

# Code Based Savings: Analytics-Enabled Study of To- and Above- Code Savings in California's Title 24 Policy Environment

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## ABSTRACT

In 2014, California's Investor Owned Utilities (IOUs) and the California Public Utilities Commission (CPUC) embarked on an effort to examine the existing codes, standards and equipment baseline policies with industry support. The impacts of California's Title 24 building code standard in existing buildings and the eligibility of to-code and above-code savings as utility claimable savings have never been fully quantified using Advanced Metering Infrastructure (AMI) consumption data.

FirstFuel Software, Inc. conducted the following bottom-up analysis to provide empirical evidence related to building energy performance in relation to 2013 Title 24 standards using its FirstAudit software. FirstFuel found that for the buildings analyzed: (1) energy efficiency savings potential is one-half to-code, one-quarter operational, and one-quarter above code, (2) for over 90% of the buildings, a majority of potential savings are to-code and operational, (3) over 90% of the buildings are performing at an average of 9.6% below code, and bringing these buildings up to code represents an estimated 7.2 GWh. (California Building Standards Commission, 2013)

## Introduction

Failing to acknowledge and count below code savings can result in substantial missed opportunities for energy efficiency (EE), as it removes the impetus for utilities to chase these EE gains and could even allow for the targeting of *more* rather than *less* efficient buildings. The CPUC Decision (D.) 14-10-046 directed the IOUs to provide evidence regarding the to-code (aka "stranded") savings potential, including by developing to-code pilots, to inform future policy changes in this area. Current policy allows utility incentives (and programmatic credit) for above-code energy efficiency projects, and in limited instances, for measures that help customers get up to code. Additional information is needed to quantify how current policies may be limiting overall efforts to maximize efficiency gains in existing buildings.

PG&E turned to FirstFuel to support their Code Baseline research effort in late 2014 while looking to respond to the CPUC Decision (D.)14-10-046, as well as gather intelligence needed to inform strategic decision-making. FirstFuel is the leading provider of customer intelligence to utilities and energy providers, and relies on data and advanced analytics to derive energy insights for business customers. This code-baseline effort leveraged FirstFuel's analytics-driven platform and its remote assessment product, FirstAudit, to identify energy savings potential in commercial buildings. The FirstAudit platform provides detailed energy intelligence,

including end-use disaggregation and building specific energy conservation measures. Once the end-uses were disaggregated, an additional code analysis was layered in to derive the to-code and above –code savings potential.

The code-baseline discussions are still evolving today and influenced by a variety of EE stakeholders. Further, toward the end of 2015, Assembly Bill (AB) 802 was passed, now creating a legislative mandate for the CPUC to interpret and evaluate normalized metered energy consumption, and authorize the utilities to support high opportunity programs and projects that capture savings as measured from existing actual baselines, as opposed to from a code baseline. This would allow savings to be claimed from measures or actions that bring a building up to code.

## Methodology

The methodology for the to-code analysis leverages FirstFuel’s data analytics capabilities to identify energy savings in commercial buildings and then layers in a code analysis on specific end-uses. As shown in Figure 1, FirstAudit requires only two inputs: (1) historical energy consumption data (15-min/30-min/hourly) and (2) the building’s address. FirstFuel then complements the analysis with additional information about the building including (a) hourly local weather data, (b) GIS building data, and (c) publicly available building data (e.g., building size, occupancy type, past renovations, etc.). FirstFuel processes this data to provide detailed energy intelligence, including end-use disaggregation and building-specific energy conservation recommendations specific to each building.

