Subsidizing Bottled Gas: Approaches and Effects on Household Use

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ESMAP’s analytical and advisory services are fully integrated within the World Bank’s country financing and policy dialogue in the energy sector. Through the World Bank Group (WBG), ESMAP works to accelerate the energy transition required to achieve Sustainable Development Goal 7 (SDG7) to ensure access to affordable, reliable, sustainable, and modern energy for all. It helps to shape WBG strategies and programs to achieve the WBG Climate Change Action Plan targets.
Summary

To help households shift to cleaner cooking fuels, many governments have subsidized liquefied petroleum gas (LPG) in the past and some continue to do so. In a number of developing countries, these subsidies have evolved in their delivery mechanisms from universal price subsidies to conditional cash transfers or subsidy elimination with strengthened social protection, although price subsidies have been observed to return from time to time after their “removal,” including in 2021. This review of LPG subsidy policies in nine developing countries finds that El Salvador, Indonesia, India, and Peru have price subsidies today, but with the exception of Indonesia, the other three countries have moved from universal price subsidies to targeted cash transfers conditional on LPG purchase. Brazil, the Dominican Republic, and Senegal had announced a policy to end price subsidies but did not maintain the policy consistently and universal price subsidies returned, covered by the national oil company in Brazil for more than a decade until several years ago and by the budget to this day in the latter two countries. Ghana and Mexico have not had a policy reversal after ending the LPG price subsidy. Ghana however has been subsidizing the initial cost of LPG adoption in rural areas.

Conditional cash transfers based on eligibility criteria for beneficiaries are more cost-effective than universal price subsidies and have been enabled by advances in mobile and other information technologies. Cash transfers can in principle enable implementation of market-based pricing at the point of sale, thereby reducing economic distortions and leakages. Replacing universal price subsidies with cash transfers has helped slash diversion, black marketing, and fiscal burdens on governments, LPG suppliers, or both. While encountering a range of teething problems, governments have continued to improve the delivery mechanisms for conditional cash transfers.

Whether conditional or unconditional cash transfers should be preferred depends on the country circumstances. Conditional cash transfers may be appropriate for merit goods, among which is arguably clean and convenient cooking. However, such support for LPG is not technology-neutral and can become a case of governments’ picking a winner. Unconditional cash transfers are technology-neutral and can help the poor meet their most pressing needs but do not specifically promote consumption of merit goods. For the same degree of targeting, conditional cash transfers cost less because not every eligible beneficiary chooses to purchase LPG. If the specific country circumstances make clean energy options other than LPG impractical or not always available, conditional cash transfers for LPG may merit serious consideration.

Examined evidence suggests that price subsidies—whether at the point of retail or offered in the form of conditional cash transfers—have boosted household use of LPG. Self-selection has not worked for universal price subsidies: even when a large price subsidy is offered only for LPG sold in inconveniently small cylinders, the rich have chosen price subsidies over convenience. Start-up subsidies covering the initial cost of LPG adoption can help poor households, but without continuing price subsidies, many have discontinued LPG use later. Even among those who continue to use LPG, abandonment of traditional stoves using solid fuels—a necessary step for fully realizing the benefits of universal access to clean modern energy—has been much more challenging to achieve.
Abbreviations

ACCESS  Access to Clean Cooking Energy and Electricity Survey of States
AHL TIN  Abridged Household List Temporary Identification Number
BPL  Below the poverty line
DBTL  Direct Benefit Transfer for LPG
ESMAP  Energy Sector Management Assistance Program
FISE  Fondo de Inclusión Social Energético (Energy Social Inclusion Fund)
FOB  Free on board
GDP  Gross domestic product
GJ  Gigajoules
HHI  Herfindahl-Hirschman Index
IMF  International Monetary Fund
kg  Kilogram(s)
kWh  Kilowatt-hour(s)
LPG  Liquefied petroleum gas
NFHS  National Family Health Survey
NSSO  National Sample Survey Organization
Osinergmin  Organismo Supervisor de la Inversión en Energía y Minería (Supervisory Body of Investment in Energy and Mining)
PM$_{2.5}$  Particulate matter with an aerodynamic diameter of 2.5 microns
PMUY  Pradhan Mantri Ujjwala Yojana (Prime Minister’s Lighting Scheme)
PPP  Purchasing power parity
SDG  Sustainable Development Goal
SECC  Socio Economic and Caste Census
SISFOH  Sistema de Focalización de Hogares (Household Targeting System)
WBG  World Bank Group
µg/m$^3$  Micrograms per cubic meter
Households cook with either electricity or gas in countries that have attained universal access to clean modern energy. In such countries, those who want to cook with gas but do not have access to natural gas pipelines—which typically include all rural households—use liquefied petroleum gas (LPG). Many developing country governments began promoting LPG with subsidies and other means in the 1980s and 1990s to fight deforestation. In the last two decades, however, there has been a growing recognition that deforestation is caused largely by agriculture (FAO 2020), and the policy focus for household energy has shifted to controlling damage to public health from household air pollution and enhancing gender equality. The universal access component of the United Nations Sustainable Development Goal 7 is about adoption of clean modern household energy, of which LPG is one form.

LPG is more expensive than most other fuels and its prices on the world market are also highly volatile, making regular use of LPG challenging for many households who are not well-off. Figure 1 shows the history of free-on-board (FOB) prices in three benchmark markets since 2003 expressed in 2021 U.S. dollars. There are regional differences. For example, the North American prices began to fall below those in other regions in 2010 and markedly so in 2012 and 2013. If a country experiences material currency depreciation, these price fluctuations may be amplified further.

**Figure 1: Global LPG prices in 2021 U.S. dollars**


Note: LPG consists mainly of propane and butane, the exact proportions of which vary by country. Propane and butane prices are approximately the same and the plotted data are for propane. The Arab Gulf sets benchmark prices for Asia and east Africa, while Mont Belvieu sets benchmark prices for the Americas.

The minimal monthly income required to afford regular use of LPG is high in times of high global LPG prices. To arrive at end-user costs, to the FOB prices must be added the costs of shipping, storage, inland transportation, bottling, distribution (typically by trucking bottled cylinders), retailing, and any taxes and fees. These costs could add US$0.25 per kilogram (kg) and frequently more before taxes and fees. Depending on the region, the FOB prices have varied by a factor ranging from 6 to 8.5 since January 2003. US$0.25 per kg can be added to the FOB prices to arrive at lower bounds on end-user prices, which can be used to calculate minimal monthly income needed before LPG becomes affordable in the absence of any subsidies. The multi-tier framework for access defines affordability as spending no more than 5 percent of the household income on cooking, inclusive of stove and other acquisition costs (Bhatia and
Regular use of LPG for cooking requires at least 10 kg per month and preferably 15 kg or more (Kojima 2011). At 10 kg per month, the minimal monthly household income required would have varied from US$80 to US$335, far beyond the reach of many households in developing countries. At 15 kg per month, the corresponding income figures would have risen to US$120–US$500.

Until recently, subsidies for household use of LPG were dominated by (often universal) price subsidies with varying delivery mechanisms (see Kojima 2018 for different delivery mechanisms) and unintended, even if predictable, consequences. Universal price subsidies typically take the form of artificially low prices for LPG sold in non-commercial-size LPG cylinders, about 15 kilograms (kg) or smaller. The adverse effects of such price subsidies are well-known and can be found elsewhere (Kojima 2013). Briefly, LPG price subsidies—and universal ones in particular—tend to be captured disproportionately by the better-off, who are also better placed to exert political pressure on governments to maintain the subsidies; are vulnerable to large-scale diversion to those not eligible for price subsidies, black markets, and fuel smuggling; frequently lead to unsustainable fiscal burdens and declining sector performance; and have resulted in fuel shortages, in some cases acute, chronic, or both.

More recently, in an attempt to reduce increasingly unsustainable price subsidies, some governments have replaced them with cash transfers. Conditional cash transfers are contingent on the beneficiaries purchasing LPG, while unconditional cash transfers provide cash assistance whether or not the beneficiaries purchase LPG. As a means of substituting price subsidies, conditional cash transfers may be targeted or untargeted, while unconditional cash transfers are nearly always targeted. Where they enable market-based pricing to replace artificially low prices set by the government, economic distortions from price subsidies are reduced substantially, although some distortions remain under conditional cash transfers because sellers know that the effective LPG prices paid by the cash recipients remain artificially lower. If targeted and confined to the poor, conditional cash transfers would require a smaller budgetary allocation because not all poor households would choose to buy LPG—only a portion of the cost is offset by the conditional cash transfer and the poor would still have to pay cash for the balance. Unconditional cash transfers, on the other hand, removes one layer of administration—having to verify each purchase—and can be integrated into a broader social protection program to help the poor purchase the basket of essential goods and services they need. Because unconditional cash transfers do not require fuel purchase, they are not classified as fuel subsidies (see Kojima 2018 for the definition of energy subsidies) and require a larger budgetary outlay than conditional cash transfers for the same degree of targeting.

LPG safety is one of the frequently cited barriers to LPG use by households, and cylinder ownership and refill arrangements significantly influence LPG safety. There are two ways by which customers obtain cylinder refills: (1) centralized system of filling, and (2) decentralized, bulk-supplied system with mini-filling plants. The latter model poses a much greater threat to public safety (Kojima 2011). For this reason, nearly all markets have the centralized system. In the countries covered in this paper, the decentralized system is the dominant mode only in Ghana, which has been attempting to switch to the centralized system but unsuccessfully to date. By virtually eliminating local commercial transport of cylinders, the decentralized system can substantially slash costs for LPG marketing companies, and conversely increase the indirect costs for consumers who are entirely responsible for cylinder delivery.

Selling LPG in small quantities makes the fuel more affordable to the poor but is costlier for each kg sold. LPG is a gas at normal temperature and pressure and must be compressed in cylinders to liquefy and sell it in fixed quantities. There are large economies of scale in LPG bottling and cylinder management and hence the smaller the cylinder size, the higher the unit cost. Globally, LPG markets have experimented with a range of cylinder sizes but markets with no price controls have settled on cylinders larger than 10 kg as striking the balance between affordability and supply cost, with smaller cylinders reserved for
camping and occasional outdoor cooking. For example, the LPG industry in Turkey experimented with cylinder sizes of 2, 3, 5, 6, and 12 kg, and eventually chose to retain only 2 and 12 kg, with 2 kg reserved primarily for camping (Matthews and Zeissig 2011). Safety inspection and maintenance also become costlier with small cylinders because of the sheer number of cylinders in circulation. LPG is spiked with a harmless but pungent-smelling gas for leak detection. In markets with poor cylinder maintenance and poor cylinder and stove operation, consumers complain that LPG or food cooked with LPG has a bad smell, presumably because of leaks.

Many governments have spent billions of dollars over the past several decades subsidizing household use of LPG. Against that backdrop, this paper examines nine countries with LPG subsidy histories—all of which have found the subsidies to be unsustainable—to probe what steps have been taken to promote household use of LPG and how LPG use has changed as policies and implementation measures have evolved, giving special attention to adoption of LPG by less well-off households if information is available. The nine countries have been selected based on (1) sizable use of LPG as the primary form of clean cooking in the country, (2) different subsidy histories and policies enabling illustrations and assessment of different approaches, and (3) the availability of sufficient data published by the government to enable analysis. The countries are discussed broadly in order of decreasing government control over pricing and budgetary support for LPG (Table 1). The table also shows the recent history of each country’s income classification by the World Bank, the population in 2019 (which gives an indication of the potential economies of scale and administrative costs of support delivery), gross domestic product (GDP) per capita in 2019 valued at the market exchange rate and purchasing power parity (PPP), and a brief description of the type of subsidies provided over the years.

**Table 1: Income classification of study countries and LPG subsidy features**

<table>
<thead>
<tr>
<th>Country</th>
<th>Income classification</th>
<th>2019 Population</th>
<th>2019 GDP per capita PPP</th>
<th>Subsidy features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesia</td>
<td>Moved from low income to lower middle income in 2003</td>
<td>271 million</td>
<td>$4,136 $12,335</td>
<td>Universal price subsidy for LPG sold in 3-kg cylinders with the initial goal of shifting households away from kerosene Subsidized LPG price frozen since January 2008 and available only from the national oil company</td>
</tr>
<tr>
<td>Senegal</td>
<td>Moved from low income to lower middle income in 2018</td>
<td>16.3 million</td>
<td>$1,447 $3,545</td>
<td>Ad-hoc price subsidies for LPG sold in 2.7-kg and 6-kg cylinders in spite of attempts to end them LPG price frozen since February 2016</td>
</tr>
<tr>
<td>Dominican Rep.</td>
<td>Moved from lower to upper middle income in 2008</td>
<td>10.7 million</td>
<td>$8,282 $19,228</td>
<td>Universal price subsidy replaced initially and latterly supplemented by targeted unconditional cash transfers Government control of LPG prices with price subsidies re-emerging from time to time Cross-subsidies across different-size cylinders have been retained</td>
</tr>
<tr>
<td>El Salvador</td>
<td>Lower middle income</td>
<td>6.45 million</td>
<td>$4,187 $9,164</td>
<td>Universal price subsidy replaced by targeted unconditional cash transfers, later changed to targeted conditional cash transfers for LPG Price ceilings for LPG sold in small cylinders set and adjusted from time to time by the government</td>
</tr>
<tr>
<td>Peru</td>
<td>Moved from lower to upper middle income in 2008</td>
<td>32.5 million</td>
<td>$6,978 $13,416</td>
<td>Universal price subsidy replaced in 2012 by sharply targeted conditional cash transfers for LPG sold in small cylinders Market-based pricing of petroleum products established in a 1993 law but not followed LPG pricing subject to pricing rules governing a fuel price stabilization fund until April 2020, resulting in</td>
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<tr>
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</tr>
<tr>
<td>India</td>
<td>Moved from low income to lower middle income in 2007</td>
<td>1.37 billion</td>
<td>$2,100</td>
<td>$6,997</td>
</tr>
<tr>
<td>Ghana</td>
<td>Moved from low income to lower middle income in 2010</td>
<td>30.4 million</td>
<td>$2,202</td>
<td>$5,652</td>
</tr>
<tr>
<td>Mexico</td>
<td>Moved from lower to upper middle income in 1990</td>
<td>128 million</td>
<td>$9,946</td>
<td>$20,944</td>
</tr>
</tbody>
</table>

Source: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups for income classification, World Development Indicators for population and GDP, and sources in the rest of the paper for subsidy features.

Some governments have concentrated their policy efforts on targeting subsidies while others, such as India, have focused on reducing loopholes in subsidy delivery that had enabled diversion, thereby reducing the cost-effectiveness and increasing the size of the price subsidies. The paper analyzes government statistics and publications, supplemented by studies carried out by independent researchers. To understand how people’s experience and perceptions have affected LPG use, information not directly related to LPG subsidies is also included, such as the safety of cylinder distribution and perceptions of LPG as a cooking fuel. Of the nine countries, India is covered most extensively because of many unique features of the revised subsidy program. Peru is also covered in detail on account of its sharp targeting of the LPG price subsidies. Where household use of LPG as the primary cooking fuel in the nine study countries has been published by their respective governments, such information is used. In the absence of more detailed information, national statistics on household use of LPG in tonnes per year are combined with the average household size from census and other data (using interpolation or extrapolation to fill in missing years) to arrive at household use of LPG averaged across all households. The latter calculations capture the combined effects of two factors, the share of households using LPG and the quantities of LPG consumed by LPG-using households. Currency conversions use the exchange rate in effect in the relevant time period. For example, a price set by a decree in 2004 is converted using the exchange rate in 2004.

The paper presents the nine country cases and draws lessons in the concluding section. Indonesia, which is the only country in this paper that has retained universal price subsidies to date, is covered first. Senegal, with repeated attempts to end price subsidies followed by re-introduction, is described next, followed by the Dominican Republic and El Salvador, two countries that have replaced universal price subsidies with cash transfers. Peru, which has set strict targeting criteria for conditional cash transfers,
and India, the conditional cash transfer program of which is the largest program of its kind in the world, follow. Three countries with deregulated pricing of LPG and no government assistance today for LPG purchase—Ghana, Brazil, and Mexico—are discussed last.

Country Cases

Indonesia

Indonesia has subsidized LPG for decades and has the lowest retail price of the nine countries studied, the longest period of freezing the price (since January 2008), and the smallest-size cylinder for subsidized LPG. Indonesia is also the only country that has closely linked the LPG subsidy for more than a decade to kerosene subsidy removal, which consists of removing subsidized kerosene from the market altogether as the LPG starter-kits are distributed free of charge. Subsidized LPG is intended to be only for households and small operators of businesses, fishing boats, and farms (although these small operators would not be using kerosene for their activities). The LPG subsidy is delivered exclusively by the national oil company, Pertamina.

After subsidizing kerosene and LPG for decades and in the face of mounting subsidies, the government in May 2007 launched a kerosene-to-LPG conversion program. The conversion program would replace subsidized kerosene with subsidized LPG and make subsidized kerosene unavailable. The fiscal rationale was the higher efficiency of LPG stoves, theoretically reducing the total subsidy for the same amount of cooking and therefore the government’s subsidy bill for kerosene and LPG combined. One benefit of the program would be contribution to universal access to clean modern energy.1 To that end, the government distributed free starter packages—consisting of an LPG stove, a 3-kg cylinder filled with LPG, a hose, and a regulator—to households, microbusinesses, and small fishing boats, and later extended the scheme to farmers. The initial goal targeted 42 million households and micro-businesses, raised to 53–56 million within three years. The priority areas were those with LPG infrastructure and high kerosene consumption. The allocation of subsidized kerosene would be cut in half if LPG starter kits had been distributed to 80 percent of the targeted consumers, and, barring serious disturbances, the kerosene withdrawal amount would be increased by a minimum of 10 percent in the following weeks until complete withdrawal had been achieved (Budya and Arofat 2011).

Initially the conversion program faced several challenges. When the program was first launched, it met with a large number of protest actions, sometimes with thousands of protesters chanting “Resist conversion.” The prices of both kerosene and LPG rose significantly, contributing to inflation, and kerosene prices in particular rose by 150–200 percent from May to December 2007. Subsidized kerosene was also illegally diverted from areas where it was still available to areas where it had been withdrawn, creating kerosene shortages. At the same time, the first year of the conversion program also saw LPG shortages, resulting in simultaneous scarcity of both kerosene and LPG. These problems were addressed over time, and by the end of 2009, 44 million starter kits had been distributed (Budya and Arofat 2011). As of September 2020, the government reported that the program had reached 57.7 million households and micro-enterprises in 29 provinces out of 34 (Indonesia 2020a).

The substantial unit price difference between LPG sold in 3-kg cylinders and all other sales of LPG has provided powerful financial incentives for illegal diversion of subsidized LPG sold in 3-kg cylinders to larger cylinders and bulk sale. The wholesale price of LPG sold in 3-kg cylinders has been fixed at Rp

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1 High-pressure kerosene lamps and stoves are clean when properly operated, but wick kerosene stoves and lamps can be highly polluting.
4,250 (US$0.33)/kg since January 2008. Once distribution and retail margins are added, the refill cost rises to Rp 5,300 or higher per kg in Jakarta.\(^2\) By contrast, LPG sold in 5.5-kg and 12-kg cylinders are much costlier, priced at about Rp 12,000 per kg in March 2021. In the first few years of the kerosene-to-LPG conversion program rollout, there was a spate of headlines from across the country about LPG cylinder explosions, injuries, and deaths, caused in part by attempts to siphon off LPG from small cylinders and transfer it to larger cylinders. The number of reported accidents rose from 9 in 2007 to 64 in 2008, 90 in 2009, and 352 in 2010, before falling to 59 in 2011 and 8 in 2012 (Thoday et al. 2018). One news report in July 2010 cited at least 22 deaths and 127 injured since the inception of the program (Asia Pulse 2010). The accidents were due to a combination of factors, including problems with accessories, lack of familiarity with proper use of LPG, illegal manufacturing and distribution of cylinders, and unsafe environmental conditions (Budya and Arofat 2011). These reports raised concerns about the safety of LPG use and the government and Pertamina have taken steps to address the concerns.

