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Pacific Gas and Electric Company Lighting Design Assistance Trial Study Final Report: Qualitative Lighting Design Supply-Side Market Assessment

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1. Lighting Design Assistance Trial Overview

The Pacific Gas and Electric (PG&E) Lighting Design Assistance Trial (the Trial) began in September 2015 with the goal of promoting the involvement of Lighting Design Practitioners (LDPs) in lighting-specific retrofit projects. Lighting-specific retrofits are defined as projects retrofitting existing lighting systems as opposed to upgrading lighting as part of a larger reconstruction project. A comprehensive lighting design, which may offer the deepest energy savings, is not usually part of these types of retrofits. Thus, PG&E created the Trial to explore the potential value of involving lighting designers in lighting-specific retrofits.¹

The Trial set project qualifying criteria by attempting to target customers that would not typically consider a lighting design as part of a lighting-specific retrofit. As such, projects qualified for incentives if they met the following criteria:

- A lighting-specific retrofit (not new construction or gut rehabilitation);
- Treating an area between 10,000 and 100,000 square feet;
- The space is a commercial office, government facility, school, or retail building;
- The space is not used for commercial storage or industrial purposes;
- The space does not include exterior site lighting or parking garage buildings/areas; and
- The proposed design does not include screw-in lamp replacement and/or linear LED tube replacement lamps)²

Furthermore, LDPs themselves had to possess one of five credentials, either a:

- Mechanical or Electrical Professional Engineer (PE);
- Lighting Certification (LC);
- Certified Management Lighting Consultant (CLMC);
- Certified Lighting Efficiency Professional (CLEP) from the Association of Energy Engineers; or
- Member of the International Association of Lighting Designers (IALD).

For further proof of qualification, LDPs had to provide documentation of work experience, including a resume with at least three years of energy efficient lighting experience and a summary of at least three recent projects in which the LDP was the primary designer and in which energy efficiency was a key component of the design.

The Trial's primary strategy for getting projects was to market the Trial to LDPs, who would then market the program to customers looking to do a lighting-specific retrofit. Trial staff identified potentially qualifying LDPs through online research, consultation with industry professionals, and consultation with other PG&E demand-side management program staff. The Trial engaged with these LDPs through direct phone and e-mail outreach

¹ For more on Trial goals, qualification criteria and review process, please see Appendix B.

² Technically, the Trial does not allow screw-in lamp replacement. However, it may accept a project if screw-in lamp replacement is only a small part.

for recruitment. In addition to this market facilitation approach, PG&E's Energy Solutions & Services (ES&S) Team, Direct Install Program staff and Statewide Partnership Programs (specifically the Community Colleges Program) staff were also asked to identify customers for the Trial.

Despite these efforts, and after a full year of implementation, the Trial was not able to attract much participation. Between September 2015 and September 2016, only two LDPs had submitted designs that qualified for an incentive but no customer projects had occurred. For more detail on Trial participation to date, please see Appendix B.

2. Market Assessment Approach

Given that the Trial faced challenges gaining participation with its initial design, we focused our research on helping PG&E determine what design modifications may be needed to successfully reach and incent customers to consider comprehensive lighting design. We focused our efforts on better understanding the LDPs that the Trial engaged with in terms of their customer base, services offered and qualifications. The Trial engaged with LDPs in the following five distinct market channels:

1. **Energy Efficiency Consultants:** This market channel provides design services focused on the energy use and energy savings opportunities of lighting systems.
2. **Energy Service Companies (ESCOs):** This market channel provides a wide range of energy efficiency, demand response and/or generation solutions, including the design and installation of lighting projects and typically provides financing as part of their offerings.
3. **Lighting Contractors:** This market channel's primary business is installing lighting retrofit projects.
4. **Lighting Designers:** This market channel's primary business is creating lighting designs, and related analyses and documentation. Lighting Designers do not sell or install equipment.
5. **Manufacturer Representatives:** This market channel's primary business is light fixture and light bulb sales, but they also provide lighting designs or lighting design guidance to customers upon request.

We interviewed 20 LDPs, four in each of the five categories above, and compared each market channel in terms of the services offered, credentials, marketing strategies and customer base they commonly serve. Detailed comparative criteria are shown in Table 1 below. We then conducted a follow-up case study interview with one Energy Efficiency Consultant, and brief conversations with three other LDPs³, to better understand the incremental cost associated with moving from a one-for-one retrofit to a comprehensive lighting design. The overarching purpose of the additional research was to understand what incentive level, if any, would be sufficient to encourage customers to complete more comprehensive lighting retrofits.

More detail on our research tasks and methods can be found in Appendix D. For a crosswalk of where we address each of these questions in the report, please see Appendix F.

³ We attempted to interview all Energy Efficiency Consultants and Contractors included in the first round of interviews, however, only one completed the interview. As a back-up, we attempted to collect high-level information through brief follow-up conversations via e-mail and phone with two Lighting Contractors and one Manufacturing Representative.

Table 1: LDA Trial Qualitative Market Assessment Research Questions

Topic	Market Assessment Research Questions
Lighting Design Services	<ul style="list-style-type: none"> • What lighting design options are available through the five market channels to non-residential customers who would qualify for the Trial? • What does each market channel offer in terms of delivery method, cost, detail, customization, and equipment, techniques or strategies they use? • How knowledgeable are these five channels about PG&E’s energy efficiency and rebate programs? How often do their customers participate in PG&E programs? Do other incentives exist for supporting lighting design, such as federal incentives or government funding? If so, how do PG&E incentives compare? • What are the features of advanced lighting design that influence the efficiency of the installation and which of these features are offered by each of the five market channels? • What does each channel see as the benefits or differentiating features of their approach versus the other four channels?
Credentials	<ul style="list-style-type: none"> • What credentials, certifications, and licenses do the five channels commonly hold?
Marketing Strategies	<ul style="list-style-type: none"> • What do the five channels see as the key touch-point opportunities for finding customers about to start a lighting-specific retrofit? • How do the five channels market their services to customers? • What are the five channels’ perspectives on which types of customers might benefit from a lighting design, but face barriers to getting a lighting design? • What challenges or barriers do these market channels face when it comes to encouraging customers to incorporate a lighting design into lighting retrofit projects? How have they tried to overcome these barriers, or what approaches, if any, have they considered for encouraging deeper energy savings from lighting retrofits?
Typical Customers	<ul style="list-style-type: none"> • What types of customers do the five channels typically serve with all services they offer generally? • What types of customers typically get a lighting design through each of the five channels?
Alignment with Trial Design	<ul style="list-style-type: none"> • How do the lighting design options through each of the five channels compare and contrast to the Trial’s design requirements? • What are the options for the LDA Trial to change its design to take advantage of these various opportunities (design or designer qualifying criteria, target market)? What are the strengths and drawbacks to PG&E incentivizing other types of lighting designs (i.e. energy savings, increased participation, etc.)? • What other market intervention strategies might allow for deeper lighting-based savings from customers about to conduct a lighting-specific retrofit?

2.1 Limitations

It is important to note that we draw our findings from a relatively small number of interviews (we spoke with 20 LDPs, four in each market channel, and conducted a follow-up case study with one of them). This study was qualitative in nature as this assessment required a deeper level of understanding of each market channel before a quantitative study could occur. As a result, while these findings provide useful insights into these

channels, we cannot confidently say they represent the general population. Although the five market segments described in this report have not been empirically defined, the segments were created based on feedback from lighting professionals and recruitment efforts. Therefore, additional research would be needed to validate that the market segments described in this report are sufficient.

3. Market Assessment Findings

Structure of this Chapter

In the chapter below, we analyze the market channels from several angles. In Section 3.1, we summarize each market channel separately, including the types of customers and projects they provide design services for, their credentials, and their marketing strategies. In the next section, 3.2, we take a detailed look at the design services they provide, comparing and contrasting each of the channels in terms of their focus on energy efficiency, level of detail, documentation, and cost. Then, in Section 3.3, we bring both of these elements together to assess how well each of the market channels align with the Trial. Finally, Section 3.4 explores market barriers, including the incremental costs associated with more comprehensive lighting design.

3.1 Market Channel Characterization

3.1.1 Lighting Contractors

Lighting Contractors serve a wide array of segments including the Trial targets— small office spaces, schools and government facilities. The vast majority of their projects are non-residential lighting retrofits that are between 10K and 100K square feet (matching the Trial’s target). The majority of their business is lighting-specific retrofits; the same target for the Trial. Three of the four Contractors we interviewed had qualifying credentials for the Trial. Among all of the market channels, Lighting Contractors were the only channel to have CLEP or CLMC certifications, which are dedicated to lighting system energy management.

Lighting Contractors mention low or no additional cost as the main advantage to working with them for design services.

"I've got the ability to design projects and help the customer to lay out their retrofit scheme... and we're not charging the customer per se, but...that's what's helping us to get those projects."

Their primary business is installation services, but the respondents we spoke with also provide lighting designs in the planning stages of a project. They suggest that, because the customer is paying for installation as well, they can offer the design services for relatively lower cost compared to other channels.

Lighting Contractors typically acquire customers through word-of-mouth and referrals, but other marketing tactics vary. One respondent mentions they have a sales team that does “on-the-street” sales, finding properties that may need retrofits. Two contractors mention that they receive work from customers who have seen their name on the list of approved PG&E Trade Professionals. One Lighting Contractor has relationships with lighting manufacturers and receives incentives for installing their lighting products. They often consider utility incentives to be critical components of their business models, and nearly all their customers participate in PG&E’s commercial energy efficiency and rebate programs. Figure 2 below provides a high-level description of this market channel.

Figure 1: Lighting Contractor Summary Snapshot



3.1.2 Energy Efficiency Consultants

Energy Efficiency Consultants most often provide lighting design services to small- and medium-sized facilities that align with the Trial’s target, with a focus on office spaces. Only one of the four typically works with buildings in the 10K-100K square footage range that the Trial targeted, while others work with smaller or larger spaces. Two of them had qualifying credentials for the Trial (i.e., a PE). These Consultants do not typically work with customers who are interested in just a lighting-specific retrofit. Instead they receive referrals from their network of customers who are already actively seeking an energy efficient lighting design. Therefore, while this channel is likely qualified to provide an energy efficient lighting design to the Trial’s target, it may not be a good marketing channel to leverage for finding customers that would not otherwise do a lighting design, as they do little marketing themselves.

Three of the four Energy Efficiency Consultants report that their ability to quickly turn around projects sets them apart from other market channels.

“[The advantage to working with our company is that] we have great speed. I think we turn projects around the same week.”

This short timeframe between initial site work and finalized design allows them to provide services to clients who are attempting to meet tight internal deadlines. They provide design services during the planning stages of retrofits, but typically do not install lighting equipment.

All four Energy Efficiency Consultants do little direct marketing, but have developed networks within the business community. Their primary source of new customers is through word of mouth referrals. Incentive programs play a critical role in their services, with two of the four saying they “always” recommend their customers to incentives programs. They estimate that about half of their customers participate in PG&E incentive programs. Figure 2 below provides a high-level description of this market channel.

Figure 2: Energy Efficiency Consultant Summary Snapshot



3.1.3 Energy Service Companies (ESCOs)

ESCOs serve a wide variety of customer segments that align with the Trial’s target, but tend to focus on larger facilities (larger than 100K square feet) or customers who sign performance contracts for multiple facilities. In addition, ESCOs do not tend to work with customers only looking to do a lighting-specific retrofit. They tend to work on much larger gut rehab or deep retrofit projects or new construction. Two of the four ESCOs had qualifying credentials for the Trial.

When comparing themselves to other market channels, all four ESCOs differentiate themselves from the other channels in terms of turnkey planning and installation services.

“...If you looked at a customer or a client that’s looking to develop a more holistic or comprehensive project that includes, for example, solar, or HVAC, or building controls, they typically need to hire a few different bodies, professional bodies on the design side and implementation side. Where a company like ours is able to... [do] the whole thing... regardless of how comprehensive that scope of work is.”

Among the five market channels, ESCOs offer the widest array of services to customers, from planning and installing energy retrofits to energy generation and procurement. Lighting design is one small piece of their larger service package, but ESCOs see it as a natural fit to their start-to-finish approach.

Though all ESCOs report primarily acquiring customers through word-of-mouth and referrals, two mention acquiring customers through trade shows. All four ESCOs take maximum advantage of incentive programs, and nearly three quarters of their customers participate in PG&E programs. Figure 3 below provides a high-level description of the ESCOs market channel.

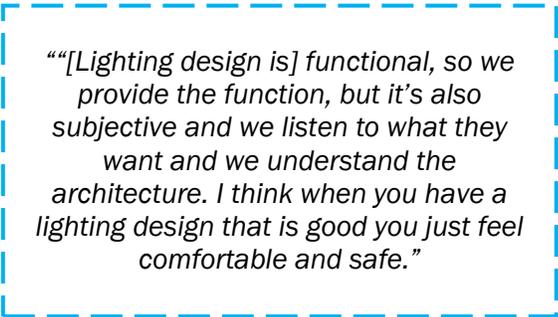
Figure 3: ESCO Summary Snapshot



3.1.4 Lighting Designers

Lighting Designers serve a wide variety of commercial and municipal customers that align with the Trial's target. This market channel tends to focus on smaller facilities. Two commonly serve the Trial's targeted size of 10K-100K square feet while the other two commonly serve smaller buildings. However, lighting-specific retrofits are a very small part of their business. All four respondents report they often work on new construction or deep retrofit projects. Only one Designer lacked the credentials required by the Trial. Therefore, similar to Energy Efficiency Consultants, this channel may have the qualifications to draft energy efficient lighting designs but may not be a good marketing channel to help attract customers that would not otherwise do a lighting design, as they do little marketing themselves.

