

Opportunities for Transition to Clean Household Energy

Application of the Household Energy Assessment Rapid Tool (HEART) in Nepal



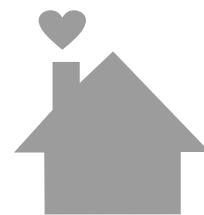
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World Health Organization

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Preface

Household air pollution (HAP) from incomplete fuel combustion is one of the most important environmental health risks today. Kerosene and solid fuels (wood, animal dung, charcoal, crop wastes and coal) are burnt by 2.6 billion people, mainly in low- and middle-income countries, in inefficient, highly polluting stoves to meet their daily energy needs. These include simple necessities like preparing a warm meal or keeping warm on a cold night. Widespread use of polluting cook stoves causes millions of premature deaths among children and adults annually from respiratory illness, cardiovascular disease, stroke and cancer, as well as serious injuries due to scalding, burns and poisoning.

The WHO guidelines for indoor air quality: household fuel combustion (1) provide recommendations on the best approaches to reducing HAP by transitioning to clean energy for policy-makers and specialists in energy, health, the environment and other issues. The Household Energy Assessment Rapid Tool (HEART) (2) was developed by WHO to support implementation of the guidelines. It is being used for conducting rapid situational assessments and mapping stakeholders to determine a country's

readiness to access clean energy technologies. The tool is used to collect and synthesize information on household energy use and its impact on national public health. Information presented can be used to stimulate informed discussion on the impacts of interventions for household energy, shared responsibilities and coordinated action, country-specific barriers to implementation and opportunities for the public health and other sectors to collaboratively accelerate the transition to clean household energy.

The rapid assessment does not replace the detailed economic evaluation required to identify national energy priorities, national and global mapping of disease prevalence associated with polluting fuels or the social and political considerations required for applying major social interventions to transition to clean energy. The assessment does provide a broad overview of the current situation of household energy and health, identifies key stakeholders and will ultimately support intersectoral cooperation to reduce HAP and improve health. This report presents the results obtained from use of HEART in Nepal.

Acknowledgements

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Acronyms

AEPC	Alternative Energy Promotion Centre
FY	fiscal year
HAP	household air pollution
HEART	Household Energy Assessment Rapid Tool
IAPHF	Indoor Air Pollution and Health Forum
LPG	liquefied petroleum gas
NEA	Nepal Electricity Authority
NPR	Nepalese rupees
NGO	nongovernmental organization
PM_{2.5}	particulate matter $\leq 2.5 \mu\text{m}$ in diameter
PM₁₀	particulate matter $\leq 10 \mu\text{m}$ in diameter
SDG	Sustainable Development Goal
UNDP	United Nations Development Programme
WHO	World Health Organization

Introduction

1.1 Background

Around the world, 2.6 billion people, primarily in sub-Saharan Africa and Asia, do not have access to clean cooking solutions. Each year, millions of people die prematurely from illnesses attributable to household air pollution (HAP) due to inefficient cooking practices on polluting stoves fuelled by kerosene, fuel wood, animal dung, crop waste and coal (3). Access to clean cooking solutions, one of the key targets of Sustainable Development Goal (SDG) 7 on energy, has become an international goal.

According to the 2016 Nepal Demographic and Health Survey (4), 66% of Nepali households use mainly solid fuel for cooking on inefficient stoves. Incomplete fuel combustion of solid fuels emits greenhouse gases and harmful smoke, contributing to climate change, forest degradation, ill health and preventable deaths. Further, the physical burden and time necessary to collect wood for fuel is borne primarily by women and children, thus compromising their productive time, such as social activities and education.

While the Government has developed several policies to facilitate the growth and expansion of use of renewable and modern energy systems for clean cooking (5), the desired results are yet to be obtained.

The cooking fuel used in most urban households of Nepal is liquefied petroleum gas (LPG), and the penetration of LPG into rural households

is increasing. LPG imports during fiscal year (FY) 2018–2019 covered 2.51% of Nepal's total import bill (6). Use of electricity for cooking started making its way into Nepal during the Indian economic blockade in 2015, which obliged Nepali households and businesses to shift temporarily from LPG. After the blockade ended, most households moved back to LPG for cooking (7). The country imported NPR (Nepalese rupees) 30.73 billion worth of LPG in 2019–2020 and more than NPR 100 billion in the past 5 years (8). Substitution of LPG is thus expected to save billions of rupees, increase consumption of domestically generated electricity and reduce stress on the environment.

The Government has committed itself to support the United Nations programme for "sustainable energy for all" by setting a target to provide clean energy for all by 2030. The 2019 Energy Progress report (9) states that 95.5% of Nepal's population (99% in urban and 95% in rural areas) have some type of access to electricity from grid and off-grid sources, such as mini- or micro-hydro- or solar-powered mini-grids, solar- or wind-powered hybrid mini-grids and home solar systems.

Given the commitment of the Government to promote electricity for cooking, the barriers to and enablers of adoption and sustained use of electricity for cooking are important to identify in order to develop interventions to achieve the desired results.

1.2 Country context

Geography

Nepal is a small mountainous country with a total area of 147 516 km² and is generally rectangular, with an east–west length of 885 km and a north–south breadth of 145–241 km. Nepal is a landlocked country, which shares borders with India to the south, east and west and with China to the north. The country lies in a sub-tropical region, with an altitude ranging from 90 m to 8848 m from south to north. Nepal is located between the fertile Gangetic Plain of India and the arid plateau of Tibet, China. Most of its area consists of mountains (15%) and hills (68%), and the remaining area (17%) consists of the lowland Terai¹. The country is divided into five physiographic regions in the east–west direction: Terai, Siwalik (Churia), middle mountains, high mountains and high Himalaya.

Climate

The country has a subtropical monsoon climate, varying by altitude from subtropical (lowland Terai) to temperate (mountains) to alpine (high Himalayas). Depending on the region, the maximum annual temperature ranges from 17.6 °C to 30.8 °C and the minimum temperature from –3.8 °C to 18.8 °C (10). The weather also varies by season: pre-monsoon (March–May), hot and dry; monsoon (June–September), wet with 80% annual rainfall; post-monsoon (October–November), transitional period; and winter (December–February), cold and dry with occasional precipitation (11).

Population and demography

Nepal is becoming urbanized more rapidly than any other country in South Asia. The World Bank estimated that the total population of Nepal in 2020 was 29.136 million (12). The national census indicated that there are about 5.66 million households, with an average size of 4.88 persons. Approximately 1.8 million (6.7%) live in the mountainous area, 11.5 million (43.2%) in the hills and 13.3 million (50.1%) in the Terai (lowlands).

Human development and economic context

The 2020 Human Development Index² for Nepal was 0.602 in 2019, ranking it as 142th out of 189 countries (13). Between 1990 and 2019, Nepal's human development index increased from 0.380 to 0.602, an increase of 58.4% (13). Life expectancy at birth of Nepalis in 2019 was 70.8 years.

The gross national income per capita in Nepal was reported to be US\$ 1190 in 2020, placing Nepal as a “low- to middle-income country” according to the World Bank economic classification.

Poverty

The Living Standards Survey in 2011 (14) showed that 25.16% of the total population lived below the poverty line. The proportion of the population living below the absolute poverty line has, however, decreased because of massive migration of young people for employment to other countries and the subsequent rise in remittance income. More recent official statistics (15) suggest a further decrease in the population living below the poverty line to 18.7% in FY 2018 (Table 1). Despite declining poverty, inequality is high, with imbalances and inequity in access to economic opportunities and the distribution of resources, including health services.

¹ A lowland belt characterized by tall grasslands, scrub savannah, *sal* forests and clay-rich swamps

² The Human Development Index is a summary measure of average achievement in key dimensions of human development: a long and healthy life, being knowledgeable and having a decent standard of living.

↓ **Table 1.** Extreme poverty and life expectancy by province in 2018

	Province 1	Province 2	Bagmati	Gandaki	Lumbini	Karnali	Sudurpashchim	Nepal (all provinces)
Population living in extreme poverty (%)	12.4	19.8	15.3	15.5	18.2	28.9	33.9	18.7
Life expectancy (years)	70.7	67.8	70.7	71.7	69.3	66.8	68.6	69.7

Source: reference 15

Note: extreme poverty is defined by the World Bank as people living on less than US\$ 1.9 per day.

1.3 Climate change in Nepal

In 2011, the net greenhouse gas emissions in Nepal were estimated to be 31 999 Gg of carbon dioxide (CO₂) equivalent; therefore, Nepal's contribution to total global emissions of 53 197 386 Gg CO₂ equivalent was about 0.06% (16). Direct greenhouse gas emissions from the residential energy sector, excluding emissions from fuel wood, was 301 Gg CO₂ equivalent (17).

Although Nepal has only 0.4% of the global population and is responsible for a relatively small percentage of total greenhouse gas emissions, the country is anticipated to be disproportionately affected by climate change, especially by increasing atmospheric temperature and melting of the snowpack and glaciers in the Himalayas due to greenhouse gases and black carbon (18, 19).

A detailed analysis over a period of 30 years (1976–2005) showed a trend in warming of 0.4–0.6 °C per decade in Nepal (20).

Greenhouse gas emissions are not covered by a carbon pricing mechanism, and there is no monitoring, reporting or verification system for these emissions, although the Ministry of Health and Population has been implementing a “Health National Adaptation Plan” with the support of WHO to address the health impacts of climate change in the country.

Policy priorities and strategies

Nepal is a federal state, with three tiers of government (federal, provincial and local), following the proclamation of a new constitution in September 2015. The local governments comprise six metropolitan cities, 11 sub-metropolitan cities, 276 municipalities and 460 rural municipalities distributed across 77 districts. Provincial and

local governments have jurisdiction under the Constitution to enact local laws, generate annual budgets and develop and execute policies and plans within their domains (21). While each tier has both shared and autonomous jurisdictions, there is substantial divergence in entrusting large autonomous jurisdictions to local governments.

2.1 Legal framework for the environment, energy and public health

Constitution of Nepal, 2015

The Constitution of Nepal ensures a cleaner environment as the fundamental right of every Nepali citizen. Likewise, Nepal's Constitution ensures the right to free basic health services from the State, and no one shall be deprived of emergency health services.

The Constitution highlights generating and developing renewable energy as an important means of ensuring an efficient, reliable, affordable energy supply and its proper use for fulfilling the basic needs of citizens.

Local Government Operation Act, 2017

The Local Government Operation Act gives the authority to all municipalities to invest in the operation and management of development projects jointly with the private sector, provincial government and the Federal Government. It further specifies the roles and responsibilities of local governments for renewable energy technology transfer, capacity development and promotion. The Act mandates local governments to adopt low carbon and environment-friendly development.

National Environment Policy, 2019

The aim of the National Environment Policy is to reduce overall sources of environmental pollution, including HAP, by promoting clean household energy, such as solar and electric stoves, biogas and improved cook stoves.

Environment Protection Regulations, 2020

The Environment Protection Regulations under Pollution Control Arrangements state that, on the recommendation of the Department of Environment, the Ministry should make the necessary arrangements for use of alternative substances, devices or instruments to control pollution.

15th Periodic Plan, 2019–2023

The Plan includes the vision of "Prosperous Nepal, Happy Nepali". The aim of the Plan is to achieve the SDGs before 2030 and to ensure that 99% of households have access to electricity and that per capita electricity consumption is increased to 700 kWh by 2024.

2.2 Health sector policies

National Health Communication Policy, 2012

The National Health Communication Policy is designed to improve access to and use of essential health services, particularly by those living in remote areas and by disadvantaged, poor and marginalized populations. Nine rationales are outlined in the policy, including ensuring that health messages are of high quality, accurate, reliable, uniform and appropriate.

Urban Health Policy, 2015

The aim of the Urban Health Policy is to increase access to and use of high-quality health-care services, particularly for women, the poor, children and marginalized groups living in urban areas.

Nepal Health Sector Strategy Implementation Plan, 2016–2021

The Nepal Health Sector Strategy Implementation Plan is designed to reduce the number of disability-adjusted life years due to communicable diseases, maternal and neonatal conditions, noncommunicable diseases and injuries by 10% during the period 2016–2021.

National Health Policy, 2019

The National Health Policy was introduced to upgrade the health standards of most of the rural population by extending basic primary health services and making modern medical facilities available. It states that: “One-door health policy shall be developed and expanded for the control and management of communicable diseases; environmental pollution such as air pollution, sound pollution and water pollution shall be scientifically regulated and controlled.”

2.3 Climate change policies

National Adaptation Programme of Actions to Climate Change, 2010

In 2010, Nepal endorsed national adaptation programmes of action and began to implement adaptation actions at the local level. A Multi-Stakeholder Climate Change Initiative Coordination Committee was formed to involve stakeholders in climate action. The programme ranks activities by priority, with nine projects, including agriculture, clean energy, disaster management and forest and ecosystem management. Of these, “adapting to climate challenges in public health” in the health sector and “empowering vulnerable communities through sustainable management of water resource and clean energy supply” in the renewable energy sector are noteworthy.

National Framework on Local Adaptation Plans of Action, 2011

The National Framework on Local Adaptation was formulated to translate local plans into action and to assist in the identification of local adaptation actions with people’s participation, as stated in national adaptation programmes. The Framework ensures that integration of climate adaptation and resilience into local and national planning will follow four guiding principles: to be bottom-up, inclusive, responsive and flexible.

Climate Change Policy, 2019

The Climate Change Policy includes clean energy as follows: “Energy security will be ensured by promoting multiple uses of water resources and

production of low carbon energy". Furthermore, strategies are introduced for proper management of harmful and hazardous waste and use of biodegradable waste for energy production by segregating the waste generated by households, hotel businesses and hospitals at source. Similarly, the policy addresses public health as follows: "A healthy living environment will be created by reducing the adverse effects of climate-induced disasters on human health".

National Adaptation Plan

Nepal is formulating its national adaptation plan to reduce the country's vulnerability to climate change and integrate climate change adaptation into policies, programmes and activities at all sectors and levels, as appropriate. The overall goal of the plan is to improve the institutional capacity of the Government to implement a climate-resilient plan. Nepal's plan covers seven thematic areas, each of which will be tied to a specific "adaptation pathway" and directly to the SDGs.