The government’s price control over “blue” cylinders has additionally forced Pertamina to devise marketing schemes to minimize its financial losses, even citing greater safety as a benefit of purchasing unsubsidized LPG. There are two categories of LPG price subsidies in Indonesia, one provided by the government and the other covered by Pertamina. In addition to the budget-financed subsidy for LPG sold in 3-kg cylinders, the government controls the price of LPG sold in blue 12-kg cylinders. As a result, depending on the global LPG price, LPG in blue cylinders is subsidized by Pertamina and yet not reimbursed by the government. To reduce financial losses, Pertamina in 2013 introduced Bright Gas, which is sold with no subsidies in exchange for greater safety in the form of improved valves to reduce chances of gas leakage (Koran Tempo 2013). Cylinders are color-coded and Bright Gas has been sold in pink 12-kg cylinders since 2014 and pink 5.5-kg cylinders starting in 2015. Bright Gas in 3-kg cylinders has also been launched but appear to be largely unavailable, presumably for a lack of demand. In 2017, Pertamina reported that LPG consumers were shifting from 12-kg cylinders to 3-kg cylinders to take advantage of the large price subsidy (Reuters 2017).

From the point of view of progress toward universal access and when measured by the share of households citing LPG as the primary cooking fuel, selling LPG at less than US$0.50 per kg for years on end irrespective of the world price movement has been successful. Annual household surveys show that only one-tenth of households used LPG as the primary cooking fuel in 2007, the beginning of the kerosene-to-LPG conversion program (Figure 2). Over the next decade, this share rose to four-fifths, a significant achievement by any measure.

**Figure 2: Share of households citing LPG, kerosene, and firewood as the primary cooking fuel**

\(^2\) https://www.pertamina.com/id/offline--faq-direktorat-pemasaran-retail--lpg-3kg.
Exclusive use of LPG, however, remains an aspirational goal. To minimize the emissions of harmful pollutants and capture the full benefits of using clean household energy, a household should be using only electricity and LPG (or another gaseous fuel, such as biogas) and stop using traditional biomass altogether. Two surveys of LPG-using households show that only a small percentage of households became exclusive users of LPG. A survey of 550 urban and rural households in central Java in 2010 showed that households using exclusively LPG increased from 2.2 percent before the conversion program to 19.5 percent after, while a survey in 2013 of 1,434 peri-urban households in Yogyakarta City in central Java found that 27 percent were exclusive users of only electricity and LPG but all others used wood in addition (Thoday et al. 2018).

From the point of view of reducing the subsidy bill, the program has not been successful, to a large measure because of the very large unit subsidy and its universal nature that make cheap LPG available to any household. The kerosene consumption and its subsidy fell rapidly, but the LPG subsidy rose just as rapidly, and LPG imports nearly doubled between 2011 and 2015 (OECD 2019). As a result, the sum of the kerosene and LPG subsidies did not decline. For example, while the global prices were lower in 2016 than in 2009 (Figure 1), the combined subsidy bill was higher in nominal terms and marginally lower in real terms in 2016.

**Figure 3: Comparison of LPG and kerosene consumption and subsidies**

Recognizing the growing burden of a universal price subsidy and its regressive nature, the government began designing a targeted LPG subsidy at the end of 2016. The government had developed a unified poverty database capturing the bottom 40 percent of households to deliver essential social services to the poor. The same database can be used to make subsidized LPG available only to the bottom 40 percent. Such targeting would reduce the number of eligible households substantially. The pilot for the targeted subsidy was completed in mid-2019 (GSI 2020) but the targeted subsidy program has not been rolled out. The Ministry of Energy and Mineral Resources in September 2020 asked the government to budget for 7.5 million tonnes of subsidized LPG in 2021 (Indonesia 2020b), signaling that material implementation of the targeted subsidy delivery was not anticipated even in 2021.

Because the LPG price subsidy is available only from Pertamina, private participation in the LPG market for households is limited to one company, Blue Gaz, with a minimal presence even in Jakarta. Over the long run LPG pricing should ideally be deregulated in a market with fair, healthy, and vigorous
competition, but the monopoly position of Pertamina makes it difficult to introduce competition. As long as there is insufficient competition, there is a need for some form of economic regulation, thereby continuing to politicize fuel pricing.

In recent months, to address growing LPG price subsidies, the government began entertaining the notion of replacing LPG with dimethyl ether, another liquid fuel (Platts Oilgram News 2021). One proposal is to manufacture dimethyl ether from coal, increasing the carbon footprint of the cooking fuel. Dimethyl ether is not used as a cooking fuel anywhere in the world, and as with the kerosene-to-LPG conversion, it is unlikely that such a fuel substitution will serve as an effective means of subsidy reduction.

The kerosene-to-LPG conversion program in Indonesia, the basis of which is continuing the very large price subsidy for LPG, has increased the use of LPG as the primary cooking fuel from less than a fifth in 2007 to four-fifths of all households by 2019. The program encountered teething problems initially, such as supply shortages and commercial malpractice involving diversion of subsidized kerosene to ineligible regions, but the government and Pertamina have addressed them in due course. The program, however, has not been able to achieve the fiscal goal of reducing the net subsidy materially. And while Pertamina’s promotion of Bright Gas is understandable in the face of the company-financed subsidy, safety should not be the price that consumers have to pay for price subsidies. While the government of Indonesia and several other governments have based their LPG subsidy policy amongst others on the assumption that wealthy households value convenience over financial benefits and choose larger-size cylinders, the program experience shows that as long as subsidized LPG is substantially cheaper, even wealthy consumers choose cheaper LPG.

Senegal

Senegal is the poorest of the nine countries, is arguably least able to finance LPG subsidies, and has a checkered subsidy history. The government has “ended” LPG price subsidies several times, only to reintroduce them and has continued to provide them in 2021. Household survey data make clear that removing price subsidies depressed household use of LPG, and sharply so in the early 2010s.

Senegal began the so-called butanization program in 1974. The government exempted LPG-related equipment and appliances from import duties and promoted cooking appliances consisting of a stove mounted on top of a 2.7-kg cylinder. Both the stove and the cylinder were too small to meet the cooking needs of households. The government shifted from promotion of the stove-cylinder package to a price subsidy for LPG sold in 2.7-kg cylinders, later extended to LPG sold in 6-kg cylinders. The rationale for selecting cylinders as small as 2.7 kg is that refilling small cylinders would reduce the cash outlays for each purchase and would help the poor, while the rich would prefer the convenience of using larger-size (unsubsidized) cylinders. However, as in Indonesia and elsewhere, the rich chose to take advantage of LPG price subsidies and benefitted disproportionately from them.

Four decades of LPG subsidies followed, punctuated by periods of subsidy “reforms.” In 1985, the LPG subsidies were repealed as part of the engagement with the International Monetary Fund (IMF), but were brought back two years later following unrest. After more than three decades of LPG price subsidies, the IMF estimated in 2008 that not only were the subsidies fiscally unsustainable—in 2006 the cost of

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3 While deregulation over the long run is the policy goal of most governments, article 33 of Indonesia’s constitution—which states that “branches of production that are important to the state, … and natural resources … are to be controlled by the state and used for the greatest possible prosperity of the people. The national economy is run on the basis of … just efficiency”—is open to interpretation with respect to its implications for pricing policy and deregulation.
subsidizing LPG was 1.4 percent of GDP—they were not reaching their intended target, the low-income groups. The bottom 40 percent captured 19 percent of the welfare benefits of the LPG subsidy, against 61 percent of the top 40 percent (IMF 2008).

The government ended the LPG subsidy in June 2009 (IMF 2010). In 2012, in the face of a presidential election campaign, the government suspended the automatic pass-through of world fuel price changes, including LPG, by adjusting the value-added tax. LPG was subsidized in 2013 and 2014, but not in 2015 despite having been budgeted for. In February 2016, at a time of the lowest global price of LPG since 2003, the government stopped adjusting the price of LPG and allowed price subsidies to re-emerge and grow as the world prices rebounded. In real terms, the domestic price of LPG declined steadily by a cumulative amount of 6.5 percent between February 2016 and August 2020. By contrast, the global prices more than doubled between February 2016 and October 2018, and only on April and May 2020 did the global prices fall below the price in February 2016. Subsidy reimbursement arrears grew, and the government in 2020 committed to settling fuel subsidies within 90 days of verification (IMF 2013, 2018, and 2020).

The share of households using LPG as the primary cooking fuel has fluctuated in recent years, falling sharply from 2010 to 2013 and not beginning to recover until 2016. The historical patterns of household use of LPG can be gauged from the Demographic and Health Surveys (Table 2), which began asking questions about the primary cooking fuel in Senegal in the 2010–11 survey, about a year after the government (temporarily) ended the LPG subsidy policy.

**Table 2: Percentage of households using LPG as the primary cooking fuel in Senegal and associated price movement**

<table>
<thead>
<tr>
<th>Dates</th>
<th>Urban</th>
<th>Rural</th>
<th>National</th>
<th>Price movement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oct 2010–Apr 2011</td>
<td>59.3</td>
<td>5.1</td>
<td>31.6</td>
<td>The government ended the LPG subsidy in June 2009. The price used to be CFAF 2,500 for 6 kg but rose to CFAF 3,715 by January 2011.</td>
</tr>
<tr>
<td>Sep 2012–Jun 2013</td>
<td>48.9</td>
<td>2.7</td>
<td>25.3</td>
<td>The government suspended the automatic pass-through for a while in 2012 and the LPG price was subsidized in 2013. The price was CFAF 4,060 for 6 kg in January 2012, lowered to CFAF 3,700 by April 2012, and maintained at CFAF 3,700 until December 2012.</td>
</tr>
<tr>
<td>2014</td>
<td>41.6</td>
<td>6.1</td>
<td>25.3</td>
<td>The price was decreased to CFAF 3,280 for 6 kg by December 2014.</td>
</tr>
<tr>
<td>2015</td>
<td>41.6</td>
<td>3.8</td>
<td>23.5</td>
<td>The price for 6 kg was lowered from CFAF 3,280 to CFAF 3,230 in June 2015.</td>
</tr>
<tr>
<td>2016</td>
<td>49.5</td>
<td>5.8</td>
<td>29.0</td>
<td>The price for 6 kg was lowered from CFAF 3,280 to CFAF 2,885 in February 2016 and has been frozen since.</td>
</tr>
<tr>
<td>2017</td>
<td>47.5</td>
<td>5.0</td>
<td>27.0</td>
<td>CFAF 2,885 for 6 kg</td>
</tr>
<tr>
<td>2018</td>
<td>55.5</td>
<td>6.4</td>
<td>31.2</td>
<td>CFAF 2,885 for 6 kg</td>
</tr>
<tr>
<td>2019</td>
<td>46.2</td>
<td>7.4</td>
<td>27.0</td>
<td>CFAF 2,885 for 6 kg</td>
</tr>
</tbody>
</table>

*Source: Demographic and Health Surveys (https://dhsprogram.com/) for LPG as the primary cooking fuel and government announcements for prices.*

*Note: The category for LPG includes “natural gas” and biogas, but there is no natural gas supplied to households in Senegal and the proportion of biogas is sufficiently small as to be unlikely to affect the findings materially.*

Despite the price of LPG barely rising in real terms between 2009 and 2019, the rate of adoption of LPG as the primary cooking fuel in Senegal fell from 2010 to 2019. In the absence of data from previous years it is not possible to tell when the decline began but the use of LPG as the primary cooking fuel fell measurably starting in 2010–11. The government decreased the price of LPG in nominal terms in 2012.
and in the subsequent years, until the price was lowered in February 2016 to CFAF 483 per kg, which has translated to between US$0.77 and US$0.91 per kg as a function of the exchange rate since. Freezing of the retail price of LPG does not seem to have contributed to increasing use of LPG as the primary cooking fuel: the adoption rate in 2019 nationally matched that in 2017 and was lower than in 2010–11, and markedly lower in urban areas. The pattern between 2016 and 2019 is such as to suggest that the relatively high adoption rate in 2018 may even have been an outlier. Given the sharp increase in the price of LPG in 2010 and 2011, it is also possible that the high adoption rate found in 2010–11 is not accurate. Such possible inaccuracies, however, would make it difficult to draw conclusions about the impact of the pricing policy on household use of LPG.

Senegal illustrates the challenges of transitioning from decades of price subsidies to market-based pricing and the inevitable reduction in the household use of costlier, even if cleaner and more convenient, forms of energy once subsidies are removed. Upon ending price subsidies in 2009, the government initially adjusted prices frequently in line with the world price movement. But the steadily rising world fuel prices in the early 2010s combined with the prospect of a presidential election—which occurs only once every seven years—in 2012 led to a policy reversal. In March 2021, the price of LPG sold in 6-kg cylinders was the same in dollar terms as in June 2009 when the LPG subsidy had been ended, whereas the global LPG prices (also in dollar terms) were about a fifth higher. Despite no material rise in the domestic price of LPG between 2009 and 2019, if the above survey results from 2010–11 are broadly accurate, the use of LPG by households seems to have declined in the intervening years. Such a pattern may suggest that once a costlier fuel is abandoned in response to higher prices, restoring the old prices may not be sufficient to shift households back.

Dominican Republic

The Dominican Republic is the second richest country in this study when GDP is valued at purchasing power parity. It is one of the first developing countries to supplement universal LPG price subsidies with targeted unconditional cash transfers in a program called Bonogás Hogar in 2008. At the time the cash transfer program was described as one ending the price subsidy. The government earlier considered, but eventually abandoned for impracticality, a proposal to deliver an LPG price subsidy only to the poor. Bonogás Hogar uses a card that is also used for other social assistance programs. For simplicity, the government fixed the amount of monthly transfers in nominal terms, allowing the value to decline over time. The government regulates the prices of LPG and those of all other petroleum products and announces prices on a weekly basis. Law 112-2000 bases weekly adjustments on import parity but the government can provide subsidies. In the first quarter of 2021, the government paid for a price subsidy for LPG in addition to providing support through Bonogás Hogar.

The government was facing growing and unsustainable energy subsidies in the 1990s. In January 1995, LPG prices were raised and the market was disaggregated into “domestic” (households) and industrial consumers (including restaurants and hotels). The domestic LPG price had been frozen between January 1995 and August 2000 when Resolution 276 more than tripled the price of domestic LPG, raising it from RD$6 per gallon (US$0.19 per kg) to RD$19.23 per gallon (US$0.60 per kg). The government lowered the domestic LPG price to RD$13.50 per gallon (US$0.41 per kg) in 2001 but raised it by about 60 percent to RD$21.42 per gallon (US$0.60 per kg) in 2002 (IMF 2003).

Following the economic crisis of 2003, the government committed to a gradual removal of the LPG subsidy in Decreto No.168-2004. Bottled LPG is sold in four cylinder sizes: 15 pounds (6.8 kg), 25 pounds (11.4 kg), 50 pounds (22.7 kg), and 100 pounds (45.4 kg). The adopted measures segmented the LPG sector into subsidized and unsubsidized markets and terminated the price subsidy for LPG sold in
100-pound cylinders, while continuing the subsidies for domestic LPG and automotive LPG. The Social Cabinet was tasked with setting a mechanism to target the subsidy to the poor in 2005 in a way that would limit the price for the subsidy beneficiaries to RD$25 per gallon (US$0.31 per kg in 2004, US$0.42 per kg by 2005 due to currency appreciation).

In 2005, the government acknowledged that targeted LPG price subsidy delivered only to the poor could not be implemented effectively. First, many poor households were not using LPG. Second, a high proportion of subsidized LPG was used as an automotive fuel in both public and private transport, affecting a large segment of the population. In the face of a price subsidy for automotive LPG and a tax levied on gasoline, many vehicle owners chose LPG—an analysis in 2003 showed that the cost per kilometer (km) driven was halved by switching to LPG (Risk and Esener 2003). Third, if only poor households were to be targeted, the cost of monitoring eligibility could become prohibitive, making it unlikely that the government could stem diversion of subsidized LPG to the automotive sector. In mid-2005, the government decided to maintain the subsidy scheme but fix the subsidy at RD$17.35 per gallon (US$0.29 per kg).

The soaring of world fuel prices from 2006 to August 2008 forced the government to move to an assistance scheme targeting the poor but not through a price subsidy. In September 2008, the government ended the price subsidy for LPG and launched Bonogás Hogar as part of the Solidarity Program. Under Bonogás Hogar, the government issued 730,000 cards to poor families, providing unconditional monthly cash transfers of RD$228 (US$6.30 at the time, US$4.00 by May 2021), intended to reduce the purchase cost of LPG but without the requirement to purchase it. The cash transfer amount was based on the subsidy at the time and observation that households on average consumed 6 gallons (12 kg) of LPG a month. The so-called Progressing-with-Solidarity card offers assistance in six programs, of which the largest in terms of enrollment is Bonogás Hogar. Poor families identified by the government in the Unified System of Beneficiaries are eligible. According to the statistics released by the Social Subsidy Administrator in early 2020, Bonogás Hogar had benefitted about 1.1 million households since its inception at a cost of RD$25,805 million (US$608 million taking the exchange rate averaged between 2009 and 2019) to provide financial support to an average of more than 800,000 households at any given time out of about 3 million households in the country. A transparency website—set up in response to the Free Access to Public Information Law 200-04 and its associated decree No. 130-05—posts detailed data about the execution of Bonogás Hogar and other government programs. In March 2021, Bonogás Hogar had 924,405 beneficiaries.

The response of households to these developments follows an expected pattern (Figure 4). As the LPG price was increased markedly in the early 2000s, consumption fell and reached the minimum in 2003 as the financial crisis struck the country. Consumption rose gradually until the subsidy was replaced by unconditional cash transfers in 2008. Against the backdrop of a fixed nominal amount of the transfer since 2008 but with flexibility to spend the cash on other goods and services, household LPG consumption declined, plateaued, and then began to rise as the LPG price fell globally. By contrast, household consumption of wood fell steadily after 2000, indicating that a fall in the consumption of LPG had not been offset by higher wood consumption on the whole.

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4 http://transparencia.progresandoconsolidaridad.gob.do/.
LPG was by far the most widely used fuel for cooking in 2014. Information on the household use of LPG in 2014 is available from the Multiple Indicators Cluster Survey (ONE and UNICEF 2016). The survey found that 86 percent of all people, comprising 91.5 percent of urban and 69 percent of rural residents, used LPG as the primary cooking fuel. Nearly half (46 percent) of those in the bottom quintile cited LPG as the primary fuel, rising to 91 percent in the second quintile from the bottom and 97 percent in the third quintile. These statistics suggest that many poor households are using the cash transfers to reduce the cost of LPG purchase.