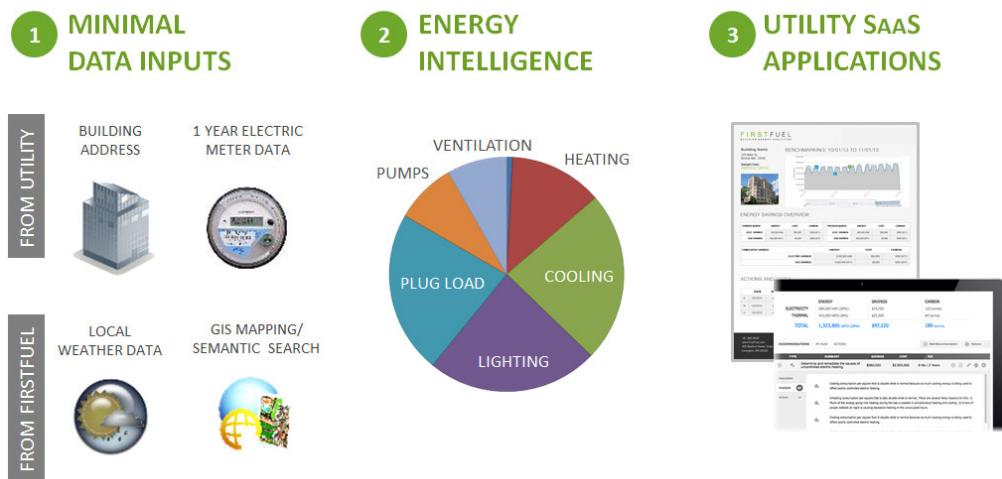


Figure 1. FirstFuel FirstAudit modeling approach

FirstAudit includes a remote auditing tool that provides detailed energy consumption and savings intelligence specific to each individual building. PG&E and others have technically validated FirstAudit, as shown in Figure 2, which concluded that the remote audits yield results consistent with on-site ASHRAE Level 2 audits. (PG&E, 2013) Thanks to the validations noted, FirstFuel’s analytics platform has been approved for use in United States Federal Government buildings. (The White House, 2015)







		Comparison to:	FirstFuel RBA results:
Published reports		Onsite audits	<ul style="list-style-type: none"> <li>• Within 8% of building end-uses</li> <li>• Consistent recommendations/savings</li> <li>• Identified opportunities missed by on-sites</li> <li>• Significant speed, cost, and scale advantages</li> </ul>
		End-use sub-metered building	<ul style="list-style-type: none"> <li>• Within 7% of building end-uses</li> </ul>
		End-use sub-metered building	<ul style="list-style-type: none"> <li>• Within 1%-5% of building end-uses</li> <li>• Identified opportunities missed by on-sites</li> </ul>
Private customer results	 US General Services Administration	End-use calculations, Onsite audits	<ul style="list-style-type: none"> <li>• Within 2% of end-use calculations</li> <li>• Consistent recommendations/savings</li> <li>• Uncovered largest savings opportunity missed by onsite audits</li> </ul>
		End-use calculations, Onsite audits	<ul style="list-style-type: none"> <li>• Within 5% of end-uses</li> <li>• Consistent recommendations/savings</li> </ul>
		Onsite audits	<ul style="list-style-type: none"> <li>• Consistent recommendations/savings</li> </ul>

Figure 2. Summary of FirstFuel technical validations

The intent of this study is to provide data regarding the to- and above code energy savings potential associated with recommendations that target typical technology levels that an energy auditing firm would make to its end users, based on reasonably available and financially viable technologies. This report is intended to estimate something similar to an “economic” potential, which is based on the simple payback range noted in Table 1, without incentives. This analysis did not look at “technical potential”, or account for a Benefit Cost Ratio (BCR), net present value (NPV), or Total Resource Cost (TRC) calculation. By focusing on shorter paybacks which are typical of what a customer is likely to adopt, this analysis may discount *technical* potential savings, i.e. technically feasible but not necessarily economically viable savings that would typically be considered above-code.

FirstFuel remote audits analyze each building’s own unique consumption patterns and signatures to deliver highly customized, actionable Energy Conservation Measures (ECMs), which include energy savings estimates.

Table 1 – Simple payback target by measure category, before incentives

Measure Category	Payback Range (years)
Lighting Retrofit	3 to 10+
HVAC	1 to 5
Plug Load Management	1 to 3
Refrigeration	3 to 5
Exterior Lighting	3 to 5
Lighting Controls	1 to 3
Motors, Pumps, and Drives	1 to 5+

FirstFuel’s general approach for determining above code and to-code savings is illustrated in Figure 3. FirstFuel starts by determining end-usage and “existing conditions” and then calculates variations from code for each measure during end-use disaggregation. Once the existing conditions have been determined, those conditions are compared with the expected usage under current 2013 Title 24 standards, which is specific to the relevant building type and climate zone. As part of this process, FirstFuel identifies energy efficiency measures based on the existing conditions.

