

India's Clean Cooking Shift

Scaling non-fossil fuel solutions

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Summary

India has made significant progress in expanding clean cooking by subsidizing liquefied petroleum gas (LPG). However, LPG is often unavailable or unaffordable for the poorest households, particularly in rural areas, leaving them reliant on biomass and exposed to air pollution and the burden of collecting fuel. LPG also has high and volatile fiscal impacts and risks locking India into an import- and fossil-dependent pathway. This study supports a shift to non-fossil clean cooking in India by proposing a twin strategy: scale biogas for rural areas and electric cooking (“e-cooking”) for urban and peri-urban households. The aim is to improve access to clean cooking in ways that support women while reducing fiscal burdens and energy security risks.

The analysis draws on fieldwork in Punjab, Rajasthan, and Uttarakhand (biogas) and in Bengaluru and Delhi (e-cooking), including household surveys and focus group discussions with users of LPG, biogas, and e-cooking technologies. The study also conducted a life-cycle cost analysis to compare upfront and recurring costs across fuel types.

Biogas was found to be cheaper than LPG on a lifetime basis for most rural households in India and works well when local maintenance services are available. At current prices, e-cooking is already cheaper than LPG or piped natural gas based on operating cost for most urban households. We also find that a strong policy push for urban e-cooking could halve household LPG demand by 2050 and deliver more than INR 2 trillion (USD 24 billion) in cumulative LPG subsidy savings, reducing imports and saving foreign exchange. Together, these pathways can cut fossil fuel imports, lower fiscal burdens, and improve sustainability. These insights can inform larger-scale testing and the design of comprehensive state-level clean cooking roadmaps.¹

¹ This brief is a condensed version of *India's Clean Cooking Shift: Scaling Non-Fossil Fuel Solutions*: <https://www.iisd.org/publications/report/india-clean-cooking>



Introduction

Globally, over 2 billion people rely on polluting fuels such as firewood, dung cakes, and crop residues to meet their cooking energy needs. These traditional fuels are affordable and often easily available in rural areas, but have severe health and environmental consequences, disproportionately affecting women as the main cooks. Transitioning to clean cooking alternatives is essential to addressing these impacts.

India has made significant progress in expanding clean cooking energy access, through flagship initiatives such as Pradhan Mantri Ujjwala Yojana and the development of extensive city gas pipeline networks. These efforts have provided millions of households with access to clean, convenient, reliable, and efficient cooking fuels—primarily liquefied petroleum gas (LPG) and, increasingly in urban areas, piped natural gas (PNG). However, many households, particularly low-income and rural ones, continue to rely substantially on solid fuels alongside LPG/PNG, primarily due to affordability constraints and uneven quality of last-mile service delivery across geographies. Further, both LPG and PNG have high and volatile fiscal impacts, and lock India into an import-dependent fossil fuel pathway that runs counter to its net-zero ambitions.

The Indian government has ramped up the use of biogas and electric cooking (e-cooking) as sustainable clean cooking alternatives. However, adoption rates have been slow, which can be attributed to a combination of technical, operational, institutional, and social factors. A significant gap in understanding household perspectives on these non-fossil alternatives hampers the development of effective policies tailored to the experiences of end-users. This study attempts to fill this gap by identifying actionable steps for policy-makers that can progressively expand non-fossil clean cooking solutions while continuing to protect household welfare and building resilience in India's clean cooking strategy over time.

Box 1. Biogas and e-cooking as alternative clean cooking strategies

Biogas, produced from organic waste such as agricultural residues, animal manure, food waste, and even municipal solid waste, is an important non-fossil clean cooking alternative, especially for rural India. Beyond providing a renewable source of household energy, biogas production also yields bio-slurry, a nutrient-rich by-product that can be used as organic fertilizer, thereby reducing dependence on chemical fertilizers and improving soil health.

E-cooking uses devices such as induction stoves, infrared-based induction, electric rice cookers, and electric pressure cookers. E-cooking is projected to meet approximately three quarters of overall cooking energy needs by 2050 in emerging markets and developing economies (International Energy Agency, 2023).

The study assesses **biogas** use in the states of Punjab, Rajasthan, and Uttarakhand and isolates potentially replicable success factors. Interviews captured insights into the benefits and challenges of using biogas. A life-cycle cost analysis compares the cost of biogas use with the cost of using LPG cylinders across different user categories.



Interviews with urban households on **e-cooking** (in Bengaluru and Delhi) and with rural households on biogas (in Punjab, Rajasthan, and Uttarakhand) explored experiences, perceptions, barriers, and enablers to adoption. The study also estimates potential savings in future LPG subsidies if urban households shift to e-cooking.

