Policy Brief on Air Pollution & Health in Kathmandu Valley – Household Energy

Introduction

Air pollution is a major public health risk in Kathmandu Valley where the annual average concentration of PM2.5 is about five times higher than World Health Organization (WHO) guidelines (WHO, 2018a). Realizing this, the Ministry of Health and Population together with the WHO is implementing the Urban Health Initiative (UHI) in Kathmandu Valley to build evidence on the health impacts of air pollution, enhance the capacity of the health sector and raise awareness on this issue. This policy brief on air pollution from household energy, mainly solid biomass fuel used for cooking, is part of a series on different sources of air pollution in Kathmandu Valley and its linkage to health.

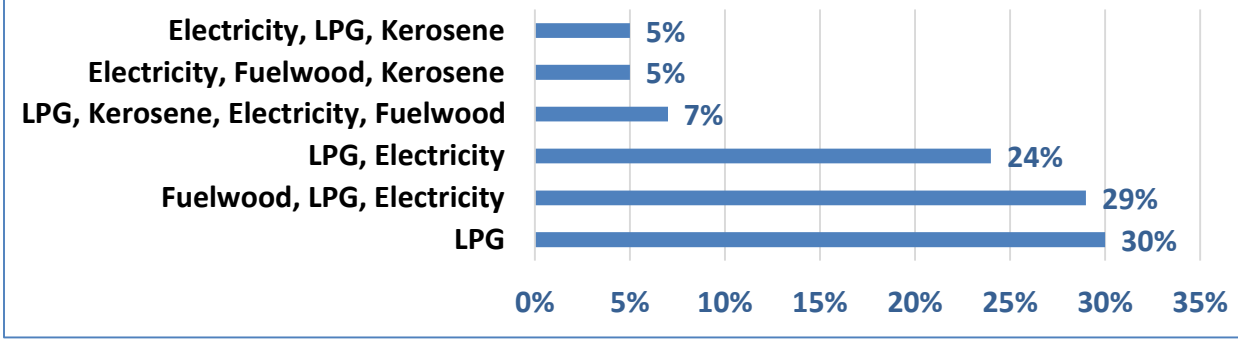
The use of solid biomass such as wood and dung cake in inefficient stoves or other heating devices in poorly ventilated rooms causes significant indoor air pollution which also contributes to ambient air pollution. Globally it is estimated that, about 3 billion people do not have access to clean, healthy and affordable cooking practices (WHO, 2018b). Although the number of people who cook with solid fuels has decreased globally from around 64% in 2005 to 49% in 2019, the number of people exposed to hazardous indoor air pollution remains high (HEI, 2020), particularly in developing countries.

Air Pollution due to Household Energy in Kathmandu Valley

Overall over two thirds of the households in Nepal still use solid biomass fuels such as firewood, dung cakes and agricultural residue for cooking which results in extremely high exposure to air pollutants, particularly for women and young children who spend many hours in their kitchen. The use of LPG is, however, increasing rapidly, particularly in urban areas.

A survey conducted in Kathmandu Metropolitan City showed that most households in Kathmandu use a variety of energy sources in their kitchen but LPG is the most common fuel (Khadka & Dhamala, 2016) (Figure 1). A more recent study indicated that 93.7 % of the households in Kathmandu Valley use LPG as their primary cooking fuel, while 4.9% use solid biomass and 1.1% electricity (CBS/UNICEF, 2020).

Figure 1: Cooking energy-mix in Kathmandu Metropolitan City



Source: Khadka & Dhamala(2016)

DoE (2017) estimates that 5.4% of the total PM10 emitted in Kathmandu Valley is from domestic cooking.

Health Impacts of Air Pollution due to Household Energy

Studies have shown the adverse health impacts of household air pollution, that include an increased risk of ischemic heart disease, lung cancer, chronic obstructive pulmonary disease (COPD), lower-respiratory infections (such as pneumonia), stroke, type 2 diabetes, adverse birth outcomes and cataracts (HEI, 2020). A study done in Bhaktapur also concluded that use of biomass as a household fuel is a risk factor for ALRI, and provided new evidence that use of kerosene for cooking may also be a risk factor for ALRI in young children (Bates et al., 2013). HEI (2020) estimates that in 2019, household air pollution from solid biomass fuel resulted in 21,600 deaths in Nepal. This is equivalent to 113 deaths per 100,000 people, which is the highest death rate in South Asia and more than three times the global average.

