Government of Nepal
Ministry of Forests and Environment

Assessment of Electric Cooking Targets for Nepal's 2020 Nationally Determined Contributions (NDC)

March 2021

Government of Nepal
Ministry of Forests and Environment
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NDC PARTNERSHIP
CLIMATE ACTION ENHANCEMENT PACKAGE (CAEP)
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IMPACT
SCIENCE BASED IMPLEMENTATION OF 1.5°C COMPATIBLE CLIMATE ACTION FOR LDC AND SIDS

CLIMATE ANALYTICS

based on a decision of the German Bundestag

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Foreword

As one of the more vulnerable countries to the impacts of climate change, Nepal remains steadfast on the Paris Agreement commitment to maintain average global temperature rise at 1.5 degrees Celsius. The Ministry of Forests and Environment (MoFE) is exploring ways to reduce the present and future carbon footprint of the country. Among others, clean energy transition is one of the climate actions that MoFE is promoting to reduce greenhouse gas emissions.

Electric cooking (e-cooking) has been identified as a promising technology that not only contributes to climate change mitigation but also significantly reduces indoor air pollution and improves the health and economic well-being of Nepali citizens. Rural areas of Nepal depend largely on biomass like firewood as a source of fuel for cooking and heating. If this situation persists, it is highly likely to promote unsustainable consumption of firewood, thereby negatively affecting sustainable forest management practices. Additionally, the inefficient burning of such biomass also contributes to indoor air pollution which severely affects the health of the households. On the other hand, urban households of the country mostly depend on Liquefied Petroleum Gas (LPG) to meet their cooking requirements, which is imported into Nepal in large quantities. This fuel not only contributes to climate change but also increases the trade deficit of the country. Taking these factors into account, reducing dependency of both biomass and LPG by switching to e-cooking, is deemed important for the social, environmental and economic prosperity of Nepal.

As a Party to the Paris Agreement, Nepal communicated its 2020 NDC to the United Nations Framework Convention on Climate Change (UNFCCC) Secretariat on December 8, 2020. This report, based on review of existing policies and markets, and consultations with state and non-state stakeholders, helped inform Nepal's 2020 NDC targets on clean cooking as well as the corresponding reductions in national greenhouse gas emissions. Additionally, this report also offers recommendations to meet the 2020 NDC targets. Finally, this report also acts as a valuable knowledge product that documents the development of the 2020 NDC's clean cooking targets for future reference.

On behalf of MoFE, I would like to express my sincere thanks to all those who were involved in the development of this report.

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Clean energy is regarded as an important instrument for achieving the Sustainable Development Goals because of its contribution in decreasing GHG emissions as well as air pollution. The Government of Nepal (GoN) has therefore been promoting clean cooking, including electric cooking, through various programs over the last few decades.

An assessment was commissioned by the GoN to define the clean cooking targets of the 2020 Nationally Determined Contributions (NDC), as well as calculate the reductions in GHG emissions through the implementation of these targets.

Various individuals and organization contributed to this study. On behalf of Ministry of Forests and Environment (MoFE), I would like to thank the German Federal Ministry for the Environment, Nature Conservation Building and Nuclear Safety for supporting this study through the IMPACT Project, as well as the support of NDC Partnership through the Climate Action Enhancement Package (CAEP).

I would also like to express my gratitude to team members at CCMD, particularly Mr. Raju Sapkota, Dr. Keshab Goutam, Mr. Hari Krishna Laudari and Ms. Shreejana Bhushal for their help in reviewing the report.

Further, I would like to thank Climate Analytics for conducting this assessment. My sincere thanks to consultant Mr. Subarna Prasad Kapali, Ms. Eriko Shrestha, Ms. Sneha Pandey, Mr. Manjeet Dhakal, Ms. Rachel Pham, and Dr. Jan Sindt from Climate Analytics for preparing this report. Additionally, I would like to thank Mr. Abhishek Yadav of NDC Partnership for his important contributions to the document as well.

I acknowledge National Planning Commission (NPC); Ministry of Energy, Water Resources and Irrigation (MoEWRI); Alternative Energy Promotion Center (AEPC); Nepal Electricity Regulatory Commission (NERC); Water and Energy Commission Secretariat (WECS) for their feedback and input. I would also like to thank The World Bank; Practical Action; UNDP-Nepal; Winrock International; GIZ/EnDev; DAI/NREP; Clean Cooking Alliance; Clean Energy Nepal; SNV Nepal; National Association of Community Electricity Users-Nepal (NACEUN); Society for Legal and Environmental Analysis and Development Research (LEADERS Nepal); and the Center for Energy Studies (CES) at Tribhuvan University for their invaluable inputs. I also appriciate Ajummery Bikas Foundation; Chaudhary Group (CG); and Husk Power Pvt. Ltd for their feedback in this document.

Finally, I am indebted to all reviewers and experts who helped to shape the document.

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Acronyms

AEPC	Alternative Energy Promotion Centre
A	Ampere
BAU	Business As Usual
BMU	Federal Ministry of the Environment, Nature Conservation and Nuclear Safety (Germany)
CAEP	Climate Action Enhancement Package
CBS	Central Bureau of Statistics
CCA	Clean Cooking Alliance
CCS4ALL	Clean Cooking Solutions for All
CO_2	Carbon Dioxide
COVID-19	Coronavirus Disease 2019
E-cooking	Electric cooking
ERC	Electricity Regulatory Commission
FY	Fiscal Year
GCF	Green Climate Fund
GDP	Gross Domestic Product
$GgCO_2e$	Gigagrams of CO_2 equivalent
GHG	Greenhouse Gas
GoN	Government of Nepal
GWh	Gigawatt Hours
ICS T2	Improved Cookstoves Ranked Tier 2
ICS T3+	Improved Cookstoves Ranked Tier 3 or Above
IKI	International Climate Initiative
IPP	Independent Power Producers
kL	Kilolitres
kV	Kilovolt
kW	Kilowatt
kWh	Kilowatt-hour
LEAP	Low Emissions Analysis Platform

LPG	Liquefied Petroleum Gas
MoEWRI	Ministry of Energy, Water Resources and Irrigation
MoFE	Ministry of Forests and Environment
MT	Metric tons
MToE	Million Tonnes of Oil Equivalent
MVA	Mega volt ampere
MW	Megawatt
NACEUN	National Association of Community Electricity Users-Nepal
NDC	Nationally Determined Contributions
NDC-P	NDC Partnership
NEA	Nepal Electricity Authority
NOC	Nepal Oil Corporation
NPC	National Planning Commission
PV	Photovoltaics
SDG	Sustainable Development Goals
SEforALL	Sustainable Energy for All
TCS	Traditional Cookstoves
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollar
WECS	Water and Energy Commission Secretariat

About the Study

Nepal, a least developed country, produces very low levels of greenhouse gas (GHG) emissions. As a Party to the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement, Nepal pursues and supports efforts to limit average global temperature rise to 1.5°C above pre-industrial levels. In 2016, Nepal submitted its first Nationally Determined Contributions (NDC) to the UNFCCC, outlining various targets for 2020 in the short-term and for 2050 in the long-run. Among other targets in the 2016 NDC, Nepal aimed to reduce dependency on biomass by scaling up renewable energy and promoting fuel-efficient biomass or biogas cookstoves. In 2020, the Ministry of Forests and Environment (MoFE) revised Nepal's NDC focusing on the timeframe of 2020 to 2030 and updated its targets on cooking fuels.

Through analysis of national policies, markets, technologies and electricity availability, and through numerous expert and stakeholder consultations (see Annex I), this report was prepared to help inform Nepal's 2020 NDC targets on electric cooking. Additionally, this assessment also helps inform NDC implementation by recognizing crucial gaps in Nepal's policy, markets and energy sector and identifying solutions to meet them.

Chapter 1 and 2 give a brief background regarding the status of cooking technologies and electricity supply in Nepal and discuss the current socio-economic context of the country. Chapter 3 identifies federal and provincial policies and strategies related to e-cooking. Chapter 4 outlines the initiatives taken by the Government of Nepal (GoN), development partners, civil society and private sector to promote e-cooking in the country. Chapter 5 discusses the current trends of electricity demand, transmission and distribution, and clean cooking appliances adoption. Chapter 6 identifies challenges and opportunities for e-cooking promotion. Chapter 7 presents the Business As Usual (BAU) Scenario and the Ambitious E-Cooking Scenario, both of which informed the 2020 NDC. The Ambitious E-Cooking Scenario informed the 2020 NDC targets on cooking technologies while the BAU Scenario provided a basis for comparison. These scenarios were designed taking the policy and trend analysis presented in this report into account, as well as the recommendations of numerous experts (see Annex I), the GoN-appointed NDC Working Group, and other line ministries and government agencies. The 2020 to 2030 trend projections on cooking technology adoption and GHG emissions under these two scenarios were developed using the LEAP (The Low Emissions Analysis Platform) modeling software. While this report presents the results of this LEAP analysis, the accompanying Nepal Mitigation Assessment Report (2021) describes the LEAP methodology in more detail. Finally, Chapter 8 provides recommendations to meet the 2020 NDC targets.

To support MoFE in Nepal's 2020 NDC revision process, Climate Analytics has provided technical services, including this e-cooking sectoral assessment, through the IMPACT project with financial support from the German BMU and IKI cluster, as well as through the NDC Partnership's Climate Action Enhancement Package (CAEP) initiative.

1. Background

In Nepal, a majority (52.4%) of the population still depend on solid biomass for cooking (CBS, 2017). About one-third (33.1%) of the population use Liquefied Petroleum Gas (LPG) as cooking fuel as shown in **Figure 1** below. The use of firewood is more prevalent in rural areas (65.8%) compared to the urban areas (35.4%). More than half (54.1%) of urban households use LPG for cooking while only 16.5% of rural households use LPG. In 2015/16, the proportion of the urban population using electricity for cooking was 37.9%, which stood at 33% in the previous year (CBS, 2016). The practice of electric cooking (e-cooking) is gradually increasing in recent years, particularly after the mega earthquake and energy crisis in 2015[1].

