market actors exist and are helping to drive the market.

Theorized barrier: There is a limited availability of qualified consultants, engineers, contractors, etc.

Theorized driver/mitigating factors: After initial learning curves, developers find qualified partners and work with them on future projects, and the market downturn weeded out some low-performing contractors.

- *Phase II evidence*: Case study interviewees were more likely to report that there were knowledgeable market actors driving and facilitating energy efficiency (36%) than report that there were not enough knowledgeable market actors (26%). One architect said that the design teams typically "know the drill" and "do a similar process each time." Section 5.2.4 discusses market actor knowledge in greater detail.

Equipment availability: Equipment availability is not a problem.

Theorized barrier: There is a limited availability of energy efficiency equipment/measures. Suppliers are slow to market in California due to testing requirements.

Theorized driver/mitigating factors: Manufacturers/distributors respond to demand. Performance modeling approaches allow flexibility to choose a variety of measures.

[91] The vast majority of these interviewees represented affordable housing projects, but respondents were able to speak to their perspectives and experiences on market-rate projects as well.

- *Phase II evidence*: Case study interviewees did not identify problems with the availability of energy efficiency equipment or measures; some (12%) did, however, say that the availability of those measures drove energy efficiency. They did not speak to performance modeling. Section 5.2.1 and Appendix B.2 discuss interviewees' observations of equipment availability.

Integrated design: Integrated Design knowledge is less of a concern than equipment knowledge.

Theorized barrier: Market actors are unaware of the value of Integrated Design.

Theorized driver/mitigating factors: Market actors learn the value of Integrated Design after participating in voluntary programs.

- *Phase II evidence*: Case study interviewees did not suggest that knowledge of Integrated Design served as a barrier or driver. As described above, however, more than one-quarter of them did observe that market actors did not possess the necessary knowledge of equipment/measures.

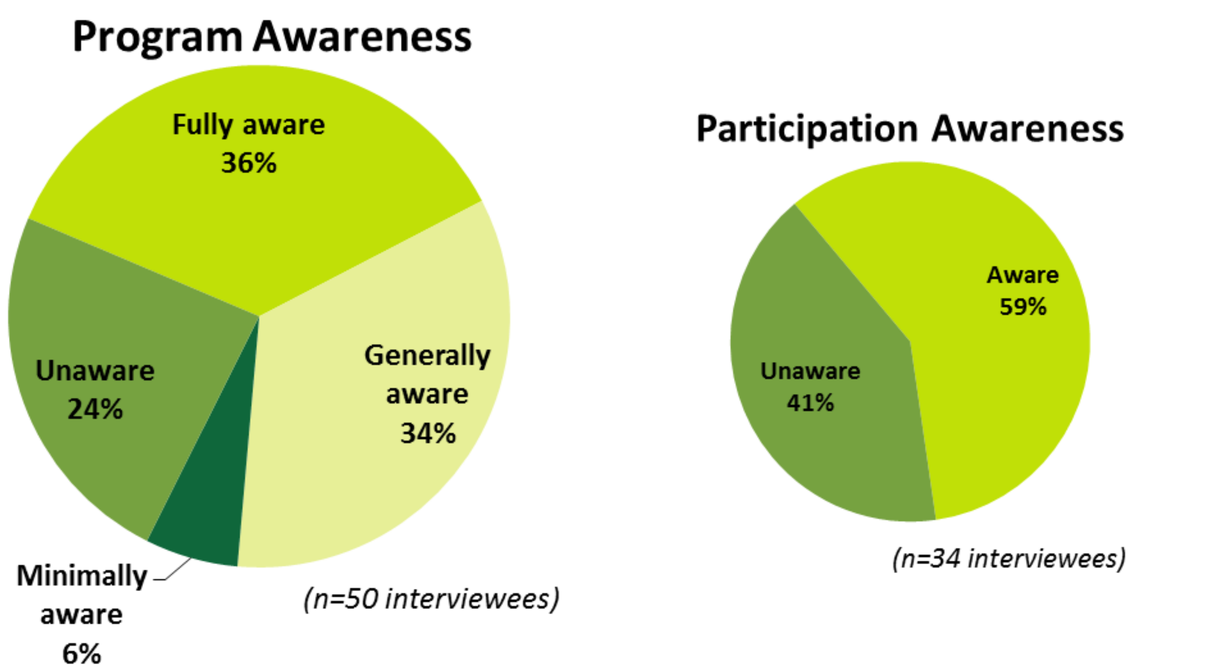
6.2 IOU Program Participation Drivers and Barriers

IOU MFNC program awareness was high among case study interviewees, but interviewees often reported that low levels of program awareness among market actors was a participation barrier.

6.2.1 IOU Program Awareness

Figure 6-1 illustrates case study interviewees' program and participation awareness levels. More than three-quarters of those assessing their level of awareness of the IOU MFNC program (76%) had some degree of awareness. Most often they were fully (36%) or generally aware (34%) of how the program functioned. The majority of those aware (59%) reported that they were *typically* aware if their projects were or were not participating in the program.

Figure 6-1: Case Study Interviewee Awareness of IOU Program and Project Participation



Note: Not all interviewees clarified their level of awareness of the program, and not all of those aware of the program reported if they were generally aware if their projects participated.

In contrast, only 48% of survey respondents were aware of the IOU MFNC program (see Section 5.2.1.1), and none of the developers whose sampled project was market rate were aware of the program.

6.2.2 IOU Program Drivers and Barriers

Case study interviewees most often reported that market actors—specifically, developers—were driven to participate in the IOU MFNC program by the opportunity to receive incentives (41%) and the ease of reaching the requirements, given that the program's requirements aligned with other program and regulatory requirements (24%). Most often they mentioned that the perceived hassles of participating (45%) and limited program awareness among market actors (31%)

presented participation barriers. Following Table 6-2, we relate the Phase I theories to the Phase II results about program participation drivers and barriers, offering further discussion of the Phase II findings; some Phase II results reinforced Phase I factors, and some contradicted them.[92]

Table 6-2: Case Study Interviewee Perceptions of IOU MFNC Participation Drivers and Barriers (Multiple Response)

General Drivers and Barriers to Energy Efficiency		Number of Mentions	Percentage of Interviewees (n=29)*
Drivers	Receive incentives	12	41%
	Easy to reach/redundant with other programs	7	24%
	Reduce operating expenses	2	7%
	Opportunity to learn new practices	2	7%
	Limited hassle	1	3%
	Other drivers	4	14%
Barriers	Hassle to participate/paperwork	13	45%
	Limited awareness/interest	9	31%
	Cost of equipment	7	24%
	Timing	7	24%
	Incentives too low	4	14%
	Skepticism about receiving incentives	3	10%
	Conflicts with other programs	2	7%
	Ineligible	2	7%
	Unnecessary	2	7%
	Other barriers	4	14%

* Interviewees did not comment on the drivers or barriers if they were unaware or not sufficiently knowledgeable about the program; percentages total to greater than 100% because interviewees typically mentioned more than one barrier or driver.

Participation requirements and processes: Program incentives and the overlap with other program/municipal requirements ease the challenge of meeting IOU requirements.

Theorized IOU program barrier: Program requirements are demanding and paperwork is complicated. Communication with IOU program staff is challenging.

Theorized IOU program driver/mitigating factors: There are several mitigating factors, including the fact that other programs with similar standards promote IOU program participation, affordable housing developers are accustomed to similar program requirements for CTCAC awards, and Title 24 requirements involve similar paperwork. In addition, performance modeling offers design flexibility and program technical and design assistance facilitates participation. Recurring participation among builders reduces the cost of participation, and consumer demand could provide further motivation to participate.

[92] All of the statements in bold are the team's summaries of market actors' responses and do not reflect our opinions.

