Minnesota Journal of Business Law and Entrepreneurship

Volume 2025, No. 4

ISSN: 1540-3270

Energy Efficiency Comparison of Induction and LPG Cooking Systems in Hotels of Amritsar

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Abstract

This research work aims to focus on chefs' experiences and opinions regarding induction and LPG cooking systems in hotel kitchen, especially emphasising on energy efficiency. As the hotel sector is shifting from increasing concern on energy conservation, this study compares energy consumption, operation cost and cooking duration between the two methods. The study found that induction cooking systems used 44% less energy per meal compared with LPG in over 10 hotels. Chefs expressed a strong preference for induction cooking due to its faster cooking times and lower energy loss. Some cooks nevertheless preferred LPG maybe for its less expensive starting price. This means that induction systems offer a lower lifecycle cost, and thus become the most viable option for hotels aiming for optimal efficiency for the planet, since they save more energy but require higher investments up-front. This research paper offer trends hotel chefs can use when considering switching to energy efficient ones. Induction vs LPG cooking It is one of the biggest concerns of an HCM (Hotel Chain Management) when the idea of sustainability is introduced to the hotel kitchens and leads to an operational cost analysis, based on that HCM put an array of parameters to be met such as 1 Degree less of energy consumption for the same cooking time in terms of kilowatts per hour 2-3 times reduction in each cooking system by increasing the efficiency of energy if we can achieve this we can register a big mark of in terms of the lowest carbon footprint of the hotel Industry on the globe through sustainable cooking technologies. Post achieving success with such targets the next step will be to make the Hotel management truly understand the cost vs performance of the cooking methods.

Keywords – Cooking, Hotels, Chefs, LPG, Induction, Hospitality, Kitchens

Introduction

Hospitality is one of the fastest growing industries in the world, but it is also one of the largest consumers of energy and natural resources. Of the consumer sector, commercial kitchens in hotels and restaurants are among the most burdened operational units that use cooking appliances, refrigeration systems, ventilation equipment, and lighting continuously. Solar Approach When working with low temperature systems radiant heating This cooking system separates around of the total energy consumption of hotels. As a result, the improvement in efficiency of cooking technologies has remained one of the most important areas of focus for hospitality managers, policy-makers as well as researchers to minimize operating costs and lessen environmental impacts.

As global energy prices have risen, and environmental concerns have heightened in the last decades, demand for more efficient solutions in commercial food production environments has increased. In the face of increasing pressure on hotels to adopt sustainable operating practices, including carbon footprint, energy consumption and international sustainability standards. Consequently, the selection of cooking technology takes place in a strategic setting with impacts on kitchen productivity and the environmental performance of hospitality operations.

The most ubiquitous used cooking fuel across hotel kitchens for the last few decades is Liquefied Petroleum Gas (LPG). Because of these pragmatic benefits (cheap setup cost however inexpensive the gas and often free cookers

available), LPG is traditionally a very popular cooking method, primarily for its ease-of-use, assumed reliability, and accessibility. One of the reasons why it has remained acceptable mostly because chefs and kitchen staff have familiarized themselves with LPG cooking appliances hence u continues playing a key role as the leading fuel in hospitality business. While LPG-based cooking systems, by contrast, operate by burning the fuel under the open flame generating high-ambient heat loss. Due to direct inefficiency this leads to a waste of fuel, higher operational costs and more greenhouse gas emissions. Some of the steeper cons include that LPG burners generate a significant amount of heat to cook food, which raises the ambient temperatures in the kitchen spaces possibly making it uncomfortable for employees without ventilation.

In contrast, the hospitality sector is now definitely focusing on new cooking process technology that could deliver higher levels of energy efficiency and improved sustainability performance. One of these technologies, and the focus of significant intellectual interest over the last 1-3 years, is induction cooking. Induction cooking generates electromagnetic fields that heat ferromagnetic cookware directly instead of transferring heat to it indirectly, as with stovetops that heat surrounding air or a cooking surface. So low heat loss, and energy pass to directly the pot to lead cook shorten duration time with efficient energy which is better than gas stove kitchen appliance.

Induction Cooking Systems: The Benefits for a Commercial Kitchen They offer features such as accurate temperature control, fast heat-up, enhanced safety because there are no open flames and a cooler environment for staff to work in. The first is, of course, that induction technology fits right in with the worldwide shift to sustainable and eco-friendly hospitality practices as it can consume less energy and decrease carbon emissions in comparison to fossil-fuel-based cooking methods.

However, the use of this modern induction cooking technology in kitchen facilities of the hotel industry is still quite limited, especially in developing areas. This slow pace of adoption is due to several factors, one of which is the large initial investment needed for induction cooking equipment and cookware. Furthermore, there are hotel operators that will have to upgrade their wiring to accommodate high-power induction systems further driving up initial costs. Hotel managers ultimately decide to stick with traditional LPG cooking systems due to the capital costs, despite LPG being a less efficient option over a longer-term investment timeframe.

