MARKET RESEARCH FOR *HRS ECO MICRO*

September 2020

Image courtesy : *Himalayan Rocket Stove archives*

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Preface

While there is abundant research and data available pointing towards the need and gaps within the clean cooking ecosystem across India, the Indian Himalayan Region has been left somewhat out of this canvas. Perhaps the complexity of its geographical terrains, extreme climatic conditions or abundant availability of forest reserves (for now) could be some of the assumed reasons as to why this critical need has been devoid of a concerted effort by the Government, solutions provided, policy makers and enabling enterprises.

Its only recently when TERI & WWF published a detailed report titled 'Sustainable space heating solutions in the Himalayan Region' that there has been a spotlight on this ignored aspect of heating requirements needed by the Himalayan communities who face long and harsh winter months.

Some crucial data points from the report need to be highlighted in the context of this report.

- *73% rural households depend on firewood for their energy needs. In the winter, the per capita consumption of wood for space heating is 1.6kg–1.9kg.*
- *The emissions from space heating for 2020 for the entire IHR is estimated at 1.5 million tonnes of CO2*
- *The relationship between population growth (expected to increase by 7.4% in 2040), urbanization, expansion of land area under cultivation and increase in livestock, intensifies demand for forest resources.*
- *This causes diminishing of forests, reduces availability of fuelwood for villagers and increases the distance travelled by women and children to collect wood. Consequently, this increases the cost of wood.*

Through this report, we have attempted to understand the issues of cooking and heating as an overlapping need of these communities. While some regions and communities do not distinguish between the two needs and hence use common methods for both heating and cooking (predominantly Uttarakhand and North Eastern States), there are some matured 'heating' markets who segregate the needs of heating and cooking in their HHs and hence acquire separate methods for both. These are areas in Ladakh, J&K and parts of Himachal Pradesh.

Since the product innovation in context - Eco Micro is meant to serve the dual purpose of an efficient heating cum cooking device, we also included a perspective of a non Himalayan region - that of the Mt. Abu tribal belt in Rajasthan which is known to experience severe winter spells albeit for a short duration. However, the drudgery faced by the community remains un catered to with all the known issues related to inefficient cooking and heating methods affecting them deeply. Does that mean that a solution framework should not include a community whose heating needs are not as prominent as the ones in the Himalayan region for the lack of deeper market potential?

As is understood from the survey responses, there is very meagre intervention done in the aspects of clean and efficient space heating solutions for lower income and marginalised communities within the Himalayan regions. And hence, they either end up using very rudimentary devices (self-made or locally made) or simply fire the logs of woods to keep themselves warm. Interesting perspective came to light to when one of the community respondents mentioned that they now have warmer clothing during winters but are happy with the existing cheap and inefficient devices like '*kangri*' or '*sigri*' since they are unaware of its harmful effects, are habituated towards their use and is also within their economic reach.

Himalayan Rocket Stove's Eco range has been identified by the TERI report as one of the successful innovations that should be scaled up quickly to create a household level impact at a larger scale. HRS's current product innovation strategy is based on its initial success with this mid-priced stove range and now envisioning to cater to lower income brackets through products based on the same Rocket Stove Technology but will be brought to market at lower price points.

However, a solution can only be successfully adopted if it is backed by sound distribution channels, favourable policy and business enabling environment including investments, consumer financing, communication and awareness about the needs and requirements of the people who would be using these solutions and also, an indication of benefits to their life and environment in general.

In order to be successful, any manufacturer cannot work in isolation and would need massive support from all the players within the ecosystem that play a role in behaviour shift leading to positive impact on the lives of beneficiary communities. But this needs to be done with a bottom's up approach by involving the user community in all possible steps involved, as ultimately they would be using it in their daily lives.

In addition, it will be crucial to consider the fuel supply chain with a perspective of cleaner, easily accessible and economically viable solutions like biomass based pellets or briquettes; focus on research and documenting the behaviour of the Himalayan communities with respect to cooking and heating as it is a dominant part of their culture; and of course, closing the gaps in buying potential of the communities through innovative financial models, education and awareness towards role of efficient and cleaner energy solutions as a whole towards the overall impact.

Scope of research

The objective of this research was to understand the economic and social factors contributing towards the specific heating habits of the inhabitants of IHR and some regions in Rajasthan that face harsh winter temperatures. Through surveys and review of grey literature, we attempted to observe and analyse the patterns of of heating devices in the following regions:

- J&K and Ladakh
- Himachal Pradesh
- Uttarakhand
- North-east India
- Desert part of Rajasthan reaching sub zero temperatures in winter season

The primary research was conducted through interviews with users of traditional cookstoves in the region, interest groups, NGOs, academia and think tanks in order to generate a clear visualisation of their heating and cooking behaviours, fuel requirements, fuel consumption patterns and subsequently identify gaps in the clean heating sector that could be addressed through the introduction of the HRS EcoMicro. The research also enabled a deeper understanding on the appropriate channels of outreach for conducting awareness building and marketing as well as potential financing models.

This research was conducted by Smokeless Cookstove Foundation over a period of two months and the report has been compiled by the team comprising Rhea Mukerjee, Ajay Sharma and Nitisha Agrawal.

Study area and Methodology

As part of the stakeholder outreach, the research team conducted detailed one on one surveys with organisations and individuals working with communities on various issues pertaining to the Himalayan region. The stakeholder universe also included perspective from non Himalayan regions experiencing few months of severe winter seasons. Purpose of this engagement was to understand the need gap in heating requirements of the low income/ underserved communities in the winter season coupled with their cooking habits. To this effect, the team ensured engagement with representatives holding key positions in these organisations and having a direct community interaction.

The areas that have been selected for the purpose of this research have been identified on the basis of their altitudes and the existence of HRS network and partners in these regions. The rationale behind these parameters is that the heating demands, requirements, fuel consumption and cultural factors differ greatly with the difference in altitudes as the availability and type of fuel varies in accordance with these geographical patterns. The key inferences that are common across all regions studied are as follows:

- 90% of the rural population uses fuelwood as a source of heating;
- 100% of the urban population uses electricity to meet heating demands;
- The duration of heating in the below 1500m altitude range is 3 months;
- The duration of heating in the above 1500m altitude range is 6 months;
- The per capita per day fuelwood use below 1500m altitude range is 1.6kg;
- The per capita per day fuelwood use in the above 1500m altitude range is 1.9kg.

The table below gives a snapshot on the population density across various altitudes in the IHR.

J&K and Ladakh	Highest population density in the 1500m-2500m category
Himachal Pradesh	Highest population density in the 500-1500m category
Uttarakhand	Highest population density in the 0-500m category
North-east India	Hybrid - maximum spread in the sub 500m category

Since a majority of firewood consumption in the IHR is seen in rural areas, the regions that have been studied for this research are primarily rural and low income communities.

