# All-Electric Commercial Kitchen Electrical Requirements Study

**Final Report**

ET22SWE0010


Prepared by:

**Joe Monsur** Energy Solutions

**Paul Kuck** Energy Solutions

**Scott Honegger** Energy Solutions



December 21, 2022

# Acknowledgement

Energy Solutions would like to thank the following for their insights, industry expertise and time in supporting the development of this report.

RBE Consulting Electrical Engineers

Metro Electric

NG Associates

Chris Galarza – Forward Dining Solutions

Richie Wilim – Vacaville Unified School District

Andre Saldivar – Southern California Edison

# Executive Summary

This study identifies the impacts of converting a gas and electric commercial foodservice facility to an all-electric kitchen. Three categories were broken out to represent the majority of foodservice sites in California (CA). The findings presented in this report will help the reader understand the increased electrical load and service requirements and cost to electrify the kitchens in each category. This study also estimates the increased electrical grid load associated with converting each foodservice business type to all-electric kitchen designs.

Out of the estimated 109,000 commercial foodservice facilities in California quick-service restaurants (QSR), full-service restaurants (FSR) and institutional foodservice facilities represent approximately 82% of the commercial foodservice market.

The analysis found the connected amp load of the foodservice sites in the study increased significantly as shown in Table 1 below. These increases caused the loads to exceed the existing service capacity in all but four of the 16 sites analyzed in the study. The average demand increased by 65% with an average peak demand increase of 35kW per site.

**Table 1: Connected Load Summary**

| Category | Connected Amp % Increase | Amperage % Variance to Existing Service |
|---|---|---|
| Quick-Service | 50% | 15% |
| Full-Service | 79% | 41% |
| Institutional | 56% | -26% |

Adding electrical load would increase the average foodservice facility's total kilowatt (kW) load 54% to 84% and increase peak demand costs $1,600 to $7,400 annually, for sites that incur demand charges. Significant upgrades to the existing electrical systems would be required to meet the added load of electric equipment. The average cost per site by category are shown in Table 2.

**Table 2: Electrical Upgrade Cost Summary**

| Category | Total Cost Per Site |
|---|---|
| Quick-Service | $123,000 |
| Full-Service | $160,000 |
| Institutional | $40,000 |

# Table of Contents

**Introduction** .......... **7**

**Objectives** .......... **7**

**Methodology and Approach** .......... **7**

Data Collection .......... 7

Foodservice Market Categories .......... 8

Building Specifications .......... 9

Equipment Specifications .......... 9

Statewide Impacts .......... 9

Cost Impacts .......... 10

**Market Characterization** .......... **10**

State of Electrification in California Foodservice .......... 10

Foodservice Site Distribution in California .......... 12

**Load Analysis** .......... **13**

Building Loads .......... 13

Site Capacity and Load .......... 13

Peak Demand .......... 16

Grid Impact .......... 17

**Cost Analysis** .......... **18**

Electrical Service Analysis .......... 18

Assumptions .......... 19

Electrical Upgrade Costs .......... 19

Kitchen Equipment Cost Variance .......... 21

Demand Cost .......... 22

**Market Observations and Program Design Considerations** .......... **23**

Market Observations .......... 23

Program Design Considerations .......... 24

Additional Commercial Kitchen Electrification Research .......... 26

**Appendix** .......... **27**

Individual Appliance Loads .......... 27

Site Level Load Data .......... 28

Site Level Cost Data .......... 32

## List of Tables

Table 1: Connected Load Summary....3
Table 2: Electrical Upgrade Cost Summary....3
Table 3: California Foodservice Market Size by Category....12
Table 4: Average Site Capacity and Connected Loads by Building Type....14
Table 5: Average Site Additional Amperage by Building Type....15
Table 6: Average Site Peak Demand....17
Table 7: Foodservice Grid Load (MW)....18
Table 8: Average Site Cost by Category....20
Table 9: Cost Variance for Upgrading Sites' Electrical Service....20
Table 10: Total Market Cost for Electrical Upgrades by Category....21
Table 11: Average per Site Cost of Replacement Electric Equipment....21
Table 12: Average Cost Variance for High Efficiency Gas to Electric Equipment Packages....22
Table 13: Additional Peak Demand and Annual Cost....23
Table 14: High-efficiency gas to electric added load....27
Table 15: QSR Amp Loads....28
Table 16: QSR Demand by Site....28
Table 17: FSR Amp Loads....29
Table 18: FSR Demand by Site....30
Table 19: Institutional Amp Loads....30
Table 20: Institutional Demand by Site....31
Table 21: QSR Electrical Upgrade Cost Estimates by Contractor....32
Table 22: FSR Electrical Cost Upgrade by Contractor....33
Table 23: Institutional Electrical Upgrade Cost by Contractor....34
Table 24: High Efficiency Gas to High Efficiency Electric Costs....34
Table 25: QSR Demand Cost Variance....36
Table 26: FSR Demand Cost Variance....36
Table 27: Institutional Demand Cost Variance....37

## List of Figures

Figure 1: Foodservice type distribution....13
Figure 2: Electrical service capacity comparison....14

# Abbreviations and Acronyms

| Acronym | Meaning |
|---|---|
| CA | California |
| CFM | Cubic Feet per Minute |
| eTRM | Electronic Technical Reference Manual |
| FSR | Full-Service Restaurant |
| FSTC | Food Service Technology Center |
| GW | Gigawatt |
| HE | High-Efficiency |
| HVAC | Heating, Ventilation, and Air Conditioning |
| IAQ | Indoor Air Quality |
| kW | Kilowatt |
| LSR | Limited-Service Restaurant |
| MW | Megawatt |
| QSR | Quick-Service Restaurant |
| S&B | Snack and Non-alcoholic Beverage |
| WH | Water Heating |

# Introduction

The California foodservice market is dominated by gas-fired cooking equipment, largely due to operational costs, historical trends, user preference, and the cost of upgrading electrical service for electric cooking equipment. However, the industry has been slowly moving towards electrification due to regulatory pressures, carbon neutrality goals, and the marketability of having an all-electric kitchen. However, there is a need for studies on the feasibility and cost for all-electric commercial kitchens. Little is known on the existing electrical capacity of foodservice facilities, the added electrical load of transitioning to electric equipment in a typical facility or the cost of that transition. This report will examine those topics.

# Objectives

The objectives of this study are to determine the electrical load requirements, electrical service upgrade costs, and potential electrical load growth for quick-service restaurant (QSR), full-service restaurant (FSR), and institutional foodservice facilities in California to convert to all-electric kitchen designs. Additionally, the study provides a market characterization to identify barriers and trends of electrification in the California foodservice market.

It is important to note this study was designed to focus only on the impacts of the installation of electric commercial foodservice equipment. The cost associated with converting heating, ventilation, and air conditioning (HVAC) and water heating (WH) equipment from gas to electric was not included. This defined scope allows for a better evaluation of the costs and benefits associated with retrofitting gas-fired cooking equipment to an all-electric design.

# Methodology and Approach

## Data Collection

Energy Solutions has extensive connections across the foodservice industry and leveraged these relationships to collect information for the market trends and data needs for the cost analysis.

The project team conducted interviews with foodservice design/build firms and consultants, industry experts, and large chains to gain insight into the California foodservice market as it relates to the following areas:

1. Electrification trends
2. Current sites installing electric kitchens
3. Attitudes of chain and independent operators towards kitchen electrification.

All building electrical load data was taken from electrical panel schedules and single line drawings from architectural drawings of foodservice facilities. These drawings were obtained from design and build consultants and online contractor bid portals. Equipment schedules were taken from the same drawings and additional site equipment specifications were provided by equipment dealers. Electrical load data included capacity in amps and peak demand in kW. Foodservice market size data for the state of California was collected from data aggregators and existing data sets. Building electrical upgrade cost data was obtained from CA licensed electrical contractors.

