



CLEAN COOKING TRANSITION FOR INDIA

A SHORT DISCUSSION PAPER



SED FUND



VASUDHA
FOUNDATION
Green ways for a good earth!



Authors

Vrinda Gupta, Bikash Sahu

Reviewers

Srinivas Krishnaswamy, Jaideep Saraswat

Editorial

Swati Bansal

Design

Santosh Kumar Singh

About SED Fund

The SED Fund stands for Sustainability, Equity and Diversity. Our model supports new and innovative programmes that take a solutions-oriented approach towards just transition and climate action by aligning with the Sustainable Development Goals. We do this through a venture philanthropy model, providing seed and scale up funding to organisations or programmes across their life cycle and continuing to support them in their growth and scale-up journey.

About Vasudha Foundation

Vasudha Foundation is a non-profit organisation set up in 2010. We believe in the conservation of Vasudha, which in Sanskrit means the Earth, the giver of wealth, with the objective of promoting sustainable consumption of its bounties. Our mission is to promote environment-friendly, socially just and sustainable models of energy by focusing on renewable energy and energy-efficient technologies as well as sustainable lifestyle solutions. Through an innovative approach and data-driven analysis, creation of data repositories with cross-sectoral analysis, along with outreach to ensure resource conservation, we aim to help create a sustainable and inclusive future for India and Mother Earth.

Disclaimer

The report's conclusions and recommendations are based on the interpretation of the data and information gathered by Vasudha Foundation, and they should not be considered as absolute or definitive. Individual circumstances and local factors may influence the applicability and effectiveness of the cooking technologies discussed. Readers are advised to consult with relevant experts, professionals, and local authorities to obtain the most up-to-date and accurate information before making any decisions or taking actions based on the content of this report. Vasudha Foundation shall not be held liable for any consequences or damages arising from the use of this report or reliance on its contents.

Copyright

© 2023, **Vasudha Foundation**

CISRS House, 14 Jangpura B, Mathura Road, New Delhi - 110014

For more information, visit www.vasudha-foundation.org

CONTENTS

1	Introduction	5
1.1	India's Cooking Journey so far	5
1.2	LPG Penetration in India	6
1.3	Need for Electric Cooking in India	6
2	Regulatory & Policy Landscape of Cooking in India	8
2.1	Clean Cooking Policy Initiatives at the Sub-National Level	8
2.2	Other Notable Developments	9
3	The Technology Landscape of Cooking in India	13
4	UP Cooking Situation	14
4.1	Cooking Related Fuel Transitions	14
4.2	Income Characteristics	16
5	Key Recommendations	17

LIST OF FIGURES

Figure 1	Share of cooking fuels usage across households in India	5
Figure 2	Usage of LPG in India	6
Figure 3	Abatement cost, € per ton of CO ₂ equivalent	7
Figure 4	Major clean cooking initiatives in India by the Union Government	8
Figure 5	Average power supply monitoring statistics	12
Figure 6	Installed and pipeline capacity of electricity generation in India	12
Figure 7	Comparison of different cooking technologies available in India	13
Figure 8	States exceeding the national average of biomass consumption for cooking	14
Figure 9	LPG consumption in Uttar Pradesh	15
Figure 10	Share of cooking fuel expense for rural and urban households in Uttar Pradesh	15

LIST OF TABLES

Table 1	Subsidy on LPG allocated and given by the Government of India	10
Table 2	State wise refill rates of LPG cylinders by PMUY holders from 2019-20 to 2021-22	10
Table 3	Comparison of LPG and electric induction cookstoves	11

In October 2022, the Government of India announced the Lifestyle for Environment (LiFE) initiative to encourage individual action to address the challenges of climate change and environmental degradation.¹ The LiFE campaign integrates the concept of resource efficiency, circularity, and energy efficiency for individual and community action. It further contributes towards achieving Sustainable Development Goal 7 to ensure affordable and clean energy for all by 2030. Aligned with these initiatives, it is crucial to envision ways for transitioning towards clean and efficient ways of cooking. The clean cooking sector has always been a priority sector since providing energy for cooking is intertwined with the developmental goals of improving public health, advancing gender equality, environment conservation, and promoting economic development.

1.1 India's Cooking Journey So Far

India has a population of 1.42 billion² with almost 314 million households (HH). Out of this, almost 127 million³ households with approximately 577 million people continue to use traditional solid fuels for their cooking needs. In rural areas, the situation becomes increasingly dire, as approximately 54.3 percent of households rely on traditional biomass-based fuels, including agricultural residues, wood, dung, briquettes, pellets, and more. Consequently, leading to twin problems of high levels of ambient air pollution coupled with health and respiratory hazards for some of the vulnerable sections of society including women and children. The magnitude of the challenge is large and hence should be a priority going forward. The use of cleaner and more efficient cookstoves and cooking solutions can address not only the exposure to harmful indoor air pollutants but also help in reducing the carbon emissions due to inefficient cooking resulting from incomplete combustion.

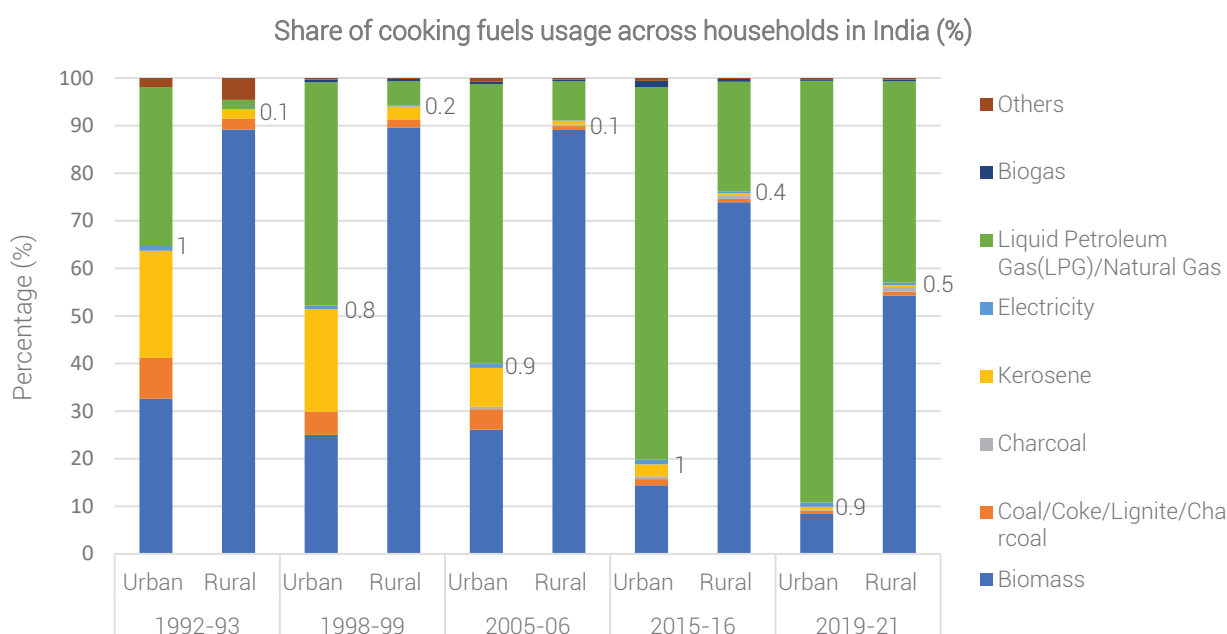


Figure 1: Share of cooking fuels usage across households in India

Note: Biomass includes wood, agriculture, crop residue, cow dung cakes, straw/shrubs/crop waste.