The two modes for conducting this market research are literature reviews and surveys with institutions and communities conducted over telephone calls. The conclusions drawn from these interviews informed the recommendations made at the end of the document.

Context

In June 2020, the Indian government's Ministry of Earth Sciences published the country's first climate change assessment report. It states that the Hindu Kush Himalayas (HKH), experienced a temperature rise of about 1.3°C during 1951–2014 and several parts of the region have experienced a declining trend in snowfall and also retreat of glaciers in recent decades. In contrast, the high-elevation Karakoram Himalayas have experienced higher winter snowfall that has shielded the region from glacier shrinkage.

The 50 million people living in the Indian Himalayan region are highly vulnerable to climate change. The geographic location and landscape makes them vulnerable to mild disturbances which directly impacts agricultural systems in the region. But with climate change, these disturbances are unfortunately a lot more severe and include extreme weather events like extreme weather events such as rainfall, floods, landslides and droughts. Coupled with massive urbanisation and population growth, the region is threatened by depleting resources and increased pressure on water, land and forest cover.

Heart disease, childhood pneumonia, chronic respiratory diseases, cancers, burns and cataracts are all linked to the use of traditional cookstoves burning solid biomass fuels which are used by around 3 billion people globally. In India, indoor air pollution causes 0.48 million premature deaths. Household air pollution is responsible for nearly 5% of the global disease burden, making it globally the single most important environmental risk factor. HAP is also a substantial contributor to outdoor air pollution-related deaths due to emissions into the ambient environment, responsible for around 0.4 million deaths.

The Indian Himalayas are one of the most ecologically fragile regions in the world. Given its cold climatic conditions and unavailability of a regular source of power and limited financial capacity of local communities, people in the Indian Himalayan region often resort to fuelwood to provide thermal comfort in their built environment. *The traditional space heating mechanisms not only contribute to the increasing emissions of the region but also lead to the degradation of natural resources and adversely impact the health of people residing in these areas.*

Impacts of burning biomass for fuel

Health	In terms of PM10 exposure, HAP can be placed somewhere between passive and active smoking and, unsurprisingly, most of the well-known health effects associated with tobacco smoking have also been documented for HAP. Recent systematic reviews show substantially increased risks for acute lower respiratory infections in children (Dherani et al. 2008), low birth weight and stillbirth (Pope et al. 2010), chronic obstructive pulmonary disease (Kurmi et al. 2010), and lung cancer (Hosgood et al. 2011). An increasing number of studies also report a link with cataracts (Pokhrel et al. 2005) and tuberculosis (Sumpter and Chandramohan 2013). Generalized exposure–response functions for combustion-derived PM2.5 (≤ 2.5 μm in aerodynamic diameter) (Pope et al. 2011; Smith and Peel 2010) present a strong case for HAP also causing ischemic heart disease and stroke. According to the Global Burden of Disease Project 2010, HAP globally accounted for 3.5 (2.7–4.4) million deaths and 4.3% (3.4–5.3) of disability-adjusted life years in the year 2010 (Lim et al. 2012). Furthermore, 16% of the 3.1 million deaths from outdoor air pollution are also attributable to HAP, due to the impact of household emissions on ambient air (Lim et al. 2012). Exposure to indoor air pollutants can lead to a wide range of adverse health outcomes in both children and adults, from respiratory illnesses to cancer to eye problems. Members of households that rely on polluting fuels and devices also suffer a higher risk of burns, poisonings, musculoskeletal injuries and accidents. It is the cause for 3.8 million premature deaths each year, mostly in low- and middle-income countries (WHO). In regions with high air pollution, the inhalation of indoor smoke caused by using traditional cookstoves deteriorates the lung capacity of residents. Diseases and respiratory infections Exposure to household air pollution (HAP) contributes to myriad diseases including acute lower respiratory infections in young children and lung cancer, ischaemic heart disease, chronic obstructive pulmonary disease, and stroke in adults.

	The health and wellbeing (Goal 3) of women, children, and infants are disproportionately compromised by HAP; research suggests that cooking with biomass fuels may increase blood pressure in pregnant women, cause lower birth weight of infants, and increase incidence of childhood pneumonia. According to Jain et al. (2015a), 72 per cent of households that use solid biomass are aware that it has adverse impacts on their health. Despite that, only 59 per cent believe that LPG has positive health benefits over traditional cooking fuels.
Environment	Household energy use is a significant source of climate-warming pollution. Emissions from the incomplete combustion of both biomass and fossil fuels in traditional stoves, inefficient heaters, open fires or wick lamps include both greenhouse gases and short-lived climate pollutants such as methane, black carbon and volatile organic compounds that contribute to the formation of ozone. Widespread collection of firewood as a source of fuel degrades the environment and can potentially lead to population-displacing disasters such as landslides, floods, and violent conflicts over scarce resources.
Gender	Women and children bear a disproportionate impact of the unavailability of clean cooking fuel and efficient stoves with higher incidence of asthma and cancer. In most developing countries, women and children perform the domestic tasks related to energy provision: gathering and processing fuel (which takes up to 5 hours per day), tending the hearth and cooking meals. In some cases, women provide 91% of households' total efforts in collecting fuel and water, and women have an average working day of 11-14 hours, compared to 10 hours on average for men. As they spend the most time in the kitchen, women and children have higher rates of exposure to particulate matter and other pollutants streaming out of stoves and open fires. (WHO) Among women and children worldwide, indoor pollution accounts for an estimated 1.5 million premature deaths each year (WHO 2006a). In India, the comparable figure, according to recent estimates, is at least 800,000 premature deaths every year (IHME, 2016).[1]

[1] Patnaik, Sasmita, Saurabh Tripathi, and Abhishek Jain. 2019. Roadmap for Access to Clean Cooking Energy in India, New Delhi: Council on Energy, Environment and Water.

	Traditional cooking also poses barriers to women's and girls' equality, since they often spend long hours in routine unpaid caregiving work each day caring for their families which includes household chores such as cooking, cleaning, and collecting water and firewood - time that could otherwise be spent on income generating activities, education, or recreation.

Covid 19

The COVID-19 pandemic has exacerbated inequalities and revealed to what extent current economic models are not sustainable. It has also shown that most countries are not equipped to cope with a health crisis. The World Food Program is warning that the lives and livelihoods of 265 million people in low and middle-income countries will be under severe threat unless swift action is taken to tackle the pandemic. This is especially true for the 840 million people in the world who still do not have access to electricity. And the further 3 billion who rely on inefficient stoves and polluting fuels like kerosene, biomass (wood, animal dung and crop waste) and coal for cooking or heating.[2]

[2] https://www.hivos.org/opinion/the-unseen-link-between-clean-cooking-and-the-covid-19-pandemic/

Image sourced from Scroll.in - A family warming themselves in Delhi winters

Emerging research suggests that patients exposed to air pollution have a higher risk of dying from COVID-19 and other life-threatening respiratory viruses. Given that 90% of low income households in India rely on solid biomass fuels such as firewood and charcoal to cook their meals, the impact of the pandemic will hit these groups the hardest. In poorly ventilated households, pollution from cooking smoke can be 100 times higher than levels deemed acceptable by the World Health Organization. Exposure is particularly high among women and children, who spend the most time near cooking fires.