## Foodservice Market Categories

Commercial foodservice kitchens can be found in a variety of settings including restaurants, grocery stores, recreational facilities, public assembly facilities, hotels, institutional facilities, and various other host facilities. Restaurants can be broken down into sub-categories which include QSRs, FSRs and snack and non-alcoholic beverage (S&B) sites. Currently, most commercial kitchens, with the exception of S&B, are highly reliant on gas cooking equipment for some or all their cooking processes.

Of the various foodservice categories, three make up the majority of facilities. QSRs are also known as fast food, fast casual, or limited service. They make up the largest percentage of sites and generally offer counter service where patrons order and pay before eating. These kitchens generally have small equipment packages with a few common natural gas appliances and, on average, have the longest operating hours of any foodservice facility.

FSRs offer table service by waitstaff with patrons paying after eating, and typically have a more diverse menus and larger, more diverse gas-focused kitchen equipment packages. FSRs provide more scratch cooking and often use a selection of equipment such as cooktops, char broilers and salamander which are almost exclusively gas-fired in the current market.

Institutional facilities include commercial kitchens located in government, military, educational, recreational, and healthcare facilities as well as employee cafeterias. These facilities often provide batch cooking with equipment developed for large output or can be smaller facilities which store and reheat food produced in commissary kitchens. The sites analyzed for this study used a mix of gas and electric cooking equipment.

The original project design identified four foodservice categories to study, including hospitality. However, in reviewing the kitchen designs, it was determined the hospitality designation overlaps with other categories included within the report. Catering kitchens in hotels are often similar to institutional kitchens and restaurants in hospitality locations are generally similar to FSRs. Most continental breakfast type kitchen set-ups are almost exclusively electric already. Due to these findings, hospitality facilities were removed as a separate category for the final analysis, but it is presumed most of the hotel restaurants were captured in the site count analysis.

Additionally, it was identified that S&B facilities are a unique category within the foodservice sector. S&B sites are often grouped with or viewed as a sub-category of QSRs but serve a smaller menu and use a smaller, less energy intensive equipment package. S&B sites serve specialty snacks such as ice cream and pastries, and/or nonalcoholic beverages like coffee, tea, boba, or smoothies. These sites typically use electric equipment in their kitchens to warm or reheat any hot food served but may use a small amount of gas equipment such as a convection oven. This category was analyzed but not included in the additional load calculations.

## Building Specifications

Energy Solutions used the collected architectural drawings from design and build consultants, equipment dealers, and online construction bid portals to provide the kitchen equipment schedules and designs of the electrical services used in this study. The buildings analyzed included:

1. Seven national QSRs
2. Five FSRs: two national chains and three independent restaurants
3. Four institutional kitchens from elementary, high school, and K12 central kitchens.
4. An additional seven S&B sites were reviewed but not used in the additional load calculations as they were almost exclusively electric only kitchens.

The building designs collected were primarily new construction sites but did contain a mix of retrofits. All sites had 208V 3-phase electrical service with most equipment rated for 208V.

While this report's focus was on the infrastructure costs of electrification, grid infrastructure upgrades were not examined.

## Equipment Specifications

Energy Solutions specified models for cooking equipment design packages found in the analyzed sites, which covers the most common equipment found in commercial foodservice operations. Models for standard-efficiency and high-efficiency (HE) electric equipment were selected and data from the manufacturer's specification sheets informed the current and power requirements in replacing gas for electric equipment.

Popular standard efficiency models were selected based on industry knowledge and engagement with equipment dealers that participate in the CA Instant Rebates program. The specified HE equipment was identified as the models with the highest participation in the Instant Rebates programs managed by Energy Solutions.

For products without an efficiency standard set by ENERGY STAR or the California eTRM, specification of the models was determined on a case-by-case basis. For example, cooktops do not have an efficiency standard. However, electric cooktops offer both a standard-efficiency, electric resistance option and an induction model. In this case, the induction model was used for the high-efficiency specification and calculations, and the resistance model for the standard-efficiency model. Alternatively, a single electric charbroiler was used for both standard and high efficiency models as there is not varying technology for this product. Ultimately, the HE equipment package was selected to as it is the more likely product selection for electric kitchens. Table 14 in the appendix provides the added amp and kW for each equipment type.

The data used for the equipment's electrical load provides a generalized view of the additional load for each category. The electrical load for product types can vary significantly from model to model based on quality and production values of the units. These variances would need to be assessed on a case-by-case basis for foodservice operators considering all-electric kitchen retrofits, particularly if panel space is an issue.

## Statewide Impacts

Data sets of foodservice sites in California were utilized to develop a breakdown of the types and counts of foodservice facilities in the state and used to extrapolate findings to the statewide market.

The average site data was multiplied by the number of facilities in each category to calculate the total load across all foodservice facilities in California. This data was used to estimate future electrical grid requirements if all facilities were to switch to all-electric kitchens.

### Cost Impacts

Using the information gathered from construction documents and the estimated additional loads, Energy Solutions utilized relationships with electrical contractors and equipment distributors to obtain pricing for electrical upgrades and electric appliances. Bid data was collected for each site to determine the labor and material costs of only the electrical work required to transition all gas kitchen equipment to electric. Pricing was averaged by category and extrapolated to estimate a total cost for the market in the three categories. California utility rate tables were used to estimate the cost per kW of peak demand load. The average peak demand from the load calculations for each category was multiplied by the cost per kW to get the current and estimated future demand costs.

## Market Characterization

### State of Electrification in California Foodservice

Energy Solutions reached out to foodservice consultants, design/build consultants, equipment dealers, chefs, and energy engineers to discuss their experience with all-electric kitchens, trends they are seeing in the market, and their customers who are asking about or installing electric kitchens. Interviews indicated electric kitchens are being used by a small subset of the market.

Some of the early adopters include corporate and university foodservice operations due to pledges to reduce carbon emissions. These large institutions tend to have the financial means to address any incremental costs of transitioning to all electric kitchens. Elementary, middle, and high schools were also noted as earlier adopters of electric kitchens. One reason for this is the use of centralized kitchens where individual schools may only require basic heating and holding equipment, which is commonly electric. One school system foodservice director noted they were electrifying some school kitchens but to keep upgrade costs to a minimum only transitioning equipment that would fit into the existing capacity of the site’s electrical service. This process of partial electrification will likely be the most common transition through all sectors of the foodservice industry as the capital costs are more acceptable to an industry with small profit margins.

Alternatively, most small independent operators have not considered electrifying their kitchens due to the additional cost to operate electric equipment. Conversations with larger chain restaurants show they are preparing to adapt to electric kitchens as needed and are taking steps to test alternative models of equipment. However, no brands interviewed have indicated plans to fully electrify their new buildings or existing sites. One interviewee stated that many chain restaurants that have a franchise structure will likely let the decision to switch cooking fuel sources rest solely on individual franchisees.

While large corporate sites and universities tend to be driven by organizational sustainability goals, there are a variety of reasons for operators to move to all-electric kitchens, and no single reason is driving the trend. Market actors also noted local regulations, marketing of sustainability efforts, simplification of equipment packages, increased safety, increased cooking uniformity, and interest in more comfortable kitchens as other reasons operations have expressed interest in electrifying their kitchens. The experience and lessons learned from these early adopters will provide an excellent basis for addressing hurdles in electrifying other foodservice operations, and their knowledge and experience should be leveraged for future electrification efforts.

Additionally, it was noted that the design and build of all-electric kitchens is not just an infrastructure issue. Designers and operators need to address a lot of operational questions in terms of menu design, staff training, equipment operation, daily maintenance, and long-term preventative maintenance. Most chefs have only trained on gas equipment and thus only used gas cooktops, woks, and charbroilers. Cooking on electric versions of this equipment is different and will require a large, concerted effort to train the cooks and chefs of an industry that has experienced mainly gas equipment. Additionally, electric model offerings of some equipment are very limited which could make full electrification very difficult for some operations.