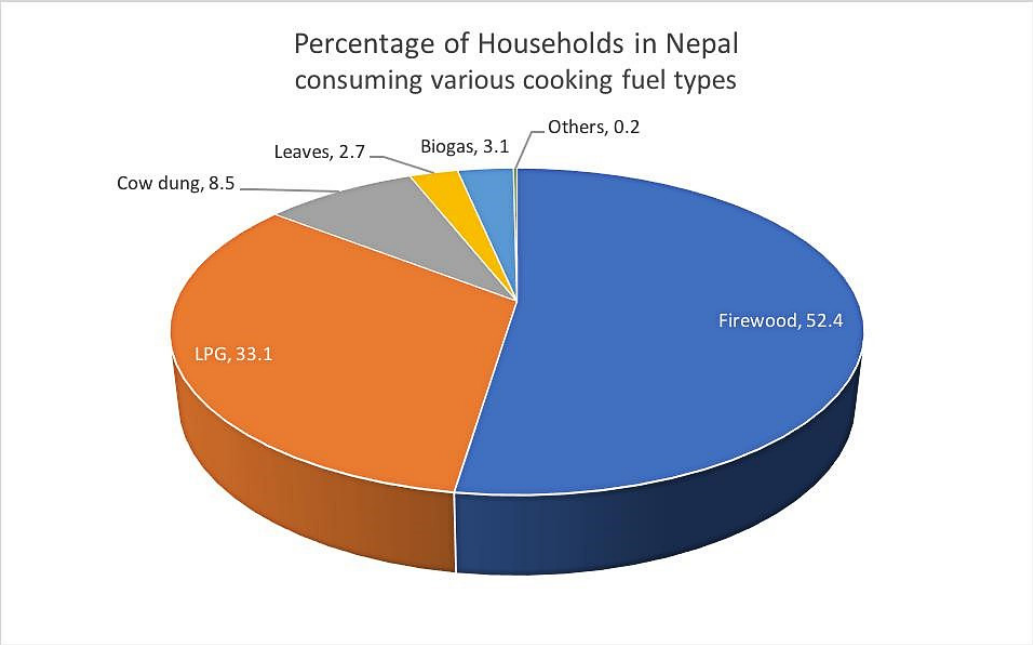

Figure 1. Percentage share of households using various cooking fuel

Source: (CBS, 2017)

There is growing political commitment and interest among policy makers, civil society and development partners to replace traditional cooking fuels with cleaner cooking options such as highly efficient biomass cookstoves, as well as biogas and electric cookstoves. Despite being the cleanest option, e-cooking was not considered a priority in programmes such as those implemented by Alternative Energy Promotion Centre (AEPC) under the Energy Sector Assistance Programme and the National Rural and Renewable Energy Programme. In contrast to past efforts which focused on technologies/devices that could more efficiently combust solid biomass, however, new opportunities are being created for the promotion of modern clean cooking fuels such as electricity, biogas and compressed biomass pellets/ briquettes. As of mid-2019, 425,511 household biogas systems, 247 institutional and community biogas plants, 1,423,242 mud improved cookstoves, and 85,805 metallic improved cookstoves have been installed (AEPC, 2019).

1 To meet its domestic needs, Nepal imports all petroleum products, including LPG, from India. The undeclared economic and transit embargo imposed by India, which began on 23rd September 2015 and lasted for over two months, sharply curtailed the supply of these petroleum products, including LPG, in Nepal. Nepali households reliant on LPG for cooking switched to firewood or electric cookstoves.

The quality and reliability of the electricity supply has greatly improved in recent years, which is a pre-condition for adopting e-cooking. Electricity production in Nepal is expected to increase significantly in the upcoming years. Nepal has several hydropower projects in pipeline, which are expected to be completed in the imminent future (such as the national priority project, Upper Tamakoshi Hydroelectric Project with the installed capacity of 456 MW). There are also several ongoing and planned projects on extension and improvement of the electricity transmission and distribution systems.

The country has political aspiration for e-cooking as it could significantly help ease the trade-deficit burden (Chitrakar, 2019) (Nakarmi, 2019). Moreover, several studies have established that cooking on efficient electric appliance (such as induction cookstove) is cheaper than cooking on traditional cookstoves (TCS) and LPG cookstoves (CCA, 2019) (Koirala, 2019) (Nakarmi, 2019).

Indoor air pollution is one of the largest health risks in Nepal. Smoke from cookstoves that utilize biomass fuels (firewood, cattle dung, or agricultural waste) can cause a range of chronic and acute health effects with deadly impacts, such as child pneumonia, lung cancer and chronic obstructive pulmonary and heart diseases. A World Health Organization study found that approximately 7,500 premature annual deaths occur in Nepal due to indoor air pollution (World Bank, 2014). Switching to more efficient cookstoves, as well as fuel sources such as biogas or electricity, has the benefit of reducing pollution-related illnesses as well as reducing deforestation. There is a significant market for biomass-efficient cookstoves transition, with approximately 3.75 million households potentially available to switch to improved biomass cookstoves in the short term, and some 800,000 households to switch to domestic biogas. TCS have an efficiency of less than 10%; whereas improved biomass cookstoves have efficiencies of greater than 25% and pose less of a threat to the environment.

2. Socio-Economic Status

Demography

By 2030, the population of Nepal is projected to cross the 33 million mark (CBS, 2018). The average household contains 4.5 persons with 4.3 in urban and 4.7 in rural areas. The proportion of population in the working-age group of 15-59 years is 60.5% (CBS, 2017).

Literacy

The overall literacy rate is 68.3% for the population of age 5 years and above. There is a wide gap in male (76.8%) and the female (60.5%) literacy rates. Similarly, the urban-rural difference in literacy is found noticeable with 73.8% in urban and 64.3% in rural (CBS, 2017).

GDP

After the enactment of the new Constitution of Nepal 2015, the Gross Domestic Product (GDP) has increased steadily and remained high compared to the period before 2015.

During the constitution formulation period from 2008 to 2015, the political situation was volatile and the GDP growth rate remained low between 2.97% to 5.72%. The FY 2015/16 saw the lowest growth rate of 0.2% due to the adverse impact of the mega earthquake and the energy crisis. The GDP (at basic prices) growth rate stood at 6.99% in 2018/19 (CBS, 2020). As almost all the sectors of Nepal's economy have been hit by COVID-19 pandemic, it is expected that the GDP for next few years will remain below average. According to the forecast by CBS, GDP is expected to fall to 2.27% in 2020/21 due to COVID-19 (CBS, 2020).

The 25 year vision set in the 15th Five-Year Plan (2019/20-2023/24) expects a steady growth of GDP during this period, achieving a 10.3% growth rate in 2024, and thereafter maintaining a 10.5% growth rate in the remaining years.[2] The ambitious macroeconomic targets set in the 15th Five-Year Plan are expected to guide Nepal into the developing country status by 2023.

Employment, Income and Poverty

The present unemployment rate in Nepal is 11.4%. The per capita income of the country was USD 1,047 in FY 2018/19, which has since increased to USD 1,085 in FY 2019/20 (MoF, 2020). Nepal's poverty is gradually decreasing: the population living under absolute poverty line has decreased from 25.2% in FY 2011/12 (MoF, 2012) to 16.67% in FY 2019/20 (MoF, 2020). Unemployment has also decreased to 16.67% in FY 2019/20 (MoF, 2020). It is expected that the employment sector will be negatively impacted by the COVID-19 pandemic, and the return of Nepali workers, mainly from Gulf countries, is projected to cause a 20% decline of remittances (CBS, 2020).

3. Policy Priorities and Strategies: Enabling Environment for E-Cooking

The existing policy interventions on energy are geared towards ensuring national energy self-sufficiency and energy access to all. Nepal has more than five decades of experience in renewable energy development. Renewable energy and clean cooking received policy prominence around two decades ago in the country.

3.1 The Constitution of Nepal 2015

With the enactment of the Constitution of Nepal 2015 on 20th September 2015, Nepal entered federalism with three levels of governance, namely, federal, provincial and local. Nepal has 7 provinces, 6 metropolitan cities, 11 sub-metropolitan cities, 276 municipalities and 460 rural municipalities make up the local government. The federal, provincial and local level governments can make decisions, enact laws, prepare and implement policies, and prepare plans and annual budgets within their areas of authority.

2 Contrary to this vision, the COVID-19 pandemic is expected to adversely impact the economy with substantially slower growth rates for the coming years. The extent of the impacts remains unclear, however.

The Constitution in its Directive Principles has given priority to national investment in water resources and renewable energy. The Directive Principles emphasize people's participation and multi-utility development of water resources including hydropower. Furthermore, it highlights the State's role in pursuing a policy of developing and producing renewable energy; ensuring a cheap, easily available and dependable supply of energy; and ensuring appropriate usage to meet the basic needs of the citizens (GoN, 2015).

As per the Constitution (Schedule 8), the development of alternative (renewable) energy falls under the jurisdiction of the local government. Likewise, the provincial level electricity development falls under the jurisdiction of the provincial government (Schedule 6). Electricity is also a concurrent jurisdictional issue for all three levels of government (Schedule 9). Local governments can formulate local level policies, laws, standards and regulations relating to renewable energy. They are responsible for project planning, implementation, technology development, technology transfer, capacity building as well as promotion at the local level.

Government jurisdiction on different renewable energy-related projects

Provincial Government	Local Government	Concurrent (Federal, Provincial and Local)
Schedule 6: no.7 Provincial level electricity, irrigation projects, drinking water, transport	Schedule 8: no.19 Drinking water, small electricity projects, alternative energy	Schedule 9: no.5 Services like electricity, drinking water, irrigation

3.2 Power Sector Policies

Various policies and legal instruments are in place guiding and regulating Nepal's hydropower dominated power sector. The power sector is transitioning to accommodate more private sector players in generation and distribution of electricity with high emphasis being placed on universal access of electricity for all citizens. A single national grid system is the backbone for distributing electricity to the population. Rural electrification through grid extension as well as through the installation of off-grid micro-hydro and solar systems, including solar and wind hybrid systems, has received high prominence in policies and plans.

The Nepal Electricity Authority (NEA), established as an autonomous corporate body under the **Nepal Electricity Authority Act 1984**, is the principal institution responsible for generating, transmitting, and distributing electricity in an efficient, reliable and convenient manner (GoN, 1984). As the owner and manager of Integrated Nepal Power System (the grid), NEA was also mandated to determine electricity fees and other electricity related service charges.

The **Hydropower Development Policy 2001**, which is a revision of the first Hydropower Development Policy (1992), remains in effect till today, and deals with electricity infrastructure aspects, such as power markets, transmission and distribution, and demand management. It emphasizes regular, reliable and sustainable power supply at a reasonable price and low-cost generation, ties up electrification to economic activities and views electricity as an exportable commodity.

A new draft of **Electricity Bill 2019** is under discussion currently which envisages a multi-actor market for electricity, proposes de-bundling of the NEA and provides space for private sector not only in generation but also in management of localised distribution systems. However, the transmission system (the national grid) and electricity planning will be the responsibility of dedicated government institutions. Quality and safety of supply is emphasized and both domestic and cross-border electricity trade are elaborated. This act is expected to bring about a paradigm shift in the electricity market in the country.

