Annexure

Annexure A1: A scenario-based analysis of PMUY's impact on emissions reduction.

India's Pradhan Mantri Ujjwala Yojana (PMUY), launched in May 2016, extended free LPG connections to 105 million women from economically weaker households, rapidly expanding LPG coverage from 62 per cent of households in FY 2015–16 to 99.8 per cent by FY 2025–26[1]. Beyond its well-documented energy access and gender equity impacts, this expansion has had a significant air-quality consequence: the large-scale displacement of solid-fuel cooking, which remains India's single largest source of household PM2.5 and Black Carbon (BC) emissions. We estimate the emission reductions from cooking attributable to PMUY over the decade from FY 2016–17 to FY 2025–26, relative to a counterfactual scenario in which the policy had not been implemented.

The cylinder-equivalent benchmarks underpinning this analysis rest on three methodological references. First, useful cooking-energy requirements follow NITI Aayog's India Energy Security Scenarios 2047 (2023), which set a representative rural household's need at about 8.6 MJ per day (roughly 3,100 MJ per year) and an urban household's at about 10.7 MJ per day (roughly 3,900 MJ per year). Second, these per-household requirements are weighted to national figures using the Census 2011 rural–urban population split of 68:32. Using these two benchmarks, the national annual cooking energy demand is approximately 3400 MJ per year. Third, on this basis, primary LPG use is defined as gas meeting at least half of a household's cooking-energy need is estimated to be 4 cylinders of 14.2 kg, and exclusive or near-exclusive use as LPG meeting almost the entire need at 8 refills a year at a national level.

We estimated PMUY's impact by constructing this counterfactual scenario based on three assumptions about how the LPG market would have evolved in the absence of PMUY. Firstly, we estimated that consumer growth without the PMUY policy scenario would have followed the average consumer growth for the last 4 years pre-PMUY from FY 2012-13 to FY 2015-16. The consumer growth rate was thus fixed at 6.5 per cent.

The second concerns the ceiling on household coverage. Without the programme's financial architecture, LPG uptake would have remained constrained by affordability. PMUY waived security deposits, provided the first refill free, and enabled instalment-based cylinder purchases. Drawing on the Household Consumption Expenditure Survey (HCES) 2022-23, we estimate that approximately **20 per cent of rural households** have a Monthly Per Capita Expenditure below INR 2,500, corresponding to a household monthly expenditure of roughly INR 10,000 for a family of five. For these households, the total upfront cost of an LPG connection, which would be approximately INR 2,903 at April 2025 prices, would have represented more than 20 per cent of their total monthly

[1] According to PPAC LPG profile report FY25-26, LPG coverage was 99.8 in FY 2022-23 and there has been no update for the years post that. Hence, we have assumed the same coverage till FY 2025-26 to estimate LPG consumers.

consumption expenditure. At this cost burden, adoption of a new scheme without direct financial support would be impossible. Accordingly, in the without-PMUY scenario, LPG household coverage would have plateaued at **80 per cent**.

Uniform Deciles *(according to MPCE for Rural India)*	**Average MPCE**
10-Highest	INR 10,206
9	INR 6,211
8	INR 5,102
7	INR 4,408
6	INR 3,885
5	INR 3,454
4	INR 3,067
3	INR 2,694
2	INR 2,299
1-Lowest	INR 1,709

Source: HCES 2022-23

Furthermore, under the Pradhan Mantri Garib Kalyan Yojana (PMGKY) package as part of economic relief during the COVID pandemic in 2020, PMUY beneficiaries received three free LPG cylinder refills between March and September 2020. More than 14 Crore LPG refills were delivered by OMCs to ~8 crore beneficiaries. There is an uptick in the LPG consumption growth rate during the period, reflecting the importance of sustained affordability support for continued use of LPG among low-income households.

The third assumption addresses per-household LPG consumption. In the without-PMUY policy scenario, as the LPG coverage increases, real-world LPG consumption does not increase at the same rate. To reflect this, the counterfactual applies a downward adjustment of a conservative **1 kg of LPG per percentage-point increase in coverage** beyond the FY2015–16 baseline average of 104 kg per household per year. The average consumption of 104 kg is

derived from Petroleum Planning and Analysis Cell data (PPAC, MoPNG) of actual domestic sales of LPG (17.2 MMT) divided by the actual consumers (166 million) for FY2015-16 (pre-PMUY). Together, the coverage ceiling and the consumption penalty produce a counterfactual in which estimated LPG sales reach approximately **22.9 million metric tonnes (MMT)** in FY 2025–26, compared with actual sales of **28.7 MMT,** reflecting a gap of nearly 5.8 MMT, and corresponding firewood displacement directly attributable to PMUY. Throughout the analysis, we have considered firewood as the proxy for solid fuels.

Emission reductions in each year are derived from the difference in total cooking emissions from both LPG combustion and residual firewood use between the actual and counterfactual scenarios. On this basis, PMUY's acceleration of LPG adoption is estimated to have cumulatively avoided approximately **4,963 kilotonnes (kt) of PM2.5** and **132 kt of black carbon (BC)** from cooking over FY2016–17 to FY2025–26.