The market actors interviewed for the report are supportive of the electrification efforts, but few are fully educated on electric equipment and the nuances of electric kitchens. Cash and Carry equipment dealers can be heavily focused on gas equipment and often do not carry certain electric equipment in their inventory. This point alone can be a major barrier for independent restauranteurs to move from gas to electric equipment. The manufacturer’s reps and design consultants are the most experienced with designing and supplying electric kitchens. They tend to work more with the large institutions implementing electric kitchens and will be the drivers and main source of industry knowledge for the initial phase of electric cooking equipment transition.

There is also an interest from manufacturers in expanded equipment sales. Electric foodservice equipment can be simpler to build and use fewer components. However, redesign, safety testing, and retooling of manufacturing lines are expensive and time intensive.

Overall, while California has set ambitious goals and there is strong interest within the energy efficiency sector to move commercial kitchens towards electrification, the reality is the transition will be a slow process in the foodservice industry. Natural gas fired cooking equipment is the primary equipment choice in the industry, and there are several market barriers that need to be resolved to accelerate the transition to all-electric kitchen designs. Additionally, within certain product lines electric equipment is an emerging technology with few products currently available, which makes transition of that equipment difficult. However, there is a growing interest in electric kitchens which will eventually encourage manufacturers and distributors to offer more electric equipment and help drive the change to all-electric kitchens.

## Foodservice Site Distribution in California

There are an estimated 109,000 commercial foodservice facilities in California.[1] A dataset of commercial foodservice sites was used to understand the total counts and breakdown of sites within each category. Additionally, a Food Service Technology Center report was used to determine the number of commercial kitchens contained within institutional facilities.

A total of 64% of the California foodservice market is comprised of QSRs and FSRs. These categories have large natural gas loads in their kitchens, with FSRs containing the largest natural gas load of the sites analyzed. Since they comprise a large majority of the market and have not taken significant steps to electrify their kitchens, the path to commercial kitchen electrification in California will involve a lengthy adoption period. However, the other 36% of the market has taken steps to adopt all-electric kitchens. A majority of the 13% that comprise the S&B category are already all-electric in their kitchen operations, and the 18% that comprise the institutional foodservice category are beginning to adopt all-electric kitchens. Approximately 50% of the 20,000 institutional sites in the state are either postsecondary or K-12 educational sites. Convenience stores, catering kitchens and miscellaneous foodservice operations make up the remaining 5% of the market. Table 3 and Figure 1 below reflect the breakdown of foodservice types in California.

**Table 3: California Foodservice Market Size by Category**

| Foodservice Category | Counts | Percent of Market |
|---|---|---|
| Quick-Service Restaurant | 40,477 | 37% |
| Full-Service Restaurant | 29,137 | 27% |
| Institutional Foodservice | 20,002 | 18% |
| Snack and Nonalcoholic Beverage Bars | 14,247 | 13% |
| Other | 4,818 | 5% |
| **Total** | **108,681** | **100%** |

Source: Energy Solutions Project Team and *Characterizing the Energy Efficiency Potential of Gas-Fired Commercial Foodservice Equipment*

[1] Figure is calculated from combining internal custom list of commercial foodservice sites in CA with data from *Characterizing the Energy Efficiency Potential of Gas-Fired Commercial Foodservice Equipment* from Fisher-Nickel, Inc.

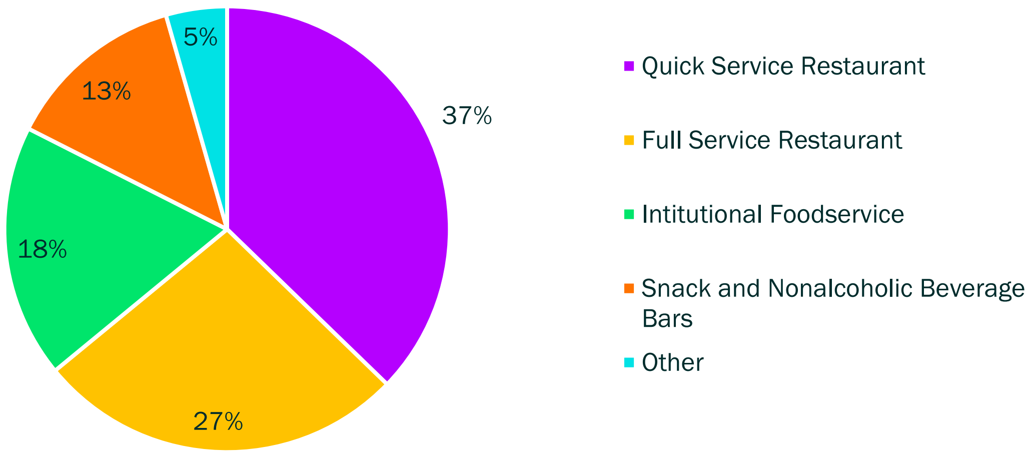


**Figure 1: Foodservice type distribution**

Source: Energy Solutions Project Team

# Load Analysis

## Building Loads

Building electrical capacity and loads were taken directly from the single line drawings and panel schedules in the construction drawings of the individual sites. This data was used to build the tables illustrating the electrical requirements of each individual site in the study. Future electrical requirements were calculated using the load data from the electric equipment specifications. Only the panels and load providing power to the kitchens were calculated for the institutional sites since these kitchens are part of much larger facilities. In general, the institutional loads consisted of the kitchen cooking, prep and refrigeration equipment, lighting, receptacles, and kitchen ventilation. The entire building loads were included for the QSR and FSR sites. All values in this section are presented in amp and kW connected loads unless noted otherwise.

### Site Capacity and Load

Except for the institutional sites, the restaurants typically had electrical systems sized just to meet the site's needs with a small amount of capacity for minor circuit expansion. This poses a problem for electrifying these kitchens as service upgrades represent a significant cost over simply adding circuits or an additional panel. The additional electrical load generated by replacing existing gas cooking equipment with electric cooking equipment increased the buildings' electrical load substantially and typically increased the total building load beyond the existing service capacity. Of the 16 buildings analyzed, 12 required higher electrical service capacity to meet the needs of the replacement equipment. Table 4 presents the existing electrical service to the buildings or kitchen area at the distribution panel, the connected load of the existing mixed fuel design and the percent of the capacity utilized with the existing gas/electric equipment. These values and all site-specific data can be found in the Appendix starting with Table 14.

**Table 4: Average Site Capacity and Connected Loads by Building Type**

| Category | Existing Service Capacity (A) | Existing Connected Amps | Utilized Capacity |
|---|---|---|---|
| **Quick-Service** | 600 | 467 | 77% |
| **Full-Service** | 640 | 533 | 87% |
| **Institutional** | 700 | 338 | 45% |

Source: Energy Solutions Project Team

The amperage requirements over the existing service ranged from a low of 6 amps at a QSR to a high of 455 amps at an FSR. Overall, QSRs had the lowest percentage of amperage increase required over existing service while FSRs had the highest average. The scale of increases varied as there was a notable difference in the number and type of equipment to be replaced from site to site. The variance of all-electric kitchens' connected amps compared to the existing service ranged from 4% under to 48% over. Figure 2 shows the existing and upgraded average capacities by category. On average, QSR and FSR locations would require a service upgrade if all gas equipment were transitioned to electric, and most institutional foodservice facilities would not need a service upgrade due to being part of a larger facility with additional capacity.