In the meantime, the GoN has enacted the **Electricity Regulatory Commission Act 2017**. As per the Act, an Electricity Regulatory Commission (ERC) has been created, which is mandated to regulate the market system of generation, transmission, distribution and trading of electricity (as envisaged by the 2019 electricity bill). It also sets an electricity tariff that ensures consumer welfare by creating a competitive environment.

3.3 Renewable Energy Policies

The renewable energy-related policies discussed in this section have provided a thrust for the promotion of renewable energy technologies, particularly for lighting and cooking in off-grid areas. Together, these policies identify community engagement, private sector participation, credit financing through commercial banks, and micro-financing as important factors to promote renewable energy. These policies envision improved biomass cookstoves, biogas and solar cooking as clean cooking options. While the policies do not mention e-cooking, they still guide the promotion of e-cooking technologies in Nepal currently.

The **Rural Energy Policy 2006** aimed to ensure access to clean, reliable and appropriate energy in rural areas contributing to rural poverty reduction and environmental conservation. The policy emphasized reducing dependency on traditional energy and conserving the environment by increasing access to clean and cost-effective energy in rural areas. The policy has identified various renewable energy technologies (RETs) to be promoted including household biogas digesters and improved biomass cookstoves as cooking options. The policy provided guidance on technology development and subsidy provision related to biogas, and additionally emphasized the importance of research and development, as well as awareness-raising to increase household and institutional adoption of improved biomass cookstoves (MoE, 2006).

The **Renewable Energy Subsidy Policy 2016**, currently in effect, is the latest revision of the Renewable Energy Subsidy Policy 2013, which was a reformulation of the subsidy provision first promulgated in 2000 and subsequently revised in 2006 and 2008. The Subsidy Policy 2016 aims to achieve universal access to clean, reliable and affordable renewable energy solutions by 2030. The policy aims to reduce dependence on traditional and imported energy by increasing access to renewable energy. It presents renewable energy as an option to improve the livelihoods of people and create employment opportunities, especially in the rural areas. The policy has stipulated subsidy amounts for various renewable energy options, including for portable metallic biomass rocket cookstoves and the amount of credit that should be mobilised. The policy has set special subsidy for earthquake-affected households. The policy also seeks to encourage public-private sector participation to help reduce private sector's investment risks and to mobilise commercial credit (MoPE, 2016).

The **Subsidy Delivery Mechanism for Renewable Energy 2016** describes the modality for disbursing subsidy as provisioned in the Subsidy Policy 2016. The Delivery Mechanism emphasises system optimization through high quality of products (i.e. renewable energy system components) assured through testing by accredited institutions, reliability of supply through mobilization of competent companies and operationalization of the government public procurement legislation (AEPC, 2016).

The **Nepal Interim Benchmark for Solid Biomass Cookstoves** is the first to set a technical standard and protocol for testing performance and safety of solid biomass cookstoves. The major parameters defining the performance include thermal efficiency and emissions of $PM_{2.5}$ and carbon monoxide (AEPC, 2016a). The standard has defined criteria to rank cookstoves into five different tiers, such that the higher tier denotes cleaner cooking.

The **Biomass Energy Strategy 2017** envisions promoting biomass energy as a reliable, affordable and sustainable energy resource to address the increasing energy demand of Nepal. It aims to promote clean cooking technologies of at least tier 3 to all households by 2030. The Strategy in its mission statement has emphasized modernizing the use of biomass energy through market development. One of the elaborated working principles (Article 9.3.3) emphasizes on developing appropriate system and market for commercialization of biomass energy, and ensuring the sales and distribution of the produced biomass energy (MoPE, 2017).

The **National Energy Efficiency Strategy 2018** is the first of its kind policy document that envisions building energy security through efficient use and distribution of available energy. It has set a long-term goal to double the energy efficiency from 0.84% per year, which existed during the period of 2000-2015, to 1.68% per year in 2030. The strategy aims to maintain environmental balance and bring positive improvements in health through efficient use of energy. Among others, the working principles of the strategy also focus on developing minimum energy performance standards for electrical and mechanical equipment being used in various sectors (MoEWRI, 2018 a). The scope of the principle includes clean cooking as well.

The Nepal Council for Standards endorsed **Electric Cooktop Standards 2018,** which sets technical standards for household induction hobs and hotplates. Of the four interlinked standards endorsed, the general safety standard (NS 564) deals with the safety of electrical appliances for household and similar purposes. The particular standards (NS 561 and NS 562) deals with electrical safety of induction cooktop and electric hotplates respectively. The fourth standard (NS 563) has set the performance values and described methods for measuring the performance of induction hobs for household use.

3.4 The Energy White Paper of MoEWRI

In May 2018, the Ministry of Energy, Water Resources and Irrigation (MoEWRI) released the "Present Situation and Future Roadmap of Energy, Water Resources and Irrigation Sector (White Paper)", which provides policy directions and sets physical targets for the energy sector.

The Energy White Paper is the first policy paper that has explicitly provided guidance for the promotion of e-cooking in every household. As a result, e-cooking has received prominence in subsequently formulated 15th Five-Year Plan and in AEPC's activity plan.

The Energy White Paper has emphasized improvement in policy regime through development and promulgation of Integrated National Water Resources Policy and revision of Electricity Act and NEA Act. The Electricity Regulatory Commission Act 2074 is already in place and the ERC is functional.

The Energy White Paper also provides impetus to develop and implement the River Basin and User Master Plan, and the Province Distribution Master Plan. Through these, in addition to modernizing the electricity distribution system, projects emphasizing renewable energy and energy efficiency will also be implemented to mobilize international and domestic carbon financing.

The Energy White Paper has formulated several campaigns to ensure provision of energy services to all including 'Every Household, Energy Household', 'Every Settlement, Energy Settlement', and 'Electric Stove in Every Household'.

The Energy White Paper (2018) has set some ambitious targets as follows:

Within Year 3	• Additional 3,000 MW capacity will be installed • Country will be self-sufficient in terms of electricity • For management and utilization of water resources river basin plan and other useful schemes will be developed
Within Year 5	• Additional 5,000 MW capacity will be installed • Transmission and distribution lines will be developed to ensure all households have access to electricity. Where central grid access is not possible, micro-hydro, solar and wind energy systems with battery storage will be used • Per capita electricity consumption will reach 700 kWh
Within Year 10	• Additional 10,000 MW capacity will be installed • Per capita electricity consumption will reach 1500 kWh

3.5 Federal Periodic Plans

Federal level plans that currently have the most relevance for the clean cooking sector include the 15th Five-Year Plan (2019/20-2023/24) and Clean Cooking Solution For All by 2017 (CCS4ALL).

The **15th Five-Year Plan** sets a plan for five years starting from FY 2019/20 to FY 2023/24 and presents the 25-year long-term vision of the GoN to achieve "Prosperous Nepal, Happy Nepali". One of the key aspects of prosperity, as defined in the Plan, includes 'Accessible modern infrastructure and intensive connectivity'. 'Increase in hydropower and promotion of green economy' is considered an important factor for transformation in this plan.

The 15th Five-Year Plan has a strategic focus on attracting domestic and foreign investment on hydropower generation, extending and improving transmission lines for the reliable supply of electricity, increasing energy efficiency and access to electricity, diversifying energy mix and bolstering energy security, and strengthening institutional mechanisms. On hydropower development, the plan aims to prepare and implement an electricity distribution master

plan focusing on scaling-up energy development and increasing electricity consumption. The plan has a working policy to extend rural electrification through community participation and to set appropriate tariff to encourage e-cooking. The plan further aims to formulate renewable energy strategy and action plan.

Guided by the policy direction provided in the Energy White Paper, the 15th Five-Year Plan has formulated strategic actions to promote e-cooking through interventions on electricity tariff and development of e-cooking standards. Along with e-cooking, the plan also envisions the promotion of improved biomass cookstoves. In line with the constitutional provision, the plan aims to capacitate and assist local governments for mobilization of resources for energy development. It also aims to establish institutional structures such as the Province Energy Fund and Local Energy Fund, and provide privileged interest rates on credit for renewable energy investments.

The major electricity-related target in the 15th Five-Year Plan is generation of more than 5,000 MW of electricity, provide electricity access to the entire population, and increase per capita electricity consumption to 700 kWh by 2023/24.

The Prime Minister of Nepal announced the **"Clean Cooking Solution For All by 2017 (CCS4ALL)"** in January 2013. The ambitious CCS4ALL has become the guiding strategy for developing subsequent policies and plans on clean cooking. While CCS4ALL did not include e-cooking as a clean cooking option to promote, mostly focusing on biogas, efficient biomass cookstoves and briquette/pellets, it still provides clean cooking aspiration for the upcoming decade.

3.6 Provincial Periodic Plans and Annual Budgets

The Provincial Periodic Plans (2019/20-2023/24), prepared for the first time by provincial governments, are focused on increasing access to electricity. This section accesses the clean energy related targets in these periodic plans as well as the Provincial Budgets for the FY 2019/20.

Table 1. Targets of provincial periodic plans (2019/20-2023/24) and annual budgets (2019/20)

Province	Targets
Province 1	• By 2024, ensure electricity access to all households • By 2024, ensure 1500 MW electricity generation through hydropower • By 2024, produce 2 MW electricity from small micro-hydro, 2 MW from small solar energy, 1 MW from wind energy • By 2024 produce 200 MW electricity from solar energy • By 2024, install biogas plants in 20,000 household • By 2024, replace LPG cookstoves with e-cooking stoves • By FY 2019/20, ensure subsidy provision for households interested in purchasing solar panels
Province 2	• By 2024, connect at least 2 MW of solar power to the grid through private and local level cooperation and 10 MW from the provincial level • By 2024, promote multifunctional technologies of renewable energy and replace cow dung used for cooking with clean energy
Bagmati Province	• By FY 2019/20, develop rural electrification program and renewable energy program to provide electricity and clean energy technology to households so that the federal government can successfully operate the 'Bright Nepal' campaign.