Source: NFHS

The cooking sector in India is one of the sectors where a variety of primary fuels are used such as solid biomass, kerosene, LPG, PNG, coal etc. While the progress of LPG has been noteworthy both in urban and rural areas, electricity-based cooking has been rather sluggish with only 0.5-1 percent of households using electricity to cook since 1992.

1.2 LPG Penetration in India

Moreover, LPG has garnered huge traction as a cleaner and more convenient fuel option. By providing 80 million LPG connections in rural areas, the Pradhan Mantri Ujjwala Yojana (PMUY) has provided increased access to LPG beyond urban areas.

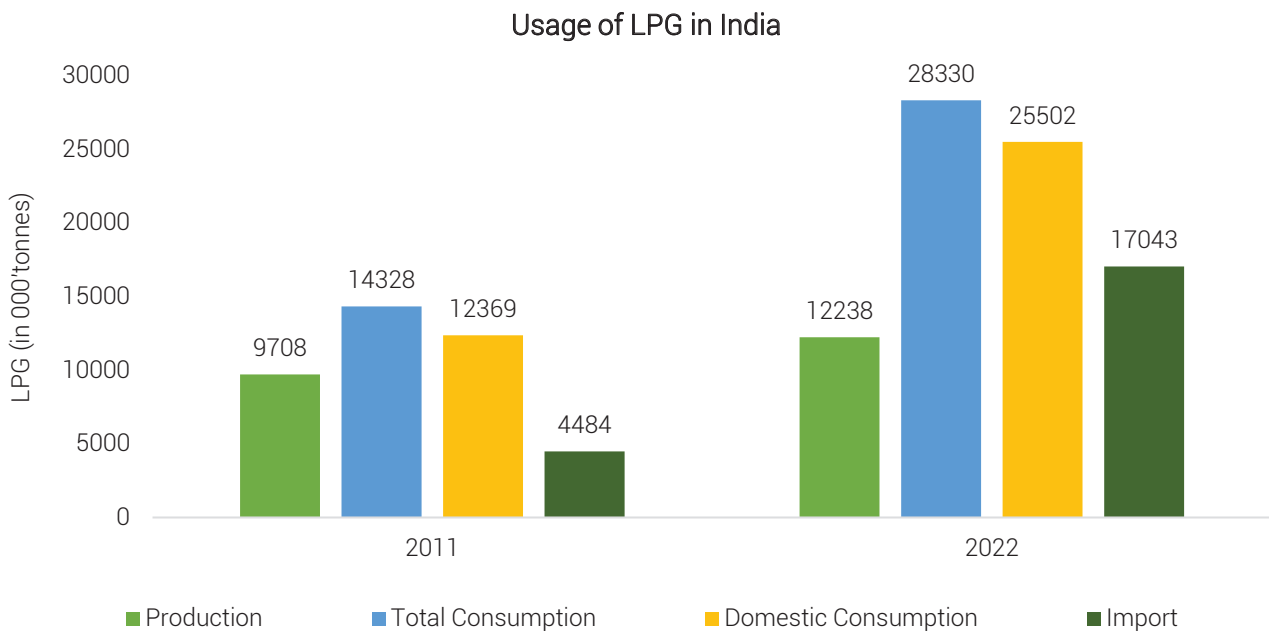


Figure 2: Usage of LPG in India

However, the sustainability of LPG as a primary cooking fuel is uncertain due to its heavy reliance on imports and subsidy dependence. Between 2011 and 2022, the consumption of LPG for cooking has more than doubled from 12,369 thousand tonnes to 25,502 thousand tonnes, although the share of LPG imports to its total consumption has risen from ~30 percent to 60 percent during this period. To put this in perspective, this translates to a six-fold increase in the import bill for LPG from INR 15,888 crores in 2011 to INR 91,468 crores in 2022.

1.3 Need for Electric Cooking in India

With the growing penetration of both centralised and decentralised renewable electricity-based capacity and its generation, it is important to consider exploring the potential of utilising RE for large-scale direct electric cooking or indirect electric to thermal conversion cooking technologies such as indirect solar cookers.

Electric cookstoves, particularly induction cookstoves and electric pressure cookers (EPC), have been shown to be more efficient, less polluting, and safer compared to gas and biomass cookstoves, in terms of exposure, efficiency, and safety.⁴ Also, the abatement cost is highest for induction cooking.⁵ Additionally, electric cookstoves are more convenient due to the increased access to electricity and the strengthened