Compounded with underlying health conditions such as malnutrition, psychosocial stress (in the case of migrant workers or displaced groups), and infectious diseases that already render them more vulnerable to diseases like COVID-19, the implications of inhaling black carbon from the burning of fuels for cooking and heating could potentially further reduce their chances of recovery from the virus.

Fuel Stacking

Fuel stacking is a common practice followed in rural India, wherein the households depend on more than one fuel for cooking. One among these fuels becomes the primary fuel. Census of India (2011) reported firewood as the primary cooking fuel among 63% of the rural households while another 23% used crop residues and cow dung cakes as cooking fuels. Only 11% rural households were using Liquefied Petroleum Gas (LPG) as primary cooking fuel. Stove and fuel 'stacking' were widely practised to meet different cooking requirements and minimise risks from (often seasonal) variations in fuel prices, access and reliability of supply.

Research suggests that cooking and heating system choices are constrained by economic and access considerations linked to variations in fuel cost, availability and service quality coupled with socio-cultural and utilitarian influences on cooking and heating practices. Depending on the regions surveyed, respondents demonstrated strong preferences for wood-fuelled traditional methods for their thermal comfort and cooking needs. Regions such as Himachal Pradesh, Uttarakhand and Meghalaya, where firewood is widely available, inhabitants invariably collect wood from nearby forests and farms. In regions such as Jammu and Kashmir and Ladakh, with lower temperatures for prolonged periods, individual heating methods such as the use of coal in *kangris* was observed.

Government interventions

The low cost of polluting fuels (such as wood or kerosene) and high costs of cleaner alternatives (such as liquid petroleum gas -LPG) is often a major barrier for the sustained adoption of clean household energy. *Shifting government fuel subsidies can play a vital role in the adoption of clean household energy fuels and technologies.*

Subsidies for clean cookstoves proved critical for enabling under-resourced families to purchase devices in India. To this end, the Government of India has made efforts to enhance access to clean cooking energy by promoting biogas, improved cookstoves (ICS), and LPG through various policies and programmes. It has launched three major national initiatives (since 2014)—PAHAL, Give it Up, and Ujjwala—to expand use of LPG in households. The most prominent among these is the Pradhan Mantri Ujjwala Yojana (PMUY) which has provided subsidised LPG connections to over 77 million households (as of August 2019). A beneficiary under PMUY is eligible for a free connection and 12 subsidised cylinders (their subsidy is around Rs 30 more than a non-PMUY user).

However, a recent study by Jain et. al (2018) in six of the most energy access-deprived states—Bihar, Jharkhand, Madhya Pradesh, Odisha, Uttar Pradesh, and West Bengal—suggested that only about one-third of the rural population use LPG as their primary cooking fuel. The Comptroller and Auditor General of India's performance audit of PMUY finds that a PMUY beneficiary uses less than three cylinders per year, while a non-PMUY household uses seven.

The Government recently announced the Pradhan Mantri Garib Kalyan Yojana for the novel coronavirus disease (COVID-19), under which 8.3 crore Pradhan Mantri Ujjwala Yojana (PMUY) beneficiaries are entitled to three 14.2 kg cylinders free of cost. PMUY now covers over eight crore households, taking the nation-wide LPG coverage to 94 percent. Liquified Petroleum Gas (LPG) and Piped Natural Gas (PNG) services have been listed under essential services.

According to ORF India,India needs to learn lessons from the past and needs to re-look at initiatives and assessment criteria of the clean cooking programmes for rural areas. The programmes need to focus on about two to three cooking fuel and technology combinations. One among the technology has to resemble the existing cooking practices and the other has to be the cleaner cooking technology.

Heating patterns in the regions of study

- In the IHR, fuelwood-based technologies are used predominantly in rural areas whereas, urban households used electricity-based technologies for space heating.
- Technologies such as mini Bukharis and rocket stoves have improved in terms of their efficiency.
- LPG/PNG-based technologies have potential of reducing emissions in space heating, however, the upfront cost of these is a deterrent in their widespread adoption.
- The one-size fits- all approach for the implementation of sustainable space heating solutions is the biggest barrier for remote locations such as the IHR due to their unique geographical placement and climatic conditions. With the Indian government's current focus on infrastructural development, it would be key to concentrate on the IHR regions and residing communities that rely on fuelwood for energy needs.
- In the IHR, the usage of space heating technologies is limited due to freely available biomass.

The current space heating methods using biofuels in rural areas in the IHR as follows:

Sl. No.	Technology	Fuel type	Cost of technology (in INR)	Energy/ fuel consumption (kg/h or L/h)
1	Saggar	Wood	1000-3000	2-3
2	Bukhari	Wood	2,000–8,000	3–4

3	Kangri	Charcoal	190-1500	0.5-0.6
4	Biomass briquettes space heater	Sugarcane bagasse, leaf	2000-15,000	Sugarcane bagasse (19.87 or 0.11kWh/kg) Sugarcane leaf (32.01 or 0.07 kWh/kg)
5	Mini Bukhari	Wood	5000-10,000	1
6	Sawdust Bukhari	Sawdust	2000-15,000	2-4

Information sourced from TERI Report

State-wise analysis

Jammu & Kashmir and Ladakh

The total population ('000) in this region in 2020 is 13,600 and is expected to increase to 15,561 by 2040. The highest concentration of population in this region is located in the altitude range of 1500-2500m. The rural-urban split for this altitude is 47% and 56%. Cumulatively, the population in this altitude consumes 13,68,628 tonnes of firewood. This is more than 50% of the total firewood consumption in the region. The total emissions by space heating in '000 tonnes of CO2 for 2020 is estimated to be 5,199.[3]

Jammu & Kashmir

The winter temperatures in J&K often fall to very low, freezing levels. Despite the marginal temperature rise and reduction in frequency of snowfall in the region owing to climate change, there is still a need for efficient heating solutions. The heating methods adopted by respondents (mostly belonging to low income groups) are wood fired *bukharis* or *angeethis* and *hamams* for space heating and coal-fired *kangri* for individual heating during the winter months. In general, there are between 3 to 4 *kangris* in a household. In the cold desert regions of Ladakh and Kargil, the demand for fuelwood is met through government subsidies which makes fuelwood available at a cost of INR 7-8 per Kg. According to a respondent from Sagg Eco VIllage in J&K, the daily wood consumption is about 15kg per day per household.