Province	Targets
Gandaki Province	• By 2024, increase installed capacity of hydropower to 3,000 MW
Lumbini Province	• Promote commercial biogas, briquette and biodiesel • By 2024, increase installed capacity of hydropower to 150 MW • By 2024, increase installed capacity of solar photovoltaics (PV) systems to 300 MW • By 2024, ensure that at least 10 industries will produce commercial biogas
Karnali Province	• By 2024, increase installed capacity of hydropower to 200 MW
Sudurpaschim Province	• Electrify communities yet unserved by grid through solar PV systems • Identify and develop hydropower projects

3.7 Sustainable Energy For All & Sustainable Development Goals

The international framework of Sustainable Energy for All (SEforALL) and Sustainable Development Goals (SDG) have provided long-term vision and goals for energy sector development. Nepal has aligned its periodic plan and long-term visions with these initiatives.

In 2013, the National Planning Commission (NPC) released the report 'Nepal: Rapid Assessment and Gap Analysis' which served as a basis for the formulation of Nepal's SEforALL Action Plan. The document proposed various targets which have been considered the SEforALL targets for Nepal as shown in **Table 2** below.

Table 2. SEforALL targets

Targets	2020	2025	2030
Reduce the proportion of the population that use solid fuels	50.4%	30.2%	10%
Increase access to electricity	83.4%	86.5%	99%
Improve universal use of high-efficiency appliances			100%

Source: (NPC, 2013)

In the report 'Nepal's SDG Status and Roadmap: 2016-2030', NPC updated national SDG indicators to align with global ones[3]. SDG 7 concerning the universal access of affordable, reliable, sustainable and modern energy is key to e-cooking promotion. The targets for several SDG 7 indicators are outlined in **Table 3** below.

Table 3. SDG 7 Indicators and Nepal's targets

SDG7 Indicators	2015	2019	2022	2025	2030
Proportion of households using clean fuel and technology as primary source of energy for cooking (%)	NA	NA	NA	NA	NA
Proportion of households using solid fuel as primary source of energy for cooking (%)	74.7	65	55	45	30
Proportion of population using LPG for cooking (%)	18	23.6	27.8	32	39
Proportion of population with access to electricity (%)	74	80.7	85.7	90.7	99
Electricity consumption (kWh per capita)	80	230	542	1027	1500
Per capita energy (final) consumption (in gigajoules)	16	18.1	19.7	21.3	24

Source: (NPC, 2017) | NA = Not available

3 NPC is the designated agency for planning, budgeting, coordinating and monitoring the implementation of the SDG Roadmap.

The proposed specific targets for SDG 7 include generation of 15,000 MW of installed capacity by 2030.

3.8 Climate Change Policies and Communications

The **Nationally Determined Contributions (NDC)** communicated by Nepal in 2016 recognizes that biomass followed by fossil fuels dominate the energy mix of the country. The 2016 NDC aimed to increase the share of renewable change in the energy mix to 20% share by 2020. Its targets also aimed to reduce the country's dependency on fossil fuel by 50% and achieve 50% electrification through renewable energy sources by 2050. Moreover, it envisioned that Nepal would pursue a low-carbon economic development strategy. The 2016 NDC has set targets for clean cooking options such as biomass-based improved cookstoves and biogas cookstoves.

The **National Climate Change Policy (2019)** aims to contribute to socio-economic prosperity of the nation by building a climate-resilient society. It seeks to guide the country towards a green economy by adopting the strategy of low-carbon economic development. Water resources and energy is one of the priority areas identified by the policy with energy security as a key policy concern. The policy also encourages production and use of renewable energy, and use of energy-efficient technologies.

The **Second National Communication of Nepal (2014)** noted that the overall GHG emission from the energy sector was increasing with a total emission of 6,894 $GgCO_2e$ from the energy sector in the base year 2000/01 (MoSTE, 2014), which increased to 13,331 $GgCO_2e$ in the year 2011 (TU, 2017). The Second National Communication identified residential sector as the largest GHG emitter in the energy sector, accounting for about 71% of the total CO_2e emission from the energy sector in 2000/01. This communication was one of the first official documents **to recognise e-cooking as a solution to reduce GHG emissions (MoSTE, 2014).**

The **National Adaptation Programme of Action (2010)** identified urgent and immediate national adaptation needs, recognized higher dependency of the population on traditional biomass for energy supply, and called for increased energy access to wider population. One of the priority adaptation options under the energy sector calls for scaling up biomass energy technologies to decrease fuelwood consumption, and promoting electrical appliance at the household level.

4. Promotional Initiatives for E-Cooking

4.1 Government

Established in 1996 through the GoN's Formation Order, AEPC has been successfully leading the promotion of renewable energy technologies including clean cooking solutions. In the first year (2019/20) of 15th Five-Year Plan, the GoN announced the implementation of a multi-year 'Terai Clean Cooking Programme'. This programme aims to replace traditional fuels such as animal dung with tier 3 or better cookstoves, modern biomass cookstoves and

biogas cookstoves in 22 districts of the Terai region. Through this initiative AEPC has, for the first time, proposed e-cooking systems as a feasible clean cooking solution as well. In the FY 2019/20, AEPC planned to promote about 10,000 induction cookstoves and 65,700 biomass cookstoves in the Terai districts in partnership with interested local governments. To accelerate the distribution, AEPC has requested the federal government for funding to promote e-cooking in 100,000 households in FY 2020/21.

Potential AEPC pipeline e-cooking projects include (AEPC, 2020):

- Acceleration of cooking solutions through modern, climate-friendly and efficient clean cooking solution, including electric cooking. Duration of 5 years benefiting 1 million households, with e-cooking promoted in 0.5 million households. Currently at proposal development. Green Climate Fund (GCF).
- Clean Cooking Program funded by World Bank/ESMAP Duration of 5 years benefiting 0.7 Million Households. Promotion of e-cooking in all households. Project is still in conceptual stage. The World Bank has not made a commitment yet.

Some local governments have taken initiatives to promote pilot scale e-cooking projects by mobilising the conditional grant they received from the federal government. Examples include Baijanath Rural Municipality that provided users partial financial support to meet upfront cost in 2019, and Ilam Municipality that has tendered for 648 units of induction cookstoves.

4.2 Development Partners

There is growing interest among international development partners and INGOs on e-cooking. International agencies such as Clean Cooking Alliance (CCA) and GIZ have undertaken some piloting initiatives to promote e-cooking in Nepal. Through the clean cooking project, 'Maximizing the Health Benefits of Clean Household Energy in Urban Nepal: A Demonstration Project', CCA and its local partners have promoted e-cooking, and aimed at combating household air pollution by promoting smoke-free kitchen communities. The project was implemented in Panchkhal and Mandandeupur Municipalities in Kavrepalanchok districts from 2017 to 2019.

GIZ's EnDev programme supported a pilot project entitled 'Market-Led Promotion of E-cooking in Timal Community Rural Electrification Area' from 2019-2020. Implemented by local partners, Ajummery Bikas Foundation and National Association of Community Electricity Users Nepal (NACEUN), the main objective of this project was to observe the impact of increased induction cooktop usage on a locally managed power distribution system in Timal Rural Municipality as well as monitor for any behaviour change in users. Under another project, GIZ/EnDev is promoting at least 1000 electric cookstoves in 2020.

Other INGOs such as Practical Action, Winrock International and SNV Netherlands Development Organisation are actively looking at opportunities to promote e-cooking by mobilising international funds[4].

4 This information was obtained through stakeholder consultations conducted to inform this study.

4.3 Civil Society and Private Sector

Some local institutions dedicated to community electrification and clean cooking have taken the initiative to promote e-cooking with the objective of improving health and economic benefits. Ajummery Bikas Foundation, NACEUN and Radio Sagarmatha jointly initiated a national campaign on 25th January 2019 to encourage market-led promotion of e-cooking in community electrification areas. The national campaign aims to promote e-cooking in more than 500,000 community electricity consumers in a 5-year timeframe in partnership with international development partners[5].

5. Energy Scenario

The GoN has recognized energy access as a vital step to achieve economic prosperity, energy security, and citizen welfare. Accordingly, producing enough electricity for self-sufficiency is a high priority for the country now. The GoN has drawn attention to this national aspiration by declaring 2018 to 2028 as the 'Decade of Energy and Hydropower' (MoF, 2019).

In 2018/19, the total energy consumption in all sectors reached 14 MToE. The total energy available in the year was 7551 GWh and the total electricity consumption was 4683 GWh (MoF, 2020). The sources of energy and total energy consumption by different sectors are given below.

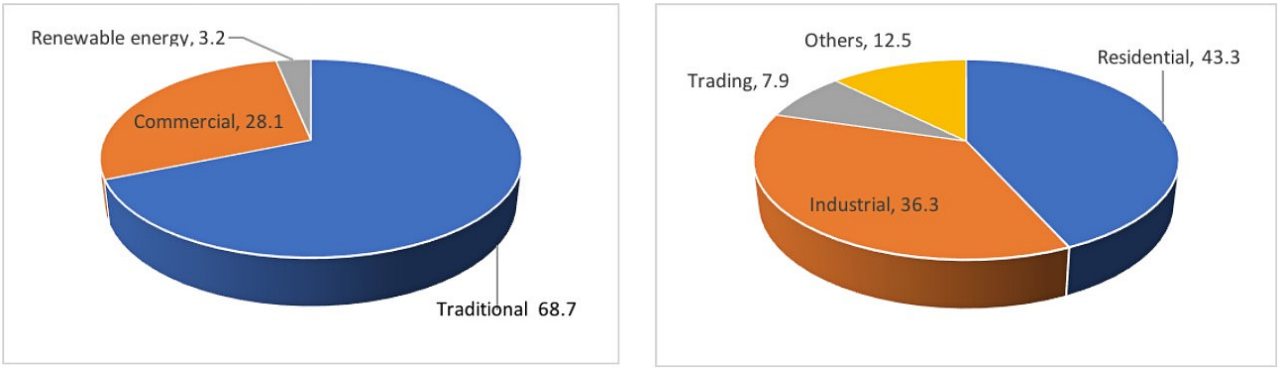

Figure 2. Source of energy consumed (L) and total energy consumed by sector (R), 2020
Source: (MoF, 2020)

5.1 Electricity

A significant growth in electricity supply and demand is expected in the upcoming decade. As shown in **Table 4**, according to a load forecast by NEA, the peak load is expected to reach 4,519 MW in 2025 and 7,542 MW in 2030. In both target years, expected demand remains well below the expected power generation capacity aspired by the policies.