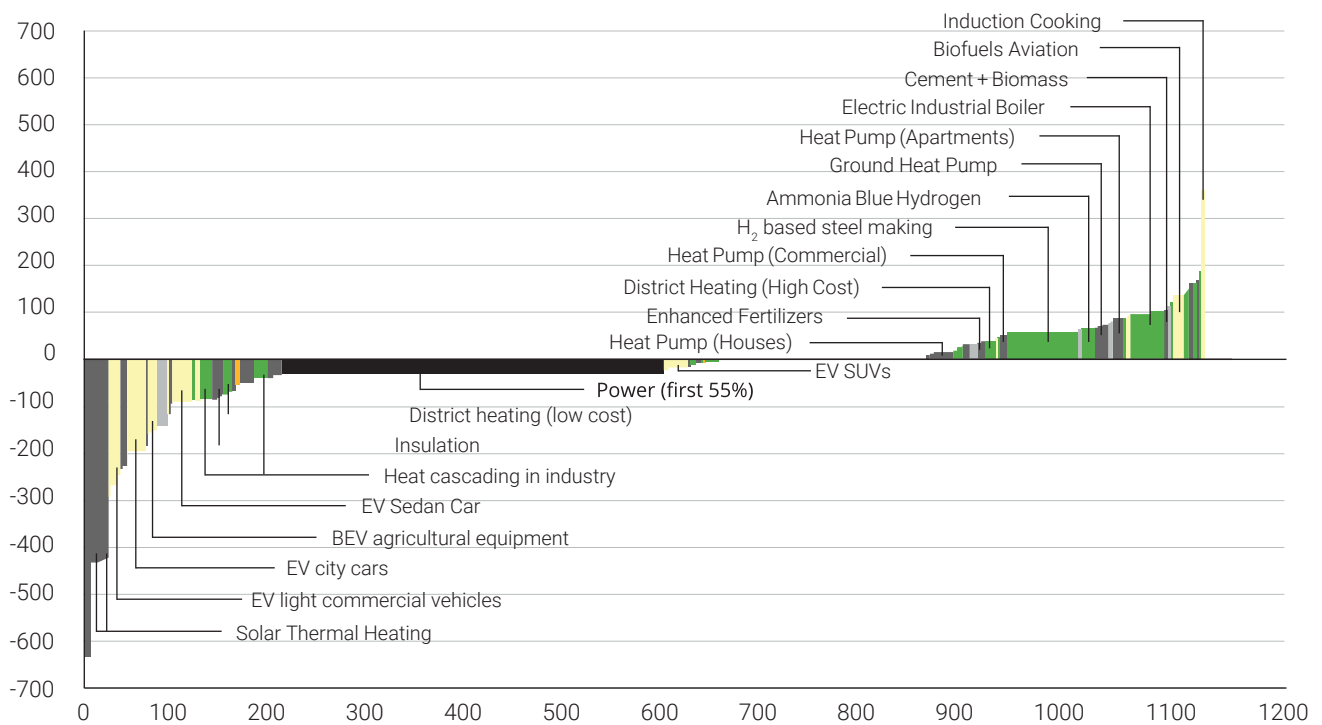


Figure 3: Abatement cost, € per ton of CO₂ equivalent

Source: McKinsey, Net-Zero Europe, November 2020

electricity distribution system under the SAUBHAGYA programme.⁶ However, to mainstream electric cooking, there is a need for careful assessment of cultural nuances related to cooking, the high upfront costs of electric-based cooking technologies and provision of affordable, reliable, and clean electricity.



REGULATORY & POLICY LANDSCAPE OF COOKING IN INDIA

The cooking sector has undergone tremendous developments with changes in technology, fuel types and programme models over the years. This spans from direct subsidy programmes like Unnat Chulha Abhiyaan for improved biomass-based cookstoves to Pradhan Mantri Ujjwala Yojana for LPG; to awareness programs like the Go Electric Campaign for electric cooking and promotion of piped natural gas; and finally, undertaking market transformation programs like Surya Nutan and Energy Efficiency Services Limited's (EESL) Solar Induction Cooktop programmes to promote electric and solar induction-based cooking solutions. However, these have been sporadically undertaken by different ministries and departments with varied objectives and visions.

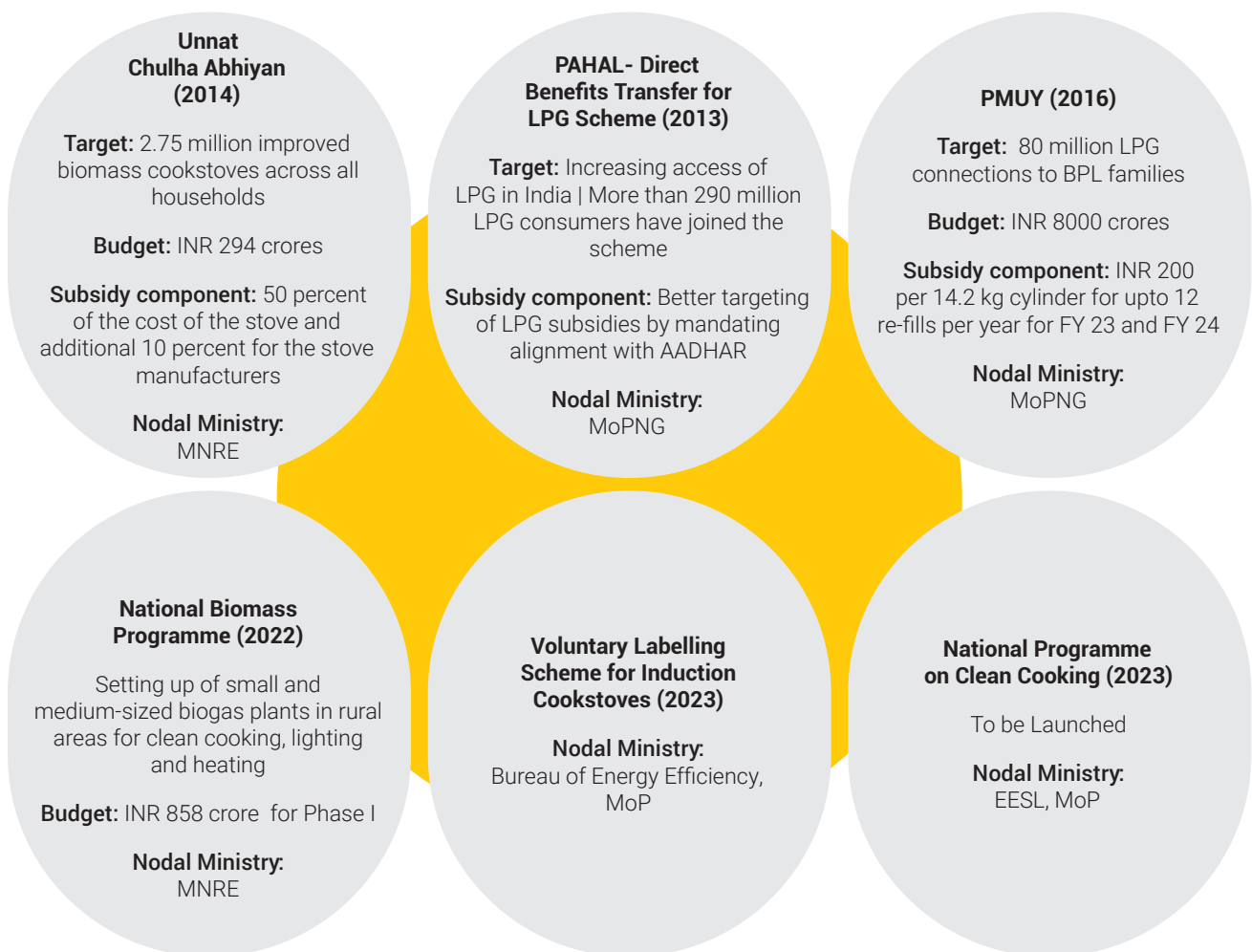


Figure 4: Major clean cooking initiatives in India by the Union Government

2.1 Clean Cooking Policy Initiatives at the Sub-National Level

- The **Uttar Pradesh** Government in its FY 2023-24 finance budget⁷ has allocated INR 3047 crores to encourage the sustained adoption of refills under the PMUY scheme. It is also providing free connections to BPL households and easy financing with 10 instalments of INR 50 per month for rural households under the SAUBHAGYA scheme benefiting 62.18 lakh households.