In 2021, against the backdrop of rising international LPG prices, the government froze the retail price starting in from January 16 to May 15, when the government intervened to subsidize LPG further and lowered the price instead of raising it. The prices of fuels other than LPG were also frozen, but LPG prices were frozen the longest while other fuel prices were raised from time to time, although still incurring varying degrees of price subsidies. Government regulation of LPG prices also sets the same unit price for LPG irrespective of the amount sold, making the unit price identical whether LPG is purchased in 11.4-kg cylinders or as much as 227 kg at a time. Because of very large differences in unit costs arising from economies of scale, such uniform pricing represents substantial cross-subsidies.

Targeting a price subsidy to the poor has been proposed by many governments as an option for reducing the subsidy bill, but the government of the Dominican Republic, after careful consideration, rejected it as impractical and vulnerable to diversion. Ending the LPG subsidy in 2008 led to a drop in LPG consumption—likely reflecting the spending priorities of less well-off households—which has been slowly recovering to the level from the subsidy era. The government regularly publishes data on Bonogás Hogar on its external website to inform the public. By freezing the monthly amount transferred, the government has allowed the assistance delivered through cash transfers to decline over time. These policy stances are worth considering where the government has the long-term political will and commitment to resist a reversal of price subsidy reform. In the case of the Dominican Republic, however, the government has reverted to introducing a price subsidy for LPG on an ad hoc basis, helped in part by the legal authority the government has to continue to control pricing of all fuels.

El Salvador

El Salvador replaced a universal price subsidy for LPG with targeted unconditional cash transfers in 2011, and then made the cash transfers conditional on LPG purchase in 2014, reducing the fiscal bill by 46

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5 https://www.micm.gob.do/noticias/.

percent in that year compared to no targeting and no requirement to purchase LPG. The reform in 2011 made the fiscal assistance much less regressive, but the “winners” of the reform initially strongly opposed it, citing the fear that the poor might be left out. The eligibility criteria are generous for households and cover the non-poor, and the scheme also provides for cash transfers to institutions and businesses using LPG for cooking. Unlike the Dominican Republic, the cash transfer amount is adjusted from time to time in line with the global LPG price movements. The government also sets price ceilings for LPG sold in cylinder sizes used by households.

Similar to the Dominican Republic, LPG is by far the most widely used cooking fuel in El Salvador. A 2014 Multiple Indicators Cluster Survey (El Salvador 2014) found that 76 percent of all people, comprising 90 percent of urban and 53 percent of rural residents, used LPG as the primary cooking fuel. The wealth distribution was more skewed than in the Dominican Republic, with only 21 percent of the bottom quintile citing LPG as the primary cooking fuel, rising to 71 percent in the second quintile, 93 percent in the third quintile, and 98 percent in the top two quintiles. The eligible beneficiaries were those connected to the electricity grid and consumed less than 200 kWh a month, those without access to the electricity grid and selected because of their socioeconomic status, certain types of subsistence businesses and non-profits using LPG for cooking, and public education facilities with school feeding programs.

About 6 percent of those entitled to receive the cash transfers did not claim them. The government estimates that the reform reduced the fiscal cost by US$37 million in 2011 from US$177 million to US$139 million and by US$82 million in 2012 from $220 million to $139 million (El Salvador 2015).

El Salvador is an interesting case because the political economy of the LPG subsidy reform initially defied expectations. The reform made the assistance substantially less regressive and was expected to improve the welfare of about three-quarters of the population. The poor, some of whom had not been purchasing LPG, received US$8.50 a month at first, rising to US$9.10 per month and maintained at that level for 30 months from June 2011 to December 2013. When used to purchase LPG, the cash subsidy reduced the refill cost of a 25-pound (11.4-kg) cylinder to less than US$7 at the most and as low as US$2 (El Salvador 2015). Yet the “winners” of the subsidy reform initially opposed it. In February 2011, the Archbishop of San Salvador spoke out about his concern that the poor might be left out. A survey in January 2011 about the proposed subsidy reform found an approval rate of only 30 percent, including only 28 percent among the bottom 40 percent of the income distribution. There was hardly a difference in the approval rate between those consuming more than 200 kWh a month (27 percent approved) and those consuming less (30.5 percent approved). The relatively high ceiling on electricity consumption allowed many households to become eligible. As households began receiving the cash transfers, the satisfaction rate rose steadily from 30 percent in January 2011 to 66 percent in August 2012 and stayed there; a survey conducted a year later in September 2013 showed a satisfaction rate of 64 percent.

A detailed analysis of the changes in the satisfaction rate with the targeted unconditional cash transfers found that the individual’s knowledge of the reform, trust in the government’s ability to deliver, and the individual’s political views explained on average about 70 percent of the survey responses. The level of satisfaction rose primarily because the government delivered as promised. Those who supported the party in power showed greater satisfaction than those who did not (Calvo-Gonzalez, Cunha, and Trezzi 2015).

The cash transfers were modified and made conditional beginning in 2013, and the conditional cash transfer program became fully operational in 2014. The subsidy was delivered through the Solidarity Card to eligible beneficiaries, who would receive a price discount equal to the monthly subsidy amount per household. Similar to the function of the Progressing with Solidarity card in the Dominican Republic, the Solidarity Card enabled consolidation of several benefits in a single instrument. The eligibility criteria
remained the same. However, the requirement to purchase LPG for subsidy disbursement reduced the percentage of households claiming benefits by another 12 percentage points (El Salvador 2015).

The savings from targeting beneficiaries and converting unconditional cash transfers to conditional cash transfers are plotted in Figure 5. Between April 2011 and December 2015, the total savings amounted to US$353 million, 59 percent of the disbursed payments (US$596 million) and 37 percent of what would have been disbursed in the absence of reform (US$949 million).

![Figure 5: Fiscal cost of support for LPG and savings in El Salvador](source: Adapted from El Salvador 2015.)

Between 2014 and 2018, the number of beneficiaries receiving the subsidy varied between 1.1 million and 1.2 million (out of about 1.8 million households), consisting of two-thirds urban and one-third rural households. The monthly payment per household has been lower than before 2014, falling at times to US$4 per month (El Salvador 2019), and has been US$5 per month since September 2019, making the net-of-subsidy price paid by the beneficiaries of the cash transfers for one refill of a 11.4-kg cylinder a month lower than the subsidized price from April 2008 to April 2011, and only marginally higher than the subsidized price before that going all the way back to 1996.

The government sets maximum prices for LPG sold in four cylinder sizes ranging from 10 pounds (4.5 kg) to 35 pounds (15.9 kg). As of June 2021, the government had last set maximum prices in September 2019. The maximum prices seemed sufficiently high to avoid the return of a universal price subsidy. Reflecting economies of scale, the unit price decreased steadily with cylinder size from US$0.86 per kg for refilling 4.5-kg cylinders to US$0.82 per kg for 15.9-kg cylinders.

Household consumption of LPG can be calculated from the residential consumption of LPG in the government’s national energy balance. However, the energy statistics for LPG published by the Ministry of Energy and Non-renewable Natural Resources show unusually (if not unrealistically) high consumption by households (Figure 6). There is virtually no response to the subsidy reform and little indication that the overall consumption fell starting in 2011, despite a switch from a price subsidy to unconditional cash transfers and despite the cash transfers, conditional or unconditional, being sufficient for only one 25-pound (11.4-kg) refill a month. The household consumption corresponds to more than four refills a month, raising questions about the accuracy of the government data and as such, the published LPG consumption needs to be interpreted with caution. If the data are accurate, it would mean

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that the bulk of LPG consumed by households in El Salvador is not subsidized, except in the form of cross-subsidies and when the government decides to revert back to providing a universal price subsidy, as in early 2021. Wood consumption appears more reasonable and fell steadily from 2008 to 2018, signaling a steady shift to cleaner fuels.

Figure 6: Monthly consumption of LPG and wood in El Salvador averaged over all households


About two-thirds of all households in El Salvador are benefitting from the LPG subsidy in the form of conditional cash transfers. The coverage is wide and the size of the monthly cash transfers is adjusted to maintain the same end-user prices for one refill a month, which may partly explain continuing use of LPG except by the bottom quintile. The unusually high consumption of LPG by households as reported by the government makes it difficult to assess the impact of the subsidy reform on household use. An intriguing and counter-intuitive aspect of the reform in El Salvador is the opposition to the first reform of 2011, which benefitted the poor—only a small fraction of whom had been using LPG and could not benefit from the price subsidy but all of whom would have stood to gain from unconditional cash transfers beginning in 2011—much more than any other group. The second reform in 2014, which made the cash transfers conditional, would have made many poor families ineligible but seemingly encountered less opposition. These developments suggest that the public buy-in at times does not necessarily depend on the substance of the subsidy reform or the manner of execution, and that early communication and persuading respected public figures with influence, such as religious leaders, are equally important. Above all, clear demonstration of the government’s ability to deliver as promised is what had made a difference in winning public support in the end in the first reform.

Peru

The pricing of LPG sold in cylinders in Peru was subject to pricing rules until April 2020, resulting in substantial price subsidies to bottled LPG. The government supplemented price subsidies with targeted conditional cash transfers in July 2012. The eligibility criteria are the most stringent of any assistance programs discussed in this paper and rank among the tightest globally. The amount given to the poor every month for purchasing LPG is set by a supreme decree, cannot be changed without changing the decree, and remained fixed from 2012 until 2021 when the amount was raised. Between 2013 and 2016, Peru also distributed free LPG stoves to the vulnerable but that program has been terminated. LPG use by the poor has increased substantially in the last decade at the expense of biomass use.

Law 26221 enacted in 1993 established the pricing principle for crude oil and refined products whereby prices and activities are to be governed by supply and demand, giving no role for the government other than to intervene in cases of anti-competitive behavior interfering with market forces. However, when global fuel prices soared from their December 2003 levels, the government in May 2014 set up a fuel price stabilization fund, initially for only 120 days. The fund has continued much longer than initially envisaged and exists to this day. The government transferred a total of US$2.4 billion to the fund between
2005 and the end of 2011. The fund’s debt in 2008 reached S/. 3,000 million (US$1 billion), which was retired in 2009. A series of decrees starting in April 2010 established parameters for price bands and the frequency of their adjustment for the fuels falling under the fund. LPG was among the fuels included in the fund, but LPG sold in bulk was removed in 2012.

Between 2012 and 2018, the price ceilings set by the pricing rules for the price stabilization fund were lower than the export-parity prices most of the time (Osinergmin 2019). The pricing rules limited price increases to smooth price volatility, but the allowed increases were insufficient to keep pace with the global price movements. For example, between January 2016 and October 2018, the price ceilings were raised consecutively 15 times and yet there were three prolonged episodes of very large unit subsidies, with the export-parity prices being higher than the price ceilings 89 percent of the time in 2017 and 2018. During 2012–2018, the price subsidies for LPG far exceeded the contributions paid into the fund. Another unintended consequence was that the resulting large gap between LPG sold in bulk (not subject to pricing rules) and bottled LPG (subject to pricing rules) had, predictably, led to significant diversion of bottled LPG to the bulk LPG market. Supreme Decree N° 007-2020-EM issued in April 2020 removed bottled LPG from the stabilization fund, citing two reasons: the compensation mechanism set up in 2012 as described in the next paragraph, which made price subsidies unnecessary, and economic distortions caused by the pricing difference between bulk and bottled LPG. The decree instructed the Ministry of Energy and Mines to submit a report evaluating the LPG price movement if the price increases by more than 5 percent for four consecutive weeks or the equivalent over two months and propose appropriate mitigation mechanisms. In January 2021, as global LPG prices rose from their low levels in 2020, there were calls to bring bottled LPG back under the price stabilization fund (Peru 2021a), and the congress passed a motion to do so in April 2021 (Gestión 2021). Diesel fuel, which had also been removed from the stabilization fund in April 2020, was brought back under the stabilization fund under a new supreme decree signed in March 2021 (Peru 2021b).

Over and above the price subsidies, starting in 2012, Peru has been using cross-subsidies across energy consumers to subsidize LPG use by the poor. The Ministry of Energy and Mines in 2010 approved the National Energy Plan 2010–2040 to promote efficient and sustainable energy for all. As part of this energy plan, the government in 2012 enacted a law establishing the Fondo de Inclusión Social Energético (FISE, Energy Social Inclusion Fund). FISE is financed by surcharges on consumption of various forms of energy by other consumers and is intended to provide to vulnerable segments of the population access to LPG, natural gas (household use as well as conversion of vehicles to enable fuel switching to natural gas), and electricity including renewable energy. The Program of Social Compensation and Promotion for Access to LPG (LPG access program hereafter) was the first program funded by FISE and its implementation began in July 2012. The program first subsidized LPG purchased by poor households who lived in areas without natural gas distribution pipelines. A supreme decree of April 2015 extended the program coverage to the National School Food Program and soup kitchens under the Food Complementation Program. From 2012 to January 31, 2020, a regulatory body under the Presidency of the Council of Ministers—Organismo Supervisor de la Inversión en Energía y Minería (Osinergmin, Supervisory Body of Investment in Energy and Mining)—acted as the temporary administrator of FISE, after which the Ministry of Energy and Mines became the administrator.

Between 2013 and 2016, the National Program of Family Cookstoves (Cocina Perú) distributed free LPG stoves to vulnerable populations to complement the LPG access program. Cocina Perú used the national household poverty classification database managed by the Sistema de Focalización de Hogares (SISFOH, Household Targeting System) to identify households classified as poor or extremely poor for eligibility. Cocina Perú delivered a two-burner LPG stove (including valve, hose, and clamps free of charge) and a
filled 10-kg LPG cylinder to each eligible household. Cocina Perú had distributed more than half a million LPG stoves by 2015 against the goal of 1 million.8

The conditional cash transfers for LPG in Peru are arguably among the most sharply targeted in the world. FISE beneficiaries receive a monthly discount voucher for refilling LPG in cylinder sizes of 10 kg or smaller sold by authorized agents. The voucher value is set in a supreme decree and was S/. 16 (about US$6 at the launch of the program, falling to US$4.42 by January 2021) from the program’s inception to January 2021, when it was raised to S/. 18 (US$4.94). To minimize the chances of better-off households benefitting from the subsidy, the eligibility criteria are more stringent than those for Cocina Perú:

- The household must be classified as poor or extremely poor in the general household register managed by SISFOH.
- The household must live in an area where natural gas is not available but LPG is commercially available.
- If connected to the grid, the household cannot consume any more than 30 kWh of electricity per month averaged over the previous 12 months. This limit disadvantages multi-family households as well as those living in Amazonian regions with less sunlight and higher electricity consumption on account of greater heating requirements (APEC 2015).

Although having an LPG stove is a requirement, the Ministry of Energy and Mines may provide free LPG stoves for those without one. Local authorities and the FISE contractors (electricity distribution companies) have different but complementary roles. Officially, FISE contractors identify FISE beneficiaries, establish agreements with local LPG providers, distribute FISE vouchers, and assess the functioning of and irregularities in FISE. However, in rural areas where FISE personnel is limited and the population is geographically dispersed, local authorities may help FISE contractors identify FISE beneficiaries and, occasionally, distribute FISE vouchers.

FISE initially distributed physical LPG discount vouchers. They were stapled to electricity bills and mailed unsealed, resulting at times in theft. It took the beneficiary’s electricity distribution company about five days to mail the physical voucher to a customer service center. In remote areas, the customer might have to travel five hours each way to the service center to pick up the voucher (Osinergmin and FISE 2020). Meanwhile, LPG suppliers had to wait two weeks or more to be reimbursed for the value of the printed vouchers, discouraging their participation. Some suppliers charged an extra fee in exchange for accepting the printed vouchers and others refused to accept them. Many LPG suppliers had unsubscribed from FISE by mid-2013. In July 2013 physical vouchers began to be replaced by digital vouchers and it became easier to reimburse LPG suppliers at the time of the transaction. Digital vouchers also made it easier for households not connected to grid electricity to take advantage of the LPG subsidy offered (Caldaza and Sanz 2018). The reimbursement time was reduced from 15 days in December 2012 to zero by December 2013.9 Physical vouchers have been replaced by so-called 1.5G vouchers, whereby the beneficiaries would receive vouchers in the form of SMS messages on their phones.

To protect the integrity of FISE, Osinergmin developed a complaint registry mechanism called Tukuy Rikuy, which was piloted in 2014 and deployed in 2015. Tukuy Rikuy enables local authorities to report complaints or inconsistencies on behalf of their communities to Osinergmin by text messages. Individuals can text one of six codes to report (1) if the voucher was not received, (2) someone has electricity and could be a voucher beneficiary, (3) someone does not have electricity and could be a beneficiary, (4) an LPG agent does not want to accept the vouchers in exchange for refilled LPG cylinders, (5) an LPG agent

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is purchasing or selling vouchers, or (6) someone who is not poor is receiving vouchers (Quin et al. 2018).

Under FISE, a beneficiary is allowed to combine two vouchers at a time but no more than two. To avoid leakage, FISE detects if a household exchanges more than two vouchers in a month. In May 2021, the cost of refilling a 10-kg cylinder in Lima ranged from S/. 28 to S/. 52, indicating a very large variation in price by location. Such wide variation is consistent with price deregulation and varying costs of LPG delivery as a function of geography, road conditions, distance, and economies of scale. Two vouchers would have been enough to enable a free refill at some locations but not at others.

Enrolment in the LPG program rose rapidly during the first four years (Figure 7). The number of households requesting vouchers is about half of registered beneficiaries, and the voucher exchange rate in October 2019 was about 10 percent lower (Table 3). The number of vouchers redeemed in the table correspond to about 8 percent of all the households in Peru. As of October 2019, more than 53 million vouchers had been redeemed and 99 percent of the districts in Peru had been covered (Osinergmin and FISE 2020).

**Figure 7: Number of beneficiaries enrolled in the FISE LPG program**

Source: http://www.fise.gob.pe/

Note: Data between July 2018 and November 2019 are not available at the government website.

<table>
<thead>
<tr>
<th>Table 3: Household LPG program statistics as of October 2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of beneficiary households registered</td>
</tr>
<tr>
<td>Number of LPG vouchers issued in the month</td>
</tr>
<tr>
<td>Number of LPG vouchers redeemed in the month</td>
</tr>
<tr>
<td>Number of LPG marketing agents</td>
</tr>
<tr>
<td>Percentage of districts covered</td>
</tr>
<tr>
<td>Total number of exchanged vouchers to date</td>
</tr>
</tbody>
</table>

Source: Osinergmin and FISE 2020.

Peru’s national household surveys show that about four-fifths of non-poor households cooked with gas (LPG and natural gas) from 2007 to 2017 and about half cooked exclusively with gas. Among the poor, three-fifths cooked with gas and about one-fifth cooked exclusively with it by 2017. Exclusive biomass use declined steadily, especially among the poor (Figure 8 and Figure 9). Although the breakdown of the data in the subsequent years is not available, a March 2021 publication by the government shows that

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10 http://www.facilito.gob.pe/facilito/actions/PreciosGLPAction.do.
nationally the share of households cooking with LPG (the sum of exclusive users of gas and users of gas and other fuels in the figures below) in the last quarter of 2020 was 86.7 percent, consisting of 93.9 percent of urban households and 61.4 percent of rural households (INEI 2021), up from 81.9 percent nationally, 89.3 percent in rural areas, and 58.1 percent in rural areas during the last quarter of 2017 (INEI 2018a).

**Figure 8: Cooking fuel use by the poor**

Source: INEI 2018b.

**Figure 9: Cooking fuel use by the non-poor**

Source: INEI 2018b.