For FY 2025–26, our analysis estimates that PMUY avoided approximately 834 kt of $PM_{2.5}$ emissions and 22 kt of black carbon (BC) emissions from cooking. For context, the PAVITRA dashboard of the Center for Study of Science, Technology and Policy (CSTEP) estimates residential emissions in 2025 at approximately 4,800 kt for $PM_{2.5}$ and 600 kt for BC (CSTEP 2026). Using these estimates as reference benchmarks, our scenario-based analysis suggests that PMUY reduced residential **$PM_{2.5}$ emissions by approximately 15 per cen**t and **BC emissions by approximately 4 per cent** relative to a counterfactual scenario without the programme. The comparison is indicative: the two estimates use different methods and emission factors, particularly for BC, and the CEEW analysis uses financial-year data (April–March), while the PAVITRA estimates are for calendar year 2025.(Detailed calculations can be found in the attached excel sheet)

These estimates have inherent limitations. The counterfactual cannot be observed; it is constructed using pre-PMUY growth trends and household consumption survey data. Also, continued fuel stacking by PMUY beneficiaries may mean that the net fuel displacement is less accurate on the ground.

Annexure A2 Actual and population projections in IGP states/ UTs (in '000)

State/ UT	2011 Rural	2011 Urban	2025 Rural (Projected)	2025 Urban (Projected)
Uttar Pradesh	155,317	44,495	182,003	58,465
Bihar	92,341	11,758	114,208	16,221
West Bengal	62,183	29,093	62,400	37,642
Jharkhand	25,055	7,933	29,731	10,730
Punjab	17,344	10,399	17,879	13,243
Haryana	16,509	8,842	17,552	13,384

Delhi (NCT)	419	16,369	59	22,087
TOTAL	369,168	128,889	423,832	171,772
Total Population in 2011 = 49,80,57,000 (49.8 Crore) Total Population in 2025 = 59,56,04,000 (59.5 Crore)				

***Source**: MoHFW, Technical Group Projections, 2020.*
***Note**: The provided document contains data tables for Total Population (Table 8) and Urban Population (Table 9). The Rural Population figures presented in the table above have been calculated by subtracting the Urban Population from the Total Population for each respective state and year. The document does not provide a separate, standalone table for rural projections.*

Annexure A3 Total cost to the government for the winter subsidy program

State	PMUY consumers (as of 31.03.2026)	Additional subsidy amount per 14.2 kg cylinder	No. of subsidised 14.2 kg cylinders	Total Subsidy Burden (INR)
Delhi	2,90,000	200	4	23,20,00,000
Punjab	13,60,000	200	4	1,08,80,00,000
Haryana	12,10,000	200	4	96,80,00,000
Uttar Pradesh	1,89,80,000	200	4	15,18,40,00,000
Jharkhand	39,80,000	200	4	3,18,40,00,000
Bihar	1,20,70,000	200	4	9,65,60,00,000
West Bengal	1,23,70,000	200	4	9,89,60,00,000
TOTAL	**5,02,60,000**			40,20,80,00,000[2]

***Source**: CEEW Compilation, PPAC 2026*

Annexure A4 Subsidy burden as a percentage of Total Expenditure of State

[2] This is an upper bound: households that opt into the e-cooking scheme would draw the top-up on two cylinders rather than four.

State	PMUY consumers (as of 31.03.2026)	80% of PMUY consumers are provided this subsidy	Recommended subsidy amount per 14.2 kg cylinder (INR)	No of subsidised 14.2 kg cylinder suggested for subsidy	Total subsidy burden for the state (INR)	Total Expenditure of State as per State Budget (in INR crores)	Subsidy burden as a percentage of Total Expenditure of State
Delhi	290,000	232,000	300	2	139,200,000	103,700	0.01%
Punjab	1,360,000	1,088,000	300	2	652,800,000	260,437	0.03%
Haryana	1,210,000	968,000	300	2	580,800,000	258,658	0.02%
Uttar Pradesh	18,980,000	15,184,000	300	2	9,110,400,000	912,696	0.10%
Jharkhand	3,980,000	3,184,000	300	2	1,910,400,000	158,560	0.12%
Bihar	12,070,000	9,656,000	300	2	5,793,600,000	347,590	0.17%
West Bengal	12,370,000	9,896,000	300	2	5,937,600,000	438,775	0.14%
TOTAL	50,260,000				24,124,800,000	2,480,416	

***Source**: CEEW Compilation*

***Note**: Budget data considered are budget estimates for 2026-27.*

Annexure A5 Majority of the states in the IGP are far from exclusive usage of LPG

State/ UT	Annual per consumer cylinders consumption FY 2025-26 (All consumers)	Annual per consumer cylinders consumption FY 2025-26 (PMUY consumers)
Bihar	5.5	4.6
Uttar Pradesh	6.1	5.4
West Bengal	5.7	5.2
Punjab	6.6	5.3
Haryana	7.5	6.7
Jharkhand	5.0	3.9

Delhi	8.7	7.4
India	6.0	4.8

***Source**: PPAC 2025-26.*