- In its annual budget for 2023-24, the **Rajasthan** Government has set a price of INR 500 per unit LPG cylinder for 12 cylinders per annum for approximately 76 lakh PMUY subscribers falling under the BPL category.⁸
- To facilitate greater adoption of LPG through the Ujjwala scheme, the **Bihar** Government planned with JEEViKA under Bihar Rural Livelihoods Promotion Society and State Rural Livelihoods Mission in FY 2020-21 to reach out to rural women and to organise 12,000 LPG panchayats in SC and ST dominant areas in collaboration with the Oil Marketing companies. The LPG panchayats bring together about 100 LPG customers in their living area for an interactive platform to discuss safe and sustainable usage of LPG in addition to targeting households not covered by the Ujjwala scheme. JEEViKA has also partnered with The Energy and Resources Institute (TERI) to provide improved cookstoves at a subsidised cost of INR 4,500 to traditional biomass users.⁹
- In the FY 2022-23 finance budget, the **Puducherry** Government allocated INR 126 crores to offer a monthly subsidy of INR 300 for 12 LPG cylinders to all households with a family ration card.¹⁰ This scheme is estimated to benefit approximately 3.5 lakhs households.
- The **Tamil Nadu** Government is currently implementing the ‘Magalir Urimai Thogai’ scheme that aims to support the women in meeting their cooking needs effectively. Under the scheme, INR 1,000 per month is provided to the women heads of the families for acquiring cooking gas.¹¹ Earlier, electric induction stoves had been provided to beneficiaries in the Nilgiris district and Kodaikanal taluk of Dindigul district with the aim to relieve the women from domestic drudgery and improve the quality of their lives.¹² Also, the Social Welfare and Nutritious Meal Programme Department of the Government of Tamil Nadu had sanctioned a sum of INR 60 lakh as a one-time expenditure towards the provision of gas connections, gas stoves, pressure cookers and a cooking platform to 1,000 Anganwadi centres.¹³

The objectives of clean cooking, however, have consistently failed to align with clean energy access and development initiatives, resulting in the underestimation of the sector by financial institutions, fund providers, and development banks, among other stakeholders. Moreover, there exists a clear requirement for enhanced coordination among ministries in order to facilitate the transition to electric cooking. For instance, by improving coordination, it becomes possible to optimise subsidy utilisation for household cooking, considering prevailing supply and demand conditions. It is also crucial to holistically integrate clean cooking with the electricity sector and develop appropriate policy support mechanisms, to support this transition effectively.

2.2 Other Notable Developments

2.2.1 Gradual Subsidy Withdrawal for LPG

The Government of India has gradually declined its subsidy allocation as well as its transfer for LPG distribution in India. This could be attributed to the rapid increase in international crude oil prices and further necessitates the need for exploring sustainable fuels for cooking and boosting energy security. Further, the anticipated risks of switching back to harmful and polluting solid fuels remain high with this gradual withdrawal of the subsidies for LPG in India.

Table 1: Subsidy on LPG allocated and given by the Government of India

Particulars	2017-18	2018-19	2019-20	2020-21	2021-22
Direct Benefit Transfer for LPG (DBTL) subsidy allocated (INR crores)	₹ 13,122	₹ 16,570	₹ 29,719	₹ 25,620	₹ 3,347
Pradhan Mantri Ujjwala Yojana (PMUY) subsidy allocated (INR crores)	₹ 2,252	₹ 3,200	₹ 3,724	₹ 9,690	₹ 1,618
Total subsidy allocated (INR crores)	₹ 15,374	₹ 19,770	₹ 33,443	₹ 35,310	₹ 4,965
Direct Benefit Transfer for LPG (DBTL) subsidy given (INR crores)	₹ 20,905	₹ 31,539	₹ 22,726	₹ 3,658	₹ 242
Pradhan Mantri Ujjwala Yojana (PMUY) subsidy given (INR crores)	₹ 2,559	₹ 5,670	₹ 1,446	₹ 76	₹ 1,569
Pradhan Mantri Garib Kalyan Package (PMGKP) subsidy given (INR crores)	-	-	-	₹ 8,162	-
Total Subsidy on LPG given (INR crores)	₹ 23,464	₹ 37,209	₹ 24,172	₹ 11,896	₹ 1,811

Source: Petroleum Planning & Analysis Cell (PPAC), Lok Sabha Unstarred Question No. 1238

2.2.2 Poor LPG Refill Rates

According to the Ministry of Petroleum and Natural Gas (MoPNG), the average refill consumption of PMUY beneficiaries for most states are less than three cylinders in a year. The situation becomes worse for some of the eastern and northeastern states with large rural inhabitants, where nearly 50 percent of the PMUY holders have refilled only once or twice in a year. This is much lesser than the average 7-8 refill rate required for an average rural household that exclusively uses LPG for cooking. Moreover, the gradual decline in the percentage of LPG connections from FY 2021 to FY 2022¹⁴ and the rise in LPG prices indicate a concerning trend of returning to traditional cooking methods, especially in rural areas.

This further alludes that the complete shift to LPG for meeting all the cooking energy demands is yet to happen, owing to the access, rising price of LPG, and sometimes cooking habits.

Table 2: State-wise refill rates of LPG cylinders by PMUY holders from 2019-20 to 2021-22

State/UT	Only one or two LPG refills		
	FY 2021-22	FY 2020-21	FY 2019-20
Assam	52%	42%	56%
Bihar	39%	22%	43%
Chhattisgarh	65%	58%	66%
Jammu & Kashmir	48%	39%	66%
Jharkhand	54%	42%	58%

State/UT	Only one or two LPG refills		
	FY 2021-22	FY 2020-21	FY 2019-20
Madhya Pradesh	50%	37%	60%
Meghalaya	48%	49%	53%
Nagaland	51%	32%	50%
Odisha	49%	30%	60%
Sikkim	50%	12%	25%
West Bengal	46%	19%	53%
Average	50%	35%	54%

Source: Public Sector Oil Marketing Companies & Answer from GoI, MoPNG to Q No. 418 on 8th Dec 2022

2.2.3 Electric Cooking is Cost-Effective when Compared with LPG

For a rural household with a family size of three adults and two children which uses two burner LPG stove as the primary cooking option, following are the results of replacing it with a two-burner electric induction cookstove. While the total cost of an induction cooker is higher than that of an LPG burner, approximately INR 2200 and INR 1000, the effective operating cost of using an induction cookstove comes out to be almost 50 percent lesser than the LPG burner.

Table 3: Comparison of LPG and Electric Induction Cookstoves

Variable	Units	LPG ¹⁵	Electric Induction Cookstove
Daily Consumption	kWh/day	5.42	5.2
Annual Consumption	kWh/year	1780.47	1708.2
Unit Cost	INR/kWh	6.38	3
Operating Expense	INR/year	11359.4	5124.6
Overheads	INR/year	1000	600
Total Operating Cost	INR/year	12359.4	5724.6

2.2.4 Increasing Renewable Electricity Supply and Reliability in Rural Areas

A clean and reliable power supply to the rural areas is a prerequisite to supporting the need for electric-based cooking. With massive rural electrification efforts under the SAUBHAGYA programme and other electricity distribution upgradation programs, the Government has been able to ensure an average power supply of greater than 20 hours to almost 70 percent of the total rural feeders. Likewise, by installing 173 GW of renewable energy as on April 2023, we are only a few gigawatts away from meeting one of the 2030 Nationally Determined Contribution (NDC) targets of installing 50 percent cumulative electricity capacity from non-fossil fuel by 2030 and greening our grid. Hence, the next few years are the opportune time to move the needle on electricity-based clean cooking in India.