FISE has attracted attention from policymakers and researchers and there are several independent assessments of the LPG access program. One based on data from 2015 looked at the impact on cooking behavior, health, and school absenteeism. Caldaza and Sanz (2018) examined data collected by Osinergmin in April 2015 from randomly selected 149 FISE beneficiaries and 279 non-beneficiaries in one province. The beneficiaries who had already owned LPG stoves did not increase the frequency of cooking with LPG except those who had exchanged the vouchers every month. The share of meals cooked with LPG was statistically different and was 71 percent among the beneficiaries and 58 percent among non-beneficiaries. If beneficiaries not using vouchers are excluded, the difference rose to 75 versus 58 percent. LPG cookstove use increased the most and by about half among the bottom 25 percent of the population who were FISE beneficiaries, followed by an increase of about 26–30 percent depending on frequency of the voucher exchange among the second quartile from the bottom. The study concluded that FISE had been effective in targeting low-income households. However, the study found a large difference in heating fuels in the reverse order—32 percent of non-beneficiaries used only LPG or electricity for heating, in contrast to 17 percent of beneficiaries. The study did not find a statistically significant impact of the vouchers on respiratory problems or school absenteeism due to respiratory problems.

Another study, based on data collected in 2015 from rural residents, assessed implementation challenges and barriers to adoption of LPG as the primary cooking fuel. Martínez, Mäusezahl, and Hartinger (2020) conducted 60 in-depth interviews between May and August 2015 in four rural communities in Andean Peru, 48 with women and 12 with FISE contractors, local government officials, and male household heads. The researchers also held one focus group discussion in each community. The findings highlighted some problems in the design of the LPG access program:

- Dwellings with no electricity consumption were assumed to be vacant and the households were cut off from the program. Some families with prepaid electricity meters would recharge S/. 50 (US$16 at the time of the interviews) at a time, enough to last half a year, but FISE contractors would then assume that people no longer lived there. Increasing the frequency of recharging would be costly because one would need to travel to San Marcos.
• FISE contractors were not interested in households with no electricity because they were not the contractors’ customers.

As expected, cash constraints presented a significant barrier to LPG use. The price of LPG fluctuated seasonally between S/. 38 and 44 ($12–14) per refill. After the FISE discount, an LPG refill would cost S/. 22–28 (US$7–9), against the typical monthly household expenditure of S/. 118 ($37), making one LPG refill account for 19–24 percent of the monthly expenditures, considerably in excess of the limit of 5 percent on spending on cooking fuels considered affordable. Some beneficiaries would save three vouchers—against the rules of the LPG access program—and negotiate lower prices. Another financial cost was that of transport to get cylinder refills. There were no FISE distributors or other LPG suppliers in the communities and therefore LPG users had to travel to urban centers, which was not affordable for many.

Other barriers were based more on cultural or social preferences and perceptions:

• Cooking with LPG required a constant presence of the cook, whereas firewood enabled the cook to feed enough wood to the stove and then walk away, go to the field, and work, because the fire would extinguish itself.

• Wood would smolder and keep food warm for hours, whereas LPG would need to be turned off, and once off, there would be no more heat given off and food would start getting cold immediately.

• Women, even those who used LPG daily, considered LPG more dangerous than firewood.

• Biomass stoves were more practical and versatile. The small surface areas of the LPG burners made it difficult to prepare routine meals.

• Most women living in the San Marcos province did not consider wood gathering an extra time burden because they collected wood while carrying out their other daily activities.

• Cooks used LPG for preparing quick meals (such as soups and teas) and for reheating meals in the morning and at night because they perceived LPG stoves, at maximum power, to boil water faster. They believed that the short exposure of these meals to LPG altered their taste only slightly. By contrast, they found that LPG was not suitable for cooking most larger meals comprising the local diet (such as legumes and stews) requiring a longer cooking time. The participants believed that the longer it took to cook a dish with LPG, the worse it tasted.

Socioeconomic barriers to adoption of LPG in rural Peru were echoed in another study collecting data in the latter half of 2015. Hollada et al. (2017) conducted 31 qualitative in-depth interviews from August to December 2015 in 11 different communities in rural Puno—a home to Southwestern Andean indigenous people—with users of traditional stoves, locally improved stoves, and LPG stoves. The comments reinforced the perception that food cooked using biomass was “delicious” but food cooked with LPG did not taste as good and could even tasted “sour.” One doctor even claimed that both the clay pots used in cooking with biomass and the smoke generated during biomass combustion provided more nutrients. As expected, financial barriers to widespread use of LPG were cited: households would rather save money by gathering their own fuel, and for the limited cash available, households gave higher priority to electricity, plumbing, and water than to LPG. For cooking, most leaders believed locally improved stoves were the most affordable and sustainable. Food cooked using LPG stoves was said to lose heat faster than that cooked over locally improved stoves. The households interviewed also named other obstacles:

• When time was available, cooks viewed fuel collection and cooking as valued social opportunities.

• Some complained that LPG cooked food too fast and was not suited for certain traditional dishes requiring slow cooking for a better flavor.
• Cooking large quantities of food on a two-burner LPG stove was difficult, making large families prefer three-burner traditional stoves.
• None of the participants had heard of an LPG accident but feared the possibility, although children and young people were not afraid of LPG.
• A few believed LPG stoves were worse for health because of the smell or the “fumes” it produced. Reducing smoke was not a top priority for most and not a priority at all for some, but people recognized that improved stoves produced less smoke. Although LPG stoves eliminated smoke, improved stoves were praised more for smoke reduction.

Rural Puno was the site of another study that found that many rural households that used to cook exclusively with solid biomass had shifted to LPG thanks to the LPG access program, but LPG use was limited and consequently had no statistically significant effects on exposure to smoke. Pollard et al. (2018) surveyed 375 households in 2017 in an area where most households belonged to the bottom two quintiles but which had the largest number of FISE beneficiaries and largest network of LPG agents. About 90 percent had heard of the LPG access program and 60 percent reported having ever participated (referred to as beneficiaries in the rest of this paragraph), among whom 90 percent (203 out of 375 surveyed) reported having exchanged at least one LPG voucher in the past year. On average households exchanged about 9 vouchers a year, with 65 percent exchanging every voucher. A majority of the beneficiaries reported using only biomass prior to enrolling in the LPG access program. The beneficiaries were nearly four times more likely to use LPG stoves than non-beneficiaries, with 96.5 percent of beneficiaries using LPG stoves. All these statistics suggest that the LPG access program was successful in promoting uptake of LPG even among the rural poor. However, 95 percent of the beneficiaries also used open-fire traditional stoves, burning dung (which was used by 90 percent of the beneficiaries and which carried no cash costs), wood, and crop residues. Only 10 households out of 226 beneficiaries used LPG exclusively for cooking. This percentage (4.4 percent of the beneficiaries) stands in contrast to 57.7 percent of all households in Peru found in the 2017 census to have used LPG exclusively for cooking (INEI 2018c). On average, about a quarter of meals was cooked with LPG among LPG users, beneficiaries and non-beneficiaries alike. Unsurprisingly, given the prevalence of fuel stacking, there was no difference in personal exposure to PM$_{2.5}$ (fine particulate matter with an aerodynamic diameter of 2.5 microns) between the beneficiaries and non-beneficiaries, although the ambient concentrations of PM$_{2.5}$ were lower among the beneficiaries at 695 micrograms per cubic meter ($\mu g/m^3$) for median 48-hour concentrations. This was statistically different from 999 $\mu g/m^3$ among non-beneficiary households, but both are substantially above the World Health Organization’s air quality guideline for a 24-hour average for PM$_{2.5}$ of 25 $\mu g/m^3$.

The LPG users surveyed spoke about various challenges to using LPG. It took LPG users on average 71 minutes to get LPG refills. This involved taking a wheelbarrow to carry the empty cylinder to a highway, wait for a bus, pay extra for carrying the cylinder onboard, and wheeling the cylinder to a retailer. Sixteen percent of the beneficiaries reported making it to retail shops, only to discover that the shops had run out of refilled LPG cylinders before they arrived. LPG users cited cleanliness—cleaner pots, hands, clothes, and kitchens—as a benefit, but many claimed that food cooked with LPG did not taste as good as food cooked with biomass on traditional stoves.

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11 This represents 218 households, whereas 213 households reported exchanging at least one LPG voucher in the past year, suggesting that at least five households citing LPG use had not refilled their cylinders in more than a year.
12 This census finding differs significantly from the national household survey results reported very quarter, which found exclusive users of gas to comprise about 45.5 percent of all households (INEI 2018a and 2018b) against a total of 62.9 percent of households who used exclusively LPG, natural gas, or both in the census. However, the 2017 census also found that 75 percent of all households used gas, whereas the national household survey found 82 percent in the same year.
How do households behave if there are no financial barriers to LPG use? Williams et al. (2020) attempted to isolate barriers due to cultural and social preferences and perceptions from financial barriers by providing, all free of charge, delivery to homes of LPG for 12 months in quantities sufficient for its exclusive use in cooking, together with three-burner LPG stoves, cylinders, and accessories. Between January 2017 and February 2018, the study enrolled 180 female cooks in Puno, Peru, who had cooked indoors with biomass daily. Approximately 15 women were randomized each month for 12 months, half of whom were placed in the intervention group receiving the free provisions and the other half in the control group. Prior to delivery of LPG, those in the intervention group participated in hands-on training on how to cook safely with LPG, including how to make traditional dishes. The study deployed stove-use monitors to track use of traditional and LPG stoves in all households to see if those in the intervention group would cook exclusively with LPG. The study also conducted 22 in-depth interviews with women from the intervention group, 10 who turned out to be exclusive users and 12 who were not.

The study found that about half of the women in the intervention group used LPG exclusively, and the other half also used LPG between 86 and 99 percent of the cooking time. However, the study noted that the women in the intervention group knew that they were expected to cook with LPG, were reluctant to admit that they used traditional stoves, and even took steps to avoid detection of traditional stove use, such as by cooking outside using an unmonitored biomass stove. The interviews pointed to the following non-monetary barriers to LPG use:

- Many women were afraid of turning on the LPG stove and adjusting heat, because the stove knobs were sensitive and caused a burst of flame when turned on too high. Additionally, almost all interviewed women said they were afraid to change the LPG cylinder because they could improperly connect the hose and cause a gas leak. Others were afraid they could cause a gas leak by opening the LPG cylinder valve too much or forgetting to close the valve or the stove knobs. A few women were afraid because they had been burned by the LPG stove, for example when cleaning the stove before it was sufficiently cool, when turning on the stove, or by overflowing pots. Many did not want their children to use or be near the LPG stove because of these fears.

- The quality of LPG supply service was perceived to vary markedly from distributor to distributor. Cylinders were distinguished by distinct colors and markings, and nearly all participants reported that the orange LPG cylinders did not last as long, were more prone to gas leaks, and produced flames that were more difficult to regulate.

- Support from children and husbands encouraged women to use LPG more, and conversely the absence of support discouraged them. Support from field workers was important, but they criticized women who went through the refills quickly, discouraging use.

- Those who had LPG stoves of their own said their two-burner stoves had a weak flame. Three-burner stoves were needed in the morning to prepare tea and soup for breakfast, lunch to take to the field, and animal feed. Most said even three-burner LPG stoves were not adequate for cooking large amounts of food. Big pots did not fit on the LPG stove. Cooks could not toast grains without burning them on the LPG stove. LPG stoves could not make quispiño, steamed bread made from quinoa flour.

- The women felt certain foods—such as quispiño, fava beans, soups, and quinoa—tasted better when cooked in clay pots, which also kept food warm for longer than aluminum pots. Some, however, liked the fact that food did not taste like smoke. Women did not have access to flat-bottom clay pots required for the LPG stove, and clay pots were said to break more easily when used with LPG compared to the fogón, the traditional stove.

- The LPG stove had to be installed on a high table above the LPG cylinder for safety, but the women were accustomed to cooking seated on the floor with the fogón and standing while cooking was tiring.
Unlike biomass stoves, LPG stoves did not provide space heating, but on the other hand because of lack of smoke they could close windows and doors to retain heat.

Poor or non-existent mobile phone service meant that some could not call for refills, and field workers could not deliver refill cylinders at night because the rural roads were not safe at night.

The study concluded that even with three burners, one LPG stove was unlikely to satisfy all cooking needs. Short of having two cylinders at all times, getting a refill immediately after running out of LPG was not realistic, especially in rural areas. Providing households with weight scales, flow meters, or pressure gauges to help users better gauge when they were likely to run out of LPG would be helpful, but doing so would add to the overall cost of LPG consumption. The study also showed the importance of social support in shifting households from traditional to LPG stoves.

The conditional cash transfers for LPG in Peru seem effective in promoting the adoption of LPG among the poor, although ending fuel stacking is much more challenging. The tight criterion based on electricity consumption that disadvantages large families or those living in areas requiring much space heating, and the tendency of electricity distribution companies to assume non-residence when a household pays in bulk using pre-paid metering, have excluded some poor households from the program. The assessment of the program is made difficult by the fact that, with the exception of mid-2014 to mid-2015, the price of LPG sold in cylinders—while increasing steadily from early 2016 to late 2018—was subsidized by the price stabilization fund (Osinergmin 2019) and cash transfers were additional to universal price subsidies. A true test of the scheme is arguably after the removal of bottled LPG from the stabilization fund in 2020, for which there is not yet sufficient evidence because of the collapse of the world fuel price in 2020. If bottled LPG is brought back under the stabilization fund, such evidence may not become available for a long time to come.

India

Enabled in part by advances in digital technology, India’s conditional cash transfers for LPG are the largest in scale in the world and offer several valuable lessons in their design, implementation, adjustments made as more experience has been gained, and how the government and the stakeholders involved have worked together to address implementation challenges. LPG subsidies—whether in the form of universal price subsidies in the past or conditional cash transfers today—have been delivered by three state-owned petroleum companies, a feature that comes with advantages as well as drawbacks. Cash transfers replaced universal price subsidies and cover the costs of cylinder refills, and more recently so-called connections—which refer to registering with LPG supplies as customers by paying the cylinder deposit fee (stove acquisition costs are not subsidized by the government)—to the poor. Also informative are the two independent assessments commissioned by the government on the schemes for cylinder refills and connections, respectively, which carried out primary data collection and analyzed them in detail with inputs at several stages from the state-owned petroleum companies. There seems to be ample evidence that replacing universal price subsidies with conditional cash transfers has substantially reduced diversion of subsidized LPG to ineligible recipients.

The government of India has subsidized LPG used by households, referred to as domestic LPG, since the late 1960s (Jain et al. 2015), while commercial users have always been excluded from subsidized LPG. Domestic LPG is sold largely in 14.2-kg cylinders and to a very limited extent in 5-kg cylinders today, while commercial users are meant to buy LPG in 19-kg, 35-kg, and 47.5-kg cylinders. Only three state-owned petroleum companies—Bharat Petroleum Corporation, Hindustan Petroleum Corporation, and Indian Oil Corporation, also called oil marketing companies in this context—have been authorized to sell subsidized LPG or enable eligible beneficiaries to claim the cash transfers. Private sector participation in the LPG market is limited because other companies cannot compete on price with the three oil marketing...
companies. If there is a long waiting list for a connection with all of the three companies, then a well-off household may go to a privately owned marketer and pay much more, but otherwise most households buy from one of the three oil marketing companies.

Diversion to ineligible beneficiaries of the price subsidies, such as restaurants and other commercial establishments, has plagued the government for decades. Attempts to tackle duplicate or ghost connections and diversion have included color coding LPG cylinders (red for domestic, blue for commercial), raids on warehouses by criminal investigation agencies, and radio frequency tagging with smartcards that could track consumers, none of which have been materially effective (Mittal, Mukherjee, and Gelb 2017). Tales have abounded of lucrative opportunities for LPG dealers in misuse of subsidized LPG. B. Somashkar, former state president of the Janata Dal (United) Party in Karnataka and himself an LPG dealer, told the media in 2012 that 90 percent of the LPG dealers and black marketeers in the state were politicians, bureaucrats, or their relatives (India Today 2012). In the same year, Shobha Karandlaje, the then Karnataka Minister for Food and Civil Supplies, wrote three times to S. Jaipal Reddy, Union Minister for Petroleum and Natural Gas, pointing out the extent of illegal LPG connections (Hindu 2012). Smith and Sagar (2014) reported that distributorships were so lucrative that granting of licenses would result in litigation by those applicants who had not been selected. Barnwal (2018) observed that delivery people held the permits to deliver LPG to both households and commercial consumers, making it easier to divert domestic LPG, and LPG distributors backed up by strong national and state-level unions had threatened to strike when reforms to tackle diversion had been announced.

In 2002, upon expiration of the so-called administered pricing mechanism, the government moved to a new subsidy system for domestic LPG. This new scheme last provided budgetary support in fiscal year 2016–17 ending on March 31, 2017. However, the government fixed the unit subsidy, reducing it for two consecutive years before freezing the unit subsidy in fiscal 2004–05. As Figure 10 shows, the gap with the costs incurred grew and had to be borne by various state-owned oil and gas companies, some of which were not at all involved in the LPG supply chain. The amounts borne by oil and gas companies are called under-recoveries.

**Figure 10: Unit subsidy for domestic LPG in India**

![Graph showing unit subsidy for domestic LPG in India](https://www.ppac.gov.in/content/150_1_Subsidy.aspx)

*Source: World Bank staff calculations using data at https://www.ppac.gov.in/content/150_1_Subsidy.aspx.*

*Note: Each year is a fiscal year starting on April 1 of the year and ending on March 31 of the following year. For example, 2014 is from April 2014 to March 2015. The government’s data series stops in fiscal 2014–15. No budgetary support was provided in fiscal 2015–16, and budgetary support was last provided in fiscal 2016–17.*

Growing under-recoveries prompted the government to set up a task force in 2011, which eventually led to the Direct Benefit Transfer scheme for LPG (DBTL). Two essential tools in the operation of the DBTL are mobile banking and the Aadhaar, India’s unique identification system based on 12-digit numbers issued by the Unique Identification Authority of India to residents who provide demographic and biometric information. The chronology of the domestic LPG subsidy scheme is detailed in the appendix.
The DBTL was preceded by more than a decade of government efforts to reform the LPG subsidy, including restricting the number of connections to one per household in 2000 and appointments of high-level technical committees producing reports with concrete recommendations. Direct cash transfers were first recommended in 2010, targeting households below the poverty line (BPL). The government launched concrete steps to remove multiple connections in June 2012, expanded to removal of multiple connections based on same name/same address and different name/same address combinations in July 2015. In parallel, the oil marketing companies began removing inter-company duplication of LPG customers on the basis of the Aadhaar number in May 2014. The government reduced the number of refills per year for subsidized LPG to six in September 2012, but due to political pressure immediately raised it to nine in January 2013, 11 in February 2014, and 12 in April 2014, which remains to this day. The DBTL itself was launched in June 2013 based on each customer’s bank and Aadhaar number, but suspended in March 2014 largely because of consumer grievances, especially in areas where the Aadhaar penetration rate was low.