Key Results

Biogas Findings

Our life-cycle cost analysis estimates the payback period: the time required for household level biogas-based cooking unit to recover its upfront cost through avoided LPG expenditure. A household-scale subsidized biogas plant with an assumed 15-year lifespan emerges as a more economical option at current LPG prices over their operational lifetime. From a fiscal perspective, supporting biogas would also imply a one-time subsidy outlay per household, unlike LPG subsidies, which require a recurring expenditure with every refill.

Other key findings include:

User satisfaction with biogas for cooking is high. Users reported that biogas was as efficient as LPG, with nearly identical cooking time.

Robust decentralized operation and maintenance (O&M) support enables sustained usage. When appropriately used and maintained, small household-level biogas plants demonstrate satisfactory longevity, challenging prevalent perceptions regarding their efficacy within sustainable energy frameworks.

Prefabricated biogas models have advantages over civil construction-based models. Manufactured off-site, they need only one to two days for installation. They are also more compact and require less maintenance, compared to civil construction-based biogas models. They may also be better suited in regions with alpine climatic conditions, being less prone to decreased efficiency during winter and leakage issues caused by heavy rains.

There was a sustained reduction in firewood usage, with users reporting a preference for biogas primarily based on cost. Households reported that, after shifting to biogas, their firewood consumption had reduced by 70%.

Challenges associated with switching to biogas included

- the high upfront costs of biogas plants,
- reduced productivity of biogas during the winter,
- larger biogas plant sizes needed for bigger families,
- land availability,
- limited manufacturing of prefabricated biogas plants within India, and
- limited numbers of biogas training centres contributing to limited installers and O&M technicians.



Policy and technology approaches can overcome these challenges.

1. Increase subsidies for biogas plants to make biogas more affordable, particularly for low-income households. Start by reallocating a small portion of existing LPG subsidies to biogas, which would also reduce recurring expenditures on LPG subsidies as households transition to biogas. Disbursing subsidies at an earlier stage, such as during planning or installation, would reduce the effective upfront costs and encourage adoption.
2. Stakeholders' collaboration is needed to scale up biogas, including the national and state governments, businesses with corporate social responsibility policies, and local-level institutions such as self-help groups. Linking biogas projects to carbon credit mechanisms can enable long-term carbon revenues (to the manufacturers), which could further significantly reduce upfront costs. Self-help groups can also play a pivotal role in addressing financing challenges.
3. Encourage users to adopt best practices to meet winter challenges, such as mixing warm water with dung, keeping feedstock fresh and well mixed, and insulating with locally available materials to help microbes stay active and optimize biogas production.
4. Promote the manufacturing of larger prefabricated plants and conduct awareness and training campaigns with diverse partners to highlight the benefits of biogas. Expand and diversify training centres to build local capacity for installation and O&M.
5. Adopt a sequenced rollout that prioritizes villages with feedstock and water, strong community networks, and nearby anchor institutions, then expand outward as O&M capacity and parts supply stabilize.

E-cooking Findings

A cost comparison between LPG, PNG, and e-cooking indicates that e-cooking would already be cheaper for most Indian households in terms of operational expenditure (Figure 1).²

However, e-cooking also faces challenges in its scale-up:

1. **Upfront costs are high.** Induction stoves (particularly, the double plated ones, which are better suited for primary use) are often prohibitively expensive for many households, discouraging widespread adoption, even in urban areas.
2. **Power supply challenges hinder adoption.** In rural areas in particular, an unreliable and poor-quality electricity supply remains a major barrier.
3. **E-cooking devices can be less versatile** than traditional LPG stoves, particularly for certain items (e.g., *chapati*, *baingan ka bharta*), which require flame-based techniques.
4. **O&M services can be inadequate.** In Bengaluru, two out of three households reported discarding malfunctioning devices owing to a lack of repair options.

² We use assumptions from Agrawal et al. (2021) for this analysis. As per this study, a typical Indian household (with four to five family members) relying exclusively on LPG would consume eight LPG refills (of 14.2 kg each) in a year. For PNG, this figure is 137.2 standard cubic metre (SCM) per year, and for e-cooking, it is 974 kWh per year. For more details on their methodology, refer to the original report.