The respondents exhibited a good level of awareness about environmental and health impacts of traditional methods of cooking and heating. However, lack of financial resources and abundance of usually free of cost firewood serve as barriers for households to make the switch to alternate, cleaner solutions. Through an interview with representatives from Sagg Eco Village based in J&K, we got a glimpse of the heating and cooking practices of this region. The respondent believed that since the geography sees harsh and long winters, there is a clear need for efficient heating solutions that could perhaps replace the existing methods of hammam, kesorse and electric heaters. The table below summarises some of the most commonly used heating devices in the state.

[3] Source: Sustainable space heating solutions in the HImalayan Region - WWF India and TERI report 2020

Bukhari is a system of space heating which involves burning wood in cast iron stoves. These stoves have a pipe going out through the window for smoke. One respondent said, *"While growing up in Kashmir we relied on elementary wood-based heating systems, like the bukhari, as there was limited access to electricity. Every winter we would hear the news of someone's passing due to carbon monoxide poisoning due to exposure to a coal bukhari".*	 *Bukhari* in use in J&K Orientnorth.org
Hamam is a structure for space heating where bricks are lined with lime mortar. The floor is strewn with sand, bits of glass and boulders, to absorb and retain heat. Firewood is placed in this contraption through a small iron door. The smoke escapes through a chimney that goes right up to the roof, through all levels of the house. A vast majority of Kashmiris use these Mughal-era *hamams* to tackle the severe cold in the valley. Each hamam costs between INR 1.20 lakh to INR 1.40 lakh to build. A major disadvantage of the *hamam* is the toll it takes on forests and orchards. The average firewood consumption for this contraption is approximately 50-60 kg per day. People are slowly moving away from the stone based hamam systems as they are costly and consume huge amounts of firewood.	 People sitting in a *hamam* heated room in kashmir (Source: Hindustan Times)

The cost of firewood for a 3-month long period of harsh winter is approximately INR 10,000 to INR 15,000 for households where the *hamam* is being used on a regular basis.	
Locally fabricated devices are also popular among the lower income groups which ranges from INR 500 and goes up to INR 4000. These include, *angeethi*, *saggar* and *bukhari*.	
One of the most prominent heating methods used in Kashmir is *Kangri*. This method is more popularly found in low income households, costs between INR 200-300 and is fueled by burning charcoal. According to Umer Qadir, a resident of Ganderbal who runs a rural enterprise, *"Firewood is either procured locally from nearby farms or it is purchased at a subsidized price of INR 7 per kg. However, for those who use the traditional kangri, coal needs to be purchased. One sack of coal can be used through a week in winter months and costs INR 400."*	 Vendor selling locally made Kangri in Srinagar (Source: The Tribune)
Kerosene based heating devices like "Heatking" are also common in Kashmir valley and prominently used by defence forces in the regions with low access to solid biomass and easy availability of kerosene.	

The *Gaddi* community in Kashmir predominantly uses the traditional mud-based *chulha* for their cooking and heating needs	

When informed about an upcoming product that would provide effective heating solutions to the inhabitants of J&K, an important insight emerged from our interview with a representative from Sagg Eco Village, *"The upcoming product should come as a complete set with pipes and accessories so that there is no additional cost involved. If the product is available on EMI, it would be great"*.

Ladakh

Ladakh accounts for more than two-thirds of the land area of the Indian state of Jammu & Kashmir. As a high altitude cold desert, it is occupied by only about 5% of the state's population.With the temperature dropping to minus 20 degrees Celsius or lower during winter nights, and to about minus 5 degrees Celsius at night during March and April, it is virtually impossible to live without proper heating in this region. In addition, due to the extreme climatic conditions and remote habitations, Ladakh faces challenges in transporting diesel, kerosene and even firewood over long distances - a situation that worsens during the winter months.

Himmotthan, an associate agency of Tata Trusts working in Ladakh region surveyed communities in the villages of Chemde, Ledho, Achianthan in Kargil and Nyoma block in Ladakh and their insights have been summarised in this section.

General household size of the respondents ranged from 5 to 6 people. The lowest average monthly income was INR 4000-6000 and the highest monthly income among those surveyed was estimated at INR 30,000. The primary source of livelihood is agriculture. Other sources of livelihoods for occupants in the region are tourism and MGNREGA. A majority of these communities use the same device for the purpose of cooking and heating.[4] The name of this device in the local dialect is *Chaks Thap Stove*. The average daily firewood

[4] The respondents from Ladakh belong to the same tribal group and they reported that the kitchens in their homes are always within the living area.

consumption is approximately 8 kgs as reported by the respondents. Firewood is usually collected from nearby farms and forests and households typically do not incur any procurement cost for this.

Chaks Thap Stove

The most commonly used heating and cooking device in this region is the wood-fired *bukhari / Chaks Thap Stove*. These are iron fabricated stoves that come in different sizes and weigh between 5 to 10 kgs. This contraption is essentially a metal box with a primitive exhaust system. It is interesting to note that a variety of design enhancements are seen for this product, improvised to suit the local needs.

There are various models of this stove that work on a variety of fuels ranging from wood, sawdust, charcoal, animal dung etc. A variety of biomass fuel that is widely used along with wood for this stove is called *Lakru*, in the traditio
nal dialect.

Majority of households who are using the traditional heating stove were satisfied with its heating performance. The biggest cause for complaint by the respondents was the high smoke emissions, poor aesthetics of the device are not attractive and the low durability of the metal box.

Himalayan Rocket Stove is emerging to be an aspirational product among the community surveyed.

Traditional *bukhari* in use at Hunder, Ladakh (Souce: Travel the Himalaya)

According to Himmotthan, all respondents expressed their interest in owning a heating device that can also serve the purpose of cooking as long as it is available at a subsidised cost, uses locally available fuel and has positive reviews among its users in the community. The price that we were comfortable to pay for making the switch to an improved heating and cooking device is INR 4000-5000.

Himachal Pradesh

The total population ('000) in this region in 2020 is 7,347 and is expected to increase to 8,037 by 2040. The highest concentration of population in this region is located in the altitude range of 500- 1500m. The rural-urban split for this altitude is 59% and 63% respectively. The next highest density is seen in the range of 1500-2500m where the rural-urban split is 26% and 24% respectively. This is less than half in numbers as compared to the 500-1500m but roughly consumes about the same amount of firewood (5,04,625 tonnes in 500-1500m range and 5,25,143 tonnes in 1500-2500m range). The requirement for firewood in the sub 500m range is negligible in comparison (82,250 tonnes). The total emissions by space heating in '000 tonnes of CO2 for 2020 is estimated to be 2,238.

The sub-regions with the highest wood consumption in Himachal Pradesh are the hill forest urban areas, plane forest areas, hill non-forest and rural areas. These regions are located at altitudes both above and below 1500m. Winter temperatures in this region range from sub-zero to -25 degrees in winters. Households rely on a basket of heating devices which vary in accordance with their economic status.