Lighting Designers said that customization was the key aspect of their delivery model. They often repeatedly revise and rework designs to meet the aesthetic desires of the client.



“[Lighting design is] functional, so we provide the function, but it’s also subjective and we listen to what they want and we understand the architecture. I think when you have a lighting design that is good you just feel comfortable and safe.”

All four Lighting Designers provide detailed drawings and renderings of their designs to the client so they can visualize the space before the lighting is installed. Lighting Designers are also more likely to consider a wider range of brands and fixtures because they are not tied down by relationships with specific manufacturers. For example, two respondents report they are IALD members, and to qualify for IALD membership, “IALD members must abide by rules of ethics and do not sell or install lighting equipment.”⁴

All four respondents receive their customers primarily through referrals and word of mouth. Two Lighting Designers specifically mentioned that they receive the majority of new customer referrals from architects. Lighting Designers are engaged with incentive programs, as three of four respondents recommend them to their customers some or most of the time. Figure 4 below provides a high-level description of the Lighting Designers market channel.

⁴ <https://www.iald.org/About/About-Lighting-Design/Importance-of-Using-a-Lighting-Designer>

Figure 4: Lighting Designer Summary Snapshot



3.1.5 Manufacturer Representatives

Manufacturer Representatives serve a wide range of segments that align with the Trial’s target, and typically serve the Trial’s target facility size: 10,000 to 100,000 square feet. As companies focused on selling equipment, only two of them held the credentials required by the Trial.

Manufacturer Representatives feel that their no-cost design service is the main advantage to working with their companies. Respondents for other market channels claim that their services are “free”, but in actuality those services are wrapped into the total project cost for which they have been contracted to perform. Manufacturer Representatives provide these services before the customer agrees to install anything, with the hope that customers ultimately will choose their products.

“We’re going to offer the design for free and so we want someone that... if we do the design, we get the business.”

They typically acquire their customers through word of mouth or through their company’s sales team. They are aware of incentive programs and three of four recommend them to customers frequently. Two Manufacturing Representatives estimated the percent of their customers that participate in PG&E programs, but their estimates differ widely (5% and 99%) while the other two were unaware. Figure 5 below provides a high-level description of this market channel.

Figure 5: Manufacturer Representatives Summary Snapshot



3.2 Lighting Design Services

In addition to credentials and target markets, we also explored the types of lighting design services each market channel provides. Variability in lighting design services can have an effect on the energy efficiency level of the lighting system. Table 2 shows the 24 common components⁵ of a lighting design, organized into six chronological stages. The table also identifies components that potentially affect the energy efficiency level.

Table 2. Lighting Design Components

Component	Component Description	Component Potentially Affects Energy Efficiency	Rationale for Potential Impact on Energy Efficiency
Pre-Design Analyses			
Site Observation	During the initial planning phase, the designer visits the space to better understand space usage and traffic patterns	✓	Improves understanding of areas that require more/less lighting and occupancy patterns so that appropriate light levels can be delivered and lighting is provided only when needed
Daylighting or Fenestration (Windows) Analysis	Examines the amount of daylight that comes into a space during specific days and/or times of the day	✓	Allows daylight controls to be utilized to reduce electric lighting
Design Development			
Tailoring to Use	Tailors the lighting to the use or traffic patterns of the space (i.e., offices vs. hallways)	✓	By tailoring the lighting to the exact space, the lighting designer can ensure that appropriate light levels are delivered
Wall Color and Reflectiveness	Considers the wall color and the reflective properties of the space, such as shined metal or mirrors	✓	
Ceiling Height and Shape	Considers how ceiling height and shape change the dispersal of light and reflectivity in the room	✓	
Fixture and Lamp Selection	Designer will consider the photometric performance of the fixture (where light is delivered), fixture energy consumption, correlated color temperature (CCT), and lamp color rendering index (CRI)	✓	
Lighting Controls	Design includes lighting controls such as dimming switches, occupancy sensors, integration with an	✓	

⁵ Prior to the in-depth interviews with LDPs, we conducted a literature review of designer websites, industry articles, and association websites to understand what goes into a typical lighting design. See Appendix D for more detail on research tasks.

Component	Component Description	Component Potentially Affects Energy Efficiency	Rationale for Potential Impact on Energy Efficiency
	Energy Management System (EMS), or other technologies		
Contrast	Creates contrast between different types of lighting for visual effect or for comfort	✓	May reduce energy use by darkening certain spaces
Highlight Areas	Design considers customized lighting for company logos, pieces of art displayed in the space, and other potential attributes of the space that the client would like to highlight	✗	Aesthetics only
Analysis and Presentation of Results			
Energy Use Analysis	Analysis that shows anticipated energy consumption of lighting system. For retrofit designs, analysis shows existing energy use, proposed energy use and estimated energy savings	✓	Provides analysis of anticipated energy use of lighting system
Financial Analysis	Provides various financial estimates for the project, such as including an opinion of probable cost, a life cycle cost analysis, and a return on investment (ROI) analysis	✓	Presenting the long-term financial benefits may encourage clients to choose an energy efficient design despite higher short-term costs
Photometric Analysis	Models the light levels and lighting density delivered throughout the space	✓	Ensures that appropriate lighting level is provided; avoids over-lighting spaces
Code Compliance	Designer will ensure that the design meets requirements of Title 24, LEED, Well Building, CALGreen, and/or other certifications	✓	Ensures that design meets or exceeds energy efficiency guidelines
Presentation of Multiple Designs	Designer presents multiple designs to the client which adjust constraints such as cost, energy efficiency, adaptability, etc.	✓	Depending on the presented designs, the client may opt for a more efficient design when given the opportunity for comparison
Finding Available Incentives	Designer helps the client find federal, state, local, or utility incentives	✓	Incentives may encourage larger-scale retrofits or more efficient equipment

Component	Component Description	Component Potentially Affects Energy Efficiency	Rationale for Potential Impact on Energy Efficiency
Design Documentation and Deliverables			
Fixture Schedule	Lists all fixtures installed in the projects, including serial numbers and specifications	✓	Clear instructions and goals may ensure that lighting designs achieve their intended energy efficiency levels
Basis of Design Report	Establishes the performance goals or energy goals of a project	✓	
Installation Documents	Describes how the contractor will install lighting design; may include installation specifications, Building Information Modeling (BIM) layouts, computer-aided design (CAD) layouts, or mounting details	✓	
3D Renderings of Lighted Space	Mock-up giving the client an idea of what the installed design will look like	✗	Additional documentation for helping the client select options from an aesthetics perspective
Installation Phase Support			
Submittals and Assistance with Requests for Information (RFIs)	Assists the customers in developing RFIs and vetting lighting suppliers/contractors	✓	May help reduce costs which may offset the costs of more efficient equipment
Review of Shop Drawings	Designer reviews contractor shop drawings to ensure that they reflect the design	✓	Designer may find errors in the implementation of the design that make the project less energy-efficient
Post-Installation Support			
Post Installation QA/QC Walkthrough	Designer does a walk-through of the space and ensures that elements of the design were installed properly	✓	Ensures the delivered light quality is satisfactory to the client and meets the design intent
Lighting Controls Assistance	Designer helps the client/occupants understand how to operate lighting controls	✓	Ensures that occupants use lighting controls in a way that maximizes energy efficiency
Assistance Completing Incentive Paperwork	Designer actively assists the client to complete Federal, State, local, or utility paperwork	✓	Incentives may encourage larger-scale retrofits or more efficient equipment

Using these 24 components as a foundation, we asked the in-depth interview respondents to walk us through their typical lighting design. Table 3 below summarizes how the lighting designs differ by market channel. The components, or services, vary in their potential impact on energy savings. Therefore, they are categorized by

high versus medium/low impact⁶. Generally, we considered “high impact” services as those that tailor the space to avoid wasted lighting, promote energy efficient equipment, or help customers understand the value of energy efficiency. As for “medium/low” impact services, while there is the possibility they affect energy usage, they tend to be indirectly related to energy usage or additional documentation and support services.

It is important to note that Table 3 shares results of self-reported information from the LDPs interviewed in this study. Further research is needed to validate these responses in such a way that we can confidently say what these LDPs are and are not including in their typical lighting design services that optimizes energy efficiency.

The lighting designs that each market channel offers are not standard for all of their customers. Therefore, the market channels varied in how often they include certain components in their designs. To illustrate this visually, darker shades of blue in the table indicate that respondents perform these services often. Medium shades of blue indicate that the respondents sometimes perform these services or that those services are less comprehensive (i.e., they do one or two of a wide variety of services included in that category). Light gray and white shades indicate that they rarely or never perform these services, respectively.

⁶ For a detailed list of the components and the responses from LDPs, and how they map to original chronological categories, please see Appendix A.

Table 3: Lighting Design Services Typically Provided by Market Channel (Self-Reported, Not Verified)

Category	Description	Market Channel				
		Energy Efficiency Consultants	ESCOs	Lighting Contractors	Lighting Designers	Manuf. Reps.
High Potential to Affect Project Energy Efficiency						
Code Compliance	Considers compliance with Title 24					
Tailoring to Space Use	Considers traffic and how spaces are used					
Energy Usage Analysis	Considers fixture and space energy consumption					
Financial Analysis	Estimates return on investment or bill savings from EE equipment					
Incentive Program Support	Identifies available incentives and/or helps with paperwork					
Controls	Includes lighting controls and energy management systems, or trains building staff on how to use them					
Daylighting & Fenestration	Considers daylighting opportunities					
Green Building Code	Helps meet green building codes (i.e., LEED)					
Moderate/Low Potential to Affect Project Energy Efficiency						
Aesthetics (Basic)	Lamp color and directionality					
Design Documentation	Fixture schedules, installation documents, documentation of energy goals, 3D renderings					
Installation Phase Support	Assists in selecting contractors or ensuring proper installation of design					
Aesthetics (Advanced)	Wall color, contrast, reflectivity, ceiling height, highlight areas					
Multiple Options	Provides the customers with several design options					

Legend: Darker shades indicate that respondents perform these services more often, lighter shades indicate they perform them less often. Medium shades indicate that the respondents sometimes perform these services or that those services are less comprehensive (i.e., they do one or two of a wide variety of services included in that category). White means they do not perform these services at all.

Services with High Potential to Affect Energy Efficiency

All respondents, regardless of market channel, offer multiple services that have the potential to significantly increase the efficiency of lighting projects. All respondents ensure code compliance, tailor lighting to the use of the space, reducing the likelihood of wasted light. Nearly all respondents consider energy usage in their design, such as comparing the energy consumption of old and new (proposed) fixtures, considering how occupants use the space and photometric analyses (mapping lighting levels across the space). Further, most respondents try to explain to their customers how upfront project cost compares to their potential return in energy bill savings.

Notably, Lighting Designers had a much stronger focus on green building code than any other market channel. This is likely because they often work on new construction projects.

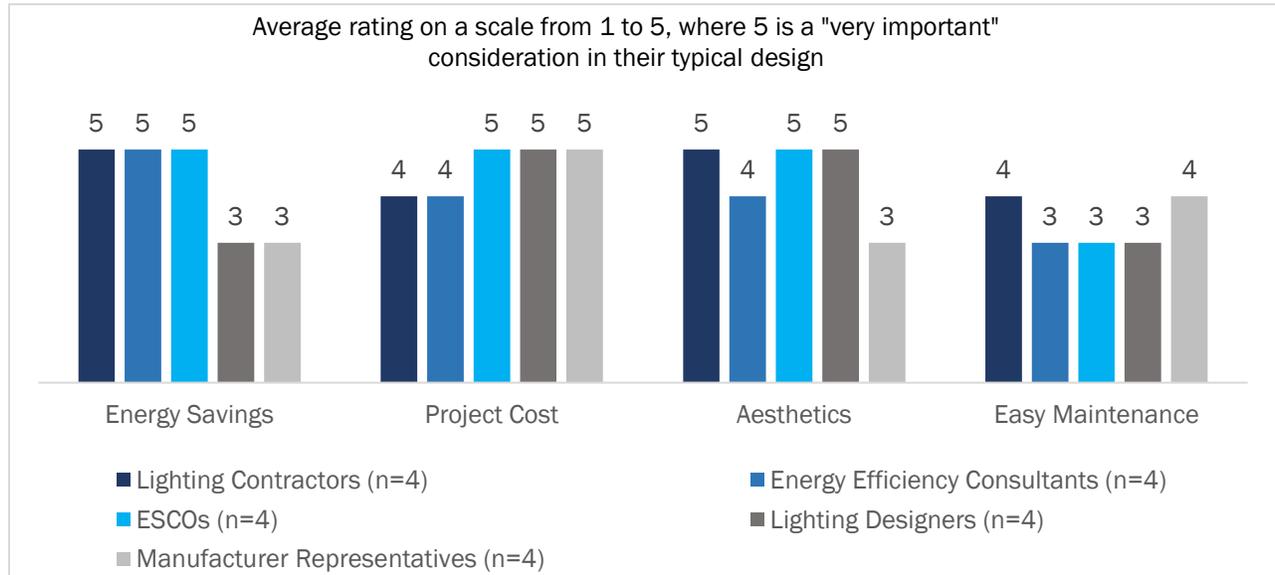
Services with Moderate/Low Potential to Affect Energy Efficiency

LDPs also generally offer a wide array of other design services that, while they may somehow affect the energy efficiency of lighting projects, are less likely to do so. For instance, all respondents consider basic aesthetics. Support during the installation phase of a project is also common, even among channels that may not be involved directly in installation. Lighting Designers, however, provide the most comprehensive set of additional services, such as advanced aesthetics and 3D renderings of the design.