This indicates a need for real-world empirical studies comparing LPG and induction cook systems under the conditions of real commercial kitchens. This paper aims to identify the differences, advantages and disadvantages of both systems, which will facilitate hospitality managers in making better decisions on energy management and market investment of this technology based on a thorough understanding of each system.

Hence the current papetr is planned to compare LPG cooking system with induction cooking system used in hotel kitchens, keeping three performance indicators: (a) energy consumption (b) cooking time (c) operational cost in with in our scope. In one of the chapters, we not only discuss the scientific side of things, but also the practical experience and opinions of professional chefs when it comes to cooking appliances they work with daily, making operating well the equipment also making it usable among the 3 different techniques we described.

It is likely a higher sample size but also data from commercial kitchen practices with fifty professional chefs in ten hotels being examined. The analysis of their experiences and comparative performance evaluations identifies a comprehensive and research-driven evaluation of all the potential for induction cooking technology as applicable to the sector.

In conclusion, the results of this study should complement the body of knowledge regarding sustainable kitchen technology and result in insights to help hotel managers, chefs and policymakers looking to enhance energy efficiency and decrease the environmental impact of food service activities. With sustainability being the buzzword in the hospitality sector, energy-efficient cooking technologies like induction systems could prove vital to the effective management of hotel kitchens for years to come.

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Volume 2025, No. 4

ISSN: 1540-3270

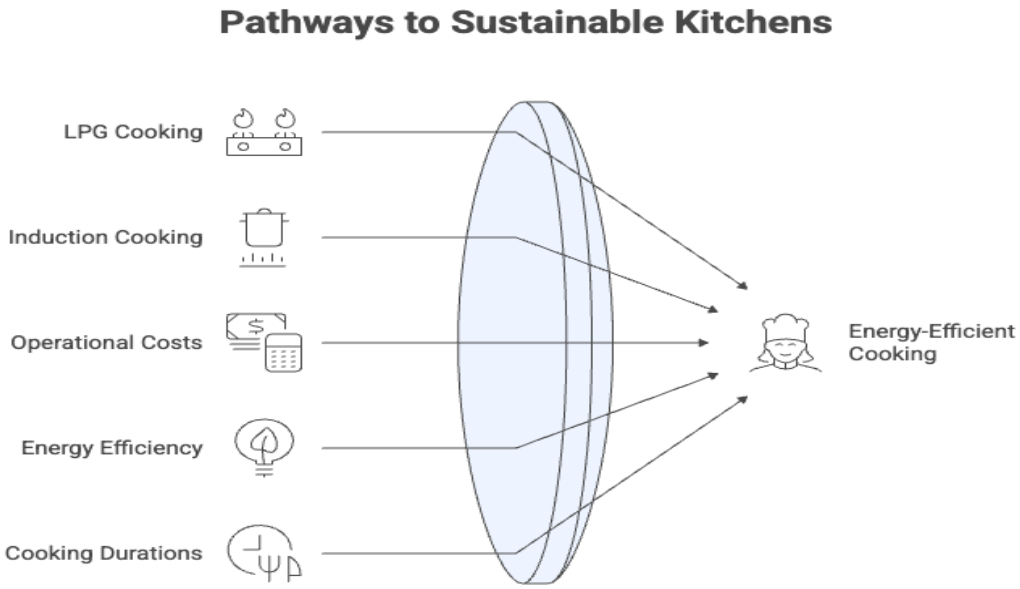

Figure -1

Literature Review

The evaluation of energy-efficient cooking appliances in commercial kitchens has become increasingly important as the hospitality industry struggles to cut costs and improve its commitment to sustainability. Research on alternative cooking methods, such as induction, which offers higher efficiency in comparison to LPG systems, has been spurred by the growing emphasis on energy conservation and environmental stewardship. Induction is currently the most popular alternative cooking method. Based on the research that have already been conducted, this part investigates the effects that induction and LPG cooking methods have on the environment, as well as their energy efficiency and operational costs.

Electromagnetic fields are utilised in the process of induction cooking in order to directly heat cookware. The elimination of heat loss that is associated with conventional cooking methods that are dependent on external heat sources is achieved through the utilisation of this method, which improves energy efficiency by feeding energy directly to the pot. According to research conducted by Thompson et al. (2019), induction cooking systems have the potential to be thirty to forty percent more efficient than both conventional electric cooking methods and LPG cooking systems simultaneously. In industrial kitchens with a large capacity, where efficiency is of the utmost importance, induction cooking shorterens the length of time needed to cook food. As a result of their lower energy consumption and the absence of combustion, induction cooktops are beneficial to the environment because they reduce the amount of carbon emissions produced. The capacity of induction cooking to reduce the amount of energy that is lost and to deliver rapid heating is extremely helpful in high-demand areas such as hotel kitchens. Nevertheless, despite these advantages, the high initial cost of induction systems continues to be a concern, particularly for hotels of a very small or medium size. It was discovered by Choi and Lee (2022) that certain companies, particularly those located in areas where LPG continues to be an affordable choice, may regard the cost of migrating to induction systems to be exorbitant.

