# Commercial Foodservice Emissions and Costs

# ET24SWG0013

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## Acknowledgements

ICF is responsible for this project. This project, ET24SWG0013, was developed as part of the Statewide Gas Emerging Technologies Program (GET) under the auspices of SoCalGas as the Statewide Lead Program Administrator. Cristalle Mauleon conducted this technology evaluation with overall guidance and management from Steven Long. For more information on this project, contact Steven.Long@ICF.com.

## Disclaimer

# Abbreviations and Acronyms

| Abbreviation | Meaning |
|---|---|
| ACC | Avoided Cost Calculator |
| CFS | Commercial Foodservice |
| UTD | Utilization Technology Development |

# Executive Summary

Electrification is being pushed by California legislators and energy efficiency policy makers in commercial kitchens just like it is in many other areas. However, based on the results of previous Gas Emerging Technology (GET) studies, the Study Team has found that, in general, electric technolgies reduce $CO_2$ emissions, but can be much more expensive to operate. The Study Team did a comparitive analysis of gas and electric fryer fuel costs and emissions using data available from a previous gas fryer study. The electric fryer saved 37% emissions compared to a baseline efficiency fryer which had more emissions savings than a a gas-fired "Tier 1" fryer, but it had more emmissions than a gas-fired "Tier 2" fryer. However, the electric fryer cost 38% more to operate than the baseline gas-fired fryer. This presents an opportunity for the GET program to expand this kind of CFS equipment fuel cost and emissions analysis to other pieces of equipment in a commercial kitchen to show the potential for emissions and operational cost savings from replacing existing gas-fired equipment with high-efficiency gas-fired equipment.

Additionally, the Study Team uncovered three areas for further research in the gas fryer market. The first is testing of advanced burners and burner controls in existing gas fryers with Hydrogen-blended gas. This work would extend or compliement previous work done by Utilization Technology Development (UTD). The Study Team suggests working with a couple of fryer manufacturers who have fryers that might be more efficient than the Tier 2 gas fryers. Fryer 1 utilizes a novel metal fiber burner and Fryer 2 has a shallow cooking vat with a significant decrease in oil volume over a standard fryer. Both fryers do not appear to be ENERGY STAR tested and their representatives were unaware of the incentives available for ENERGY STAR certified fryers.

# Introduction

Electrification is being pushed in commercial kitchens. In two previous studies (ET23SWG0005 Dual Fuel SF Modeling [1] and ET24SWG0005 Multifamily DHW GHG and Costs [2]) the electric equipment saved emissions compared to the gas equipment, but in some instances, it cost twice as much to run. A previous CalNEXT study (ET22SWE0010 [3]) looked at the capital costs to convert a gas kitchen to all electric, but did not look at the operating costs. Further research is needed to understand the effects of electrification in restaurants. This study addresses the operating costs gap by using electric and gas tariffs in like for like usage conditions to obtain operating costs for gas and electric fryers. This will inform future GET research studies.

# Methodology

The Study Team used hourly gas fryer data from a previous emerging technology study (ET13SCG002: Energy Star Gas Fired Fryers Field Evaluation Report) [4] to estimate the fuel costs and $CO_2$ emissions for gas and electric fryers. The first step was to investigate which utility tariffs should be used. The study focused on the territory covered by SoCal Gas (SCG) and Southern California Edison (SCE). The gas tariff that was chosen was SCG's G-10 tariff. This is because the other tariffs did not apply since they pertained to emerging technology or water pumping services. The electric tariff that was chosen was SCE's GS-2. This is because their general service demand tariff and the voltage and energy use matched a previous customer bill for a similar application.

The next step involved consolidating existing hourly fryer gas use data collected from a total of fifteen sites. This was done by averaging the fryer data across all locations to create a unified daily gas usage profile. The goal was to determine the percentage of total gas fryer usage for each hour of the day. Next, the Study Team used equations from Measure Package SWFS021 [4] and Measure Package SWFS011 [5] to determine daily electricity and gas use for the fryers. The hourly gas usage profile was applied to the daily energy consumption for the gas and electric fryers to determine hourly gas and electric energy consumption.

Lastly, the selected tariffs and hourly emissions values were applied to the hourly energy consumption profiles to determine yearly operating cost and CO2 emissions. The emissions came from the 2024 Avoided Cost Calculator (ACC) [6].

