Assessing the Adoption of Liquefied Petroleum Gas (LPG) as Clean Fuel: Challenges and Policy Interventions in Jammu and Kashmir

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Abstract: **As per WHO, the affordability of clean cooking solutions like liquefied petroleum gas (LPG) fuel is one of the major barriers to reducing exposure to household air pollution in low-income households. The NEP recognizes LPG as a key component of the clean cooking solution. The present study examines the key Challenges and Policy interventions in the adoption of Liquefied Petroleum Gas (LPG) as clean cooking fuel in Jammu and Kashmir using secondary data. The status of clean cooking fuel in Jammu and Kashmir shows notable progress from 2019 to 2021, with around 66% of households using clean fuel for cooking. However, challenges persist in providing universal access, particularly in rural areas. Despite the PMUY's initial success in facilitating LPG access, sustaining its usage remains challenging. The focus of the policy should be on the targeted strategies, government interventions, and addressing the unique challenges hindering the adoption of cooking gas by the low-income households.**

Index Terms- **Liquefied Petroleum Gas (LPG), Clean cooking fuel, Policy intervention, Pradhan Mantri Ujjwala Yojana (PMUY)**

1. INTRODUCTION

Clean cooking is regarded by international organizations as a pivotal driver for poverty eradication, health improvement, and gender equality. Energy poverty includes the lack of access to clean cooking fuels and technologies. As of 2020, over 2.6 billion people in developing countries still rely on traditional fuels like wood, dung, coal, or kerosene. Their use in open fires or stoves causes severe household air pollution, leading to about 3.8 million deaths each year (WHO) and creating major health, socio-economic, and environmental challenges.

Global poverty is exacerbated by India's large population and extensive consumption of solid fuels. Goal seven of the United Nations Sustainable Development Goals (SDGs) commits the international community to providing access to clean cooking fuels and technologies to all by 2030. Achieving this goal will help to solve the issues of health, deforestation, energy security, and climate associated with relying on biomass for fuel (Bruce et al.,2018). Over 70 percent of residential areas use LPG as their main fuel source. One important sign of multifaceted poverty is the lack of access to clean cooking fuels, which has an impact on the health, well-being, and climate goals of women and children. The WHO recommends scaling the adoption of clean fuels to improve maternal and child health. By improving LPG supply and availability in cylinders, the government aims to increase use of LPG from less than 20% to 58% of the population by 2030. The NEP recognizes LPG as a key component of the clean cooking solution. (NEP Report 2017). Liquefied Petroleum Gas (LPG) represents a scalable clean fuel that provides health and environmental benefits when used for household energy in LMICs (Rosenthal et al., 2017). Both the quantity and quality of energy consumed by a family or individual have become significant parameters for evaluating their well-being. While per capita energy consumption is regarded as a key indicator for assessing the development level within a society, the absence of access to cleaner fuels for domestic cooking is among the twelve indicators employed to measure multidimensional poverty, which categorizes individuals as poor or non-poor in the National Multidimensional Poverty Index (MPI) Baseline Report issued by NITI Aayog in September 2021. In India, approximately 54% of households continue to utilize traditional solid fuels, either

exclusively or in conjunction with LPG, thereby contributing to indoor air pollution. In rural regions, the use of LPG is even more limited; despite 80% of households having an LPG connection, 67% still rely on firewood for at least some of their cooking requirements. https://mecs.org.uk/