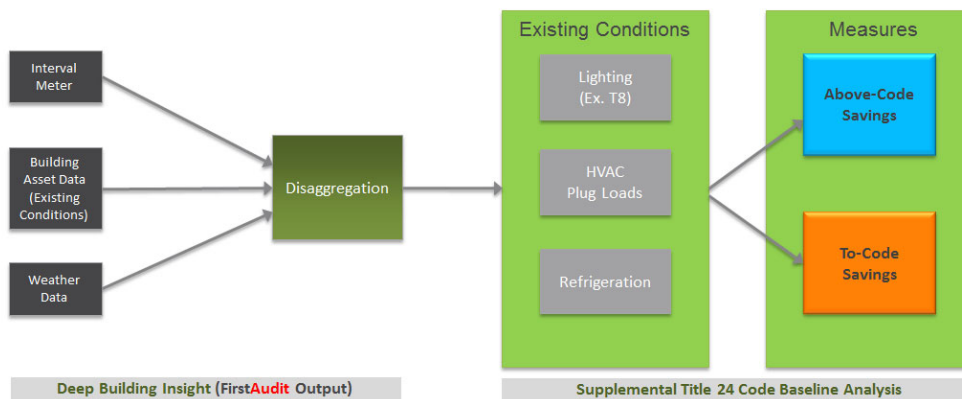


Figure 3. Summary of FirstFuel Title 24 analysis approach

## Building Selection

This analysis reflects findings for a 100 building sample set that were selected as part of a 300 building random sample prepared by an independent third party specifically for this project. The sample is not designed to be representative of PG&E’s overall territory, which is quite large and spans multiple climate zones. Nor is it designed to be representative of all building types. It is designed to provide insights on the savings potential of the building types and climate zones, which reflect common building sizes and types in popular PG&E service regions.

The buildings selected by for the Code Baseline Study had the following characteristics:

- Climate zones 12 and 13, as defined by the California Energy Commission (CEC, 2013).
  - Climate Zone 12: 62 buildings
  - Climate Zone 13: 38 buildings
- The building types were Office, Retail, or Grocery (including drug stores).
  - Office: 55 buildings
  - Retail: 34 buildings
  - Grocery: 11 buildings
- Buildings had to have over 150,000 annual kWh to be included in the target population.

## Findings

FirstFuel evaluated retrofit savings and operational savings potential across the portfolio of 100 buildings. Figure 4 illustrates only retrofit savings potential in the sample. Retrofit measures, which are typically capital intensive rather than commissioning or behavior based, represent a significant opportunity for savings, more than 10.2 GWh. This analysis concluded that, of the identified retrofit energy savings potential, more than two-thirds is deemed to be to-code and one-third of all retrofit savings is determined to be above code.

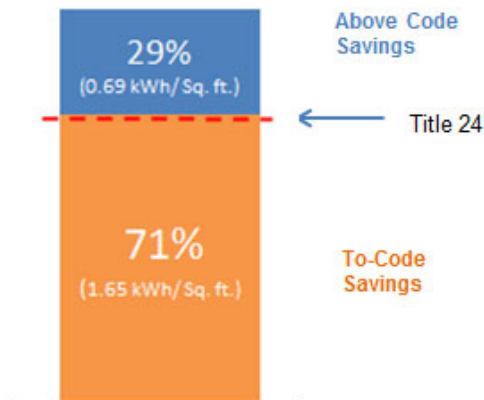


Figure 4. Average to- and above code savings

While there are differences that exist across the building portfolio, particularly when normalized for building size, there appears to be no correlation between savings potential and to- and above code savings potential. Figure 5 illustrates that variation. Building size is also not a good predictor of to- and above code savings.