# Tariffs

The Study Team looked at commercial tariffs for SoCalGas and SCE. The SoCalGas tariffs are found in Table 1 below. The Study Team selected Tariff G-10 for the analysis in this study because it most closely matched the tariff which a restaurant would use.

**Table 1 :SoCalGas Commercial Tariffs**

| Tariff Name | Application |
|---|---|
| **SCG_GAS_G-SCHEDS_GO-ET** | Emerging technologies optional rate for core commercial and industrial |
| **SCG_GAS_G-SCHEDS_G-EN** | Core gas engine water pumping service for commercial and industrial |
| **SCG_GAS_G-SCHEDS_GO-IR** | Incremental rate for existing equipment for core commercial and industrial |
| **SCG_GAS_G-SCHEDS_G-10** | Core commercial and industrial service |

The SCE tariffs are shown in Table 2 below. The Study Team selected GS-2 for the analysis in this study because it closely matched the tariff a restaurant would use.

**Table 2: SCE Commercial Tariffs**

| Tariff Name | Application |
|---|---|
| **Schedule EDR-A** | Economic Development Rate-Attraction |
| **Schedule EDR-E** | Economic Development Rate-Expansion |
| **Schedule EDR-R** | Economic Development Rate-Retention |
| **Schedule GS-1** | General Service Non-Demand |
| **Schedule GS-2** | General Service Demand |
| **Schedule GS-APS-E** | General Service Automatic Powershift-enhanced |
| **Schedule TOU-GS-3-RTP** | GENERAL SERVICE REAL TIME PRICING |
| **SCHEDULES_TOU-GS-3** | GENERAL SERVICE Demand Metered |
| **SCHEDULES_TOU-GS-2-RTP** | General Service - Medium Real Time Pricing |
| **SCHEDULES_TOU-GS-2** | Demand Metered |
| **SCHEDULES_TOU-GS-1-RTP** | General Service Small Real Time Pricing |
| **SCHEDULES_TOU-GS-1** | General Service |
| **SCHEDULES_TOU-8-S** | Large Standby |
| **SCHEDULES_TOU-8-RTP-S** | Large Real Time Pricing - Standby |
| **SCHEDULES_TOU-8-RTP** | Large Real Time Pricing |
| **SCHEDULES_TOU-8-RBU** | Large Reliability Back-up Service |
| **SCHEDULES_TOU-8** | General Service Large |

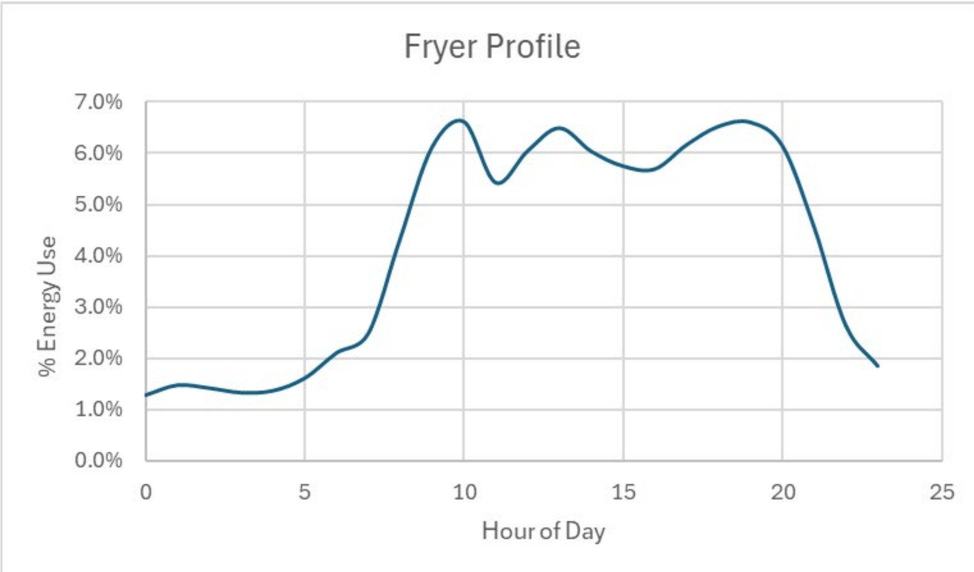
## Fryer Energy Use Profile

The Study Team had access to hourly gas fryer energy use data from a previous emerging technology study. The gas data covered a total of fifteen sites evaluated over a period of 1.5 years (April 2013 to December 2014). The Study Team combined all of the fryer data into a single file and calculated the average hourly therm consumption. The hourly therm consumption was converted into an hourly percentage consumption. Table 3, below shows the average hourly therm consumption and associated percentage consumption. Figure 1 below shows the percentage consumption for each hour of the day in a chart.