As per WHO affordability of clean cooking solutions like LPG is a major barrier to reducing household air pollution in low-income households. Studies show that despite hardships, LPG consumption remains stable, demonstrating how smart devices can address affordability challenges, especially during COVID-19, and promote sustainable living. The food-energy nexus offers a chance to achieve SDG 2 (zero hunger) and SDG 7 (clean energy) by 2030, enhancing health benefits. Making LPG affordable, accessible, and suitable for families' needs should be a policy priority to improve food and energy security for the urban poor and prevent diseases. https://www.who.int/. Clean cooking involves affordable, efficient fuels that are safe for health and convenient for women to use. LPG stoves replaced kerosene stoves in urban homes in the 1970s as India's refineries produced bottled LPG. In 1977, India had 3.2 million LPG connections (2.5%). By 1984, connections tripled to 8.8 million (5%), and by 1990, reached 19.6 million (11%). Growth at over 14% between 1977 and 1990 surpassed electricity, driven by government subsidies that halved cylinder costs, mainly benefiting city middle-class families. Rural adoption remained low due to high costs and dealer availability, making LPG a privilege for the wealthy. In the late 1990s, southern states launched BPL household programs, increasing LPG access and garnering political support, later adopted nationally via the 2009 RGGLV scheme, which doubled rural LPG dealers. While urban middle-class LPG adoption grew, it also fostered clientelism similar to electricity. In 2016, the government rebranded RGGLV as Pradhan Mantri Ujjwala Yojana with minor updates. In 2021-22, LPG accounted for 13% of petroleum use, mainly for households (90%), with 8% industrial and 2% vehicles. Over 60% was imported, with 99% from public refineries. Consumption rose over 84% from 15.3 MT in 2011-12 to 28.3 MT in 2021-22, mainly due to packaged LPG. Domestic use increased over 76%, commercial over 108%, industrial about 59%, but auto use dropped over 37%. Private LPG imports declined over 83%, from 489,000 to 82,000 T, driven by policies to improve LPG access. https://www.orfonline.org/

2. LITERATURE REVIEW

2.1 India's Clean fuel Energy scenario and policy intervention

In India, though household electrification has advanced, clean cooking remains under-prioritized, only 63.4% of households use clean fuel, with rural adoption at 49.5%, versus 92.9% in cities. This gap fuels indoor air pollution, as 660 million rely on biomass (IEA). The health toll is severe: household air pollution causes 3.8 million deaths yearly globally, with India bearing a significant share (WHO). A case study was done by Ravindra et al.,2019 to analyse the fuel use patterns and trends in India, along with the socio-cultural, economic, and behavioural factors influencing the transition to cleaner fuels. It found that between 1993–94 and 2009–10, 90% of the rural population continued to use non-clean fuels for cooking, while only 2% adopted clean cooking fuels. Over the years, the fuel mix has shifted toward cleaner sources such as electricity (hydropower) and LPG. This presents a major opportunity to adopt modern, efficient cooking technologies like induction cooktops, reducing fuel and wood use. According to Niti Aayog's Indian Energy Security Scenario portal, the energy demand for cooking in 2047 will be between 410 terawatt-hour (twh) to 599 twh https://www.downtoearth.org.in.

The study by Aryal et al., (2024) investigates disparities in clean cooking fuel usage among social groups in India from 2004 to 2018, highlighting energy justice and the need for equitable transition policies. It finds that in rural areas, only 19.6% of General Caste households and 14.5% of underprivileged groups utilize clean energy, while in urban areas, the figures are 60.4% and 46.3%, respectively. In India, only 59% of households use clean fuel for cooking, while 41% rely on solid fuels like wood or dung cakes, mainly in rural areas. Lack of access to clean cooking methods poses serious risks to public health, climate, the environment, and gender equality. This issue was discussed extensively at the United Nations Climate Change Conference in Dubai (COP28). Clean cooking is a proven, essential part of the climate solution. Today's efficient biomass stoves

can cut fuel consumption by 30–60%, reducing greenhouse gases and black carbon emissions. Transitioning quickly to LPG and other cleaner fuels will lower climate emissions and offer notable benefits for health, women's empowerment, and local economies. According to the IRES 2020 report, approximately 85 percent of Indian households have access to LPG. Furthermore, the share of LPG in primary cooking fuels increased from 28.5 percent in 2011 to 71 percent as of March 2020. The rise in LPG utilization is largely attributable to recent government initiatives, notably the Pradhan Mantri Ujjwala Yojana (PMUY) scheme. (State of clean cooking energy). The Pradhan Mantri Ujjwala Yojana has provided over 100 million LPG connections, but sustained usage grew just 2.1 percentage points, reflecting ongoing regional and socioeconomic disparities. (Asharaf and Richard, 2024). The fast-growing population and increased LPG use in rural areas have resulted in an 8.4% average rise in LPG consumption, positioning India as the world's second-largest LPG consumer with 22.5 million tonnes. Only 17.5% of Indian households mainly use LPG for cooking, whereas 90% of rural homes depend on biomass. To enhance living conditions for this large population, providing clean, renewable cooking options like LPG is crucial.