Because of its low initial cost and the ease with which it may be employed, LPG is the fuel that is most commonly used for cooking in commercial kitchens. The combustion of gas results in the production of a flame, which has the effect of heating the cookware. Induction cooking is more efficient than LPG cooking systems because of the heat loss that occurs during combustion. However, LPG cooking systems are extremely adaptable and cost-

effective and exhibit lesser efficiency. The energy efficiency of LPG systems is around 60–70%, which is much lower than that of induction systems, which can attain efficiencies of up to 90% (Thompson et al., 2019).

Another problem is the influence that LPG systems have on the surrounding environment. Carbon dioxide (CO2), a significant contributor to global warming, is one of the many pollutants that are produced when LPG is used. Due to the fact that it does not require the burning of fossil fuels, induction cooking is an environmentally sustainable alternative for businesses who are concerned about their impact on the environment. Despite concerns about the environment, LPG is rapidly becoming a popular alternative due to the fact that it has reduced installation costs and is compatible with a wide range of cookware.

As a result of the consumption of fuel and the logistics involved in petrol delivery, LPG systems have higher long-term expenditures. In places where the cost of LPG is on the rise, hotels may discover that, despite the fact that it has a higher initial cost, induction cooking is more cost-effective in the long run owing to the fact that it consumes less energy and has lower operational costs. Multiple investigations have been conducted to determine whether or not induction and LPG cooking systems are effective in commercial conditions. A study that was carried out by Thompson et al. (2019) demonstrated that induction cooking lowered the amount of energy that was consumed by 30–40% in comparison to LPG kitchen appliances. This reduction in energy consumption can be attributed to the direct heating method of induction, which is responsible for reducing the majority of the heat loss that is connected with LPG. Induction cooking gadgets, in addition to being more energy efficient, greatly cut down on the amount of time needed to cook food. Compared to cooking with LPG, induction cooking can cut cooking times by as much as fifteen percent, which results in an increase in the efficiency of the kitchen and a reduction in the costs associated with staffing, as stated by Patel and Jadhav (2021). Additionally, Singh et al. (2020) highlighted the dependability and precision of induction cooking, which makes it an excellent choice for companies that provide high-quality culinary services.

The adoption of induction cooking is hindered by the significant initial expenditures associated with it, despite the benefits it offers. In spite of the fact that induction cooking has long-term advantages in terms of energy efficiency, Patel et al. (2021) observed that a large number of hotels, particularly smaller ones, choose LPG because of the lower initial expenses.

Research Gap

The literature reviewed above makes a fairly consistent case for induction's efficiency advantage over LPG figures in the 30–40% range show up repeatedly (Thompson et al., 2019), and the operational upsides in speed and precision are well documented (Patel & Jadhav, 2021; Singh et al., 2020). But most of this evidence comes from controlled testing or general commercial kitchen studies rather than hotel kitchens specifically, which operate under their own pressures high covers, fixed menu standards, mixed-brigade staffing, and guest-facing service timelines that a generic commercial kitchen doesn't necessarily deal with.

Research Methodology

Research Design

This study used a cross-sectional quantitative research design to determine the difference energy effectiveness of commercial hotel kitchens cooking using induction cooking systems versus Liquefied Petroleum Gas (LPG) cooking systems. This study uses a comparative approach that permits its to systematically analyse and compare how each technology's performance operates in actual kitchens.

Sectors such as hotels where both gas cooking and induction can be used in practice were also of interest in this study, and ten hotels in Amritsar where both of them were used for cooking related activities on a daily basis were selected as the study sites. In our research, we considered three key performance indicators.

- Energy consumption per meal
- Cooking time it takes to prepare your meals

- Operational cost per meal

Besides the quantitative assessment, professional chefs were asked to comment on their experience with the cooking technologies in terms of usability, efficiency, and practicality. The mixed observational and survey-based approach provides a more holistic view on the real-life operational impact of introduction of induction technology in hotel kitchens.

Data were collected over 30 non-consecutive days of kitchen observations to avoid the performance of laboratory like cooking which is contrary to the design intention of capturing routine practice.

Location of the Study and the Sample Hotels

Samples were selected from Hotels of Amritsar ranges from mid-scale to upscale hotels that have high volume of meal production in their commercial kitchens. The hotels chosen for this exercise are those that typically employ both traditional LPG-based cooking setups and other modern cooking devices that run on induction.

