

Implementation of national policy for elimination of kerosene use for cooking in Indonesia: co-benefits analysis

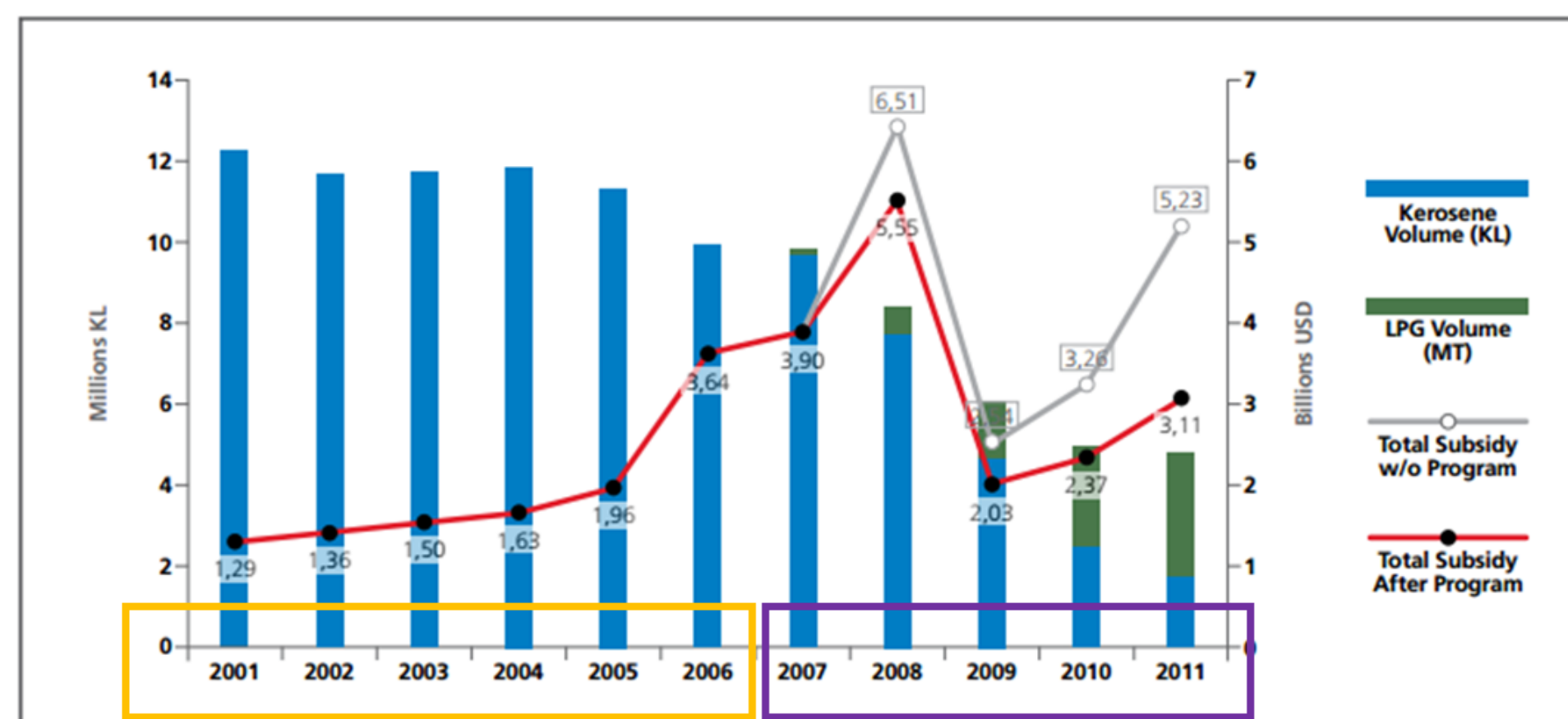
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INTRODUCTION



Before:

- Kerosene main fuel for households and fisheries → heavily subsidized by government for decades
- This subsidy did not reach end-user → diverting to industry and commercial
- Presidential Decree No. 104/2007