Energy accessibility requires state intervention as it needs huge infrastructure development with massive financial outlays (Sen, 2000). Energy transitions don't occur alone. They need a strong foundation of public policy and a sufficient institutional framework to assist bring about change. To guide us through the energy transitions, the research indicates that significant institutional and policy changes are required. Major national initiatives implemented by the Indian government over the last few decades have included subsidies for cleaner burning fuels like liquid petroleum gas (LPG) and kerosene to encourage a transition. The Planning Commission of India found a strong positive link between energy use and human development, noting that per capita energy consumption and modern fuel progress indicate economic development. Reddy (2009) emphasized that modern energy services for cooking and lighting are vital for welfare, health, and education, but policymakers give them little attention.

The Government of India has introduced several policy measures to address the limited adoption of liquefied petroleum gas (LPG) in rural areas and improve access for low-income households. To increase LPG coverage, the Rajiv Gandhi Gramin LPG Vitran Yojana (RGGLVY) was introduced in 2009. The Direct Benefit Transfer for LPG (DBTL), launched in 2013, provides subsidies directly into beneficiaries' bank accounts to curb diversion and eliminate fraudulent connections. The 'Give It Up' campaign, launched in 2015, encourages middle-class families to voluntarily surrender their LPG subsidies, resulting in over 1.13 crore households doing so. The most significant intervention, the Pradhan Mantri Ujjwala Yojana (PMUY), launched in 2016, provides LPG connections to women from below-poverty-line (BPL) families, with the dual aim of empowering women and reducing health risks associated with traditional biomass fuels. As per (oil) ministry's projections and forecasts, LPG consumption is expected to grow to 30.3 million tonnes by 2025 and 40.6 million tonnes by 2040. Government initiatives in recent years, such as PAHAL, Give it UP and Ujjwala, could further accelerate the rate of LPG access. Ujjwala in particular is targeting an additional 50 million poor families by 2019, with an allocated budget of US$300 million in 2016−2017 (Ministry of Petroleum and Natural Gas, 2016). Under Pradhan Mantri Ujjwala Yojana (PMUY) of providing free cooking gas (LPG) connection to poor, over 6.31 crore connections have been provided since the launch of the scheme on May 1, 2016. This program subsidized the set-up costs of liquid petroleum gas (LPG) for rural households. Subsidy offered by the government that amounted to roughly half the cost of an LPG cylinder was the primary driver behind this growth which benefited middle-class families in cities and towns. https://economictimes.indiatimes.com/. Union budget of FY 2021-22, announced a provision for a further one crore LPG connection under Ujjwala 2.0 aiming to provide deposit-free LPG connections to low-income families which were not covered under the earlier phase of PMUY and ensure energy security in India. Despite numerous efforts, LPG penetration in rural India remains uneven (Sharma & Dash,2022).

According to the 76th round of NSSO, only 48% of rural households use LPG, with particularly low coverage in the North-East and eastern states such as Jharkhand (21.5%), West Bengal (24.5%), and Odisha (23.8%). Further, evidence from Gupta et al. (2019)

suggests that although PMUY has expanded LPG access in northern India, nearly 98% of beneficiary households continue to rely on traditional cooking stoves, highlighting the gap between LPG access and sustained use. The study suggests that LPG refill subsidies, awareness programs, and changes in the use of alternative cooking fuels have helped improve public perceptions of the scheme (Swain and Mishra, 2021). The study mainly analyses household shifts to clean cooking fuel (LPG), emphasizing its use. It highlights both common and region-specific factors that influence LPG adoption. The study shows that the capital subsidy provided for LPG access is helping in the LPG transition (Sharma, Parikh, and Singh, 2019). North Indian society generally assigns low status to women, advocates for women's seclusion, and restricts women's participation in economic activities outside the domestic sphere. Such beliefs encourage women to conserve gas resources, support women's employment that involves solid fuel use, and obstruct communication between the cook and the decision-maker regarding LPG refills. Research findings indicate that patriarchal gender norms and attitudes promote the continued use of solid fuels in this region. (Vyas et al.,2021) The study by Sharma and Dash (2022) explores household energy use in rural India, highlighting reliance on traditional solid fuels despite efforts to promote cleaner cooking fuels (CCFs). Only 49% have access to CCFs, with income, education, and household decision-making significantly affecting fuel choices. In India, LPG cylinders are delivered directly to urban households by public sector OMC distributors, while rural consumers often need to collect from distribution centres. Results suggest policies and community education and awareness are needed to encourage cleaner energy use and achieve SDGs by 2030.