**Table 3: Hourly Gas Fryer Energy Consumption**

| Hour of Day | Average Consumption [therm] | Percentage |
|---|---|---|
| 0 | 0.0021 | 1.3% |
| 1 | 0.0024 | 1.5% |
| 2 | 0.0023 | 1.4% |
| 3 | 0.0021 | 1.3% |
| 4 | 0.0022 | 1.4% |
| 5 | 0.0026 | 1.6% |
| 6 | 0.0034 | 2.1% |
| 7 | 0.0040 | 2.5% |
| 8 | 0.0070 | 4.3% |
| 9 | 0.0099 | 6.1% |
| 10 | 0.0107 | 6.6% |
| 11 | 0.0087 | 5.4% |
| 12 | 0.0097 | 6.0% |
| 13 | 0.0105 | 6.5% |
| 14 | 0.0097 | 6.0% |
| 15 | 0.0093 | 5.7% |
| 16 | 0.0092 | 5.7% |
| 17 | 0.0099 | 6.2% |
| 18 | 0.0105 | 6.5% |
| 19 | 0.0106 | 6.6% |
| 20 | 0.0099 | 6.1% |
| 21 | 0.0073 | 4.6% |
| 22 | 0.0042 | 2.6% |
| 23 | 0.0030 | 1.8% |

**Figure 1 : Fryer Daily Energy Profile**




# Daily Fryer Energy Use

The Study Team used equations from Measure Package SWFS021 and Measure Package SWFS011 to determine daily electricity and gas use for the fryers.

## Gas Fryer Energy Use

The equations used for gas were as follows:

**Equation 1: Daily Unit Energy Consumption – Gas**

$$cookingEnergy_{Btu} + idleEnergy_{Btu} + preheatEnergy\_Btu$$

Where:

*cookingEnergy_Btu* = Cooking energy - Gas (Btu/day)
*idleEnergy_Btu* = Idle energy - Gas, (Btu/day)
*preheatEnergy_Btu* = Preheat energy - Gas, (Btu/day)

**Equation 2: Cooking Energy – Gas**

$$\frac{constCalc\_lbs\_Day \ * gasBase\_Btu\_lb}{GasBase\_Eff}$$

Where:

*constCalc__lbs_Day* = Estimated pounds of food cooked per day (lb)
*gasBase__Btu_lb* = ASTM energy to food ratio, the energy absorbed by food during cooking (Btu /lb)
*gasBase__Eff* = Heavy load cooking efficiency, baseline (%)

**Equation 3: Preheat Energy – Gas**

$$costCalc\_preheats\_Day \; * GasBase\_preheatBtu$$

Where:

*constCalc__preheats_Day* = Estimated number of preheats per day (#)
*gasBase__preheatBtu* = Preheat energy, baseline (Btu/preheat)

**Equation 4: Idle Energy – Gas**

$$GasBase\_idleBtuh \; * (ConstCalc\_ophr\_Day \; - \frac{constCalc_{lbs_{Day}}}{GasBase_{ProdCap}} - \frac{constCalc_{preheats_{Day}} * gasBase_{preheatTime}}{Cfac\_\mathrm{min}\ \_hr}))$$

Where:

gasBase__idleBtuh = Idle energy rate, baseline (Btu/hr)
constCalc__ophr_Day = Operating hours per day (hrs/day)
constCalc__lbs_Day = Pounds of food cooked per day (lbs/day)
gasBase__ProdCap = Production capacity, baseline (lbs/hr)
constCalc__preheats_Day = Estimated number of preheats per day (#)
gasBase__preheatTime = Preheat time, baseline (min/day)
CFac__min_hr = Conversion factor, 60 minutes per hour (min)

Measure Package SWFS021 assumes an inefficient gas fryer baseline while SWFS011 has values for efficient gas fryers. SWFS011 has two tiers of efficient gas fryers. The Study Team calculated the daily energy consumption for all three cases. The inputs and assumptions from the measure packages are shown below in Table 4.