Phase II evidence:

- Nearly one-half of case study interviewees who were familiar enough with the IOU program to comment (45%) reported that the hassles involved in participating and completing IOU program paperwork were indeed a barrier to participation. One GreenPoint Rater, for example, said that most developers think "it is more trouble than it is worth" because of the additional design, communication, and verification costs. Additionally, our Phase II developer survey responses indicated that the second most common reason respondents did not participate (23%) was that they or their team were deterred by the hassles and paperwork involved in participating (Appendix E.3).
- However, nearly the same percentage of interviewees (41%) reported that program incentives acted as a strong driver to participation, and nearly one-quarter of them (24%) said that the program requirements were so similar to other programs in which they participate or regulations to which they are subject that meeting the IOU program requirements is easy. In fact, they said that the IOU program incentives helped them to meet the other requirements, such as reach codes, or were just "whipped cream" (i.e., an unnecessary but attractive bonus). One developer called the IOU incentives "free money" because the requirements are so easy to meet: "We usually go for those programs and try to get as much funding as we can."
- Only two interviewees added that returns on investments were a mitigating factor. Interviewees did not identify consumer demand as a driver to IOU program participation. Only one interviewee identified recurrence of participation as a driver, noting that once market actors participate in the program, they are more likely to participate in it again. The same interviewee added that program staff's helpfulness served as a driver.

Incentives: Incentives drive participation, despite some dissent that incentive levels were too low and others had concerns about the reliability of receiving them.

Theorized IOU program barrier: Incentive levels are not high enough to offset hassles and participation cost. Long-term funding is uncertain. Incentives paid later in the development process do not help with capital costs. Incentives do not support non-gas/electric measures.

Theorized IOU program driver/mitigating factors: Few competing or alternative incentive opportunities exist.

- *Phase II evidence*: Only four case study interviewees (14%) think that incentive levels are too low to encourage participation, and two others said that the IOU incentives are not necessary for their projects to move forward; meanwhile, more than two-fifths of case study interviewees (41%) said that participation was driven by incentives. One developer characterized IOU incentives as "drops in the bucket" or "nominal gestures." Another developer summarized, "It is not something that's going to either get your project done or not get it done." A few interviewees did express concern that incentives would not necessarily come through, especially because the incentives are issued after measure installation, and an investor added, "Incentives come and they go," insinuating that market actors could not base their plans on programs like those of the IOUs. None mentioned a shortage of competing or alternative incentive opportunities resulting in IOU program participation, and they did not talk about shortcomings as far as the scope of IOU-supported measures as a barrier. However, interviewees did identify other funding opportunities as drivers; specifically, 70% pointed to CTCAC as a driver to energy efficiency in the MFNC market, as it comes with valuable financial incentives in the form of tax credits that are highly sought after by tax credit investors and syndicators.

Participation timing: Program timing does not always align with project cycles.

Theorized IOU program barrier: Program incentives and requirements change across cycles and program deadlines do not line up with time-intensive larger projects.

Theorized IOU program driver/mitigating factors: Few competing or alternative incentive opportunities exist.

- *Phase II evidence*: The theorized program barrier was reinforced: About one-quarter of interviewees (24%) viewed program cycle timing as a problem. For example, one developer said that the IOUs' design assistance suggestions for one project came during "ribbon cutting" after construction was complete and, as such, were irrelevant. Further, the fact that incentives come after measure installation causes skepticism (because market actors are uncertain that the incentives will ultimately be issued) and "contention" among some teams (3%).

Program awareness: Limited program awareness may be a major hurdle.

Theorized IOU program barrier: Developers have limited awareness of the IOU program.

Theorized IOU program driver/mitigating factors: Most market actors think big developers are aware of the IOU program. The IOUs conduct marketing and outreach.

- *Phase II evidence*: While more than two-thirds of case study interviewees (70%) are either fully (36%) or generally (34%) aware of how the IOU program functions (recognizing that this sample is weighted toward above-code case study sites), only 48% of the Phase II developer survey respondents are aware of the program. Despite high levels of awareness among case study respondents, nearly one-third of the case study interviewees with some level of awareness of the program (31%) speculated that one participation barrier was a general lack of program awareness among market actors—developers in particular. Further, interviewees did not cite IOU program marketing and outreach as a driver. Additionally, from our Phase II developer survey, of those developers who were aware of the program, the most common reason respondents did not participate (38%) was that they or their team were unaware of the program at the time they were developing the project (Appendix E.3).

Design assistance: IOU program design assistance represents some value to market actors.

Theorized IOU program barrier: Market actors do not always desire or value integrated design assistance. Program recommendations are not specific enough for some participants.

Theorized IOU program driver/mitigating factors: Developers value design assistance, and program design assistance may lead to spillover.

- *Phase II evidence*: As described in Section 5.2.4 and Appendix B, some case study interviewees reported some degree of increased knowledge from IOU program design assistance (5 of the 14 case study interviewees that received it—10% of interviewees), saying that it helped them a great deal and they use the practices they learn from it. As reported, a larger number, however, did not find it valuable, indicating that communicating with the program professionals was challenging and the concepts that the program staff provided were too broad to be helpful. One GreenPoint/HERS Rater reported that the IOU program design assistance is a driving force in that it engages developers with the lowest levels of focus on energy efficiency "who have not heard of these things and shows them that it is doable." That same interviewee added that for more experienced developers and designers, the design assistance was ineffective, saying that there is "a little bit of disconnect between [the program's] advice and the construction realities."

Consistency: Eligibility requirement consistency across programs is not a pivotal factor.

Theorized IOU program barrier: IOU programs have inconsistent program eligibility for mixed-use buildings.

Theorized IOU program driver/mitigating factors: Inconsistency may be more of a challenge for program administrators than participants.

- *Phase II evidence*: Respondents were not asked in the Phase II research to discuss their experiences regarding mixed-use projects participating in the IOU MFNC program in different IOU jurisdictions. However, multiple respondents did discuss how different code requirements on the residential and commercial spaces resulted in compliance margins that were not directly comparable between these two spaces. Case study respondents regularly opined that the compliance margins on the residential spaces on their projects were commonly higher than on the commercial spaces of the same building due partly to comfort and safety code requirements of commercial spaces, but also because the energy compliance margins are calculated differently on the commercial spaces.

6.3 LEED and GreenPoint Participation Drivers and Barriers

Sections 5.2.8 and 5.2.9 as well as Appendix B report how interviewees and survey respondents emphasized the weight that LEED and GreenPoint Rated carry in their marketing efforts and in stimulating consumer demand. A number of interviewees more specifically identified the varied dynamics involved in the drivers of and barriers to LEED and GreenPoint Rated participation. We describe these in more detail below.

When asked what drives developers and other design professionals to LEED, case study interviewees were most likely to say that gaining the LEED brand is an excellent avenue to increase their marketability (50% of 36). On a similar note, they often pointed to its attractiveness for drawing support from investors, lenders, and municipal partners (22%). Regarding GreenPoint Rated, fewer respondents used it for branding or marketing (5 of 20) and only one interviewee reported that he had participated in GreenPoint Rated to attract funders and investors.

GreenPoint Rated was commonly identified as a means to meet CTCAC efficiency guidelines (35% of 20), and also as being attractive because it was easier and less expensive to meet its requirements than to meet those of LEED (35%). Some respondents added that it included fewer hassles and less paperwork than LEED (10%). In fact, we learned in our Phase I study that GreenPoint Rated was *designed* to be more attainable than LEED.[93]

In terms of barriers, the 36 interviewees commenting on LEED often reported that market actors might not pursue LEED because of the cost (33%), hassles (22%), and effort (19%) required for certification. For example, they often described the amount of coordination and focus that obtaining LEED certification requires, with one GreenPoint Rater emphasizing that LEED "requires more coordination among design teams." That said, slightly more than one-fifth of those commenting on LEED (22%) thought that LEED requirements were easy to meet, especially given that they are often incorporated into other requirements that the interviewees sought to meet. Eight of the 20 interviewees commenting on GreenPoint Rated (40%) still thought that it requires more effort than they would have exerted otherwise, despite many of them saying it was easier than LEED. Table 6-3 details the findings.