After:

- Replacing kerosene with LPG would greatly reduce the subsidy
- Energy equivalent: 1 L kerosene = 0.57 kg LPG → LPG subsidy
- Lesson: successful implementation in Malaysia and Thailand

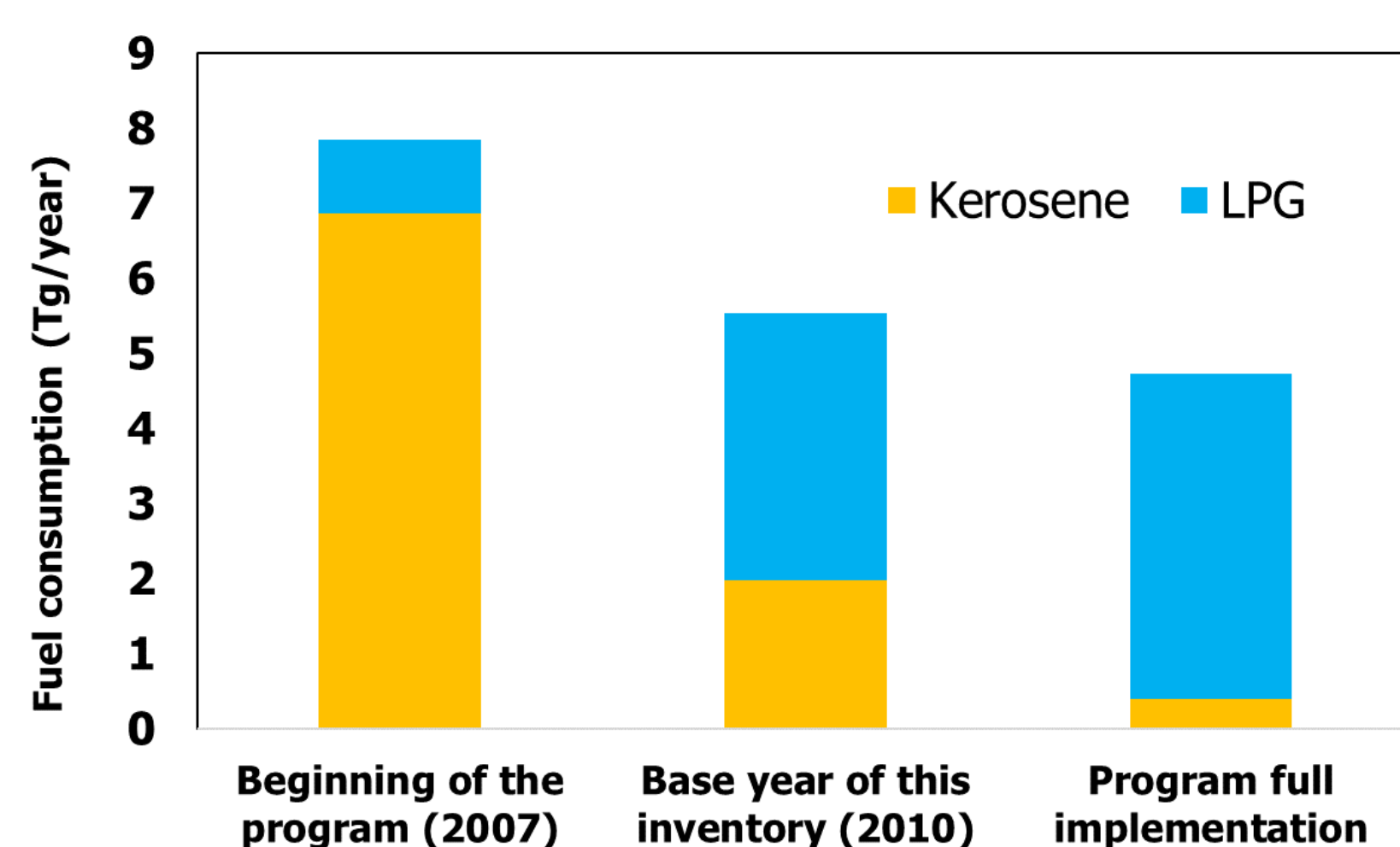
Figure 1 Government's subsidy and fuel consumptions before and after the conversion program