Lighting Design Priorities

While energy savings is at least somewhat important for all market channels when creating lighting designs, some focus on it more than others. We asked respondents to rate the importance of various considerations in their typical designs. This included energy savings, retrofit project cost, aesthetics, and easy maintenance of installed equipment. Energy Efficiency Consultants report the greatest focus on energy reduction amongst the five market channels. As would be expected for ESCOs, companies that provide and manage energy use, energy efficiency is also top-of mind, but they tend to balance that equally with other customer concerns about project cost and aesthetics (especially the visual performance of lighting). Similarly, energy savings and aesthetics (especially visual performance) are the key foci for Lighting Contractors. Lighting Designers stand out amongst the market channels as being the most concentrated on the visual aspects of lighting design, and less concerned with energy efficiency. Lighting Designers not only reported this directly, but we also found this to be true based on the design services they provide (see Table 3). Finally, by nature of their profession, Manufacturer Representatives provide lighting designs that focus primarily on selling the brands they represent while staying within the customer's budget and ensuring easy maintenance. Energy savings and aesthetics are somewhat secondary concerns. Figure 6 below summarizes each market channel's design priorities.

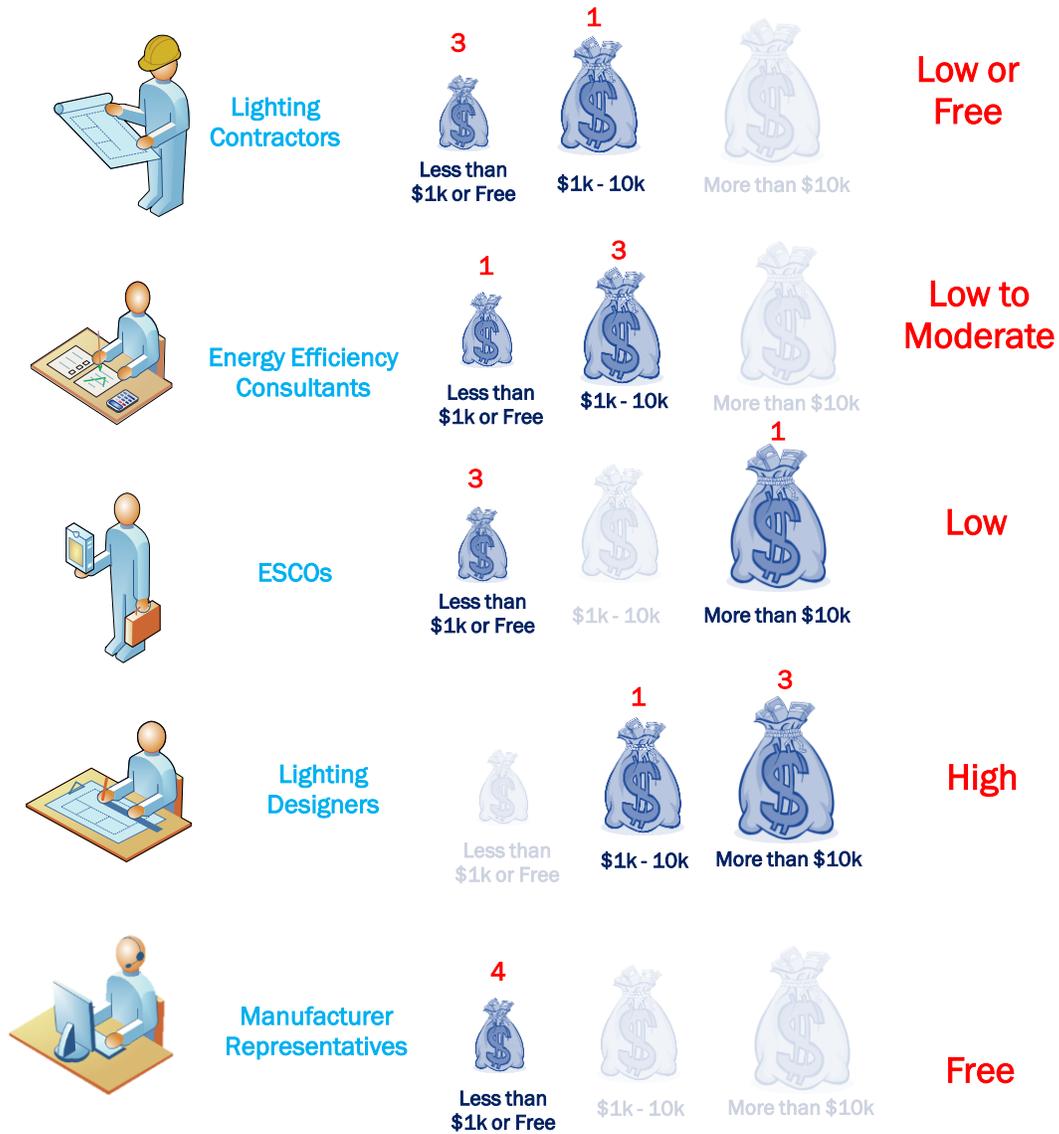
Figure 6: Design Priorities by Market Channel



Lighting Design Cost

The five market channels varied widely in terms of the average cost of their designs. The Energy Efficiency Consultants we spoke with reported that quick project turnaround reduces the number of hours they must spend on the design itself, which in turn allows them to reduce the cost of their services. They quoted low to moderately-priced lighting design services, between \$800 and \$7,500. ESCOs and Lighting Contractors typically do not charge an additional fee for their design services, but rather roll the costs into their larger service package. However, respondents were unclear as to whether they typically increase their overall service price when they add a lighting design. Lighting Designers report offering the most customization and options to customers, but this attention to detail does garner a higher price point as three of four designers quoted average prices between \$31,000 and \$57,000 dollars. Finally, all four Manufacturer Representatives indicate that they do lighting designs for free. As we mention earlier, these design are done without the customer agreeing to install anything, but with the hopes that the customer will install the products they represent. Figure 7 below summarizes each market channel’s typical design costs.

Figure 7: Cost of Typical Design by Market Channel



Note: Numbers above icons indicate the number of respondents in that category.

3.3 Alignment with Current Trial Design

Based on our findings in the two previous sections, we assess each market channel’s alignment with the LDA Trial’s current design (See Table 4). Some market channels are a better fit for the current Trial design than others. However, it is important to note that the Trial might benefit from altering its design, which we discuss in the Conclusions chapter (see Section 4.1). In the table below, we assess Trial alignment with green, yellow and red colors. Green highlights indicate high alignment, yellow indicates moderate alignment, and red

indicates low or no alignment. Dark red highlights indicate critical misalignments with Trial design, which we discuss in more detail after the table.

Table 4: Summary of Market Channel Alignment with Current Trial Design

Category	Alignment Criteria	Lighting Contractors	Energy Efficiency Consultants	ESCOs	Lighting Designers	Manuf. Reps.
Alignment with Project and LDP Requirements						
Customer Segment	Do they typically work with Trial target segments?	Yes	Yes	Yes	Yes	Yes
Project Type	Do they typically work on lighting-specific retrofit projects?	Yes	Yes	No-- Typically new constr. & gut retrofits	No-- Typically new constr. & gut retrofits	Yes
Facility Size	Do they typically work on areas between 10,000 and 100,000 square feet?	Yes	No-- Typically smaller	No--Usually larger	Some smaller	Yes
LDP Qualifications	Do they have PE, LC, CLEP, CLMC, or IALD certification?	All	Some	Some	All	Some
Alignment with Documentation Requirements						
Track Energy Use of Old and New Lighting Designs	Do they submit this documentation?*	All	All	All	Few	Some
Fixture Schedule or Spec Sheet	Do they submit this documentation?	Some	Some	Few	All	None
Photometric Analysis	Do they perform this analysis?	Some	Most	Some	Most	All
Alignment with Incentive Levels						
Designer Incentives	Is the design incentive attractive considering the time/effort needed to meet Trial requirements?	Somewhat attractive	Highly attractive	Not very attractive	Not very attractive	Somewhat attractive
Customer Incentives	Is the customer incentive attractive considering design cost?	Somewhat attractive	Highly Attractive	Somewhat attractive	Not very attractive	Highly Attractive
Overall Alignment with Current Trial Design						
Rating		Medium	High	Low	Low	Medium

Legend: Green: high alignment; yellow: moderate alignment; light red: low alignment; dark red: critical misalignment.

*Based on if they provide the required Title 24 Line Voltage Track Lighting Worksheets

Alignment with Project and LDP Requirements

The Trial's target sectors align with the sectors that these market channels serve; however, facility size alignment varies by channel. All market channels commonly work with the Trial's target segments (a commercial office, government facility, school, or retail building). At least one respondent from each channel reports that their average project size is 10,000 to 100,000 square feet (the Trial's target), but the Lighting Contractors and Manufacturer Representatives we spoke with were much more likely to work within this range. Lighting Designers appear to be highly misaligned with the Trial's target project. While they serve the target segments, and sometimes the target facility sizes, all four Lighting Designer respondents emphasized that they focus their business on gut retrofits and new construction projects, which are currently excluded from the Trial. ESCOs also appear to be highly misaligned, for similar reasons. Further, they typically install more holistic retrofits, rather than lighting-specific ones.

Some market channels are more likely to have the required credentials than others. However, at least one respondent in each of the market channels held the required credentials, indicating that other Trial design requirements may be more important to address. Based on our interviews, all respondents would be able to fulfill the Trial's energy efficiency experience requirements (three years and three related projects).

Alignment with Documentation Requirements

Though alignment with Trial documentation requirements varies widely across market channels, Energy Efficiency Consultants are the most aligned with documentation requirements. The Trial requires LDPs to provide a scope and design narrative, fixture submittals or spec sheets, and, at the customer's request, a photometric analysis. Typically, one or two respondents in each market channel produces the necessary documentation to satisfy the Trial's requirements, but Energy Efficiency Consultants do it more often. Lighting Contractors fall in the middle, as three of four respondents provide only the minimum documentation to satisfy Title 24 and two of four provide fixture schedules or photometric analyses. Lighting Designers also fall in the middle. They typically provide fixtures schedules and photometric analyses, but rarely track the energy use of old and proposed fixtures.

Manufacturer Representatives are the least aligned with the Trial's documentation requirements. They stress that their lighting designs should only be used as building blocks for customers, and should be reviewed by a lighting design expert to finalize them; their drawings are not approved by engineers. Their lighting design services are intended to illustrate how their products can best be showcased in a space.

Alignment with Incentive Levels

The customer bonus incentive is an attractive "icing on the cake" for market channels that provide lighting design services for free, such as Lighting Contractors. However, for customers working with the other channels, the incentive may not be high enough to convince them to pay the extra cost for a lighting design.

The LDP incentive is trying to encourage one or more things depending on the market channel. For some, such as ESCOs, it is trying to incent them to market their services to entirely different market segment than current business operations. For other channels, such as Lighting Contractors or Manufacturer Representatives, it is trying to incent them to enhance their design services for their current customers. While for some channels, the incentive may be trying to incent both enhanced design and marketing support.

Therefore, the LDP incentive is more attractive for some market channels than others. Given that many channels do not perfectly align with the Trial, we considered whether the LDP incentive was high enough to convince the channels that do not currently meet the design requirements to spend additional resources to

meet them. Lighting Contractors and Manufacturer Representatives would need to do more documentation to meet requirements. Thus, a higher incentive might be needed to attract them. Lighting Designers and ESCOs target different projects and facility sizes than the Trial, making them unlikely to be interested without an enormous incentive.

3.4 Barriers to Participation

We asked respondents about barriers to participation, both from their perspective and the customers'. As shown in Table 5, regardless of market channel, Trial awareness and concern over certification requirements were the main barriers amongst the potential designers. Per customer barriers, more than half of respondents reported cost as the largest barrier.