Second Nationally Determined Contribution, 2020

The nationally determined contribution lists 14 activity targets and policy targets, of which the following are directly related to reducing air pollution by promoting residential cooking, biogas and waste management.

- By 2030, extend clean energy generation from approximately 1400 MW to 15 000 MW, of which 5–10% will be generated by mini- and micro-hydropower and solar, wind and bioenergy.
- By 2030, ensure that 25% of households use electric stoves as their primary means of cooking.
- By 2030, ensure that 15% of the total energy demand is supplied from clean energy sources.
- By 2025, install 500 000 improved cook stoves, specifically in rural areas.
- By 2025, install an additional 200 000 household biogas plants and 500 large-scale biogas plants (institutional, industrial, municipal and community).
- Strengthen transmission and distribution links to increase electric cooking, electric heating, electric transport and charging stations.

2.4 Household energy policies

The Government has designated 2018–2028 as the Decade of Energy and Hydropower in order to realize the dream of Prosperous Nepal, Happy Nepali (15). The government's goal is to provide electricity to every household by 2022 and promote use of electric cook stoves in every household. In 2018, the Government established targets for generation capacity of 5000 MW by 2023, 10 000 MW by 2028 and 15 000 MW by 2033, including widespread adoption of electric cooking.

Subsidy policy

Following the National Rural and Renewable Energy Programme of 2012–2017, the subsidy policy is designed to develop the renewable energy sector and encourage households to use renewables by providing subsidies for people living in extreme

poverty. The policy primarily addresses off-grid applications and provides subsidies for mini- or micro-hydropower, improved water mills, solar energy (home systems, mini-grids, grid connected), biogas, biomass energy, wind energy and wind-solar hybrids. For technologies that produce electricity, the subsidy is given not only for equipment and civil work but also, when applicable, for development of distribution infrastructure. Thus, the subsidy is also provided for installation of solar photovoltaic systems in grid connected areas with irregular supply. This includes subsidies for solar street lighting in urban and rural areas and for solar photovoltaic systems in households, public educational institutions, public health facilities and religious sites (22).

The amount of the subsidy depends on the technology and the region, with higher subsidies

being offered for remote areas.³ The amount is expected to cover 40% of the total cost, about 30% coming from credit and about 30% from private sector investment and/or community or household contributions (cash or in-kind).

Isolated off-grid networks cannot provide a reliable, robust supply for industrial use of electricity. Moreover, isolated community micro-hydro or solar projects have been shown to be unsustainable, and provision of subsidies to communities that help build and operate the plants have resulted in chronic dependence on such handouts (23).

Rural Energy Policy, 2006

A rural energy policy was introduced to promote environmentally friendly energy sources for rural households, such as micro- and mini-hydropower, solar energy and wind energy. The goal of the policy is to contribute to reducing rural poverty and conserving the environment by ensuring access to clean, reliable, appropriate energy in rural areas.

Renewable Energy Subsidy Policy, 2016

The Renewable Energy Subsidy Policy was promulgated by the Government for the first time in 2000 and was subsequently amended. The 2016 version is the latest and focuses on gradual replacement of a subsidy by long-term credit. The Policy sets a special subsidy for households affected by the 2015 earthquake. It makes provision for an additional subsidy to address the transport barrier for promoting renewable energy technologies in remote areas, particularly with difficult terrains. The Policy allows companies to own and operate mini-grids and receive subsidies. The aim is to achieve the objectives of the United Nations SDGs and “Sustainable Energy for All”.

Subsidy Delivery Mechanism for Renewable Energy, 2016

The Subsidy Delivery Mechanism describes the modality for disbursing the subsidies described in the Renewable Energy Subsidy Policy (2016). The Mechanism promotes system optimization by ensuring that the quality of the system components

is high and that the supply is reliable. This involves testing by accredited institutions, mobilizing competent companies and operationalizing the Government’s public procurement legislation.

Biomass Energy Strategy, 2017

Although biomass is a solid fuel, it is potentially a renewable energy source and can be used in a more sustainable, cleaner way. For example, it can be transformed into biogas or pellets and be burnt in improved, more fuel-efficient stoves. The Biomass Energy Strategy (24) sets the target that all households will have access to at least tier 3 cooking technologies (as defined by the International Organization for Standardization) by 2030. The aim is to improve living standards by modernizing the use of biomass energy through research and development, creating public awareness, market development, technology transfer, capacity development and efficient use of biomass energy.

National Energy Efficiency Strategy, 2018

The National Energy Efficiency Strategy is the first policy document that envisions building energy security through efficient use and distribution of the available energy. It has set a long-term goal of doubling the average rate of improvement in energy efficiency in Nepal from 0.84% per year between 2000 and 2015 to 1.68% per year in 2030. The aim is to maintain environmental balance and improve health by efficient use of energy. The working principles of the strategy include developing minimum energy performance standards for electrical and mechanical equipment used in various sectors, including clean cooking.

Electric Cooktop Standards, 2018

As part of the assessment of electric cooking targets for the 2020 Nationally Determined Contributions, the Electric Cooktop Standards are technical standards for induction cookers and hotplates for household use. Of the four interlinked standards that have been endorsed,

³ Selected examples are as follows. Solar photovoltaic mini-grid: generation – equipment: US\$ 1410–1640 per kWp; distribution: US\$ 260–300 per household. Mini- or micro-hydropower: generation – equipment: US\$ 750–1175 per kW; generation – civil. (per kW): US\$ 190–300; distribution: US\$ 260–333 per household.

the general safety standard (NS 564) applies to the safety of electrical appliances for household use and similar purposes. Standards 561 and 562 address the electrical safety of induction cooktops and electric hotplates, respectively. The fourth standard (NS 563) sets the performance values and describes methods for measuring the performance of induction hobs for household use.

Provincial Periodic Plans, 2019–2023

The periodic plans prepared by provincial governments that are intended to increase access to clean household energy are shown in Table 2 (25).

↓ **Table 2.** Provincial periodic plans (2019–2020 and 2023–2024) for access to clean household energy

Province	Targets
Province 1	<p>By 2024, ensure electricity to all households.</p> <p>By 2024, ensure 1500 MW electricity generation through hydropower.</p> <p>By 2024, produce 2 MW electricity from small micro-hydropower, 2 MW from small solar energy, 1 MW from wind energy.</p> <p>By 2024, produce 200 MW electricity from solar energy.</p> <p>By 2024, install biogas plants in 20 000 households.</p> <p>By 2024, replace LPG cook stoves with electric cook stoves.</p>
Province 2	<p>By 2024, connect at least 2 MW of solar power to the grid through private and local cooperation and 10 MW from the province.</p> <p>By 2024, promote multifunctional renewable energy technologies, and replace cow dung with clean energy for cooking.</p>
Bagmati	By FY 2019–2020, develop a rural electrification and a renewable energy programme to provide electricity and clean energy technology to households so that the federal Government can operate the “Bright Nepal” campaign.
Gandaki	By 2024, increase installed capacity of hydropower to 3000 MW.
Lumbini	<p>Promote commercial biogas, briquettes and biodiesel.</p> <p>By 2024, increase the installed capacity of hydropower to 150 MW.</p> <p>By 2024, increase installed capacity of solar photovoltaic systems to 300 MW.</p> <p>By 2024, ensure that at least 10 industries produce commercial biogas.</p>
Karnali	By 2024, increase installed capacity of hydropower to 200 MW.
Sudurpashchim	<p>Electrify communities by grid through solar photovoltaic systems.</p> <p>Identify and develop hydropower projects.</p>

Source: reference 25

Annual budget speech (2021–2022) – Household energy sector

The federal Government has allocated NPR 121.97 billion to the Ministry of Energy, Water Resources and Irrigation, which is 7.4% of the total budget. The Government plans to add 1600 MW of electricity to the national grid by completion of large construction projects for hydropower, with priority

given to semi-storage and full-storage types, to meet internal demand during the dry season.

The Government implements a clean household energy programme in rural areas, called “Ujyalo Nepal Abhiyaan”. In 2021–2022, the Government is expected to complete electrification free of charge to deprived families in 43 districts. Moreover, to encourage consumption of household electricity,

the customs duty on electric appliances has been reduced; for example, for induction stoves, the duty is only 1% and 100% of excise duties are waived. Customs duties on refrigerators, grinders, rice-cookers, fans and other electronic equipment have also been reduced. Additionally, 50 000 biogas plants will be installed in the Terai region through a clean energy programme that aims to provide access to renewable energy.

Kathmandu Valley Air Quality Management Action Plan, 2020

The Government issued the Kathmandu Valley Air Quality Management Action Plan to ensure the fundamental right of citizens to live in a clean, healthy environment. The aim is to mitigate air pollution in various sectors (transport, construction, industry, waste management), and also to reduced HAP in the residential sector. The plan includes developing and facilitating the air quality management decision system, improving awareness of air pollution in valleys and raising awareness about the sources and effects of air pollution and means for mitigation.

2.5 Air quality standards

National Indoor Air Quality Standards Implementation Guideline, 2009

The Guideline (26) is designed to improve public health and the environment by (1) minimizing indoor air pollution, (2) maintaining a balance between the objectives of climate change, energy-savings and a healthy indoor environment, (3) increasing awareness about HAP and its probable adverse effects and (4) monitoring to set standards for indoor air quality. The standards for the concentrations in indoor environments of Nepal are 200 $\mu\text{g}/\text{m}^3$ for particulate matter $\geq 10 \mu\text{m}$ in diameter (PM_{10}), 100 $\mu\text{g}/\text{m}^3$ for particulate matter $\geq 2.5 \mu\text{m}$ in

diameter ($\text{PM}_{2.5}$) and 35 ppm for carbon monoxide (CO) for an average of 1-h exposure. The guideline is, however, outdated and should be revised.

National Ambient Air Quality Standards, 2012

Nepal first introduced national ambient air quality standards in 2003, for seven air pollutants: total suspended particles, PM_{10} , sulfur dioxide, nitrogen dioxide, CO, lead and benzene. The Government revised the Standards in 2012 (27) to introduce a standard for $\text{PM}_{2.5}$ of 40 $\mu\text{g}/\text{m}^3$ for a 24-h average exposure.

The national air quality standards and how they compare to the WHO air quality guidelines are shown in Table 3.

↓ **Table 3.** Nepal's national air quality standards in relation to WHO guidelines for air quality

Indoor air			
Pollutant	Average exposure (h)	National, 2009 (26)	WHO, 2005* (28) and 2010 (29)
PM ₁₀	24	120 µg/m ³	50 µg/m ³
	1	200 µg/m ³	–
PM _{2.5}	24	60 µg/m ³	25 µg/m ³
	1	100 µg/m ³	–
CO	8	9 ppm	10 mg/m ³
	1	35 ppm	35 mg/m ³
CO ₂	8	1000 ppm	–
Ambient air			
Pollutant	Average exposure	National, 2012 (27)	WHO, 2005* (28)
Total suspended particulates	24 h	230 µg/m ³	–
PM ₁₀	Annual	–	20 µg/m ³
	24 h	120 µg/m ³	50 µg/m ³
Sulfur dioxide	Annual	50 µg/m ³	–
	24 h	70 µg/m ³	20 µg/m ³
Nitrogen dioxide	Annual	40 µg/m ³	40 µg/m ³
	24 h	80 µg/m ³	–
CO	8 h	10 000 µg/m ³	10 mg/m ³
	15 min	100 000 µg/m ³	100 mg/m ³
Lead	Annual	0.5 µg/m ³	–
	24 h	–	–
Benzene	Annual	5 µg/m ³	–
	24 h	–	–
PM _{2.5}	Annual	–	10 µg/m ³
	24 h	40 µg/m ³	25 µg/m ³
Ozone	8 h	157 µg/m ³	100 µg/m ³

* The same guideline values apply to both indoor and ambient environments for particulate matter, ozone, nitrogen dioxide and sulfur dioxide

Household energy

3.1 Electricity generation

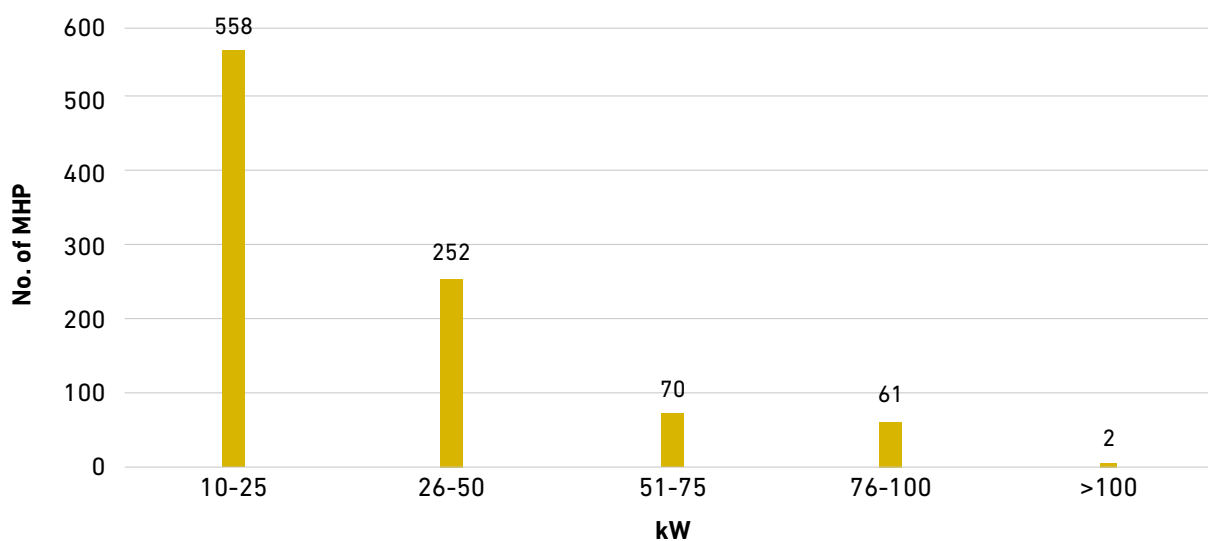
Current status of national grid, pipeline projects and Government plan for expansion

In Nepal, 386 projects for electricity generation, with a cumulative capacity of 9828 MW, have signed a power purchase agreement with the Nepal Electricity Authority (NEA). Of these, 134 projects, are operational and another 131 projects with a capacity of 3157 MW are under construction. The remaining 121 projects, with a capacity of 5343 MW, are seeking funding.