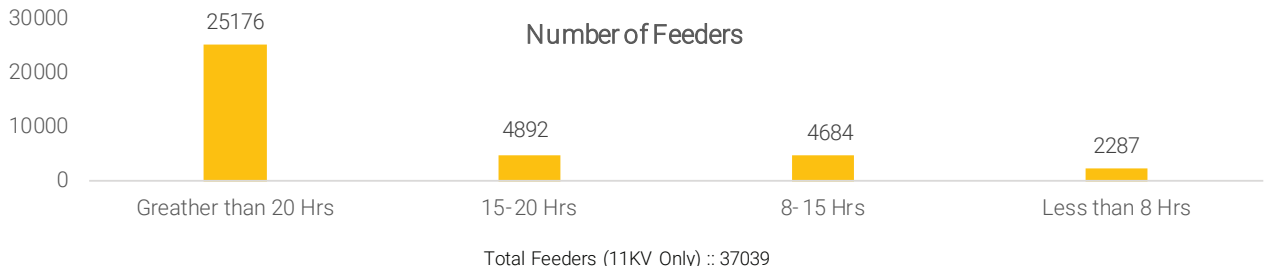


Figure 5: Average power supply monitoring statistics

Source: National Power Portal¹⁶

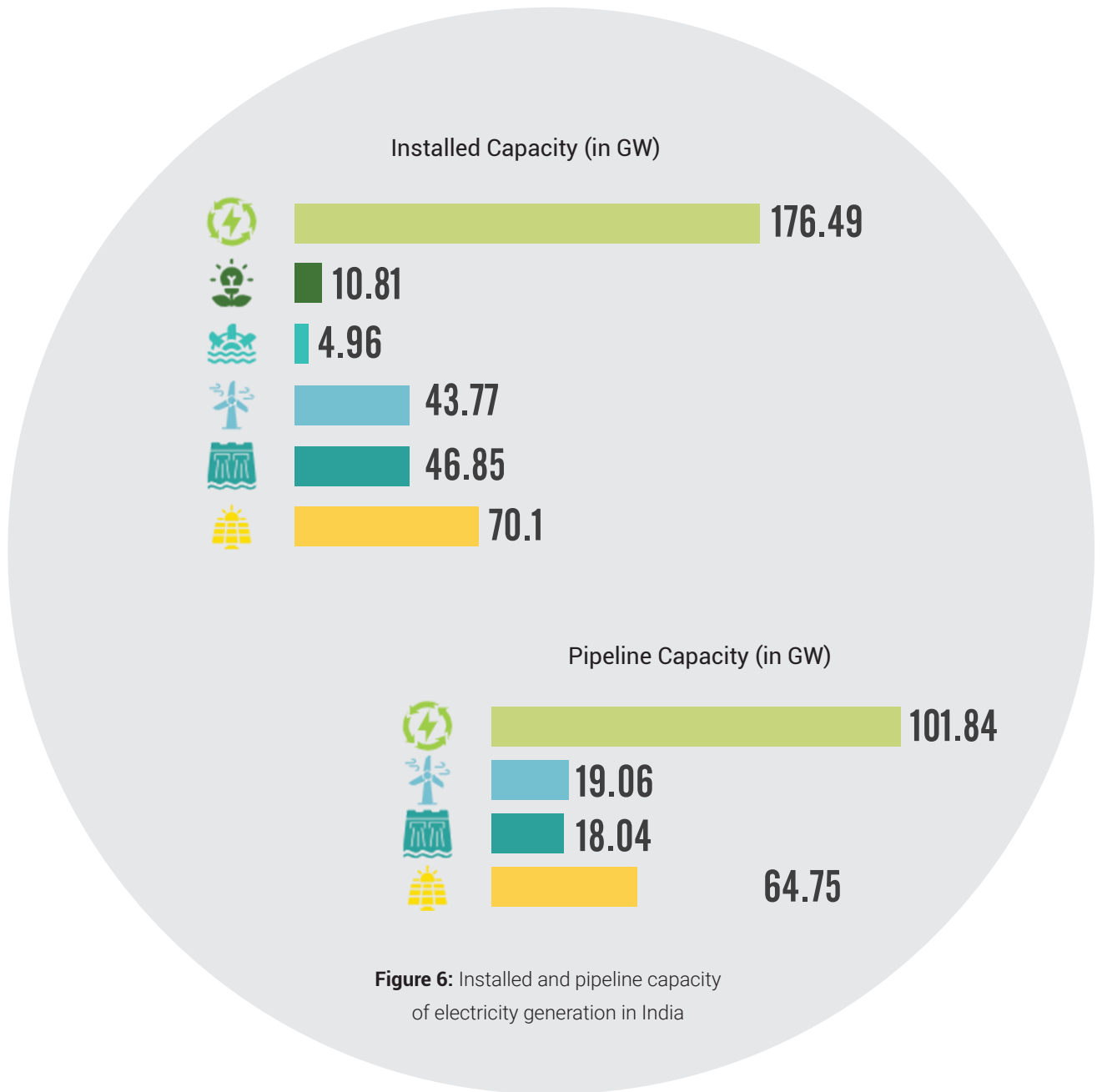


Figure 6: Installed and pipeline capacity of electricity generation in India

Source: India Climate Energy Dashboard (ICED)¹⁷

THE TECHNOLOGY LANDSCAPE OF COOKING IN INDIA

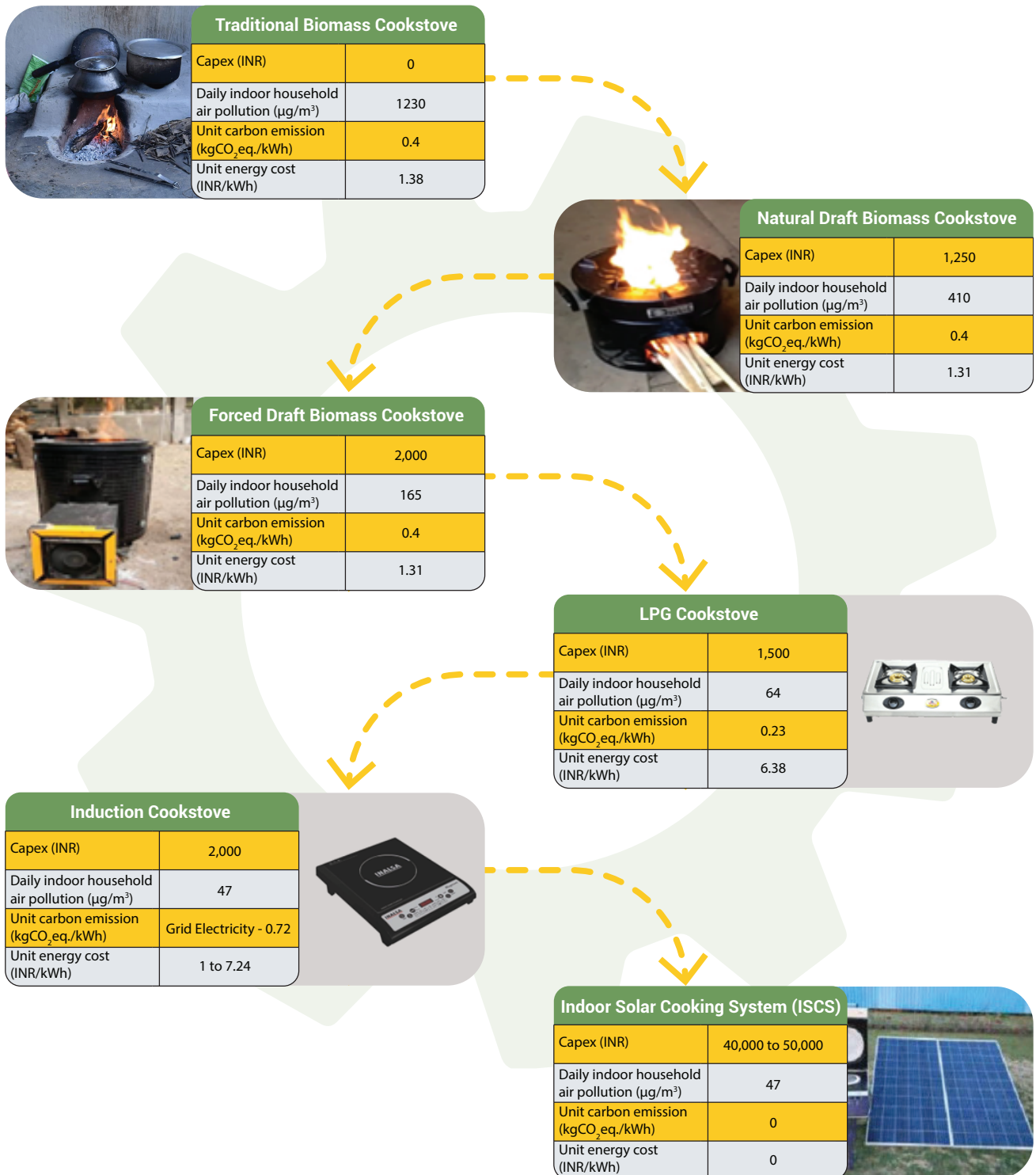


Figure 7: Comparison of different cooking technologies available in India

Note: Capex cost assumed based on secondary research of cookstove options available in the market and through schemes^{27 28 29 30 31 32 33 34 35}

UTTAR PRADESH COOKING SITUATION

The estimated number of households in Uttar Pradesh as of April 1, 2021 is 39.6 million.¹⁸ According to the recent National Family Health Survey-5 (NFHS-5) conducted in 2019-21, an average household consists of 5.2 members, and approximately three-quarters (75 percent) of the households are located in rural areas.¹⁹

4.1 Cooking Related Fuel Transitions

- With respect to clean cooking fuel penetration and usage, 50 percent of households in Uttar Pradesh used clean fuel for cooking during the period 2019-21.²⁰ This is a significant improvement in the use of clean cooking fuels compared to 2005-06 when 81.7 percent of the households used solid fuel for cooking.²¹