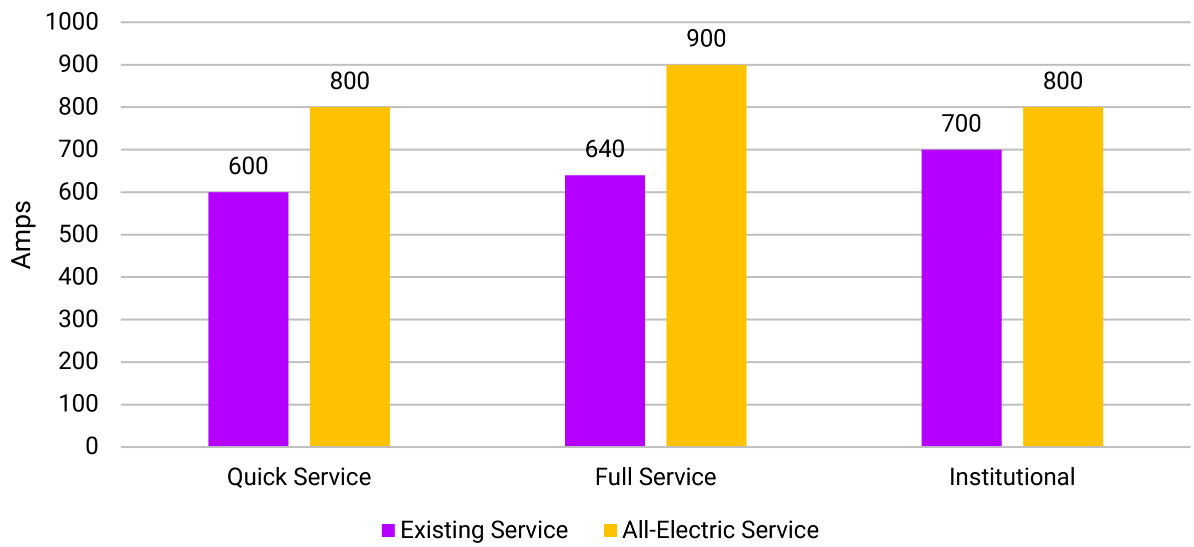


**Figure 2: Electrical service capacity comparison**

Source: Energy Solutions Project Team

The increase in connected amp load from the existing design ranged from a low of 38A for an elementary school in the institutional category to a high of 554A for an independent FSR. The average additional connected amp load was 258A across all facilities in the study. Total amperage increases were as low as 22% for replacing fryers at a QSR site and as high as 122% for replacing multiple ovens and fryers, and a griddle at an FSR. FSRs had the highest amperage increase and would require the highest percentage of service upgrades to move to an all-electric kitchen. Table 5 presents the average additional load and the increase over the existing connected load and service capacity. The data collected for QSRs came from national chain restaurants. Load data for independent QSRs is unknown and could affect the reported numbers. Additionally, the data collected for institutional foodservice facilities contains some K12 kitchens that are smaller than other facilities such as prisons and universities in the category, which could underestimate the average load. Construction drawings for the larger types of institutional foodservice facilities were unavailable.

**Table 5: Average Site Additional Amperage by Building Type**

| Category | Added Amps | All-Electric Connected Amps | Connected Amp % increase | Variance to Existing Service (A) | Amperage % Variance to Existing Service |
|---|---|---|---|---|---|
| **Quick-Service** | 222 | 688 | 50% | 88 | 15% |
| **Full-Service** | 371 | 904 | 79% | 264 | 41% |
| **Institutional** | 181 | 520 | 56% | -180 | -26% |

Source: Energy Solutions Project Team

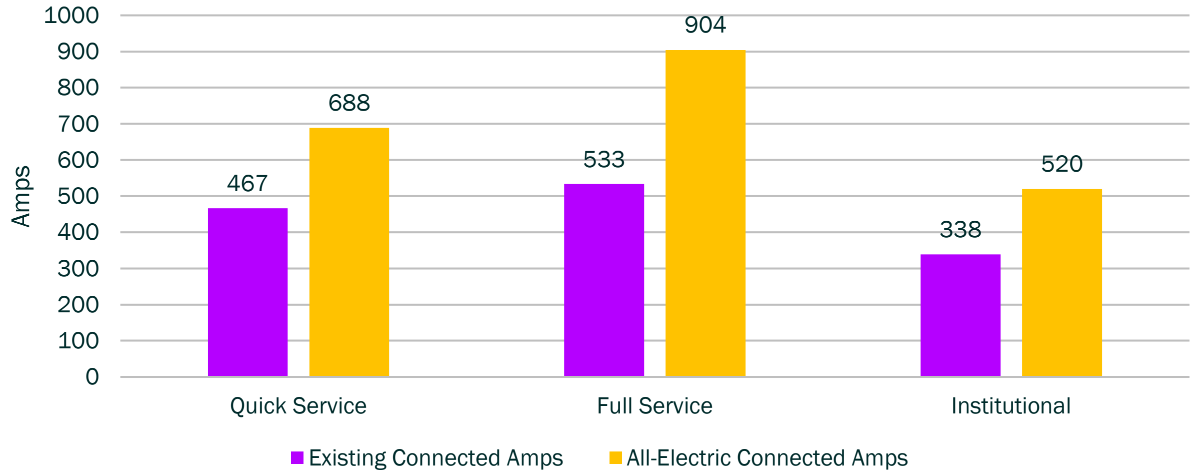


**Figure 3: Mixed fuel and all-electric connected amp comparison**

Source: Energy Solutions Project Team

## Peak Demand

Peak demand was calculated by using a ratio of the specified equipment's average kW to rated kW. The average kW was calculated by dividing daily kWh by operating hours taken from measures packages in the California electronic Technical Reference Manual (eTRM). The kW to rated kW was averaged across all equipment and multiplied by the connected load of the building to calculate the predicted peak load. The values calculated for the existing peak load were validated against billing data from national chains used in the analysis.

Table 6 shows the average site peak demand increase and the difference between the existing connected and all-electric loads. FSRs had the most gas equipment to convert, accounting for the largest increase in load. Institutional foodservice facilities had the lowest increase in peak demand due to some of the cooking equipment in these locations already being electric. QSRs were consistent in types and amounts of foodservice equipment and therefore had a narrower range of increased load values. FSRs had the largest range of increased load values due to variations in types and amounts of equipment needed at each location studied.

**Table 6: Average Site Peak Demand**

| Category | Existing Peak Demand (kW) | All-Electric Peak Demand (kW) | Peak Demand Increase |
|---|---|---|---|
| **Quick Service** | 58 | 92 | 58% |
| **Full Service** | 72 | 123 | 71% |
| **Institutional** | 41 | 61 | 50% |
| **Average** | **57** | **92** | **65%** |

Source: Energy Solutions Project Team

## Grid Impact

The California commercial foodservice market consists of an estimated 109,000 facilities. The building loads that were calculated for each category were multiplied by the estimated number of sites in each category to get the total market impact. S&B facilities, which were not included in the added load analysis due to existing electric kitchens, were included in the existing grid calculation. Additionally, this estimate does not factor in existing all electric kitchens in these categories, which would reduce the overall total. Currently, there is no publicly available data to estimate the number of electric commercial kitchens in the market. Industry experts estimate the percentage of existing all-electric kitchens to be under 5% of the total market.

The existing total grid demand for 95% of all foodservice facilities in California, which includes QSRs, FSRs, institutional and S&B, is approximately 16.4 GW of connected load. If those categories were to transition to electric kitchens, they would add approximately 9.4 GW of connected load. The remaining 5% contained in the “Other” category referenced in Figure 1 lacked sufficient data to calculate the added demand. The values presented in this section are connected load values which do not represent the actual demand on the grid. The demand data in Table 7 was intended to be used as a reference only. The data required to calculate the average site demand of each foodservice category was not available.

The additional connected load to the grid across the three foodservice categories was 9.37 GW which is an increase of 62% if all foodservice facilities in these three categories were to upgrade to electric equipment. It was forecasted that institutional foodservice facilities would be the first to upgrade to all-electric kitchens. This would be an increase of 1.12 GW.