The average household size of the respondents ranged from 5 to 6. The lowest average monthly income was INR 8000-1000, and the highest was estimated at INR 80,000. The main source of livelihood is agriculture. Other common occupations in the region include tourism and government services. Wood is the most commonly used fuel used in the state owing to the vast forest cover particularly in rural areas. Other fuels in the energy mix of a typical household include a combination of wood with cow-dung or crop residue. The average firewood consumption is approximately 8 kg per household. Expectedly, the consumption of firewood peaks during the winter as the stove is excessively used for both heating and cooking.

Rapid deforestation in IHR - *Image Courtesy : Himalayan Rocket Stove archives*

Bukharis Wood-fired *bukharis* are the most commonly used heating devices in the region. In areas where electricity supply is regular, electrical appliances are also in common usage. *Bukharis* are used in the winter months from November to February for heating. A majority of the cooking needs are met by LPG. A majority of the communities surveyed use the same device for cooking and heating. Preferred device is a brick/ mud stove with 1 or 2 burners. Other cooking and heating devices in use are LPG-powered stoves, electric heaters and induction stoves.	 Wood-fired *bukhari* being used for cooking in Himachal Pradesh

When we asked the respondents about the improvements that they wish to see in the methods of cooking and heating currently in use, we received an interesting insight from one of our respondents. Mr Deshraj, an agriculturist based in Kangra, shared, *"If this device can be made portable by adding a nut clip to the pipe section, it can be shifted from the kitchen (after cooking) into the living room for heating. Additionally, it should come with a handle, so that it is easy to lift the stove when it is hot. Finally the product should be affordable and accessible." He also suggested that the product demonstrations should be done for the local Mahila Mandal or at awareness camps organised at the village where the benefits of the product are clearly outlined."*

Another respondent mentioned that he would be willing to buy the product if it comes with an EMI option. The preferred durability for an improved cookstove, according to the respondents, is at least 5 years.

NGO - Jansamarth, Uttarakhand & Himachal Pradesh
Respondent - Yogeshwar Kumar

"My experience of working with Uttarakhand communities has not been encouraging as far as cookstoves are concerned. They want to continue with the old traditional open fire for cooking. However, there are some interesting examples from Himachal Pradesh, especially in Kullu district, Lahaul and Spiti and other high altitude areas where people use locally fabricated cook stoves popularly known as 'tandoor'. People set up tandors in their kitchens or sitting rooms, and they use tandoor for at least 6 months a year. I am not sure about the efficiency of tandoor. It costs about Rs 2000-3000 in the market. Almost every large village or a small town has fabricators of tandoors."

The respondent mentioned, that scale can be achieved if the manufacturers look at decentralising the production over a period of time and involve the already skilled labour who make local tandoors to create small hubs for sales and distribution all over the Himalayan region. This will help reduce the costs of the products as well as an existing market channel can be utilized to sell a product which is high in efficiency and good for the environment.

Uttarakhand

The total population ('000) in this region in 2020 is 11,270 and is expected to increase to 13,559 by 2040. The highest concentration of population in this region is located in the altitude range of below 500m.

The rural-urban split for this altitude is 38% and 56% respectively. Cumulatively, the population in this altitude consumes 3,60,650 tonnes of firewood. This is roughly 25% of the total firewood consumption in the region. The sub-regions with the highest consumption patterns are Garhwal Himalayas and Nanda Devi Biosphere Reserve. The highest consumption of firewood is in the altitude bracket of 1500-2500m where the rural- urban population split is 15% and 24% respectively. The total emissions by space heating in '000 tonnes of CO2 for 2020 is estimated to be 2,349.

In Uttarakhand,nearly 70% of the total population is rural, and therefore, the dependence on fire wood for daily household energy needs is very high.The excessive consumption of firewood for domestic and commercial use is a cause of severe deforestation in Himalayan state, causing lasting damage to the ecology in the area.

The respondents of the survey come from households with an average size of 1 to 12 persons with the average number of persons per household being 6. The lowest monthly income level was INR 4000 to 6000 and the highest was INR 50,000. Similar to the states mentioned above, a majority of the population earned its livelihood from agricultural activities. The other sources of income were from the tourism industry, MNREGA and services.

The major energy source is wood which is used for cooking and for heating purposes. Other energy sources that are sometimes used are electricity, kerosene and oil lamps (for lighting purposes). A majority of the households have access to Liquefied Petroleum Gas (LPG). However, the use of a traditional *chulha* is very common for cooking whereas LPG is used only for preparing tea and small meals. Firewood is collected from the forest mostly by women and children. There is a spike in the volume of firewood collected in the months of October through March. *(Image on left: Locally fabricated chulha in Garhwal)*

Bulk storing of firewood and drywood is observed also in the pre-monsoon months. This fuel is acquired free of cost. It is important to note that given the climatic conditions, the demand for domestic energy peaks during these months, whereas the demand for agricultural labour falls during these months. This severely impacts the economic status of households engaged in agricultural activities as their primary source of livelihood.

The table below summarises the commonly used devices in the region.

A range of heating devices are used by the respondents ranging from *Saggar*, *Bukhari*, *Angeethi* and self made *tandoor*. Open burning of firewood during the winter months is also common among the communities. On an average, these devices are used for 3 to 4 months from November through February.	 Traditional *bukhari* in Uttrakhand

Traditional mud stove Majority of the households stated that their preference was for a traditional mud stove owing to the ease of access and affordability of firewood. The absence of any cost-effective alternative forces them to continue the usage of these primitive stoves. “The fuel burns quickly so it has to be constantly fed. It has started smoking recently. Unavailability of biomass briquettes locally is also a major challenge” reported Anshuman, who runs a rural enterprise in Nainital.	 Traditional mud stove in Himalayas

Rapid deforestation has significantly impacted the availability of firewood in many parts of the IHR. In the Gangotri region, the situation is more severe in the winter due to unavailability of fuel for heating. According to one respondent, Swami Sridhar from the Gangotri region, “Since there is no alternative for heating, *sadhus* in Gangotri staying during winters face extreme cold conditions with temperature falling to even -30 degrees. There is also lack of firewood in the region and it has to be procured from Uttarkashi. An affordable heating device with an option of cooking would be great for the *Sadhu* community in the region”.

Piled up logs of firewood in Ladakh during peak winter; *Image courtesy : Nitisha Agrawal*

All the respondents stated that there was a need for an efficient heating device to help them keep warm in the winter months. In general, there was general awareness about the health and environmental impacts of traditional cooking and heating methods. The barriers to discontinue the practice of burning solid biomass for fuel was primarily the easy availability of wood from forests and farms nearby which is mostly procured free of cost. Other reasons for their continued usage are the low economic status of the households and the absence of alternate energy sources that fit their budget and lifestyles.