Table 6-3: Case Study Interviewee Perceptions of LEED and GreenPoint Rated Participation Barriers and Drivers

Drivers and Barriers	LEED		GreenPoint Rated	
	Number of Mentions	Percentage of Interviewees (n=36)*	Number of Mentions	Percentage of Interviewees (n=20)*
Drivers				
General marketing/branding	18	50%	5	25%
Easy to reach/redundant with other programs	8	22%	-	-

[93] Davis Energy Group's "GreenPoint Rated and LEED for Homes," comparing the two standards, available at: http://www.builditgreen.org/_files/GreenPointRated/GPR-LEED%20FAQs2010.03.10.pdf.

Attract lenders and municipal partners	8	22%	1	5%
Easier and less costly than LEED	n/a	n/a	7	35%
Appeal to CTCAC	7	19%	7	35%
Reach codes require	3	8%	2	10%
Less paperwork/hassle than LEED	n/a	n/a	2	10%
Reduce operating expenses	2	6%	-	-
Opportunity to learn new practices	2	6%	6	30%
Standard practice	2	6%	2	10%
Receive incentives	1	3%	-	-
Other	-	-	2	10%
Barriers				
Cost of equipment/application process	12	33%	2	10%
Hassle to participate/paperwork	8	22%	1	5%
Calls for effort/coordination	7	19%	8	40%
Limited awareness/interest	-	-	4	20%
Other	3	8%	1	5%

* Not all interviewees commented on the drivers or barriers; percentages total to greater than 100% because interviewees typically mentioned more than one barrier or driver.

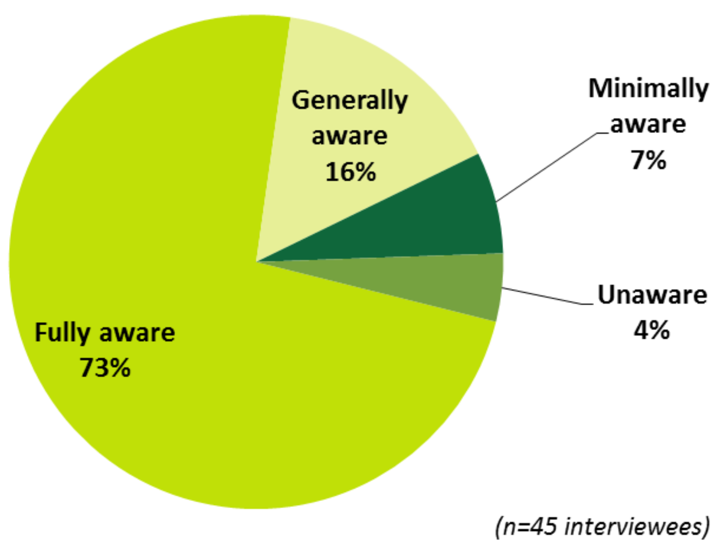
6.4 ZNE Implementation Drivers and Barriers

Case study interviewees had a fairly high level of awareness of ZNE, but they perceived that their peers and consumers had low levels of awareness, which they considered to be a major barrier to the success of ZNE. Developers responding to the CATI survey were somewhat less familiar with it than case study interviewees. Case study interviewees frequently pointed to equipment and building costs and technical limitations—space availability, specifically—as ZNE's biggest hurdles. These responses were echoed by the fact that ZNE played a very limited role in the case study projects; in the few cases where it was a consideration, it was quickly ruled out due to cost and inadequate physical space needed for renewable energy measures. Interviewees commonly added that government requirements and promotional efforts and incentive offerings would be critical for ZNE success. We provide details below.

6.4.1.1 ZNE Awareness

Of those case study interviewees that we asked about their familiarity with ZNE, nearly three-quarters (73%) had a detailed understanding of it (Figure 6-2). Only two interviewees (4%)—a developer and a builder—were entirely unaware that ZNE existed. Figure 6-2 illustrates the distribution of awareness among case study interviewees. Developer CATI survey respondents were less likely to report a high of level of awareness, with 6% reporting being very familiar, 30% being moderately familiar, and 55% being somewhat familiar.

Figure 6-2: Case Study Interviewee Awareness of ZNE

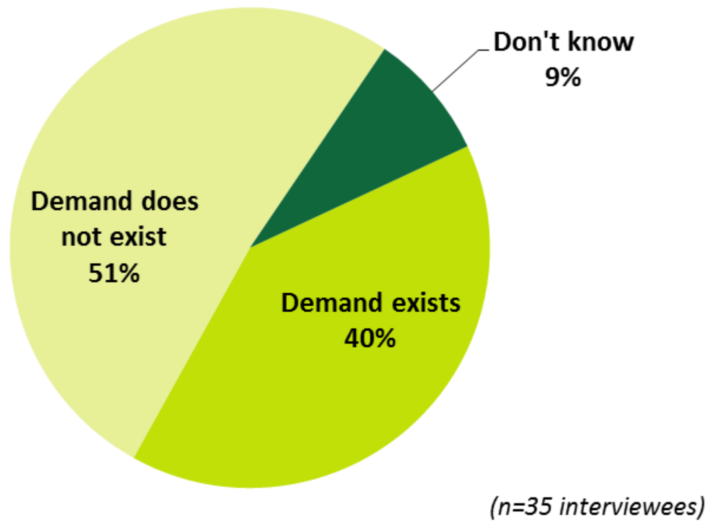


Note: Six interviewees did not assess their awareness of ZNE.

6.4.1.2 ZNE Demand

We asked interviewees who were familiar with ZNE if demand for ZNE exists in the marketplace. Two-fifths of those who responded reported that consumers did desire projects that were ZNE (Figure 6-3).

Figure 6-3: Case Study Interviewee Perceptions of ZNE Demand



Note: Sixteen interviewees did not assess demand for ZNE, either because they were not familiar with ZNE or because they did not express an opinion.

Developer survey respondents anticipate moderate growth in the number of ZNE projects they expect to build over the next five years. In the next three years, the vast majority of respondents familiar with ZNE (94%) do not expect to build any ZNE projects (Table 6-4). One outlier expects to build about 50 ZNE projects in the next three years. Within the next four to five years, 36% of respondents expect to build at least one ZNE project, though over three-fifths of respondents (64%) do not expect to complete any.

Table 6-4: Anticipated Zero Net Energy Projects

Number of Projects	In the Next Three Years (n=33)	In the Next Four to Five Years (n=33)
No projects	94%	64%
1 to 10 Projects	3%	9%
15 to 25 Projects	-	15%
50 to 100 Projects	3%	12%

6.4.1.3 ZNE Drivers and Barriers

When it came to drivers to ZNE in the marketplace, case study interviewees most often pointed to local and state government regulations and/or promotional efforts, including incentives (28%) and consumer demand for sustainability (17%), as pivotal to driving demand for ZNE (Table 6-5). In the words of one architect, “Without incentives, builders aren’t going to go there. They’ll have to be forced there. That’s just the market reality.”

Interviewees most often reported that the main barriers to ZNE were that consumers and market actors—such as developers—had limited awareness of it and did not understand what it meant (39%), the high up-front costs and limited levels of cost-effectiveness associated with measures required to achieve ZNE (39%), and the possibility to technically implement it was limited (33%). Five interviewees specifically pointed to space limitations and how renewable energy measures implicitly require physical space but that their projects are often not large enough to accommodate them. One San Francisco architect explained that, in spite of consumers’ interest in it, the feasibility remains a problem:

> *There are so few examples to actually go and see. It’s always on everyone’s wish list, but it’s very difficult to implement in the urban areas where we’re working.*

One engineer who had participated in ZNE projects recalled experiencing a high learning curve, speculating that developing the technical abilities among construction and design professionals generally would be a challenge to successfully launching ZNE. A GreenPoint Rater also pointed out that there are limited measurement tools necessary to make it happen.