Hotels that fulfilled the following criteria were selected using purposive sampling:

- Same kitchen environment with Induction & LPG cooking systems
- Same type of menu and kitchen operations
- Cooperation from the hotel management
- Professional chefs who have used both cooking systems

Size and Profile of the Respondents

The target respondents of the study were chefs currently working in the assigned hotels.

Sample Details

Category	**Number**
Number of hotels	10
Total chefs surveyed	50
Average chefs per hotel	5
Average professional experience	3–12 years

The chefs included:

- Executive chefs
- Sous chefs
- Chef de parties
- Commis chefs

Having experience in using both LPG and induction cooking equipment ensured all the respondents of the study provided context specific answers that improved working conditions.

3.4 Data Collection Methods

The study adopted both primary and secondary sources of data.

3.4.1 Primary Data Collection

The three main techniques used to collect their primary data.

Direct Observation

Kitchen operations were systematically observed during breakfast, lunch, and dinner food preparation times. Observations focused on:

- Type of cooking equipment used
- Time to prepare/cook specific types of dishes
- Energy usage during cooking
- Heat loss and efficiency
- Chef interaction with equipment

The observational data provided an opportunity to observe "real world" practices in the kitchen and operational efficiencies,

Induction Cooking Systems

The energy consumption of induction cooktop was measured by connecting digital electricity meters to the equipment. The meters measured electricity consumption in units of kilowatt-hours (kWh).

Energy consumption was computed as follows:

Energy Use (kWh) = Power Rating (kW) × Cooking Time (hr)

LPG Cooking Systems

Gas flow meters were fitted to LPG based cooking systems to quantify the volume of gas used during the cooking operations. Gas use was collected in m^3 and converted into energy equivalents using usual LPG calorific values.

By this means, gas energy demand and electric energy demand could be directly compared.

Structured Questionnaire

Perceived performance of the two cooking technologies was surveyed among chefs in a structured questionnaire.

The first part of the questionnaire comprised three sections

Section A – Demographic Information

- Age
- Years of professional experience
- Position in the kitchen brigade

Section B – Operational Experience

Questions related to:

- Cooking speed
- Temperature control
- Ease of use
- Safety
- Maintenance requirements

Preference and Sustainability Awareness: Section C

Questions focused on:

- Preferred cooking system
- Perceived energy efficiency
- Environmental awareness
- Willingness to adopt induction cooking
- Likert Scale Ratings & Percentages Responses

3.5 **Experimental Cooking Tests**

More comparable data was collected through a series of controlled cooking experiments done in the kitchen of each hotel.

Selected Test Dishes

Dishes with high frequency of preparation in hotel kitchens were chosen such as;

Dish	**Cooking Technique**
Stir-fried vegetables	High heat sautéing
Grilled chicken	Protein cooking
Pasta boiling	Water heating

The steps of preparation of each dish using induction and LPG systems were conducted under similar conditions.

Controlled Variables

To maintain consistency and reliability during the testing process, the following variables were Controlled:

- Same quantity of ingredients
- Same cookware material and size
- Cooking process by same chef
- Same kitchen environment
- Same recipe and cooking procedure

This reduced the experimental bias as differences recorded in cooking technology could be attributed to the respective technology alone and not controlled variables.

3.6 Energy Efficiency Indicators

Three important indicators were used to access energy efficiency.

Energy Consumption per Dish

All comparison values have been converted to units of kilowatt-hours (kWh) for the two cooking systems.

Cooking Time

It is a minutes-based system of time spent completing cooking.

Cost per Meal

Calculated based on:

- A case for induction cooking in terms of electricity tariff rates
- Market price of LPG gas

Costing will give an idea on the economics of different cooking technology.

3.7 **Data Analysis Techniques**

Descriptive statistical methods were used to analyse the collected data.

The following techniques were used:

- Mean energy consumption calculation
- Percentage analysis of chef responses
- Induction vs LPG - A Comparison

The results were presented through:

- Comparative tables
- Percentage charts
- Performance comparison graphs

Such analytics assisted in finding patterns, difference in efficiencies and chefs preferences.

3.8 **Data Reliability and Validity**

A few measures were taken to ensure the reliability and validity of the data and these are as follows.

- Then came several rounds of tests for each dish.
- Prior to measurement, energy meters were accordingly calibrated.
- Data was captured over several days and over different shifts of cooking.
- Responses to surveys were collected anonymously so as to avoid bias.

This was done to enhance the accuracy and credibility of the research findings.

Results

In this section, we deliver the results obtained through comparative analysis induction and LPG cooking systems in Hotel kitchen. The implementing results are from measurements of energy consumption, cooking time, operating cost and chefs' preference data of ten Hotels for a thirty-day natural observational period.

The research results are highlighted through comparative tables and descriptive analysis demonstrating differences of each cooking technologies.