In our view, the availability of sustainable fuel options and positive feedback from trusted community members who have used improved devices would be effective in driving adoption of alternative heating solutions in the region. The cost of locally available heating devices is in the range of INR 2000-3000. A relevant solution that is priced competitively in the same range should ideally be easy to adopt by the households.

The research team interviewed TARE (Tirambhapur Askote Raj Ecosystem), a rural enterprise working in the districts of Uttarakhand. The organisation works on an SHG model and is aimed at enhancing the livelihood of women, in addition to addressing certain challenges faced by the community. According to this respondent, SHGs are a strong community in this region and should be leveraged when introducing a new product in order to increase mobilization and uptake among potential users.

North-east India

Meghalaya

Meghalaya has an abundance of forest reserves which are a source of livelihood and sustenance for the ethnic communities in the region. They heavily rely on firewood for their cooking needs. The survey for this region was conducted by North East Slow Food and Agrobiodiversity Society (NESFAS[5]) and the respondents belong to a community in a village named Mawhiang situated in the East Khasi Hills district of Meghalaya. Mawhiang is at an altitude of 1400m and its winter months are from November through March. Mawhiang village has 170 households and a population of approximately 1800 with a majority of the population engaged in agriculture as their source of livelihood. The other occupations include daily labour and business enterprises.

The average daily consumption wood in a small family (average 6 households) is 3kgs and a large family (average 10 households) is 5kgs. Firewood to meet their fuel requirements is collected from nearby forests and farms by members of the family. It is common practice for firewood to be collected in advance and stored for the next winter. For their thermal comfort, charcoal is purchased in sacks which cost INR 450 and can be used by a small family for 2-3 weeks.

Similar to other NGOs and organisations working in the north-eastern part of the country, the respondent from NESFAS also highlighted the issue of charcoal burning for heating which costs upto INR 500 per month. According to a respondent from this organisation, the usage of charcoal is highly prevalent in Khasi tribal villages, and is a major cause of indoor and ambient pollution. LPG

[5] As part of their efforts in the region, NESFAS conducts health and environmental awareness programs in the villages, promoting the use of sustainable technologies.

penetration is scarce in the hills of Meghalaya and households are still using traditional cooking practices and burning charcoal to keep themselves warm in the winter. Lack of ventilation in the kitchen creates a smoky environment and leads to health hazards. NESFAS has been conducting awareness programs in the villages related to environmental issues and adoption of sustainable technologies.

The community preferred mud *chulhas* as their primary cooking device and their heating requirement in the winter months are met by burning charcoal. In addition, these communities also use fuel wood for cooking pig feed on large pots placed on their mud *chulhas*. In the Khasi tribal villages, the use of charcoal is a major cause of indoor and ambient pollution.	 Charcoal-based heating device used in Meghalaya

Manipur

The team connected with an organisation in Manipur, SNL Energy Solutions. According to this respondent, communities in Manipur face long and severe winters with no particular methods for efficient heating and cooking. There is also a heavy dependency on firewood in this region. The respondent spoke about the importance of service and aftersales that should be looked at by the manufacturers or programme coordinators towards the implementation of any cookstove programme and since there has been no concerted efforts in clean heating projects, there needs to be strong awareness building campaign which needs to precede any household level implementation.

Assam

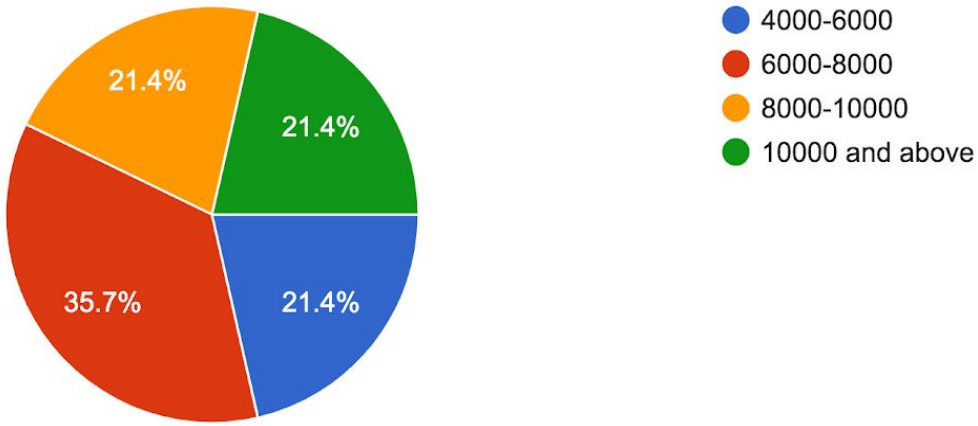
A loyal customer for the Eco range of stoves, Utsow Pradhan from Teedi Forest Garden is known for his efforts in conscious and ecological movements in the north-eastern states. On the Eco Micro he said, "This heating device will also attract the middle income segment as slowly there has been consciousness building among the community regarding open burning. Additionally the two pot SCF chulha would also attract this segment as people nowadays are interested in cooking on mud chulha as a secondary cooking option." This insight could be an interesting angle to explore for additional market channels. The respondent also indicated that the government has not done much to highlight the need for clean and efficient heating solutions and hence, this aspect will need to be incorporated in any community roll out.

Institutional surveys

Most of the organisations surveyed are working with a beneficiary base of low income rural and urban households and some of these communities hold tribal statuses. Agriculture and related activities were the dominant source of income for the beneficiary communities served by these organisations in the Himalayan region. Other sources of employment included daily wage labour work, tourism and handicrafts.

Since 85% of the target group is engaged in agricultural activities as their source of livelihood, it is important to note the correlation between fuel usage and firewood collection patterns given their proximity to farmlands. Being an agricultural population, they will continue to have access to fire wood and hence will continue to use this as their primary source of fuel for heating and cooking purposes.

The typical family size in the communities where these organisations work is between 6 and 8 members. For households in urban slums, the size of the family was 5 and below. Households in urban slums exhibit different cooking and heating practices from their counterparts in rural areas owing to limited access to fire wood and better access to LPG. However, within our survey landscape, only a few organisations were working with these communities. More than 50% of the associated communities earned a monthly income of Rs 8000 which makes them a price sensitive group. The break-up of household income for the groups surveyed is shown below:



Given the low temperatures and harsh winter conditions in the higher altitudes of the Himalayan region that last from 3 to 5 months each year, a majority of respondents felt that there was a need for efficient heating devices. We also spoke to representatives from organisations working with communities in the northern plains and the colder parts of Rajasthan. One was from Jan Chetna Sansthan, a non-profit organisation operating in Mt. Abu, Rajasthan and the other was Pollinate, which has pan-India operations. Both highlighted a need for heating devices among households in regions which experience low temperatures for a few months during the winter.