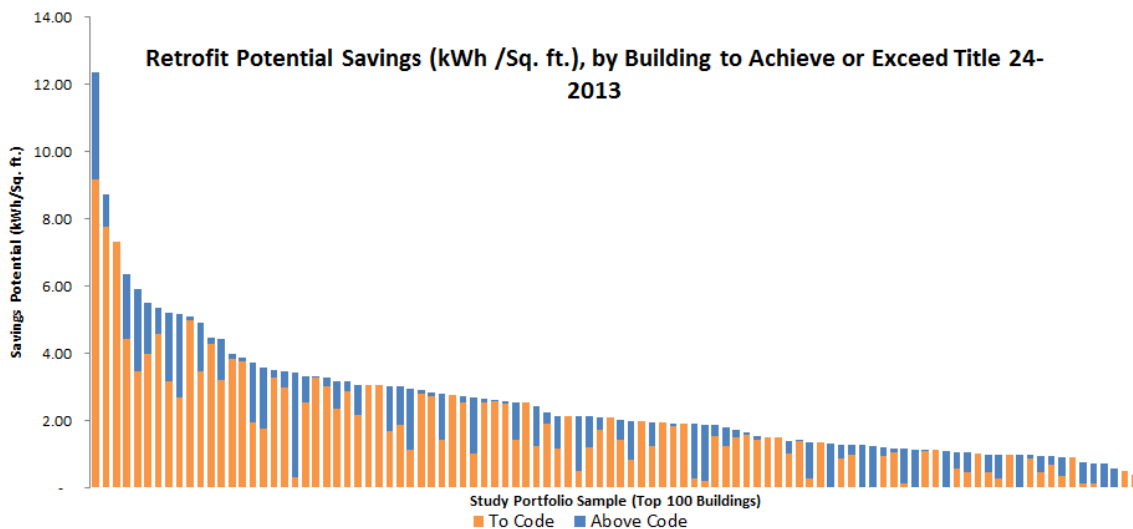


Figure 5. Retrofit potential savings (kWh/Sq. ft.)

One way to look at this same analysis is to calculate the percentage of a building's consumption that could be reduced by bringing that building to code. For the same 100 buildings reviewed in Figure 5 (above), Figure 6 (below) illustrates that potential reduction, per building. This % figure is effectively the amount of consumption below code for each building. On average, the base case for this population suggests about 9.6% savings reduction needed per building can be associated with getting to code. Some buildings have no above code savings potential.

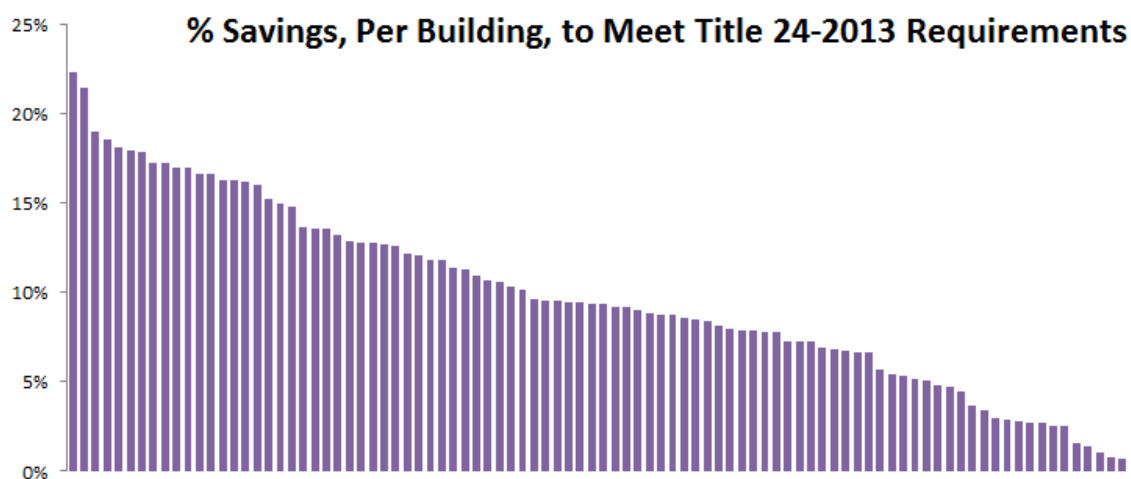


Figure 6. Average savings, per building, needed to achieve Title 24-2013 compliance

## Retrofit and Operational Savings Potential

FirstFuel also analyzed the operational savings potential across the portfolio of buildings. For purposes of this report, FirstFuel has defined operational savings as savings achieved through the optimization of existing building equipment, including but not limited to:

- HVAC equipment
- Lighting
- Refrigeration and related control systems

This optimization can be completed via the identification and implementation of low/no cost measures that reduce energy consumption and demand, and improve performance in buildings over time. This category includes retro-commissioning.