Table 6-5: Case Study Interviewee Perceptions of Market Drivers and Barriers to ZNE

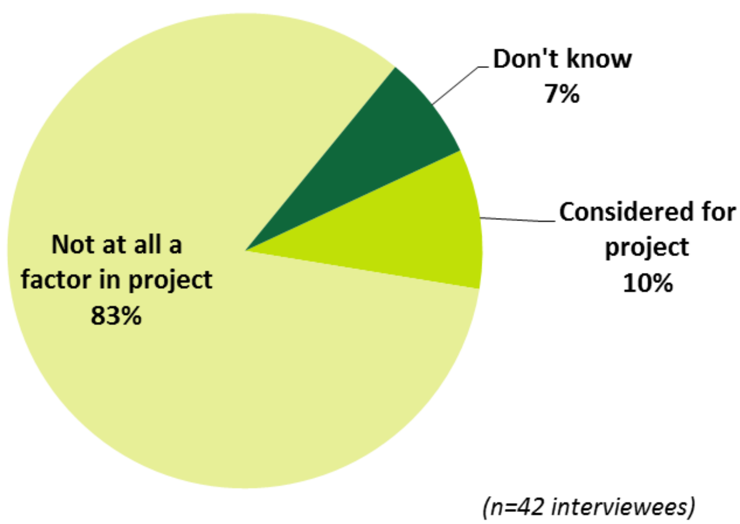
Drivers and Barriers to ZNE		Number of Mentions	Percentage of Interviewees (n=36)*
Drivers	Government regulations and promotion	10	28%
	Consumer demand for green building	6	17%
	Existence of funding and incentives	5	14%
	Company profile and mission	3	8%
	Lowering operating costs	3	8%
	Other	2	6%
Barriers	Limited awareness and understanding	14	39%
	High upfront cost/cost-effectiveness too low	14	39%
	Technical feasibility is limited	12	33%
	Other	*2*	6%

* Fifteen interviewees did not comment on the drivers or barriers; percentages total to greater than 100% because interviewees typically mentioned more than one barrier or driver.

6.4.1.4 ZNE Influence on Case Studies

We asked those familiar with ZNE the extent to which it was considered as a goal for their respective case study projects (Figure 6-4). Four interviewees (10% of those asked) said that ZNE was at least considered for their project but was not incorporated as a final project goal. They explained that pursuing ZNE was not appropriate for the sites because of space limitations required for renewable energy equipment (e.g., solar PV panels) and that the costs involved in achieving ZNE were prohibitive. (It is possible that some respondents may not have been involved in early discussions about whether or not to pursue ZNE.)

Figure 6-4: Extent to which ZNE Included as Case Study Project Goal



Note: Nine interviewees did not characterize ZNE's role in the case study project, either because they were not familiar with ZNE or because they were not asked.

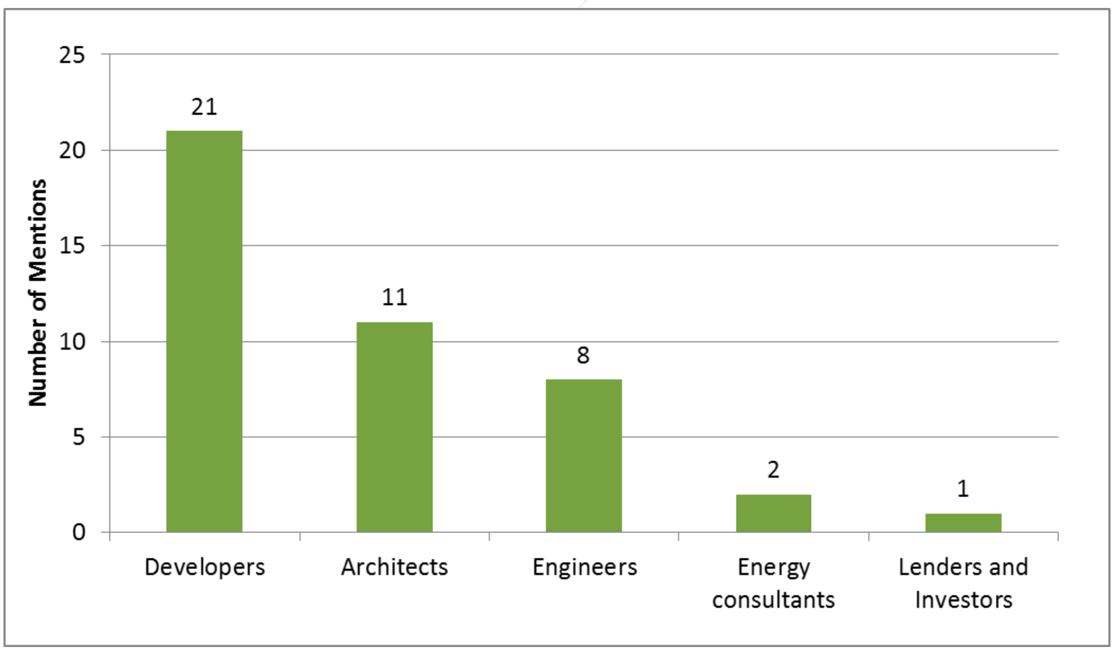
7 Additional Market Dynamics

This section includes analyses of various market dynamics discussed in our case study interviews. We assess interviewees' perspectives on market actor roles in influencing energy efficiency decisions, project stages, reach code awareness and enforcement, project delivery systems, and the prioritization of solar measures compared to energy efficiency measures.

7.1 Key Market Actors

While not necessarily using the term *key market actor*, case study interviewees characterized their own roles, and those of other market actors in the MFNC market generally and on their respective case study projects, when it comes to making decisions about projects' energy efficiency. If interviewees described someone's role as pivotal in making decisions about energy efficiency in MFNC projects, we categorized their description as indicating that player as a key market actor. Figure 7-1 compares the number of times they characterized the specified person/entity as a key actor in energy efficiency decisions. Developers were most often depicted as pivotal decision makers, with architects and engineers often described as playing essential roles; interviewees very infrequently considered energy consultants and financiers as critical players. Below this chart, we provide more details on the respective roles of each market actor.

Figure 7-1: Case Study Interviewee Identification of Key Market Actors



Note: 47 interviewees identified market actors' roles in energy efficiency decision making. If interviewees described someone's role as pivotal, we categorized that role as a *key market actor*.

Survey respondents were also asked to identify the key decision makers regarding energy efficiency for the sampled project. Nearly all of the respondents (97%) said the developer was a key decision maker, and over three-fourths of respondents (79%) said that the architect was another key decision maker. Other common decision makers reported by respondents included the engineer (27%) and the financer/investor (27%). When asked to identify the *primary* decision maker for the project, 60% identified the developer or builder.

Developers. Developers are key decision makers. Their relationship with energy efficiency generally relates to prioritizing and defining financial goals for the project.

- Of the 31 case study interviewees who described the roles of developers (including their own roles, when applicable), 68% identified developers as primary decision makers when it comes to their projects' energy efficiency goals or approaches. Their descriptions emphasized developers' roles as focusing on meeting financial goals by making decisions about the types of funding to pursue and the expected return on investment, both of which are critical to the energy efficiency goals of a project. One developer described how he sets the energy targets and the rest of the construction and design team "just jumps on the bandwagon"; he explained that he "leans on" designers to estimate costs and suggest technical elements and on the architect to organize the implementation process. Some interviewees described projects in which developers used a "hands-off" approach (not as key actors). In these cases, the developer's role is *limited to* solidifying funding, setting budgets, or managing construction and design teams.

