

6. LPG Vs Cooktop - Science & Technology

The disruption of global LPG supply chains due to West Asian conflicts has accelerated India's shift toward Induction Cooking. As a modern, electricity-driven alternative, induction technology offers a resilient solution to the rising costs and unpredictable availability of fossil fuels.

1. Background and Definitions

What is an Induction Cooktop?

An induction cooktop is an advanced kitchen appliance that uses electromagnetic induction to heat a cooking vessel directly. Unlike traditional gas stoves or electric heaters that use thermal conduction (transferring heat from a flame or a hot coil), induction makes the pot itself the heat source.

Key Scientific Principles

Faraday's Law of Induction- States that a changing magnetic field induces an electromotive force (EMF) in a conductor.

Eddy Currents- These are circular loops of electric current induced within a conductor when exposed to a changing magnetic field.

Joule's Law of Heating- The heat produced in a conductor is proportional to the square of the current (I^2), the resistance (R), and the time (t), expressed as $H = I^2Rt$.

2. The Physics of How it Works

The operation of an induction cooktop is a seamless application of classical electromagnetism-

Generation of Magnetic Field- Beneath the ceramic/glass surface lies a copper coil. When an alternating current (AC) flows through this coil, it creates a rapidly oscillating magnetic field.

Induction in the Vessel- When a ferromagnetic (magnetic-based) utensil is placed on the surface, the magnetic field penetrates the metal.

Creation of Eddy Currents- The changing field induces swirling "eddy currents" within the base of the utensil.

Direct Heating- Because the metal base offers resistance to these currents, the energy is converted into heat (Joule heating). The heat is generated inside the pan, not on the cooktop surface.

3. Comparative Analysis- Induction vs. Conventional LPG

The following table differentiates between the two dominant cooking technologies in Indian households-

Parameter	Induction Cooktop	Conventional Gas Stove (LPG)
Working Principle	Electromagnetic induction (Eddy currents).	Combustion of LPG (Chemical to Thermal).
Energy Efficiency	High (85–90%); minimal heat loss.	Moderate (40–50%); heat lost to air.
Cooking Speed	30–50% faster than gas.	Relatively slower.
Safety	No open flame; surface stays cool.	Open flame; risk of gas leaks/fire.
Environmental Impact	Zero on-site emissions; cleaner.	Emits CO ₂ and combustion by-products.
Initial Cost	Higher (device + magnetic cookware).	Lower initial setup cost.
Operating Cost	Lower long-term (high efficiency).	Rising due to global LPG volatility.
Utensil Compatibility	Only Ferromagnetic (Iron/Steel).	All types (Aluminium, Clay, Copper).
Maintenance	Complex electronics; higher repair cost.	Simple mechanical parts; easy to service.

4. Advantages of Induction Cooking

Superior Efficiency- Because the vessel is heated directly, there is no "spillover" heat. In a tropical climate like India, this also keeps the kitchen significantly cooler compared to a gas flame.

Localized Heating- A gas flame loses massive energy to the ambient air. Induction targets the energy exactly at the base of the pot, ensuring maximum thermal utilization.

Enhanced Safety- Since the cooktop surface does not get hot (it only picks up some residual heat from the pot), the risk of accidental skin burns or kitchen fires is drastically reduced.

Precision Control- Modern induction units allow for instant temperature adjustments, providing a level of control similar to (or better than) gas, which is essential for delicate cooking tasks.

Sustainability- It reduces the "carbon footprint" of a household, especially when the electricity is sourced from solar or wind energy.

5. Limitations and Implementation Challenges

Despite its benefits, induction cooking faces specific hurdles in the Indian socio-economic landscape-

The "Magnetic" Requirement- Induction requires cookware made of iron or stainless steel. Non-magnetic materials like traditional aluminium (widely used in India) or copper are incompatible unless they have a specialized "induction base."

Electricity Dependence- In many parts of India, frequent power cuts and voltage fluctuations can make induction unreliable as a *sole* cooking source.

Durability and Repair- Unlike the robust, decades-long lifespan of a brass-burner gas stove, induction cooktops have electronic motherboards that are sensitive to moisture and hard to repair in rural areas.

Cultural Fit- Certain traditional Indian cooking styles, such as roasting *rotis* directly on a flame (Phulka) or using round-bottomed kadhais, are difficult on the flat surface of an induction cooktop.

6. Way Forward

As India moves toward its Viksit Bharat 2047 goals, the integration of induction cooking is vital for energy independence.

Hybrid Kitchens- Encouraging households to maintain a "hybrid" setup (one gas burner and one induction) to balance cost and reliability.

Standardizing Cookware- Promoting the manufacture of "induction-ready" affordable aluminium cookware to ease the transition for low-income families.

Solar-Induction Links- Integrating induction cooktops with rooftop solar schemes (like PM-Surya Ghar) to make cooking essentially free of fuel costs.

7. Conclusion

Induction technology represents a shift from combustion-based living to electricity-based efficiency. While the initial setup cost and electricity reliability remain challenges, its superior speed, safety, and 90% efficiency make it a highly resilient alternative to the volatile global LPG market.

Source- <https://sciative.com/research-articles/when-lpg-ran-dry-the-story-behind-indias-induction-stove-price-surge>