5 This is as per a campaign paper jointly issued by Ajummery Bikas Foundation, NACEUN and Radio Sagarmatha.

Table 4. Load forecast

Year	Energy (GWh)	Peak load (MW)	Policy aspiration (MW)
2019/20	10,138.28	2,225.7	-
2023/24	15,332.65	3,703.3	5,000
2025/26	20,585.22	4,519.1	-
2030/31	34,355.49	7,542.0	15,000

Source: (NEA, 2019)

Currently domestic energy generation is insufficient and this scenario is expected to last for a few more years. However, this gap can be met by importing power from India. In 2018/19, more than a third (around 37%) of the total energy demand was met by electricity imported from India, as seen in **Table 5**. NEA's latest annual report shows that the import of electricity from India has decreased to around 22%[6] in 2019/20 (NEA, 2020).

Table 5. Total electricity availability and peak demand

	FY 2018/19 (a)	Target by end of FY 2019/20 (b)
Peak demand (MW)	1,320.28	-
NEA generation (GWh)	2,548.11	2,964
Power purchase from IPP (GWh)	2,190.05	2,901
Power purchase from India (GWh)	2,813.07	2,792
Available energy (GWh)	7,551.23	8,657

Source: (a) (NEA, 2019); (b) (NEA, 2020)

Domestic consumers consume the largest share of the available energy. In 2018/19 around 4,157,887 domestic consumers consumed about 44% (or 2,806 GWh) of the total available energy. While NEA has experienced about a 3% growth in total electricity sales since, the share of consumption by domestic consumers has also slightly increased to around 46% in 2019/20 (NEA, 2020) as shown in **Table 6** below.

Table 6. Electricity sales (GWh)

Consumer segment	FY 2018/19 (a)	Target by end of FY 2019/20 (b)
Domestic (including community sales)	2,806	3,360.39
Non-commercial	186	215.72
Commercial	466	540.67
Industrial	2,422	2,719.29
Others	458	460.49
Total	6,338	7,296.56

Source: (a) (NEA, 2019); (b) (NEA, 2020)

Substantial efforts are being made to improve the electricity generation, transmission and distribution systems of Nepal. While current generation capacity has lagged behind peak demand, necessitating the country to import electricity from India, a large number of projects (more than 2,500) are under construction or have already achieved financial closure. **Table 7** shows that if all projects under construction are completed by the final year (2023/24) of the 15th Five-Year Plan, the total installed capacity of 4,759 MW will be more

6 This is a provisional figure and may be subject to change later.

than enough to meet the expected peak load of 3,703 MW outlined in **Table 5** above. An NEA presentation shows that the grid will be able to sustain an additional 500,000 induction cookstoves next year when an additional 1000 MW will be generated **(see Annex II)**.

Table 7. Capacity of installed, pipeline and proposed projects

Status	NEA, MW (a)	IPP, MW (a)	Total 2019, MW	Target of 15th Plan 2023/24 MW (b)	Target of SDG, 2030 (c)
Total installed capacity (including NEA isolated plants)	625.98	560.76	1,186.75	5,000	15,000
Under construction	957.1	2,613.895	3,570.995	-	-
Planned and proposed	2,285.2	2,869.384	5,154.584	-	-

Source: (a) (NEA, 2019); (b) (NPC, 2019); (c) (NPC, 2017)

Transmission and distribution capacities are being improved through the construction of a number of high voltage transmission lines and high voltage substations as demonstrated in **Table 8.**

Table 8. Current status of high voltage transmission lines

Transmission line	Existing length, circuit km, 2019 (a)	Under construction, circuit km, 2019 (a)	Target of 15th Plan, 2023/24, circuit km (b)
400 kV	78	756	-
220 kV	255	1,318	8,000
132 kV	3,143	949	
66 kV	515	-	-
33 kV	-	-	7,277
11 kV	-	-	43,352

Source: (a) (NEA, 2020); (b) (NPC, 2019)

In total, the country has about 150,000 circuit km of distribution line (NEA, 2020).

Table 9. Current status of high voltage grid substations

Substation	Units (a)	Capacity, MVA (b)
Existing	54	3,652
Under construction	32	9,500
Planned and proposed	27	-

Source: (a) (NEA, 2019); (b) (NEA, 2020)

The current trends in electricity availability, sales and distribution signal that Nepal will have sufficient power availability to meet the projected demand for 2025 and 2030. While this expected situation is encouraging, we must also bear in mind that the load forecast does not take into account the scale of e-cooking ambition outlined in the Energy White Paper and the subsequent additional electricity demand due to this. Therefore, in such a case, electricity generation may not meet demand.

According to NEA, grid electricity has reached around 80% of the population. However, electricity has not reached to 91 (out of 753) municipalities as shown in **Table 10** below.

Table 10. Electrification status of municipalities (FY 2018/19)

Province	Completely electrified		Partially electrified		Not electrified	
	Urban	Rural	Urban	Rural	Urban	Rural
Province 1	16	9	33	66	0	13
Province 2	21	16	56	43	0	0
Bagmati	27	27	18	41	0	6
Gandaki	20	24	7	28	0	6
Province 5	19	19	17	46	0	8
Karnali	0	0	19	17	6	37
Sudurpaschim	9	2	19	41	4	11
Total	114	97	169	282	10	81

Source: (NEA, 2020)

Future electricity access and consumption as projected by the SDG Roadmap and the 15th Five-Year Plan is presented in **Table 11**.

Table 11. Electricity access and consumption past trends and future targets

SDG 7 Indicators	2015 (a)	2019 (a)	2022 (a)	2023 (b)	2025 (a)	2030 (a)
Proportion of population with access to electricity (%)	74	80.7	85.7	99	90.7	99
Electricity consumption (kWh per capita)	80	230	542	700	1027	1500
Per capita energy (final) consumption (in gigajoules)	16	18.1	19.7	-	21.3	24

Source: (a) (NPC, 2017); (b) (NPC, 2019)

5.2 Renewable Energy

Nepal has utilized renewable energy sources such as micro-hydro and household solar PV systems to meet electric lighting and productive end use needs of populations that do not have access to reliable electricity from the central grid.

In FY 2018/19, about 55 MW of electricity was produced from mini/micro-hydro and solar energy systems promoted by AEPC. This renewable electricity generation helped to serve around 18% of the total population (AEPC, 2019). **Table 12** shows the cumulative achievement in the renewable energy sector. In the past, such renewable energy was used to power off-grid households and communities. Today, in addition to this, new opportunities have opened up to interconnect renewable energy systems with the central grid. The 15th Five-Year Plan, for example, envisions connecting the solar, wind and micro-hydro mini grids to the central grid with a net metering arrangement. The 15th Five-Year Plan aspires to generate a total of 13 MW of micro/mini hydropower and 137 MW of solar/wind power in five years.

Table 12. Renewable energy technology status and target

	2019 (a)	Target of 15th Plan 2023 (b)
Solar home system (units)	911,097	-
Institutional solar PV system (units)	1,993	-
Urban solar home system (units)	21,144	-
Solar drinking water and irrigation pump (units)	1,364	-
Micro/mini hydro (kW)	32,159	13,000
Solar/wind mini grid system (kW)	563	137,000

Source: (a) (AEPC, 2019); (b) 15th Five-Year Plan (2019/20-2023/24)

5.3 Petroleum Products

The dependence of households on imported LPG for cooking is increasing over the years. The annual import of LPG in the last decade has grown by 15% on average. In 2018/19, the total import of LPG stood at 426,609 MT, which is equivalent to 30,042,887 canisters (14.2 kg each). Residential sector consumes around 54% of all LPG imported into the country.

Table 13. Import of petroleum products in 2018/19

Fuel	Quantity Imported
Petrol (in KL)	566,827
Diesel (in KL)	1,714,917
Kerosene (in KL)	25,004
Aviation Turbine Fuel (in KL)	200,108
LPG (in MT)	429,609

Source: (NOC, 2020)

According to a projection by International Atomic Energy Agency's energy planning tool called Model for Analysis of Energy Demand (MAED), the demand for LPG is expected to grow by 5.56% annually in economic growth scenario and by 6.79% in sustainable scenario. **Table 14** shows the projected demand of LPG.

Table 14. Total LPG consumption in MT

Year	Economic Growth Scenario	Sustainable Scenario
2020	38,7311	432,711
2022	437,427	533,198
2024	478,035	598,955
2026	526,654	668,912
2028	584,709	742,786
2030	654,349	820,444

Source: (Regmi & Manandhar, 2019)

5.4 Clean Cooking

According to AEPC, more than 1.9 million households have adopted fuel-efficient biomass or biogas cookstoves replacing their traditional biomass counterparts by mid-July 2019. As per **Nepal Interim Benchmark for Solid Biomass Cookstoves**, these improved biomass cookstoves fall under the tier 2 category. Today, AEPC and development partners have stopped the distribution of tier 2 cookstoves and given priority to the promotion of cookstoves from tier 3 to tier 5.

Table 15. Fuel-efficient biomass and biogas cookstoves status and target

Clean cooking option	Achievement as of 2019, units (a)	Target of 15th Plan, 2023, units (b)
Biogas cookstove	425,511	200,000
Large biogas plant	247	500
Improved cookstove	1,423,242	500,000
Metallic improved cookstove	85,805	

Source: (a) (AEPC, 2019); (b) 15th Five-Year Plan (2019/20-2023/24)

5.5 E-Cooking Appliances

E-cooking appliances are being increasingly adopted by well-to-do urban households since the past few decades. Today, households use a combination of e-cooking appliances including electric rice cookers, microwave ovens, electric pressure cookers, roti makers, electric kettles and electric cookstoves. Electric cookstoves available in the market include resistance type cookstoves, infrared cookstoves and induction cookstoves.

Today, induction cookstoves are gaining popularity, albeit slowly, because of their versatility, safety and energy efficiency. Promoting agencies have also focused on popularising induction cookstoves: As of February 2020, about 1,200 induction cookstoves have been promoted under different piloting and research projects in Nepal. Moreover, private sector suppliers have sold about 50,000 induction cookstoves in the last three years. During the energy crisis of 20157 when LPG was unavailable in the Nepali market, the sale of induction cookstoves is said to have reached a few hundred thousand. However, data is on this is not available8.

During the 2020 COVID-19 pandemic lockdown, the GoN encouraged people to adopt e-cooking by waiving custom duty on induction cookstove imports (MoF, 2020a) and providing a 25% discount on electricity consumption of up to 150 kWh per month (MoF, 2020b).

According to a study conducted among selected households in Panchkhal Municipality, cooking on induction cookstoves was found to be almost 40% cheaper than cooking on LPG cookstoves. Only 1.22 kWh of electrical energy was consumed a day while cooking on induction cookstoves (Bajracharya, 2019). Another lab-based study conducted by the Centre for Energy Studies showed a 42% saving when cooking on induction cookstove compared to cooking using LPG (Shrestha, 2020).