- In 2022, the consumption of LPG reached 3.85 million tonnes.²² This remarkable growth of 134 percent over the past decade, starting from 2013, can be correlated with the simultaneous increase in the percentage of households opting for clean cooking fuels.
- The state also had 16.7 million PMUY connections in 2022, which is the highest amongst any state in India.²³
- In terms of refilling rates by PMUY holders in Uttar Pradesh, more than 50 percent of them have at least ordered three or more refills in the fiscal years from 2019-20 to 2021-22.²⁴

The NFHS-5 also highlights the negative impacts of using biomass fuel on health. For instance, the survey found that 45 percent of women in Bihar, 47 percent of women in Madhya Pradesh, 27 percent of women in Rajasthan, 41 percent of women in Uttar Pradesh, and 38 percent of women in Chhattisgarh reported respiratory problems such as coughing, wheezing, and shortness of breath due to indoor air pollution from cooking with biomass fuels.

States exceeding the national average of biomass consumption for cooking (~56%)

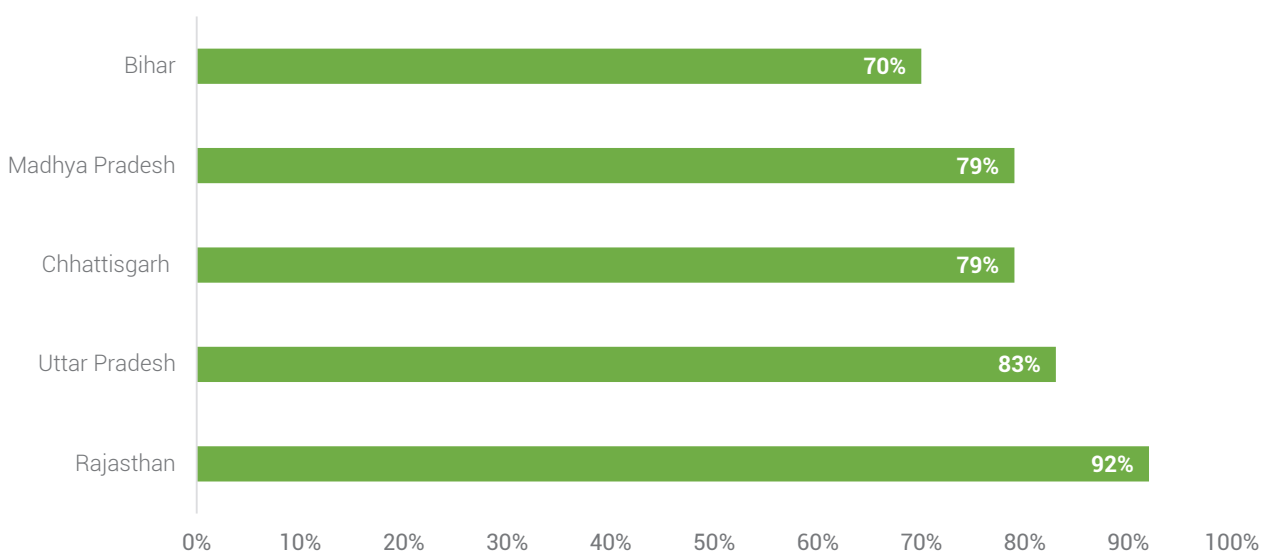


Figure 8: States exceeding the national average of biomass consumption for cooking