In November 2014, the DBTL was relaunched as Pratyaksh Hanstantrit Labh Yojana, PAHAL (DBTL) scheme (DBTL hereafter for brevity) in 54 districts in the first phase. The objectives were to (1) remove incentives for diversion, (2) end multiple and other fraudulent connections, (3) ensure subsidy delivery to eligible consumers, (4) improve availability and delivery of LPG cylinders, and (5) allow self-selection for the cash transfer. In January 2015, the DBTL was extended to 622 districts in the second phase. Aadhaar linking was no longer required until December 2016, when it was made mandatory again. Distributors maintained the consumer database (unique LPG identification, name, address, date of birth, bank account details, Aadhaar number if available) and periodically synchronized the database with the central system maintained by the oil marketing companies. Distributors would deliver LPG cylinders at market prices in response to customer requests and upload the proof of receipt (indicating completion of the transaction) to the oil marketing company’s central system. Reimbursement to the customer is initiated by the latter, which sends the advice to the State Bank of India and onward to the payment platform managed by the National Payment Corporation of India for crediting the consumer’s bank account. Funds for subsidies are kept in the so-called Buffer Accounts of the oil marketing companies, which submit audited statements of DBTL sales each month to the Petroleum Planning and Analysis Cell, which would scrutinize the sales figures and forward them to the Ministry of Petroleum and Natural Gas. If the ministry is satisfied with the figures, it would give concurrence for the release of the subsidies to the oil marketing companies.

In 2016, the government took two steps to reduce the number of eligible beneficiaries. In January, the government ended the DBTL eligibility of those with taxable income in the previous year (applicable to both the beneficiary and the spouse) in excess of Rs. 1 million (about US$15,000). In practice, obtaining accurate information about taxable income in India has been challenging. In March, the government rolled out the Give-It-Up campaign in which well-off households were encouraged to opt out of the DBTL to create more fiscal space for the government. After surrendering subsidized connections, households could reapply after a year.

To help poor families, the government in May 2016 launched Pradhan Mantri Ujjwala Yojana (PMUY), setting aside a budget of Rs 1,600×50 million or Rs 80 billion (US$1.2 billion) to provide 50 million BPL women with free LPG connections within seven working days after registration. The target number of beneficiaries was increased to 80 million in February 2018 with March 2020 as the achievement date. A BPL household that satisfies at least one other condition, which differed between rural and urban areas, is eligible. The poverty status is determined by the Socio Economic and Caste Census (SECC) – 2011 census, which had assigned a unique AHL TIN (Abridged Household List Temporary Identification Number) of 29 digits to each BPL household. Each registration is required to be in the name of a woman in the eligible household. The 2011 SECC identified 245 million households (180 million rural and 65
million urban), of whom 103 million were found to suffer from at least one deprivation (87 million rural and 16 million urban). The PMUY also provides an optional loan facility to cover the cost of the stove and the first refill, the recovery of which is made from the subsidy payments under the DBTL. A physical inspection of the beneficiary’s household is required every two years.

The government has taken two steps to improve cylinder delivery. In June 2016, the Ministry of Petroleum and Natural Gas issued the guidelines specifying that LPG distributors even in rural areas should generally be set up within 15 km of its customers. With effect from November 2018, the Ministry of Petroleum and Natural Gas issued another set of guidelines requiring distributors to provide adequate delivery infrastructure for making home delivery of LPG cylinders.

A step taken to make refills more affordable is introduction of 5-kg cylinders for subsidized LPG. A pilot was started in July 2017. In May 2018, eight focus states were identified to promote switching to 5-kg cylinders, such as by maintaining an adequate stock, close monitoring of distributor performance, and wide publicity.

The government has also been active in public education. In September 2017, the government launched Pradhan Mantri LPG Panchayat, a series of community meetings bringing together about 100 LPG customers at a time and serving as a platform for them to interact, promote mutual learning, and share experience. The goal was to hold 100,000 such meetings across India before March 31, 2019.

Government statistics indicate that, as of July 1, 2020, there were 281 million active domestic LPG customers, 80 million PMUY beneficiaries, 24,733 LPG distributors, and 195 LPG bottling plants in India, covering 98 percent of all areas. The waiting list for domestic LPG connections had about 100,000 names. BPL households were covered under three different schemes, 12.6 million by schemes sponsored by state governments, 7 million by corporate social responsibility programs of the three oil marketing companies, and 80 million by PMUY (PPAC 2020). The fiscal 2020–21 budget set aside Rs. 356 billion (US$4.8 billion) for the DBTL, of which Rs 220 billion (US$2.9 billion) was to be for cash paid into the accounts of the DBTL beneficiaries. The target for the average time taken for benefit transfer was 40 hours, and for the total number of beneficiaries was 267.9 billion (India 2020), which had been surpassed by July 1 of the fiscal year.

The costs of the LPG subsidies over the years (excluding those provided by state governments and corporate social responsibility programs of the three oil marketing companies) and the corresponding FOB prices of LPG are shown in Figure 11. Before fiscal 2015–16, oil and gas companies bore a disproportionately large share of the LPG price subsidy (shown as “under-recovery” in the figure). As expected, LPG subsidies moved broadly in line with FOB prices. An interesting comparison is between fiscal 2005–06 and fiscal 2017–18, when the FOB prices of LPG were essentially identical. Possibly in part because of wider coverage, despite substantially reducing consumption by ineligible consumers, the total subsidy in fiscal 2017–18 was one-fifth higher before accounting for the PMUY, and one-third higher if connection subsidies are included.
In fiscal 2020–21, the subsidies for domestic LPG fell sharply in the second and third quarter (second half of calendar 2020) due to the fall in the global price of LPG. The nominal price of domestic LPG after accounting for the subsidy—as a price subsidy in 2013 and in the form of a cash transfer in 2019—had doubled between January 2013 and May 2019 (the last month for which subsidized LPG prices are available from the websites of the oil marketing companies). As a result, against the budgeted amount of Rs 255 billion (US$3.3 billion) for the DBTL, provisional estimations posted by the government shows that only Rs 35.6 billion (US$0.48 billion) had been transferred during the first 11 months of the fiscal year. The budget for fiscal 2021–22 has been halved to Rs 125 billion (US$1.7 billion) for the DBTL, while none has been allocated for the PMUY (India 2021).

The impact of the DBTL on LPG adoption is particularly pronounced in rural areas, doubling the share of households citing LPG as the primary cooking fuel from 23 percent in 2015–16 to 48 percent in 2018. The National Sample Survey Organization (NSSO) carries out large-scale household surveys that ask questions about each household’s primary cooking fuel. The results are tabulated in Table 4, which also includes the findings of the National Family Health Survey (NFHS). The adoption of LPG by rural households quadrupled between 2011 and 2018. Nationally, use of LPG as the primary cooking fuel tripled in 16 years between 2002 and 2018. Averaged across all households, monthly consumption of LPG rose from about 3.5 kg in the mid-2000s to about 6.3 kg by 2019 (Figure 12). The actual increase is likely to have been even greater, because “domestic” consumption of LPG in the earlier years would be expected to include a greater share of domestic LPG diverted to commercial LPG users than in the later years.

Table 4: Share of households using LPG as the primary cooking fuel

<table>
<thead>
<tr>
<th>Survey</th>
<th>Start date</th>
<th>End date</th>
<th>India</th>
<th>urban</th>
<th>rural</th>
</tr>
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<tbody>
<tr>
<td>NSS 50th round</td>
<td>July 1993</td>
<td>June 1994</td>
<td>9.3%</td>
<td>29.6%</td>
<td>1.9%</td>
</tr>
<tr>
<td>NSS 55th round</td>
<td>July 1999</td>
<td>June 2000</td>
<td>15.9%</td>
<td>44.2%</td>
<td>5.4%</td>
</tr>
<tr>
<td>NSS 58th round</td>
<td>July 2002</td>
<td>December 2002</td>
<td>20.1%</td>
<td>52.4%</td>
<td>7.4%</td>
</tr>
</tbody>
</table>

13 https://www.ppac.gov.in/content/150_1_Subsidy.aspx.
## Figure 12: Monthly consumption of LPG averaged over all households

![Chart showing monthly consumption of LPG averaged over all households]

*Source: World Bank staff calculations using data on domestic consumption of LPG available at https://www.ppac.gov.in/content/5_1_ReportStudies.aspx. Note: Each year is a fiscal year starting on April 1 of the year and ending on March 31 of the following year.*

While pricing of LPG is now market-based, it is not without problems. There are only three suppliers and their prices are essentially the same at a given location. The private sector cannot compete or hope to achieve economies of scale when subsidies are offered only through the three state-owned petroleum companies, a problem similar to that faced in Indonesia. This set-up makes it difficult for competition to emerge, which could be a problem if and when price subsidies through conditional cash transfers are eventually phased out and the government wishes to deregulate the market to increase efficiency through competition.

A greater challenge in the near term is that there are multiple prices for the same fuel depending on end use. At the retail level, the LPG market is segmented into four end-use categories: domestic bottled LPG, non-domestic exempt LPG, commercial (non-domestic, non-exempt) bottled LPG, and automotive LPG. Pricing is based on market forces for all but taxes and other government charges differ by category. Whether subsidized (through cash transfers) or unsubsidized, domestic LPG is exempt from duties, taxes, and other levies, while commercial LPG is not exempt, making the unit price of the latter much higher. The definition of a subsidy according to the World Trade Organization, also adopted by the World Bank (Kojima 2018), includes the government’s forgoing taxes and other revenues, making the domestic LPG price in India subsidized. There is also a small consumer category called non-domestic exempt, comprising hospitals, charitable institutions, and certain government entities. In 2020, the unit price of non-subsidized domestic LPG sold in 14.2-kg cylinders in New Delhi averaged 72 percent of that sold in 19-kg cylinders. Everything else being equal, economies of scale would result in lower unit prices for LPG sold in larger-size cylinders. This significant price difference is responsible for continuing diversion of domestic LPG to commercial users, although the former is not subsidized by the budget. Households with home-based business may find it especially easy and tempting to (illegally) divert domestic LPG for

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commercial purposes. To stem such diversion, the oil marketing companies have introduced an annual limit of 15 refills of 14.2-kg cylinders (the first 12 of which are eligible for the cash transfers).

The Comptroller and Auditor General of India has issued two audit reports, one on the DBTL (India 2016) and the other on PMUY (India 2019). The audits identified problems, asked the relevant stakeholders (such as the oil marketing companies) to explain and remedy the problems where appropriate or possible, summarized the final results, and made recommendations. These reports arguably present the most comprehensive review of the two schemes.

The audit report on the DBTL covered the period from January 1, 2015 to October 31, 2015 and found persistence of multiple connections in various combinations as well as cash transfers numbering more than 12 times a year, aided by missing or clearly incorrect key information in the database including the date of birth; inadequate documentation for blocking and unblocking of customers, raising the specter of ineligible customers being unblocked or eligible beneficiaries continuing to be blocked; more than 10 million LPG customers deterred from joining the DBTL by a lack of knowledge and the lengthy enrollment process as of the end of 2015; failure of cash transfers to some beneficiaries because of inaccurate data entries by the LPG distributors; and failure by the government to reimburse the oil marketing companies on time for the cash transfers. The complaint mechanism offering a toll-free number and a web-based portal appeared to be working well: the oil marketing companies were found to have addressed most complaints, although the target of resolution within seven days could not be achieved, especially when other institutions—such as banks, the National Payment Corporation of India, and the Unique Identification Authority of India—were involved. The audit found total savings of Rs 51 billion (US$0.78 billion), of which US$0.22 billion was attributed fully to the DBTL.

There was evidence of large-scale diversion from domestic LPG to non-domestic non-exempt LPG consumers following the suspension of the DBTL in March 2014. This conclusion was deduced from comparison of sales to these two end-users between the period April to October 2014, when the DBTL had been suspended, and the corresponding period a year later from April to October 2015. Consumption of non-domestic non-exempt LPG and automotive LPG fell measurably over the seven-month period in 2014, whereas the same market segments grew markedly a year later. Correspondingly, the average monthly growth rate of domestic LPG consumption fell from 2014 to 2015.

The audit recommended taking more steps to reduce diversion of domestic LPG to the commercial sector, improve the accuracy of the database and make the process of blocking and unblocking connections more transparent, and inform the public more to increase participation in the DBTL.

The audit report on the PMUY covered the period from May 2016 to December 2018. The audit found numerous cases of connections released with inadequate or invalid documentation; connections released to under-age women or to men (both ineligible); exceptionally long periods between enrollment and LPG cylinder delivery, far in excess of the seven days permitted; many customers falling outside of the 15-km limit and some as far as 92 km away from the distributors with no home delivery; delays of more than 10 days and as long as 664 days for a refill against the limit of seven days; a declining refill rate from 2015 to 2019 among the beneficiaries with one-third of those who had had LPG for at least a year having refilled only three times or less; about 200,000 beneficiaries refilling more than 12 times a year, suggesting diversion in some cases; the virtual absence of use of 5-kg cylinders; and two-thirds of those having taken out interest-free loans to buy LPG stoves and pay for the first refill struggling to pay back the loans, even when spread over six refills. The performance review recommended full and accurate documentation, safety campaigns, and monitoring of high-consumption households.

Another independent review of the DBTL, with a much narrower geographic focus, was carried out in the same year as the government audit. Jain, Agrawal, and Ganesan (2016) evaluated the execution of the
DBTL in Gujarat, Haryana, and Kerala by holding interviews and collecting data in May 2015 from households, LPG distributors, and other parties. The details are provided in the appendix. Less than 1 percent of the households enrolled reported corruption. Half reported improved LPG delivery in the previous two months and almost three-quarters of households felt enrolment was easy. However, nearly half households had to make three or more trips to complete enrolment and 14 percent had to open new bank accounts. The oil companies provided financial incentives to the LPG distributors, but banks received no financial incentives, creating more on-the-ground problems with banks. Most distributors surveyed reported that the DBTL had significantly decreased illegal diversion of domestic LPG.

The review identified several challenges, including incorrect data entries; high volumes of applications rejected by banks, which about a third of distributors found uncooperative; challenges in convincing customers to go through the application process and training staff on data entry; non-receipt of cash transfers; and long distances to banks in rural areas, making it difficult to access the cash transfers. Overall, the assessment found that the DBTL was constantly being improved to address the problems encountered. The positive impact and impressions were attributed to strong leadership from the central government, good stakeholder coordination, willingness to incorporate lessons learned and adjusting the scheme to improve, the resources made available to providing support and daily monitoring, and raising awareness to inform the affected stakeholders.

Actual use of LPG by households, their preferences, and drivers of energy choice with and without the subsidies provided by the DBTL and PMUY schemes have been studied by several research groups. Particularly informative is the analysis of the data collected in 2015 and 2018 by the largest study of rural households, the Access to Clean Cooking Energy and Electricity Survey of States (ACCESS). The first ACCESS survey was administered between November 2014 and May 2015 (denoted as 2015 hereafter) to 8,568 households in 714 villages across six energy-poor contiguous states of Bihar, Jharkhand, Madhya Pradesh, Utta Pradesh, Odisha, and West Bengal. This was followed by a second survey of 9,072 households—7,317 of whom had been surveyed in the first wave forming panel data—between March and June 2018. The second wave covered a period of rapid growth of LPG adoption in rural areas, making ACCESS data collection especially relevant.

There was a marked increase in the use of LPG between the two surveys, including a large increase in those households reporting exclusive use of LPG for cooking (Figure 13). However, the information on whether a household was an exclusive user of LPG was self-reported and based on one question, “Do you use LPG for all your cooking needs (barring special occasions)?” Given the findings from other studies that have attempted to verify self-reported cooking behavior independently and found that households tend to over-state the use of cleaner fuels, the shares found may be over-stated.

**Figure 13: Share of households using LPG for cooking**

<table>
<thead>
<tr>
<th>Year</th>
<th>Exclusive use of LPG</th>
<th>Primary fuel</th>
<th>Non-primary fuel</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2018</td>
<td></td>
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</tbody>
</table>

Source: Jain et al. 2018.

Detailed information on self-reported expenditures in 2015 collected in ACCESS is available (Gould and Urpelainen 2018). The median monthly expenditure among those not using LPG was Rs 4,000 (US$64), whereas the median cost of LPG adoption (cylinder deposit fee, stove purchase) was Rs 4,700 ($75). This alone would have constituted a serious barrier to adoption of LPG. The PMUY, which provides Rs 1,600 toward the cylinder deposit fee, would have helped but the LPG stove purchase and refill costs would still
have presented a serious financial challenge. Refilling a 14.2-kg cylinder cost between Rs 400 (US$6.40) and Rs 550 (US$8.80), or between 10 and 14 percent of the median monthly expenditure, essentially ruling out exclusive use of LPG, which would require about one cylinder refill a month.

Comparison of the same LPG-using households in 2015 and 2018 found in the ACCESS panel data showed that the number of exclusive users of LPG nearly doubled from 295 in 2015 to 583 in 2018, while the number of minority users declined from 570 to 371 during the same period. Mani et al. (2020) examined the evolution in the cooking patterns of the 7,317 households, including 1,411 households who had reported using LPG in both 2015 and 2018 (Figure 14). In the latter group, nearly a quarter of minority LPG users and half of primary LPG users in 2015 became exclusive users in 2018, and two-thirds of exclusive users in 2015 continued to use only LPG for cooking in 2018. At the same time, a tenth of exclusive and a fifth of primary users of LPG in 2015 had become minority users by 2018.

**Figure 14: Evolution of cooking patterns between 2015 and 2018 among rural households in six states**

![Chart showing cooking patterns]

Source: Mani et al. (2020).

The PMUY boosted the share of households using LPG significantly in the six states (Figure 15). In four states, the percentage of LPG-using households who were PMUY recipients in 2018 exceeded the total share of households using LPG in 2015. However, the proportion of PMUY beneficiaries using biomass was high, ranging from 60 percent in West Bengal to 95 percent in Odisha, and exceeding four-fifths in five out of six states. The corresponding proportion was much lower among non-PMUY users of LPG. Consistent with greater use of biomass, the annual LPG consumption was lower among PMUY beneficiaries than among non-PMUY LPG-using households in every state. PMUY beneficiaries were also most likely not to have refilled cylinders after obtaining the connection (Jain et al. 2018). Mani et al. (2020) used a generalized-ordered logistic regression taking cross-sectional data from the 2018 ACCESS dataset and found that PMUY beneficiaries had much lower odds of using LPG as the primary or the exclusive cooking fuel than non-PMUY LPG users even after accounting for socio-economic factors. The researchers also found that the odds were higher with increasing number of years of LPG use.
The quality of service improved markedly from 2015 to 2018. The share of households with home delivery of LPG cylinders increased significantly in all but one state, and in four states the share more than doubled, with a tripling in Uttar Pradesh. However, even in 2018 the share was less than half in all states except West Bengal, where it had reached four-fifths. Moreover, home delivery was much more common among non-PMUY LPG users in half of the states, and lower for non-PMUY LPG users only in Uttar Pradesh. The median one-way distance traveled to exchange an empty cylinder for a refilled one declined in every state, from 3–11 km in 2015 to 2–7 km in 2018 (Jain et al. 2018).

In terms of perceived benefits and disadvantages of LPG, 86 percent of those who used LPG as the primary cooking fuel (including exclusive users) were satisfied with the quality of cooking, against 92 percent of households using biomass as the primary cooking fuel. LPG was far more favored than biomass when it came to time taken to cook, ease of cooking, and smoke emissions, although one out of every six LPG user replied that LPG produced excessive smoke, which is not easy to explain. Fewer than two-fifths of LPG users thought LPG was dangerous, against three-fifths of biomass users, but 70 percent of LPG users reported that LPG was too expensive, up from 57 percent in 2015. However, LPG did not rank among top policy priorities: only 6 percent of all households ranked LPG as a top policy priority in 2015, and among them 26 percent used LPG for cooking. By contrast, more than half of households ranked government support to education as the highest priority, followed by electricity, ranked the top priority by about a fifth of households, and water, ranked the top priority by slightly less than a fifth.