4.1 Energy Consumption Comparison

Energy consumption per meal for inductive systems was measured using an electricity meter and a gas flow meter (Saffire, Hightower) was used for LPG systems. Energy consumption analysis and comparison analysis between induction cooking systems and LPG system The energy efficiency results imply that the actual energy use of induction cooking systems is less than one-tenth of an equivalent gas type (LPG system directly)

Table 1: Energy Consumptions per Meal Union Energy Consumption per Meal

Cooking System	Average Energy Consumption	Equivalent Energy (kWh)	Efficiency Level
Induction Cooking	0.25 kWh	0.25 kWh	High
LPG Cooking	0.45 kWh	0.45 kWh	Moderate

Interpretation

The results show that induction cooking uses approximately 44% less energy per meal compared to LPG cooking systems. This is because induction technology transfers electromagnetic energy directly into the cookware and prevents heat loss to air surrounding the cookware.

Unlike LPG cooking, which burns directly in an open flame where only some of the heat load is transferred to the pot (with a lot going into heating surrounding air), electric cooking is more controllable.

4.2 Cooking Time Comparison

Long cooking time in Hotel kitchens = operational efficiency and probably one of the measures that can be tracked as a key performance indicator. The kitchen can function at a higher efficiency (more productive time, serving more customers in peak-hour periods) with shorter cooking times.

Table 2: Average Time Taken For Cooking Per Meal

Cooking System	Average Cooking Time (Minutes)
Induction Cooking	10 minutes
LPG Cooking	12 minutes

Interpretation

It also shows that the study results concluded induction cooking systems save time in a shorter period, while LPG cooking system consumes the long time. For instance, induction is up to ~16–20% faster in terms of food prep time compared to other cooking methods which also lead to greater overall efficiency in commercial kitchens. Many advancements in induction cooktop technology help to make this cooking time shorter. Think about it: Induction, which is not a stovetop but more of an electromagnetic generator, works impossible fast because all traditional stovetops release heat into the atmosphere or onto the surface of cookware; induction heats everything directly hyped by micro electromagnetic energy in your pan. Second, with induction systems also have the advantage of no time lag to use heat. The key is instant and precise with temperature controls by chefs may adjust the temperature during cooking directly without any wait at all. Finally, when using induction cooktops, there is minimal heat dissipation since most of energy generated directly passes into the cooking utensil. It more efficiently uses heat, also allowing for faster cooking with lower wasted energy. All of these factors tend toward increasing productivity and saving precious operating time in the kitchen, as speed and consistency are crucial for a hotel restaurant that is continually busy.

4.3 Cost per Meal Analysis

Operational cost stands out as the key driver for the adoption of cooking technologies in hotel kitchens. The average electricity tariff and LPG price prevailing at a particular time during the study period were used to estimate the cost per meal in the existing system.

Table 3 — Cost Per Meal

Cooking System	Average Cooking Time (Minutes)
Induction Cooking	10 minutes
LPG Cooking	12 minutes

Interpretation

In the context of the study, meals prepared using LPG cooking systems were marginally cheaper to prepare compared with induction systems — since LPG was cheaper than electric tariffs. As a result, the hotels using LPG for preparing daily meals witnessed some drop in their running cost initially. However, despite this short term edge in price, induction cooking systems are billions of times more energy efficient over their lifetimes. Induction utilizes electromagnetism to transfer heat directly to the cookware, minimizing energy waste and employing power efficiently in the cooking process. Induction systems are likely to be more financially viable in the long-term due to their reduced total energy consumption, very low heat losses and significantly higher cooking efficiencies than conventional LPG stoves. These elements can also translate to huge savings over time with operational expenses — especially for commercial kitchens where exciting parameters of cooking are taking place one after another, day in and day out. So while the business case for LPG continues to seem economically

attractive in the short term, due primarily from financial and energy value logic of induction cooking systems in hotels and many other hospitality settings (up to 30% savings available),

4.4 Experimental Dish Testing Results

Three cuisines, typically prepared in hotel kitchens, were tested in each of the two cooking systems to obtain a realistic comparison.

Table 4: Energy consumption and cooking time per dish

Test No.	Cooking System	Dish Name	Energy Consumption (kWh)	Cooking Time (Minutes)
1	Induction	Stir-fried Vegetables	0.26	9
2	LPG	Stir-fried Vegetables	0.47	13
3	Induction	Grilled Chicken	0.23	10
4	LPG	Grilled Chicken	0.46	12
5	Induction	Pasta Boiling	0.24	9
6	LPG	Pasta Boiling	0.45	14

Interpretation

The study builds upon the past studies suggesting that induction cooking is not only more energy efficient but also a faster cooking technology compared to LPG cooking systems as confirmed though dish-based testing. Induction cooktop had lower time and energy consumption with all the dishes tested. In stir fried vegetables for instance, induction cooktop was four minutes faster than LPG Cooktop. Similarly, an experiment on boiling water and cooking pasta showed that induction cooktops boil water and cocook the pasta about five minutes earlier than with an LPG stove. It also noted that the energy consumed is lower for all multiple dishes prepared through induction as this is generally due to shorter cooking time. The results highlight the concrete advantages of induction technology in realistic environments, where a specific type of dish is prepared at normal working conditions. Conclusion The results show that induction cooking does indeed yield quantifiable and practicable efficiencies in typical domestic use, which may give advantages to traditional LPG cook systems in commercial kitchens as a more energy efficient and time-saving alternative.