Nepal is on its way to reach the Government's targets for generating capacity of 5000 MW by 2023, 10 000 MW by 2028 and 15 000 MW by 2033. The NEA has significantly reduced the signing of new power purchase agreements, citing the Government's call for a more balanced mix between different types of hydropower (run-of-the-river and storage types) and other renewable sources, such as wind and solar (30). The mix calls for 30–35% run-of-the-river projects for generating 15 000 MW capacity.

Current status and future plans for off-grid renewables for electrification

Off-grid renewables play an important role in extending access to modern energy services in rural areas. The geographical and topographical challenges and costs associated with grid extension to remote mountainous areas of Nepal make solar-powered micro-grids and micro- and mini-hydropower the only solutions currently viable for electrification in these communities. The low power allowance per household subscription (200–250 W) from micro-hydro and solar mini- and micro-grid systems limits the use of heavy electrical appliances or use of multiple appliances at a time. Therefore, most households use electricity only for lighting and operating a few electrical appliances that consume little electricity, such as mobile chargers, televisions and radios. The off-grid renewable systems are not designed for electric cooking. Fig. 1 shows the capacity of mini-grids for household subscriptions.



Source: reference 31

↑ **Fig. 1.** Numbers and capacity of micro-hydropower plants in Nepal

Most solar mini-grid projects are funded by grants, with contributions from local governments, which mobilize private developers to operate the facilities. The Government has signed a project with the World Bank, valued at US\$ 17.2 million, to implement a “private sector-led mini-grid energy access project”, which is expected to benefit over 100 000 people in rural areas and many rural micro-enterprises.

Private developers are planning to develop larger-capacity (about 1 MW) solar mini-grids in remote areas to meet the potential load of electric cooking; however, this may take some time. Nepal already has 943 micro-hydro and 28 solar mini- or micro-grids, which provide basic access to electricity (31), and a private solar mini- and micro-grid installation company. About 300 households are connected to each micro-hydro plant and about 120 households to each solar mini- or / micro-grid. Most micro-hydro plants are owned by communities, and most solar mini- and micro-grids are constructed with Government subsidies and funding from development organizations, such as the Asian Development Bank and the United Nations Development Organization (UNDP). The unit cost of electricity to the government is

usually higher from mini- and micro- grids than from the NEA grid.

Access to electricity

Various policies are implemented to increase access to electricity for vulnerable populations and populations isolated from the grid. These include:

- financing for connection to electricity specifically for households headed by women;
- a mechanism to support low-volume consumers, such as a social or “lifeline” tariff;
- capital subsidies paid to utilities to provide distribution systems to rural areas and villages;
- mini-grids, which are legal and can be owned and operated privately, and programmes to develop them, with tariffs for electricity that may be different from the national tariff; and
- international quality standards for stand-alone systems.

Periodic reporting ensures compliance with the standards (quality supply), although the data and results of the quality testing are not available to the public.

3.2 Transmission and distribution of electricity

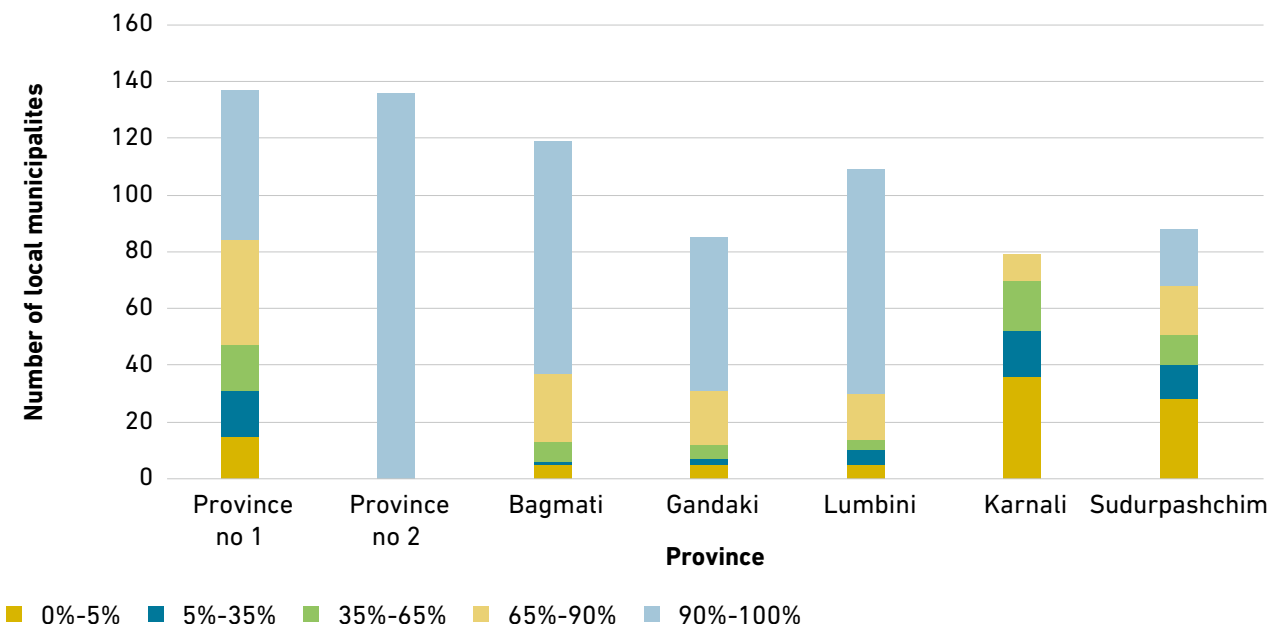
Status of existing and planned transmission network for an integrated power system

Currently, 3803 circuit km lines have been constructed, and some 3356 circuit km of transmission lines are at different stages of construction. The under-construction transmission lines are expected to be completed by FY 2022–2023, with 1992.80 circuit km lines to be completed by 2020–2021.

The electricity distribution system in Nepal is a monopoly, with the NEA overseeing the system in all seven provinces. The transformer capacity available per consumer is an important factor in promoting clean cooking; it is necessary to have sufficient spare capacity in the distribution transformer to accommodate the increase in load that would occur if more households use electricity

for cooking. The distribution line feeding the transformers should also have sufficient capacity. The voltage regulation is the most important factor in rural areas. Rural feeders are longer, which could result in a considerable voltage drop given increases in electricity demand, even with just a small increase in load.

The NEA encourages electrification in rural areas with the concept of “community rural electrification”. The Community Rural Electrification Department within the NEA has been developing “community rural electrification entities” since 2003. The Government contributes 90% of the cost of infrastructure for electrification and the Community Rural Electrification Department contributes the rest. In the 17 years of the programme, 565 000 consumers in 54 districts in all seven provinces have benefited (32). The percentage of electrification of local communities is shown in Fig. 2.



Source: reference 32

↑ **Fig. 2.** Percentages of local municipalities that have received electricity

The National Association of Community Electricity Users advocates for adoption of electric cooking

among members of rural electrification entities. The Association successfully promoted electric

cooking in Timal, with the support of the German Technical Cooperation Energy Development programme in partnership with the Indian Agri Biotech Foundation. More than 10% of households in the rural electrification entities have adopted electric cooking due to a quick response to the

Association's advocacy from the Community Rural Electrification Department in upgrading transformers to higher capacity. Users do not receive subsidies but have received either small grants or discounts for wiring upgrades and product purchase.

3.3 Current situation of household energy

In 2018–2019, the residential sector consumed the most energy (43.3%), followed by the industrial sector (36.3%) (33). Mapping of the prevalence of unclean fuel use by district and province in Nepal showed that the proportion of households that use

unclean fuel is higher in some provinces, and even in some districts within a province, than in others, reflecting geographical disparity in domestic access to clean energy (34).

3.4 Access to clean energy

According to the Energy Sector Management Assistance Program of the World Bank (35), 58% of rural households in Nepal that use LPG as their primary cooking fuel supplement its use with a traditional stove; however, only 15% of urban households in Nepal practice stove stacking with LPG and traditional stoves. In households in which cooking is done primarily with electricity, cooking takes at least 85 min less time than in households that primarily use wood.

Almost half (47.4%) of grid-connected households receive 24 h of electricity supply, while 41.7% of households receive fewer than 4 h of electricity between 18:00 and 22:00. On average, grid-connected households consume 46.63 kWh each month. An unreliable electricity supply affects 70% of households, and 17% of households report serious voltage problems that damage appliances. To offset the voltage issues and the high incidence of unscheduled and unpredictable outages, households invest in stabilizers and often in back-up sources of lighting with rechargeable batteries and solar lighting systems.

Households connected to mini-grids have less access to electricity than others, accounting

for 38.1% of households with the least access to energy, mainly due to capacity constraints and limited availability, reliability and quality of electricity services. The capacity constraints occur when operators impose restrictions on household appliances and load, limiting use to lighting, mobile phone charging, radios and televisions. Unlike households that are on the grid, most (91%) of those in mini-grid areas have a sufficient electricity supply only between 18:00 and 22:00. These households are generally less well-off and consume less electricity than grid-connected households.

Most of the households (89.6%) in which a solar device is the main source of electricity also have the least access to energy because they are limited by the capacity of their devices. They cannot power appliances other than basic lights, radios and mobile phone chargers. Only 4% of solar users own televisions, even though there is latent demand; households report that one of their main problems with existing solar devices is that they cannot power larger appliances. Their devices provide a limited supply, used mainly between 18:00 and 22:00. The main obstacles to households gaining access to electricity are the expense of connecting to the grid and the distance from the grid.

Nepal offers subsidies for improved biomass cook stoves and biogas (35), and there is a national or regional plan to increase access to clean cooking solutions. The plan does not currently allocate resources; however, several agencies leading clean cooking strategies and action plans set, monitor and enforce standards for clean cooking and monitor access to and adoption of clean cooking solutions. The goal is universal access to clean cooking by involving women throughout the supply chain

and prioritizing the most vulnerable consumers and a “last-mile” distribution strategy. A targeted awareness-raising strategy for adoption of clean cooking solutions includes messages for both men and women in order to involve local community organizations, but it does not include the health sector. Standards and testing facilities have been established for assessing the efficiency, emissions and safety of clean energy technologies.

3.5 Household use of energy for cooking

Most Nepali households (52.4%) continue to use firewood as their primary cooking fuel. Specifically, 15.1% of households cook on an open fire, 47.6% cook on a traditional stove with an enclosed fire, and 8.9% of households use improved biomass stoves. Other fuels used for cooking are LPG (33.1%), cow dung (8.5%), biogas (3.1%), leaves (2.7%) and others (0.2) (36). Despite various attempts to encourage the use of clean solutions, a comparison of energy use between 2001 and 2016 indicated that solid fuels remained the overwhelmingly predominant choice of cooking fuel (37).

In Nepal, 16.3% of households use two types of stoves for cooking, while 1% use three types; 7.3% of households use an LPG stove with a traditional stove. With regard to annual household expenditure on cooking fuels, 14.3% of households spend

more than 5% of their household expenditures on cooking fuels. Given the high cost and time for importation of LPG, the Government is prioritizing increasing access to biogas and electric cooking for households who wish to switch to clean options. Biogas, which requires widely accessible biomass waste, could also be adopted by a large proportion of the population. The Government has policies to promote use of biogas and to increase the penetration of biogas with various financing incentives.

A recent household energy survey showed that use of traditional cook stoves is higher in Sudurpashchim Province (80.1%) and Province 2 (74.1%) than in the other provinces of Nepal (38, 39) (Table 4).

↓ **Table 4.** Percent of the population using different types of clean cook stoves and fuels by province (%)

Province	Traditional stove	Improved stove	Biogas stove	Kerosene stove	Solar cooker	LPG stove	Electric stove
Province 1	58.2	9.0	2.2	0.0	0.0	30.0	0.6
Province 2	74.1	0.0	0.2	0.0	0.0	25.5	0.2
Bagmati	36.7	3.8	1.0	0.1	0.0	57.1	1.3
Gandaki	42.4	7.2	2.9	0.0	0.0	47.5	0.0
Lumbini	54.0	11.8	0.7	0.0	0.0	33.3	0.2
Karnali	59.2	27.9	0.8	0.0	0.0	12.1	0.0
Sudurpashchim	80.1	6.9	2.8	0.0	0.1	10.0	0.0
Nepal	55.8	8.6	1.5	0.0	0.0	33.6	0.5

Source: Based on analysis of raw data from references 38 and 39

Gender implications

In Nepal, most households are headed by a man (81.8%). Households headed by a woman (18.2%) generally have a lower income, less education and lower wealth. Of all the female-headed households, 31.3% are in the bottom quintile of household expenditure; whereas only 17.6% of households headed by a man are in the lowest quintile (40). Differences in socio-economic status between households headed by women and by men likely play a critical role in access to and adoption of clean energy. Once the infrastructure for clean energy is available, however, households headed by women and by men have similar access to clean energy. In grid-electrified areas, households headed by women and by men have similar rates of connection, 95.1% and 91.7%, respectively. The rates of uptake of mini-grid connection in areas with only mini-grid and of solar devices in areas with neither grid nor mini-grid are also similar in households headed by women and by men. Additionally, an electric, LPG or biogas cook stove was used by 43.6% of households headed by women and 36.1% of households headed by men (40).

Types of household cooking devices

Improved cook stoves

Improved cook stoves have been promoted in Nepal since the 1950s by collaboration between Government, nongovernmental cooperation agencies and private organizations. The AEPC has installed more than 1.42 million improved cook stoves, including 85 805 metallic improved cook stoves, throughout the country (41). The 15th 5-year plan (2019–2020 to 2023–2024) foresees installation of 500 000 improved cook stoves in the country.



A woman using electric cooker.
Credit: HIVOS/PAC consortium

Electric cooking

In the first year of the 15th Five-year Plan, 2019–2020, the Government announced the multi-year Terai clean cooking programme to replace traditional fuels such as animal dung and firewood with better cook stoves, modern biomass cook stoves and biogas cook stoves in 22 districts of the Terai region (25). As a part of this initiative, AEPC proposed electric cooking systems as a feasible clean cooking solution for the first time.