Before 2007, kerosene consumption in residential sector in Indonesia was heavily subsidized by the government. The subsidy did not fully reach the intended end-users and it was reported that it was somehow diverted to industry and commercial sector. The kerosene to LPG national conversion program was launched in 2007 through the enactment of Presidential Decree No. 104/2007 to reduce the subsidy on kerosene use in residential sector and to introduce cleaner fuel for cooking (World Bank, 2013). At the end, all kerosene use for cooking in 30 provinces (out of 33 provinces in the country) would be eliminated and declared as "closed and dry" (Pertamina, 2012). In 2012, the program was reported to be successfully implemented in 23 provinces with a 53.9 million conversion packages was distributed to replace the kerosene cookstoves.

This study analyzed the impacts of an existing national policy of replacing the kerosene by Liquefied Petroleum Gas (LPG) for cooking in the residential sector. The potential emission reductions of toxic air pollutants and climate forcers (both GHGs and short-lived climate pollutants, SLCPs) were estimated to assess the potential co-benefits on air quality and climate forcing mitigation resulted from the full implementation of the program.

METHODOLOGY

While the energy consumption and social impacts of this national program has been widely conducted (Andadari et al., 2014), the impacts on emissions of air pollutant and greenhouse gas (GHGs) has been yet comprehensively analyzed. Therefore potential co-benefits on air pollutant and GHGs emissions reduction resulted from the program implementation can be further investigated considering three (3) milestones: 2007, 2010 and end of the program (fully conversion in 30 provinces).



EMISSION INVENTORY FRAMEWORK BASED ON UNEP ATMOSPHERIC BROWN CLOUD EMISSION INVENTORY MANUAL (Shrestha et al., 2012)

Table 1 and 2 Summary of emission factors and global warming potential of different species included in this study

Air pollutants and GHGs	Kerosene (g/kg)	LPG (g/kg)	Species	GWP	
				20-y	100-y
PM ₁₀	0.30	0.33	CO ₂	1	1
PM _{2.5}	0.30	0.33	CH ₄	72	25
SO ₂	0.01	0.0003	N ₂ O	289	298
CO ₂	3,130	2,980	NO _x	43	-28
CO	7.39	3.82	VOC	14	4.5
NO _x	1.1	1.8	CO	6, 7.2	2, 2.3
CH ₄	0.56	0.56	BC	1,700	480
BC	0.04	0.04	OC	-540	-150
OC	0.03	0.033	SO ₂	-57	-16
N ₂ O	0.07	0.09	Regional specific values compiled by Permadi et al. (2017)		
NM VOC	0.22	0.23			

Compiled from various sources by Permadi et al. (2017)

KEY FINDINGS

Table 3 Total residential cooking emission Indonesia in 2010

Fuel type	Emission, Gg/year					Total
	Wood	Coal	Kerosene	LPG	Charcoal	
PM ₁₀	498	0.19	0.59	1.2	80	580
PM _{2.5}	423	0.16	0.59	1.2	67	493
SO ₂	69.7	0.07	0.02	0.001	10	80
CO ₂	154,392	64	6,176	10,621	48,136	219,389
CO	7,720	1.9	15	13	4,037	11,786
NO _x	20	0.03	2.2	6.3	8.6	37
CH ₄	797	1	1.1	2	171	972
BC	85	0.01	0.1	0.1	20	105
OC	169	0.1	0.1	0.1	27	196
N ₂ O	6	NE	0.1	0.3	3.5	10
NM VOC	896	0.1	0.4	0.8	102	1,000
GWP 20-y	327,027	114	6,600	11,413	111,542	456,696
GWP 100-y	210,335	83	6,248	10,676	68,446	295,788