**Table 4: SWFS021 & SWFS011 Inputs and Assumptions for Equations 1 to 4**

| Input | Inefficient (SWFS021) | Tier 1 (SWFS011) | Tier 2 (SWFS011) |
|---|---|---|---|
| **Preheat Time (min)** | 7.0 | 7.0 | 7.0 |
| **Preheat Energy (btu)** | 16,609 | 10,278 | 9,181 |
| **Idle Energy Rate (btu/hr)** | 12,847.32 | 7,571 | 3,957 |
| **Cooking Efficiency (%)** | 37% | 52% | 61% |
| **Production Capacity (lb/hr)** | 58 | 63 | 69 |
| **ASTM Energy to Food (Btu/lb)** | 570 | 570 | 570 |
| **Operating Hours Per Day (Hr/Day)** | 12 | 12 | 12 |
| **Operating Days/Year (Days/Yr)** | 351 | 351 | 351 |
| **Preheats per day (units)** | 1 | 1 | 1 |
| **Pounds of Food Cooked per Day (Lb/Day)** | 110 | 110 | 110 |

The daily energy consumption values for each type of fryer are in Table 5, below.

**Table 5: Gas Fryer Daily Energy Consumption**

| Gas Fryer Type | Daily Energy Consumption [btu] |
|---|---|
| **Inefficient** | 315,348 |
| **Tier 1** | 208,673 |
| **Tier 2** | 153,405 |

## Electric Fryer Energy Use

The Study team used equations from SWFS021 for the hourly electrical consumption of an electric fryer. The following equations were used:

**Equation 5: Daily Unit Energy Consumption – Electric**

$$cookingEnergy_{Btu} + idleEnergy_{Btu} + preheatEnergy\_Btu$$

Where:

*cookingEnergy_kWh* = Cooking energy – electric (kWh/day)
*idleEnergy_kWh* = Idle energy - electric (kWh/day)
*preheatEnergy_kWh* = Preheat energy - electric (kWh/day)

**Equation 6: Cooking Energy - Electric**

$$\frac{constCalc\_lbs\_Day \ * elecMeas\_kWh\_lb}{elecMeas\_Eff}$$

Where:

*constCalc__lbs_Day* = Pounds of food cooked per day (lbs)
*elecMeas__kWh_lb* = ASTM energy to food ratio, energy absorbed per lb of food during cooking (kWh/lb)
*elecMeas__Eff* = Heavy load cooking efficiency (%)

**Equation 7: Preheat Energy – Electric**

$$constCalc\_preheats\_Day \ * elecMeas\_preheatkwh$$

Where:

*constCalc__preheats_Day* = Estimated number of preheats per day (#)
*elecMeas__preheatkWh* = Preheat energy - measure case (kWh)

**Equation 8: Idle Energy – Electric**

$$elecMeas\_idlekW \ * \left(CostCalc\_ophr\_Day \ - \frac{constCalc\_lbs\_Day}{elecMeas\_ProdCap} - \frac{ConstCalc\_preheats\_Day \ * elecMeas\_preheatTime}{Cfac\_\min \ \_hr}\right)$$

Where:

*elecMeas__idlekW* = Idle energy rate, measure case (kW)
*constCalc__ophr_Day* = Estimated operating hours per day (hrs)
*constCalc__lbs_Day* = Estimated pounds of food cooked per day (lbs)
*elecMeas__ProdCap* = Production capacity, measure case (lbs/hr)
*constCalc__preheats*_Day = Estimated number of preheats per day (#)
*elecMeas__preheatTime* = Preheat time, measure case (min)
*CFac__min_hr* = Conversion factor, 60 minutes per hour (min)

The inputs and assumptions for Equations 5-8 are shown below in Table 6.

**Table 6: SWFS021 Inputs and Assumptions for Equations 5 to 8**

| *Input* | *Value* |
|---|---|
| ***Preheat Time (min)*** | *8.93* |
| ***Preheat Energy (kwh)*** | *1.56* |
| ***Idle Energy Rate (kw)*** | *0.682* |
| ***Cooking Efficiency (%)*** | *86.21%* |
| ***Production Capacity (lb/hr)*** | *62.12* |
| ***ASTM Energy to Food (kwh/lb)*** | *0.1670* |
| ***Operating Hours Per Day (Hr/Day)*** | *12* |
| ***Operating Days/Year (Days/Yr)*** | *351.44* |
| ***Preheats per day (units)*** | *1* |
| ***Pounds of Food Cooked per Day (Lb/Day)*** | *110.74* |

Note the Pounds of Food Cooked per Day for the electric fryer was the same as it was for the gas fryer. SWFS021 values are for an efficient electric fryer. The total energy use for the electric fryer was 29.88 kWh.