During FY 2019–2020, AEPC planned to introduce about 10 000 induction cook stoves and 65 700 biomass cook stoves in the district in partnership with local governments (25). In FY 2020–2021, AEPC promoted electric cooking in 100 000 additional households. As of February 2020, about 1200 induction cook stoves had been distributed in various pilot and research projects, and private sector suppliers had sold about 50 000 induction cook stoves in the past 3 years (25). While the NEA has seen a 3% increase in overall energy sales, the percentage consumption by domestic consumers also increased, from 44% in 2018–2019 to 46% in 2019–2020 (32).

Biogas

According to the AEPC (41), about 1.1 million Nepali households could use domestic biogas. The AEPC has already installed 425 511 small scale biogas and 277 large-scale biogas systems. The 15th Five-year Plan plans to install 200 000 biogas cook stoves and 500 large biogas plants in the country. An example of a biogas stove used in Nepal is shown in Fig. 3.



Credit: LEADERS Nepal

↑ **Fig. 3.** Biogas stove commonly used in mid-hills

LPG

The reliance of households on imported LPG for cooking has grown over time, with imports having increased by 15% on average over the past decade. Overall importation of LPG in 2018–2019 was 426 609 MT, corresponding to 30 042 887 canisters (each weighing 14.2 kg). The residential sector uses about 54% of all LPG imported into the country (42). According to the International Atomic Energy Agency's model for analysis of energy demand, demand for LPG is anticipated to rise by 5.56% per year in an economic growth scenario and by 6.79% in a sustainable scenario (43).

Annex 1 lists completed and ongoing studies on clean household energy.

3.6 Household use of energy for lighting

The 2019 report on progress in energy (9) states that 95.5% of Nepal's population (99% in urban and 95% in rural areas) have access to electricity through grid or off-grid solutions. The Government launched a programme in 2007 called "Karnali Ujjyalo programme" to enable the people in the Karnali zone and adjoining districts to purchase solar lamps, known locally as "solar *tuki*". In this

programme, the Government distributed 31 000 solar *tuki* in five districts of the Karnali region and 29 000 in the four adjoining districts of Jajarkot, Bajhang, Achham and Bajura, subsidizing 95% of the total cost. The objective of the programme was to provide lighting systems for households in the Karnali zone, especially for low-income people living in remote areas (44).

3.7 Household use of energy for heating and cooling

Little information was available on energy used for heating in Nepal, and the Government has not launched a specific programme on household space heating. Most residents of mountains and rural areas use solid biomass for space heating,

while some of those in urban areas use electric heaters. Electric appliances such as fans, coolers and air conditioning are used for space cooling.

4

Health sector in Nepal

4.1 Status of health facilities

Nepal's health system operates under the stewardship of the Ministry of Health and Population and is responsible for overall policy formulation, planning, organization and coordination of the health sector at national, provincial, district and local levels. Provincial and district hospitals are the main centres for tertiary care. Primary care is provided in community health centres, such as

primary health-care centres, urban health centres and health posts.

Nepal is increasing its health infrastructure and facilities for critical care. During the past 6 years, the number of hospitals increased by 17% and the number of doctors by 23% (Table 5).

↓ **Table 5.** Numbers of health facilities and the health workforce, 2013–2020

Type of health facility or health worker	2013–2014	2014–2015	2015–2016	2016–2017	2017–2018	2018–2019	2019–2020
Hospital	107	116	116	116	123	125	134
Primary health-care centre	215	215	216	200	203	203	203
Health post	2 175	3 790	3 883	3 803	3 808	3 805	3 805
Private facility	–	–	–	–	1 822	2 168	2 277
Hospital beds	7 750	7 640	7 748	8 172	8 172	8 172	8 172
Doctor	2 154	2 457	2 550	2 550	2 640	2 640	2 640
Nurse or auxiliary nurse midwife	9 535	20 346	20 423	20 423	20 510	20 653	20 653
Health assistant	11 551	11 551	12 646	12 646	14 347	14 347	14 347

Source: references 33, 45

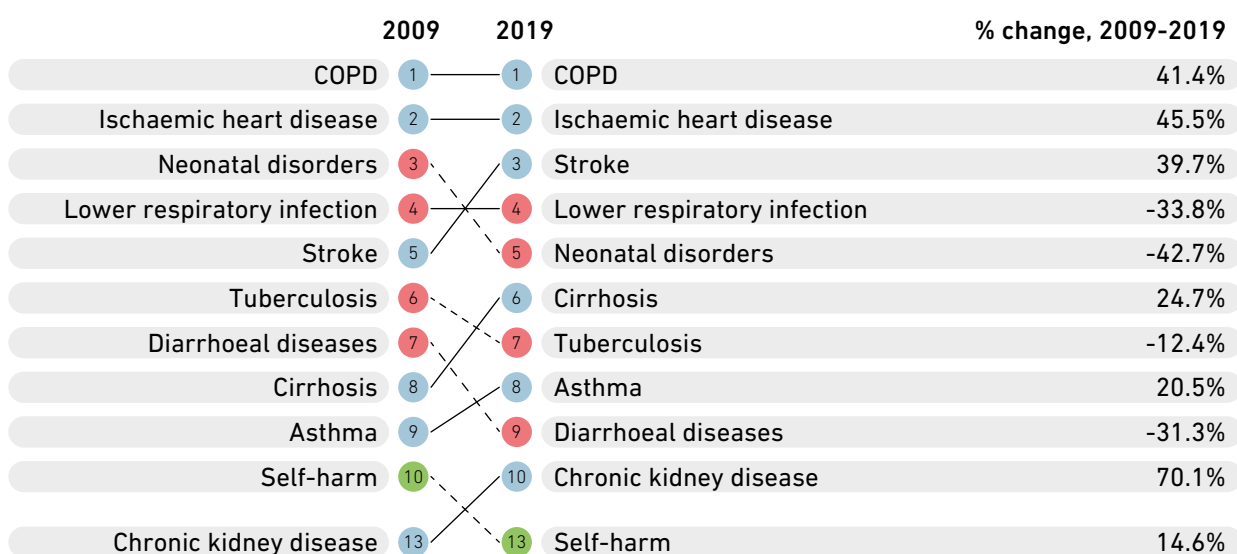
In the first 8 months of FY 2019–2020, a total of 20.98 million health services were provided by all Government, private and community health institutions in Nepal; 855 488 patients were admitted to hospitals, and 1.54 million patients

received some sort of emergency service (33, 45). The mortality rate of children under 5 per thousand was 30.8 in 2019 (46). An average of 186 maternal deaths/100 000 live births were recorded in 2017 (47).

4.2 Burden of disease due to air pollution

Air pollution is recognized as an important risk factor for chronic obstructive pulmonary disease, ischaemic heart disease, acute lower respiratory infection, stroke and lung cancer. Both mortality

rates and disability-adjusted life years for all of these diseases, except for lower respiratory infection, have increased substantially in Nepal over the past decade (Fig. 4) (48).



Source: reference 45
COPD, chronic obstructive pulmonary disease

↑ **Fig. 4.** Causes of deaths (all ages and both sexes) and percentage change between 2009 and 2019 in Nepal

WHO estimated that 193.8 deaths per 100 000 population are related to ambient and household air pollution in Nepal, which is one of the highest rates in South Asia, followed by India (184.3 deaths per 100 000 population) and Bangladesh (149 deaths per 100 000 population in 2016 (49).

HAP from burning solid fuels and kerosene is also a major risk to health on its own, and is one of the leading risk factors for death in Nepal (50). The number of deaths due to diseases related to exposure to HAP in Nepal in 2016 was 23 397, for a rate of 119.9 per 100 000 population (51) (Table 6).

↓ **Table 6.** Numbers of deaths attributable to exposure to household air pollution in Nepal, 2016

Cause	No. of deaths			Death rate per 100 000 population (age-standardized)		
	Both sexes	Males	Females	Both sexes	Males	Females
Lower respiratory tract infections	4 588	2 122	2 466	21.92	20.73	22.83
Trachea, bronchus lung cancers	1 218	552	666	5.82	5.77	5.9
Ischaemic heart disease	8 059	4 524	3 235	41.21	52.03	31.59
Stroke	3 578	1 915	1 664	18.21	20.66	16.01
Chronic obstructive pulmonary disease	5 954	2 357	3 598	32.71	28.06	36.67
Total	23 397	11 769	11 628	119.9	127.3	113

Source: reference 51

The total number of disability-adjusted life years due to diseases related to HAP in 2016 was 710 929, for a rate of 2453 per 100 000 population (52) (Table 7).

↓ **Table 7.** Disability-adjusted life years attributable to household air pollution in Nepal, 2016

Cause	Disability-adjusted life years			Rate of disability-adjusted life years (per 100 000 population)		
	Both sexes	Males	Females	Both sexes	Males	Females
Lower respiratory tract infections	205 595	104 805	100 789	709	745	676
Cancers of the trachea, bronchus and lung	36 880	15 034	21 846	127	107	146
Cataract	8 424		8 424	29		56
Ischaemic heart disease	210 413	13 0839	79 574	726	930	533
Stroke	91 266	49 755	41 512	315	354	278
Chronic obstructive pulmonary disease	158 351	64 738	93 613	546	460	627
Total	710 929	365 171	345 758	2 453	2 597	2 317

Source: reference 52

Annex 2 lists completed and ongoing studies on the health effects of HAP.

Social welfare

5.1 Social security allowance programmes

The Government of Nepal runs various social protection programmes, consisting of social insurance, cash and in-kind assistance programmes and labour market programmes. The cost of social assistance programmes, usually intended to assist the poor and the vulnerable, amounts to about 0.9% of the gross domestic product. The social

security allowance programme is the largest social assistance programme in Nepal. The allowances are not explicitly targeted to the poor, but to people who are considered socially and/or economically vulnerable. Programmes related to social welfare are listed in Table 8.

↓ **Table 8.** Social security allowance programmes and criteria for inclusion

Programme name or target population	Criteria for inclusion	Benefits (NPR/ month unless otherwise specified)	Year introduced
Senior citizens	Allowance for all citizens over the age of 70	4000	1995
	All Dalit citizens and Karnali residents over the age of 60	2660	
Single women	Allowance for single women over the age of 60 and widows of all ages	2660	1996–1997
Disability	Allowance for all citizens with “full” disability, who carry red identity cards	3990	1996–1997
	Allowance for all citizens with “partial” disability	2128	
Endangered ethnic group	Allowance for all members who belong to one of 10 endangered ethnic groups	3990	2009
Child protection grant	For all children under 5 years in Karnali Province and Bajura and Bajhang districts, up to two children per household	532 per child	2009
	For all “poor” Dalit children under the age of 5, up to two children per household		
Karnali Employment Programme	In households with no employed member, one member of the household qualifies as “poor” in Karnali	50 NPR/day for 100 days	2006
Rural Community Infrastructure Works Programme	Assists poor households facing food insecurity in 21 selected districts	NPR 130–140 per day or 4 kg rice and 0.5 kg pulses per week, or both	1995

For all programs, households receiving a pension from the Government, the Army or the police are not eligible
Exchange rate: US\$ 1 = NPR 119.2; US\$ 0.84 = NPR 100

The Department of Civil Registration under the Ministry of Federal Affairs and Local Development is responsible for administering social security allowances. In FY 2015–2016, approximately 2.2 million beneficiaries were given social security allowances (2.01% of the total budget), fully financed by the Government (53).

Disbursement of social security allowances is currently recorded manually. Beneficiaries renew their enrolment annually at a local ward office,

which forwards the roster of beneficiaries to the district coordination committee. The committee then collates the rosters into a document providing the number of beneficiaries for each category of social security allowance and sends it to Ministry of Federal Affairs and Local Development. The district coordination committee releases the funds for payment vouchers to local levels within 15 days of receiving a progress report.

5.2 Subsidies for clean household energy

The Government introduced its renewable energy subsidy policy in 2000 and subsequently revised it four times to make it more efficient. Nevertheless, there has been no critical review of the effectiveness of such policies in achieving their target. The Government provides additional subsidies to remote areas and groups that include households headed by a woman with dependent children, victims of the 2015 earthquake,

endangered indigenous communities identified by the Government and people of Dalit ethnicity.

No direct subsidy is provided to promote mud improved cook stoves; however, local bodies are encouraged to provide financial support to install mud improved cook stoves to targeted beneficiaries.

Subsidies for renewable energy are listed in Table 9.

↓ **Table 9.** *Subsidies for renewable household energy*

Subsidy	Region			Remarks
	Very remote regions	Remote regions	Accessible areas	
Solar thermal domestic cooker	60% of total cost or NPR 15 000, whichever is lower	50% of total cost or NPR 12 000, whichever is lower	40% of total cost or NPR 10 000, whichever is lower	
Solar photovoltaic home systems	10–20 peak W: NPR 5 000	10–20 peak W: NPR 4 800	10–20 peak W: NPR 4 500	Per household per system
	50 or more peak W: NPR 10 000	50 or more peak W: NPR 9 000	50 or more peak W: NPR 8 000	

Subsidy	Region			Remarks
	Mountain	Hill	Terai	
Domestic biogas plant	2 m ³ : 25 000	2 m ³ : 20 000	2 m ³ : 16 000	An additional 10% of the subsidy per plant per household will be provided to "targeted beneficiary groups" For biogas plants filled with kitchen waste and other household biodegradable waste and a capacity of 4 m ³ or less, a subsidy of up to 50% of the total cost but not exceeding NPR 10 000 will be provided.
	4 m ³ : 30 000	4 m ³ : 25 000	4 m ³ : 20 000	
	6 m ³ : 35 000	6 m ³ : 30 000	6 m ³ : 24 000	
Improved cook stoves with biomass energy	A maximum subsidy of up to 50% but not exceeding NPR 3000 and NPR 4000 per stove per household for a metallic improved cook stove with one or two potholes and three potholes, respectively, will be provided in areas above 1500 m altitude for cooking and space heating.			Additional subsidy amount of NPR 1000 per stove per household will be provided for the metallic improved cook stoves to the "targeted beneficiary groups".
	A maximum subsidy of up to 50% but not exceeding NPR 3000 will be provided for a stove with one or two potholes with full or partial metal body or for a portable, higher-efficiency rocket cook stove in rural and peri-urban areas.			
	A maximum subsidy of up to 50% of the cost but not exceeding NPR 4000 will be provided for a household cook stove with one or two potholes with full or partial metal body and gasifier system in rural and peri-urban areas.			