2.2 Status of clean cooking fuel in Jammu and Kashmir

Jammu and Kashmir hold vast potential for renewable energy development, offering solutions to energy scarcity while ensuring sustainability. Harnessing solar, wind, hydro, and biomass resources can boost energy security, economic growth, and environmental protection, provided strong policies, awareness, and investments are in place (Lohan and Sharma,2012). The status of clean cooking fuel in Jammu and Kashmir shows notable progress from 2019 to 2021, with around 66% of households using clean fuel for cooking. However, challenges persist in providing universal access, particularly in rural areas. Although the Prime Minister's Ujjwala Yojana (PMUY) has begun providing some households with clean cooking options, the challenges are significant. The current reliance on LPG as the primary cooking fuel is necessary for moving away from solid fuels. Efforts to shift towards electricity and solar power as cooking sources could increase their adoption in the future. However, Jammu and Kashmir, which experiences a temperate climate and tough winters, faces many challenges if the issue isn't properly understood and addressed with thoughtful planning.

On September 28, 2016, the Pradhan Mantri Ujjwala Yojana (PMUY) launched in Jammu and Kashmir. By September 7, 2019, India issued 80,339,993 connections, with around 12,03,246 in Jammu and Kashmir. Within a month of launch in the region, about 1 lakh free LPG connections were distributed to eligible beneficiaries.

3. OBJECTIVES OF THE STUDY

The primary objective of the study is to assess the adoption of LPG, concerning Challenges and Policy interventions in Jammu and Kashmir.

4. METHODOLOGY AND SAMPLING

The research is done by reviewing the secondary data collected from various sources like officially published statistics available from different publications including Economic Survey of India; Reports of CSO, Government of India, National Family Health Survey (NFHS) Data, Petroleum Planning and Analysis cell and various other published reports, journals, articles, websites and official records. The present study will specifically focus on to assess the adoption of LPG, concerning Challenges and Policy interventions in Jammu and Kashmir.

5. RESULTS AND DISCUSSION

5.1 Recent Developments and Policy Announcements

A significant regional development is the announcement that India plans to auction newly

discovered lithium reserves in Jammu and Kashmir by December,2023. While this news mainly pertains to the potential for battery and energy storage technologies, it also signifies a broader trend of the region becoming an important contributor to energy transitions and resource management. The introduction of these regional projects indicates that Jammu and Kashmir is not only in line with national policies but is also seeking new opportunities to enhance its energy security and economic growth.

The government of Jammu and Kashmir has implemented several initiatives to promote clean cooking fuels to improve health outcomes and environmental sustainability. Some key initiatives include:

1.Pradhan Mantri Ujjwala Yojana (PMUY):-This flagship scheme provides free LPG connections to women from Below Poverty Line (BPL) households, facilitating access to cleaner cooking fuel.

2.Subsidized LPG Cylinder Distribution:- The government offers subsidies on LPG cylinders, making them more affordable for households, particularly in rural areas.

3.Promotion of Biogas Plants:- Encouragement of biogas production from organic waste is part of the strategy to provide an alternative clean cooking method, especially in rural settings.

4. Awareness Campaigns:- Various awareness programs and workshops aim to educate the public about the benefits of clean cooking fuels and their impact on health and the environment.

5.Infrastructure Development for LPG Supply :- The government is working on enhancing the infrastructure for LPG distribution to ensure timely supply to remote areas.

6. Collaboration with NGOs and International Organizations :- Partnerships with NGOs and organizations like UN agencies help to promote clean cooking solutions and access to alternative fuels. These initiatives reflect a comprehensive approach towards transitioning households in Jammu and Kashmir to cleaner and healthier cooking methods.