4.5 Chef Preference Analysis

They also gathered the comments from 50 chefs about what their choice for a great cooking system would be.

Chef Preference of Cooking Systems in Table 5

Respondent Type	Induction Preferred	LPG Preferred	Neutral
Chefs (n=50)	65%	25%	10%

Interpretation

Their findings of cooking system preferences indicated a strong preference for induction in regards to operational benefits experienced by chefs within the commercial kitchen environment. Chefs pointed out how these induction cooktops will fit in with our ever-increasing demand for speed, including the fact that food cooks more quickly (providing productivity gains and faster food service during lunch and dinner rushes). Induction systems also offer higher, more precise temperature control and instantly adjust the heat to changing cooking needs by different dishes. Another very strong and dominating decision making aspect whichever positively impacts on product selection is the lesser ambient heat sensing rate due to induction cooking which results in a more safe and cool

kitchen environment that was never possible with the use of LPG stoves. They are aesthetically pleasing, and they are also known to be safer; there are no open flames, gas leaks or stove heat burns, hence induction cooktop wins in safety hands down.

Yet the research also found that about a quarter of chefs still preferred LPG cooking systems. Their reliance on tradition was partly comfort: gas is the type of stove most chefs have cooked with as professionals for their whole careers. Further, the economical nature of LPG correlates to esteemed equipment and installation prices therefore mapping scenario for various facilities. However, some chefs also consider even LPG cooking appliances to be more efficient last — especially when the power goes out — for some which experience extremely unreliable power supply. This indicates that even though induction cooking is now emerging as a viable alternative because of its efficiency and safety advantages at scale, LPG systems are still preferred with such lowest values in the short run (Speed & Scale over time or first drivers found in some hotel kitchens) on average to operate most often of hotel kitchens for long-term use.

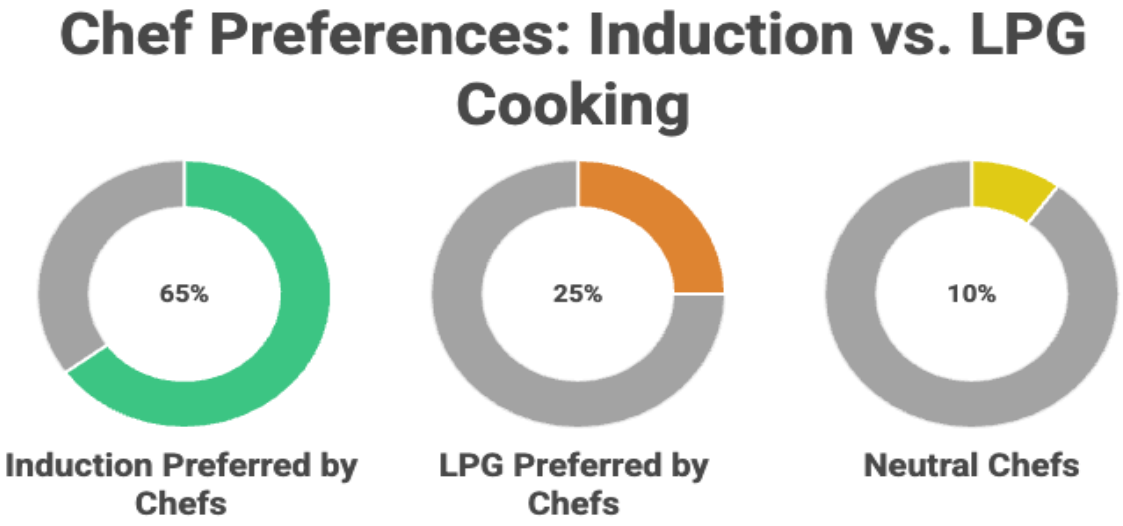

Figure -2

4.6 Heat of Kitchen and Working Environment

While conducting the study, it was observed that induction cooking systems produce low ambient heat in their surroundings, in kitchens when compared with LPG cooking systems.

Kitchen Heat and Comfort Levels.table6

Cooking System	Heat Generation	Kitchen Comfort
Induction	Low	High
LPG	High	Moderate

Interpretation

Since induction cooking solely heats the pots and pans without heating up the air surrounding them, it aids in removing some of the heat from the kitchen. Indeed, it enhances chefs' working wellbeing and cuts down the extra ventilation or cooling systems.