**Table 7: Foodservice Grid Load (MW)**

| Category | Number of Facilities | Total Existing Connected MW | Added MW | All-Electric Total Connected MW |
|---|---|---|---|---|
| Quick-Service | 40,477 | 6,719 | 3,920 | 10,639 |
| Full-Service | 29,137 | 5,986 | 4,276 | 10,262 |
| Institutional | 20,002 | 2,339 | 1,166 | 3,505 |
| Snack & Beverage | 15,117 | 1,389 | 10 | 1,399 |
| **Total** | **104,733** | **16,433** | **9,372** | **25,805** |

Source: Energy Solutions Project Team

Due to insufficient data, the total grid peak demand load could not be calculated. Significant volumes of time-of-use data would need to be obtained to develop an accurate estimate.

# Cost Analysis

The cost analysis is composed of the infrastructure cost of electrifying a site, the cooking equipment purchase price, and the additional demand charges incurred due to the increased load.

## Electrical Service Analysis

The infrastructure cost estimates were developed by two different electrical contractors and included the material and labor cost to install all equipment necessary to meet the electrical requirements of the added connected load. The field data used for these estimates came from electrical drawings, equipment lists, and the specs of the proposed high efficiency, electric replacement equipment for each site. Each quote included pricing for main service panel upgrades, any additional panels needed, and the cost of installing new breakers and service to the equipment.

Cost estimates did not include design fees, gas line removal, alterations to the building or site foundation, or cost outside of typical electrical scope. The quotes also did not include any expenses or fees from the utility such as connection fees, new meters, or potential work on transformers. Snack and beverage facilities were not included in the contractor electrical upgrade estimates.

Additionally, the estimates provided are based on a straightforward design that factored the existing capacity and added load and did not assess opportunities for redesign or reduction in the existing load to install the electric equipment without expensive service upgrades discussed below. For example, one QSR site was only 6 amps over the building's existing service capacity. However, this site was priced to include a new electrical service to the building due to the need for more capacity.

Actual upgrade costs per site could be potentially reduced with the incorporation of energy efficiency measures to reduce overall load.

### Assumptions

The following list of assumptions were used to estimate the electrical installation costs.

1. Material cost is volatile at the time of this writing due to the current supply chain issues. Provided cost are per the current market.
2. Costs include material, shipping, mark up (distributor and contractor) and sales tax.
3. Costs include basic testing and commissioning at project completion.
4. Costs do not include general contractor cost where work is significant enough to require a general contractor.
5. Costs account for non-union, regular working hours.
6. Cost for construction services provided by the utility were not included
7. Quotes conformed to current California and national building electric codes.
8. Branch circuit, panel feeder, transformer feeder lengths = 50 feet
9. Added sub-panel installed and fed by an existing panel within 20 feet of the existing panel
10. Panels are surface mounted and top fed

## Electrical Upgrade Costs

The total electrical upgrade costs for each site were comprised of the labor and materials for new breakers for each electrical appliance, running branch circuits to each appliance, new panels when applicable, and upgrading the main service panel when the added load exceeded the current electrical capacity of the site. There was a total of 16 sites that were quoted (7 QSRs, 5 FSRs, and 4 Institutional foodservice sites).

There were significant variations in cost based on the different foodservice categories in the study and within the categories themselves. QSRs on average required less appliances than FSRs which resulted in lower additional amperage increases. However, most of the QSR electrical capacities were not designed with electric appliances in mind. Six out of the seven QSRs in the study required additional panels and upgrades to the main service panel. Electrical upgrade costs ranged from $5,300 to $173,000.

FSRs required the most appliances resulting in the largest amperage increases. FSR's in the study were also not designed with all electric kitchens in mind, and all five of the sites in the study required additional panels and main service panel upgrades. The electrical upgrade costs ranged from $96,000 to $300,000.

The Institutional foodservice category had the largest internal variation of the three categories. Three of the four sites only required additional breakers and branch circuits, and one of the sites required a service panel upgrade. Upgrade costs ranged from $1,700 to $131,000. In general, if the panel servicing the kitchen did not have capacity, other existing panels were able to supply the needed load for the institutional sites. Additionally, since the commercial kitchens were only part of a much larger facility the additional load did not require an upgrade to the service supplying the building.

Table 8 shows the average cost to upgrade electrical systems for each foodservice category and the average number of appliances converted from gas to electric.

**Table 8: Average Site Cost by Category**

| Category | Average Number of Equipment Converted | Total Cost Per Site |
|---|---|---|
| Quick-Service | 5 | $123,000 |
| Full-Service | 8.2 | $160,000 |
| Institutional | 4.8 | $40,000 |

Source: Energy Solutions Project Team

The large variance in per site and category cost is due to the need of most sites to upgrade the electrical service to the building. Only four of the 16 sites had enough electrical capacity available and only needed breakers and branch circuits ran to the new equipment. The remaining sites required an upgrade to the main distribution panel and the feeder from the utility to the building,

The costs associated with upgrading the service to the building are significant and represent a major barrier to commercial kitchen electrification. Table 9 presents the average cost of sites that did require a service upgrade and those that did not. Of the four sites that did not require an upgrade, three were institutional sites where additional load and electrical panels were available to carry the additional load of the electric equipment. Only one QSR site had enough spare capacity for the additional load. This distinction will play an important part in any electrification efforts of existing commercial kitchen facilities.

**Table 9: Cost Variance for Upgrading Sites' Electrical Service**

| Category | Total Cost for Upgrade |
|---|---|
| Service Upgrade | $148,000 |
| No Service Upgrade | $12,000 |

Source: Energy Solutions Project Team

Table 10 shows the total cost for the California market to upgrade all sites in each of the studied categories. This figure uses the market sizes noted in Table 3: California Foodservice Market Size by Category and multiplies it by the average cost provided in Table 8. The total cost factors in the variance between sites requiring service upgrades or not, but the data set is not large enough to provide an accurate estimate of the breakdown between the two groups. Additionally, this estimate does not factor in existing all electric kitchens in these categories, which would reduce the overall cost. Currently, there is no publicly available data to estimate the number of all-electric commercial kitchens in the market. Industry experts estimate all-electric kitchens to represent under 5% of the market,

**Table 10: Total Market Cost for Electrical Upgrades by Category**

| Category | Number of Facilities | Total Market Cost (Billions) |
|---|---|---|
| Quick-Service | 40,477 | $4.99 |
| Full-Service | 29,137 | $4.67 |
| Institutional | 20,002 | $.81 |
| Total | 89,616 | $10.46 |

Source: Energy Solutions Project Team

## Kitchen Equipment Cost Variance

To calculate the cost variance of the electric kitchen equipment, pricing was collected to provide an average price for each equipment type in both gas and electric options. The price data used California eTRM data for any appliance with an active measure in the eTRM. For equipment that did not have a measure listed in the eTRM, pricing was collected from online retailers on a variety of manufacturers and models for each equipment type and averaged. The values in Table 11 are for the total cost of new electric equipment, assuming a site would replace all existing gas equipment with new electric equipment. Individual models prices can vary significantly based on the specific type, quality, and efficiency of each model. Table 12 below provides the total incremental cost difference per site comparing new equipment for both fuel types in new construction situations. Based on this representative list, the overall pricing of electric equipment was found to be approximately 25% higher than equivalent gas equipment. Table 24 in the appendix provides the retail price and incremental cost for each piece of equipment analyzed in the report.

**Table 11: Average per Site Cost of Replacement Electric Equipment**

| Category | Average Number of Equipment Converted | Equipment Package Cost |
|---|---|---|
| Quick-Service | 5 | $35,060 |
| Full-Service | 8.2 | $57,740 |

| Category | Average Number of Equipment Converted | Equipment Package Cost |
|---|---|---|
| Institutional | 4.8 | $64,410 |

Source: Energy Solutions Project Team

**Table 12: Average Cost Variance for High Efficiency Gas to Electric Equipment Packages**

| Category | Average Number of Equipment Converted | Equipment Package Cost Variance |
|---|---|---|
| Quick-Service | 5 | $3,750 |
| Full-Service | 8.2 | $12,970 |
| Institutional | 4.8 | $4,180 |

Source: Energy Solutions Project Team

## Demand Cost

The annual demand cost was calculated for each site and averaged for each of the three foodservice categories. Demand charges from SoCal Edison rate tables were used along with billing data from multiple foodservice sites to calculate a blended average demand charge for the state of California which was estimated at $12.03 for any values above 20 kW. Demand charges are highly variable and actual peak demand costs may differ greatly between similar sites in different locations or even with the same utility. More billing data would be needed from individual utilities to determine a more accurate cost for individual service territories.