Table 5: Barriers to Participation Mentioned by Market Channels

Category	Number of Respondents (Multiple Response: n=20)	Example Quote
LDP Barriers to Participating in Trial		
Lack certifications	5	"None of us have certifications even though we are doing this work...They wanted us to hire an engineer for the Trial and it was just outside the scope of what we really needed in our day to day."
Need more information about the Trial	5	"Maybe just...better educate us. Because obviously we're not familiar with - I don't think anybody on my team has heard about [the Trial]."
Too busy to participate	3	"I talked to somebody about being involved in it but I didn't do it because I was just so busy. I just didn't have time to participate."
Trial caps the number of designs that can be submitted	2	"I wanted to get extra [projects] but they wouldn't give me any extra."
Documentation requirements are too much additional effort	1	"If it is a LEED project, I am [already] tracking both [Title 24] and ASRAE 90.1 and a third thing to keep track of is really [difficult]."
Not sure if their design services qualify	1	"I wasn't sure they really understand that we are not [technically] lighting designers. So I think it was a miscommunication there. I thought maybe she really was looking for lighting designers."
Incentive is too small	1	"It didn't look like those financial incentives were going to push a project one way or another to go through with it."
Customer Barriers to Getting a Lighting Design		
Financial constraints	12	"When you're talking about public sector clients, these customers usually don't have a lot of money to spend on a lighting project. So it always comes down to 'what's [the] dollar amount that I'm saving' rather than how nice are these classrooms looking now."
Does not understand the value of a lighting design	3	"..[If] they don't see the value of...paying for my services, then that's ok, the contractor can put something together for them that I am sure will be fine."
Title 24 requirements	1	"...A lot of times the costs associated with meeting the Title 24 requirements make the retrofit... financially unattractive."

Category	Number of Respondents (Multiple Response: n=20)	Example Quote
Shortened timeline of projects	1	“...Because a lot of these people, our end users, have a certain schedule that they need to be [kept on]. I think that’s the thing...us keeping them on time or on schedule.”

Note: Responses sum to less than 20 because we only include responses from LDP who mentioned barriers. Some did not have any feedback on this topic, or “did not know”.

Only two respondents out of the 20 provided ideas for overcoming the customer cost barrier. Since suggestions were so limited in this area, this points to the Trial likely having more success by marketing direct to the customer instead of the market facilitation approach. One suggested that engaging the staff in charge of finances (e.g., the Chief Financial Officer) is critical, as they are often hesitant to invest in anything above Title 24. Thus, it’s important to have conversations with them about the long-term potential savings from energy efficiency. Another suggested that PG&E might try to market on-bill financing alongside the Trial.

Finally, none of the LDPs could identify other incentives in the marketplace specifically for lighting design. The lack of incentives to overcome customers’ cost barriers supports the core theory behind the Trial, which is to incentivize customers to achieve greater savings by getting a design. However, as we discuss in detail in Chapter 4, the Trial’s current incentive levels may not be sufficient to convince customers to take this additional step, or to convince LDPs to make the extra effort to either enhance their design specifications or find customers for the Trial.

3.5 Case Study: Incremental Cost of Lighting Design

Based on the finding above that cost is a key barrier, we conducted a follow-up data collection effort to better understand the incremental cost associated with more comprehensive lighting designs. We completed an interview with one Energy Efficiency Consultant, the results of which are presented in the case study below. For more information on our outreach approach, please refer to Appendix D (specifically, the “Follow Up Case Study Interviews” section).

Prior to the interview, we provided the respondent with a hypothetical office building with the characteristics listed in Table 6 below. The hypothetical case also contained information on the number of rooms by use (room type), the average number of fixtures by room type, and the average annual hours of lighting use by room type. The detailed case is provided in Appendix E.

Table 6: Hypothetical Office Building Case Summary

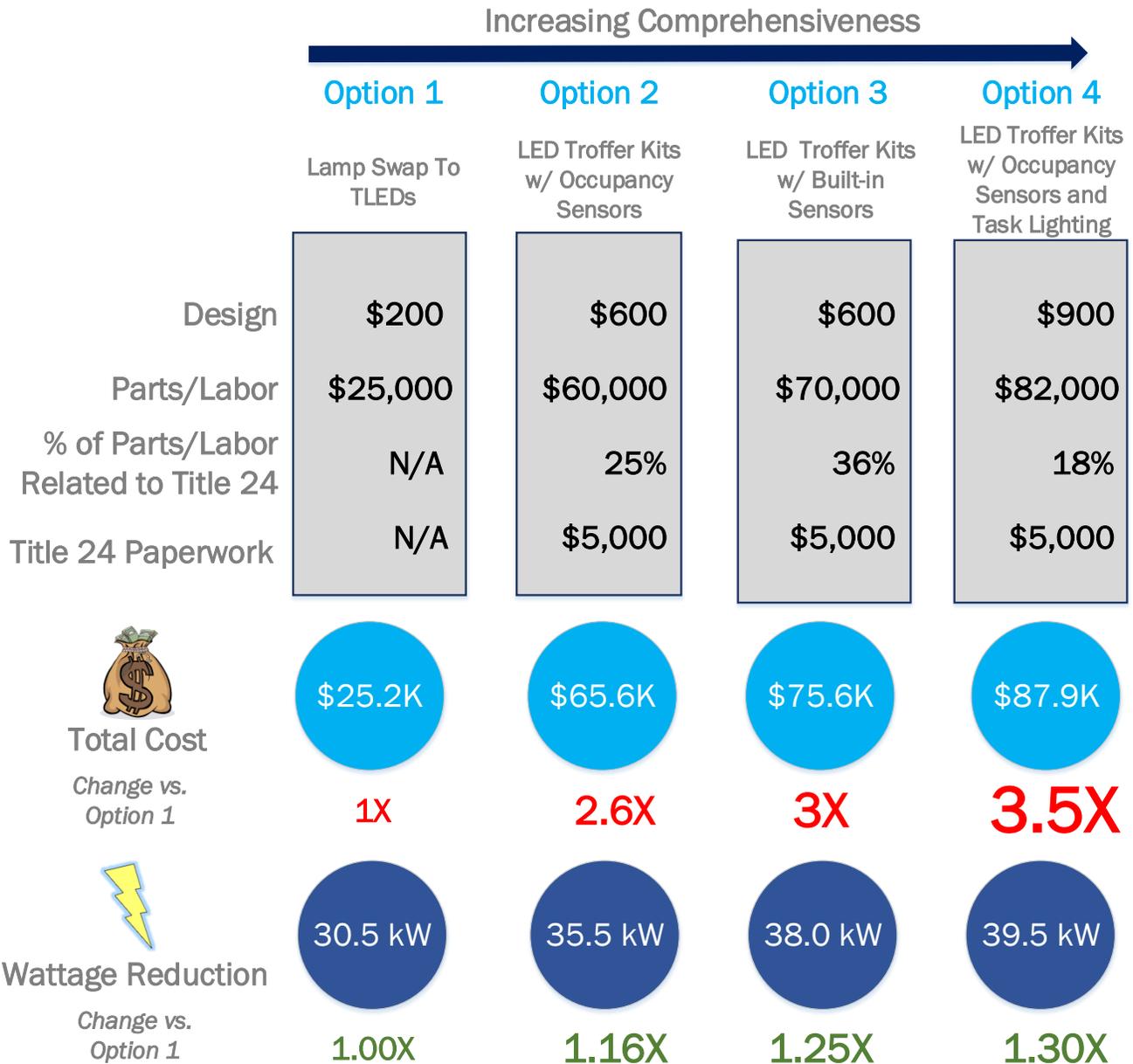
Basic Facility Information	
Use	Office building
Square footage	46,460
Most Common Lighting Fixture:	Three 32W Fluorescent T8s in a 2x4 Troffer
Number of Lighting Fixtures:	Approx. 500
Total Wattage from Lighting Fixtures (W)	50,432
Facility Lighting Power Density	1.09
Controls (dimmers, occupancy sensors, etc.)	No controls are present

During the interview, we asked the respondent to describe four lighting retrofit options that they would likely offer this customer. For each option, we discussed tasks and costs related to designing the project, implementing the project (parts and labor), and Title 24 (extra parts and labor and paperwork/application costs). Using this framework, the respondent would have offered the following four design options.

- **Option 1, Simple Lamp Replacement (No Title 24):** In a situation where a customer wants to completely avoid triggering Title 24, the designer would offer a simple lamp swap-out, replacing T8s with TLEDs. The design process would be relatively simple and low cost (about \$200), including a brief phone call or e-mail to learn about the facility and potentially asking maintenance staff to install a mock-up in one private office and take pictures. The materials would cost about \$25,000 and the designer would recommend that the customer avoid labor costs by asking maintenance staff to install the lamps. There would be no associated Title 24 costs. The designer estimated the project cost as just over \$25,000, achieving a 30.5 kW reduction.
- **Option 2, Meet Title 24:** If the customer was willing to trigger Title 24 to complete a more comprehensive retrofit, but was still cost-conscious, the designer would offer an option that invokes the “35% rule”. Namely, if the wattage reduction from the lighting retrofit is at least 35%, then there are less stringent controls requirements from Title 24. To achieve this, the designer would recommend LED troffer kits (also known as “retrofit kits”) along with occupancy sensors (one for each private office and ceiling-mounted in open spaces). The design process would be about three times more expensive (\$600) than Option 1, with the additional cost mostly related to developing detailed specification sheets, energy savings estimates, and diagrams for lighting controls placement. Parts and labor costs would also more than double (\$60,000 total). The troffer kits and occupancy sensors would be more expensive per fixture than the TLEDs and labor costs would increase since a contractor would need to be hired to complete the retrofit. The designer estimated that preparing Title 24 compliance forms would cost about \$5,000 in labor and fees. Further, roughly 25% of the parts and labor (about \$15,000) would be associated with installing controls to meet Title 24. In total, the designer estimated the project would cost nearly \$66,000 and achieve a 35.5 kW reduction. Nearly a third of the total project cost would be associated with Title 24 (about \$20,000).
- **Option 3, Above and Beyond Title 24:** If the customer was willing to go a bit further than the Title 24 minimum to save more energy, the designer would recommend upgrading to retrofit with LED troffer kits with built-in occupancy sensors. Design costs and tasks would not change compared to Option 2. Although separate occupancy sensors would no longer be needed, the upgraded troffer kits would lead to a net increase in parts costs of about \$10,000 (total of \$70,000). Costs associated with preparing Title 24 compliance forms would not change (\$5,000), but the cost of installing controls to meet Title 24 would increase to \$25,000 (representing the built-in sensor upgrade to the troffer). In total, the designer estimated the project would cost about \$76,000 and achieve a 38.0 kW reduction. More than a third of the total project cost would be associated with Title 24 (about \$30,000).
- **Option 4, Maximum Energy Savings:** Finally, if the customer was willing to pay top-dollar to maximize energy savings, the designer would have retained the separate occupancy sensors from Option 2 but added tunable LED task lighting to each office space to reduce ambient load. The design steps would remain the same, but increased documentation for the task lighting and additional equipment for the mock-up would increase the total to \$900. The addition of task lighting would also increase parts costs by about \$20,000 compared to Option 2. Costs associated with preparation of Title 24 compliance forms would remain the same as Options 2 and 3 (\$5,000), and the costs of controls would remain the same as Option 2 (\$15,000). In total, the designer estimated the project would cost about \$88,000 and achieve a 39.5 kW reduction. About 23% of the total project cost would be associated with Title 24 (about \$20,000).

Figure 8 below summarizes the four options and presents the change in cost and wattage reduction as the project becomes more comprehensive (relative to Option 1).

Figure 8: Incremental Cost Case Study Summary



Note: Totals are slightly different from the actual case due to rounding.

As shown in Figure 8 above, as the retrofit becomes more comprehensive, the increases in costs significantly outpace the projected return in energy savings. This makes it very difficult to justify the investment in comprehensive lighting based on solely the cost. The designer emphasized this point and suggested that the company (and the LDP) will have to include non-energy benefits in their business case, especially reducing maintenance costs and increased employee productivity.

“Not only are you saving energy, you are giving people more control. They can turn down the task lights. They can aim it. They can dim it... They can improve work satisfaction and maybe productivity.”

“Sometimes we are saving more regarding work or productivity than we are for energy savings in this day and age.”

While they did not complete the case study, one Lighting Contractor and one Manufacturer Representative also reinforced this finding in brief follow-up conversations regarding cost.

“More comprehensive lighting designs reduce maintenance and increase the longevity of the lighting products. Customer also have much more control: they can define what they want them [lights] to do and how you want to control them [lights].”

“Customers are still looking for large energy cost savings, and many times looking for long term maintenance savings.”

“I would say costs are increased because of engineering, permitting, doing the walk-throughs afterwards to make sure everything works. You know, here in California, we have a lot of those things to check off after a project.”

Lastly, Title 24 is a significant driver of cost. Specifically, in the case study, between a quarter and a third of total project cost (depending on the option) would be related to Title 24 permitting and controls requirements. However, one of the Manufacturer Representatives we spoke to made the point that some companies are already going to trigger Title 24 with their project, so taking the lighting retrofit a step further may not require a significant additional investment as someone not planning to trigger Title 24. This suggests that a pilot like the LDA Trial may be better off targeting these types of customers.

Once they reach Title 24, the marginal costs of improvements are lower. ...Customers are very willing to get deeper savings if they are already reaching Title 24.”