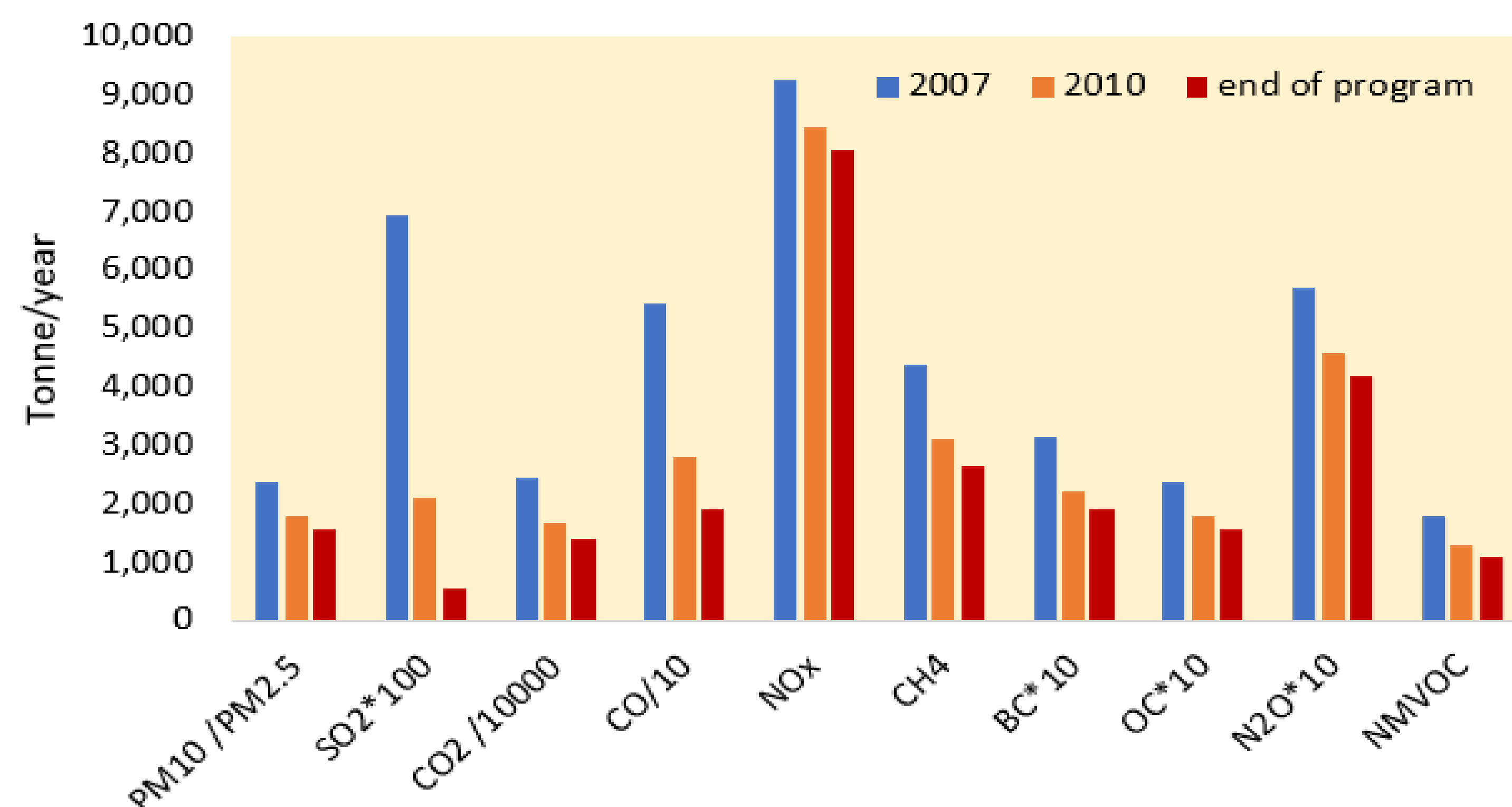


Figure 2 Total residential cooking emission (kerosene + LPG) in 2007, 2010 and at the end of the conversion program