Some recent studies show a correlation between air pollution, cooking and COVID-19 infections. The results indicate that for developing countries where indoor air pollution is prevalent this can contribute to higher mortality rates after infection with COVID-19. In addition, the economic downturn or interruption of fuel supply chains due to lockdowns may lead households to revert to firewood or other polluting cooking methods (CCA, 2020).

Besides health impacts of air pollution from household energy, use of different fuels and open fires for cooking and heating also increases the risks of burns and accidents such as explosions and kerosene poisoning.

As part of the UHI, KU/WHO, 2020 estimated the health impacts of air pollution caused by household energy under three different scenarios, using Household Multiple Emission Source (HOMES) model and Household Air Pollution Intervention Tool (HAPIT). The baseline situation and the assumptions made for the three different scenarios – business as usual (BAU), moderately progressive (MP), and aggressively progressive(AP) – are shown in Table 1.

Table 1 Scenarios on fuel use for household energy in 2030

Region	Baseline (2018)	Business As Usual (2030)	Moderately Progressive (2030)	Aggressively Progressive (2030)
Urban areas	Electricity use- 35% LPG use- 65%	Electricity use- 50% LPG use- 50%	Electricity use- 70% LPG use-30%	Electricity use- 90% LPG use- 10%
Rural areas	Electricity use- 10% LPG use- 10% Biomass use- 70% Kerosene use– 10%	Electricity use- 30% LPG use- 20% Biomass use- 45% Kerosene use- 5%	Electricity use- 62% LPG use- 15% Biomass use- 20% Kerosene use- 3%	Electricity use- 85% LPG use- 5% Biomass use-5%

The results of the analysis indicate that the household contribution to PM2.5 exposure reduction from 116 µg/m3 in the baseline to 54 µg/m3 in the aggressively progressive scenario. The decrease in PM2.5 exposure due to the increasing use of electrical stoves instead of biomass and kerosene resulted in improved health benefits mainly in the semi-urban and rural areas of the valley. The health benefits were highest in the AP scenario where a total of 3,745 deaths and 117,475 DALYs associated with indoor air pollutants will be prevented by 2030 (Table 2).

Table 2 Averted deaths and DALYs by disease types for different scenarios in Kathmandu Valley by 2030

Scenarios	**Business as Usual (BAU)**		**Moderately Progressive (MP)**		**Aggressively Progressive (AP)**	
$PM_{2.5}$ exposure	92 µg/m^3		68 µg/m^3		54 µg/m^3	
Air pollution-related diseases	Total Averted Deaths	Total Averted DALYs	Total Averted Deaths	Total Averted DALYs	Total Averted Deaths	Total Averted DALYs
ALRI	143	12,227	347	29,835	529	45,516
COPD	159	5,047	350	11,105	491	15,582
IHD	353	7,639	818	17,692	1,221	26,399
Lungs Cancer	35	893	78	1,980	110	2,793
Strokes	330	6,445	822	16,028	1,394	27,185
Total	**1,020**	**32,301**	**2,415**	**76,640**	**3,745**	**117,475**

**ALRI- Acute lower respiratory infection; COPD-Chronic Obstructive Pulmonary Disease; IHD- Ischemic Heart Disease*

Institutional and policy framework for household energy

Nepal has several policies, particularly sectoral policies related to energy and environment, which has provisions to minimize indoor air pollution (Table 3). Ministry of Energy Water Resources and Irrigation (MoEWRI)'s White Paper, 2018 also mentions "Electric Stove in Every House" program to promote electricity as cooking fuel with priority to develop nationwide clean energy carbon market.

Table 3 Policies for Clean Cooking Energy in Nepal

Policies	**Provisions related to indoor air pollution**
Rural Energy Policy, 2006	• Identifies various renewable energy technologies to be promoted including household biogas digesters and improved cook stoves. • Emphasizes awareness raising, research and development, dissemination and technology transfer for increased use of improved cook stoves
Renewable Energy Subsidy Policy, 2016	• Mentions subsidy amounts for various renewable energy options including biogas plants and portable metallic biomass rocket stoves. • Also encourages public-private sector participation to reduce private sector's investments risks and to mobilize commercial credit
Biomass Energy Strategy, 2017	• Aims to enhance the living standards of people by modernizing the use of biomass energy through research and development, public awareness; through market development, technology transfer and capacity development; as well as through efficient use of biomass energy. • Targets to promote clean cooking technologies of at least Tier 3 to all households by 2030.
Nepal Interim Benchmark for Solid Biomass Cook stoves, 2016	• Sets technical standard and protocol for testing performance and safety of solid biomass cook stoves. Major parameters defining the performance include thermal efficiency and emissions of PM2.5 and carbon monoxide. Standards have defined criteria to rank stoves into five different tiers.
Electric Cooktop Standards, 2018	• Sets technical standards for induction cookers and hotplates for household use. • Of the four interlinked standards NS 564 deals with the safety of electrical appliances for household and similar purposes, NS 561 and NS 562 deal with electrical safety of induction cooktop and electric hotplates respectively, and NS 563 has set the performance values and described

