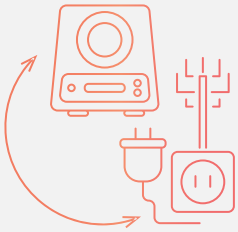

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Briefing Note
Electric cooking as an alternative to Liquified Petroleum Gas (LPG) in Tamil Nadu

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Purpose

This document explores opportunities of partially replacing Liquefied Petroleum Gas (LPG) with electric cooking solutions in Tamil Nadu.

Key messages

- Switching from LPG to electric cooking is expected to result in 36% to 43% energy cost saving to homes.
- Fuel stacking i.e. using a mix of both electric cooking and LPG cooking will be an optimal solution to reduce dependence on LPG and scale electric cooking.
- Ensuring a reliable electric supply in both urban and rural areas can drastically help scale up the adoption of electric cooking.

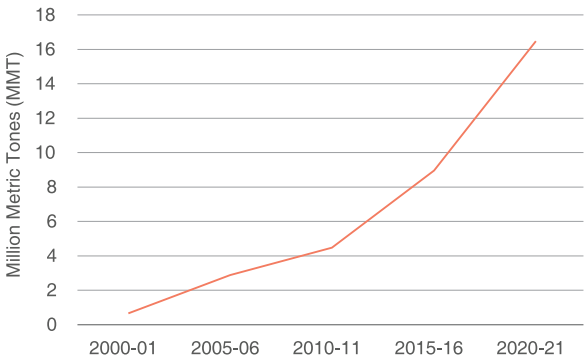
Background

Traditionally, India's cooking fuel needs were met with biomass. The use of biomass caused various health and environmental implications.

Over the years, supported by Government subsidies, India transitioned to cleaner cooking fuels such as LPG. Government aided subsidy schemes like Pradhan Mantri Ujjwala Yojana (PMUY) and Pratyaksh Hanstantrit Labh (PAHAL) helped increase the LPG connection numbers from 62% up until 99.80% from 2016 to 2021 (PMUY) .In 2021, the country had 2,895 lakh active LPG consumers. The state of Tamil Nadu alone had 216 lakh active domestic LPG consumers in 2021 (PPAC 2021 b).

India has become the second largest importer for LPG in the world, with LPG imports increasing drastically from 2001 onwards, touching 16.5 million metric tons in 2021 (refer to figure 1). The import dependency of India for LPG stands at around 57% (PPAC 2022).

Figure 1 LPG imports from 2001 to 2021



Source: Petroleum Planning and Analysis Cell (PPAC 2021 a)

With increased imports and high global inflation rates, the price of LPG cylinders have drastically risen. As of June 2022 the cost of an unsubsidized LPG cylinder (14.20 kg) in Tamil Nadu stood at INR 1,018.50, this represents a 32% cost increase as compared to the cost in June 2021 at INR 770.50 per cylinder (Good Returns 2022).

The PMUY scheme that was introduced in 2016 enables eligible consumers to avail an amount INR 1,600 for a new LPG connection (PMUY). Since 2013, the direct benefit transfer scheme for LPG or PAHAL allowed domestic consumers to receive subsidies on LPG cylinders directly to their bank accounts (PAHAL).

In wake of the pandemic in 2020, the LPG subsidies were withdrawn as the global oil and gas prices dipped. In May 2022, owing to the increase in the price of LPG cylinders, a subsidy of INR 200 per cylinder was announced for eligible households (NewsonAIR 2022).

Considering the country's high LPG prices, the instability in global trade and the high import dependency, the need to explore complementary and alternative energy sources for domestic and commercial cooking presents itself. Electric cooking is such an alternative, it is an easily adaptable and techno-commercially viable solution.

Electrical cooking cannot be scaled without universal access to reliable electricity supply. Electricity access has increased steadily from 56% in 2000 to 96% in 2020. As of 2022, 98% of Tamil Nadu's population has access to electricity (CEEW 2020 a). The average daily electricity supply in Tamil Nadu is around 23 hours, both in the urban and rural areas (CEEW 2020 a).

With an adoption rate of 17%, Tamil Nadu stands as one of the states with the highest adoption of electric cooking in India. Electric cooking is majorly adopted by the urban households (CEEW 2021).

Energy Cost Model

A high level cost comparison of cooking with LPG or electricity is undertaken.

LPG cost per kWh

For the sake of comparing LPG with electric cooking, the per unit costs have been converted to kWh. In the below Table 2, the cost per unit of LPG has been computed and found to be INR 5.60 kWh.

Table 2 Computing cost of LPG per kWh

LPG cost per kWh	Value	Unit
Cylinder volume	14.20	kg
Energy density*	46.10	MJ/kg
Energy per cylinder	654.62	MJ
Energy per cylinder	181.98	kWh
Cost of cylinder*	1,018.50	INR
Cost per unit	5.60	INR/kWh

**Sources: Energy density : Reji Kumar Pillai 2021*
Cost of cylinder :Good Returns 2022
MJ to kWh: Unitconverter

Cost savings per unit

Table 3 below indicates the per unit cost savings in percent of using electric coil cooking and induction stove over LPG. The per unit cost of usable energy, after considering efficiency losses of the respective appliances is compared. INR 6.60 per kWh has been assumed as the cost for electricity, this is equal to the highest tier of the domestic electricity tariff in Tamil Nadu. Savings of 36% and 43% from electric and induction cookstoves over LPG is expected.

Table 3 Cost savings from switching to electric cooking

Energy Cost Model	LPG Stove	Electric Coil Cooktop	Induction stove
Cost per kWh	5.60	6.60	6.60
Efficiency*	40%	74%	84%
Cost per kWh after efficiency losses	13.99	8.92	7.86
Savings INR/kWh		5.07	6.13
Savings %		36.26%	43.84%

**Source for efficiency rates: Bijli Bachao 2016*

Case study- energy cost modelling

An energy cost modelling (refer to Annexure 1) was carried out to determine the savings and payback of replacing LPG cooking with electric cooking completely (100%) and partially (50%).