7 Refer to footnote 1.
8 Based upon various references, induction stoves sales have been estimated in Section 8 below.

6. Opportunities and Challenges for E-Cooking Promotion

In the current context, e-cooking promotion work can capitalize on many opportunities in the country but also needs to address certain challenges.

Opportunities for promotion of e-cooking are as follows:

Political commitments

- At the federal level, there is a high level of political commitment for e-cooking as detailed in the Energy White Paper. Moreover, the practice of promoting e-cooking in 100,000 households every year also demonstrated political commitment from MoEWRI.
- The Prime Minister withdrew a Nepal Oil Corporation (NOC) plan to extend an LPG pipeline between Nepal and India. This was done to promote Nepal's hydropower sector.
- E-cooking first received policy prominence in the Energy White Paper and is now reflected in the long-term vision, 15th Five-Year Plan and AEPC programmes.
- Cutting down on LPG, which we import from India, would significantly reduce Nepal's trade deficit. Therefore, the leaders are keen on promoting e-cooking technologies that run on nationally produced hydropower electricity.

Availability and reliability of electricity supply

- Power availability is increasing. Nepal's grid is expected to have more energy available than the projected demand in both five years and ten years scenario.[9]
- Transmission and distribution systems are being improved and will become more reliable and able to accommodate the use of electrical appliances at a large scale.
- Generation, transmission and distribution system can already accommodate 500,000 induction cookstoves (Gyawali, 2019).

Market readiness

- A range of imported e-cooking appliances are available in the market. To ensure the quality of the products, electric cooktop standards are already in place.

Social acceptance

- Evidences from pilot and research projects show the cost-effectiveness of e-cooking compared to other cooking technologies that use LPG and firewood.
- Nepali society is undergoing modernisation and people are opting for more clean and smart technologies in their daily lives. With improved literacy rate and easier access to information, consumer preference for clean cooking is also rising. This change is more visible in urban areas than in rural areas where literacy rate and access to information are lagging.
- Cutting down on LPG, which we import from India, would significantly reduce Nepal's trade deficit. Thus, technologies that run on nationally produced hydropower electricity are gaining more grounds in urban areas with high literacy rates and easy access to information.

9 This 'projected demand' does not take into account the potential increase in demand due to electric cookstoves, however.

Example: A 5-member middle-class family uses on average 7 LPG cylinders in a year. After adopting e-cooking, this reduces to 3 LPG cylinders a year (as they use both electricity and LPG for cooking). With a saving of 4 cylinders per year per household, the existing 5.15 lakh e-cooking users would have avoided an import of 29,252 MT of LPG in FY 2018/19 (6.8% less than the actual LPG import of 429,609 MT that year). Assuming an additional 10 lakh households will adopt e-cooking by 2025, the country will avoid an import of 86,052 MT of LPG in that year.

However, there are also many challenges that hinder the rapid adoption of e-cooking:

- Peak load management is still challenging because of which people are not confident about the reliability of electricity supply during cooking hours.
- A vast number of residential consumers have a low level of connection with 5 A meter capacity, which limits the use of heavy appliances or use of multiple appliances at the same time.
- A large number of residential consumers do not have proper wiring or earthing protection which compromises household electrical safety.
- Local level governments, in general, have not yet formulated policy frameworks (including policies, acts, procedures, guidelines) for promoting renewable energy, clean cooking and e-cooking. Hence clean cooking programmes development is lagging in the country.
- The general awareness of some people, particularly in rural areas, about the benefits of e-cooking is still low. Many of them do not have access to information regarding the benefits of e-cooking.
- A vast number of potential supply chain actors, such as retailers dealing with kitchen appliances see more risk in the e-cooking business and are therefore reluctant to keep electric appliances in stock. Semi-urban and rural areas lack enthusiastic supply chain actors such as retailers.

7. E-Cooking Targets in the 2020 NDC and Background LEAP Analysis

Taking into considerations the findings and recommendations of this report (discussed in the chapters above), as well as the subsequent feedback provided by numerous experts (see Annex 1), the GoN-appointed NDC Working Group, and other line ministries and government agencies, two e-cooking scenarios were developed. The impacts of these scenarios on residential cooking technology shift and the corresponding GHG emissions was then modeled using the LEAP software. This chapter discusses in brief the e-cooking targets of the 2020 NDC and the scenarios these targets were based on.[10]

Nepal's 2020 NDC (GoN, 2020) has set the following quantified targets for residential cooking and biogas sub-sector of the energy sector:

10 The LEAP modeling methodology has been described in detail in the accompanying Nepal Mitigation Assessment Report (2021).

- By 2030, ensure 25% of all households use electric cookstoves as their primary mode of cooking.
- By 2025, install 500,000 improved cookstoves, specifically in rural areas.
- By 2025, install an additional 200,000 household biogas plants and 500 large scale biogas plants (institutional/industrial/ municipal/community).

LEAP modeling software was used to support the 2020 NDC target-setting process. Projections were made for year 2020 (year of NDC submission), 2022 (when Nepal expects to graduate to developing country status), 2023 (the last full year of 15th Five-Year Plan), 2025 (mid-decade), 2028 (the final year of Energy and Hydropower Decade), and 2030 (the final target year of the 2020 NDC, SEforALL and SDG Roadmap).

The projections are made for two possible scenarios: (i) Business As Usual (BAU) Scenario, and (ii) Ambitious E-Cooking Scenario. The BAU Scenario involves conditions which are substantiated by some evidence from experience or commitment of concerned agencies. It is a conservative scenario that yields minimum achievement in the stipulated timeframe. The Ambitious E-Cooking Scenario is an optimistic scenario based upon aspirations envisaged in the policies and programmes of the GoN. The 2020 NDC targets on various cooking technologies are based on this ambitious scenario. The BAU projections were also included in the 2020 NDC for comparison.

Table 16. Typology of cookstoves considered in this study

Electric cookstove	A range of electrical cooking appliances such as induction cooktop, infrared cooktop, hot plate, electric pressure cooker, rice cooker which are used for cooking rice, lentils, vegetables etc.
LPG cookstove	A cookstove with single or multiple burner that uses LPG stored in a portable standard canister.
Biogas cookstove	A cookstove with a burner that uses biogas produced by a biogas digester of varying capacity e.g. 2 m^3, 4 m^3, 6 m^3 or 10 m^3.
Improved cookstove ranked tier 3 or above (ICS T3+)	Factory made portable cookstove; uses solid biomass or pellets; efficiency above 30%; tier 3 or above.
Improved cookstove ranked tier 2 (ICS T2)	Mud cookstove with a chimney outlet or factory-made portable rocket cookstove; uses solid biomass, loose biomass, dung cake; efficiency below 30%; tier 1 or tier 2
Traditional cookstove (TCS)	Three stone open fire, mud cookstoves; uses solid biomass, loose biomass, or dung cake; efficiency below 10%, tier 0

The major difference between these two scenarios is that the Ambitious E-cooking Scenario favours policy interventions that promote electric cooking, biogas, and ICS T3+ over LPG cookstoves and TCS.

Among users of LPG, biogas, and electric cookstoves, cookstove and energy stacking (i.e. use of multiple cookstoves and energy sources in one household) is common. For example, whenever biomass is available, households generally use biomass cookstoves as their primary cookstove. A study conducted by the World Bank (World Bank, 2019) found that LPG and biogas cookstoves were used in combination with traditional or improved biomass cookstoves in most households. In terms of fuel stacking, electricity is found to be used along with LPG as the energy source for cooking. To avoid double counting due to fuel and

cookstove stacking, this study estimates percentage share of households by the primary cookstove, which is the main cookstove used on a regular basis for cooking.

The data for the baseline (2010 -2019) and the two future scenarios (2020 -2030) is synthesized using expert judgement through reference to LPG Import Statistics of Nepal Oil Corporation, Annual Household Survey 2016/17 of the Central Bureau of Statistics, Foreign Trade Statistics of Department of Customs, Reports of Alternative Energy Promotion Centre, and a peer-reviewed journal article on LPG (Regmi & Manandhar, 2019). Estimations in both scenarios are made for the total population of Nepal considering an annual population growth rate of 0.8% (CBS, 2014).

The baseline data for percentage share of households using different types of primary cookstove for 2010 to 2019 is estimated as shown in **Figure 3** below.

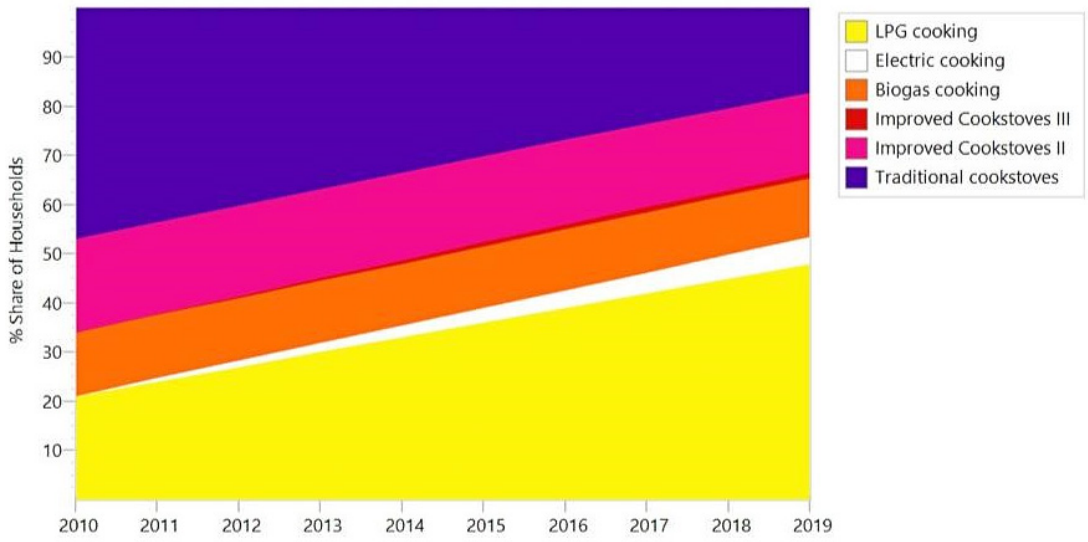

Figure 3. Percentage share of households using different types of primary cookstoves from 2010 to 2019

From 2010 to 2019, the share of households using LPG cookstoves as their primary cookstoves increased rapidly so that LPG cookstoves were the most commonly used primary cookstoves in 2019. Share of electric cookstoves increased slightly in this time period but was still very low in 2019. Share of biogas cookstoves and ICS T2 decreased slightly, whereas share of ICS T3+ increased slightly. Share of TCS, the most commonly used primary cookstove in 2010, decreased steadily but was still significant in 2019.