Source: reference 5

The price of domestic renewable energy technologies, particularly solar home systems, biogas, metallic improved cook stoves and metallic higher-efficiency rocket stoves, will be determined for suppliers every fiscal year according to the demand of the district or region. Users will receive a subsidy from a recognized company on the basis of the determined unit cost. The subsidy will not, however, exceed the amount mentioned in the technology-specific clauses of the policy.

As subsidies are provided to rural households and communities for supply and installation of renewable energy technologies and systems from recognized private companies, no tax will be levied on the subsidies; however, as the remaining cost, apart from the subsidy, is borne by households and communities, tax is applicable on that amount as per prevailing laws.

5.3 Health insurance programme

The health insurance programme is a social security programme run by the Government to enable citizens to access high-quality health-care services at a minimal financial cost. The Health Insurance Board is responsible for the health insurance programme, which is voluntary and based on family contributions. Families of up to five members contribute NPR 3500 per year and NPR 700 per additional member, which covers benefits of up to NPR 100 000 per year with an additional

NPR 20 000 covered for each additional member. The maximum amount available per year is NPR 200 000. Membership must be renewed annually. At the end of FY 2019–2020, the programme was being implemented in 58 districts and 563 localities. A further 19 districts will be included shortly. In FY 2019–2020, there were 3 158 212 insurers covering 11.92% of the population of Nepal, although 976 260 insurers had dropped out of the programme.

5.4 Poverty alleviation

The Government established the Poverty Alleviation Fund in 2003 as a specific, focused initiative to integrate excluded communities into the mainstream of development by putting poor and disadvantaged groups in charge of development activities. The Fund was thus intended to improve the living conditions and livelihoods of the rural poor and empower them, especially those who

have traditionally been excluded due to gender, ethnicity, caste or geography. With the recent addition of 15 districts, a total of 55 programme districts were covered. The Poverty Alleviation Fund was financed by the Government through grants from the World Bank; however, the budget for FY 2021–2022 has discontinued it.

5.5 Other welfare programmes

School Meals Programme

The National School Meals Programme is a key part of the Social Welfare Act (1992). It was established in 2002 to improve educational outcomes by providing school meals for children from pre-primary to grade 8. It was launched in Karnali and implemented in 19 districts, reaching 600 000 schoolchildren in basic education in 2017. It is an important part of the Government's strategy to increase children's academic, nutritional and health outcomes (54) and has been incorporated into the School Sector Development Plan (2016–2022) and the National School Health and Nutrition Strategy (2006) to address malnutrition and serve as an incentive for school attendance. The cost, however, is a

concern, as the Government provides NPR 15 per child per meal, which does not account for the invisible costs of transport of food and of cooking, including cooking fuel (54).

In this programme, the Department of Education provides assistance either directly by distributing food items such as fortified rice, vegetable oil and lentils or indirectly by giving cash to primary schools through the District Education Office to provide nutritious midday meals to students (55). In the latter approach, known as "home-grown school feeding", local communities are given autonomy over the school meals programme and some of the food is sourced locally, which may

strengthen local ownership and improve the quality of meals (54). Meals are delivered by school staff.

Lack of nutritious lunches during closure of schools during lockdowns due to COVID-19 has significantly affected children, especially those from vulnerable households for whom the school lunch is often the only full meal they have.

Scholarships for secondary education

For girls, all Dalit children, all children with disabilities and marginalized communities, the Ministry of Education provides a scholarship of NPR 100–2500/month according to the severity of need or disability and up to NPR 600 for stationery and uniforms for secondary education.

National Safe Motherhood Programme

This programme is run by the Family Welfare Division and the Department of Health Services for pregnant women and newborns. The goal is to reduce maternal and neonatal morbidity and mortality and to improve maternal and neonatal health through prevention and promotion and by

addressing avoidable factors that cause death during pregnancy, childbirth and post-partum. The programme consists of a birth preparedness package and community activities for maternal and newborn health, a rural ultrasound programme and a mother (Aama) and newborn programme.

Women's affairs

The Women's Empowerment Division of the Ministry of Women, Children and Senior Citizens has two sections, Women's Development and Gender Mainstreaming and Gender-based Violence Prevention, which both work on women's affairs.

Mobilization of local health volunteers

To facilitate health promotion at the local level, female community health volunteers and mothers' groups are mobilized in community outreach programmes to deliver counselling and general support on clean energy. Evidence indicates that local health workers are effective facilitators of community adoption of improved cook stoves (56).



*A man using gas stove to prepare food in wok, Nepal
Credit: Adobe/EyeEm/Marie Cristabern Joyce Villamor*

Stakeholder organization and coordination

6.1 Government agencies

National Planning Commission

The National Planning Commission is a specialized agency that prepares development plans for rapid, balanced, sustainable economic growth in Nepal, advises the Government and facilitates implementation, monitoring and evaluation. It also provides guidance to the Ministry of Finance and all other line ministries on policy targets and priorities for the annual budget.

Ministry of Finance

The Ministry of Finance is responsible for revenue administration, preparation and implementation of fiscal and revenue policies, foreign currency and foreign grants and loan mobilization, allocation and management of economic and financial resources, management of national accounts, State-owned commercial enterprises, budgetary allocations, control, disbursement and monitoring.

Ministry of Health and Population

The Ministry of Health and Population is responsible for overall policy formulation, planning, organization and coordination of the health sector at national, provincial, district and community levels. Its goal is to improve health through effective, efficient policies, resource mobilization, monitoring and regulation of the delivery of health services by different health institutions.

Ministry of Energy, Water Resources and Irrigation

The Ministry of Energy, Water Resources and Irrigation is responsible for developing policies, laws, standards and regulations related to sustainable development, conservation, use and sharing of water and energy, as well as for studies,

research and technology related to energy and water resources. Its roles include:

- ensuring the availability of clean energy by increasing the production of hydropower;
- increasing electricity consumption by extending access to electricity to all households and productive sectors in a high-quality, reliable, accessible manner (e.g., ensuring energy efficiency);
- contributing to the balance of payments by increasing regional energy export and gradually replacing imports of petroleum products; and
- reducing energy consumption density and increasing productivity by efficient use of energy.

The Department of Electricity Development is the licensing authority for power projects involving the generation and transmission of electricity.

Alternative Energy Promotion Centre

The AEPC is a governmental agency under the Ministry of Energy, Water Resources and Irrigation, which assists in the formulation and implementation of appropriate policies and programmes, resource mobilization, coordination and information management in the renewable energy sector with a focus on energy access in rural areas. Before the federation of Nepal, the AEPC was solely responsible for providing technical assistance and evaluating applications for subsidies for renewable energy systems and projects. Since federation in 2015, local governments have been responsible for managing renewable energy projects.

In line with the new constitution, AEPC is transforming itself by assuming a new role of capacity-building and acting as a knowledge hub for local governments to expedite fulfilment of their constitutional mandate for rural energy development. The AEPC has introduced interim

guidelines for allocation of renewable energy subsidies under conditional grants at local and provincial levels through fiscal transfer.

Nepal Electricity Authority (NEA)

The NEA is responsible for planning, constructing, operating and maintaining all power generation, transmission and distribution facilities in Nepal, both interconnected and isolated. Recently, the NEA has shown interest in promoting electric cook stoves. It provides electricity at a reduced rate during off-peak hours at night. The NEA is the sole buyer and seller of electricity in the country. The Electricity Regulatory Commission was recently established to regulate the electricity sector and to approve power purchase agreements and determine electricity prices for consumers.

Ministry of Forests and Environment

The Ministry of Forests and Environment is the main Government agency responsible for environmental conservation. Its functions include setting standards and monitoring air quality, developing policies and standards for a green economy and formulating policies and regulations for the environment and for climate change mitigation and adaptation. The Environmental Standards and Monitoring

Section under the Environment and Biodiversity Division and the Climate Change Management Division are responsible for issues related to air pollution.

Ministry of Women, Children and Senior Citizens

The Ministry of Women, Children and Senior Citizens is involved in empowering women and other sectors of society socially, economically and politically and strengthening their role in sustainable peace and development, giving higher priority to children. The Ministry has initiated the President's Women Upliftment Programme in 26 districts of Nepal and is also responsible for safeguarding and reducing the health impacts of smoke inhalation from household cooking.

Ministry of Federal Affairs and General Administration

This Ministry of Federal Affairs and General Administration coordinates, cooperates, facilitates, monitors and evaluates the activities of local governments, and regulates and manages the national civil service. Its main responsibility is to facilitate development and delivery of services at the local level.

6.2 Nongovernmental organizations

Name	Background
Biogas Sector Partnership – Nepal	<p>This Partnership and the National Rural and Renewable Energy Programme installed 400 000 biogas plants across districts of Nepal, of which about 100 000 were constructed with credit from various commercial banks and microfinancing institutions. The Partnership is also the national service provider for the AEPC. Recent projects include:</p> <ul style="list-style-type: none"> • the Biogas Support Programme funded mainly by the Government, Netherlands Development Assistance Dangerous Goods Information System and the KfW; • implementation of Gold Standard Voluntary Emission Reduction biogas projects with funding from the World Wildlife Fund; • a national rural renewable energy programme funded by the AEPC, the Government of Nepal and various external development partners; and • scaling up of renewable energy funded by the Government of Nepal and the World Bank.

Name	Background
Dhaulagiri Community Resource Development Centre	<p>The Development Centre works as a regional renewable energy service centre as part of the AEPC in Mustang, Kaski, Parbat, Syangja, Palpa, Gulmi, Magdi, Baglung, Kapilbastu and Rupendah districts of Nepal. Projects under way in Baglung are:</p> <ul style="list-style-type: none"> • an improved water Mills programme, • a rural water supply programme and • a sanitation programme.
Nepal Forum of Environmental Journalists	<p>Environmental journalists have been raising public awareness on sustainable development and lobbying and advocating for environment-friendly public policies to slow the pace of climate change since the early 2000s.</p>
Indoor Air Pollution and Health Forum – Nepal (IAPHF-Nepal)	<p>IAPHF undertakes studies and research on policies related to indoor air pollution and health to address and raise awareness about them. The Forum has 55 members, including Government agencies, multilateral organizations, international and NGOs, the private sector and professionals. Major projects implemented by IAPHF-Nepal include:</p> <ul style="list-style-type: none"> • healthy homes by improving household energy and the environment in Sindhulipalchok district in partnership with the Global Environment Fund Small Grants Programme and UNDP; • improving household energy management practices in the sacred Himalayan Langtang National Park, Rasuwa, in partnership with the Global Environment Fund Small Grants Programme and UNDP; • contribution to endorsement of indoor air quality standards and guidelines, 2009 in partnership with Practical Action; and • preparation of a manual for female community health volunteers in partnership with Practical Action and the Mirgendra Shamjana Medical Trust. <p>Ongoing activities of IAPHF-Nepal are:</p> <ul style="list-style-type: none"> • development of a HEART report on clean household energy and health, supported by WHO; • awareness, prevention and control measures for COVID-19 in Kathmandu (Nagarjun Municipality), Kamalimai and Marin Municipality (Sindhuli) and Timal and Bethanchowk (Kavrepalanchowk); and • the Green and Inclusive Energy Project with the Centre for Rural Technology and the International Network on Gender and Sustainable Energy, hosted by Hivos International.
Society for Legal and Environmental Analysis and Development Research	<p>The Society works with universities and international and NGOs. It is involved in research, training, workshops, seminars and mass awareness campaigns. It monitors air quality and occupational exposure and provides concerned stakeholders with the latest equipment at the proper price. Some of its programmes are:</p> <ul style="list-style-type: none"> • community behaviour change and clean fuel interventions in Kavre, with the support of the Clean Cooking Alliance; • evaluation of the impact of a major disaster (earthquake and aftershocks) on air pollution and children's health in Nepal; • community building with biogas; and • participation in the Partnerships for Enhanced Engagement in Research project of the United States national academies of Sciences, Engineering and Medicine (PEER Health Project).

Name	Background
Mrigendra Samjhana Medical Trust	<p>The Trust works on advocacy and community action research programmes to address indoor and ambient air pollution and tobacco smoking. It provides medical care, health services and social services to underprivileged communities, with education, clean drinking-water, income- and employment-generating facilities, improved indoor environments and anti-tobacco activities. Its publications address:</p> <ul style="list-style-type: none"> • pioneering work on acute respiratory infection, • indoor air pollution, • pioneering work in the fight against tobacco use, • heart disease and • hygiene and sanitation
Namsaling Community Development Centre	<p>The Centre has innovated several types of household and institutional cook stoves and trained more than 1500 community stove promoters in the eastern development region of Nepal. The Centre is also the regional service centre of the AEPC in Sankhuwasabha, Bhojpur, Dhankuta, Taplejung, Terathum, Panchthar and Illam districts. Projects in renewable energy include:</p> <ul style="list-style-type: none"> • regional technical service provision of alternative energy and • a productive energy use programme.
National Association of Community Electricity Users – Nepal	<p>The Association is committed to ensuring a future in which every Nepali, irrespective of caste, gender or position in the community, has access to clean, affordable, reliable electricity and benefits from its productive use. The Association has grown into a strong network comprising over 300 community rural electrification entities in 53 districts of Nepal. The members share a vision of achieving sustainable socioeconomic development through community rural electrification areas.</p> <p>Some of the projects under way are:</p> <ul style="list-style-type: none"> • market-led promotion of electric cooking in Timal community electrification area, Kavrepalanchok district; • strengthening the capacity of the energy sector to ensure gender equality and social inclusion; • comparative analysis of economic activities and job creation spurred by the advent of electrification between the NEA and community rural electrification entities; and • The Green and Inclusive Energy Project
Nepal Biogas Promotion Associations (NBPA)	<p>The NBPA is the umbrella organization of biogas companies in Nepal, and with more than 114 member companies, it is one of the largest private sector organizations in biogas in the country. It offers expertise in biogas, bio-slurry and new technologies. Its aim is to improve the sustainability of the biogas sector by improving technologies and developing the sector. NBPA is also the national service provider of the AEPC.</p>
Renewable Energy Confederation of Nepal	<p>The Confederation conducts advocacy, lobbying, opinion-building and research on alternative energy in Nepal. It acts at national and international forums to advocate for better alternative energy policies, programmes and modalities to deliver services and materials to target groups according to Government plans and programmes through efficient private sector professionals. Its activities include:</p> <ul style="list-style-type: none"> • The Green and Inclusive Energy Project • Green Homes Project • Forestry Enterprise Division
Renewable Energy Test Station	<p>Autonomous body governed by the “renewable energy test station rules 2063” in clause 31 of the Nepal Academy of Science and Technology Act 2048. Contributes to the quality and sustainable utility of the renewable energy sector by providing quality testing and related services.</p>

Name	Background
Centre for Rural Technology, Nepal	<p>The Centre is upgrading traditional technologies, developing new ones and promoting them to strengthen the capability of poor rural communities. Its projects include:</p> <ul style="list-style-type: none"> • development and labelling of clean cook stoves and standardized biomass fuels, • regional testing and strengthening knowledge base of cook stoves, • improving gender-inclusive access to clean and renewable energy, • the Green and Inclusive Energy Programme, and • advocating for scaling up of local adaptation to climate change, such as “eco village development” to strengthen the pro-poor climate agenda in South Asia, with support from donor agencies and the Government of Nepal.