Architects. Architects are commonly key decision makers in that they help to conceive and construct a project that meets the goals of the developer; they are involved in very early stages of the project's conception and design, often before many other consultants. They are important to a project's efficiency, but ultimately serve to meet the needs of the developer. They also often act as project coordinators and work closely with the other consultants hired on projects (engineers, HERS Raters, etc.). Sometimes their roles are limited to making technical suggestions for developers to assess.

- About one-half of case study interviewees commenting on the role of architects in MFNC projects characterized the architect as an important figure in a project's energy efficiency goals and approaches (11 of 21). Many case study interviewees summarized the architect's role as that of a project manager or team coordinator who moves the project from conception to completion—not necessarily acting as a key decision maker. Others also characterized architects' roles as fulfilling the goals set by the developer in the sense that they tailored the design recommendations with the intent to meet the developers' stated goals. These interviewees perceived architects as only indirectly taking part in the final decision-making process. One architect described how architects act in support of developers' goals:

  > *As architects, we do not establish [energy] goals, other than that we are required to meet basically the laws that govern the project. So for us, [the energy goal] is the minimums. If there is something that exceeds that goal, that is up to the owner. So, basically, we parallel the owner's goals.*

Engineers. Engineers are involved in energy efficiency decisions most often in a technical capacity, making recommendations about what measures to install to reach previously set goals and offering suggestions to the developer (and architect) about measure cost and feasibility, rather than setting overall efficiency goals themselves.

- About one-third of case study interviewees commenting on engineers' roles in MFNC projects (8 of 22) described the engineer as a key decision maker in energy efficiency goals and approaches. The majority, however, characterized the engineer's role as one that designs systems and suggests measures to fulfill the goals presented by the developer or architect. One engineer explained that because the developer is "the one footing the bill," the engineer's goal is "to provide the developer with the project that they want and make it compliant." Others reported that the engineer's role was limited to that of an energy modeler conducting calculations to estimate the impact of different system options on the project's energy efficiency, similar to that of Title 24 consultants (which may be employees or subcontractors of engineering firms).

Energy Consultants. Title 24 Consultants, HERS Raters, GreenPoint Raters, and other energy consultants are rarely key actors; they typically offer input on measure selection, provide general guidance, and verify impacts and installation quality. Similar to engineers, they help projects achieve a developer's goals (or provide suggestions for improving upon them), but they do not set those goals. Title 24 consultants provide energy modeling services to design teams to determine cost-effective means of complying with various codes and programs, while other raters serve typically to ensure that measures are properly installed and that program requirements are satisfied.

- Only two interviewees suggested that energy consultants acted as decision makers. Of the 17 interviewees commenting on the roles of Title 24 Consultants, HERS Raters, GreenPoint Raters, and other energy consultants, the majority observed that they were in the position to offer input on what energy-related measures are most cost-effective or impactful (11), and many characterized their roles as guides or educators when it came to energy efficiency. Three interviewees commented on their roles as a Title 24 Consultant, HERS Rater, or GreenPoint Rater, concluding that their roles were limited to verifying compliance and that they had no real influence on projects' design or efficiency levels.

Investors/Lenders. Investors and lenders are typically uninvolved in energy efficiency decision making, though they often take efficiency into account as part of their underwriting analyses.

- Only one of the interviewees commenting on the role of investors and lenders suggested that they had substantial input on the level of energy efficiency of the project. As discussed in Section 5.2.10, investors and lenders care about energy efficiency to the extent that they are concerned with long-term operating costs as a factor in their payback and underwriting analyses. In addition, investors want to ensure that projects achieve CTCAC support and meet municipal codes, but they emphasized that they had no real influence or involvement in the decision making or goal setting for the projects. One investor concluded:

We know what we are good at, and we know what our developers and the architects and the engineers are good at.

- A CTCAC investor specifically described how she has to compete with other tax credit investors to participate in CTCAC-supported projects, and she has minimal leverage to push the developers to build more efficiently than they already planned to do.

7.2 Key Project Stages

Case study interviewees generally categorized the design and construction phases involving decision making about energy efficiency into five stages. These phases may overlap and are not necessarily distinct from one another on every project. More often than not, interviewees reported that the most important construction phases in MFNC related to energy efficiency decision making were in the earliest points of a project. Following are the five major stages and the dynamics that case study interviewees depicted:

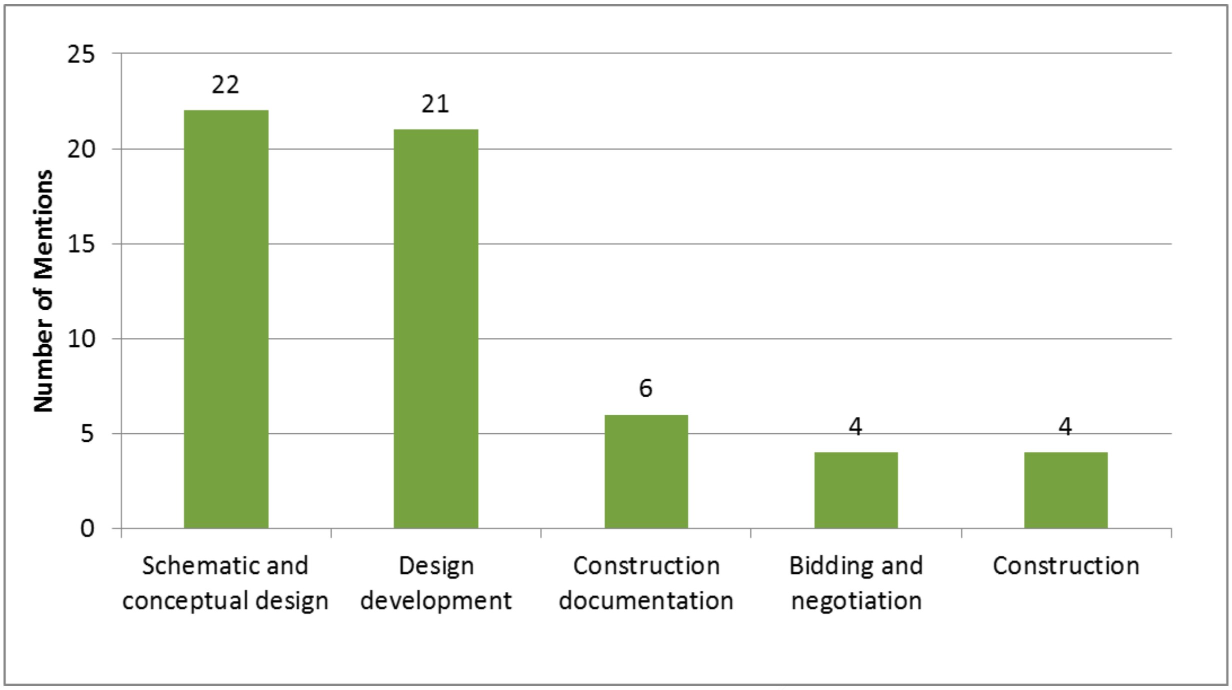
- **Schematic and conceptual design.** The very start of the project, often referred to as schematic and conceptual design, is the phase in which the developers select their design team and begin to outline the general scope and design of a project's size and building components. Designers will offer general technical suggestions to the developers, and the team reaches a basic consensus regarding the project goals, physical design, and project management expectations.
  - Twenty-three case study interviewees identified this as a critical stage in addressing the energy efficiency of a project. About one-fifth of all interviewees (11) reported that developers know at the outset the level of energy efficiency that they are going to pursue because they normally have determined if they are going to pursue CTCAC or other funding that requires high-efficiency designs, or they know the project is located in a community that has adopted reach codes. Interviewees also explained that, at this point in the process, developers determine if they will pursue LEED or GreenPoint Rated certifications. In contrast, only 6% of developers responding to the CATI survey suggested that project conception was the most important phase (Appendix E.7.2); they most often identified design development (48%)—following conception—as the most important stage.[94]
- **Design development.** Following schematic and conceptual design, the team reaches a somewhat more concrete phase in which the designers make more specific written recommendations and illustrations for building elements, such as selecting mechanical equipment and drafting detailed building plans. This is a critical phase for projects, wherein consultants—including engineers, Title 24 consultants, etc.—become heavily involved in fleshing out the details of the project as initially conceived by the architect and developer.