Sharma, Parikh, and Sing (2019) collected data from a total of 800 rural and urban households in two districts in Jharkhand from April to June 2018 and made similar observations. Marginal effects calculated by Tobit regression estimation showed that being a PMUY beneficiary increased LPG consumption per capita significantly after accounting for household income, location (urban or rural), education, and other potential explanatory variables. The effects were equally significant on LPG’s share in total household energy. The only other factor that was significant at 1 percent in both districts and for both dependent

15 The coefficients estimated in the Tobit are not the marginal effects of the independent variables on LPG consumption. They are a combination of the change in the dependent variable, weighted by the probability that the observation is above the limit of the censored range, and the change in the probability of being above the limit, weighted by the expected value of the dependent variable. The authors merely refer to the computer program used to obtain results and present them as “marginal effects of Tobit regression estimation.” No mention is made of the steps needed to convert the regression parameters to marginal effects, and the absence of any discussion on this point raises doubt that the tables of parameter values may not be marginal values as claimed.
variables was the number of years of LPG use. Both per capita consumption and LPG’s share increased with years of use but at a diminishing rate.

India illustrates how improving the delivery mechanism for a price subsidy can reduce diversion, making the subsidy more cost-effective. As with Indonesia, continuation of a price subsidy (in the form of conditional cash transfers and forgone government revenue) has promoted adoption of LPG, its use as the primary cooking fuel by many, and even exclusive use of LPG. India’s two subsidy schemes offer many useful lessons on how to tighten the enforcement of the eligibility criteria for LPG subsidies. Problems identified and addressed (or are in the process of being addressed) include coordination between retail agents, banks, wholesale LPG suppliers, and the government; how to spot and stop various means of fraud; how to listen to customers and resolve the issues raised; and how best to inform the public, familiarize users about cooking with LPG safely, and build community-wide interest and trust. Connection subsidies are effective arguably because in India they are combined with price subsidies delivered through conditional cash transfers. Connection subsidies alone may be less effective, as the next case study of Ghana seems to show.

Ghana

Ghana began promoting household use of LPG in 1990 and has encountered several problems with subsidy delivery and unintended consequences. LPG pricing was deregulated in 2015 without a policy reversal since, resulting in a measurable increase in competition in the market. Ghana’s decentralized LPG distribution system has led to a number of safety concerns and accidents, although the government has been making efforts to shift to a centralized system for several years. The Greater Accra Metropolitan Area dominates the adoption and sustained use of LPG by households, while the government has been promoting LPG use in rural areas since 2013 by subsidizing the initial adoption.

The government of Ghana has been promoting household use of LPG for three decades, having offered a universal price subsidy until 2015. The government launched the National LPG Promotion Program in 1990 to promote substitution of LPG for charcoal and firewood. Given the disproportionately higher costs of LPG stoves compared to the alternatives—twice to as much as 20 times more expensive than charcoal and wood stoves as cited in a 2014 publication (CEESD 2014)—the government distributed free 14.5-kg and 5-kg LPG cylinders to the public largely in urban areas, and later extending the coverage to educational, health, and prison institutions. The government in the 1990s upgraded the only refinery in the country to increase the domestic supply of LPG, carried out promotional and educational campaigns, established LPG storage and distribution facilities, set up operational standards for LPG filling stations, and created the Ghana Cylinder Manufacturing Company. A higher unit price subsidy was provided in areas more than 200 km away from the refinery. The government also limited the profit margin on LPG sales to make LPG more affordable.

These government policy actions had unintended consequences, partially undermining its goal (STEPs 2014):

- Relying on a single domestic refinery with financial problems and equipment breakdowns, combined with inadequate storage capacity, meant more frequent supply disruptions than otherwise.
- Delays in subsidy reimbursement payments by the government aggravated supply disruptions, because LPG suppliers could not continue making losses while waiting for the reimbursements. In the past decade LPG shortages were sufficiently serious to warrant an explanation from the National Petroleum Authority on its external website in 2013 (NPA 2013).
- Major LPG suppliers exited the market on account of problems arising from the price subsidy and price ceilings, while smaller companies that remained in the market struggled to obtain the
financing needed to set up infrastructure for storage, transport, and filling cylinders. The end result was inadequate infrastructure capacity.

- The price of automotive LPG, which was much lower than the gasoline price, provided large incentives to shift from gasoline to LPG. Gasoline was levied a fee to cross-subsidize LPG as well as a higher excise duty and a higher refinery debt recovery levy, while fees for the road fund, energy fund, and exploration were charged to gasoline but not to LPG. Use of LPG in vehicles became very attractive financially and diverted a significant proportion of subsidized LPG to the automotive sector. This shift created LPG shortages so serious that, in 2011, commercial LPG vehicle drivers asked the government to end the LPG price subsidy to ensure reliable supply (All Africa 2011).

The government in 2013 launched the Rural LPG Promotion Program, which has been distributing free 6-kg cylinders, cookstoves, and accessories to rural households. The program’s original goal was to shift half of all households in Ghana to use LPG as the primary cooking fuel by 2020—up from 22 percent of households using LPG as the primary cooking fuel, as reported in a national household survey—and subsequently moved to 2030. The Ghana Cylinder Manufacturing Company is involved in manufacturing the cylinders for distribution. Budget statements since 2015 suggest that at least 150,000 LPG cylinders and 200,000 LPG cookstoves had been distributed as of mid-2020 under the program. In 2020 alone, a mid-year review by the finance ministry reported that 39,240 cylinders and 53,840 LPG stoves had been distributed in 80 districts. Asante et al. (2018) report that a total of 170,000 LPG stoves had been distributed to rural households by the end of 2017.

In mid-2015, the National Petroleum Authority announced and deregulated the prices of petroleum products including LPG (Kojima 2016). Because the LPG prices on the world market fell after mid-2015 and did not return to the level at the start of deregulation until the end of 2016, the initial impact of the price deregulation was not dramatic. For example, the regulated price of LPG in the latter half of June 2015 was Ȼ3.00 (US$0.70) per kg, and a year later the median indicative price calculated by the NPA was Ȼ3.52 (US$0.90) per kg. The government increased the fees and taxes levied on LPG from Ȼ0.36 (US$0.09) per kg in May 2015 to Ȼ1.26 (US$0.22) per kg by September 2020.17

Ghana’s decentralized bulk-supplied system with mini-filling plants has been posing a serious threat to public safety, resulting in a number of accidents at LPG filling stations. A document dated October 2015 on the website of the National Petroleum Authority begins by referring to “horrifying spectacles of victims of explosions involving Liquefied Petroleum Gas (LPG) cylinders and other mishaps at some domestic places in many parts of the country, usually leading to fatality” (NPA 2015). In the decade from 2007 to 2017, there were 120 deaths and 635 injuries in 22 recorded incidents (Business and Financial Times 2017).

To address safety concerns, the government has tried to replace the decentralized bulk-supplied system with a centralized system. In 2017, the president directed the so-called Cylinder Recirculation Model—proposed at least four years earlier—to be implemented within a year. In the recirculation model, instead of individual cylinders being filled at various filling stations across the country, cylinder refilling would be centralized at bottling plants away from congested commercial and population centers. These plants would procure, brand, maintain, and fill empty cylinders for distribution to LPG users through retail outlets. Consumers would exchange empty cylinders for filled ones instead of having their own cylinders refilled at refilling stations. The government would designate low-risk stations to supply automotive LPG (NPA 2017). Despite the expected improvement in safety, however, the implementation of the Cylinder Recirculation Model has suffered significant delays. In March 2020, the National Petroleum Authority

17 http://www.npa.gov.gh/.
launched a pilot program for the model, and in April 2020 introduced a cylinder recovery margin of C0.135 (US$0.023) per kg to support the roll-out of the model but the new levy was withdrawn within two weeks following strong opposition (Ghana News Agency 2020; Ghana Report 2020).

Price deregulation has increased competition in the market. The National Petroleum Authority publishes disaggregated data on LPG suppliers at the wholesale and retail level, from which the Herfindahl-Hirschman Index (HHI)—a commonly accepted metric for market concentration—can be calculated. Broadly, a market with an HHI of less than 1,500 is considered competitive, one with an HHI between 1,500 and 2,500 moderately concentrated, and one with an HHI greater than 2,500 highly concentrated. In 2015, in the year of deregulation, the market was highly concentrated at the wholesale level with an HHI of 4,008 and dominated by two companies. By the first seven months of 2020, the HHI had declined to 1,143. The retail end of the supply chain was highly competitive with an HHI of 319 in 2015 and 345 in the first seven months of 2020.18

Despite the fiscally unsustainable subsidies, the prices could not be lowered sufficiently to enable regular use by many households. The National Petroleum Authority does not disaggregate LPG consumption by sector and therefore it is not possible to track household use of LPG by year, but changes in the household use of LPG can be gleaned from household surveys (Figure 16). When the government first began promoting LPG as a household fuel, only about 2 percent of all households in the country used LPG as the primary cooking fuel. During the time of LPG price subsidies, the share rose to nearly 10 percent by 2006 and more than doubled in the next seven years to 2013, dominated by growth in urban areas. It follows from these statistics that, predictably, the LPG price subsidy policy benefited urban households disproportionately, especially in the Greater Accra Metropolitan Area. Following price deregulation, LPG use stagnated in urban areas between 2013 and 2017, although the number of households citing LPG as the primary cooking fuel increased by about 200,000. Among rural households during the same period, the share increased by more than half and the number increased by about 120,000, perhaps indicating the impact of the Rural LPG Promotion Program. Among rural households in the 2016–2017 survey, the top 20 percent of all households (by per capita expenditure) accounted for more than 60 percent and the top 40 percent for more than 80 percent of households using LPG as the primary cooking fuel, whereas the bottom 40 percent comprised only 5 percent, showing a substantial skewing toward the rich.

Figure 16: Percent of Ghanaian households using LPG as the primary energy source for cooking

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round 6 October 2012–October 2013, and 2017 is from round 7 October 2016–October 2017. The Rural LPG Promotion Program was launched in 2013 and LPG pricing was deregulated in 2015.

Asante et al. (2018) reported the results of the first systematic evaluation of the Rural LPG Promotion Program in which data had been collected in five rural communities between November 2015 and October 2016. The study conducted focus group discussions with women who were primary cooks (both beneficiaries and non-beneficiaries of the program) and male household heads from beneficiary households, and assessed the use of traditional three-stone-fire stoves and LPG stoves before and after the delivery of the LPG stoves among 200 randomly selected primary cooks who were beneficiaries of the program. The study also measured personal exposure to carbon monoxide.

The findings pointed to limited effects of the program. Nine months after the stove distribution, 58 percent of the selected beneficiaries had never refilled their 6-kg cylinders, 24 percent had refilled once, 10 percent had refilled twice, and about 9 percent had refilled three or more times. These households did not use LPG exclusively even in the initial stage of evaluation. More revealing was the result of the survey conducted 18 months after cylinder delivery: only 8 percent of the respondents were still using LPG. Given these findings, it is not surprising that the delivery of free LPG cylinders and cookstoves had no impact on exposure to carbon monoxide. The study also found that there was a perception among some that the stoves were distributed based on political affiliation, favoring those who belonged to the ruling party.

A lack of affordability was the main reason for the very limited use of LPG, mirroring the findings of a similar program in Andhra Pradesh in India (Rajakutty and Kojima 2002), in which cylinder deposit fees were waived for women members of self-help groups from households below the poverty line. At the time of the evaluation of the Ghanaian rural program, the cost of refilling a 6-kg cylinder was ᴶＣ２₂ (US$5). Switching entirely to LPG might have required two refills a month, or US$10, a considerable sum of money for rural households, many of whom had seasonal income. Regular monthly outlays of US$10 would require minimal monthly income of US$200 based on 5 percent for affordability. Further, these financial barriers existed despite the fact that world LPG prices during the survey period were among the lowest in the last two decades. In addition, each refill required travelling an average of 25 km, incurring additional cash expenditures. A lack of spare parts also deterred some households, who had experienced minor damages to LPG stoves, from continuing to cook with LPG.

The participants cited several benefits of cooking with LPG. It enabled fast cooking, facilitated multi-tasking, and kept cooking utensils clean. LPG substituting for wood enabled children to do more schoolwork because they did not have to collect as much firewood. Lastly the perception that cooking was women’s task began to change because of these benefits.

Building on the above findings, a study replicating the conditions of the Rural LPG Promotion Program has produced additional evidence that recipients of free LPG stoves make little use of LPG. An innovative cluster-randomized factorial intervention trial was carried out in 27 rural communities in Kintampo, Ghana from June 2017 to October 2018 involving households who had never used LPG before (Carrión et al. 2021). The researchers broadly replicated the Rural LPG Promotion Program by giving all participants a free stove, two 14.5-kg LPG cylinders, and one free refill. The participants were divided into four groups: (1) control group with no further intervention; (2) awareness-raising group receiving information about health and non-health benefits of LPG, options for how to pay for LPG refills, cooking demonstrations, government LPG policy, and other relevant factors; (3) delivery group receiving free taxi delivery of LPG refills; and (4) dual intervention group to whom both interventions 2 and 3 were provided. The results showed that the delivery group nearly doubled LPG use (measured during the last six months of the year-long monitoring period) compared to the control group. The difference was highly statistically significant but was also immaterial: the control group used LPG an estimated 12 minutes per
week on average, the delivery group used it 23 minutes, the dual intervention group 22 minutes, and awareness-raising group 15 minutes. A test conducted after the trial showed that the delivery group—but not the dual intervention group—had gained nearly as much knowledge about various aspects of LPG use as the awareness-raising group.

In Ghana, the timing of LPG pricing deregulation coincided with falling global prices, helping to ease the transition to market-based pricing to the point where the government was able to increase fuel taxes. The government’s previous support to promotion of household use of LPG led to problems associated with state-led development of a sector, at times driving away private investment. Despite price subsidy elimination, LPG use has not declined. The subsidy scheme to promote household use of LPG in rural areas has no income criteria for eligibility. As such, the rural rich are the primary consumers of LPG and the evidence so far is that distribution of free LPG stoves, cylinders, and accessories does not enable sustained use among the bottom 60 percent in rural areas.

Brazil

Decades of LPG price subsidies enabled widespread use of LPG as a household fuel in Brazil. Cooking with electricity is rare and urban households use LPG extensively (and more recently natural gas where it has become available). Household consumption of LPG, however, peaked in the 1990s and has been declining since the price subsidy was officially ended in 2001.

The government introduced incentives to increase LPG consumption between 1955 and 1973. Between 1973 and 2001, the government subsidized LPG and equalized prices throughout the country. In 2001, as part of the broader downstream sector deregulation, the government removed the LPG subsidy and deregulated prices. Subsidy removal in 2001 increased the average retail price by 17 percent and decreased household purchase by more than 5 percent.

Between 2002 and 2004, the government pursued a social policy to assist low-income households in purchasing LPG through auxílio gás (gas aid), cash transfers of about US$10 every two months to households with an income no higher than half of the minimum wage under the Rede de Proteção Social (Social Protection Network). The energy minister in early 2002 explained that shifting to such targeted cash transfers would reduce the LPG subsidy bill by about 60 percent and benefit approximately 9.3 million families (Folha 2002). Article 5 of Law 10453, which authorized the cash transfers, set the per capita family income as the only eligibility criterion, making it a system of unconditional cash transfers. However, auxílio gás was not found to be effective in that many low-income families could not buy LPG regularly despite the cash assistance. The government’s national energy balance statistics show that LPG consumption by households in aggregate fell by 3.5 percent in 2002 and 6.5 percent in 2003, which were not compensated by higher natural gas use. When natural gas and LPG are combined, the decline was still 3.3 percent in 2002 and 5.8 percent in 2003. Household wood consumption rose by 11.9 percent and 3.8 percent in 2002 and 2003, respectively.

In 2004, auxílio gás and all other programs under the Rede de Proteção Social were incorporated into the Programa Bolsa Família (Family Allowance Program), which transfers cash to poor households. The cash transfers are conditional upon children attending school if the beneficiaries have school-age children but not on LPG purchase. The program enrollment has been about 14 million households, or a fifth of households in 2020.

The Programa Bolsa Família has little connection to LPG by now and, as such, the government has relied mostly on the national oil company, Petrobras, to offer implicit support to household use of LPG. Despite the official policy of complete price deregulation since 2001, the government has leaned on Petrobras to subsidize the prices of socially sensitive fuels—gasoline, diesel, and LPG. The financial losses suffered
by Petrobras exceeded US$10 billion in 2012 and 2014 (Kojima 2016). The producer price of LPG was essentially frozen in the local currency from December 2002 to August 2015, and after a 15-percent increase, from September 2015 to November 2016. Not until after March 2017 did the producer price begin to rise measurably.\(^{19}\) By contrast, the nominal end-user prices rose, as explained next.

Household consumption of LPG has been falling gradually since 2001, although stabilizing between 2006 and 2011. Figure 17 traces the history of household consumption of LPG and wood as well as the national average price of LPG sold in 13-kg cylinders, the type used by households. From 2003 to August 2015, although the government’s pricing policy was complete deregulation, enough political pressure was applied to freeze the producer price of LPG at about R$1.04 (US$0.29–0.67) per kg or R$13.5 (US$3.8–US$8.7) for LPG sold in 13-kg cylinders.\(^{20}\) The retail prices, however, rose from R$29 (US$9.40) per 13 kg in 2003 to R$46 (US$13) by August 2015, primarily due to higher distribution and retail margins. In real terms, the price peaked in 2003 and did not return to that level until 2018. Between 2000 and 2019, household consumption of LPG fell every year except in 2007, 2008, and 2010. If consumption of LPG and natural gas by households is added on a common energy basis, then the only year when the LPG consumption by households fell but the combined consumption of LPG and natural gas rose was 2013. By contrast, household consumption of wood rose from 2001 to 2003 during the time of the steep LPG price increase and associated fall in its consumption, rose again in 2014 and 2015, and increased sharply in 2019 for reasons that are not clear.

**Figure 17: Monthly consumption of LPG and wood in Brazil averaged over all households and corresponding LPG prices sold in 13-kg cylinders**


Notes: Population and consumer price index are taken from the World Development Indicators (https://datacatalog.worldbank.org/dataset/world-development-indicators) and household size data are from the Database on Household Size and Composition of the United Nations Population Division (https://www.prb.org/international/indicator/hh-size-av/table). The number of households are calculated by dividing the total population by the average household size. 2001 marks the end of the official price subsidy policy for LPG.

For many years after 2001, Brazil relied largely on the price subsidies offered by Petrobras to keep fuel prices artificially low. Despite freezing producer prices for more than a decade and the resulting large financial losses suffered by Petrobras, household wood consumption—which rose immediately after

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deregulation and did not fall back to the level last seen in 2001 until six years later—has declined only marginally since 2011, perhaps in part because the LPG prices rose faster than the rate of inflation after 2014. These observations highlight the challenges of managing a fuel with well-established international benchmark prices subject to both price and currency fluctuations.