The Jammu and Kashmir Energy Development Agency (JAKEDA) responsible for managing and implementing the LPG fuel program and related policies in Jammu and Kashmir, including the Pradhan Mantri Ujjwala Yojana (PMUY), which aims to provide clean cooking fuel to rural and marginalized communities with the motive to increase LPG accessibility. As of mid-2024, the PMUY has achieved notable progress in Jammu and Kashmir, supporting the national effort to expand LPG access to rural and underprivileged households.

5.2 Recent Progress and Data on PMUY in Jammu and Kashmir:

1. Number of Beneficiaries:
   - Over 600,000 BPL households in Jammu and Kashmir have been provided LPG connections under PMUY.
   - The region has seen a steady increase in LPG adoption, with a focus on rural and remote areas.
2. Connectivity and Infrastructure:
   - The government has expanded the LPG distribution network by partnering with local distributors and establishing new distribution points, particularly in difficult terrains such as Ladakh, Kishtwar, and Kupwara.
   - Mobile LPG refill vans and local entrepreneurship programs have been launched to improve access.
3. Safety and Awareness Campaigns:
   - Focused safety training programs have been conducted, especially targeting women-headed households.
   - Outreach efforts have increased awareness about safe LPG use, reducing safety-related incidents.
4. Refill Coverage:
   - The refill rate among beneficiaries has improved substantially, with many households now using LPG regularly rather than just for initial connections.
   - The government's digital monitoring system helps track refill frequency and beneficiary satisfaction.
5. Government Initiatives & Policy Support:
   - Additional subsidies and financial incentives have been provided, especially under state-specific schemes designed to boost LPG intake.
   - Special campaigns during festivals and government outreach programs have increased adoption rates.

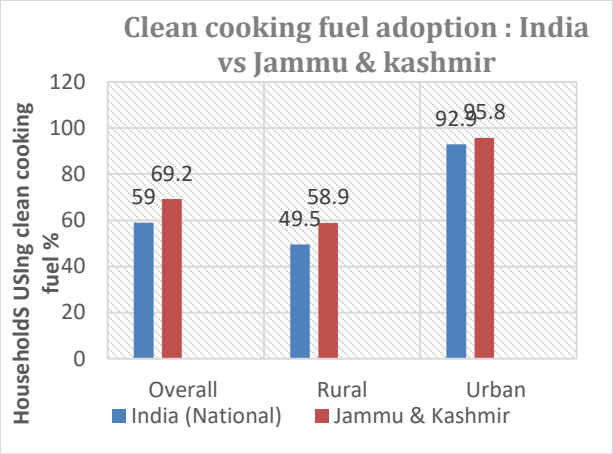
5.3 Assessment Using National Family Health Survey (NFHS) Data

According to NFHS-5 (2019–21), 88.6% of urban households primarily use LPG or PNG, compared to 42% in rural areas. Overall, 56.2% of the population uses LPG or PNG as the main fuel. About 8.9% of urban households and 54.6% of rural households use solid fuels for cooking. Nationally, 43.3% of households still rely on solid biomass.

One important strand of research employs two waves of the NFHS dataset (2014–15 and 2019–21) to gauge the impact of PMUY on LPG consumption among BPL households. This evaluation underscores that while there is an uptick in LPG connection rates, the overall consumption level remains modest. Researchers attribute this to the predominance of intent-to-treat methodologies in the absence of an explicit policy variable in the NFHS dataset. Nonetheless, the observed improvements in LPG consumption correlate with positive health outcomes and a reduction in firewood usage, especially in the regions where complementary policies support sustained LPG consumption.

Comparing the adoption of clean cooking fuel (like LPG, electricity, or biogas) between India and Jammu & Kashmir (J&K), using NFHS-5 data (2019–21). In India, household electrification has advanced faster than the transition to clean cooking. As of NFHS-5 (2019–21), 96.8% of India's population lives in electrified households, yet only 58.6% of households use clean cooking fuel (urban 89.7%, rural 43.2%), leaving roughly 41.4% still reliant on polluting options. Jammu & Kashmir (J&K) reflects similar dynamics but at a comparatively higher level of clean-fuel adoption: 99.3% of its population lives in electrified households, and 69.2% of households use clean cooking fuel (urban 95.8%, rural 58.9%). Despite this lead over the national average, a substantial rural gap persists, mirroring India's broader urban–rural disparity. This can also be observed from the given table below,

Table 5.1: Clean cooking fuel adoption, a comparison between India and Jammu & Kashmir



Source: NFHS-5 (2019-21): Outlook Business (2023); Kashmir life (2021)

Taken together, the figures underscore that while electrification is near-universal, clean cooking access still lags nationally and in J&K necessitating targeted policies that accelerate rural transitions, sustain LPG affordability and refills, and support adoption of other verified clean options.