[94] Survey respondents also identified applying for financing (21% of respondents) and project feasibility assessment (15%) as other stages important to the final energy efficiency of the project.

    - Twenty-one interviewees described this as a pivotal point in making energy efficiency decisions. One architect called this the point at which they "put the flesh on the bones" of the project. The importance of this phase was echoed by CATI survey results; as mentioned, respondents were most likely to suggest design development, with nearly one-half of developers (48%) listing it as the most important stage (Appendix E.7.2).
- **Construction documentation.** In preparing construction documents, the design team formalizes the discussions and plans developed in the design development phase. The period of construction documentation adds further details to the project, documenting in writing and illustrations plans for components such as building materials and system types. The construction documentation facilitates and enables the developer to request project bids.
    - Interviewees pointed to the importance of this stage less frequently, with six interviewees identifying this stage as a point at which they can still incorporate energy efficiency into the approach.
- **Bidding and negotiation.** During these next phases, contractors bid to implement project plans and negotiate with the developer (and the rest of the design team) to reach agreement on the project approach and construction budget.
    - Four interviewees thought that the bidding period continued to be relevant for integrating energy efficiency as a consideration into the project approach. One developer characterized this stage as a "first *reality check* where we can reallocate budget and make tradeoffs."
- **Construction.** The processes of breaking ground or excavation through building completion constitute the construction period.
    - Four interviewees reported that energy efficiency continues to be a topic of discussion and planning during this implementation period. A few interviewees mentioned that energy efficiency or other solar measures often can be added—or eliminated—toward the end of construction because it is at this point that teams are assessing their budgets and have the opportunity or necessity to change direction. One engineer judged, however, that if teams *begin* to think about energy efficiency during construction, it is too late to modify and cannot be incorporated into the design.

Figure 7-2 shows the number of times that interviewees mentioned a stage as a pivotal point in energy efficiency decision making. As described previously, they most commonly identified the schematic and conceptual design and design development stages.

Figure 7-2: Case Study Interviewee Identification of Key Project Stages (n=45)



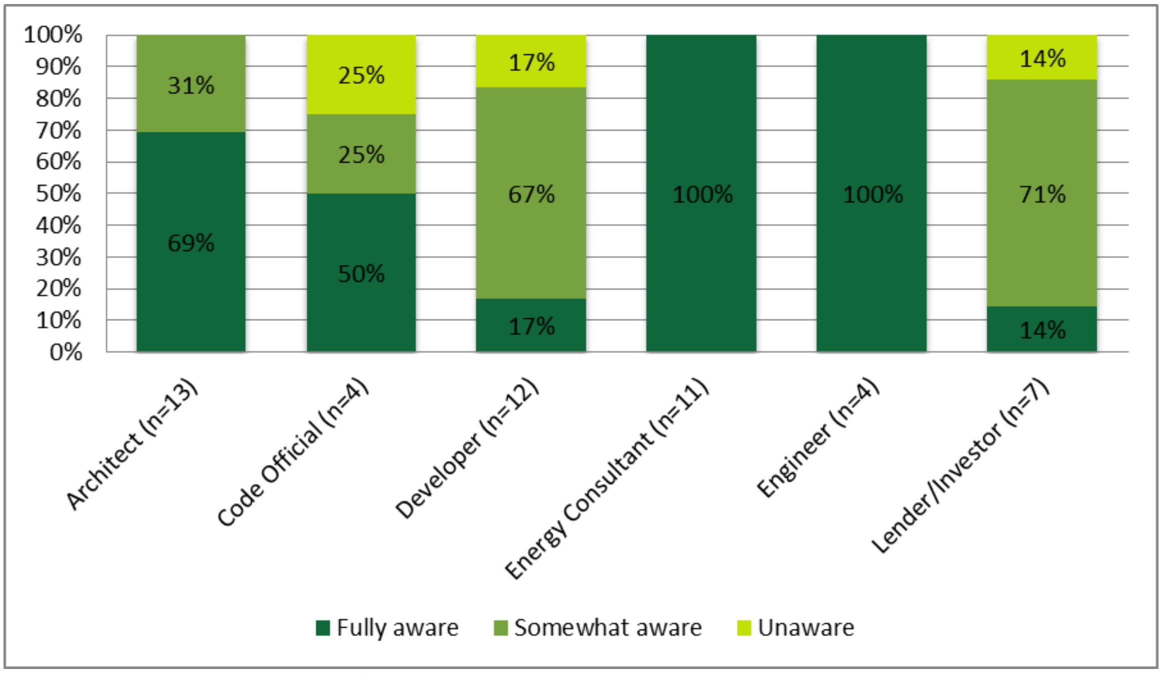
7.2.1 Case Study Respondents: Integrated Design

According to our interviews, 9 of the 15 case study projects were implemented in a style approaching that of an Integrated Design method, in which teams incorporated energy efficiency as a factor throughout the entire project's design and construction stages. Four interviewees reported that they commonly use this type of approach. Some interviewees noted that performing the Title 24 modeling throughout the process impacts decision making. A couple of interviewees reflected that the LEED participation process acts as a feedback loop throughout the design and construction process.

7.3 Reach Code Awareness

Most case study interviewees (92% of 51) were at least somewhat aware of the existence and requirements of reach codes in California municipalities, and the majority (57% of all interviewees) were *fully* aware of these above-Title 24 mandatory energy ordinances. Figure 7-3 shows the relative familiarity with reach code by respondent type. Architects, energy consultants, and engineers were frequently fully aware of reach code and the associated requirements, while developers, financiers, and even code officials were more mixed in their awareness of reach code requirements.

Figure 7-3: Case Study Interviewee Awareness of Reach Code



Just over one-half (55%) of developers from the CATI survey reported being aware of the existence of reach codes in California.

7.4 Code Enforcement

7.4.1 Priority of Energy Efficiency

As discussed in the Phase I report, local building officials are responsible for enforcing the Title 24 building code and any additional efficiency standards required by the municipality, such as reach codes. Phase I interviews implied that, for a variety of reasons—including staffing levels, differing jurisdictional priorities, and so forth—energy efficiency was not consistently a high priority from jurisdiction to jurisdiction.

In both Phases I and II interviews, market actors reported that building officials focused their inspections more on life safety code requirements, reporting that they were building officials' top priority and that energy efficiency is always a lower priority.[95] Three of the four Phase II code official interviewees said that they spent only between 5% and 10% of their time and effort reviewing a given MFNC project's energy efficiency measures.[96]

7.4.2 Reach Code Enforcement

Our case study interviews explored the extent to which officials enforce reach code regulations and the dynamics involved in that enforcement. Fifteen municipalities (including three counties) adopted reach codes under the 2005 Title 24 energy efficiency standards,[97] whereas 46, including five counties, adopted reach code requirements under the more stringent 2008 Title 24 standards.[98] However, since the 2013 Title 24 energy code went into effect in July 2014, only six municipalities (including one county) have adopted reach code requirements based on that most recent code version (as of June 2015).[99] As described in Section 5.2.7, the IOUs have played a key role in the adoption of reach codes, providing both policy guidance and technical support to local municipalities regarding adoption and implementation.