6.3 Research institutes and academia

Name	Background
Research Centre for Applied Science and Technology	<p>The Centre was established in September 1977 as the premier research and development institution in the organizational framework of Tribhuvan University. With a well-equipped mechanical workshop and laboratories, it has conducted research projects and designed and fabricated prototypes and offers instrumental and analytical expertise and consulting services. Research and development in clean cooking include development of a gasifier stove for domestic use and standard testing protocols for improved cook stoves. The Centre has also contributed to the development of improved cook stoves (e.g., two potholes with a smoke hood).</p>
Kathmandu University	<p>Kathmandu University was established in December 1991 as an autonomous, non-profit, self-funding public institution. The School of Medical Science, the Department of Environmental Science and Engineering and the Department of Mechanical Engineering conduct research and technology development projects (Score stove) and on clean energy, indoor air pollution and health. Kathmandu University recently established the Renewable and Sustainable Energy Laboratory to promote collaboration among academia, policy-makers, national and international development partners and society to find holistic, useable solutions to challenges at the agro-energy nexus by interdisciplinary activities and scientific, local and professional knowledge. The transdisciplinary research centre will develop human resources for work in civil society, the public sector and innovative enterprises. The Laboratory contributes to research and development for clean energy solutions, enhances the quality of university education, provides a platform for undergraduate and graduate students to learn by doing, disseminates scholarly publications, runs workshops, seminars, conferences and trainings and inspires researchers and students to consider how research outcomes and activities can be transferred to the community and translated into evidence-based policies.</p>
Centre for Energy Studies	<p>The Centre was established in January 1999 in the Institute of Engineering, Tribhuvan University to bring eminent national energy experts together. As renewable energy experts in other countries have recognized the work of the Centre, it serves as a bridge between national and international organizations involved in energy.</p>
Nepal Academy of Science and Technology	<p>This autonomous Government body was established in 1982. It explores alternative and renewable energy resources to replace traditional biomass fuel and has a laboratory to test stoves, bio-briquettes and emissions and to conduct research to improve the efficiency of stoves and raw materials. The Academy has a database of the results of testing of raw materials and biomass for their moisture, volatile matter, ash and carbon content.</p>

Name	Background
Nepal Health Research Council	The Health Research Council is a national body established in 1982 to conduct high-quality scientific and health research. It cooperates with ministries, nongovernmental agencies and the private sector to provide consultation, assistance and advice on health research, policies and health-care services. The Council increases the research competence of national scientists through training and grants and maintains the technical and ethical standards of health research in the country. The 12 research priorities include noncommunicable diseases, neonatal and child health and environmental and health issues such as medical waste management, air pollution, household energy and climate change and the associated health effects.

6.4 International nongovernmental organizations

Name	Background
Clean Cooking Alliance	<p>The Clean Cooking Alliance works with a global network of partners to build an inclusive industry that makes clean cooking accessible to the nearly three billion people in the world who live each day without it. Established in 2010, the Alliance drives consumer demand, mobilizes investment to build scalable businesses and fosters an environment that ensures that the sector thrives. Clean cooking transforms lives by improving health, protecting the climate and the environment, empowering women and saving time and money for consumers. The Alliance supports the development, sale, distribution and consistent use of clean cooking solutions that transform lives. In 2020–2021, its activities were:</p> <ul style="list-style-type: none"> • landscape analysis with market assessment; • electricity status assessment; • consumer assessment for electric cooking; • Clean Cooking Explorer to determine the consumer base for electric cooking technologies in Nepal, including the market size; • mapping of the supply value chain of cook stoves and fuels (LPG, biogas, biomass, improved cook stoves) from manufacturing to user; • assessing the current impacts of tax, tariffs and subsidies; and • developing and testing standards for infrared stoves and electric pressure cookers, and updating the strategy for implementation of standards.
International Centre for Integrated Mountain Development	The Centre is a regional platform for experts, planners, policy-makers and practitioners to exchange ideas and perspectives for sustainable mountain development. It facilitates knowledge exchange, tailors international knowledge to the region's needs and brings regional issues to the global stage. A regional programme for adaptation and building of resilience, Renewable Energy and Energy Efficiency Capability for the Hindu Kush Himalaya is being conducted.

Name	Background
Practical Action, Nepal	<p>Under the theme “Energy that transforms”, Practical Action is bringing together rural communities, displaced people, energy providers and decision-makers to find sustainable, clean energy solutions, such as enabling people to access electricity to improve their health, education and livelihoods; helping commercial providers of mini-grids, biogas and solar systems to reach poor, remote communities; and reducing harmful smoke inhalation by introducing cleaner cook stoves and fuels. Clean cooking projects include results-based financing for development of a market for improved cook stoves in Nepal funded by the German Technical Cooperation energy development programme.</p> <p>Other research projects include:</p> <ul style="list-style-type: none"> • assessment of the market for efficient electric cooking appliances in Nepal, funded by the Modern Energy Cooking Services programme; • research on gender-responsive electric clean cooking in Nepal, with Energia and 60 Decibels; • analysis of factors affecting adoption of electric cooking in an electrified community of Nepal, funded by the Modern Energy Cooking Services programme; • a study on the institutional and market readiness of Nepal for electric cooking; • a study on energy market transformation; and • a landscape analysis of the cook stove sector in Nepal.
World Wildlife Fund Nepal	<p>WWF Nepal is a longstanding partner of the Government in its conservation programmes in the Terai Arc and Sacred Himalayan landscapes. WWF initiated the Gold Standard Biogas Voluntary Emission Reduction project in 2007 and installed 7500 biogas plants in the Terai Arc. The project is generating carbon credits, and the revenue from the sale of credits is given to local communities to extend the biogas programme. The carbon credits are sold for 13.5 € a tonne, and local communities have earned US\$ 600 000.</p>
Winrock International, Nepal	<p>Winrock adapts innovative approaches in natural resources management, clean energy, agriculture and leadership development. With more than 100 projects worldwide, Winrock provides individuals and communities with new ideas and technologies to increase long-term productivity, equity and responsible resource management. Their projects in clean energy promotion include:</p> <ul style="list-style-type: none"> • market uptake of efficient electric cooking in Nepal; • Nepal renewable energy programme; • assessment of readiness for widespread adoption of electric cooking in Nepal; • comparative analysis of economic activities and job creation associated with electrification by the NEA and community rural electrification entities; and • unlocking credit to promote use of commercial biogas in the poultry industry.

6.5 Bilateral and multilateral organizations

Name	Background
German Technical Cooperation	The German development agency considers that its core competence is capacity development. Under Sustainable Infrastructure, the projects and programmes being conducted are the Renewable Energy for Rural Areas programme; improving access to modern energy services in Nepal; and advisory services for energy efficiency. In the health sector, it advises national authorities on the design of health reforms and supports implementation in selected municipalities and provinces.
Japan International Cooperation Agency	The Agency is supporting a school and community health project to improve community health by disseminating health information to schoolchildren and school staff. It intends to improve health conditions in Nepal by extending support to basic health and medical service delivery. It also intends to improve planning and establishment of facilities for a stable power supply by improving the planning capability of the Ministry of Water Resources and the technical standards of the NEA to contribute to sustainable economic and industrial development and stable livelihoods. Projects underway in Nepal include a technical cooperation project in the hydropower sector for sustainable, stable development of the energy sector to contribute to achievement of SDG 7, "Ensure access to affordable, reliable, sustainable and modern energy for all".
Netherlands Development Assistance	Netherlands Development Assistance currently provides capacity development services to local organizations in three sectors: agriculture, energy and water, sanitation and hygiene. The services include advice, brokering and stakeholder engagement, advocacy, fund management, results-based financing and delegated management. Biogas Sector Partnership – Nepal was established to take over the responsibilities and liabilities of the Netherlands Development Assistance and to continue the biogas programme. An energy project in Nepal is EnDev-III Nepal to increase access to clean energy with pico-hydro and clean cooking technologies. In this project, 10–15 rural municipalities are being identified to collaborate in implementation and to strengthen their capacity to promote clean cooking technologies and pico-hydro schemes.
Norwegian Cooperation Agency	The Agency contributes to achievement of the SDGs in Nepal, focusing on education, clean energy and governance. With the Government of Nepal and the Asian Development Bank, the Agency supports projects to improve the transmission and distribution of infrastructure in Nepal to improve access to energy for the population and to import and export power. Projects for clean energy and environmental and economic development include: Energize Nepal and the South Asia sub-regional economic cooperation for strengthening power transmission and distribution systems.
United Kingdom Department for International Development	The Department's areas of work are in education, health, social services, water supply and sanitation, government and civil society, the economic sector (including infrastructure, production sectors and planning), environmental protection, research and humanitarian assistance. The Department assists communities in making appropriate demands for health services for equitable access and high-quality care. It assists Nepal's renewable energy sector through the Nepal Renewable Energy Programme, which was initiated in February 2019 and operates in provinces 2 and 5 and Karnali, in line with the decentralization of authority to subnational governments after federation, in coordination with the AEPC.

Name	Background
UNDP	UNDP is implementing six cross-cutting, multi-dimensional approaches, which they call “signature solutions”, to meet the aims of the strategic plan. The fifth solution, “Energy: Cleaner, affordable, renewable energy for everyone”, is to increase access to energy, promote use of renewable energy and improve energy efficiency that includes and responds to the needs of different sectors of the population (urban and rural, women and men, household and business), in line with SDG 7. The transition to clean, affordable energy will help countries to reduce the impacts of indoor and outdoor air pollution, particularly in rapidly developing urban areas. The UNDP project to provide renewable energy for rural livelihoods provides technical support to the AEPC to build off-grid infrastructure as part of the South Asia Sub-regional Economic Cooperation project funded by the Asian Development Bank.
United States Agency for International Development	The Agency has provided technical assistance, training, behaviour change and communication initiatives and logistics management for a number of national programmes, including family planning, community child health (Integrated Management of Childhood Illness), vitamin A, safe motherhood and female community volunteers. Within activities for maternal and child health, it supports interventions for community control and prevention of the primary causes of childhood deaths: acute respiratory infections, diarrhoeal diseases and vitamin A deficiency. The interventions are implemented collaboratively by both the public sector and NGOs. Support to female community health volunteers is an important component of the child health programme.
The World Bank	The World Bank supports countries that are most severely polluted by providing technical assistance on pollution management, knowledge generation and sharing and raising awareness about the impact on global health. In the past 12 years, the World Bank Group approved 534 activities relevant to pollution, representing approximately US\$ 43 billion in commitments. A recently approved project on the energy sector is providing additional financing for reforming the power sector and developing sustainable hydropower. The Bank has established a multi-donor trust fund for pollution management and environmental health to promote more systematic, effective responses to deadly, costly air pollution.
WHO	<p>WHO is building capacity in the country and the region to address HAP through direct consultations and workshops on household energy and health impacts. WHO also supports international initiatives to reduce air pollution and its health impacts, such as the Clean Cooking Alliance and the Climate Clean Air Coalition. A country cooperation strategy set up for 2018–2022 supports the Government in implementing WHO air quality guidelines.</p> <p>The WHO Country Office supports the Government technically and financially in a study on health impacts and an economic analysis of air pollution in Kathmandu Valley for the WHO Urban Health Initiative. The WHO also provides training and workshops on tools for addressing HAP, such as the “clean household energy solutions toolkit” (CHEST), “benefits of action to reduce household air pollution” (BAR-HAP), “air pollution risk” (Air Q+), “household air pollution interventions tool” (HAPIT) and “household multiple emission sources” (HOMES). It also organized a science policy dialogue on air pollution.</p>

6.6 Coordination mechanism

With so many stakeholders in various elements of household energy, air quality management and related health effects, from municipalities to central Government ministries, the private sector and international and NGOs, coordination is essential to

ensure that there are no gaps or overlaps in policy, activities and responsibilities. The Government sets policies, invests in programmes and monitors success; however, ensuring clean household energy and indoor air quality management are the

responsibility of various Government authorities, the Parliament and the judiciary. At present, there are inadequate links among road maps, strategies and medium- and short-term planning, financial allocation and monitoring, the development plan and the annual budget.

Furthermore, Nepal is still undertaking institutional reform since promulgation of a new Constitution in 2015 and elections for the three tiers of government (federal, provincial and local) and the responsibilities of different Government agencies are still uncertain.

Multi-stakeholder involvement in household energy management, advocacy and empowerment

is necessary for a clean energy environment. The AEPC is responsible for promoting clean household energy nationally through policies and research and for providing technical and financial support as necessary. The AEPC collaborates with local governments, cooperatives, community groups and the private sector to implement its programmes. The Department of Health Services and the Nepal Health Research Council conduct research on health and indoor air pollution, raise awareness about the health consequences of air pollution and ensure public health and safety, and the Department of Environment prepares emission standards and guidelines. Private sector organizations, NGOs, media and academia also play an important role.