## Emissions

The Avoided Cost Calculator (ACC) [6] for 2024 was used to determine the $CO_2$ emissions for the gas and electric fryers. The gas emissions factor is constant at 0.00531 Metric Ton $CO_2$/therm, whereas the electric emissions factor varies hourly. The gas emissions equation was straight forward, and the study team was able to multiply the total hourly therm by the constant natural gas emissions factor. The following equation was used to calculate the gas emissions.

**Equation 9: Gas Emissions**

$$Emissions_{hrly-Gas} = Gas\ Fryer\ Therm_{hrly} * Gas\ EF_{ACC}$$

<u>Where:</u>

$Emissions_{hrly-Gas}$ is the hourly emissions from the gas fryer

$Gas\ Fryer\ Therm_{hrly}$ is the hourly therm consumption from the gas fryer

$Gas\ EF_{ACC}$ is the constant natural gas emissions factor from the ACC

The electric emissions calculation was done by multiplying each hourly kWh by the hourly electric emissions factor since it was variable. The following equation was used to calculate the electric emissions:

**Equation 10: Electric Emissions**

$$Emissions_{hrly-Elec} = Elec\ Fryer\ kWh_{hrly} * Elec\ EF_{ACC,hrly}$$

<u>Where:</u>

$Emissions_{hrly-Elec}$ is the hourly emissions from the electric fryer

$Elec\ Fryer\ kWh_{hrly}$ is the hourly kWh consumption from the electric fryer

$Elec\ EF_{ACC,hrly}$ is the hourly electric emissions factor from the ACC using all 8760 hours of data from 2024

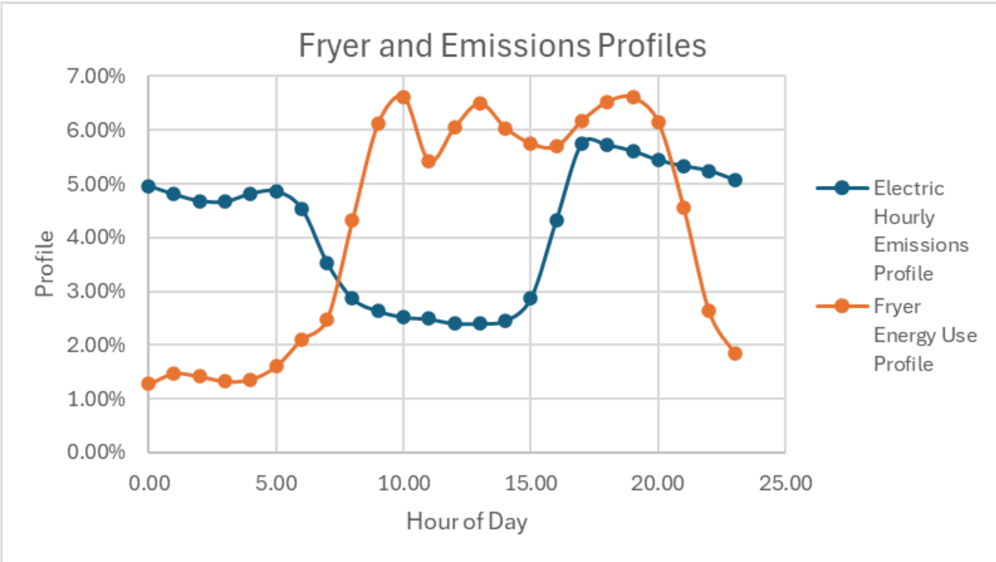
The daily energy use for each type of fryer was applied to 351 days annually. Both measure package SWFS021 and SWFS021 assume that the gas fryers operate 351 days. The emissions from each type of fryer are shown in Table 7.