4. Conclusions and Recommendations

In this Chapter, we summarize the overall conclusions based on the findings above. First, we assess the cost-effectiveness of the Trial, the level of opportunity each market channel represents, and the Trial's marketing strategy. Following that, we provide recommendations to Trial staff.

4.1 Cost-Effectiveness Assessment

While further research is needed to confirm our findings, our case study results suggest that it would not be cost-effective to offer an incentive large enough to encourage customers to move from a simple lamp replacement to a more comprehensive lighting retrofit. According to the case study, the incremental costs of a comprehensive lighting design quickly outpace the benefits (up to three times the cost for up to a 30% increase in energy savings). While triggering Title 24 is a significant proportion of that cost, changing the Trial design to target customers who were already completing a comprehensive retrofit to go a bit further may still not achieve enough incremental savings to make the incentive cost-effective. Thus, as we detail further in the Recommendations to Trial Staff section below (Section 4.4), PG&E should consider whether to attempt to re-design the current Trial (the target customer, the target LDP, or the incentive levels), or to seek other ways to encourage customers to complete more comprehensive lighting designs.

4.2 Opportunity Assessment by Market Channel

Whether or not the Trial continues in a re-designed form, our research has shown that certain types of LDPs may be higher opportunity partners than others for identifying and encouraging customers to complete more comprehensive retrofits.

Lighting Contractors → High Opportunity

- Energy efficiency is a high priority for this channel and they are the only respondents who had certifications specific to lighting energy management (CLMC, CLEP).
- Their lighting design customers are typically the size the Trial is currently targeting.
- They are the most interested in incentive programs among the market channels, and nearly all of their customers participate in PG&E programs.
- Most provide designs for no extra charge within their bundle of services, so a small incentive may be “icing on the cake” for customers. However, it's unclear if Lighting Contractors charge more for their services when they include lighting designs.
- Not all contractors fulfill the documentation requirements and the current incentive level may not be high enough to encourage them to make the additional effort to participate.

Energy Efficiency Consultants → High Opportunity

- Energy efficiency is the number one priority for this channel.
- They typically fulfill the Trial's documentation requirements already, so little adjustment would be needed for them to participate.
- Their design cost is relatively low, and the incentive could make it even more attractive to customers.

- They are highly engaged with incentive programs, typically recommending them, but may need assistance in encouraging customers to actually participate in PG&E programs.
- They may need more flexibility on eligible project size and credential requirements to attract them as a partner. Some serve slightly larger or smaller customers than the Trial's current target and some may not have the required credentials.

Manufacturer Representatives → **Some Opportunity**

- Energy efficiency is a secondary priority for this channel, though they often do consider it in their designs.
- Their lighting designs are provided free of charge but they have the lowest level of detail and they do not consider the designs they provide to be comprehensive.
- Their free lighting designs may be an opportunity to acquire customers. Manufacturer Representative may be a good referral source, as they typically consider energy efficiency, and respondents were open to the idea of handing their initial drafts over to lighting design experts for vetting. See Section 4.3 for more on this opportunity.

Energy Service Companies (ESCOs) → **Low Opportunity**

- Their business model focuses on acquiring performance contracts with larger customers, and they would be less interested in working with the Trial's target facility size.
- ESCOs typically focus on gut rehabilitation projects

Lighting Designers → **Low Opportunity**

- The bulk of their customers are residential or new construction.
- Their non-residential lighting retrofit designs are more concerned with the aesthetics of the space, rather than energy efficiency.
- Lighting Designers are the most expensive of the market channels
- Their lack of focus on energy efficiency as well as their higher cost (and opportunity cost) makes them unlikely to make the effort to meet Trial requirements.

4.3 Assessment of Trial Marketing Strategy

The Trial's primary marketing strategy has been to recruit LDPs and encourage them to promote the Trial to customers. However, our findings suggest that this may not be an ideal strategy for several reasons:

- **The LDPs do not typically market their services:** The LDPs we spoke with rely primarily on referrals from their business networks or sales teams. As further evidence of their lack of experience with marketing, very few LDPs had any recommendations for ways to market the Trial to customers.
- **The LDPs work with customers who are already looking for a lighting design:** Theoretically, the Trial could help incent these customers to get lighting designs with greater potential for energy savings. However, this does not necessarily help the Trial target customers who would not get a lighting design at all.

However, there may be ways to leverage these business networks to identify customers just looking to do a lighting-specific retrofit. As we mentioned earlier, working with Manufacturer Representatives is an opportunity to increase participation in several ways:

- **Identify more potential participants:** They typically have a sales team behind them that find customers looking to do lighting retrofits and seeking advice on what equipment to install.
- **Teach customers the value of lighting design:** Their preliminary designs are free and would be an easy first step for customers to learn about how a lighting design could benefit them.
- **Drive customers to the Trial:** Further, they do not consider their design to be final and would prefer to have another expert review them. This suggests that they may be open to referring their customers to the Trial.

Further, Manufacturer Representatives are a central connector for lighting designers, manufacturers and contractors. Their sales team could disseminate information about the Trial to a wide range of market players involved in lighting-specific retrofits.

4.4 Recommendations to Trial Staff

- **Consider whether the Trial can become cost-effective:** The incremental cost of triggering Title 24 and completing a more comprehensive retrofit may be too high and the incremental savings too low to make an incentive cost-effective. PG&E should explore whether any re-design of the Trial's target market or incentive level could make it cost-effective. We recommend further case study research to confirm or refute the cost-effectiveness findings. This could include, for example, reviewing Core Lighting projects and estimating the incremental costs and benefits of increasing comprehensiveness.
- **Consider alternatives to a design incentive:** If PG&E decides to discontinue the Trial, they should consider whether there are other types of interventions that can cost-effectively deliver additional savings on lighting projects. For instance, PG&E could consider partnering with LDPs to reach out to customers in the early stages of Third Party direct install or Core Lighting program participation to encourage them to complete a lighting design. However, PG&E should consider the following when designing such an approach:
 - **Explore Partnerships with Manufacturer Representatives:** While this study has identified Lighting Contractors and Energy Efficiency Consultants as high-opportunity partners for the current Trial design, Manufacturer Representatives may also be an ideal partner for this proposed new approach, especially considering that their lighting designs are often provided for free and could help customers understand the value of a lighting design.
 - **Focus on non-energy benefits:** The incremental energy savings may not be enough to convince customers of the value of lighting design and more comprehensive retrofits. We recommend that marketing messaging also emphasizes non-energy benefits such as potential reduced maintenance costs and increased employee productivity. One of the LDPs we interviewed already includes this in the cost-effectiveness calculations they deliver to customers and many other LDPs consider it an important part of the lighting design process.
 - **Provide alternatives to the certification requirements:** Many LDPs have the expertise to develop energy efficient lighting designs but some do not meet the qualifying certifications. Consider

waiving the certification requirement if the LDP can show documentation of at least three years and three projects of energy efficient lighting design experience.

- **Consider other documentation requirement options:** Lighting contractors already document their projects according to Title 24 standards. Rather than asking them to create all new documentation, the Trial could consider giving them the option to enhance their existing documentation by providing the Tier 2 Voluntary Title 24 documentation, which includes a photometric analysis.
- **Explore increasing designer incentives:** A designer incentive may still be necessary, as LDPs must feel that the net benefit of participation outweighs the extra effort of producing the required documentation on their lighting retrofits. For instance, we found that Lighting Contractors may not be interested in the current incentive but could be convinced to participate if the Trial increased it. We recommend conducting further research into what their opportunity costs would be (in terms of time and effort) and what incentive level would be sufficient to attract them to the Trial.

Appendix A. Matrix of Design Approaches

Please see the tables below for a detailed list of the lighting design components we asked LDPs about and their responses. In the tables, numbers indicate the count of respondents that provide that service.

Lighting Design Component	Aesthetics (Basic)			Aesthetics (Advanced)				
	Lamp Color Temperature (CCT)	Lamp Color Rendering Index (CRI)	Fixture and Lamp Directionality	Wall Color	Reflectivity	Ceiling Height and Shape	Highlight Areas (artwork, company logo, etc.)	Lighting Contrast within Space
Energy Efficiency Consultants (n=4)	4	4	4	4	3	3	2	1
ESCO (n=4)	4	4	4	1	1	3	1	0
Lighting Contractor (n=4)	4	4	4	2	2	4	1	1
Lighting Designers (n=4)	4	4	4	3	3	4	4	4
Manufacturer Representatives (n=4)	4	4	4	3	3	3	2	2
All Market Channels (n=20)	20	20	20	13	12	17	10	8

Lighting Design Component	Code Compliance		Construction Phase Support		
	Code Compliance	Title 24 Compliance	Submittals and Assistance with Requests for Information (RFIs)	Review of Shop Drawings	Post-Installation QA/QC Walkthrough
Energy Efficiency Consultants (n=4)	4	4	3	2	4
ESCO (n=4)	4	4	1	1	4
Lighting Contractor (n=4)	4	4	3	2	4

Appendices

Lighting Design Component	Code Compliance		Construction Phase Support		
	Code Compliance	Title 24 Compliance	Submittals and Assistance with Requests for Information (RFIs)	Review of Shop Drawings	Post-Installation QA/QC Walkthrough
Lighting Designers (n=4)	4	4	4	4	4
Manufacturer Representatives (n=4)	4	4	2	2	2
All Market Channels (n=20)	20	20	13	11	18

Lighting Design Component	Controls			Daylighting/Fenestration	
	Inclusion of Lighting Controls in Design (occupancy sensors, dimming switches, etc.)	Energy Management Systems Integration	Lighting Controls Assistance	Daylighting Analysis	Fenestration Analysis
Energy Efficiency Consultants (n=4)	3	1	2	1	1
ESCO (n=4)	4	2	4	2	3
Lighting Contractor (n=4)	4	2	4	3	3
Lighting Designers (n=4)	3	1	3	1	1
Manufacturer Representatives (n=4)	4	2	3	0	1
All Market Channels (n=20)	18	8	16	7	9

Lighting Design Component	Design Documentation				Energy Usage Analysis		
	Fixture Schedule	Documentation of Performance or Energy Goals	Construction Documents	3D Renderings of the Space	Fixture and Lamp Energy Consumption	Energy Analysis	Photometric analysis
Energy Efficiency Consultants (n=4)	4	3	3	1	4	4	3
ESCO (n=4)	3	4	0	0	4	4	3

Appendices

Lighting Contractor (n=4)	3	3	3	1	4	4	2
Lighting Designers (n=4)	4	4	4	4	4	4	3
Manufacturer Representatives (n=4)	3	2	3	1	4	3	4
All Market Channels (n=20)	17	16	13	7	20	19	15

Lighting Design Component	Financial Analyses	Green Building Code	Incentive Program Support		Multiple Options	Tailoring to Space Use	
	Financial Analyses	Green Building Codes/Certifications (LEED, Well Building, or CALGreen)	Identifying Available Government or Utility Incentives or Financing Options	Assistance with Incentive Paperwork	Presentation of Multiple Lighting Design Options to Client	Site Observations of Usage and Travel Patterns in the Space	Tailoring to Use (Traffic and Room Use)
Energy Efficiency Consultants (n=4)	4	0	3	2	1	2	4
ESCO (n=4)	4	0	4	4	2	4	4
Lighting Contractor (n=4)	4	0	4	4	2	4	4
Lighting Designers (n=4)	2	3	3	1	2	4	4
Manufacturer Representatives (n=4)	3	1	3	0	0	2	4
All Market Channels (n=20)	17	4	17	11	7	16	20

Appendix B. Trial Goals and Progress To-Date

The high-level goals of the PG&E LDA Trial include:

- Create a pool of qualified lighting design practitioners to provide design assistance to customers;
- Increase project level savings from involvement of lighting design practitioners;
- Increase awareness of and demand for advanced lighting design on retrofit projects within the lighting design community;
- Make a positive impact on customer satisfaction;
- Inform Trial/program design that can be shared across IOU portfolios; and
- Understand any barriers to Trial participation, or providing this service for retrofit projects, amongst lighting design practitioners

Specifically, the Trial sought to:

- Recruit 20+ projects with a cap of 1 million total square feet.
- Recruit a mix of qualified lighting design practitioners across design firms, manufacturers, distributor sales channels, and electrical and lighting retrofit contractors.
- Recruit lighting design practitioners that are geographically balanced.
- Successfully screen and recruit with the goal of getting at least 50% of the customers to uptake the proposed project designs (conversion rate).

After the first year of attempting the Trial design and delivery model (finding customer projects through LDPs), the Trial was not able to attract much participation. The Trial engaged with 51 LDPs and ten enrolled. Only two submitted a design and received an incentive.

Table 7. LDP Trial Participation (September 2015 – September 2016)

Status	Energy Efficiency Consultants	ESCOs	Lighting Contractors	Lighting Designers	Manufacturer Representatives	Total
Total engaged or contacted	9	3	9	21	9	51
No response	5	0	2	8	6	21
Responded (non-participants)	2	2	7	6	3	20
Not interested	0	0	1	0	2	3
Expressed interest but did not enroll	2	2	6	6	1	17
Enrolled (partial & full participants)	2	1	1	6	0	10
Submitted a lighting design (full participant)	1	0	0	0	0	1 (2 projects)*

Note: Based on data provided by PG&E on 9/21/2016. Four additional LDPs are included in the data but have no contact notes.