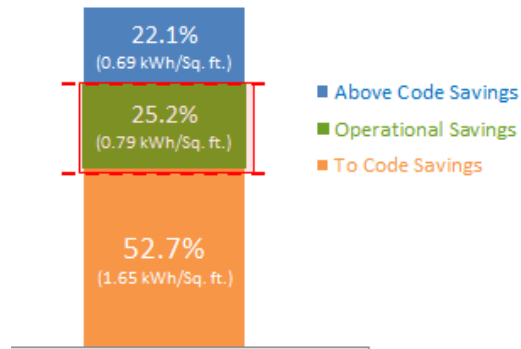


Figure 7. Illustration of to- and above code retrofit and operational savings potential

Figure 7 illustrates the breakdown of the total identified potential energy savings between to-code, above code, and operational savings, across the portfolio, while Figure 8 illustrates the variation across the portfolio. More than 3.5 GWh of savings potential is operational.

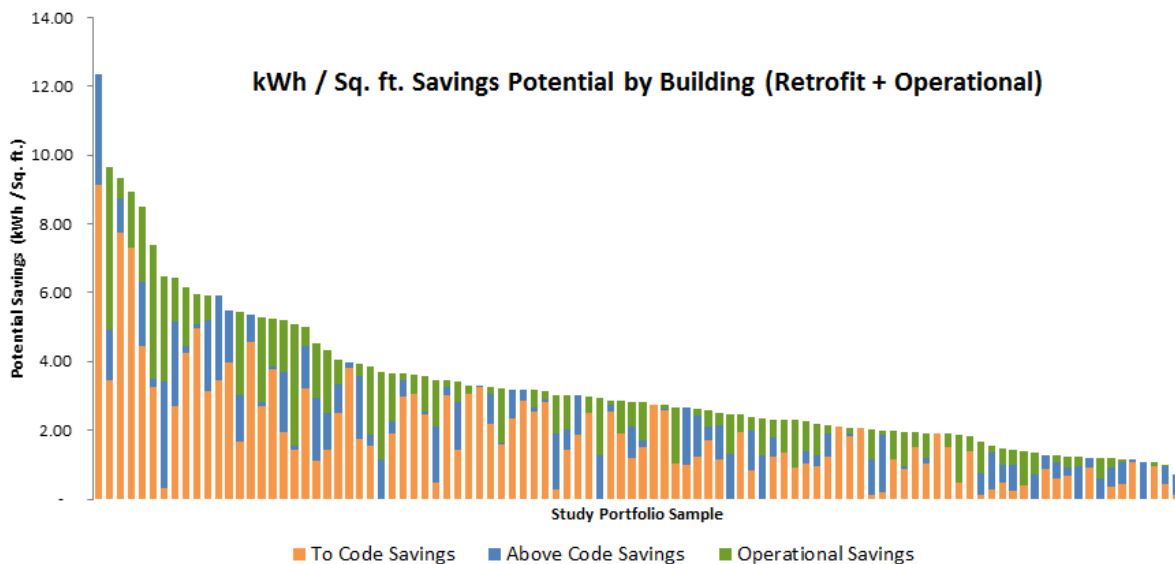


Figure 8. Retrofit and operational savings potential (kWh / Sq. ft.)

## Segmentation Analysis

To identify and evaluate variations across the audited buildings, FirstFuel examined to- and above code savings potential by building and measure type. As shown in Figure 9, for the 100 buildings examined, supermarkets, regardless of size, tend to reflect the largest *total* to-code potential savings, whereas offices show the highest *percentage* of to-code potential. While not meant to be comprehensive, the findings may point to areas for additional research to inform program resource deployment and/or policy choices regarding the treatment of to-code savings.