LPG consumption - Uttar Pradesh

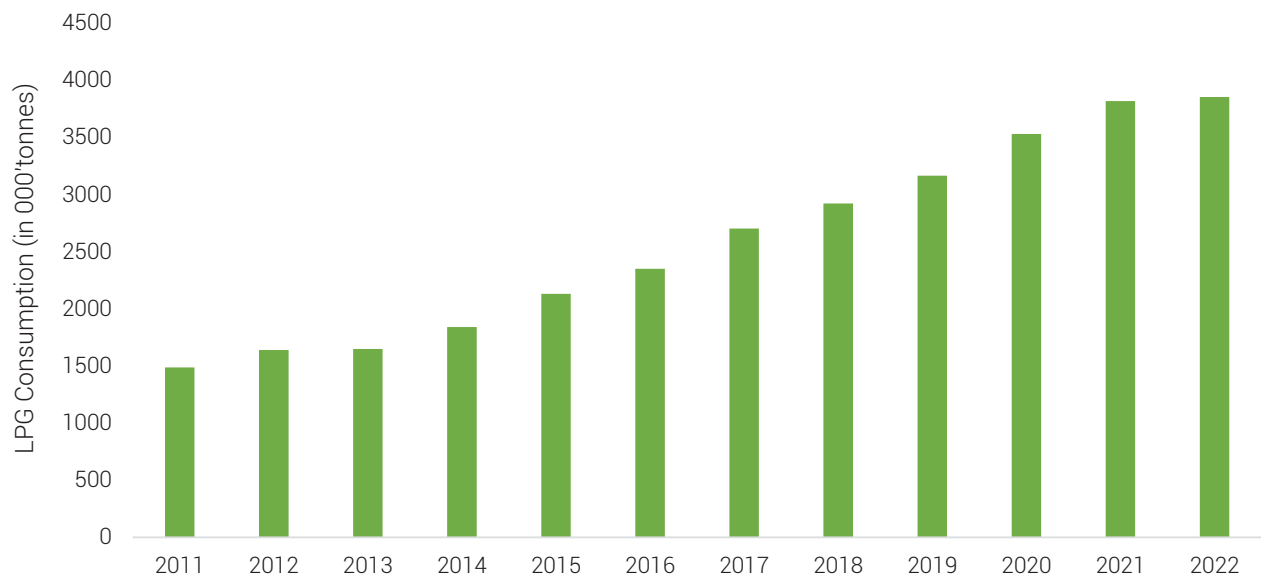


Figure 9: LPG consumption in Uttar Pradesh



4.2 Income Characteristics

There is a looming concern regarding the potential escalation of LPG prices, driven by the upward trend in international markets and geopolitical concerns. Consequently, this poses a significant risk, in particular, to the households with a higher proportion of their income allocated to cooking fuel expenses. In rural regions, the average per capita cooking fuel expenditure is INR 86.77, whereas in urban areas, it is INR 109.19, highlighting the fact that urban households that predominantly rely on LPG, spend a considerable amount of their budget towards cooking fuel expenditure.²⁵

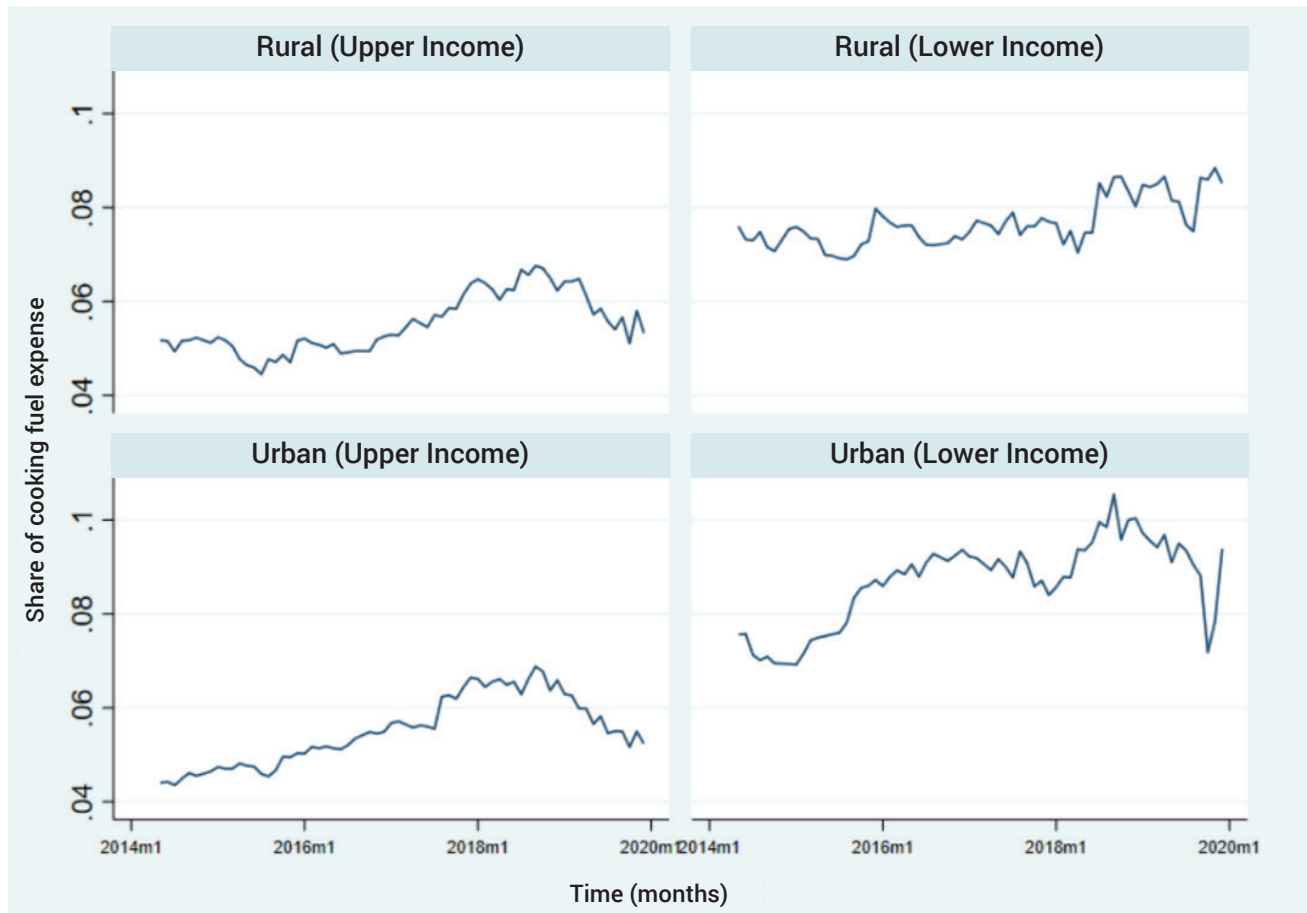


Figure 10: Share of cooking fuel expense for rural and urban households in Uttar Pradesh

Source: Explaining household expenditure on cooking fuel: Role of income and socio-economic status by Salman Haider

Figure 10 illustrates the proportion of expenditure allocated to cooking fuel costs in Uttar Pradesh between May 2014 and December 2019. It indicates that the lower-income households in both regions face a higher cooking fuel cost. Both rural and urban areas experience this cost burden of approximately 7 to 10 percent, which is much higher than the 5 to 6 percent burden experienced by the upper-income group.