*One additional LDP that has submitted a design, but has not yet provided sufficient documentation to receive the incentive.

Twelve customers expressed interest in participating but only three projects officially enrolled in the Trial, which is significantly below the Trial’s goal of 20 projects. None have implemented their lighting design.

Table 8. Customer Trial Participation (September 2015 – September 2016)

Status	Number of Projects
Total who expressed interest	12
Submitted a project screening form	5
Eligible projects	4
Not eligible projects	1
Submitted a lighting design (partial participant)	3

Status	Number of Projects
Implemented lighting design (full participant)	0*

Note: Based on data provided by PG&E on 4/29/16, 6/30/2016, and updates provided by PG&E on 9/21/2016.

*One customer is currently considering implementation and has ordered test fixtures to decide whether to participate.

Appendix C. Trial Incentive Structure

The Trial adds lighting design assistance to influence increased energy savings of projects going through PG&E’s Core Commercial Lighting Program. Through the Trial, participating lighting designers receive a bonus incentive for presenting a lighting design to the customer that achieves a lighting power density of 0.50 watts per square foot (W/sf) or less. After receiving the design, customers receive an additional incentive bonus, on top of the Core Commercial Lighting Program incentives, should they implement the project according to the specified lighting design.

For the lighting design itself, LDPs receive \$1,000 plus \$0.03 per square foot of the lighted space of approved lighting designs. As shown in Table 9 below, the customer incentive structure is on a sliding scale based on the efficiency of the design.

Table 9: Customer Incentive for Implemented Lighting Designs

Target (W/sf)	Performance Bonus
0.46 to 0.50	\$0.02/sq. ft.
0.41 to 0.45	\$0.03/sq. ft.
0.36 to 0.40	\$0.04/sq. ft.
0.35 or less	\$0.05/sq. ft.

Appendix D. Research Task Details

Below we detail the research tasks we conducted to answer the study research questions.

Trial Staff Interviews

Our first step was to interview Trial staff to understand how the Trial had performed, challenges encountered, and the Trial’s design and implementation processes. The data we collected was used to inform our evaluation plan, analytical approach, and our assessment of market channel alignment with current Trial design.

Secondary Research

Next, we reviewed over 45 company websites, several industry reports, and many industry association websites to gain a broad understanding of the market actors offering lighting design services in PG&E’s territory and the design services they offered. Synthesizing these findings, we developed a list of components that might be included in a lighting design (i.e., technologies used, tests performed, or aesthetic and comfort considerations) and identified the features that likely impact energy efficiency. We used this analysis to design an in-in-depth interview guide for lighting designers. This analysis also provided the foundation for our approach for comparing market channels.

In-depth Interviews with Lighting Design Practitioners

We completed 20 interviews with LDPs across the five market channels as shown in Table 10 below. We leveraged the list of market channel contacts PG&E developed as part of its LDP recruitment efforts. Through these efforts, PG&E identified 46 companies representing various market channels.⁷ While this data was our primary sample source, it did not include any Energy Service Companies (ESCOs) and only a few Manufacturer Representatives. We used online resources to collect additional contacts in those categories, leading to a final sample of 59 LDPs. To ensure that we collected feedback from a wide range of LDPs, we set a quota of four interviews per market channel and offered a \$50 incentive for completing an interview.

Table 10. LDP In-depth Interviews Sample and Completes

Market Channel	Sample	Completed Interviews
Lighting Designers	24	4
ESCOs	11 ^a	4
Lighting Contractor	11	4
Energy Efficiency Consultants	7	4
Manufacturer Representatives	6 ^a	4
Total	59	20

a: 13 sample points (11 ESCOs and two Manufacturer Representatives) were not included in PG&E’s original tracking files.

⁷ PG&E Trial staff contacted 55 individual Lighting Design Practitioners who represented 48 unique companies.

To ensure we spoke only with LDPs who had relevant lighting design experience, we asked screening questions about the services offered and the types of customers for whom LDPs provide service. Whenever possible, we focused interview questions on non-residential lighting retrofit customers. We provide our list of interview questions in Appendix E..

Follow-up Case Study Interview

To better understand the incremental cost associated with moving from a one-for-one lamp replacement to a comprehensive lighting design, we attempted to conduct follow-up interviews with the Lighting Contractors and Energy Efficiency Consultants who participated in the first phase of interviews (eight total). We reached out to each LDP between four and seven times across two weeks by phone and e-mail. Four LDPs refused the interview, two scheduled interviews but did not call-in at the schedule time (“no-show”), and one never responded to our invite. We ultimately were able to complete an interview with one Energy Efficiency Consultant, though we were able to complete brief follow-up conversations via e-mail and phone with two Lighting Contractors and one Manufacturing Representative.

Using designs submitted to the Trial, we developed a hypothetical case of an office building seeking to complete a lighting retrofit. This case study included key building characteristics (e.g., square footage, number of rooms by use) and existing lighting information (e.g., number and type of fixtures by room type). We provided this case study to the respondent prior to the interview. During the interview, we asked the respondent to describe what they would recommend to the customer under four scenarios, ranging from a one-for-one lamp replacement to a comprehensive lighting retrofit design aimed at maximizing energy savings. Discussions of each scenario focused on calculating the incremental cost associated with each option, including design costs, project implementation (i.e., equipment installation costs), and Title 24 compliance costs (including paperwork and additional required measures). Using this information, we were also able to estimate wattage reduction in each scenario and understand incremental savings compared to incremental cost. We provide the hypothetical case and interview questions in Appendix E.

Appendix E. Additional Documents

In the following appendix, we provide:

- More information on Trial recruitment approaches, review processes, and qualification requirements.
- The lighting designer interview guide from the first phase of interviews
- The interview questions used in our case study interviews
- The hypothetical case from the case study interviews

LDA Trial Recruitment and Participation Process

This memo outlines the recruitment and participation processes for the PG&E Lighting Design Assistance (LDA) Trial. We collected this information via interviews with LDA Trial staff on May 19, 2016, including the PG&E Trial Manager and the independent consultant to PG&E (referred to hereafter as “the Trial Implementer”). We also reviewed planning and design materials provided by Trial staff.

Lighting Design Professional Recruitment

Trial staff identified Lighting Design Professionals (LDPs) through online research, consultation with industry professionals, and consultation with other PG&E demand side management program staff. The Trial Consultant engages LDPs through direct phone and e-mail outreach.

Interested LDPs electronically submit the Lighting Design Professional Application. This application requires LDPs to demonstrate qualifications through possession of one of five credentials:

- Mechanical or Electrical Professional Engineer (PE)
- Lighting Certification (LC)
- Professional and Associate Members of the International Association of Lighting Designers (IALD)
- Certified Management Lighting Consultant (CLMC)
- Association of Energy Engineer’s Certified Lighting Efficiency Professional (CLEP)

For further proof of qualification, LDPs must provide documentation of work experience. Documentation of work experience must include a resume with at least three years of energy efficient lighting experience and a summary of at least three recent projects in which the LDP was the primary designer and of which energy efficiency was a key component of the design.

The Trial Implementer reviews the LDP Application and verifies that the qualification criteria are met. The Trial Implementer then informs the design professional of acceptance as a Qualified Lighting Design Professional, and sends the LDA Trial Participating Designer Agreement to the designer. Once the Designer Agreement is executed and received by PG&E, the designer can officially participate with the Trial.

Customer Recruitment

Trial staff uses four strategies to recruit customers. The initial design of the Trial included two customer recruitment strategies:

1. LDPs use the Trial to market to customers and enroll participants
2. PG&E Energy Solutions & Services (ES&S) team (i.e., the customer's Account Representative) identifies potential customers. For customers identified by the ES&S team, Trial staff would provide the customer with a list of qualified LDPs from which they can choose a design professional. Both participating LDPs and the ES&S team members receive information about the Trial (including a PowerPoint presentation), a marketing flyer, and training on the Trial processes, either through a webinar or individual discussion with the Program Implementer.

In response to limited success with the original two recruitment strategies, Trial staff initiated two additional strategies:

3. PG&E Direct Install Programs identify customers that would enroll in the LDA Trial to consider a second, more efficient, design in addition to the lighting design provided by the DI program.
4. PG&E Statewide Partnership Programs (specifically the Community Colleges program) identify customers that would enroll in the LDA Trial to provide design services to supplement partnership resources.

Participation Process

Below we outline the process for completing a project through the Trial. We include steps completed by the customer, the LDP, and Trial staff.

Step 1: Project Identification and Screening

- LDP submits Project Screening Form, which includes information such as square footage, age of the building, and building property type
- The Trial Implementer reviews the information, and decides if the project meets project qualification criteria:
 - Treating an area between 10,000 and 100,000 square feet
 - The space is a commercial office, government facility, school, or retail building
 - The space does NOT fall into one of the following categories:
 - Commercial storage
 - Industrial buildings
 - Exterior site lighting
 - Parking garage buildings and areas
 - No other buildings on the same campus have already participated in the Trial
- The Trial Implementer uses professional judgement to gauge whether the project has the potential to:
 - Achieve the Trial's Lighting Power Density (LPD) requirements; and
 - Fit within the budget of the Trial (based on the square footage; the Trial Consultant can estimate the incentive amount)

- Trial Consultant recommends approval to the PG&E Trial Project Manager, the Trial Project Manager gives final approval

Step 2: Customer Agreement

- Customer signs Customer Agreement (CA)
- Trial staff approves CA, informs customer

Step 3: Lighting Design

- LDP completes the audit and lighting design, with the following requirements as listed in the Designer Agreement.
 - Design services must be professional and delivered in a timely, ethical and responsible manner.
 - Adhere to all federal, state and local laws, the California Building Energy Standard (Title 24) and other applicable building, energy and safety codes.
 - Adhere to the recommendations of the Illuminating Engineering Society of North America (IESNA). PG&E is not responsible for any customer issues resulting from a change in light level.
- LDP submits the design package, including:
 - Lighting Design Package Submittal Form
 - Savings calculations that demonstrate achievement of estimated energy savings, using Microsoft Excel or similar software program, as approved by PG&E.
 - Site Audit, including all Customer information included in the Customer Site Screening Form, existing lighting equipment, and the full proposed work scope associated with the installation of new lighting equipment and controls
 - Scope and design narrative
 - Fixture submittals or spec sheets
 - Photometric analysis demonstrating lighting performance is acceptable to the customer
- Trial Consultant reviews the design package and confirms the project meets the LPD requirement of 0.5 W/sf or less.
- Trial Consultant recommends approval to the PG&E Trial Project Manager, the Trial Project Manager gives final approval
- Trial staff informs the customer and LDP that the design is approved
- PG&E pays design incentive to LDP \$1,000 plus \$.03 per square foot.
 - If the incentive does not cover the entire cost of the lighting design, the LDP may receive additional payment from the client

Step 4: Project Implementation

- Customer decides whether to incorporate lighting design into their project
- Customer completes project and submits for equipment incentives through the appropriate standard PG&E incentive programs (Customized, Deemed, etc.)

Step 6: Post-Installation Verification and Incentive Payment

- If the customer installs the proposed LDA Trial lighting design, the customer is eligible to apply for the LDA Trial bonus incentive. The customer provides required post-installation submittals, including:
 - All applicable Title 24 lighting compliance forms (up to eight)
 - Final scope and design narrative
 - Final fixture submittal or spec sheets
 - Final photometric analysis demonstrating lighting performance acceptable to the customer
- Trial Consultant reviews submittal to confirm installation is completed per original design
- Trial Consultant recommends approval to the Trial Manager, the Trial Manager gives final approval
- PG&E pays incentive to customer:
 - The Customer Performance Bonus Payment is in addition to any applicable standard equipment incentives and is intended to offset fees associated with lighting design services as follows:
 - Designs meeting 0.46 to 0.50 (baseline) Watts/square foot receive a Performance Bonus of \$0.02/square foot.
 - Designs meeting 0.41 to 0.45 Watts/square foot receive a Performance Bonus of \$0.03/square foot.
 - Designs meeting 0.36 to 0.40 Watts/square foot receive a Performance Bonus of \$0.04/square foot.
 - Designs meeting less than or equal to 0.35 Watts/square foot receive a Performance Bonus of \$0.05/square foot.

Lighting Designer Interview Guide

Introduction and Approach

To assist in considering redesign options for PG&E’s Lighting Design Assistance (LDA) Trial, Opinion Dynamics will conduct interviews with lighting design practitioners (LDPs) in PG&E territory. To ensure that we capture as many approaches to lighting design as possible, we will interview LDPs spanning five different market channels through which commercial customers might seek assistance developing or implementing lighting projects. Specifically, the goals of this interview are to:

- Compare the lighting design services offered by market channel and the typical customers they serve;
- Understand how these channels market lighting design services to customers;
- Identify customer barriers to getting a lighting design, LDP barriers to participating in the Trial, and opportunities for Trial design improvements to encourage participation;
- Compare the level of importance each market channel places on energy efficiency in their lighting designs, and how practitioners could be encouraged to increase their focus on energy efficiency ;
- Measure lighting design practitioner awareness of PG&E, government, or other utility incentive programs and how often their customers participate in them;

We will complete up to 20 interviews across the five market channels shown in Table 11 below. To ensure that we collect feedback from a wide range of LDPs, we have set quotas by market channel and plan to offer a \$50 incentive for completing an interview. If we are unable to complete four interviews for a given channel, we will complete additional interviews for other channels to achieve 20 total interviews.