The IOUs' promotion of reach code adoption in California clearly encourages developers and their design teams to follow advanced energy efficiency practices. However, based on case study interviews, reach codes do not appear to be consistently enforced across jurisdictions: Only about one-quarter of the respondents who discussed reach code enforcement (n=21) reported that they had experienced these standards to be consistently enforced across jurisdictions. About three-quarters (76%) said that reach codes were enforced either poorly or inconsistently across jurisdictions. Respondents described some jurisdictions, and even some individual code officials, as having a greater focus on energy efficiency than others; as one architect noted, enforcement might vary "within the same jurisdiction, down to the plan checker." Interviewees thought that the

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95 Two code official case study interviewees specifically said that energy efficiency was a low priority for them, one said it was a medium priority, another said it was the same importance as MEP code (but still less than life safety).

96 Code officials reported that, in some cases, depending on project size, they will visit a MFNC site five times, while for others they will visit a site over 150 times; two of them mentioned spending between 30 minutes and two hours at each site visit.

97 http://www.energy.ca.gov/title24/2005standards/ordinances_exceeding_2005_building_standards.html

98 http://www.energy.ca.gov/title24/2008standards/ordinances/

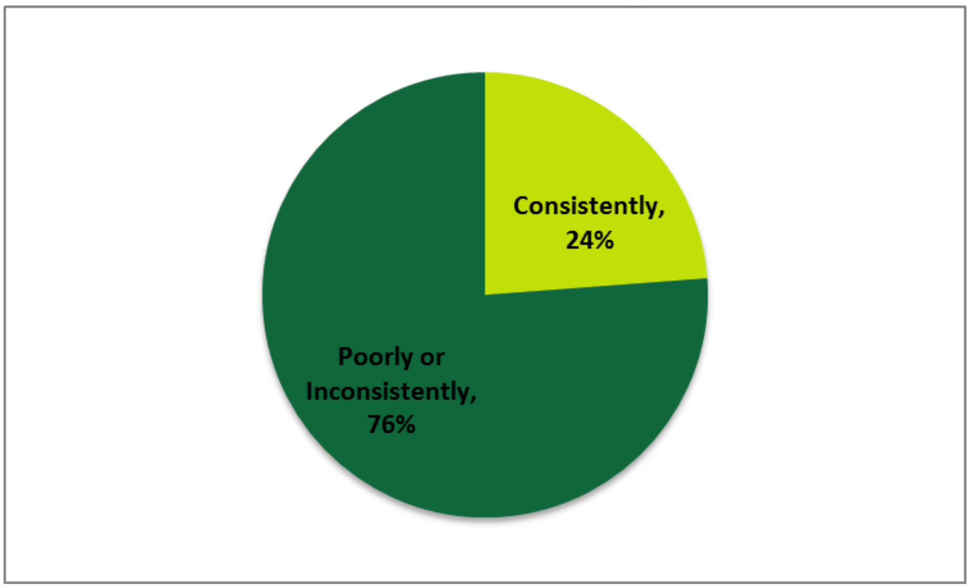
99 http://www.energy.ca.gov/title24/2013standards/ordinances/

inconsistent enforcement that affected reach- and non-reach-code municipalities was due to a lack of knowledge or interest in energy efficiency among code officials, as well as state budget cuts that had left some building departments understaffed. In jest, a HERS/GreenPoint Rater concluded that the inconsistent enforcement and different program requirements are confusing to developers, and the "confusion . . . gives me business."

While some design teams might feel tempted to cut corners due to poor enforcement, design teams who participate in above-code programs that have their own verification requirements (CTCAC, IOU programs, LEED, GreenPoint Rated, etc.) reported pressure to avoid corner cutting, despite inconsistent enforcement from building departments. Five of these 21 respondents who discussed reach code enforcement specifically noted that their design teams follow consistent practices, regardless of the perceived level of the building department's enforcement of statewide code or reach code. One interviewee expressed the implications of potentially falling short of code:

> *There are legalities to that, too. If our stamp's on the drawings and we haven't exceeded Title 24 by 15% because we're trying to sneak it through, we could get sued.*

Figure 7-4: Case Study Interview Perspectives on Reach Code Enforcement Consistency (n=21)



CTCAC investors reported using their own consultants to verify that construction practices adhered to the developer's design commitments, serving as a quality assurance check to verify that the project would definitely receive the low-income tax credits that attracted the investors.

As previously discussed, few municipalities have adopted above-code energy ordinances following the implementation of the 2013 Title 24 energy efficiency requirements (see Section 7.4.2). A few respondents confirmed our research findings that few municipalities have adopted reach codes based on the newer 2013 Title 24 standards. The same respondents suggested that those jurisdictions who had only "grudgingly implemented" reach code standards in the first place (under previous versions of Title 24) were among the ones that have discontinued reach codes.

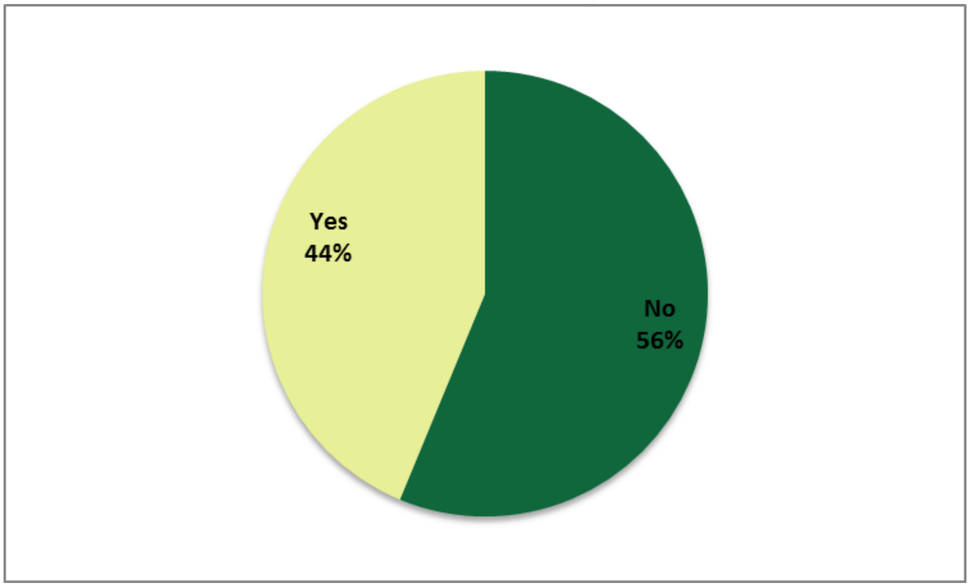
The CATI survey developer respondents did not report on reach code enforcement.

7.5 Project Delivery Methods: Design-Bid-Build vs. Design-Build

Developers can choose between multiple project delivery methods for their construction projects, such as design-bid-build (wherein the project owner hires a designer to create plans and contractors are chosen through competitive bidding) or design-build (wherein the project owner typically hires contractors to both design and build the project under one contractor).[100]

Sixteen case study interviewees expressed an opinion about whether or not a project's delivery method, focusing on design-bid-build (DBB) or design-build (DB) methods, impacted the energy efficiency level of MFNC projects; they were fairly evenly divided, with slightly more (9 of 16) saying it did not have an impact (Figure 7-5). Four of these 16 respondents indicated that if the construction team and builder were part of the early design process (design-build), they could have a larger impact on the project than in a design-bid-build scenario, but it was not clear that this factor alone would consistently improve or negatively impact a project's efficiency.

Figure 7-5: Case Study Interviewee Perspectives on Delivery Methods' Impact on Energy Efficiency (n=16)



[100] https://cmaanet.org/files/Owners%20Guide%20to%20Project%20Delivery%20Methods%20Final.pdf

8 Conclusions and Recommendations

We note several key findings and conclusions from this Phase II report.