	methods for measuring the performance of induction cookers for household use.
National Environment Policy, 2019	• Aims to reduce overall sources of environmental pollution including indoor air pollution, with promoting clean household energy such as solar and electric stoves, biogas, and improved cooking stoves. • Promote proper ventilation system in the kitchen and focus to build energy-efficient buildings.
National Climate Change Policy, 2019	• Minimize GHG emissions by encouraging the use of clean energy, such as hydropower, biogas and alternative energy sources, and by enhancing energy efficiency and supporting the use of green technologies.
15th Plan	• Includes a working policy to extend rural electrification through community participation and setting appropriate tariff to encourage electric cooking. • Targets for 2024 include 99% of households have access to electricity and per capita electricity consumption increases to 700 kWh.
2nd Nationally Determined Contributions (NDC) 2020	• Nepal's enhanced NDC which was submitted to UNFCCC mentions "by 2030, 25% of households use electric cook stoves as their primary mode of cooking," as one of the targets.

The only policy document that specifically aims to reduce indoor air pollution in Kathmandu Valley is the Kathmandu Valley Air Quality Management Action Plan (KVAQMAP), 2076,. The plan has mentioned 'minimize household air pollution' as one of its objectives and also identified it as one of the main strategic areas of intervention. Within this strategic area, the Action Plan mentions three activities: (i) implement National Indoor Air Quality Standard Implementation Guideline, 2009 within a year; (ii) initiate programs to promote electricity and alternative energy (such as biogas, ICS) for household activities; and (iii) promote the practice of proper exhaust system in kitchen. While these activities are important, they lack clarity. For example, it is not clear how alternative energy and clean kitchens will be promoted and by when the target of clean kitchen in every household in Kathmandu Valley will be achieved. The Action Plan could also mention the role of the private sector and how to encourage the private companies involved in supplying clean cooking options to strengthen the supply chains.

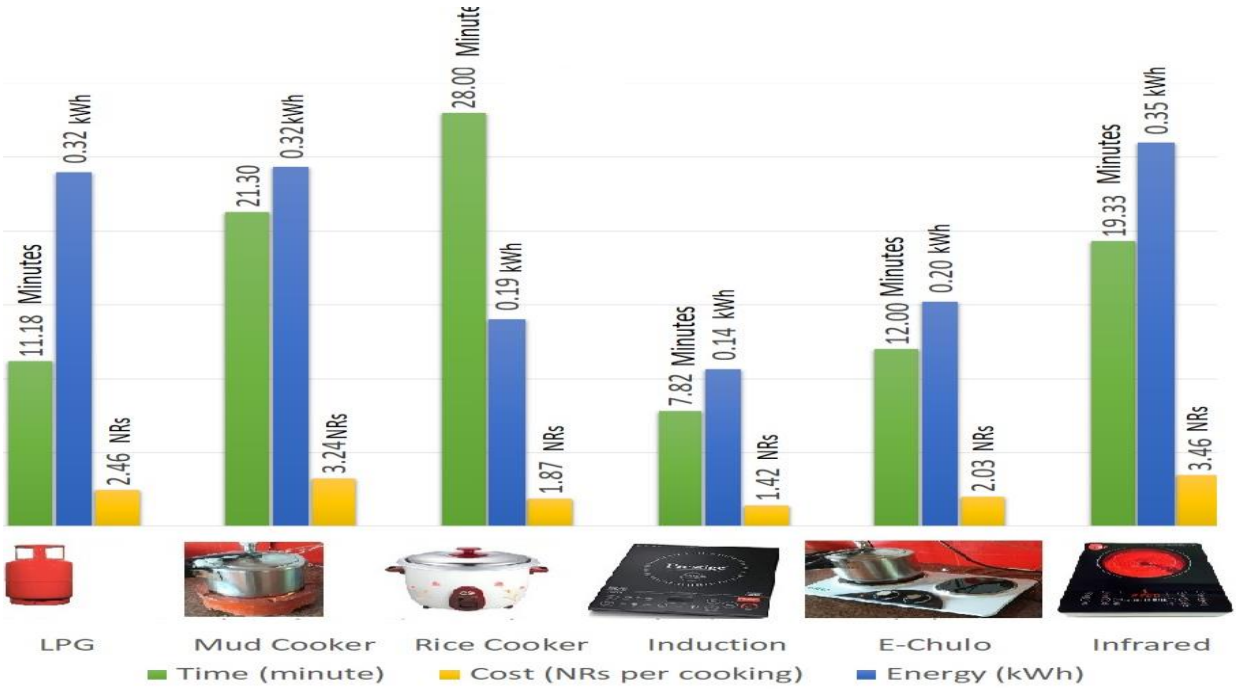
At the national level, the Alternative Energy Promotion Centre (AEPC), under the MoEWRI is responsible from promoting clean household energy through policies, research and development and providing technical and financial support where necessary. AEPC works in collaboration with local governments, cooperatives, community groups and private sector to implement its programmes. Municipalities can also promote clean energy options on their own.