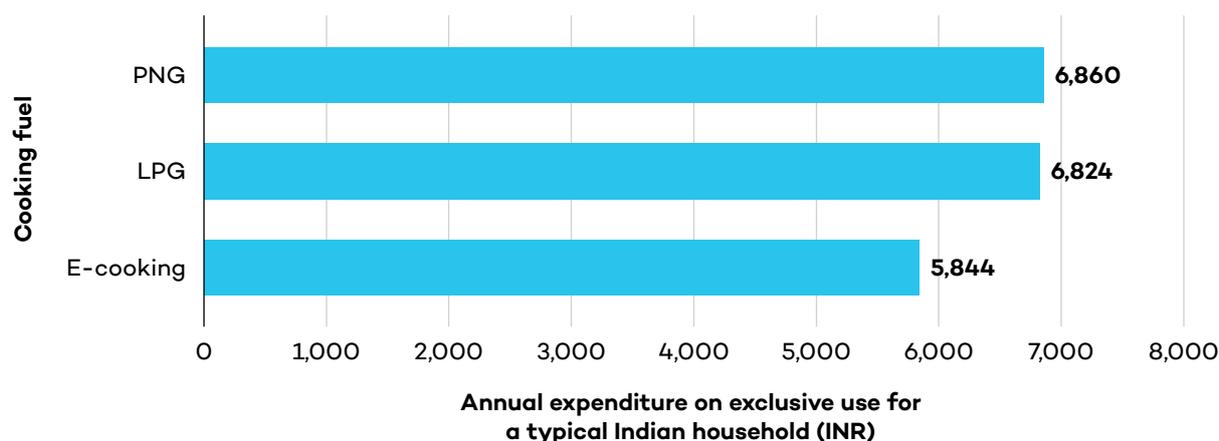


5. **Access to subsidized electricity is limited for low-income urban households.** Low-income urban households are often excluded owing to a lack of formal connections.
6. **Skepticism toward e-cooking persists.** Many households are reluctant to adopt e-cooking owing to concerns about rising electricity costs and proper connections.

These challenges can be overcome using policy interventions:

- Redirect a small share of LPG subsidies for urban households to provide targeted electricity subsidies to cover the operational costs of e-cooking and incentivize its sustained use.
- Invest in research and development to design cheaper and more efficient double-plated electric cookstoves that are also compatible with existing utensils used on LPG stoves.
- Establish decentralized after-sales service centres for e-cooking devices, with different manufacturers collaborating to share costs and resources. Train local technicians to provide repair and maintenance services (even post-warranty expiration) to reduce the likelihood of devices being discarded after a malfunction.

Figure 1. Using e-cooking would be at least 15% cheaper than PNG/LPG



Note: For Figure 1, we only consider the operational cost of using each of these three cooking fuels. While the price of LPG is considered to be INR 853 per 14.2 kg refill (8 such refills would be consumed by a typical Indian household in a year), the price of PNG is assumed to be INR 50 per SCM (assuming an annual consumption of 137.2 SCM for a typical Indian household). The electricity tariff is assumed to be INR 6 per kWh (assuming an annual consumption of 974 kWh in a year for a typical Indian household). These reflect market prices paid by consumers (all of them subsidized) for these cooking fuels in New Delhi, India.

Source: Authors' diagram.



Conclusions

Biogas and e-cooking are viable alternatives to fossil fuel-based cooking solutions, with significant savings possible for both the government and households. Each solution has unique advantages and challenges that require tailored policy interventions.

Biogas presents a decentralized and sustainable solution for rural India, leveraging locally available organic waste to provide clean cooking energy while addressing waste management challenges. Successful models in Punjab, Rajasthan, and Uttarakhand demonstrate that, with improved financial support and robust O&M support, biogas can significantly reduce firewood usage and provide a cost-effective alternative to LPG.

E-cooking, particularly in urban areas, offers a promising pathway over the long term, especially as India's power grid integrates more renewable energy into the system. Recent electricity distribution reforms are increasing the feasibility of e-cooking in urban and peri-urban areas. Urban adoption can serve as a testing ground for refinement, driving economies of scale and making e-cooking more accessible for rural households in the future as grid services improve.

The government's role in facilitating the transition will be pivotal. This will entail rebalancing a portion of recurring LPG subsidy outlay, leveraging corporate social responsibility funds for public-facing pilots, and building local awareness and skills.

References

- Agrawal, S., Mani, S., Ganesan, K., & Jain, A. (2021, October). *Are Indian homes ready for electric cooking? Insights from the India Residential Energy Survey (IRES) 2020*. <https://www.ceew.in/sites/default/files/ceew-study-on-clean-electric-cooking-transition-in-indian-homes.pdf>
- International Energy Agency. (2023). *A vision for clean cooking access for all*. World Energy Outlook Special Report. <https://iea.blob.core.windows.net/assets/f63ebbc-a3df-4542-b2fb-364dd66a2199/AVisionforCleanCookingAccessforAll.pdf>

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