Table 13 shows the average annual demand cost for each of the three foodservice categories. These values averaged out to an added annual demand cost of $4,650 per foodservice facility with QSRs ranging from $3,300 to $8,900, FSRs ranging from $3,300 to $11,200, and institutional foodservice facilities ranging from $0 to $5,000. With the added demand from electric equipment, many sites that do not currently pay demand charges with mixed fuel kitchen designs would likely move to rate structures that incur a demand charge. A small commercial rate structure was used in the calculation of these figures which assumed a peak demand between 20kW and 200kW. Although the majority of foodservice facilities would fall under this rate structure, some larger institutional foodservice facilities could fall under a 200kW to 500kW rate structure. They could also qualify for a special rate structure such as in the case of some universities and government facilities. Therefore, rates may vary.

**Table 13: Additional Peak Demand and Annual Cost**

| Category | Existing Annual Peak Demand Cost | All-Electric Peak Demand Cost | Additional Annual Peak Demand Cost |
|---|---|---|---|
| Quick Service | $5,500 | $10,400 | $4,990 |
| Full Service | $7,490 | $14,900 | $7,420 |
| Institutional | $3,400 | $6,200 | $1,640 |

Source: Energy Solutions Project Team Additional Considerations

To provide a consistent analysis across kitchens in all building types, this report was based on one-for-one direct replacement of each gas appliance in the kitchen. In practice, there are variables that affect the type and capacity of final equipment choices. A restaurant may determine there is a need for a larger or smaller version of their existing equipment or replace a convection oven and steamer with a single combination oven. Additionally, a restaurant owner may be reluctant to change all their gas appliances to electric or find limited availability of models for certain cooking equipment. For example, 6-burner gas ranges are standard equipment, but 4-hob induction units are more common and readily available than a 6-hob unit. Essentially, electrifying a commercial kitchen is a process of redesigning the kitchen, which will be very site specific.

# Market Observations and Program Design Considerations

## Market Observations

While there is curiosity and some early adoption of electrification in commercial kitchens, the interest mainly resides at the policy level and not on the ground in foodservice operations. To a certain degree, this can be viewed as an opportunity as there has been limited research into electrification in the foodservice sector and there are various areas within the sector which still require analysis to facilitate the transition.

Realistically, the electrification of the foodservice industry will be slow. Existing site level electrical infrastructure will be a major barrier as existing electrical services are generally not large enough to handle the additional load required for an all-electric cookline. This factor alone will exclude many operations from transitioning to electric kitchens due to the extensive costs identified in this report as foodservice operations operate on very narrow profits margins.

In addition to cost, other barriers such as operator experience, preferences, and electric product availability will pose challenges to electrification of commercial kitchens. Many cooks and chefs have only used natural gas equipment or have strong preferences for gas equipment. In the FSR sector in particular, transitioning experienced chefs away from their equipment of choice will be difficult. In the QSR and institutional sectors where there is less scratch made products and less professionally trained kitchen staff, the transition to electric equipment will be easier. Equipment where the fuel type plays less of a role in the cooking process such as convection ovens, fryers, combination ovens, and steamers will be easier to transition than equipment like charbroilers or cooktops where the gas flame is part of the cooking process.

Limited electric product availability is another barrier for certain cooking equipment. Products like woks, charbroilers, and conveyor broilers have limited or no electric product availability in the United States. The market is changing rapidly to fill the gaps of limited equipment options, but it still should be a focus of supporting the electric transition for the sector.

Finally, the foodservice sector is very diverse in terms of the buildings and infrastructure and the operations and ownership. Businesses range from owner-chefs with a small, single restaurant operating five days a week to McDonalds, which operates approximately 1,250 sites in California. The process for transitioning to electric kitchens will be quite different for these businesses and will require a diverse offering of customer engagement and market interventions to help in the transition.

## Program Design Considerations

The following program design considerations may help accelerate progress on commercial kitchen electrification.

1. **Take a holistic view of electrification**

   While commercial kitchens present the largest gas load of a commercial foodservice facility to transition to electric, they are one component of a larger facility. Water heating and HVAC systems must be considered in a full transition from natural gas to electric operations. Additionally, the transition of commercial kitchens from gas to electric is often not just a simple one-for-one equipment replacement and will require a more holistic view of the cookline operations and kitchen design, including the type of equipment used, how it will be used, and where it will sit on the cookline.

2. **Incentivize electrical service upgrades for fuel substitution**

   Electrical service upgrades constitute a significant cost to commercial foodservice facilities looking to convert to all-electric kitchens. Providing market interventions through incentive programs can help resolve this cost barrier and support commercial foodservice customers in electrification of their kitchens.

3. **Create a pathway for phased electrification retrofits**

   Some commercial foodservice facilities may benefit from taking a phased approach to electrification. Partial or incremental transitions will help to minimize cost to operators while accomplishing the goal of reducing carbon emissions.

4. **Prioritize fuel agnostic equipment**

   There are certain types of commercial cooking equipment where the fuel type is only a heat source and plays little to no role in the process or end product. This type of equipment requires no change in operations or training, is readily available, and offers an easier transition from gas to electric. Common cooking equipment that falls into this category include convection ovens, fryers, combination ovens, griddles, and steamers. Focusing on adoption of this equipment can be an initial and incremental step in transitioning to electric equipment.

5. **Fully support early adopters**

   The success of early adopters will be vital to the continued rollout of electric kitchens. Utilities can offer services such as electrical design expertise, construction support and engagement with custom and deemed incentive programs to ensure operators willing to take a risk in transitioning to an electric kitchen are successful.

6. **Leverage experience and knowledge of early adopters**

   The success and experience of early adopters will also be vital to continued adoption of electric kitchens. The experience and knowledge of the first electric kitchens will spread inherently but should also be leveraged to educate and teach best practices to encourage and promote the transition within the industry through activities such as case studies, webinars, and test kitchen demonstrations.

7. **Continued research on foodservice electrification**

   The foodservice industry is an exceptionally diverse market with many variables and uncertainties regarding efforts to electrify the operations. Continued research will help identify and resolve barriers while providing more data for the industry to confidently make the transition to electric kitchens. A detailed list of recommended research areas is provided in the Additional Commercial Kitchen Electrification Research section below.

8. **Operating cost reduction**

   Operating electric equipment can cost more than twice as much as the equivalent natural gas equipment. Special electric rate structures for all-electric commercial kitchens could minimize the additional operating cost of electrification and the hesitancy of operators to electrify their kitchens.

9. **Market engagement and training**

   The hesitancy of operators to transition to unfamiliar equipment is a large market barrier, but utility based educational programs, the IOU foodservice labs, and equipment loan programs offer resources to engage the market at an operations level and address these concerns.

10. **Engage manufacturing sector**

    A full transition to electric kitchen will not happen without a broad commitment from the foodservice equipment manufacturers to produce the needed models and volumes to meet the desired demand. Utilities should engage the commercial foodservice manufacturing sector to encourage and support electric equipment development, product testing, pilot projects and incentive measure development.

11. **Address electrification readiness**

    This analysis showed most sites are not designed to carry additional electrical capacity and upgrading existing sites adds a significant expense. Addressing future electrical needs in new construction will allow for cost effective future electrification in a market which is usually exempted from natural gas ban regulations.