This prevailing trend can therefore be observed in numerous instances, notably among rural communities, where there is a tendency to rely on traditional *chulhas* or cookstoves resurfaces. Therefore, it is imperative to address this issue urgently by improving subsidy targeting. This would facilitate the transition of beneficiaries from traditional cooking solutions to cleaner alternatives, ensuring access to affordable and environmentally friendly cooking methods through the implementation of technological advancements, financial support, and innovative policy interventions.

KEY RECOMMENDATIONS

Taking into account the urgent need to expedite the clean cooking transition in India towards electric cooking, the following key recommendations are proposed in consultation with stakeholders to assist in the implementation of effective policies and initiatives.



Communication and Awareness Creation- There is a need to inform and build awareness about the cost-benefits of transitioning to electric cooking. As per the Indian Oil Corporation Limited's (IOCL) experiments using various cooking technologies, cooking using an induction stove consumes less than three units per day which include breakfast, lunch, dinner and tea/snacks. This translates to a monthly expenditure of around INR 600.²⁶ This is much cheaper compared to an LPG cylinder of 14.2 kg which costs approximately INR 1100 and lasts for 45 days.



Brand Cities- Identifying regions as pioneers for a transition initiative has shown an increased public interest in participation. Similar efforts could be made vis-à-vis clean cooking to incentivise consumers to align with other social and cultural aspects.



Deploying 'Cooking as a Service' - Given the high capital cost of solar stoves, there is a need to re-look at the concept of sales of these products. The sale of cooking products whose purchase cost exceeds INR 20,000 needs to be looked at as a service and not just as an individual appliance sale. A pay-as-you-go mechanism for providing cooking as a service may be viable solution for consumers.



Understanding Demand Characteristics- Altering users' perception towards accepting clean cooking is of paramount significance. Therefore, for an effective implementation, it is imperative to formulate policies that are based on reality and encompass solutions capable of resolving end users' concerns. An illustrative example of such concerns is users' dissatisfaction with the taste and aroma of food prepared using electric induction. Thus, it is essential to adopt a comprehensive approach to address such issues by implementing targeted interventions on the demand side.



Building a Strong Supply Chain - Taking away the inefficient and polluting products from the market and making only efficient clean cookstoves available in the market. Furthermore, developing a well-knit delivery system that can provide easy and affordable clean cooking access to the end users along with post-sales services; Self Help Groups and Farmer Producer Organisations might be the best options.



Financing Commercial Kitchens - A support system is required to finance commercial kitchens, which is a non-traditional banking project presently due to the different nature of cash flows and assets. Hence, in addition to raising awareness, the whole ecosystem around electrifying commercial kitchens needs to be developed. Some of the immediate areas that need focus are the technology options available, price, electricity consumption and future upgradation.



Enabling Policy Alignment - The scope of electric cooking should be incorporated into the Revamped Distribution Sector Scheme (RDSS) program. Going forward, the Ministry of Power, Government of India must consider this in future efforts to upgrade and strengthen the rural electricity infrastructure.

REFERENCES

- 1 <https://pib.gov.in/PressReleasePage.aspx?PRID=1886051>
- 2 United Nations Population Division. World Population Prospects: 2022 Revision.
- 3 World Bank staff estimates based on the United Nations Population Division's World Urbanization Prospects: 2018 Revision.
- 4 <https://sustainablereview.com/electric-stoves-are-better-for-the-planet-and-human-health/>
- 5 The Green Shift, MoPNG, 2023.
- 6 <https://pib.gov.in/PressReleaseSelfframePage.aspx?PRID=1897040>
- 7 <https://budget.up.nic.in/>
- 8 <http://cmo.rajasthan.gov.in/pressreleasedetail/85493>
- 9 <https://mnre.gov.in/img/documents/uploads/670406a017f54c9386fcde911ee5abe6.pdf>
- 10 https://budget.py.gov.in/Doc/CM_BUDGER_SPEECH_2023_Englsih.pdf
- 11 Tamil Nadu Finance Budget FY23-24 (https://cms.tn.gov.in/sites/default/files/documents/budget_speech_e_2023_2024.pdf)
- 12 Policy Note 2015-2016, Food & Consumer Protection (Cooperation, Food & Consumer Protection Department), Government of Tamil Nadu 2015
- 13 http://cms.tn.gov.in/sites/default/files/go/swnmp_e_10_2012.pdf
- 14 The year 2020-21 saw the implementation of the Pradhan Mantri Garib Kalyan Package where subsidies were provided by the central government for providing up to three free LPG cylinders to PMUY beneficiaries. The scheme was valid during April to September 30, 2020
- 15 The units for the LPG burner mentioned in this report have been converted to kWh using an appropriate conversion factor.
- 16 National Power Portal
- 17 Vasudha Foundation India's Analysis
- 18 https://ppac.gov.in/uploads/rep_studies/1679987824_READY_RECKONE_Magazine.pdf
- 19 http://rchiips.org/nfhs/NFHS-5Reports/Uttar_Pradesh.pdf
- 20 http://rchiips.org/nfhs/NFHS-5Reports/Uttar_Pradesh.pdf
- 21 <http://rchiips.org/nfhs/NFHS-3%20Data/VOL-1/Chapter%2002.pdf>
- 22 Indian Petroleum & Natural Gas Statistics 2021-22 (https://mopng.gov.in/files/TableManagements/IPNG-2021-22_L.pdf)
- 23 https://ppac.gov.in/uploads/rep_studies/1679987824_READY_RECKONE_Magazine.pdf
- 24 Annexure referred in part (a) to (d) of Lok Sabha Unstarred Question No. 418
- 25 <https://iegindia.org/upload/publication/Workpap/WP454.pdf>
- 26 Assuming an electricity unit price of INR 6 and the food is for a family of four, each meal consists of 12 rotis, 230 grams of dal, 430 grams of vegetables, and 125 grams of rice.
- 27 <https://acp.copernicus.org/articles/18/15169/2018/acp-18-15169-2018.pdf>
- 28 <https://www.mdpi.com/2073-4433/10/12/729>
- 29 <https://cea.nic.in/cdm-co2-baseline-database>
- 30 <https://www.sciencedirect.com/science/article/abs/pii/S0301421513010719>
- 31 DISCOMs Electricity Tariff Orders of 2021-22 and 2022-23
- 32 <https://www.sciencedirect.com/science/article/pii/S0160412018324772>
- 33 https://www.researchgate.net/publication/337429023_In-Field_Emission_Measurements_from_Biogas_and_Liquefied_Petroleum_Gas_LPG_Stoves<https://bmcpublihealth.biomedcentral.com/articles/10.1186/s12889-020-09865-1>
- 34 <https://bmcpublihealth.biomedcentral.com/articles/10.1186/s12889-020-09865-1>
- 35 https://www.isid.ac.in/~epu/dispapers/dp22_04.pdf



CISRS House, 14, Jangpura B, Mathura Road, New Delhi – 110 014, India

www.vasudha-foundation.org | www.vasudhapower.in