Table 11. Sample and Target Number of Completes by Market Channel

Channel	Definition	Number in Sample	Target Completes
Lighting Designers	Primary business results from the creation of lighting designs, related analyses, and related documentation; does not sell or install equipment; has a lighting designer certification or is a member of a lighting designer association (but no engineering degree).	30	4
Turnkey Lighting Contractors	Primary business results from implementation of lighting projects from start to finish, including design, procurement, and construction	12	4
Energy Efficiency Consultants	Provides design services focused on the energy use and energy savings opportunities of lighting systems. Has an engineering degree or other energy efficiency related certification, such as LC, CLEP, or CLMC.	5	4
Lighting Manufacturer Representatives	Light fixture and light bulb sales constitute the core part of their business but representative also provides some design guidance	8	4

Channel	Definition	Number in Sample	Target Completes
Energy Service Companies (ESCOs)	Company provides a wide range of energy efficiency, demand response and/or generation solutions, including the design and implementation of lighting projects and typically provides financing as part of their offerings.	5	4
Total	N/A	60	20

We wrote this interview guide to facilitate open dialogue, yet many questions will require systematic coding into categories to allow for comparison across respondents. To ensure that we correctly document LDP categorical responses, we will keep a checklist of the design services LDPs mention. We will then share this checklist with the interviewed LDP and ask them to review for accuracy. We plan to record and transcribe these interviews.

E-Mail Invitation

[CONTACT NAME],

We are reaching out on behalf of Pacific Gas & Electric (PG&E) to speak with companies who create lighting designs [IF MARKET CHANNEL IS NOT “LIGHTING DESIGNER”: or plan lighting installations for commercial customers in PG&E territory]. We would like to speak with you regarding the typical lighting design services you provide. Our records indicate that [IF PARTICIPANT: you have recently began participating in PG&E’s] [IF NON PARTICIPANT: you may have spoken recently with PG&E regarding their] Lighting Design Assistance Trial, which provides additional incentives to customers and lighting designers on top of the rebates available for energy efficient lighting. Your feedback is critical for improving future lighting design assistance programs for professionals like you. This interview should take no more than an hour. If your company completes qualified services and you complete the interview, we will send you a \$50 check as thanks for your participation. Would you have time to speak in the next few weeks? If so, would any of the following times work well for you? [INSERT LIST]

Thanks in advance for your help,

Robert Saul

Research Analyst

Opinion Dynamics

Interview Introduction

Do you mind if I record this conversation? [IF YES] Thanks for giving me permission to record.

Before we begin, I wanted to note that I might ask for averages and rough estimates. Please just give me your best professional judgement on those numbers of behaviors. Do you have any questions for me about the study we are conducting?

[STATE ONLY IF MARKET CHANNEL IS NOT “LIGHTING DESIGNER”]: For this interview, we define “lighting design” somewhat loosely. It could be an in-depth design effort that considers the usage, traffic, or shape of the space, or just guidance provided to customers on the best new fixtures for a lighting upgrade.

1. [ASK IF MARKET CHANNEL IS NOT “LIGHTING DESIGNER”] Do you provide any services that might fit somewhere within this definition? If so, could briefly describe the types of services you provide? [IF NO] Does someone else within your company provide any services that might fit somewhere within this definition? Would you mind sharing their contact information? [IF NOT, THANK AND END INTERVIEW]
2. [ASK ALL MARKET CHANNELS] Do you provide lighting design services for non-residential lighting retrofits? [IF NO] Does someone in your company provide lighting design services for non-residential lighting retrofits? Do you also install non-residential lighting retrofits for customers?

Firmographics

To start, we would like to learn a little bit more about your company.

3. Do you yourself have any certifications related to lighting design? If so, which? [PROBE: PE Electrical or Mechanical Engineering, LC, Certified Light Management Consultant, Certified Lighting Efficiency Professional, other]
4. Are you yourself a member of any lighting design industry associations? If not, is your company? [PROBE: IALD, IES, NCQLP, NALMCO, other]
5. Describe the general geographic area that your company serves. [IF NEEDED: think Northern and Central California]
 - a. [IF YES] Roughly, what proportion of your company's total projects are in California? Your best guess is fine.
6. How many of your company's employees provide lighting design services? [IF UNSURE: ask rough proportion of total employees]
7. Does your company typically serve non-residential lighting retrofit customers? [PROBE: proportion of customers that are non-residential]
8. Please think only about the non-residential projects that you either oversee or complete yourself. How many non-residential projects of any kind are you involved with in a typical year? What proportion of those include lighting design services? Your best guess is fine. [PROBE: Is this proportion roughly the same for your company overall? If not, what would you say it is?] [IF INTERVIEWEE WILL NOT GIVE NUMBER] What would you say the range is?
9. [IF OFFERS MORE THAN DESIGN] How much of your company's total revenue would you say comes from lighting design services? Would you say very little, some, most, or all?
10. Do you charge a flat fee for lighting design services or by square foot? [IF ONLY OFFERS DESIGN] What is the average cost of a lighting design? [IF OFFERS MORE THAN DESIGN] What is the average additional cost of adding a lighting design service to a project? (If applicable, collect cost for square foot)

Typical Customers and Projects

I would now like to dig a bit deeper into the types of non-residential lighting design clients you serve.

11. What would you say are the most common business segments for which your company completes the most lighting design services? [IF NEEDED] What would you say are the top three? [TRY TO CATEGORIZE INTO THE FOLLOWING SEGMENTS: Healthcare, Higher Education, K-12 Schools, Civic/Public, Cultural/Non-profit, Restaurants, Office, Hotel, Retail, and Residential]
12. What is the typical square footage of a space for which your company creates a lighting design? [IF NEEDED] Would you say less than 10,000 square feet, between 10,000 and 100,000 square feet, between 100,000 and 500,000 square feet, or more than 500,000 square feet?

Lighting Design Services

I would like to hear more about the lighting design services your company provides. We understand there are many different types of lighting design services you could provide. For the following questions, please focus on the typical services you offer to lighting design customers. We recognize your services may vary widely depending on the customer. If needed, please just think about your typical [TOP SEGMENT Q11] customer.

13. Before you start developing the design, do you typically conduct any analyses or observations of the space? [IF YES] What type of analysis do you provide? [PROBE FOR: observing usage and travel patterns in the space, daylighting analysis, fenestration analysis]
14. When you develop designs, what aspects of the space do you usually consider? [PROBE FOR: traffic and use, wall color, reflectivity, ceiling height and shape]
15. How do you go about deciding what types of fixtures should be installed? [PROBE FOR: where the light is delivered, energy consumption, color temperature, lamp color, code compliance]
16. Are there any other aesthetic considerations we have not discussed? [PROBE FOR: highlight areas, contrast]
17. How often, if ever, do you include lighting controls in your designs? How about Energy Management Systems? [FOR EACH]: Would you say always, frequently, sometimes, rarely or never?
18. Do you perform any of the following analyses to vet your design?
 - a. Do you estimate the energy consumption of the new lighting system compared to the old one?
 - b. Do you develop financial estimates, such as probable job cost, life cycle cost of the equipment, or return on investment?
 - c. Do you do a photometric analysis, or some other analysis to estimate the lighting levels?
19. How often do you consider code compliance when creating a lighting design? How often do you consider reach codes (LEED, etc)? [PROBE FOR: Title 24 compliance or green building codes/certifications like LEED, Well Building, or CALGreen]
20. When presenting the design to the client, do you tend to offer one design or multiple options? If multiple, how many do you usually provide?

21. How often, if ever, do you try to identify any available incentives for financing options available from government or utility programs? Would you say always, frequently, sometimes, rarely or never?
22. **[IF DOES NOT IMPLEMENT PROJECTS]** After the design is complete, what support would you offer to this customer while they install the project, if any? **[PROBE FOR: submittals and assistance with Requests for Information (RFIs), review of shop drawings]**
23. What types of documentation, if any, do you typically provide to the client? **[PROBE FOR: a fixture schedule, documentation of performance or energy goals, construction documents, 3D renderings]**
24. What support, if any, would you offer to this customer after the lighting project is complete? **[PROBE FOR: post installation QA/QC walkthrough, lighting controls assistance, incentive paperwork]**
25. On a scale of 1 to 5, in which 1 is not all important, and 5 is very important, how would you rate the importance customers place on the following areas in a typical lighting design **[RANDOMIZE, KEEP "i" LAST]**:
 - a. Installed cost of the lighting system
 - b. Reducing energy use
 - c. Visual performance
 - d. Aesthetics
 - e. Exceeding energy codes
 - f. Convenience of maintenance

i. You rated reducing energy use as a ___ out of 5. Why did you give it that rating?

Thanks for all of that information. I have been filling out a checklist of all the different services you mentioned. After the interview, it would be great if we could have you give this list a look to confirm that I have captured everything correctly. Would you be willing to do that for us?

Marketing and Barriers

Okay, we are more than halfway done. I am interested in how your company acquires customers and some of the barriers they may face to getting a lighting design.

26. How do lighting design customers typically hear about your company? (i.e., word of mouth, referrals, advertisements, other marketing efforts, etc.)
 - a. **[IF APPLICABLE]** Could PG&E acquire customers in a similar way? **[FOR MANUFACTURER REPS]** Do you think that large manufacturers would pass on information about the LDA Trial when they send you customers?
27. **[IF OFFERS MORE THAN DESIGN]** Are customers looking to get a lighting design when they first contact you, or is it an additional service you tend to offer on top of the services they were looking for? If so, how do you usually go about describing the benefits of a lighting design?

28. What barriers, if any, are typical for customers when it comes to getting a lighting design (on top of their retrofit project)? [PROBE: size, segment, one-for-one vs. large-scale remodeling, lighting-specific vs. more comprehensive projects]

- a. Are there specific types of customers that face barriers in particular?
- b. Does your company face any barriers in providing lighting designs to certain types of customers?
- c. Are there times where you could provide a design with more energy efficiency, but the customer isn't willing to invest in? if so, why, and how do you overcome that barrier?

Market Channel Benefits

Lighting design practitioners need to differentiate themselves in the market to be competitive. I'm interested in what sets your company apart from other companies that offer lighting design services.

29. What would you describe as the advantages to working with your company on a lighting design versus another company? [PROBE FOR: cost, level of customization, techniques or strategies, equipment/controls offered, level of detail, in-person versus remote service, speed]

PG&E Programs

I have just a few final questions about your familiarity with government or utility programs.

30. What government or utility incentives in PG&E territory do you know of that support lighting designs?

31. How often, if ever, do you recommend your customers participate in government or utility incentive programs in PG&E territory? Would you say always, frequently, sometimes, rarely, or never?

32. What percent of your company's customers participate in PG&E incentive programs?

33. [IF NON-PARTICIPANT] How familiar are you with PG&E's Lighting Design Assistance Trial?

[IF NON-PARTICIPANT AND AT LEAST SOMEWHAT FAMILIAR WITH LDA TRIAL]

34. Why haven't you participated in the Lighting Design Assistance Trial?

[IF NON-PARTICIPANT AND AT LEAST SOMEWHAT FAMILIAR WITH LDA TRIAL]

35. What could be done to encourage you to participate in the Trial?

[IF NON-PARTICIPANT]

The Trial requires that lighting design practitioners have the following:

- One of the following credentials: PE, LC, IALD, CLMC, or CLEP
- A resume with three years of energy efficient lighting experience
- Three recent projects in which you were the primary designer and energy efficiency was a key component of the design

36. Would any of these criteria restrict you from participation in the Trial?

The Lighting Design Assistance Trial (which I will refer to as the LDA Trial), defines their target customer as:

- This customer would be a non-residential customer and could be a school, commercial building, government facility, or retail space;
- They are not a hotel, hospital, or restaurant;
- They are planning a one-for-one lighting retrofit of their interior space; and
- Their facility is between 10,000 and 100,000 square feet

37. Do you ever provide or suggest lighting design services to the LDA Trial target customer? If not, why not?

38. What services, if any, that you offer to your typical lighting design customers would you not offer to the LDA Trial target customer? [PROBE FOR: each of the services previously mentioned in the “Lighting Design Services” section]

[IF AT LEAST SOMEWHAT FAMILIAR WITH LDA TRIAL]

39. How could PG&E change the Trial to better support companies like yours?

- a. Do any elements of the Trial run counter to what you consider best practices? Are there any measures you would leave on the table if the client qualified for LDA?

Closing

40. We are at the end of the interview! Where should we send your \$50 incentive for completing the interview?

Thank you for your thoughtful responses. I will send along a list of the lighting design services we discussed for your review in the next week. Have a wonderful day.