## Additional Commercial Kitchen Electrification Research

This report's market engagement and analysis identified several areas outside the existing scope that warrant additional research to provide additional insights on the electrification of commercial foodservice facilities.

- **Hot water and HVAC load analysis** – HVAC and water heating represent approximately 30% of natural gas use in restaurants[2] and a conversion of those systems would have a notable impact to the electrical requirements of commercial kitchens. The cookline load analysis provided in this report can be combined with load analyses of commercial hot water and HVAC systems to provide a whole building view of the electrification of commercial foodservice facilities.
- **Kitchen exhaust reduction** – Kitchen exhaust hood CFM (cubic feet per minute) can be reduced for electrical kitchen equipment in comparison to the equivalent gas equipment. The potential savings and effects on kitchen comfort is unknown and presents opportunity for study into potential savings impacts.
- **Indoor air quality (IAQ) analysis** – Recent research on IAQ in residences with natural gas stoves has shown significant decreases in air quality due to unvented flue gas. IAQ in commercial kitchen settings has not been studied extensively but could have a significant effect on the adoption of electric kitchens if shown to improve working conditions of kitchen staff.
- **Utility infrastructure upgrade costs** – Upgrades to sites or multiple sites can trigger the need to upgrade utility side equipment such as service feeds and transformers. This cost and potential occurrence is unknown.

[2] Energy Information Administration, 2012 Commercial Buildings Energy Consumption Survey

# Appendix

## Individual Appliance Loads

**Table 14: High-efficiency gas to electric added load**

| Equipment | Amp | kW |
|---|---|---|
| Combination Oven | 37.7 | 13.7 |
| Convection Oven | 19.0 | 5.7 |
| Conveyor Oven | 85.2 | 31.5 |
| Fryer[1] | 48.0 | 22.0 |
| Pressure Fryer | 25.9 | 10.6 |
| Rethermalizer | 42.0 | 15.8 |
| Griddle 2' | 27.0 | 9.6 |
| Griddle 3' | 40.0 | 14.3 |
| Griddle 4' | 40.0 | 14.3 |
| Griddle 5' | 75.0 | 27.0 |
| Griddle 6' | 90.0 | 32.4 |
| Steamer | 39.0 | 14.3 |
| Salamander | 9.4 | 4.5 |
| Charbroiler 2' | 25.0 | 6.0 |
| Charbroiler 3' | 25.0 | 9.0 |
| Conveyor Broiler | 42.0 | 13.8 |
| 2 Burner Range | 30.0 | 7.0 |
| 4 Burner Range | 47.2 | 17.0 |
| 6 Burner Range | 58.3 | 21.0 |
| 6 Burner Range w/Standard Oven | 66.7 | 21.6 |
| 6 Burner Range w/Conv Oven | 63.2 | 21.0 |
| Stock Pot | 20.0 | 7.0 |
| Tilting Skillet 40-gallon | 48.6 | 17.8 |
| Titling Kettle 40-gallon | 68.8 | 19.2 |
| Titling Kettle 80-gallon | 82.4 | 24.1 |

Source: Energy Solutions Project Team

[1] Some high efficiency gas fryers contain electrical components with a small load. However, among the models submitted in the California Energy Wise program, a small fraction use any electricity. A weighted average on the models submitted in the program resulted in an amp load of less than 0.1A.

## Site Level Load Data

**Table 15: QSR Amp Loads**

| Site | Existing Service (A) | Existing Connected Amps | Added Amps | All-Electric Connected Amps | Amps % Increase | Variance to Existing Service (A) |
|---|---|---|---|---|---|---|
| National QSR A | 400 | 262 | 144 | 406 | 55% | 6 |
| National QSR B | 600 | 413 | 163 | 576 | 39% | -24 |
| National QSR C | 600 | 527 | 226 | 753 | 43% | 153 |
| National QSR D | 600 | 504 | 384 | 888 | 76% | 288 |
| National QSR E | 600 | 371 | 307 | 678 | 83% | 78 |
| National QSR F | 800 | 667 | 148 | 815 | 22% | 15 |
| National QSR G | 600 | 523 | 180 | 703 | 34% | 103 |
| **Average** | **600** | **467** | **222** | **688** | **50%** | **88** |

Source: Energy Solutions Project Team

**Table 16: QSR Demand by Site**

| Site | Existing Connected kW | Existing Peak Demand (kW) | Added kW | All-Electric Connected kW | All-Electric Peak Demand (kW) | kW % Increase |
|---|---|---|---|---|---|---|
| National QSR A | 94 | 33 | 66 | 160 | 56 | 70% |
| National QSR B | 147 | 51 | 72 | 219 | 77 | 49% |
| National QSR C | 176 | 62 | 94 | 270 | 95 | 53% |

| Site | Existing Connected kW | Existing Peak Demand (kW) | Added kW | All-Electric Connected kW | All-Electric Peak Demand (kW) | kW % Increase |
|---|---|---|---|---|---|---|
| National QSR D | 182 | 64 | 176 | 358 | 125 | 96% |
| National QSR E | 134 | 47 | 129 | 263 | 92 | 97% |
| National QSR F | 240 | 84 | 65 | 306 | 107 | 27% |
| National QSR G | 189 | 66 | 76 | 264 | 92 | 40% |
| Average | 166 | 58 | 97 | 263 | 92 | 58% |

Source: Energy Solutions Project Team

**Table 17: FSR Amp Loads**

| Site | Existing Service (A) | Existing Connected Amps | Added Amps | All-Electric Connected Amps | Amps % Increase | Variance to Existing Service (A) |
|---|---|---|---|---|---|---|
| Independent FSR A | 1200 | 1085 | 554 | 1639 | 51% | 439 |
| National FSR A | 800 | 557 | 356 | 913 | 64% | 113 |
| National FSR B | 400 | 218 | 266 | 485 | 122% | 85 |
| Independent FSR B | 600 | 551 | 504 | 1055 | 92% | 455 |
| Independent FSR C | 200 | 256 | 176 | 432 | 69% | 232 |
| Average | 640 | 533 | 371 | 904 | 79% | 264 |

Source: Energy Solutions Project Team

Table 18: FSR Demand by Site

| Site | Existing Connected kW | Existing Peak Demand (kW) | Added kW | All-Electric Connected kW | All-Electric Peak Demand (kW) | kW % Increase |
|---|---|---|---|---|---|---|
| Independent FSR A | 390 | 137 | 222 | 612 | 214 | 57% |
| National FSR A | 268 | 94 | 134 | 402 | 141 | 50% |
| National FSR B | 79 | 28 | 107 | 186 | 65 | 136% |
| Independent FSR B | 198 | 69 | 206 | 404 | 141 | 104% |
| Independent FSR C | 92 | 32 | 66 | 158 | 55 | 72% |
| Average | 205 | 72 | 147 | 352 | 123 | 84% |

Source: Energy Solutions Project Team

Table 19: Institutional Amp Loads

| Site | Existing Service (A) | Existing Connected Amps | Added Amps | All-Electric Connected Amps | Amps % Increase | Variance to Existing Service (A) |
|---|---|---|---|---|---|---|
| Elementary School A | 400 | 84 | 38 | 122 | 45% | -278 |
| Elementary School B | 800 | 265 | 250 | 515 | 94% | -285 |
| Consolidated School Kitchen | 800 | 590 | 303 | 893 | 51% | 93 |
| High School A | 800 | 415 | 135 | 550 | 32% | -250 |
| Average | 700 | 338 | 181 | 520 | 56% | -180 |

Source: Energy Solutions Project Team

**Table 20: Institutional Demand by Site**

| Site | Existing Connected kW | Existing Peak Demand (kW) | Added kW | All-Electric Connected kW | All-Electric Peak Demand (kW) | kW % Increase |
|---|---|---|---|---|---|---|
| Elementary School A | 27 | 9 | 11 | 39 | 13 | 42% |
| Elementary School B | 82 | 29 | 83 | 164 | 57 | 101% |
| Consolidated School Kitchen | 209 | 73 | 99 | 308 | 108 | 48% |
| High School A | 150 | 53 | 40 | 190 | 67 | 27% |
| **Average** | **117** | **41** | **58** | **175** | **61** | **54%** |