7.1 Business As Usual (BAU) Scenario

For the BAU Scenario, the percentage share of households using different types of primary cookstoves is projected in **Figure 4** below. From 2020 to 2030, the share of households using LPG cookstoves as their primary cookstove increases steadily. The share of electric cookstoves and ICS T3+ increase slightly, whereas biogas cookstoves remain the same. Share of TCS decreases only slightly, whereas ICS T2 is phased out entirely since they are no longer promoted by the GoN and have a short life span.

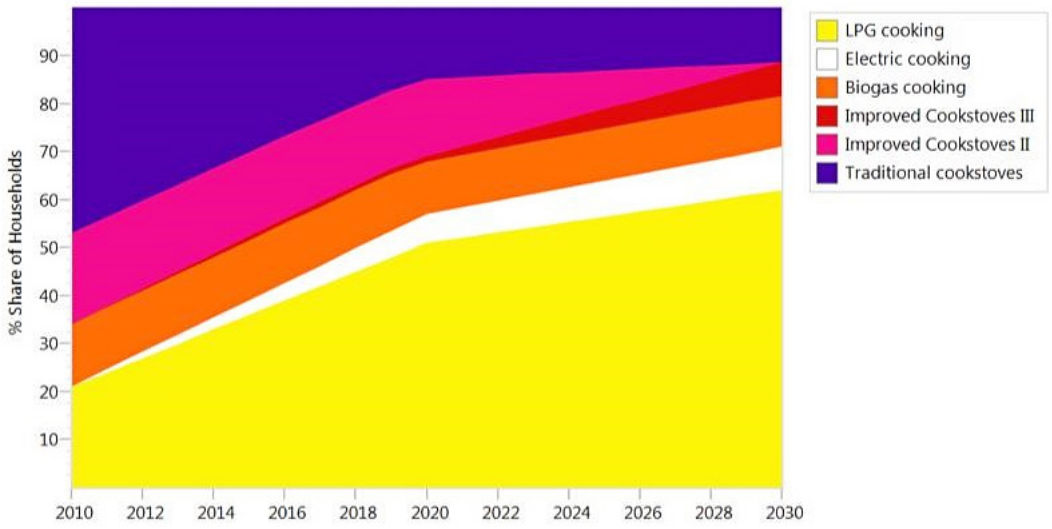

Figure 4. Percentage share of households using different types of primary cookstoves in the BAU Scenario.

Source: LEAP modeling, 2020

The detailed assumptions and the accompanying projections for this scenario are discussed below:

Electric Stove

Although electric cooking has received some policy prominence, the GoN has no ongoing projects to promote electric cooking. The GoN has halted the promotion of electric cooking under the Terai Clean Cooking Programme due to the COVID-19 pandemic and also retreated from its political commitment to promote 100,000 electric cookstoves every year. It is not known when these will be resumed. The development agencies are still in the planning phase and their contribution in the upcoming years remains unclear. Thus, e-cooking increases only slightly in this scenario.

- An average annual increment of 5% is estimated from 2020 to 2030 so that the percentage share of households using electric cookstoves as their primary mode of cooking increases from 6% in 2020 to 9% in 2030.

LPG Stove

The annual LPG import of the GoN is very high and increasing and subsidy on LPG is being provided.

- An average annual increment of 2% is estimated from 2020 to 2030 so that the percentage share of households using LPG cookstoves as their primary mode of cooking increases from 51% in 2020 to 62% in 2030.

Biogas Stove

Biogas is being promoted but on average users are switching from home-based biogas to canisters from larger biogas plants.

- The percentage share of households in Nepal that use biogas cookstoves as their primary mode of cooking remains constant from 2020 to 2030 at around 11%.

Improved Cookstove Ranked Tier 3 or Above (ICS T3+)

ICS T3+ are currently being promoted by government agencies.

- An average annual increment of 48% is estimated from 2020 to 2030 so that the percentage share of households using ICS T3+ as their primary mode of cooking increases from 1.2% in 2020 to 7% in 2030.

Improved Cookstove Ranked Tier 2 (ICS T2)

ICS T2 are no longer being promoted because of their low efficiency, and they have a short lifespan, so households stop using them after a few years.

- An average annual decrement of 10% is estimated from 2020 to 2030 so that the percentage share of households using ICS T2 as their primary mode of cooking decreases from 16% in 2020 to 0% in 2030.

Traditional Cookstove (TCS)

While TCS use is slightly reduced by the promotion of cleaner cookstoves, it is still prominent.

- An average annual decrement of 2.5% is estimated from 2020 to 2030 so that the percentage share of households using TCS as their primary mode of cooking decreases from 14.8% in 2020 to 11.3% in 2030.

Finally, the cumulative number of households that adopt various primary cooking technologies from 2020 to 2030 in the BAU Scenario is estimated while also taking into account population growth. They are given in **Table 17** below.

Table 17. Cumulative number of households adopting different primary cooking options in BAU scenario [11]

Cooking Options	2020	2022	2023	2025	2028	2030
Electric cookstove	373,605	422,809	448,085	512,947	594,627	667,132
LPG cookstove	3,175,640	3,408,098	3,526,235	3,864,198	4,233,181	4,595,801
Biogas cookstove	684,942	698,276	707,845	738,643	759,565	793,146
ICS T3+	74,721	153,749	188,326	280,411	413,408	51,881
ICS T2	996,279	819,994	727,327	547,143	226,525	0
TCS	921,558	903,274	896,170	895,947	851,591	837,622
Total households	6,226,745	6,406,200	6,493,988	6,839,289	7,078,898	7,412,582

Source: LEAP modeling, 2020

7.2 Ambitious E-Cooking Scenario

In the Ambitious E-Cooking Scenario, the percentage share of households using different types of primary cookstoves is projected in **Figure 5** below. From 2020 to 2030, the share of households using LPG cookstoves as their primary cookstove decreases significantly. These are replaced by increasing electric, biogas and ICS T3+. Use of TCS also decreases significantly due to adequate policy interventions, whereas ICS T2 is completely phased out.

11 The average household growth rate depicted in Table 17 and Table 18 is higher than the assumed population growth rate of 0.8% (CBS, 2014) because it takes into account the increasing scale of urbanization in the future. Urban households are on average smaller in size than rural households. So we assume that as more of Nepal becomes urbanized, the average size of Nepali households will decrease, and the total number of households will increase.

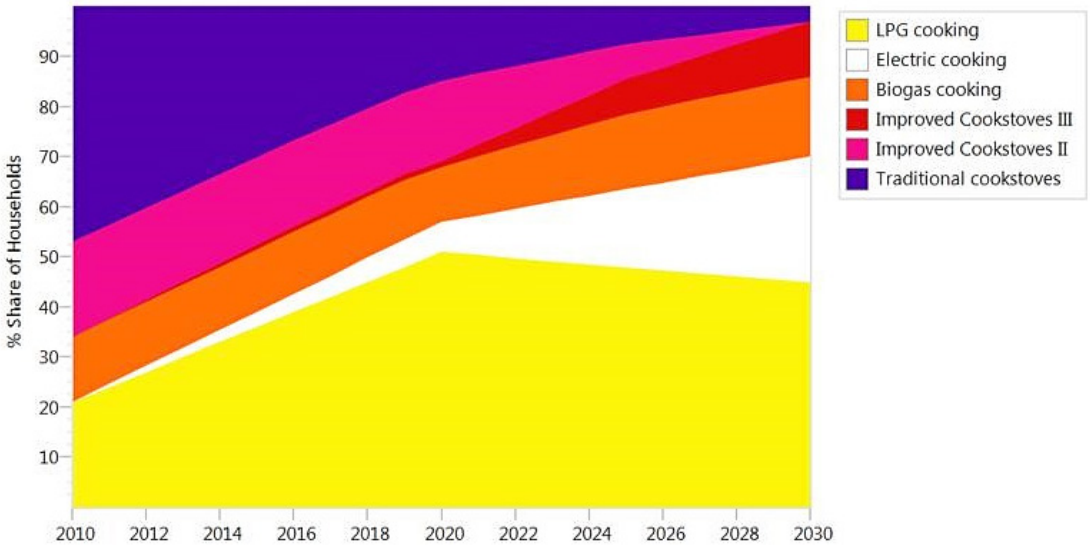

Figure 5. Percentage share of households using different primary cooking option in the Ambitious E-Cooking Scenario

Source: LEAP modeling, 2020

The assumptions made and the accompanying projections for this scenario are discussed below:

Electric Stove

The GoN implements the GCF-supported project on e-cooking and continues with its political commitment to promote 100,000 electric cookstoves every year. Some of the local governments also promote electric cooking on their own every year. The development agencies bring promotional projects. E-cooking is scaled up significantly due to adequate policy interventions.

- An average annual increment of 32% is estimated from 2020 to 2030 so that the percentage share of households using electric cookstoves as their primary mode of cooking increases from 6% in 2020 to 25% in 2030.

LPG Stove

Policy interventions curb the use of LPG so that it decreases significantly.

- An average annual decrement of 1% is estimated from 2020 to 2030 so that the percentage share of households using LPG cookstoves as their primary mode of cooking decreases from 51% in 2020 to 45% in 2030.

Biogas Stove

Promotional programs help to increase biogas adoption steadily.

- An average annual increment of 5% is estimated from 2020 to 2030 so that the percentage share of households using biogas cookstoves as their primary mode of cooking increases from 11% in 2020 to 16% in 2030.

Improved Cookstove Ranked Tier 3 or Above (ICS T3+)

Promotional programs help to increase ICS T3+ adoption substantially.

- An average annual increment of 82% is estimated from 2020 to 2030 so that the percentage share of households using ICS T3+ as their primary mode of cooking increases from 1.2% in 2020 to 11% in 2030.

Improved Cookstove Ranked Tier 2 (ICS T2)

ICS T2 are no longer promoted because of their low efficiency and households only use these cookstoves for a few years because of their short life cycle.

- An average annual decrement of 10% is estimated from 2020 to 2030 so that the percentage share of households using ICS T2 as their primary mode of cooking decreases from 16% in 2020 to 0% in 2030.

Traditional Cookstove (TCS)

Most TCS are replaced by cleaner cookstoves due to adequate policy interventions.

- An average annual decrement of 8% is estimated from 2020 to 2030 so that the percentage share of households using TCS as their primary mode of cooking decreases from 14.80% in 2020 to 3% in 2030.