A total annual LPG consumption of 12 nos. cylinder was assumed and a double burner induction stove of an initial investment INR 13,000 was considered.

The annual savings were found to be INR 6,456 and INR 3,228 for complete and partial replacement of LPG with electric cooking with an attractive payback on electric cooking investment of 2.01 and 4.02 years respectively. The average lifespan of an induction stove is 10,000 hours (Inductioncooking), or approximately 9 years assuming an average of 3 hours cook time each day. Thus the payback on electric cooking is attractive.

Table 4 Savings by replacing LPG with an induction stove

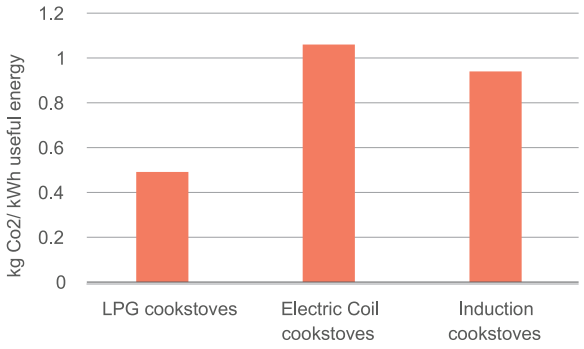
Financial Parameter	100% replacement	50% replacement	Units
Annual savings	6,456	3,228	INR
Simple Payback	2.02	4.02	years

Source: Refer to Annexure 2

Emissions comparison

The carbon emissions impact of using LPG, electric coil and induction cookstoves based on the per kWh of useful energy output of the three types of cookstoves is shown below in figure 5.

Figure 5: Emission comparison



Source: Refer to Annexure 2

It is evident that in numbers ,the total CO2 emissions from LPG is much lesser than that of electric cooking. However the emissions for transporting and supplying LPG have not been accounted for. Additionally, with an increase of renewable energy in the electric grid the emission comparison is expected to tilt to the favour for electric cooking in the near future. Moreover, electric cooking provides more thermal comfort as LPG cooking causes more heat dissipation indoors.

Drivers & Barriers for electrial cooking

The drivers

High cost of LPG: LPG price has risen drastically and as of May 2022 tipped at INR.1,018 for a 14.20 kg cylinder in Tamil Nadu. With the un availability of subsidy for many households, electric cooking becomes an economic viable option.

Heavy import dependence: India is heavily dependent on meeting its LPG demand through imports. The LPG imports for India has grown at around by 82% (PPAC 2021a) from 2010 until 2021. The high import dependency compromises India's energy supply security.

Barriers

Grid reliability: One of the barriers of scaling e-cooking is grid reliability and outages, in particularly so in rural areas.

Culture: There is also a knowledge gap in the use e-cooking appliances which may slower the scale of adoption (CEEW 2020 b).

Upfront cost of appliances: The upfront cost of e-cooking appliances like microwaves, rice cookers and induction stoves etc. may discourage people from using them specially for low income households.

Recommendations

Some recommendations for the promotion or e-cooking in Tamil Nadu are listed below:

Reliable power supply: Ensure reliable power supply for both rural and urban areas. To ensure reliable power supply, strategic investment into maintenance and upgradation of the electrical distribution network will need to be undertaken.

Fuel stacking: Fuel stacking i.e. adopting a mix of LPG and electric cooking will prove beneficial in the scaling of electric cooking.

With the availability of highly efficient appliances like electric pressure cooker that consume only 0.16 kWh of electricity per hour, partial replacement of LPG becomes easy and efficient (Reji Kumar Pillai 2022). Fuel stacking is therefore a transitionary step to help the scaling up of electric cooking.`

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Annexure 1: Energy Cost Model

Assumptions	Value	Unit
Annual no of gas cylinder usage	12	nos
LPG cylinder cost (14.2 kg)*	1,018.50	INR/cylinder
Annual cost of gas	12,222.00	INR
Energy per cylinder*	181.98	kWh
Annual gas use in kWh	2,183.81	kWh
Efficiency*	40%	%
Annual gas use in kWh after efficiency	873.52	kWh
Equivalent cost of electricity	5,765.26	INR
Annual savings if LPG is 100% replaced by electric cooking	6,456.74	INR
Annual savings if LPG is 50% replaced by electric cooking	3,228	INR
Purchase cost of induction stove (two burners)*	13,000.00	INR
Simple payback if LPG is 100% replaced by electric cooking	2.01	Years
Simple payback if LPG is 50% replaced by electric cooking	4.02	Years

*References:
LPG cylinder cost: Good Returns 2022
Efficiency: Bijli Bachao 2016
Purchase cost of induction stove : Mirrorless Prestige

Annexure 2: Carbon Emissions Calculation

Description	Value	Unit
Emissions from one kg of LPG*	2.21	kg Co2
Emissions from one LPG cylinder of 14.2kg	35.76	kg Co2
Emissions per kWh of LPG	0.19	kg Co2
Emissions per kWh of LPG (factoring 40% efficiency)	0.491	Kg Co2
Emissions per kWh of electricity *	0.79	kg Co2
Emissions from electric coil stove (factoring 74% efficiency)	1.06	kg Co2
Emissions from induction stove (factoring 84% efficiency)	0.94	kg Co2

*References:
Energy in one LPG cylinder: Refer to Table 4
Emissions from one kg of LPG: GHGP 2017
Emissions per kWh of electricity: CDM CO2 database