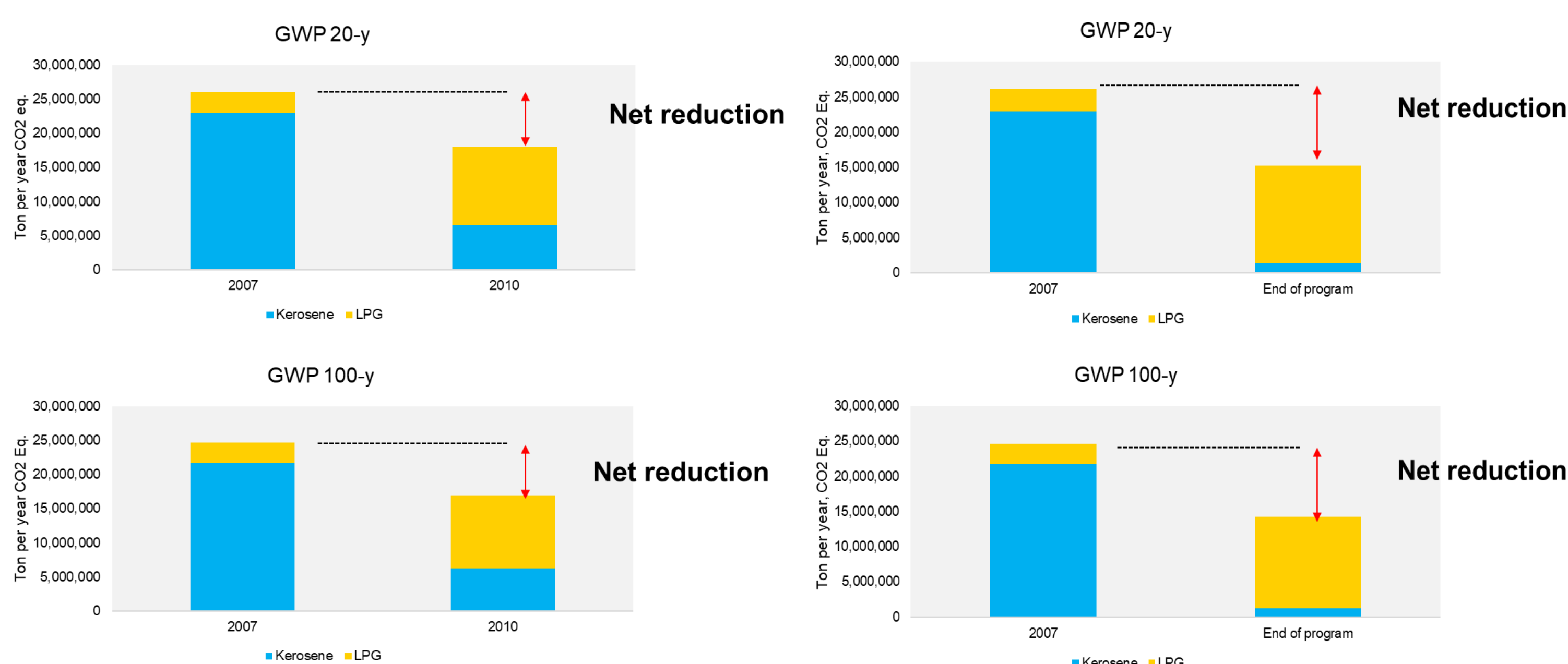


Figure 3 Changes in total GWP emission, 2010 -2007

Figure 4 Changes in total GWP emission at the end of the program

- Kerosene – LPG conversion program brought emission reductions of toxic air pollutants and GHGs as well as GWPs
- Emission reduction would be 0.1-5% to the total national residential cooking emission in 2010
- The reduction would contribute around 0.01-2% to the total national emission
- Total GWP of residential cooking would reduce by 2-4%
- Total GWP of national total emission would reduce by 1-2%
- More significant reductions in the residential sector emission would be achieved if the LPG conversion is applied for solid cooking fuel users in the country

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