5.4 Issues and Challenges

In 2012, the retail price of a 14.2-kg LPG cylinder was about INR410 after subsidies. By 2022, it rose to over INR1000 in most Indian states as subsidies ended. This likely hampers LPG adoption among poor rural households. Bureaucratic biases against the poor lead politicians to provide LPG connections as a means of gaining votes. Political economists show that reforms shifted political rent-seeking from licenses to distributing public resources like LPG and electricity to the poor. Source: Petroleum Planning & Analysis Cell

Key Challenges in the Clean Cooking Sector (As per National Energy Policy, NEP 2017 by NITI Aayog)

- Low Policy Priority (until PMUY): Clean cooking fuel did not receive significant national attention until the launch of the Pradhan Mantri Ujjwala Yojana (PMUY). As a result, over 40% of the population continues to rely on solid biomass and inefficient cookstoves, with severe health impacts, particularly on women and infants.
- Rural–Urban Divide: A clear disparity exists in access to modern cooking fuels. Unlike urban households, rural households lack diverse fuel choices and often resort to fuel stacking, combining traditional and modern fuels.

- Dependence on LPG Imports: Nearly half of India's LPG demand is met through imports. The absence of a stable market limits the supply of non-subsidised cylinders, while inadequate infrastructure and supply chain constraints make it difficult to scale up LPG imports under PMUY.
- Slow Adoption of Improved Cookstoves: Despite three decades of government intervention, less than 1% of rural households use improved cookstoves. The market remains underdeveloped, with few manufacturers, limited adherence to design/testing standards, and lack of profitability. Challenges related to research and development, fiscal incentives, and after-sales service further hinder large-scale adoption.
- Information Gaps: Limited awareness persists regarding the long-term health and environmental benefits of clean cooking fuels, as well as the harmful effects of traditional fuels and inefficient cookstoves.

On the other side Jammu and Kashmir faces the numerous challenges like despite progress, rural remote and isolated areas still face logistical problems, some regions report lower refill frequency due to transportation issues or lack of awareness, there are challenges in safety practices as well, which require continuous training. https://jakeda.nic.in

Despite the PMUY's initial success in facilitating LPG access, sustaining its usage remains challenging.

6. POLICY IMPLICATIONS AND SUGGESTIONS

Promoting LPG as a clean cooking fuel in the country is expected to reduce dependence on firewood. Budget support will be required for poorer households, Rural areas still lack access to efficient energy solutions, thus Improvement in the supply of modern fuels in rural areas is vital and ensuring basic infrastructure for them should be the policy priority.

Investigators should use an appropriate, and reliable survey method for the purpose of identifying the targeted beneficiaries of the schemes. So that the benefits should reach to the needy. For that transparency is essential in implementing government policies and programs at the grassroot level.

The focus of the policy should be the targeted strategies, government interventions and address the local and community-specific discrepancies for the sustained LPG use.

All the socio-economic and cultural factors are interconnected, and addressing them together can speed up the transition toward cleaner, more sustainable cooking practices. Further policy efforts should also consider gender norms, and attitudes, Safety and awareness program that hinder the adoption of cooking gas by the households and also address the unique challenges faced by the beneficiary households.

7. CONCLUSION

Overall, transitioning to clean cooking fuels not only improves individual health but also contributes to broader public health improvements in the community. Continued efforts to enhance access to these fuels are crucial for achieving better health outcomes in Jammu and Kashmir. Hence, from the study it is concluded that J&K performs better than the national average in clean cooking fuel adoption, both in rural and urban areas, but rural households in both cases still lag far behind urban ones. Thus, in order to enhance the adoption rate and access to clean cooking fuel in rural it is important to address the barriers and challenges faced by the targeted beneficiary households.

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