Way Ahead

Exposure to air pollution from household energy use can be reduced through the use of cleaner fuels, efficient stoves and proper ventilation. As the use of LPG has already expanded rapidly within the Valley, with increased electricity supply, availability of different types of electric stoves in the market, and government's policy to promote electric stoves, three is an opportunity to promote electric cooking in Kathmandu Valley. A recent study comparing the time, energy and cost required for using different

types of cooking devices shows that electric induction cooker is the most cost effective and least time consuming device in the market (Shrestha et al., 2020).

Figure 2: Comparison of cooking time, cost and energy consumption using different cookers



Source: Shrestha et al., (2020)

The following measures can be undertaken by local municipalities and AEPC to discourage the use of biomass and promote electric cooking:

- Implement communication campaigns with targeted messaging to consumers to spread and raise demand for clean cooking technologies such as electric cooking,
- Improve reliability of electricity supply and related infrastructure,
- Ensure availability of electric cooking equipment, along with after-sales services, in coordination with the private sector.

References

Bates M.N., Chandyo, R.K., Valentiner-Branth, P., Pokhrel, A.K., Mathisen, M., Basnet, S., Shrestha, P.S., Strand, T.A., Smith, K.R. (2013). "Acute Lower Respiratory Infection in Childhood and Household Fuel Use in Bhaktapur, Nepal." Environmental Health Perspectives, Vol. 121 No. 5. National Institute for Environmental Health Sciences. Durham. https://ehp.niehs.nih.gov/doi/full/10.1289/ehp.1205491

CBS (2020). *Nepal Multiple Indicator Cluster Survey, 2019, Survey Findings Report*. Central Bureau of Statistics and UNICEF Nepal. Kathmandu.

CCA (2020). "COVID-19, Air Pollution and Cooking: A Deadly Connection." Clean Cooking Alliance, Washington DC.

DoE (2017). *Air Quality Management Action Plan for Kathmandu Valley*, Department of Environment, Kathmandu.

ESMAP (2020). *The State of Access to Modern Cooking Services*, Energy Sector Management Assistance Program, World Bank, Washington DC. https://esmap.org/the-state-of-access-to-modern-energy-cooking-services

HEI (2020). *State of Global Air 2020*. Health Effects Institute, Boston. https://www.stateofglobalair.org/

Khadka & Dhamala (2016). "Patterns of Cooking and Lighting Energy uses in Kathmandu Metropolitan City." Goldengate Journal of Science & Technology 2016. Kathmandu.

KU/WHO (2020). *Technical Report on Health Impacts and Economic Analysis of Air Pollution in Kathmandu Valley* [Unpublished]. World Health Organization & Kathmandu University. Kathmandu.

Shrestha, J.N., Raut, D.B., Shrestha D.L. (2020). "Cooking Cost Comparison using LPG, Rice Cooker, Induction and Infrared Cooker." Centre for Energy Studies, Institute of Engineering. Tribhuwan University. Kathmandu.

WHO (2018a). WHO Global Ambient Air Quality Database (update 2018). Geneva. https://www.who.int/data/gho/data/themes/topics/topic-details/GHO/ambient-air-pollution

WHO (2018b). *Household Air Pollution and Health*. World Health Organization. Geneva. https://www.who.int/news-room/fact-sheets/detail/household-air-pollution-and-health