Source: Energy Solutions Project Team

## Site Level Cost Data

**Table 21: QSR Electrical Upgrade Cost Estimates by Contractor**

| Site | Total Appliances | Total Cost for Upgrade |
|---|---|---|
| National QSR B - Contractor A | 4 | $5,310.62 |
| National QSR B - Contractor B | 4 | $19,877.75 |
| National QSR A - Contractor A | 3 | $113,972.10 |
| National QSR A - Contractor B | 3 | $147,675.50 |
| National QSR C - Contractor A | 5 | $116,922.44 |
| National QSR C - Contractor B | 5 | $170,690.75 |
| National QSR E - Contractor A | 6 | $119,034.27 |
| National QSR E - Contractor B | 6 | $172,323.75 |
| National QSR D - Contractor A | 8 | $126,925.60 |
| National QSR D - Contractor B | 8 | $173,443.00 |
| National QSR F - Contractor A | 4 | $114,469.00 |
| National QSR F - Contractor B | 4 | $164,636.00 |
| National QSR G - Contractor A | 4 | $115,214.35 |
| National QSR G - Contractor B | 4 | $164,641.75 |
| Average | 4.9 | $123,224.06 |

Source: Energy Solutions Project Team

Table 22: FSR Electrical Cost Upgrade by Contractor

| Site | Total Appliances | Total Cost for Upgrade |
|---|---|---|
| Independent FSR A - Contractor A | 15 | $138,217.59 |
| Independent FSR A - Contractor B | 15 | $299,939.25 |
| National FSR A - Contractor A | 9 | $120,543.60 |
| National FSR A - Contractor B | 9 | $203,510.00 |
| National FSR B - Contractor A | 4 | $118,071.53 |
| National FSR B - Contractor B | 4 | $151,700.50 |
| Independent FSR B - Contractor A | 9 | $136,711.36 |
| Independent FSR B - Contractor B | 9 | $222,314.25 |
| Independent FSR C - Contractor A | 4 | $115,462.80 |
| Independent FSR C - Contractor B | 4 | $96,014.55 |
| **Average** | **8.2** | **$160,248.54** |

Source: Energy Solutions Project Team

Table 23: Institutional Electrical Upgrade Cost by Contractor

| Site | Total Appliances | Total Cost for Upgrade |
|---|---|---|
| Elementary School A - Contractor A | 2 | $1,677.04 |
| Elementary School A - Contractor B | 2 | $8,061.50 |
| Elementary School B - Contractor A | 5 | $7,475.24 |
| Elementary School B - Contractor B | 5 | $21,528.00 |
| Consolidated School Kitchen A - Contractor A | 8 | $120,546.71 |
| Consolidated School Kitchen A - Contractor B | 8 | $130,950.25 |
| High School A - Contractor A | 4 | $14,180.18 |
| High School A - Contractor B | 4 | $17,922.75 |
| Average | 4.8 | $40,292.71 |

Source: Energy Solutions Project Team

Table 24: High Efficiency Gas to High Efficiency Electric Costs

| Equipment | High Efficiency Gas | High Efficiency Electric | Price Difference | Percent Difference |
|---|---|---|---|---|
| Combination Oven | $15,287 | $15,203 | ($84) | -1% |
| Convection Oven | $5,759 | $5,646 | ($113) | -2% |
| Deck Oven* | $7,731 | $8,227 | $496 | 6% |
| Conveyor Oven* | $12,407 | $18,344 | $5,937 | 48% |
| Fryer | $4,496 | $5,708 | $1,212 | 27% |
| Pressure Fryer | $24,336 | $22,467 | ($1,868) | -8% |
| Rethermalizer | $11,090 | $10,234 | ($856) | -8% |

| Equipment | High Efficiency Gas | High Efficiency Electric | Price Difference | Percent Difference |
|---|---|---|---|---|
| Griddle 2' | $3,320 | $2,593 | ($727) | -22% |
| Griddle 3' | $4,980 | $3,889 | ($1,091) | -22% |
| Griddle 4' | $6,640 | $5,186 | ($1,454) | -22% |
| Griddle 5' | $8,300 | $6,482 | ($1,818) | -22% |
| Griddle 6' | $9,960 | $7,779 | ($2,181) | -22% |
| Steamer | $12,324 | $8,201 | ($4,123) | -33% |
| Salamander | $4,326 | $6,695 | $2,369 | 55% |
| Charbroiler 2' | $5,321 | $4,860 | ($461) | -9% |
| Charbroiler 3' | $3,177 | $7,290 | $4,113 | 129% |
| Conveyor Broiler | $10,404 | $11,428 | $1,024 | 10% |
| 2 Burner Range | $1,277 | $2,596 | $1,319 | 103% |
| 4 Burner Range | $2,553 | $5,192 | $2,639 | 103% |
| 6 Burner Range | $3,830 | $7,788 | $3,958 | 103% |
| 6 Burner Range w/Standard Oven | $4,968 | $13,623 | $8,654 | 174% |
| 6 Burner Range w/Conv Oven | $11,076 | $13,623 | $2,546 | 23% |
| Stock Pot | $1,182 | $6,630 | $5,448 | 461% |
| Tilting Skillet 40-gallon | $28,420 | $23,321 | ($5,099) | -18% |
| Titling Kettle 40-gallon | $42,578 | $52,714 | $10,137 | 24% |
| Titling Kettle 80-gallon | $73,468 | $75,061 | $1,593 | 2% |

Source: Energy Solutions Project Team

Table 25: QSR Demand Cost Variance

| Site | Existing Peak Demand (kW) | All Electric Peak Demand (kW) | Existing Annual Demand Cost | All-Electric Annual Demand Cost |
|---|---|---|---|---|
| National QSR A | 33 | 56 | $1,862 | $5,197 |
| National QSR B | 51 | 77 | $4,540 | $8,163 |
| National QSR C | 62 | 95 | $6,005 | $10,760 |
| National QSR D | 64 | 125 | $6,329 | $15,221 |
| National QSR E | 47 | 92 | $3,858 | $10,396 |
| National QSR F | 84 | 107 | $9,259 | $12,548 |
| National QSR G | 66 | 92 | $6,642 | $10,462 |
| Average | 58 | 92 | $5,499 | $10,392 |

Source: Energy Solutions Project Team

Table 26: FSR Demand Cost Variance

| Site | Existing Peak Demand (kW) | All Electric Peak Demand (kW) | Existing Annual Demand Cost | All-Electric Annual Demand Cost |
|---|---|---|---|---|
| Independent FSR A | 137 | 214 | $16,838 | $28,045 |
| National FSR A | 94 | 141 | $10,654 | $17,399 |
| National FSR B | 28 | 65 | $1,084 | $6,490 |
| Independent FSR B | 69 | 141 | $7,127 | $17,520 |
| Independent FSR C | 32 | 55 | $1,761 | $5,086 |
| Average | 72 | 123 | $7,493 | $14,908 |

Source: Energy Solutions Project Team

Table 27: Institutional Demand Cost Variance

| Site | Existing Peak Demand (kW) | All Electric Peak Demand (kW) | Existing Annual Demand Cost | All-Electric Annual Demand Cost |
|---|---|---|---|---|
| Elementary School A | 9 | 13 | $0 | $0 |
| Elementary School B | 29 | 57 | $1,236 | $5,404 |
| Consolidated School Kitchen | 73 | 108 | $7,673 | $12,695 |
| High School A | 53 | 67 | $4,692 | $6,713 |
| **Average** | **41** | **61** | **$3,400** | **$6,203** |

Source: Energy Solutions Project Team