**Table 7: Annual Emissions for Gas and Electric Fryers**

| Fryer Type | Emissions [Metric Tonnes $CO_2$] | Percent Difference with Respect to Inefficient Gas Fryer |
|---|---:|---:|
| **Inefficient Gas** | 5.88 | 0% |
| **Efficient Gas Tier 1** | 3.89 | -34% |
| **Efficient Gas Tier 2** | 2.86 | -51% |
| **Electric** | 3.68 | -37% |

The electric fryer saves more emissions than the Tier 1 gas fryer, but the Tier 2 gas fryer saves the most emissions overall on a sources basis. This is due to the fact that the fryer energy use is high when the emissions is at its highest between hours 16 through 21. Figure 2 shows both profiles on the same chart to illustrate this.

**Figure 2: Fryer and Emissions Profiles**




# Fuel Cost

The Study Team then calculated the fuel cost for the Gas and Electric fryers using the tariffs GN-10 for SoCalGas and GS-2 Option D for SCE.

## Gas Cost

The natural gas cost was straightforward. The charges are fixed within certain tiers of usage and a customer cost is calculated per gas meter per day. Table 8 shows the gas costs for GN-10.

**Table 8: Fixed Gas Costs**

| | Tier 1 | Tier 2 | Tier 3 |
|---|---|---|---|
| **Cost [$/therm]** | 1.55302 | 1.08768 | 0.77567 |
| **Tier** | < 250 therms | 250 to 4,167 therms | >4,167 therms |

The maximum fryer therm usage was under 250 therms for all months for all gas fryers (inefficient, efficient Tier 1, and efficient Tier 2). Therefore, the constant fuel cost of $1.55302/therm was used to calculate the gas fryer fuel cost. The per meter per day charge from G-10 is $0.004315, but this cost was ignored since a customer would already have a gas meter when replacing a gas fryer.

## Electric Costs

The electric costs have an energy and a demand component and the energy charges vary based on the season. Table 9 shows the costs from GS-2 Option D.

**Table 9: Electric Costs from GS-2 Option D**

| Charge | Summer[1] | Winter |
|---|---|---|
| Facilities related demand charge [$/kW] | 24.57 | |
| Delivery Demand Charges [$/kw] | 0 | 0 |
| Delivery Energy Charge [$/kWh] | 0.10375 | 0.05992 |
| Generation Demand Charge [$/kW] | 18.81 | |
| Generation Energy Charge [$/kWh] | 0.07757 | 0.08036 |
| Fixed Recovery Charge [$/kWh] | 0.00137 | |
| **Customer Charge $/month** | **239.34** | |
| **Total Energy Cost [$/kWh]** | **0.18269** | **0.14165** |
| **Total Demand Cost [$/kW]** | **43.38** | |

The Study Team calculated the total monthly electric use and multiplied that value by the total $/kWh cost from Table 9. The Study Team also calculated the maximum hourly kW in each month and multiplied it by the total $/kW from Table 9. The total monthly energy and demand charges were added and then the total monthly charges were summed to determine the annual energy cost. The Customer Charge [$/month] was ignored because a customer would already have an electric meter with that charge even if they replaced their gas fryer with an electric one. The monthly and annual energy costs are summarized in Table 10.

**Table 10: Electric Fuel Costs**

[1] June-September

| Month | Total Energy Use (kWh) | Max Electric Use (kW) | Demand Charges | Energy Charges | Total Charges |
|---|---|---|---|---|---|
| 1.00 | 866.48 | 1.98 | $48.57 | $122.74 | $171.31 |
| 2.00 | 806.72 | 1.98 | $48.57 | $114.27 | $162.84 |
| 3.00 | 926.23 | 1.98 | $48.57 | $131.20 | $179.77 |
| 4.00 | 866.48 | 1.98 | $48.57 | $122.74 | $171.31 |
| 5.00 | 896.35 | 1.98 | $48.57 | $126.97 | $175.54 |
| 6.00 | 866.48 | 1.98 | $85.76 | $158.30 | $244.05 |
| 7.00 | 896.35 | 1.98 | $85.76 | $163.76 | $249.51 |
| 8.00 | 926.23 | 1.98 | $85.76 | $169.21 | $254.97 |
| 9.00 | 896.35 | 1.98 | $85.76 | $163.76 | $249.51 |
| 10.00 | 866.48 | 1.98 | $48.57 | $122.74 | $171.31 |
| 11.00 | 836.60 | 1.98 | $48.57 | $118.50 | $167.08 |
| 12.00 | 836.60 | 1.98 | $48.57 | $118.50 | $167.08 |
| | | | | **Grand Total** | **$2,364.28** |

## Fuel Cost Results

The overall fuel cost results for each type of fryer are shown in Table 11.