Mexico

Mexico is the richest country in this study and deregulated LPG pricing in 2017. Despite rising world LPG prices aggravated by currency depreciation, the government has not re-introduced LPG subsidies since. Household use of gas as the primary cooking fuel was already high in 1995 at 81 percent and rose to 86 percent by 2018. Mexico implemented cash transfers prior to deregulation, supplementing the price subsidy with a social safety net program, which ended several years before deregulation. This stands in contrast to other countries, which introduced social protection after subsidy reform.

The government of Mexico subsidized LPG until 2015. The government imposed location-specific price ceilings on end-use prices—typically below market-based levels—from March 2001 to December 2014. Between 2003 and 2012, the cost of below-market pricing of LPG was estimated to exceed Mex$147 billion (US$12 billion). In 2015 and 2016, prices were adjusted only at the beginning of the year, and then lowered in September 2016 for the rest of 2016. Despite the infrequency of their adjustments, the price ceilings in 2015 and 2016 were sufficiently high to avoid subsidies. The government deregulated LPG pricing in 2017, opening the market fully to competition in January 2017. LPG is subject to a value-added tax and, since 2014, also to a carbon tax equivalent to Mex$39.80 (US$3 in 2014 but less than US$2 by 2020) per tonne of carbon dioxide. This stands in contrast to natural gas, which is fully exempt from the carbon tax (G20 2017; Sener 2012).

For a period of five years between 2007 and 2011, in addition to the price subsidy, the government’s social safety net program Oportunidades (opportunities) included an energy component, Oportunidades Energéticas (energy opportunities), which offered conditional cash transfers in the first year and then switched to unconditional cash transfers in the subsequent years. Two requirements for eligibility for the Oportunidades Energéticas were enrolment in the Oportunidades and presentation of electricity bills. The Oportunidades was open only to those who lived in areas selected by the government. The geographical selection was in turn based on the levels of education, income, literacy, housing conditions, and access to piped water, sanitation, and electricity. About 90 percent of those enrolled in the Oportunidades, or between 4.5 million and 5.2 million households, received the energy cash transfers over the five years of the program. The monthly amount provided increased from Mex$50 (US$4.22) in 2007 to Mex$60 (US$4.83) by 2011. For a household consuming 75 kilowatt-hours (kWh) of electricity and 20 kg of LPG a month, these amounts would have covered about 20–25 percent of the total spending on these two forms of energy (Ombudsman Energía México 2020).

In July 2017, the government initiated a pilot program to sell subsidized LPG through a network of state-owned distribution centers typically located in small, rural settlements. The pilot ended within a year. In the pilot the government provided 13,000 LPG stoves and 10-kg cylinders to marginalized households in 12 states at a cost of Mex$12 million (US$670,000). The subsidized price of LPG was set at Mex$15 (US$0.84) per kg. Information on how much LPG was sold in the pilot, the total subsidy paid out, and its effects is not available (Ombudsman Energía México 2020).

Mexico has been historically known to have relatively high residential consumption of LPG. Many households have used LPG not only for cooking but also to meet all their water heating requirements. Household use of LPG declined steadily from 1998 and 2006, and after a rise in 2007 has been declining since (Figure 18). Household consumption of LPG in fact halved between 1993–1998 and 2018. Inclusion of natural gas does not change the pattern: consumption of LPG and natural gas combined by an average
household halved during the same time period. The temporary increase in LPG consumption in 2007 could have been due to the introduction of a conditional cash transfer program. Comparison of LPG and wood consumption on a common basis (in gigajoules) shows that wood consumption has been monotonically declining since 1990, suggesting that wood is not substituting LPG measurably.

Figure 18: Monthly consumption of LPG and wood in Mexico averaged over all households

Notes: GJ = gigajoules. 2014 marks the end of the LPG price subsidy.

The national survey on energy consumption in private homes conducted in the first half of 2018 found that 79 percent of households used LPG as the primary cooking fuel and 7 percent used natural gas, or a total of 86 percent of households used gas, up from 81 percent in 1995 and 83 percent in 2015. Comparison of the above national survey data with LPG consumption averaged across all households in Figure 18 suggests that the average monthly consumption by LPG-using households fell markedly from 1995 to 2018, partly on account of higher appliance efficiency. The survey found that 43.5 percent of households had water heaters, and of the 14.6 million water heaters in use, 11 million used gas, mainly in temperate regions of Mexico. The thermal efficiency standard for gas water heaters came into effect for the first time in 1996, set at 65 percent. The most recent standard went into effect in 2011 and was set at 84 percent (INEGI 2018). The declining consumption of LPG is consistent with the timing of the introduction of these efficiency standards.

Mexico is unique among the study countries in ending price subsidies without offering compensatory measures to the poor and still being able to maintain a high level of LPG use as the primary cooking fuel. Households have been helped by tightened efficiency standards for gas water heaters, reducing the historically high residential consumption of LPG in the 1990s to a level more representative of other countries by the latter half of the 2010s. If the hypothesis that higher thermal efficiency has contributed to lower consumption is correct, that would point to the value of policy focus on efficiency standards and, equally important, ensuring durability of high efficiency of LPG stoves in use. Based on international experience, it is far from clear that the government’s proposal to sell subsidized LPG through government-owned distribution centers would have been successful or cost-effective. As such, although virtually no information about the pilot program is available, terminating it before scaling up might have been sensible.

Conclusions

Universal price subsidies for LPG require government intervention in price setting for a commodity that is otherwise freely traded on the world market and can deter market entry of new service providers.
because subsidies are seldom reimbursed fully or on time. Once involved, governments find it politically
difficult to end price controls and allow prices to rise to market levels, as demonstrated in Indonesia,
Senegal, the Dominican Republic, Peru, and Brazil in this paper. Artificially low prices are almost always
accompanied by diversion to ineligible consumers, both inside and outside the country, increasing the
subsidy bill substantially beyond what is intended. Evidence for diversion emerged clearly when the
conditional cash transfer scheme in India was temporarily suspended in 2014. India’s DBTL appears to
have reduced diversion of subsidized LPG substantially.

Selling LPG at market prices and transferring cash to eligible LPG consumers is a significant
improvement over price subsidies. If LPG sellers have concerns about timely and full reimbursement by
the government for the subsidies, conditional cash transfers delivered to LPG buyers might be more
effective than cash transfers delivered to LPG sellers, as in Peru, because there are many more buyers
than sellers and the government’s failure to reimburse could become known more widely and quickly,
given the sheer number of people affected. While the government of India transfers cash to LPG
consumers, the transfers go through the three state-owned petroleum companies, who have been owed
some payment arrears by the government. If cash transfers bypass LPG suppliers altogether, suppliers do
not have to wait for reimbursements and can operate on a commercial basis, allowing governments to
focus on engendering fair and healthy competition in the market.

Some economic distortions remain with cash transfers that are conditional upon LPG purchase, although
the sharper the targeting the smaller the distortions. If targeting criteria are so strict that cash transfers
cover a negligibly small fraction of the total LPG consumption, the economic distortions would be
correspondingly small, but so would the impact on household LPG use unless the vast majority of the
population is already using clean modern energy and the cash transfers are intended to help the remaining
few. If conditional cash transfers are provided to a large swath of the population and cover a sizable
fraction of the LPG purchase cost, they could diminish the incentives to improve efficiency along the
supply chain. If the amount of the cash transferred is dependent on the market price of LPG and is
adjusted to maintain some measure of stability in the costs borne by consumers, the government continues
to be involved in calculating costs and act as an economic agent, thereby potentially prolonging the
politicization of fuel pricing.

Unconditional cash transfers take the LPG supply chain completely out of the subsidy delivery
mechanism and have the least distorting effects. They are also typically targeted. The fiscal burden,
however, is greater than that of conditional cash transfers with the same degree of targeting, because not
every eligible household chooses to participate in the conditional cash transfer program and the only
deterrence to participation in the unconditional cash transfer program is the transaction cost of the initial
enrolment. Not all eligible households take advantage of conditional cash transfers because LPG is
unaffordable even after cash transfers, spending on LPG may not be a priority for them, or both, as
observed in household responses to surveys asking about spending priorities in India and Peru and
witnessed by households who seldom or never refill their LPG cylinders after the initial uptake of LPG in
Ghana and India.

Price subsidies—either in the form of lower prices offered or conditional cash transfers—increase
household use of LPG, even among the rural poor. The history of residential use of LPG as provided by
government statistics in five of the countries studied offers some insights (Figure 19). Brazil and Mexico,
which have deregulated LPG prices largely without conditional cash transfers or other targeted assistance
program and have the highest end-use prices, have seen declining use of LPG by households, at times
accompanied by rising wood use. The more dramatic of the two is the near halving of consumption in
Mexico from the mid-1990s to today, perhaps on account of higher efficiency of water heaters and to a
small extent due to a shift to natural gas. The Dominican Republic saw a marked decline in LPG
consumption as prices were increased in the early 2000s, saw a gradual increase, but then a decline as the universal price subsidy was eliminated or substantially reduced and offset by targeted unconditional cash transfers. Indonesia, which has the lowest end-user price and is the only country among the five that has kept a large universal price subsidy consistently for years, has seen a steady and significant increase in residential LPG consumption. India, which has the second lowest price paid by households and has largely untargeted conditional cash transfers complemented by subsidies for the poor to cover the initial cylinder deposit fee, has also seen a steady increase in LPG consumption.

**Figure 19: Monthly consumption of LPG averaged across all households and LPG prices in July 2018**

![Graph showing monthly consumption of LPG across different countries](image)

**Sources:** For monthly household consumption of LPG, calculations by World Bank staff based on data cited in this paper, and for retail LPG prices, [https://www.gov.br/anp/pt-br/assuntos/precos-e-defesa-da-concorrencia/precos for Brazil], [https://www.micm.gob.do/direcciones/combustibles/avisos-semanales-de-precios/aviso-semanal-de-precios-de-combustibles for the Dominican Republic], [https://iocl.com/TotalProductList.aspx for India], and [http://sie.energia.gob.mx/ for Mexico].

**Note:** The price in the Dominican Republic subtracts the monthly cash transfer amount from the price of a 25-pound (11.4-kg) cylinder refill and that in India is after subsidy reimbursement through the DBTL. The price in Indonesia is that of subsidized LPG sold in 3-kg cylinders.

Consumer complaint mechanisms, such as those instituted in India and Peru, can help identify and improve subsidy delivery. Such mechanisms are important especially in the early days of implementation of a new scheme when teething problems are especially prevalent. They can also serve as hotlines to help identify illegal diversion of subsidies. Making complaint mechanisms useful would require cooperation of LPG suppliers and relevant government agencies.

The comprehensive audits of two LPG subsidy schemes conducted by the government of India provided invaluable data in assessing the performance of the schemes and suggesting areas for improvement or remediation steps. Such audits are rare but are well worth the costs for large-scale subsidy schemes.

Commercial malpractice arising from dual pricing in the market on account of tax and fee exemption for certain consumer categories is evident in India, where a government audit found evidence of diversion of unsubsidized domestic LPG, given the large price difference between domestic LPG and non-domestic non-exempt LPG. The simplest solution would be to eliminate the exemption for all consumers and add the extra taxes and charges to the cash transfers in the DBTL. There is a non-domestic exempt category for some government institutions and charitable organizations, but government institutions could be compensated by other budgetary transfers and it is not clear that it would be worth risking continuing diversion simply to help charitable institutions. If the tax and fee exemption is eliminated, there would be
no need to limit household LPG refills to 15 a year (the last three of which are unsubsidized according to the ceiling on subsidized LPG of 12 a year). This is important because a large household that meets both cooking and all its heating needs using LPG could need more than 15 refills a year. The difference in price between bottled and bulk LPG in Peru prompted the government to document evidence of diversion from the bottled LPG to the bulk LPG market and led to the removal of bottled LPG from the price stabilization fund in 2020, thereby eliminating the driver of the price difference—although the congress is considering bringing bottled LPG back under the stabilization fund.

Subsidies may increase the adoption of LPG but not necessarily its regular use. Ghana and India provide two examples: in Ghana one study found that only eight percent of households in the Rural LPG Promotion program were still using LPG after 18 months, and in India one-sixth of rural households in six states who had been registered for LPG for more than a year had never refilled. Government policies need to consider how best to use limited resources to facilitate access to clean modern energy in a meaningful way. One simple metric to check is the minimal income needed to limit spending on LPG to 5 percent or less of total household expenditures. If regular use of LPG requires much more than 5 percent, such households are most unlikely to adopt LPG as the primary cooking fuel. Another item of evidence related to the inability of some households to continue buying LPG is the poor repayment record of PMUY beneficiaries to pay back interest-free loans for the stove purchase and the first refill spread over six refills in India. Taking out a loan for consumption is often not sustainable and the evidence from India illustrates the challenges for households who are cash-constrained.

Regular, let alone exclusive, use of LPG requires, amongst others, preferably four-burner stoves that can accommodate large pots as well as immediate availability of a refilled cylinder when the one in use becomes empty. A one-burner stove on top of a 3-kg cylinder by design cannot meet most cooking needs but is affordable. Immediate delivery may be possible for households in densely populated urban areas with LPG suppliers ready to deliver at short notice but is virtually impossible for households in rural areas and others with no home delivery or where suppliers are far away. One way to guarantee non-disruption to LPG supply is to have two cylinders at all times. This is the standard practice among households who can afford LPG relatively easily, but not affordable for many in developing countries. Devices that meter the amount consumed and alert households of the need to refill in advance would be useful—such as meters used in pay-as-you-go LPG schemes—although that too would add to the cost. These are some of the challenges requiring attention.

The history of LPG pricing in the countries studied point to the difficulties of ending price subsidies once started and the high risk of policy reversal. It is frequently argued that times of low international fuel prices are ideally suited for subsidy removal because the upward price adjustments can be limited or may even be unnecessary. However, if a period of low prices is followed by a prolonged period of rising prices on the world market, political pressure to reverse the subsidy reform can mount quickly. Such a period of rising prices was observed from 2017 to 2019, and again from mid-2020. While Ghana and Mexico have maintained their deregulation policy, the Dominican Republic and Senegal have resorted to freezing prices. Although Peru stopped subsidizing LPG using the price stabilization fund in April 2020, political pressure has begun to appear in 2021 to re-introduce price control as global prices steadily rose from the second half of 2020 into 2021.

It may be appropriate to provide conditional cash transfers for merit goods. Clean and convenient cooking may be a merit good, but one criticism that can be levelled is that conditional cash transfers for LPG are not technology- or fuel-neutral and can become a case of governments’ picking a winner when there are several ways of achieving clean and convenient cooking, of which cooking with LPG is only one. The specific country circumstances may be such that other options are impractical or not always available. For example, cooking with electricity would not be practical if the country is suffering from chronic
electricity shortages and frequent blackouts. But in other countries electricity may be practical and even preferred, given its safety and the potential to become carbon-neutral over time. Unconditional cash transfers are technology-neutral but promote consumption of merit goods less than conditional cash transfers. For that reason, for the same degree of targeting, conditional cash transfers cost less because not every eligible beneficiary will choose to purchase the good in question. Which pathway is more appropriate depends on the country circumstances and the government policy needs to be tailored accordingly.

A general pattern that emerges from the experience of these countries is that without price subsidies to keep prices low, it would be difficult to achieve sustained use of LPG among the less well-off, making the “connection subsidy” less effective than with grid electricity. This is because the upfront expenditure to adopt LPG is much less than the cost of connection to grid electricity, and while there are many households who cannot cover the cost of the initial connection but who are willing and able to pay the monthly electricity bills, there are far fewer households who cannot pay for the initial cylinder deposit fee and the stove purchase but who can pay for regular consumption of LPG as the primary cooking fuel. International experience also shows that it is challenging to keep on subsidizing LPG to achieve sustained use, although targeting using digital technology and other means has helped in India and Peru.

There are several no-regrets steps that all governments can take to increase LPG use, the first three of which also decrease the cost of using LPG:

- Set standards for thermal efficiency of LPG stoves and monitor and enforce them. Mexico tightened the efficiency standards for LPG-based water heaters in 2011, and higher efficiency may account for the reduction in household use of LPG in the subsequent years. Shen et al. (2018) tested five LPG stoves from Cameroon, China, Peru, and Uganda. Thermal efficiency varied with a difference of approximately 10 percent between the most and the least efficient stoves. Surprisingly, the stove with the highest thermal efficiency had a corroded stove body and corroded burners after use from 2009 to 2016 in a rural home in Cameroon.

- Monitor and enforce rules against short-selling. The weight of LPG in a cylinder is opaque in many markets, leading to the suspicion that cylinders are under-filled. Short-selling of LPG is difficult to detect at the point of purchase, but effective monitoring and enforcement can minimize it. In many markets the tare weight of the cylinder may not be clearly marked and, even if it is, its accuracy is difficult to verify; the customer may not be able to weigh the cylinder at the point of purchase; and the cylinder may be filled with substances other than LPG. It is no coincidence that the only law devoted to LPG in Brazil concerns transparency in weighing cylinders, starting with the requirement that the cylinder tare weight be clearly visible to the customer. Kenya in 2009 issued LPG regulations requiring every LPG retailer to have a properly calibrated weighing instrument.

- Promote other measures that can reduce supply costs. Governments can do more to make the market as efficient as possible and promote competition so that efficiency gains are passed on to consumers in the form of lower prices. There is tangible evidence in Ghana that competition has increased after deregulation. To that end, governments can encourage hospitality arrangements and third-party access to import terminals and storage tanks, thereby reducing duplication of infrastructure and lowering the barrier to entry. Improving roads can reduce transport costs and enable more areas to be reached, while improving ports and customs clearance could reduce congestion. Better port infrastructure may also facilitate LPG imports in larger parcels, again lowering costs. Fair competition—essential for increasing efficiency—requires establishing a modern regulatory framework, which may include formal adoption of international standards so that they are automatically updated, and effective monitoring and enforcement to curb commercial malpractice and ensure safety. Where institutional capacity is still being developed
for monitoring and enforcement, one option is to establish a system of certified installers and private inspectors under government supervision.

- Monitor and enforce safety measures. Safety concerns are frequently cited as one of the main reasons households are reluctant to use LPG. Ensuring safety calls for a clear definition of cylinder ownership; assignment of legal responsibility for cylinder maintenance, repair, and replacement; effective enforcement of the ban on cross-filling where such a ban exists; proper training of operators throughout the supply chain; extensive education campaigns for end-users; and penalizing companies that refill unsafe cylinders. Turkey requires training of all personnel involved in supplying LPG and educating consumers about proper handling of LPG, sets strict rules about the conditions under which cylinders can be refilled, and even authorizes charging of small fees to marketing companies to finance monitoring and enforcement.
Appendix: India

A timeline tracing the evolution of the LPG subsidy reform in India is provided in Table 5. The table is followed by information on the two government-commissioned audit reports, one on the DBTL (India 2016) and the other on PMUY (India 2019).