Minnesota Journal of Business Law and Entrepreneurship

Volume 2025, No. 4

ISSN: 1540-3270

4.7 Overall Efficiency Comparison

Table 7: Overall Performance Comparison

Performance Indicator	Induction Cooking	LPG Cooking
Energy Efficiency	High	Moderate
Cooking Time	Faster	Slower
Operational Cost	Moderate	Low
Kitchen Heat	Low	High
Chef Preference	High	Moderate
Initial Investment	High	Low

Interpretation

When we sum up the overall comparison, induction cooking systems offer better operational efficiency, particularly with regards of energy saving, cooking speed as well as working environment.

Nevertheless, due to the lower investment costs, the attractiveness of LPG systems remains, and hence many hotels depend on them despite their inefficient nature.

Discussion

User perception, energy efficiency, cooking time and operational cost, are assessed and broad comparison between induction and LPG cooking system in hotel kitchen is presented in this study. These results confirm the energy and operational superiority of induction cooking systems over traditional LPG cooking methods.

The study's most important result is that induction cooking systems can, in general, reduce energy consumption substantially. Induction cooking systems showed about 44% lower energy per meal than the LPG cooking systems, the results showed. The efficiency gains fly mostly due to the manner through which induction technology works — it conducts electromagnetic energy directly to a cooking vessel. Whereas LPG systems are combustion based and, therefore, a significant part of thermal energy is lost to the environment, induction cooking minimizes heat lost to the environment and aim to maximize energy usage.

The present results are in line with other commercial kitchen energy management studies that have reported energy efficiency of induction cooking systems to the range of 85–90% and that of LPG systems at 60–70% efficiency. Due to the high efficiency of induction systems, they offer great advantages to high–volume hotel kitchens due to low energy consumption being the primary component of the operating expenditure.

Lastly, the study points to the difference in preparation time between the two systems. Induction cooking was found to decrease average cooking time by about 16–20% as compared to LPG based cooking thereby helping in faster cuisines. Induction cooktops have the advantage of heating up rapidly and enable chefs to get to the desired cooking temperature in almost no time, thus aiding kitchen productivity immensely. Such improvements enable faster service delivery and enhance customer satisfaction in the hospitality industry, specifically in busy hotel environment where it is imperative that large number of food need to be prepared in a short time period.

The study also looked into working environments in hotel kitchens, on top of assessing energy efficiency and how fast a restaurant can cook. Induction cooking systems were observed to produce significantly lower amounts of ambient heat, compared to LPG cooking systems. The kitchen stays much cooler as induction technology only heats the cookware, not the air around it. Reduced ambient heat can add to chef comfort, decrease fatigue, and optimize overall workplace safety. Moreover, a cooler kitchen area may also reduce the reliance on elaborate exhaust and air-conditioning systems which may lead to further energy savings on the part of the hotel.

However, there are few reasons why induction cooking systems are not widely adopted in hotel kitchens. Induction equipment costs significantly more to purchase and install than LPG systems. High upfront cost of this technology

is significant barrier to adoption of induction technology for many small and medium hotels operating under constrained capital budgets. However, the cost of installing LPG systems is pretty cheap, and they are available on a massive scale, thus perfect for hotels that have a lower budget.

Interestingly, the survey of chefs also uncovered user preference and industry familiarity insights. Even though most (65%) of the chefs mentioned that induction cooking systems save a lot of time, are easier to use, are more efficient, and more precise in temperature control and the remaining 25% preferred LPG systems. This preference for LPG was largely driven by chefs' familiarity with flame cooking methods coupled with the belief that LPG allowed for greater control for some traditional cooking styles. This indicates that there may be a need for training and skill development programming for the transition of LPG to induction cooking technologies in professional kitchens.

The other important reason for the continued use of LPG systems is due to the availability and reliability of electricity supply. In certain areas where there are worries about disruptions in power supply or high cost of electricity, hotels may be deterred from making a complete switch to induction cooking systems. As a result of this, and if they want to invest long-term, hotels have to assess local energy infrastructure and the price of electricity prior to going for induction cooking.

The findings from this study indicates very high benefits of implementing induction cooking technologies in the hospitality industry for sustainability credentials. On the other hand, LPG burning (used in the other cooking methods such as gas based cookers) generates carbon dioxide and leads to environmental pollution while induction cooking does not have direct fuel burning. Induction cooking still potentially uses fossil fuels to generate electricity in some places, but its overall environmental impact tends to be lower than that of LPG systems — particularly when the electricity comes from renewable energy sources.