**Table 11: Fuel Cost Summary**

| Fryer Type | Annual Operating Cost | Percent difference with respect to Inefficient Gas Fryer |
|---|---|---|
| **Inefficient Gas** | $1,718.99 | 0% |
| **Efficient Gas Tier 1** | $1,137.50 | -34% |
| **Efficient Gas Tier 2** | $836.23 | -51% |
| **Electric** | $2,364.28 | 38% |

The Tier 2 gas fryer was the least expensive to operate and the electric fryer was the most expensive to operate.

## More Efficient Fryers

This study included a brief scanning and screening activity of gas fryers that may be more efficient than the Tier 2 fryer listed in SWFS011. The scanning and screening turned up three areas that may warrant futher testing.

The first area is testing of existing fryers with hydrogen-blended gas. Utilization Technology Development (UTD) noted in their 2022-2023 Project Summary Report [8] that commercial foodservice (CFS) equipment relies on relatively simple, old, and inexpensive burner technology. As a result, burning Hydrogen-blended gas in CFS equipment can cause safety issues and food cooking issues. UTD was doing testing of severall off-the-shelf CFS appliances with advanced burner technologies and better burner controls. The final phase 1 report was released to UTD members. The Study Team recommends to obtain this report to understand which burner technologies showed promise in existing fryer equipment. Follow on lab work could be done to test the burners in a test kitchen with Hydrogen-blended gas to see how the food quality is affected with they blended gas.

While at the CFS Expo at SoCalGas in October 2024, the Study Team observed a fryer using a metal fiber burner from Company 1. The company representative touted the oil filtration system in the fryer and noted the extended oil life with the filtration and the metal fiber burner, but did not seem aware of potential energy benefits of the metal fiber burner. The fryer is not Energy Star certified, but the company representative also did not seem to be aware of potential rebates for the fryer if it was Energy Star certified. The Study Team recommends follow-up outreach to this fryer manufacturer to discuss bringing it in for lab testing to see if the metal fiber burner results in more efficiency gains than the Tier 2 gas fryer.

Also while at the CFS Expo, the Study Team observed a shallow fryer with significantly less oil volume than standard fryers. This fryer is produced by Company 2 and is called Fryer 2. The Study Team witnessed this fryer cooking food in the demonstration kitchen. With significantly less oil volume, there is also potential that this fryer can produce the same amount of food per day in SWFS011 with less preheat and idle energy than the Tier 2 fryer. The representatives of Company 2 did not seem aware of the potential energy benefits this fryer could present and then did not seem aware of the potential incentives for energy saving fryers. The Study Team also recommends reaching out to this fryer manufacturer to dicuss bringing it in for lab testing to see if the idle and preheating energy are substantially less than the Tier 2 gas fryer.

# Conclusion

The results of this study reveal critical trade-off between environmental impacts and operational costs when comparing gas and electric fryers. While electric fryers emit significantly less $CO_2$ on a source basis than an inefficient gas baseline they emit more $CO_2$ than a Tier 2 gas fryer and only marginally less than a Tier 1 gas fryer. However, they cost 38% more to operate than an inefficient gas fryer and significantly more than Tier 1 or Tier 2 gas fryers. The Study Team expected the fuel costs to be higher for the electric fryer based on previous work done. However, unlike the previous work done, this is a case where the electric technology results in more $CO_2$ emissions. In previous work, the electric technology resulted in $CO_2$ emission decreases. This is likely because the fryers are used heavily between 5PM and 9PM when the electric grid is at its highest emissions. This shows that there are clear cost and emissions advantages to sticking with Tier 2 level gas-fired equipment in commercial kitchens. Potential GET projects could expand this study to other types of equipment to showcase the energy and emissions reductions of higher efficiency gas-fired equipment, along with lower costs to operate them.

During the scanning and screening process for this project, the Study Team found two fryers for which futher lab testing is recommended. Those are Fryer 1 and Fryer 2. Additionally, the Study Team recommends that a previous UTD report be leveraged which gave details on the performance of burners in existing CFS equipment when Hydrogen-blended gas is used. The Study Team recommends continuing on with this work or providing complementary work if UTD is still performing follow-up testing.

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