The representative from Jan Chetna Sansthan (Mount Abu) shared that the community that she is engaged with is largely marginalised and they do not have access to efficient heating and cooking devices. In addition, their homes are not built to sustain low temperatures, unlike those in the Himalayan region. For warmth, these households largely depend on bonfires lit outside their homes and warm clothing. Given the small size of their homes, fires are necessarily lit in the outdoors. Heavily dependent on wood fire for both heating and cooking, an introduction of the right kind of cooking and heating device could create a significant impact on their lives.

These findings would need to be studied more through a baseline evaluation at the time of market outreach.

Insights on current practices in heating & cooking practices

One of the key research objectives was to understand the overlap between heating and cooking practices of interested communities. 57% of the communities surveyed were using the same device for the purpose of cooking and heating. This could be any of the following: a traditional *chulha* made of mud and stone, a traditional tandoor or a bukhari depending on the geographical location.

The data gathered so far does not indicate if there is a clear state or altitude wise pattern to this practice but it can be assumed that income levels, awareness levels and the unavailability of a seperate heating device could be the reasons.

For communities that used separate devices for their heating and cooking needs, the device used is typically made locally. The cost of these heating devices range from INR 150 for *angeethi* to INR 4000 for a *tandoor*. In communities living in semi urban-urban areas where electricity access is more reliable, the use of electric heaters costing upto INR 3000 is observed. Other devices that are common in these geographies include *kangri* and *bukhari* which are either procured from local markets or are self-made.

The ease of access to the local manufacturers or the self-made nature of these devices make them easy to maintain and repair. The factor of after-sales service is important in the purchase decision of these communities. Some communities are also directly burning wood to keep themselves warm in winter. The traditional *chulha* remains to be the dominant heating device for these communities. *(Image on the right: traditional bukhari used in Himachal Pradesh)*

Fuel consumption, expenses and collection indicators

In regions where firewood is more easily available, there is a tendency of households to not allocate any part of their monthly budget towards fuel costs. This is particularly common in some regions of Uttarakhand and the north-eastern states. For households that do not have access to LPG connection, firewood is the primary source of fuel. This firewood is collected from nearby farms and forests, both of which are more abundantly available in Himalayan region as compared to the plains.

Firewood stocking ahead of winter and monsoon months in Manali; *Image courtesy : Nitisha Agrawal*

The responsibility of collecting firewood is held by the women of the households who spend anywhere between 6 to 12 hours per day in this activity, according to the findings of our survey. There is an indication of bulk firewood collection prior to the monsoon and winter in most areas. In preparation of particularly harsh days, households spend 4 to 6 hours a day collecting firewood. The number of days spent stocking up on wood in anticipation of excessive winter or monsoon can go up to two months in some regions.

In general, the per day fuel consumption for cooking and heating is in the range of 8kgs to 12kgs per household. In Manipur, variations were seen in the per day fuel usage depending on the altitudinal location of the community. Households residing in the hills used upto 40kgs per day and those in the valleys, upto 20kgs per day. For communities that rely on burning coal for their heating and cooking requirements, the monthly expenditure on fuel (coal and charcoal) is upto INR 600 per sack, which is sufficient to meet their monthly needs. Examples of coal-powered heating devices are *angithi* and *kangri*.

Impact on health

While there is an abundance of literature on the impact of household air pollution caused by traditional cooking methods on the health of families, there is very little information available to correlate HAP with heating practices in the winter months of colder regions. Based on our field experience with Himalayan communities, we are working on the assumption that traditional heating practices also contribute to HAP since the devices used by households to meet their thermal comfort needs are either the same as their cooking devices or are similar in their built.

Through this research, we also tried to understand the health impact of traditional heating methods on families that are exposure to severe winters. According to our respondents, cough and cold are the most common cold-related ailments, followed by body ache and soreness, severe skin dryness and swelling in limbs during the winter. This, when coupled with issues related to HAP is a cause for concern.

An interesting insight from the survey is that almost 64% of the beneficiary communities are aware of health issues caused by inefficient cooking and heating devices despite low levels of awareness programmes by various organisations. However, it is seen that the communities do not consider this to be a good enough reason to switch to devices using cleaner fuels as they consider it to be a part of their lifestyles that they are comfortable with.

It is important to note that 86% of our respondents stated that not much efforts have been undertaken to create awareness about health and environmental effects caused due to traditional cooking methods. While our respondents indicate that the health impacts are not a major deterrent in their choice of devices, there is merit in designing an awareness program that highlights both the health and time-saving benefits using improved devices for cooking and heating.

Image sourced from ndtv.com in Lucknow, UP for representation purpose

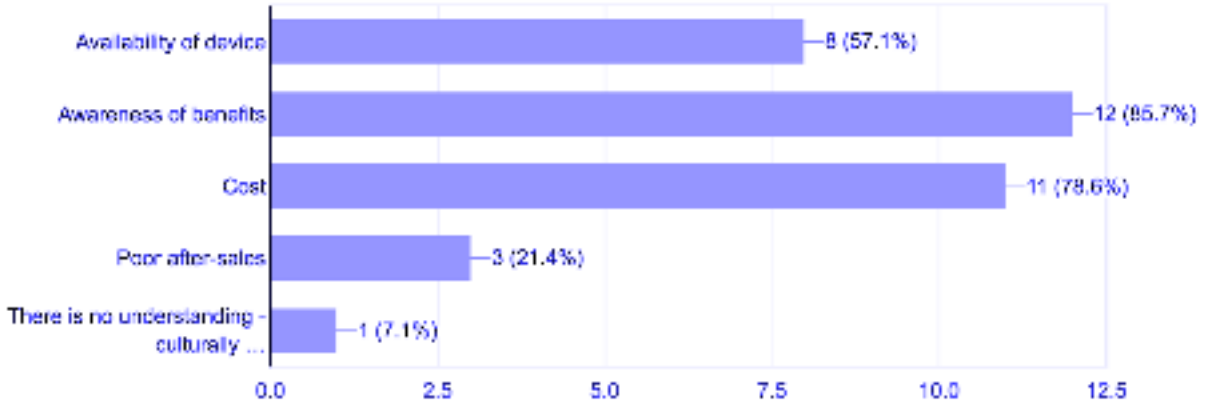
Barriers to using improved devices

Literature suggests that the most common barriers in adoption of improved cookstoves are liquidity constraints, present bias, and poor information on fuel savings and stove durability. We drew similar conclusions from our survey and these were the top 3 barriers that our respondents cited:

- Low awareness of the benefits
- High cost of procurement
- Unavailability in local stores

It is worth noting that the institutions surveyed were of the opinion that asymmetric or insufficient information was the top reason for slow adoption as opposed to high procurement costs, a factor that stood out when we spoke with respondents in communities. This insight suggests that any intervention programme for households in the region should not only provide a solution for efficient heating and cooking, but it should also involve an awareness programme covering the health, livelihoods and ecosystem related impacts of a continuous use of inefficient methods of cooking and heating.