Finally, the cumulative **number of households** that adopt various primary cooking options from 2020 to 2030 in the Ambitious E-Cooking Scenario is estimated while also taking into account population growth. These are given in the **Table 18** below:

Table 18. Cumulative number of households adopting different primary cooking options in the Ambitious E-Cooking Scenario

Cooking Options	2020	2022	2023	2025	2028	2030
Electric cookstove	373,605	627,808	759797	1,060,090	1,500,726	1,853,146
LPG cookstove	3,175,640	3,190,288	3,195,042	3,282,859	3,270,451	335,662
Biogas cookstove	684,942	807,181	870,194	1,025,893	1,104,308	1,186,013
ICS T3+	74,721	224,217	305,217	478750	665,416	815,384
ICS T2	996,279	794,369	688,363	478,750	198,209	0
TCS	921,558	762,338	675,375	512,947	339,787	222,378
Total households	6,226,745	6,406,200	6,493,988	6,839,289	7,078,898	7,412,582

Source: LEAP modeling, 2020

7.3 Emission Reductions Attributable to Ambitious E-Cooking Scenario

In the Ambitious E-cooking Scenario, e-cooking technologies primarily replace the use of firewood and LPG leading to substantial decrease in emissions compared to the BAU Scenario. Cooking-related emissions in the BAU Scenario is approximately 2,000 $GgCO_2e$ in 2025 and 2,060 $GgCO_2e$ in 2030, whereas, cooking-related emissions in the Ambitious E-Cooking Scenario is around 1,780 $GgCO_2e$ in 2025 and 1,600 $GgCO_2e$ in 2030. Compared to the BAU Scenario, the Ambitious E-Cooking Scenario results in a decrease in emissions from the cooking sector of around 11% in 2025 and 23% in 2030. This major decrease in emissions comes from the replacement of LPG, ICS T2 and TCS by electric cookstoves, ICS T3+ and biogas cookstoves.

8. Recommendations

To ensure timely achievement of the e-cooking targets in the 2020 NDC this report provides the following recommendations:

- Ensure affordable supply of quality e-cooking products
  - Provide financial incentives including on custom duty and value added tax (VAT) facilities of e-cooking products (For example, the custom duty on import of induction cooktop during COVID-19 lockdown was waived)
  - Encourage domestic manufacturing of electric cookstoves
  - Set household electricity tariffs that encourages people to consider e-cooking[12]
  - Gradually phase out subsidies on LPG
  - Gradually adopt standards on electric cooktops on mandatory basis

- Ensure reliability of electricity supply at household level
  - Upgrade the current 5 A connection to households to at least 15 A
  - Ensure electrical safety provisions e.g. house wiring with quality products and earthing systems
  - Upgrade local distribution systems with appropriately sized transformers to ensure uninterrupted power supply

- Ensure adequate planning and promotion measures
  - Provide local governments support to ensure adequate formulation of e-cooking related policy and regulatory procedures
  - Conduct mass awareness campaigns on clean cooking, with an emphasis on e-cooking, highlighting its health and economic benefits, and safety advantages for sustained behaviour change
  - So far, the GoN's approach to e-cooking promotion has been subsidy-driven or central procurement-based. However, it must also pursue market-based approach that encourages the private sector to serve semi-urban and rural market segments and provide technical backup support for its products, including after-sales service.

12 The ERC held a public virtual hearing of electricity tariff proposed by NEA on 25 May 2020. Members of the audience suggested domestic consumer-friendly tariff targeting e-cooking.

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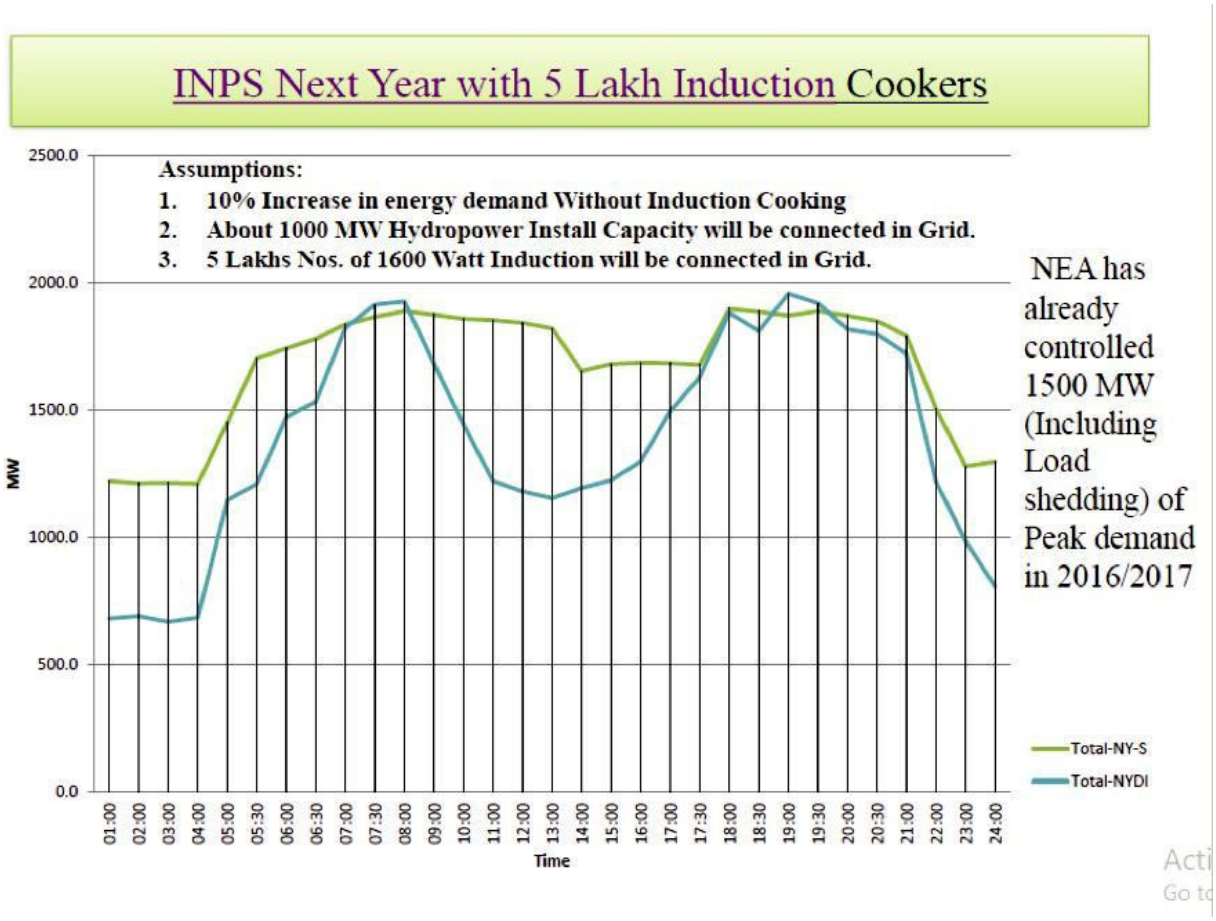
Annex I: List of Experts and Stakeholders Consulted During the Study

Person	Affiliated Institution	Mode of consultation
Dr. Arun Prakash Bhatta	Ministry of Forests and Environment	Focus group discussion (09/07/2020)
Shrijana Shrestha	Ministry of Forests and Environment	Focus group discussion (09/07/2020)
Muna Neupane	Ministry of Forests and Environment	Focus group discussion (09/07/2020)
Somnath Gautam	Ministry of Forests and Environment	Focus group discussion (09/07/2020)
Yam Nath Pokharel	Ministry of Forests and Environment	Focus group discussion (09/07/2020)
Ram Prasad Awasthi	Ministry of Forests and Environment	Focus group discussion (09/07/2020)
Suresh Ghimire	Ministry of Forests and Environment	Focus group discussion (09/07/2020)
Subhadra Bhattarai	Ministry of Forests and Environment	Focus group discussion (09/07/2020)
Jyoti Prajapati	Ministry of Energy, Water Resources and Irrigation (MoEWRI)	Focus group discussion (09/07/2020)
Mukesh Ghimire	Alternative Energy Promotion Centre	Telephone conversation and focus group discussion (09/07/2020)
Raju Laudari	Alternative Energy Promotion Centre	Telephone consultation
Rana Bahadur Thapa	Alternative Energy Promotion Centre	Focus group discussion (09/07/2020)
Narayan Khatiwada	National Planning Commission (NPC)	Focus group discussion (09/07/2020)
Kiran Gautam	Water and Energy Commission Secretariat (WECS)	Focus group discussion (09/07/2020)
Prof. Dr. Jagan Nath Shrestha	Center for Energy Studies (CES)/ Institute of Engineering (IOE)/ Tribhuvan University (TU)	Telephone consultation, written response and focus group discussion (09/07/2020)
Muhan Maskey	United Nations Development Programme-Nepal	Focus group discussion (09/07/2020)
Apar Paudyal	United Nations Development Programme-Nepal	Focus group discussion (09/07/2020)
Bhushan Chandra Adhikari	GIZ/ Energising Development (EnDev)	Telephone consultation and written response
Barsha Pandey	The World Bank	Online consultation and written response
Alisha Noella Pinto	The World Bank	Online consultation and written response
Pooja Sharma	Practical Action	Telephone consultation, written response and focus group discussion (09/07/2020)
Badri Baral	Winrock International	Telephone consultation and written response

Person	Affiliated Institution	Mode of consultation
Karuna Bajracharya	Clean Cooking Alliance (CCA)	Telephone consultation, written response and focus group discussion (09/07/2020)
Bhushan Tuladhar	Clean Energy Nepal (CEN)	Focus group discussion (09/07/2020)
Subash Dhakal	SNV Netherlands Development Organisation	Telephone consultation and written response
Prem Sagar Subedi	DAI/Nepal Renewable Energy Programme (NREP)	Telephone consultation
Narayan Gyawali	National Association of Community Electricity Users-Nepal (NACEUN)	Telephone consultation
Dhiraj Pokhrel	Society for Legal and Environmental Analysis and Development Research (LEADERS Nepal)	Written response
Gyanendra Raj Sharma	Ajummery Bikas Foundation	Telephone consultation
Suresh Acharya	Chaudhary Group (CG)	Telephone consultation
Manoj Gupta	Husk Power Pvt. Ltd.	Telephone consultation

Annex II: NEA's Estimation of Impact of 500,000 Induction Stoves on Peak Demand



Source: (Gyawali, 2019)

Government of Nepal
Ministry of Forests and Environment