Discussion

Representatives of 26 organizations working in the energy and health sectors were sent an unstructured questionnaire (Annex 3) by post, followed by a telephone call. Responses were received from

15 key informants in three organizations involved in both energy and health, nine involved only in the health sector and the remaining three only in the energy sector. The findings are presented below.

7.1 Challenges to adoption of clean household energy

Household energy is not recognized as a health issue.

The survey showed that consumers are unaware of the risks associated with using traditional cook stoves and solid fuels and the benefits of improved cook stoves and renewable energy, particularly in rural areas. Clean cooking solutions are often not prioritized by men in the household. There is a lack of effective communication between those promoting clean energy and local communities. Nepal has distinctive cooking practices, which are important to be considered and accounted for in presenting new technologies and fuels. Factors that play a role in communication include geographical context, gender, age, ethnicity and family etiquette. Qualitative research should be undertaken to understand people's perceptions and energy needs for a people-centred strategy and behaviour change initiatives.

Access to clean energy options is limited.

Clean options like LPG or electricity are not available in some regions or not at the quality, quantity and reliability required for cooking. Many people collect biomass or buy it daily, whereas clean fuels must be paid for in one large sum, making affordability the most important barrier to adoption of clean fuels for cooking. There is a lack of availability, affordability, and accessibility of clean energy

technologies on the demand side, and on the supply side, there is a lack of distribution, marketing and sales of clean cooking technologies.

Good-quality, regularly updated data and scientific evidence are lacking.

Information on cooking practices, HAP and health consequences is derived mainly from individual research projects, and there is limited understanding of trends and geographical variation in household energy use and of the health implications. The lack or poor quality of health records (e.g., no International Classification of Diseases codes in hospital records), limited resources and competing policies make it difficult for decision-makers to identify effective strategies to safeguard public health from HAP (57).

Institutional arrangements and coordination among sectors are inadequate.

Annex 4 presents an organigram of the current institutional framework of the Government. Cooperation among ministries, departments, institutions and organizations should be improved. The health sector is largely unaware of initiatives to promote clean cooking. Many institutions, such as provincial governments, municipalities, the AEPC and the Department of Environment, require proper institutional systems to manage household energy

and issues of air quality. Furthermore, many of the government, nongovernmental and private organizations involved in clean energy, air quality management and associated health effects lack the necessary financial and human resources to act effectively.

Policy-makers show lack of awareness of practical constraints.

Although the Government and many NGOs are promoting electric cooking, the survey showed, for example, that 61% of households in Kathmandu have only a 5-amp electricity supply, which is not sufficient for using electric stoves.

7.2 Opportunities for increasing access to clean household energy to benefit health

The Government and its development partners are aware of the risk of HAP and are interested in promoting electricity for cooking. Access to affordable modern energy for all (SDG 7) and energy security could be increased in a number of ways.

Take advantage of existing social programmes.

A number of social welfare programmes in Nepal target people living in poverty, disadvantaged populations, women and children. Female community health volunteers could support the uptake of clean cooking solutions. Similarly, conditional cash transfers would help to promote use of clean fuel by making it more affordable. The school food programme could provide an opportunity for parents to try new technologies and fuels while cooking children's meals.

Include the health sector in promoting a transition to clean fuels for cooking and heating.

Health professionals have respect and authority in communities and work in all regions for all people,

regardless of social status or ethnicity. They could therefore promote better cooking practices and support a transition to clean technologies and fuels. Several programmes have been launched to raise awareness and build the capacity of health professionals, the public and policy-makers. The health sector could play a key role in awareness-raising campaigns.

Promote electric and biogas cooking.

In the past decade, urban households have progressively been adopting a combination of electric cooking appliances, such as rice cookers, microwave ovens, electric pressure cookers, roti makers, electric kettles and electric cook stoves (induction, infrared, resistance). The Government has encouraged adoption of electric cooking by waiving custom duties on imported induction cook stoves (58), providing a 25% discount on electricity consumption of up to 150 kWh/month and waiving the fee for household consumption of less than 20 kWh/month (59). The Government has set targets of introducing induction stoves into 100 000 households in FY 2020–2021 and building 200 000 biogas cook stoves and 500 large biogas plants by the end of FY 2023–2024.

7.3 Implementation and facilitation of programmes to promote clean household energy

The AEPC coordinates the renewable energy sector with partners and stakeholders in periodic consultations and meetings, and the private sector, local finance sectors, NGOs and the media are beginning to be recognized as having key roles in bridging the fields of energy and health.

Many stakeholders must be involved in household energy management. The role of the federal Government is to create a conducive policy environment, allocate funds, develop a national plan of action, facilitate coordination of energy and health stakeholders and build connections with partners from external developmental organizations and the private sector. The role of provincial governments is to facilitate and support local government strategies for promotion and introduction of household energy, while local governments should formulate detailed plans for the promotion of household energy and generate local contextual evidence and solutions.

An integrated approach is necessary to promote clean cooking solutions, and the participation of the private sector should be encouraged so that clean cooking solutions reach every corner of the country. Coordination with stakeholders and the private sector is necessary to ensure the availability of logistics, raise awareness in communities, orient and mobilize communities and provide subsidies for people who use clean energy. Civil society can

play a key role in bringing together Government agencies, international and NGOs and the private sector to discuss and collectively find solutions to HAP issues in Nepal.

The key informant interviews indicated the importance of organizations concerning their efforts in implementing Government programmes to promote clean household energy and the following actions are important to consider:

- Coordinate awareness-raising campaigns by different levels of government.
- Encourage the energy and health sectors to collaborate on efforts to promote transition to clean household energy for health and on awareness raising campaigns.
- Conduct research on communication strategies to promote clean cooking technologies and fuels.
- Develop a set of enabling policies to make clean fuels more accessible and affordable, particularly to biomass users and other vulnerable populations.
- Take advantage of social programs already in place by integrating promotion of clean household energy in their mandates.
- Invest in skills development and capacity building.
- Provide technical knowledge and business mentoring to local entrepreneurs on the sale and distribution of clean cooking solutions and technologies.

7.4 Policy proposals for clean household energy

- Federal, provincial and local governments should come to a common understanding on implementation of a clean household energy programme, particularly for cooking.
- Local policies and plans should be prioritized.
- Innovation should be encouraged for the manufacture, fabrication, installation, after-sales service and price regulation for clean cooking solutions targeted to vulnerable and

disadvantaged communities, with strong support from the Ministry of Health.

- To ensure the affordability of clean household energy solutions, the Government should design appropriate financial tools and policies, such as provision of subsidies, grants and credits and reallocation of LPG subsidies.
- Maintaining a gender balance in terms of the target audience for clean cooking promotion and leadership of promotion efforts is essential.
- Opinion leaders should be mobilized to advocate for smoke-free households and promote clean cooking technologies.
- Campaigns should be conducted to raise awareness of the impact of HAP on health.
- Consumer choices of cooking fuels should be studied through research and modelling.
- Potential business models should be explored for successfully scaling up the clean cooking market.
- Governmental institutions, nongovernmental sectors, the private sector and research institutions should collaborate in promoting clean cooking technologies and controlling HAP.

Conclusions and suggested pathways forward

8.1 Conclusions

Most Nepali households use traditional cooking fuels, which pose health risks, accelerate climate change and put pressure on natural resources; however, limited access, preferences and socioeconomic and demographic factors have limited household energy choices. Furthermore, there is limited awareness and understanding of the consequences of HAP at all levels, from the public to policy-makers.

A coordinated effort by all relevant sectors of the Government and an appropriate institutional framework are necessary to address access to clean energy solutions and HAP comprehensively. Although the Government has enacted many policies and legal instruments to increase access to clean technologies and fuels, many of the policies require an adequate budget and should be tested in several scenarios.

Although the Government, NGOs, academia and bilateral and multilateral organizations are actively engaged in increasing access to clean energy, there is limited coordination.

A successful transition to electricity for cooking will require adequate generation capacity, transmission and distribution of electricity. The reliability and quality of the electricity supply and financial incentives will be necessary to encourage use.

Reduction of air pollution, especially HAP, by promoting clean energy is critical to attaining the SDGs and particularly SDG 3 on health and SDG 7 on energy. Development of the clean cook stove sector will contribute to fulfilment of the Government's global and national commitments.

8.2 Suggested pathways forward

General proposals

- Establish intersectoral working mechanisms within the Ministry of Health and Population that involve Government, academia and other stakeholders to monitor and generate data on household energy, HAP and surveillance and evaluation of health for a robust national household energy and health monitoring system.
- Emphasize health in strategies to reduce polluting household energy use, such as direct care pathways (linkage to other noncommunicable diseases) and demonstrating the benefits of clean cooking for health by linking types of household energy with health outcomes.

- Design appropriate surveys and foresee future scenarios, possibly using tools within the WHO Clean Household Energy Solutions Toolkit (CHEST) as a basis for action plans and targets.
- Improve health professionals' understanding of the health effects of household energy and empower them to "prescribe" clean household energy to safeguard health.

Infrastructure

- Update electricity infrastructure to allow an increase in per capita use of electricity, and improve the reliability and coverage of services.

Policy

- Adopt WHO air quality guidelines and tools to formulate relevant policies and targets.
- Review and upgrade current household energy-related policies.
- Formulate additional household energy policies with specific health targets.
- Enact policies to provide fuel subsidies to poor and marginal groups and those living in rural areas.
- Provide financial incentives, including exemption from customs duties and value added tax, to promote and increase access to clean fuels and technologies.

Awareness, communication and education

- Design communication and awareness-raising programmes for stakeholders and the public to change behaviour, in accordance with people's needs and perceptions.
- Increase capacity to promote clean household energy through campaigns, training of health professionals and providing information and raising awareness among policy-makers, practitioners and local populations.

-
- Develop integrated packages for marketing campaigns, including involving national champions on social media, and targeted messages to consumers.
- Provide training and orientation to local government representatives and officials on renewable energy, clean cooking and associated health and climate issues.

Monitoring and research

- Regularly monitor and conduct research on energy use and technologies and their health implications, including geographical, socio-economic, ethnic, cultural, gender and other dimensions.
- Conduct research on cooking practices, and model influencers of consumer choices of household fuels.
- Conduct a well-represented sampling survey of consumers as a basis for policies, plans and strategies, investigating choice of technology, the necessary incentives and willingness and ability to pay.

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Annex 1. Studies on clean household energy

The Government of Nepal and development partners conducted several studies on adoption and sustained use of clean fuels and technology for cooking, heating and lighting. Some of the institutions involved in the studies are: Modern Energy Cooking Services, AEPC, Practical Action, the Nepal Health Research Council, the Nepal Academy of Science and Technology, the Renewable and Sustainable Energy Laboratory at Kathmandu University, the Research Centre for Applied Science and Technology, the Centre for Energy Studies and

the Institute of Engineering at Tribhuvan University and the South Asian Network for Development and Environmental Economics. The main areas of study are technology development for improved cook stoves and fuel processing, health impact assessments of clean household energy interventions and policies and cost–benefit analyses for investment in clean household energy. In some studies, exposure to PM_{2.5} was measured in relation to type of cook stove (Table A1.1).

↓ **Table A1.1.** PM_{2.5} (µg/m³) concentrations measured in kitchens in various regions of Nepal and their relations to type of cook stove

Region	Mean PM _{2.5} (µg/m ³)	Type of fuel used for cooking	Device for monitoring PM _{2.5}	Reference
Janakpur	417.6	Biomass	TSI Dust Track II 8530	1
Bhaktapur	656	Biomass	PATS+	2
Bhaktapur	169	Kerosene	PATS+	2
Bhaktapur	101	LPG	PATS+	2
Bhaktapur	80	Electric	PATS+	2
Rural Nepal	455 ± 2.4	Biomass	AM510, Dust Track 8520	3
Urban Nepal	129 ± 2.7	Non-biomass	AM510, Dust Track 8520	3
Rural area of southern Nepal	1376	Traditional	Data RAM, PDR 1000, LASCAR CO	4

In another study, a 63.2% reduction in the average PM_{2.5} concentration was observed after 1 year of use of an improved cook stove (5). Similarly, introduction of proper mechanical hood ventilation

(with a fan) in kitchens significantly improved indoor air quality in terms of PM_{2.5} and CO concentrations (Fig.A1.1) (6).

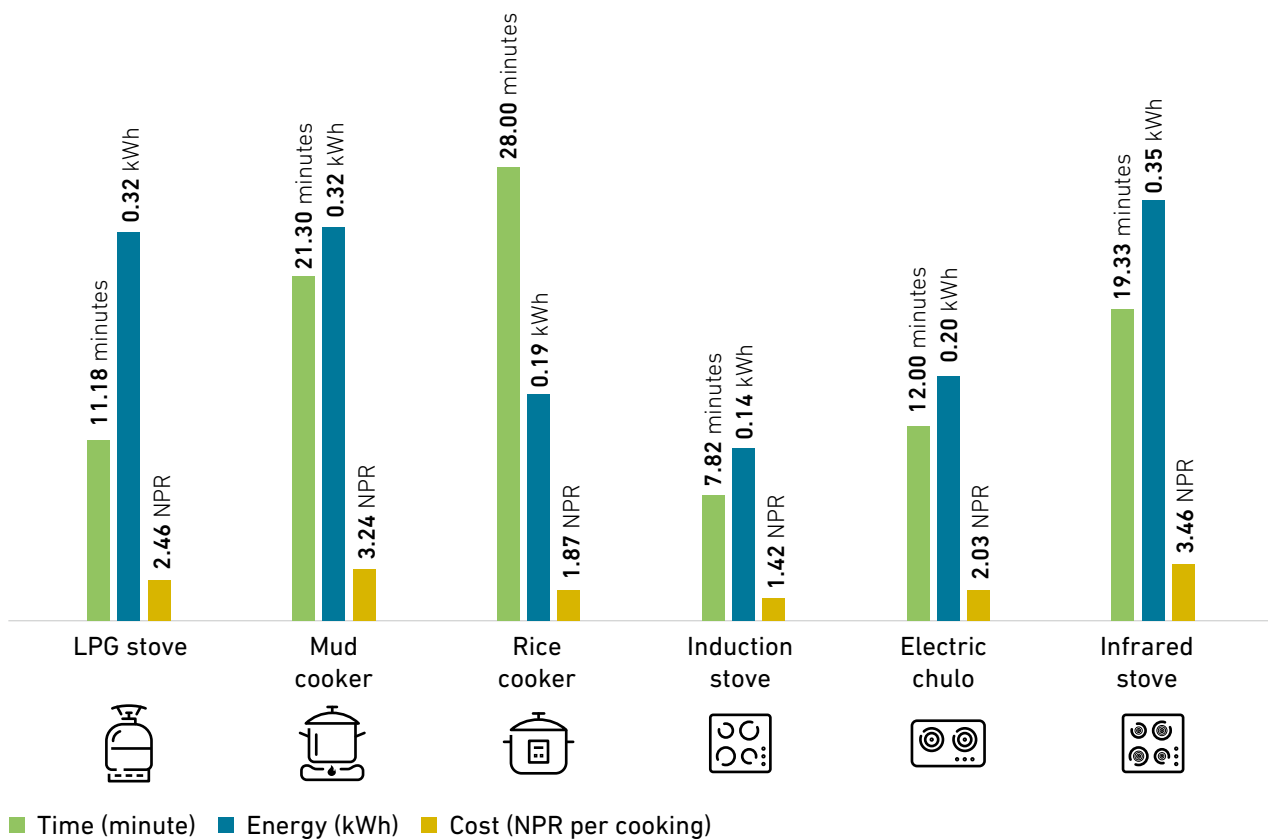


Source: reference 6

↑ **Fig. A1.1.** Set-up for a study on the effects of introducing a mechanical hood ventilation system on indoor air quality

A recent study on the time, energy and cost required for use of different types of cooking devices showed that electric induction cookers are

the most cost-effective and least time-consuming devices on the market (Fig. A1.2) (7).