Case Study Interview Guide

Introduction and Approach

Opinion Dynamics will interview approximately eight Lighting Contractors and Energy Efficiency Consultants (collectively, Lighting Design Practitioners, or LDPs) that participated in the Phase 1 research. The purpose of these interviews is to understand what design options the LDPs might provide to the hypothetical customer and at what cost. Because we expect LDPs to provide a considerable amount of effort in reviewing a hypothetical case and completing an hour-long interview, we will provide an incentive of \$100 to encourage them to participate.

We will provide respondents with a hypothetical project case at least a few days prior to the interview. This case provides significant detail on a hypothetical office building, including square footage, the number of rooms, existing fixture types, the number of fixtures per room, and lighting power density. This data will be provided at the facility level and by space-use type (i.e., private office, conference room, elevator).

During the interviews, we will ask respondents to consider different design/project options they might offer to the hypothetical customer (including specific measures and design tasks) and how that affects design, implementation, and Title 24 costs. Specifically, we will ask them to comment on four different scenarios, in the following order:

1. *The “simple” scenario:* a one-for-one lamp replacement that does not trigger Title 24; this may or may not include a design;
2. *The “Title 24-only” scenario:* the design services (if any) and retrofit project they would implement if the goal was to do a lighting retrofit and ensure it meets Title 24 standards, but does not exceed them;
3. *The “maximum savings” scenario:* the most comprehensive design, above and beyond the hypothetical case, that potentially results in the most energy bill savings;
4. *The “sweet spot” scenario:* a design and project somewhere between scenarios two and three; one that achieves some additional savings compared to “Title 24-only” but achieves less than the “maximum savings”.

We will attempt to collect rough cost estimates and, as a backup, we will ask them to provide their cost estimates as relative proportions (i.e., “one-half/one-third as expensive”) or orders of magnitude (“two times/three times” more expensive) in comparison to the previous scenario. We will also ask LDPs to estimate what proportion of the cost goes to the design service versus the project (implementation) and what proportion of the project cost is related to meeting Title 24 requirements (paperwork, permits, and/or additional measures that must be installed). We plan to record and transcribe these interviews.

Interview Questions

Introduction

Thank you again for taking the time to participate in this study. Just to be clear, your responses will remain completely confidential. Would it be okay to record this conversation for note-taking purposes?

1. Did you have a chance before the interview to review the hypothetical case that we sent you? **IF NOT:** No problem, let's go over the case together. **IF SO:** Great! Do you have any questions about the case before we begin?
2. Are there any assumptions about the building that you would like to make before we start thinking about project options?

I'll be filling out the summary table you see on your screen as we talk. Many of these questions ask for cost estimates. Please give us your best guess and we will note any caveats or assumptions. Also, we are interested in the cost to your customers, not your company. The fundamental purpose of this interview is not to compare your company's cost structure with others, but to understand how different design options affect what the customer pays and how PG&E can best incentivize more comprehensive lighting designs.

We would be happy to share the table with you after the interview in case you would like to add more detail or make any changes. Any other questions before we begin? Okay, let's get started!

The Simple Scenario

In the first scenario, the customer would like to do a simple, one-for-one lamp replacement in all fixtures. Importantly, this customer would like to avoid triggering Title 24 requirements.

3. First, let's talk about designing the project. Let's assume you don't have the information we provided in the hypothetical case. What steps would you take to learn about the facility? [**IF NEEDED:** For instance, would you go on site?]
4. What steps would you take to decide what new lamps to install? [**IF NEEDED:** For instance, would you need to spend time back at the office considering options or is the project simple enough that you could quickly provide a few options?]
5. Would you perform any other design-related tasks?
6. How much do you think it would cost the customer for project design and planning?

[**IF NOT A SEPARATE CHARGE:** Do you roll the project design and planning costs into the overall proposed project costs? Do you add that cost as a flat rate, hourly, or some other way?]

IF UNSURE ABOUT COST:

- a. Could you give me a sense of about how long it would take in terms of labor hours to complete each of the steps we discussed?
 - b. Would you mind giving us an approximate hourly rate that we could use to calculate cost?
7. What lamps would you recommend the customer install? If you have several options, let's assume they would go with the lamps that save the most energy.

8. Assuming we're replacing about 500 fixtures with a total of about 1,500 lamps, how much would the lamp replacement cost the customer, including parts and labor?

IF UNSURE ABOUT COST:

- a. About how much would each lamp cost the customer?
 - b. How long in terms of labor hours would it take to complete the lamp replacement? **[IF NEEDED COLLECT RATE]**
9. Are there any other costs to the customer we have not considered? If so, let's add them to the table.
 10. Thanks for all that information. This is the total project cost we came up with. Does it look about right? Would you make any adjustments to the table?

The Title 24-Only Scenario

Great! Now that we've completed one scenario, it should be a bit easier to make changes and calculate the cost of different options.

In this next scenario, the customer wants to do more than a lamp swap-out, but they are a bit cost-conscious. They would like to do a lighting retrofit that results in energy bill savings, but aren't prepared to pay top-dollar. Importantly, they want to make sure the project meets Title 24 requirements. To note, there are no lighting controls in the facility.

11. Let's return to designing the project. Would the steps you take to design the project change? How so? **[IF NEEDED: For example, would you spend more time observing the facility or designing the project? Would you develop any additional documents presenting your proposed design?]**
12. How would the costs of designing the project change compared to the last scenario?
13. How much do you think it would cost the customer for project design and planning? **[IF NEEDED: As a reminder, this can be a direct cost or the cost that's rolled up into the final bill]**

IF UNSURE ABOUT COST:

- a. I understand this can get a little complicated to estimate. Roughly speaking, how would costs compare to the simple lamp replacement? For instance, would it be twice as much or three times as much?
 - b. How long would the time it takes to complete project design and planning take?
14. What retrofits might you recommend to the customer? **[IF NEEDED: Would you recommend the same lamps as the first scenario? Would you remove fixtures? Would you change fixture types? Would you add lighting controls?]**
 15. How much do you think it would cost the customer to implement the project, including parts and labor?

IF UNSURE ABOUT COST:

- a. Roughly speaking, how would costs compare to the last scenario? For instance, twice as much or three times as much?

16. What equipment would be specifically associated with Title 24? What proportion of equipment and labor costs would be associated with meeting Title 24? Would you say “a third”, or “half”, or more?
17. Do you have experience assisting customers with the Title 24 compliance process? [IF NEEDED: For instance, “pulling a permit” and filling out the necessary documentation.]
18. How much would the Title 24 compliance process cost? [IF NEEDED: How much would it cost the customer to complete the required paperwork?] [IF UNSURE: How long would it take in terms of labor hours?] [IF NEEDED COLLECT RATE]
19. Are there any other costs to the customer we have not considered? If so, let’s add them to the table.
20. Thanks for all that information. This is the total cost we came up with. Does it look about right? Would you make any adjustments to the table?

The Maximum Savings Scenario

Okay, in the next scenario, the customer is willing to pay top-dollar to maximize their energy bill savings. Let’s walk through the steps again from design to project completion. [COMPARE COSTS TO TITLE 24-ONLY]

[REPEAT QUESTIONS 11-13, REPLACE Q14 WITH Q21]

21. What retrofits and design changes might you recommend to the customer? How would this project go above and beyond the Title 24-only scenario?

[REPEAT QUESTIONS 15-20]

22. Per our table, the “maximum savings” project costs [INSERT DOLLAR VALUE FROM CELL H23] more than the original one-for-one lamp replacement. PG&E is interested in how best to incentivize customers to complete comprehensive lighting retrofits. What incentive level do you think is needed to encourage customers to complete the more comprehensive lighting retrofit?
23. The difference in design cost between these two projects is [INSERT DOLLAR VALUE FROM CELL H24]. Do you think covering just the design cost difference with an incentive would be enough to encourage customers to complete a more comprehensive lighting retrofit?

The “Sweet Spot” Scenario

We’re now on the last scenario. This customer is willing to pay a bit more to save on their energy bills, but isn’t prepared to pay top-dollar. Is there a middle-ground option, or “sweet-spot”, somewhere between paying top-dollar and just meeting Title 24? Let’s walk through the steps again from design to project completion. [COMPARE COSTS TO MAXIMUM SAVINGS SCENARIO]

[REPEAT QUESTIONS 11-13, REPLACE Q14 WITH Q24]

24. What retrofits and design changes might you recommend to the customer? How would this project be different from the Maximum Savings Scenario?

[REPEAT QUESTIONS 15-20]

Closing

We are at the end of the interview! Thank you for patiently working with me through all those scenarios. Where should we send your \$100 incentive for completing the interview?

Would it be okay if we contacted you with any quick follow-up questions? Would you like to review the tables we developed? Thanks again for your thoughtful responses. Have a wonderful day.

Case Study Interview Hypothetical Case

Basic Facility Information	
Use	Office building
Square footage	46,460
Most Common Lighting Fixtures:	
Elevators/Closets/Storage	4ft. Strips with Two 32W Fluorescent T8s
All Other Spaces	Three 32W Fluorescent T8s in a 2x4 Troffer
Number of Lighting Fixtures:	
Total Facility	539
Elevators/Closets/Storage	41
All Other Spaces	498
Total Wattage from Lighting Fixtures (W)	50,432
Average Lighting Power Density	1.09
Controls (dimmers, occupancy sensors, etc.)	No controls are present

Details by Room Type									
Room Type	Private Offices	Open Offices	Equipment/ Storage & Closets	Hallways	Stairwells	Conferenc e Rooms	Lobby	Elevator	Restrooms
# Rooms	50	5	20	5	4	5	1	1	5
Sqft./Room	200	3,300	200	1,500	600	600	1,500	60	300
Fixture In Room	Three 32W Fluorescent T8s in a 2x4 Troffer	Three 32W Fluorescent T8s in a 2x4 Troffer	4ft. Strips with Two 32W Fluorescent T8s	Three 32W Fluorescent T8s in a 2x4 Troffer	4ft. Strips with Two 32W Fluorescent T8s	Three 32W Fluorescent T8s in a 2x4 Troffer			
# Fixtures/Room	2	40	2	20	7	8	10	1	4
Watts/Fixture (W)	96	96	64	96	96	96	96	64	96
Total Wattage/Room (W)	192	3,840	128	1,920	672	768	960	64	384
Lighting Power Density (W/sq.ft)	0.96	1.16	0.64	1.28	1.12	1.28	0.64	1.07	1.28
Annual Hours of Use	2,250	3,000	500	3,857	8,760	1,528	3,333	8,760	4,000

Appendix F. Research Questions Crosswalk

Below we identify the report sections that address each of the research questions.

Table 12: Research Questions Crosswalk

Topic	Market Assessment Research Questions	Report Section
Lighting Design Services	What lighting design options are available through the five market channels to non-residential customers who would qualify for the Trial?	3.1 and 3.2 (Characterization and Services)
	What does each market channel offer in terms of delivery method, cost, detail, customization, and equipment, techniques or strategies they use?	3.1 and 3.2 (Characterization and Services)
	How knowledgeable are these five channels about PG&E’s programs? How often do their customers participate in PG&E programs? Do other incentives exist for supporting lighting design, such as federal incentives or government funding? If so, how do PG&E incentives compare?	3.1 (Channel Characterization)
	What are the features of advanced lighting design that influence the efficiency of the installation and which of these features are offered by each of the five market channels?	3.2 (Design Services)
	What does each channel see as the benefits or differentiating features of their approach versus the other four channels?	3.1 (Channel Characterization)
Credentials	What credentials, certifications, and licenses do the five channels commonly hold?	3.1 (Channel Characterization)
Marketing Strategies	What do the five channels see as the key touch-point opportunities for finding customers about to start a lighting-specific retrofit?	4.3 (Marketing Strategy Assessment)
	How do the five channels market their services to customers?	3.1 (Channel Characterization)
	What are the five channels’ perspectives on which types of customers might benefit from a lighting design, but face barriers to getting a lighting design?	3.4 (Barriers)
	What challenges or barriers do these market channels face when it comes to encouraging customers to incorporate a lighting design into lighting retrofit projects? How have they tried to overcome these barriers, or what approaches, if any, have they considered for encouraging deeper energy savings from lighting retrofits ?	3.4 (Barriers)
Typical Customers	What types of customers do the five channels typically serve with all services they offer generally?	3.1

Topic	Market Assessment Research Questions	Report Section
		(Channel Characterization)
	What types of customers typically get a lighting design through each of the five channels?	3.1 (Channel Characterization)
Alignment with Trial Design	How do the lighting design options through each of the five channels compare and contrast to the Trial's design requirements?	3.3 (Alignment with Trial Design)
	What are the options for the LDA Trial to change its design to take advantage of these various opportunities (design or designer qualifying criteria, target market)? What are the strengths and drawbacks to PG&E incentivizing other types of lighting designs (i.e. energy savings, increased participation, etc.)?	4.2 (Opportunity Assessment)
	What other market intervention strategies might allow for deeper lighting-based savings from customers about to conduct a lighting-specific retrofit?	4.3 (Marketing Strategy Assessment)

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