The research also put forward the economic benefits of energy-efficient cooking technologies able to last for a long time. LPG systems will seem cheaper at first glance because the equipment is less expensive but the energy savings of an induction system can make up for it in the long run. In terms of the key benefits of induction in the long-term, hotels with large kitchens or with high-volume food service will reap the most cost-effective incentives from this technology.

Ultimately, the study findings indicate that induction cooking provides an upgraded and more sustainability-oriented technology than traditional LPG cooking systems used by the hotel sector. But this move to kitchens based on induction will not echo without careful planning over capital expenditure, supporting infrastructure and trained per kitchen staff. Further studies could focus on the long-term cost-benefit analysis and lifecycle environmental impacts, as well as the progress and development of induction cooking technology to facilitate widespread adoption in the hospitality sector.

Conclusion

This study provides a detailed comparative evaluation of an induction and LPG cooking systems in hotel kitchens based on the key parameters of the energy efficiency, cooking time, operating cost and sustainable environment. The results are unequivocal as they show that induction cooking technology offers definite benefits necessary over traditional LPG systems, especially in energy use efficiency and kitchen output.

Among the different conclusions that could be drawn from the study, it is worthy to mention the decrease in cooking time and energy consumption because of the use of induction cooking systems. Experimental result shows that average between cooking time on induction is reduced by about 44% as compared to an average between cooking over LPG-based cooking methods. The main reason for this enhancement is that in induction systems, heat losses are reduced thanks to the electromagnetic energy being directly transferred to the cookware, resulting in quicker heat generation. Consequently, hotel kitchens leveraging induction technology can realize greater operational efficiency, faster food prep, and better workflow-management.

Besides shortened cooking time, the study also emphasizes induction cooking advantages where energy efficiency is concerned. LPG has a limited amount of heat transfer capability due to the combustion method that many

systems employ, which causes high energy loss to the ambient. On the other hand, the induction cooking makes use of conduction to directly transfer the heat to the cooking vessel thus reducing the energy utilization to a greater extent and wastage to the least. Induction technology is also a more energy-efficient method for commercial kitchen operations, as the increase in efficiency leads to a reduction in the amount of energy consumed for each cooking cycle.

Now induction cooking systems are more economical at the end. For large hotels with a lot of kitchen workload and constant food production, induction may save energy and space costs overall. Lower power usage means lower utility bills in the long run — something that could compensate a lot for the higher upfront cost of induction appliances. Also, cutting down time taken for cooking is crucial in improving kitchen productivity and improving manpower productivity which ultimately means the chefs could be taking more number of orders within same timeframe.

Additional aspects considered by this study include the environmental effects of cooking systems. LPG is a hydrocarbon fossil fuel, the burning of which releases carbon and pollutes the environment. As the hospitality industry makes the shift towards more sustainable and eco-friendly ways — one of which has yet to be achieved is reducing dependence on fossil fuels. This conforms with the sustainability goals — induction cooking reduces energy wastage and keeps the kitchen environment cleaner (it does not use open flames, & combustion-based emissions).

According to the study, chefs and cooking staff preferred adoption of induction cooking once they had adjusted to it. With very fine ability to control temperature, induction systems are especially appealing for many modern commercial kitchens also cooks food more rapidly than most other methods of cooking and keep the kitchen cooler. This is indicative of how simple it can be for chefs to adapt and even embrace induction cooking technology with a little bit of practice.

Hence, we might as well claim that in the light of these findingsInduction cooking systems are sustainable, efficient and future-oriented option for the hotel kitchens. Although in some cases the initial overall cost of LPG systems and their current widespread use inhibits the uptake of induction cooking, in fact, the long-term benefits related to energy savings, operational efficiency and environmental sustainability associated with induction cooking dismiss using these sources as an alternative for a large-scale hospitality operation.

Therefore, while determining what cooking technologies hotel management and decision-makers should build, not only the monetary restrictions for short term operations are analyzed but also positive implications on long-term operation. Investing in induction cooking infrastructure may seem an extravagant price to pay, but the economic and ecological externalities can dwarf upfront costs even over a relatively short period of time.

This research will also offer multiple directions for future research in the same area. Studies going forward must incorporate a lifecycle total cost-of-ownership perspective on cooking systems, in terms of how operations and maintenance costs, equipment lifetime as well as the price of electricity and productivity shifts in commercial kitchens may counterbalance up front kit prices. Future experts can also by engineering induction equipment at lower costs, increasing energy efficiency in commercial-grade induction/carbon-based devices, and train chefs and kitchen staff to shun conventional cooking systems.

In a nutshell, induction cooking systems has the potential to be the futuristic commercial hotel kitchen that will become necessary for greater energy efficiency, sustainability & technology advancements as both hospitality industry and hotels themselves advance in time. This can be done through an arrangement in the form of stimulation via policy, subsidy, and training for the adoption of this technology that would subsequently bring leverage to significantly increase hospitality industry scale from all economic, environmental, and operational performances.

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