There is evidence suggesting that the IOU MFNC program has affected the practices and efficiency levels of non-participating MFNC projects, but that other market interventions (in particular, CTCAC funding), other green building programs (such as LEED and GPR), and other policies (such as reach codes) are having more substantial impacts on the efficiency levels of non-participating MFNC projects.

In addition, the case studies confirmed and emphasized the importance of a finding from the Phase I research regarding the importance of the role of local officials in encouraging developers to build to above-code standards. Respondents described the importance of “soft money” partners, including local agencies (such as the now-dissolved Redevelopment Agencies), municipalities, housing authorities, and other public officials that assist with the development of a MFNC project (such as providing financial support, zoning variances, marketing assistance, etc.) in exchange for the developer tailoring the project to meet those backers’ goals. In other words, the IOU programs are operating in a market that includes a particularly complex array of public programs and policies influencing the energy efficiency of the MFNC market, even after the dissolution of the Redevelopment Agencies.

Despite the complexity of the market, the Phase II findings suggest that the program has affected the market through trainings, design assistance and plan reviews, affecting the knowledge and practices of developers and their design teams. In addition, the requirement to use CEPEs to prepare Title 24 documentation and HERS Rater inspections creates further impacts by providing a level of quality control for energy efficiency measures, designs, and practices. CEPEs are commonly used outside the program because official Title 24 documentation encourages their use. While we did not find evidence that the programs led to increased marketing or consumer demand for efficiency, developers indicated that efficiency and green labels are important marketing tools, particularly for high-income buyers in the market-rate sector. This suggests program elements that the programs could revisit.

From our sample of 24 low-rise and four high-rise MFNC projects, we found that all of the sampled MFNC projects exceeded the applicable Title 24 energy code requirements (an average of 23% BTS). Although the sampled projects from this assessment are overrepresented by low-income projects and projects with efficiency requirements, there is clear evidence that projects are being built outside of the IOU MFNC program to above-code standards.

The Phase II research confirms the Phase I findings that financial considerations dominate developers’ energy-related decisions and that developer perspectives on the value of energy efficiency vary greatly. For example, some developers view efficiency as a hassle, while others view it as a marketable feature or a core part of their mission.

Several recommendations for future research and IOU program design emerge from the findings of this study, many of which are premised on the assumption that increased program participation could lead to informed market actors being more willing and able to extend some program practices to their non-program projects.

- **Design assistance:**
    - **Speed up recommendations**
    - **Focus on upgrades other than higher mechanical system efficiencies**
    - **Provide data on maintenance costs**
    - **Provide more advanced support for experienced teams, in addition to basic support for new participants**

  Several case study interviewees reported that the design assistance was too basic, came too late, and was too focused on developers who are inexperienced with energy-efficient designs. This made it less useful for experienced developers who would be willing to participate and learn new strategies for efficient design. Design assistance must be a fast process targeted at the early development stages, such as conceptual/schematic design and design development, or developers cannot implement the suggestions cost-effectively.

  Technical support should focus on cost-effective *practices* rather than expensive upgrades to mechanical systems. A mechanical system upgrade may not be an effective recommendation unless it comes not only with detailed explanations of upfront and long-term costs, but also with clear and accurate information on system reliability. This could in turn provide the information that might encourage developers to carry over these practices into their non-program projects.

- **Increase outreach beyond repeat participants to non-participating developers in order to expand the market of developers working on above-code projects.** While this recommendation may be limited by available program funding, awareness of and participation in the program's outreach and training efforts was low, even among program participants. Over one-half of survey respondents were unaware of the MFNC program, and participation in IOU training and design assistance was low among respondents. This outreach will be most effective if the IOUs can succinctly explain the following to developers:
    - Specific practices that meet program criteria
    - The upfront and long-term costs of those practices, *including maintenance*
    - Impacts on design/construction timelines
    - How the program can help simplify the design team's learning curve (design assistance)

- **Consider partnership with LEED or other green certification programs, such as GreenPoint Rated.** While the IOU program has strong measure verification requirements, LEED is a very powerful driver with a well-known name; investors care about this marketable label more than the actual energy savings. The IOUs should consider the costs and merits of creating a hybrid incentive or program structure that allows developers to follow the criteria of a program such as LEED, while retaining the quality control elements of the IOU program participation. This would be complicated by the use of the CAHP score in current IOU program standards. As it stands, developers have many options for green program participation, and some consolidation is likely to encourage above-code building.

- **Reconsider the timing and amount of IOU program incentives so as to increase participation.** While the IOU incentives can reduce the marginal cost of building to above-code standards, some developers find them not only too low, but also perceive barriers to program participation because the incentives are only received at project completion, well after developers have had to put together their project financing and capital, and because some developers do not view the IOU incentives as reliable enough to count on without making other provisions. IOUs should consider the feasibility of either providing the incentives earlier in the development process or enhancing the guarantees of financial payments to developers, along the lines of CTCAC tax credit awards that respondents felt absolutely confident in receiving, assuming they met their various commitments.

- **Demonstrate feasibility of energy efficiency via benchmarking of energy performance *and maintenance costs;* offer publicity and marketing support to developers who participate.** Developers, particularly those who continue to own and operate their MFNC projects, value the benefits of reduced operating expenses from investments in energy-efficient equipment and measures, while investors and lenders view utility expense as a critical component of their underwriting protocols. Demonstrating the performance of program participants could help drive increased interest in energy efficiency in MFNC, including outside of the program.

  Developers who own and operate their properties must factor long-term operating costs into their design specifications, but utility costs are only one factor. The IOUs should provide accurate data regarding the maintenance costs of efficient systems in order to demonstrate the feasibility of these systems to design teams. Respondents described choosing inefficient but reliable systems as one strategy for lowering operating costs.

  Both non-profit developers of low-income housing and for-profit developers of market-rate housing may view public recognition for their efficient projects as a significant incentive to participating in benchmarking efforts.

- **Increase marketing and advertising.** The IOUs should consider increasing their advertising and marketing of the IOU programs to potential renters and buyers in order to increase consumer demand for energy efficiency. Developers already perceive some consumer demand and have responded to demand for some projects. Stimulating consumer demand could increase developers' production of energy-efficient MFNC projects.

- **Continue coordinating with CTCAC.** CTCAC is a key driver of energy efficiency in the low-income MFNC market. By coordinating with CTCAC, the program can help expand the influence of both programs on the market. For example, CTCAC investors reported using their own consultants to verify that construction practices adhered to the developer's design commitments, serving as a quality assurance check to verify that the project would definitely receive the low-income tax credits that attracted the investors. The program's quality assurance practices could provide this service for investors and generate more market interest and confidence in energy efficiency.

- **Coordinate with the Codes and Standards Program to improve enforcement of and compliance with base and reach codes.** About three-quarters of case study interviewees who worked in reach code jurisdictions reported that reach codes were enforced either poorly or inconsistently across jurisdictions, similar to their experiences in non-reach-code jurisdictions.

Appendices (in separate document)

Appendix A Comparison of Case Study Projects to Broader MFNC Population

Please see Appendix A in the accompanying volume.

Appendix B Detailed Findings of Individual Market Effects Indicators and Expected Outcomes

Please see Appendix B in the accompanying volume.

Appendix C Site-by-Site Discussion of Case Study Projects

Please see Appendix C in the accompanying volume.

Appendix D Detailed Methodology and Findings from On-Site Visits

Please see Appendix D in the accompanying volume.

Appendix E Detailed Methodology and Findings from Developer Survey

Please see Appendix E in the accompanying volume.

Appendix F Data Collection Instruments and Survey/ Interview Guides

Please see Appendix F in the accompanying volume.

Appendix G Appendix G Recommendations and IOU Responses

Please see Appendix G in the accompanying volume.