Source: reference 7

Note: electric chulo in this study is with two cook stoves and based on infrared technology.

↑ **Fig. A1.2.** Cooking time, cost and energy consumption with different cookers

In a study on assessing the readiness for widespread adoption of electric cooking in Nepal (8), consumers who used less than 400 kWh/month reported that electric cooking is financially viable, as the electricity tariff depends on monthly consumption. For consumers who regularly consumed more than 400 kWh/month, however, it was still cheaper to use LPG for cooking. At about 60 kWh/month, the tariff becomes more expensive. Therefore, tariffs should be revised to make electric cooking affordable as compared with LPG in order to promote the use of electricity for cooking.

In a similar study, the cost–benefit of replacing LPG stoves with induction stoves was studied in rural areas of Kavre district (9). About two thirds of the households in the study would not benefit economically from adoption of electric induction stoves if no subsidy for electricity was provided. The amount of the subsidy would depend on baseline electricity consumption and the LPG usage of the household.

Switching of household cooking fuel from traditional biomass and petroleum products to hydroelectricity is essential for the sustainable future of Nepal. Switching entirely to hydroelectricity is, however, unrealistic because of inadequate generation capacity. This may be possible in the future with installation of additional hydropower, which has been started by the Government under the declaration of an “energy emergency” and new energy legislation (10).

The Clean Cooking Alliance is conducting a pilot campaign in Kavre district (east of Kathmandu) to change behaviour and promote clean cooking options and to accelerate demand for and use of clean cooking solutions. Such campaigns could be replicated in the other parts of the country, with preference to electric cooking, biogas and improved cook stoves. The factors that play a significant role in determining household energy choices in Nepal are accessibility, preferences and socioeconomic and demographic factors.

The Modern Energy Cooking Services programme is a 5-year programme funded by UK Aid. The current work of the programme in Nepal is the Electric Cooking Outreach project, which finances five field studies with Practical Action Nepal, Winrock, Irade and the People, Energy and Environment

Development Association. The objective of four of the regional studies is to document cooking practices and factors that would influence adoption of electric pressure cookers, while the fifth is a market assessment of electric cooking.

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Annex 2. Studies on the health effects of household air pollution

Little research has been conducted in Nepal on the health effects of household air pollution. Relevant studies on household energy, household air pollution and health effects are outlined in Table A2.1.

↓ **Table A2.1.** *Studies on the health effects of household air pollution*

Description	Reference
Analysis of data from Nepal Demographic Health Surveys showed that, despite a reduced prevalence of childhood pneumonia between 2006 and 2016, household air pollution remains a major cause of childhood pneumonia, which is an important cause of mortality in children under 5. The prevalence of childhood pneumonia could be reduced by 31% if kitchens are separated from living areas and by 40% if cleaner cooking fuels replace polluting fuels.	1
This study shows correlations between air pollution, cooking and COVID-19 infection. Household air pollution from cooking increases susceptibility to respiratory infections, which can contribute to higher mortality rates after infection with COVID-19. In addition, the current economic downturn or interruption of fuel supply chains may lead households to revert to firewood or other polluting cooking fuels.	2
The Household Multiple Emission Sources (HOMES) model and the Household Air Pollution Intervention Tool (HAPIT) indicate that a significant increase in electric cooking, supplemented by biogas, could reduce exposure to PM _{2.5} by more than half (116 µg/m ³ to 54 µg/m ³) and prevent 3745 deaths and 117 475 disability-adjusted life years associated with household air pollutants in Kathmandu Valley by 2030.	3
The study reports how women interpret the harm of air pollution from their experience. The results may be useful in designing locally appropriate solutions.	4
This cross-sectional study of secondary data from the 2011 Nepal Demographic Health Survey suggests a strong association between exposure to biomass fuel smoke and stunting among children under the age of 5.	5
The aim of this case-control study was to estimate the risk for lung cancer associated with exposure to household air pollution in Nepal. The findings suggest that long-term exposure to household air pollution from biomass is associated with an increased risk for lung cancer among people who have never smoked.	6
The review shows that household air pollution affects health at all stages of life, from pre-conception to old age. Furthermore, exposure <i>in utero</i> affects health throughout life. Exposure to household air pollution affects the respiratory system, which tends to garner the most attention, but it also affects the cardiovascular, endocrine and nervous systems. Household air pollutants have been implicated in various types of cancer.	7
Major predictors of PM _{2.5} concentrations in households were investigated with a device to monitor PM _{2.5} in 824 households in Bhaktapur, Nepal. The four primary cooking fuels used in these households were electricity (22%), LPG (29%), kerosene (23%) and biomass (26%). Use of biomass as a household fuel was found to be a risk factor for acute lower respiratory infection, and use of kerosene for cooking may also be a risk factor for acute lower respiratory infection in young children.	8

Description	Reference
A cross-sectional study was performed in a rural part of Nepal to identify the consequences of household air pollution among 157 housewives who had been cooking for more than 5 years. It was found that 87.3% of the population had health problems, including difficulty in breathing, tearing, dry cough, headache and productive cough, particularly among women who used unrefined biomass for cooking on traditional mud stoves.	9
Biomass combustion for cooking is associated with low birth weight, independently of gender, birth order, mother's literacy, living standards and type of care during pregnancy.	10, 11
The cross-sectional study supports previous evidence that the use of biomass cook stoves is associated with an increased risk of cataracts, specifically nuclear opacification. The study also suggests that kerosene use for cooking may be a risk factor for nuclear cataracts and nuclear colour.	12
This cross-sectional study was conducted in the central hilly region of Nepal, where 87% of the surveyed households used solid biomass fuel as a primary source of fuel, to estimate the burden of acute respiratory infection and pneumonia due to exposures from biomass fuel use. It was found that 1284 disability-adjusted life years were due to acute respiratory infection and pneumonia among children under 5, and 50% of disability-adjusted life years were attributed to household air pollution.	13
A cross-sectional study conducted in the mountainous region of Nepal found a significant relationship between exposure to poor-quality indoor air and respiratory disorders in both adults and children. Eight types of respiratory illness and symptoms were found in 67.7% of households: cough, otorhinolaryngological problems, phlegm, breathlessness, wheezing, bronchial asthma, ocular problems and chronic obstructive pulmonary disease.	14
A case-control study on the Nepal-India border provides clear evidence of a higher risk of cataracts in women who cook on unvented solid-fuel stoves than in those who use stoves fuelled by liquid fuel, gas or a vented solid-fuel stove.	15
A case-control study on tuberculosis in Pokhara, where cooking with biomass fuels in unvented indoor stoves is common, provides evidence that indoor use of biomass fuel, particularly as a source of heating, is associated with tuberculosis in women. It also provides evidence of an association between use of kerosene stoves and wick lamps with tuberculosis.	16

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*Boiling water on a traditional stove, Nepal
Credit: Adobe/Frederic Faure*

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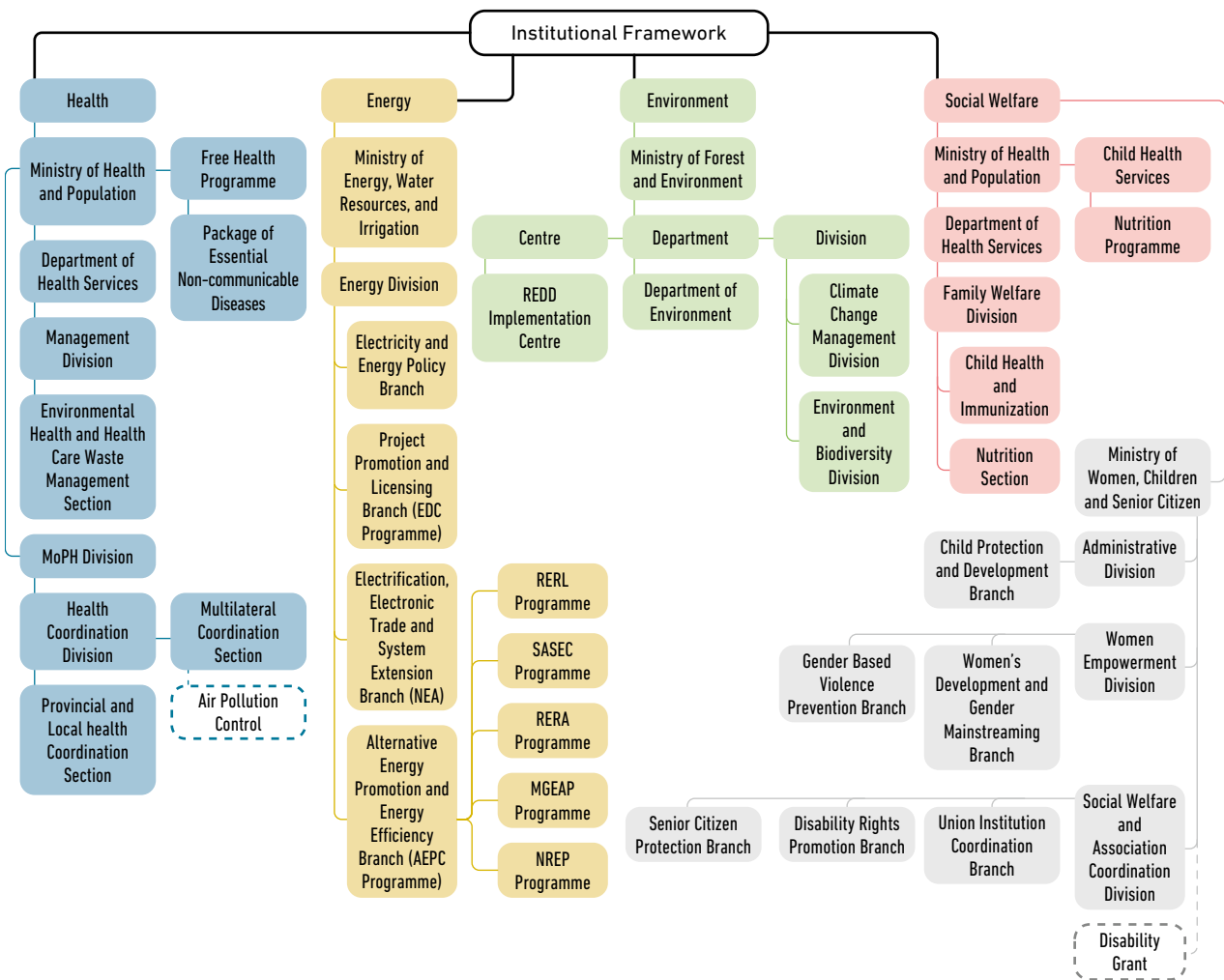
Annex 3. Sample questionnaire distributed to energy and health stakeholders

1. Brief information

Name of organization	
Name of a contact person	
Designation	
Address, telephone, fax, email, web address	
Type of organization (international or NGO, government organization, academic institution)	
Sector(s) involved (energy, health, others)	
Nature of involvement (awareness-raising, financing, research and development, manufacture, installation, operation and maintenance, other)	
Operation of programme or project; promotion	
Geographical coverage	

2. Is household energy perceived as an air pollution issue in Nepal?
3. Is air pollution seen as an issue that affects only urban areas in Nepal?
4. What is your opinion with regards to the current situation of health problems caused by household air pollution?
5. Has your organization or institution introduced or/and promoted any clean household energy solutions?
6. List the studies conducted by your institution related to clean household energy and health.
7. List the barriers and challenges in introducing clean cooking technologies from public health perspectives.
8. What in your opinion are the major gaps and constraints to attaining clean cooking for all?
9. Do you have any information about the programmes of the Government or international or NGOs for distributing clean appliances (such as for space heating, lighting or cooking)? If yes, please provide a brief description.
10. Is there a mechanism for coordinating governmental and nongovernmental actors in household energy, air pollution and health? If so, please provide information.
11. What are the roles of district, local, provincial and federal governments in promoting clean household energy?
12. What is the role of your organization in implementing or facilitating Government programmes for the promotion of clean household energy in Nepal?
13. Do you have any recommendations for policies on clean household energy and related health problems? Please list.

Annex 4. Organigram of institutional framework of the Government of Nepal



Source: reference 1

Abbreviations: AEPC: Alternative Energy Promotion Center; EDC: Energy Development Council; MGEAP: Mini Grid Energy Access Project; MoHP: Ministry of Health and Population; NEA: Nepal Electricity Authority; NREP: Nepal Renewable Energy Programme; REDD: reducing emissions from deforestation and forest degradation in developing countries; RERA: Renewable Energy for Rural Areas; RERL: Renewable Energy for Rural Livelihood; SASEC: South Asia Sub-regional Economic Cooperation

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