### Table 5: Chronology of LPG subsidy reform in India

<table>
<thead>
<tr>
<th>Year</th>
<th>Action</th>
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<tbody>
<tr>
<td>2000</td>
<td>The LPG Control Order, 2000 (as amended) allowed only one connection per household for subsidized LPG under the public distribution system (PDS).</td>
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<td>2002</td>
<td>The Ministry of Petroleum and Natural Gas issued “PDS Kerosene and Domestic LPG Subsidy Scheme, 2002” effective April 1, 2002. Although the gazette publication did not explicitly say so, the scheme effectively limited the budgetary support for subsidy reimbursement, resulting in a large subsidy burden on state-owned oil and gas companies.</td>
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<td>2006</td>
<td>The Rangarajan Committee Report recommended restricting subsidized kerosene to below-poverty-line (BPL) families and raising the subsidized LPG price, with any remaining subsidies financed directly by the federal budget.</td>
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<td>2009</td>
<td>The Rajiv Gandhi Rural LPG Distribution Scheme (RGGVY) was launched to increase the number of LPG distributors, resulting in about 4,000 new distributors between 2009 and 2014. This, along with PMGSY (Prime Minister’s Rural Road Scheme) to enhance the rural road network, was intended to increase LPG availability. The RGGVY also provided a one-time grant to BPL households in rural areas to get new LPG connections. The eastern region experienced a 59-percent increase in distributor density but northeast experienced only a 25-percent increase (Sankhyayan and Dasgupta 2019).</td>
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<td>2010</td>
<td>The Parikh Committee Report recommended rationing subsidized LPG, replacing the subsidy with direct cash transfers to BPL households, and fully deregulating prices.</td>
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<td>2011</td>
<td>A task force was set up to tackle growing under-recoveries by the oil marketing companies. Its report, Nilekani Task Force Interim Report, in July recommended (1) imposing a limit on subsidized LPG, (2) switching to direct cash transfers to Aadhaar-enabled bank accounts of consumers, and (3) targeting subsidies.</td>
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<td>2012</td>
<td>The National Informatics Centre in June began removing multiple connections based on same name/same address and different name/same address. The Kelkar Committee Report recommended elimination of LPG subsidies over three years as part of a roadmap for fiscal consolidation, noting adverse effects of fuel price subsidies on macro-fiscal management. In September, the government imposed a limit of six refills of 14.2-kg cylinders per year.</td>
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<td>2013</td>
<td>The annual limit on LPG cylinder refills was increased from six to nine in January. In May, the oil marketing companies began removing intra-company duplication of LPG customers on the basis of the Aadhaar number. In June, the DBTL was launched. Compliant consumers had to link their bank and Aadhaar numbers to LPG-consumer identifications and were eligible to receive a one-time permanent advance of Rs 435 (US$7.45) for the first refill, which would remain with the customer until the connection was terminated. The DBTL was implemented in 201 districts.</td>
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<td>2014</td>
<td>In February, the annual limit on the number of refills was increased to from nine to 11, and then to 12 in April. In March, the DBTL scheme was suspended, largely because of consumer grievances, especially in areas where the Aadhaar penetration rate was low. The government formed a committee headed by Shri S.G. Dhande to review the operation of the scheme.</td>
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<tr>
<td>Time</td>
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<tr>
<td>In May, the oil marketing companies began removing inter-company duplication of LPG customers on the basis of the Aadhaar number.</td>
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<td>In November, the DBTL was relaunched as Pratyaksh Hanstantrit Labh Yojana, PAHAL (DBTL hereafter for brevity) in 54 districts in the first phase. The objectives were to (1) remove incentives for diversion, (2) end multiple and other fraudulent connections, (3) ensure subsidy delivery to eligible consumers, (4) improve availability and delivery of LPG cylinders, and (5) allow self-selection for the cash transfer.</td>
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<td>2015</td>
<td>In January, the DBTL was extended to 622 districts in the second phase. Aadhaar linking was no longer mandatory. Distributors maintained the consumer database (unique LPG identification, name, address, date of birth, bank account details, Aadhaar number if available) and periodically synchronized the database with the central system maintained by the oil marketing companies. Distributors would deliver LPG cylinders at market prices in response to customer requests and upload the proof of receipt (indicating completion of the transaction) to the oil marketing company’s central system. Reimbursement to the customer is initiated by the latter, which sends the advice to the State Bank of India and onward to the payment platform managed by the National Payment Corporation of India for crediting the consumer’s bank account. Funds for subsidies are kept in the so-called Buffer Accounts of the oil marketing companies, which submit audited statements of DBTL sales each month to the Petroleum Planning and Analysis Cell, which would scrutinize the sales figures and forward them to the Ministry of Petroleum and Natural Gas. If the ministry is satisfied with the figures, it would give concurrence for the release of the subsidies to the oil marketing companies. In March, the government rolled out the Give-It-Up campaign in which well-off households were encouraged to opt out of the DBTL to create more fiscal space for the government. After surrendering subsidized connections, households could reapply after a year. In July, the National Informatics Centre began removing multiple connections based on same name/same address and different name/same address combinations.</td>
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<td>2016</td>
<td>In January, the government ended the DBTL eligibility of those with taxable income in the previous year (applicable to both the beneficiary and the spouse) in excess of Rs. 1 million (about US$15,000). In practice, obtaining accurate information about taxable income in India has been challenging. In February, the Ministry of Petroleum and Natural Gas directed the oil marketing companies to recruit 10,000 new LPG distributors. In the same month, the number of consumers opting out of the DBTL in the Give-It-Up campaign numbered 6.7 million. In April, the government discontinued the practice of providing a permanent advance to each newly connected household joining the DBTL. In May, the government launched Pradhan Mantri Ujjwala Yojana (PMUY). It aimed to set aside a budget of Rs 1,600×50 million or Rs 80 billion (US$1.2 billion) to provide 50 million women with free LPG connections within seven working days after registration. A BPL household that satisfies at least one other condition, which differed between rural and urban areas, is eligible. The poverty status is determined by the Socio Economic and Caste Census (SECC) – 2011 census, which had assigned a unique AHL TIN (Abridged Household List Temporary Identification Number) of 29 digits to each BPL household. Each registration is required to be in the name of a woman in the eligible household. The 2011 SECC identified 244.9 million households (179.7 million rural and 65.2 million urban), of whom 103.1 million were found to suffer from at least one deprivation (87.2 million rural and 15.9 million urban). PMUY also provides an optional loan facility to cover the cost of the stove and the first refill,</td>
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the recovery of which is made from the subsidy payments under the DBTL. A physical inspection of the beneficiary’s household is required every two years. In June, the Ministry of Petroleum and Natural Gas issued the “Unified Guidelines for Selection of LPG Distributorships,” specifying that LPG distributors even in rural areas should generally be set up within 15 km of its customers. In December, the government made linkage to each beneficiary’s Aadhaar number mandatory in the DBTL.

2017
In July, a pilot to replace 14.2-kg cylinders with 5-kg cylinders was launched. In September, the Ministry of Petroleum and Natural Gas launched Pradhan Mantri LPG Panchayat, a series of community meetings bringing together about 100 LPG customers and serving as a platform for them to interact, promote mutual learning, and share experience. The goal was to hold 100,000 such meetings across India before March 31, 2019.

2018
In February, the government increased the target for PMUY to 80 million, set March 2020 as the date by which to reach the new target, increased the initial budget of Rs 80 billion to Rs 128 billion (US$2 billion), and expanded the eligibility criteria in the so-called extended PMUY (e-PMUY). All adult women belonging to BPL families identified in the 2011 SECC survey as well as the families falling under any of seven additional notified categories are eligible. In May, eight focus states were identified to promote switching to 5-kg cylinders, such as by maintaining an adequate stock, close monitoring of distributor performance, and wide publicity.

With effect from November 1, the Ministry of Petroleum and Natural Gas issued “Marketing Discipline Guidelines 2018 for LPG Distributorship,” requiring distributors to provide adequate delivery infrastructure for making home delivery of LPG cylinders.

2019
The Cabinet Committee on Economic Affairs approved e-PMUY-2.

The compliance audit report on the DBTL covered the period from January 1, 2015 to October 31, 2015. The audit first selected 1 percent of distributors as of August 1, 2015 but, upon finding numerous cases of multiple connections (one household registered as a DBTL-eligible customer for more than one LPG cylinder), increased the number to 34 percent of all distributors (5,716), yielding 118.9 million consumers (62 percent of all consumers). The top 1 percent of distributors, or 165, was also selected for detailed verification. The central server of the three oil marketing companies provided the data.

The audit report on the DBTL noted the following (India 2016):

- Multiple connections were checked by identifying two or more customers linked to the (1) same Aadhaar number, (2) same bank account number and the Indian Financial System Code, (3) same name and same address, or (4) same name, date of birth, and registered mobile number. One bank account was found to be linked to 16 active users. All three companies highlighted the poor quality of the database, particularly with respect to the date of birth and mobile numbers, and two companies implied that distributors had entered dummy data.

- Some active customers had more than one connection with the same oil company, while others had one connection each with more than one company; some were even registered with all three companies (same Aadhaar number, same bank account). Those with multiple connections could exceed the limit of 12 subsidized refills a year and receive the one-off permanent advance more than once. The consumers with multiple connections and more than 12 subsidized refills numbered 37,499 among those who had more than one connection with the same oil marketing company and 38,286 among those who had obtained connections with more than one oil
marketing company in fiscal 2014–15, with these numbers falling to 8,707 and 6,488, respectively, in fiscal 2015–16. The consumers receiving the permanent advance twice numbered 51,433 and 65,498, respectively.

- The permanent advances were not refunded by the customers when they became non-compliant.
- The annual limit of 12 refills was violated in fiscal 2014–15 by 155,700 consumers. The cylinder refill counters sometimes repeated the same numbers, thereby undercounting the numbers of refills.
- The process of blocking and unblocking customers with multiple connections was problematic. Most blocked customers were unblocked, but the reasons for unblocking were inadequately documented (such as “other”) or not at all, or dates were not mentioned. A field audit of blocking and unblocking showed that the extra permanent advances had not been recovered and there was no mechanism for recovering cash transfers for the extra refills.
- There were inadequate checks on data entries in the database. The date of birth could not be found in 34 percent of all cases. There were also many incorrect entries—many beneficiaries were recorded as having been born in 1900, while others had future dates as their dates of birth. About 0.83 million had incorrect postal index numbers and some had incorrect Aadhaar numbers. The field audit of 165 distributors showed that the available Aadhaar numbers were not linked to the LPG customer identification numbers in 104 cases. Some customers experienced problems linking Aadhaar to bank accounts.
- Where subsidies failed to be transferred, 64 percent of such cases was due to factors attributable to inaccurate data entries by the distributors.
- There was evidence of large-scale diversion from domestic LPG to non-domestic non-exempt LPG consumers following the suspension of the DBTL in March 2014. This conclusion was deduced from comparison of sales to these two end-users between the period April to October 2014, when the DBTL had been suspended, and the corresponding period a year later from April to October 2015. Consumption of non-domestic non-exempt LPG fell at an average monthly rate of 11 percent and automotive LPG at 24 percent over the seven-month period in 2014, whereas the same market segments grew at 42 percent and 8 percent a month, respectively, a year later. Correspondingly, the average monthly growth rate of domestic LPG consumption fell from 12 percent in 2014 to 7 percent in 2015.
- The complaint mechanism has a toll-free number and a web-based portal for each oil marketing company. The goal was to address 98 percent of complaints in seven days. The oil marketing companies had addressed most of the DBTL-related complaints, although the target of seven days for resolution could not be achieved, especially when other institutions—such as banks, the National Payment Corporation of India, and the Unique Identification Authority of India—were involved.
- About 15.5 million LPG consumers had not been enrolled in the DBTL as of December 31, 2015, and less than half had voluntarily opted out of the scheme under the Give-It-Up Campaign. A market study in May 2015 found that about three-quarters of those who had not enrolled wished to join the DBTL but had been deterred by a lack of knowledge and the lengthy enrollment process.
- The oil marketing companies had not been reimbursed on time for the cash transfers. By design, they are not able to recover the full subsidy amounts, although they are paid management fees, amounting to about 1.2 percent of the total claimed reimbursements for the permanent advance and the refill subsidies between November 2014 and March 2015. During the same period, beyond what they are not able to recover by design, the oil marketing companies were not reimbursed one-quarter of the claimed amounts lodged with the government.
The audit also observed that the oil marketing companies in June 2012 began identifying and blocking consumers with multiple connections, and by April 1, 2016, 34.6 million duplicate, fake, ghost, or inactive connections had been terminated. Another 13.3 million customers were not participating in the DBTL, resulting in a total of 47.9 million connections that might have claimed the subsidies but did not. The annual savings from the 47.9 million would have been the average cylinder subsidy of Rs 169.45 prevailing in fiscal 2015–16 multiplied by the average refill rate of 6.27 a year, or Rs 1,062 per connection for a total of Rs 51 billion (US$0.78 billion), of which the audit attributed Rs $1,062 \times 13.3$ million, or US$0.22 billion, fully to the DBTL.

The audit made the following recommendations:

- Take steps to reduce diversion of non-subsidized but exempt domestic LPG to the (non-exempt) commercial sector.
- Scrutinize each oil marketing company’s existing database to enhance the accuracy and integrity to identify and eliminate multiple connections, and transparently document blocking and unblocking of suspected multiple connections.
- Enhance quality control over the interface with distributors to ensure correct data entry.
- Carry out public awareness and education campaigns to ensure that those who are entitled to and are in need of subsidies are not among the 15.5 million who were not participating in the DBTL as of December 31, 2015.

The audit report on the PMUY reviewed its performance (excluding extended PMUY) covering the period from May 2016 to December 2018. Field visits examined transactions up to March 2018. The audit selected 1 percent of distributors (164) covering 5 percent of PMUY beneficiaries (1.7 million). For each distributor, a minimum of 100 know-your-customer records were studied and at least 10 beneficiaries were surveyed, resulting in know-your-customer records of 18,558 beneficiaries being studied and 1,662 being interviewed. The review made the following observations (India 2019):

- One of the requirements for enrolling in the PMUY is that the applicant must supply the Aadhaar numbers of all family members to avoid enrolling more than one woman in any given household. However, of the 37.8 million enrolled at the time of the audit, 16 million (42 percent) had been enrolled after supplying only the Aadhaar number of the applicant.
- The audit found 410,000 connections that had been released against AHL TINs for which all but one member had blank entries in the SECC-2011 database, and about 10,000 connections released against AHL TINs for which the names of the beneficiaries and all other family members were blank in the SECC-2011 list. A lack of input validation allowed the release of 42,187 connections against invalid AHL TINs that did not exist in the SECC-2011 database.
- Although only women 18 years of age or older are eligible, 859,000 connections had been released to individuals below the age of 18 and the Indian Oil Corporation had released 188,000 connections to males.
- The audit found incorrect linking of names in 52,271 cases, and subsequently the oil marketing companies confirmed that about 29,000 of them were ineligible.
- The maximum number of days permitted to deliver LPG cylinders upon enrollment, seven days, and some safety procedures had not been complied with. After subscription vouchers were issued, 435,000 beneficiaries waited more than 365 days to get their LPG cylinders. Pre-installation inspection reports were not available in 14 percent of cases and installation certificates were not available in 13 percent of cases. Some unsafe practices were observed during home visits.
- Obtaining refills was problematic in many cases. Despite the general guideline to locate distributorships within 15 km of consumers, 58 percent of the distributors examined took on customers falling outside of the recommended 15-km limit, some as far as 92 km, and with no...
home delivery. This is in part because 10,000 new distributorships could not be established. For 3.7 million refills, delays of more than 10 days and as long as 664 days were observed against the required delivery time limit of seven days.

- Only 92,005 beneficiaries (0.24 percent) had 5-kg cylinders.
- Because of inadequate allocation of the budget, the three oil marketing companies were compensated only partially for the connection subsidies every fiscal year, resulting in long delays in reimbursement.
- The average annual refills declined across the board, from 7.7 in fiscal 2015–16 to 6.73 in fiscal 2018–19 among non-PMUY beneficiaries and from 3.9 in fiscal 2016–17 to 2.98 in fiscal 2018–19 among PMUY beneficiaries. Among the 31.8 million PMUY consumers who had had LPG for at least a year as of 31 December 2018, 17.6 percent had never refilled and 33 percent had refilled only three times or less.
- The risk of diversion was highlighted by the fact that 198,464 customers had refilled more than 12 times a year. There were 2 million instances when a costumer refilled three to 41 times in a month, and 344,000 instances when a given beneficiary had bought two to 20 refills on a single day. It was in response to these findings that the oil marketing companies introduced a limit of 15 refills per year.
- Among the PMUY beneficiaries who had taken out interest-free loans to buy LPG stoves and pay for the first refill as of December 31, 2018, 68 percent was struggling to pay back the loans, although the oil marketing companies had extended the repayment periods to six refills. Among those who had had LPG for more than a year, only 17 percent of the borrowed amounts had been paid back as of December 31, 2018.

The performance review made the following recommendations:

- Enter the Aadhaar number of every adult family member. Have appropriate input controls and data validation. Transfer the LPG connections released to minors to adults.
- Organize safety campaigns. Explore subsidies to cover the cost of mandatory safety inspections in the beneficiaries’ homes.
- Closely monitor high-consumption households.

Another independent review of the DBTL, with a much narrower geographic focus, was carried out in the same year as the government audit. Jain, Agrawal, and Ganesan (2016) evaluated the execution of the DBTL in Gujarat, Haryana, and Kerala by holding interviews and collecting data in May 2015 from 1,270 households and 92 LPG distributors, field officers, bank managers, oil marketing companies, and the officials of the Ministry of Petroleum and Natural Gas. Less than 1 percent of the households enrolled reported corruption. Half reported improved LPG delivery in the previous two months, although another 9 percent thought the quality of service in delivering cylinders had deteriorated. Almost three-quarters of households felt enrolment was easy, and the satisfaction rate was especially high in Haryana, where in some urban areas distributors had delivered DBTL application forms to households and collected the forms afterward. However, 45 percent of households had to make three or more trips to complete enrolment and 14 percent had to open new bank accounts.

The oil marketing companies quickly enrolled 15,930 distributors and compensated them at a flat rate for each enrolment, providing an incentive. By contrast, there was no compensation for banks involved in the DBTL. There were significant on-the-ground problems during the first few weeks of the nationwide roll-out of the scheme at the level of district bank managers. The in-house information and technology teams of the oil marketing companies promptly handled the requests from distributors to modify the software to address the challenges faced in the enrolment process. Most distributors surveyed (85 percent) reported that the DBTL had significantly decreased illegal diversion of domestic LPG.
The review identified several challenges:

- Inbuilt fuzzy logic prevented entry of invalid Aadhaar numbers, but distributors sometimes entered wrong bank account numbers.
- Another challenge cited by 58 percent of distributors was entering the Aadhaar and bank account numbers in the seeding process. Document verification by or form submission to banks was the most problematic. Banks rejected high volumes of applications for spelling mismatches and 36 percent of distributors found banks uncooperative.
- Close to a third of distributors said convincing customers to join or guiding them through filling in the forms and training staff on data entry were major challenges.
- One fourth of distributors reported not being compensated by the oil marketing companies and one-third of those compensated found the compensation inadequate.
- Three-quarters of households had received cash transfers after buying LPG, but 8.6 percent (7 percent urban and 13 percent rural) had not received cash transfers for any LPG refills. The rest of the households (17 percent urban and 14 percent rural) did not know whether they had received cash transfers. Non-receipt was confirmed by interviews with field officers, distributors, and district bank managers. However, all stakeholders also agreed that the rate of complaints about non-receipt of cash transfers decreased significantly over time.
- In rural areas, banks were far and taking money out of bank accounts could entail losing half a day’s wage, in addition to losing wages in getting the cylinders refilled.

Overall, the assessment found that the DBTL was constantly being improved to address the problems encountered. The positive impact and impressions were attributed to strong leadership from the central government, good stakeholder coordination, willingness to incorporate lessons learned and adjusting the scheme to improve, the resources made available to providing support and daily monitoring, and raising awareness to inform the affected stakeholders.
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