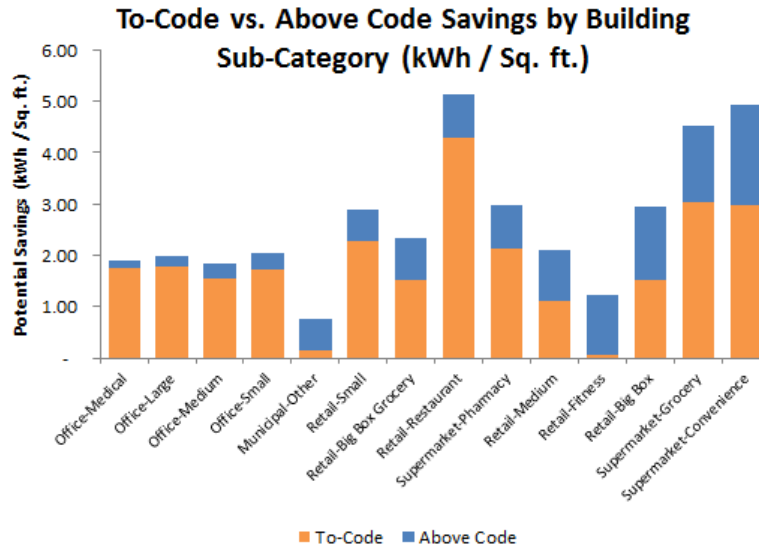


Figure 9. Savings potential (kWh / Sq. ft.) to- and above code retrofit savings, by building subcategory

Measure subcategories highlight some potential policy and program challenges and opportunities. For instance, Figure 10 highlights there is significant above code potential in HVAC retrofit and lighting retrofit measures. The average HVAC recommendation represented nearly 140,000 kWh in year 1 savings, and more than half of that savings is potentially above code. Conversely, there are a number of measure categories that represent little to no above code savings potential, such as motors, pumps and drives, lighting controls, and most ventilation measures as a result of stringent California requirements. If to-code savings became eligible for incentives, this analysis indicates some technologies that may be ideal future program targets.

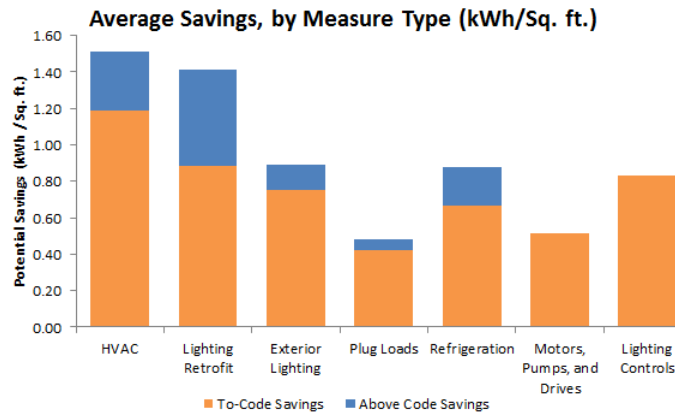


Figure 60. Average to- and above code retrofit savings (kWh / Sq. ft.), by measure subcategory



## Conclusion

This analysis provides a glimpse into the to-code and above-code savings potential for 100 buildings located in climate zones 12 and 13 in PG&E's service territory. The commercial building segments represented are office, retail, and grocery. The methodology for this analysis is grounded in AMI data and FirstFuel's analytics-driven intelligence platform. The findings of this code-baseline analysis indicate that:

1. Of the buildings analyzed, one-half of the identified savings is to-code potential, one-quarter represents operational savings potential, and one-quarter is above code.
2. For over 90% of the buildings a majority of potential savings are to-code and operational savings.
3. 92 out of 100 buildings are performing at an average of 9.6% below code. Bringing these buildings up to code would save an estimated 7.2 GWh from traditional measure based retrofit projects.
4. Operational savings potential represents an incremental 3.5 GWh of unclaimable savings potential.
5. HVAC and lighting retrofits indicate areas of high "to-code" potential.
6. Supermarkets reflect the largest *total* to-code potential savings, whereas offices show the highest *percentage* of to-code potential.

FirstFuel operates on the premise that there is an abundance of underutilized data in the energy sector. This analysis reveals that there is still a lot of opportunity when it comes to "stranded" savings potential in existing buildings. AB 802 is driving EE programs to evolve in real time to meet the expectations of this legislation, and it is only a matter of time before the policy also becomes adaptive to support this changing landscape of normalized metered energy consumption and existing conditions baseline.

## References

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