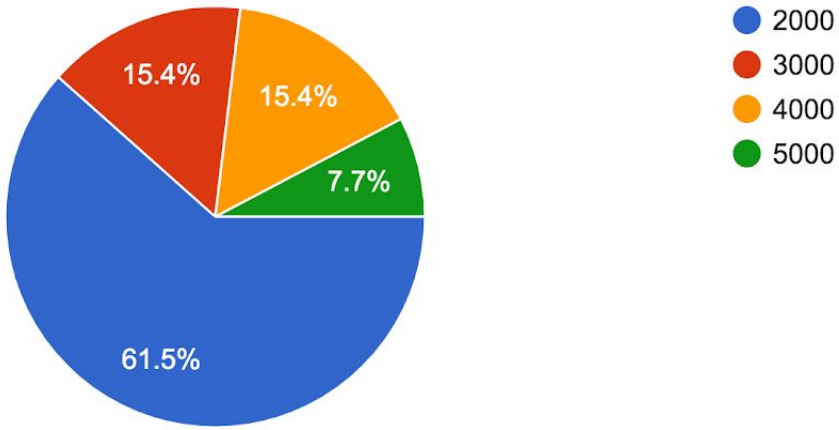
On behalf of their beneficiaries, all respondents indicated an interest to consider an efficient heating device that could also be used for cooking. In this light, the research team attempted to understand the key motivators for communities to consider switching to an efficient cooking and heating device. The main motivators influencing the purchase decision of households are innovative financing, positive feedback from trusted community members and peers, availability of the product at a subsidized cost and finally, ease of availability at a local store. Unsurprisingly, favourable pricing is the key motivator for communities to consider an efficient heating device.



Coal-based *angeethi* in Shimla, Himachal Pradesh

Favourable price points

Based on the income segments being considered, it emerged that the majority of the communities would not spend above INR 2000 on the purchase of an efficient heating and/ or a cooking device. This price point is in line with what they would have spent on their existing methods. Hence, it will be crucial to consider this insight while designing a model of stove dissemination to such communities. The chart below shows the price points that our respondents were willing to pay for an improved cookstove.



Enablers for transition

In order to create an eco-system for the communities to shift towards efficient heating and cooking devices at a sustainable level, the research team tried to understand potential stakeholders who could affect this shift. According to the respondents, local government and grassroots NGOs working with the communities will play a key role in this transition. This also led to an understanding that while innovative financial models are an important element to consider, a part-subsidy model seems to be the most important model to explore for a deeper penetration of these stoves. Based on our interactions, there is no subsidy in existence that can drive usage of clean and efficient stoves in this region. Another sore point in the financing options is the unavailability of MFIs in the Himalayan Region that would be willing to support solutions around heating and cooking devices in low-income communities.

On a positive note, almost all organizations expressed their desire to collaborate with HRS towards implementing programmes of disseminating these stoves for the benefit of their communities. The collaborations could be designed based on their expertise and experience in the fields of community outreach, awareness building, monitoring and evaluation, training etc.

Insights from Pollinate Group

In India, the organisation is largely working with urban slums dwellers in cities like Hyderabad, Bangalore, Kolkata, Mumbai, Lucknow, Kanpur etc. In these areas, clean cooking is an issue and programmes targeted towards clean cooking inevitably fail due to the high cost and design of cookstoves. To address this crisis, Pollinate Group works towards increasing the LPG penetration among users of traditional cookstoves. LPG is the fuel of preference for the organisation as it is more easily accessible owing to the PMUY. However, fuel stacking is a reality in these households and despite having awareness about HAP and easy access to LPG cylinders, these communities continue to use traditional *chulhas* as their additional cooking device.

The respondent provided an insight into the framework adopted by Pollinate which has put women at the centre of their projects, using them as the agents of change in the community. He suggests that interventions to promote clean cooking could be designed in such a way that the objectives of the programme go beyond adoption of a clean cookstove and could instead include a component of improvement in the livelihoods for women. This could be done by identifying women as community representatives, building their entrepreneurial skills, or having them take charge of the administrative requirements for the community cluster at the time of product roll out. In theory, this model promises to be mutually beneficial for the manufacturer as well as the community. For the manufacturer, this move could increase recall of their products by way of community peers recommending them to others. It would also provide deeper inroads into the community through having local partners, thereby addressing the problem of poor distribution lines. For the consumers, who are typically women, this model would play an important role in bridging the gender gap by providing women with a source of income that will bring about an overall community development.

One of the interesting financing models for products in the sub-INR 6000 price range is described below. While the model has been successful for their solar-based product categories, their success rate with cookstoves has not been great.

- 50% payment is made by the community and the remaining is split across weekly EMIs based on a mutually decided payment recovery duration.
- The local woman entrepreneur first takes the orders from interested households and then places an order to the product distributor. The numbers are usually kept small but repeat orders are encouraged.
- The number of units in the market are always kept small so the credit amounts are never too large to hurt
- The women entrepreneurs are given monthly targets and incentives on sales achievements.

Pollinate Group helps in creating awareness about the products through workshops and camps on a regular basis to help the women entrepreneurs grow their business. This also encourages other women to become entrepreneurs and expand the penetration circle.

Financing Models for renewable energy products

Consumer credit/lease arrangements	Rent-to-own is one such sales model which is well suited to selling improved stoves, especially for customers who purchase their own fuel. The initial time payment can be set so that customers pay it largely or entirely from fuel savings they have already accrued during the free trial. If those savings don't turn out to be enough to begin making payments, the consumer can just return the stove. This process repeats, so subsequent time payments are also largely paid for by recent fuel savings and, if the stove breaks down, the consumer returns it and owes nothing more. An interesting case study from Uganda where the implementation of this model is explained.[6]
PPP model	While many climate actions will continue to be undertaken by governments, the scale of the challenge means that governments cannot act alone, as they may not have adequate funds, skills or capacity. Since public finance will be limited, multiple sources of finance, including private sector finance, can usefully be combined in different ways to deliver sustainable solutions.
Results-based financing	RBF refers to a mechanism where financing bodies make a payment only after the pre-agreed results or output has been achieved. Under the RBF a donor or a Government agency provides financial support, subject to the recipient undertaking a set of predetermined actions or achieving predetermined outputs. Funds are disbursed based on demonstrated and independently verified results. There are several RBF instruments explored by different donor agencies. While RBF originally came as a financial modality used in the health sector, it is increasingly becoming popular in other sectors such as infrastructure and in renewable energy and deployment of low carbon technologies. Examples: 1) In Bangladesh, an RBF grant is blended with household loan finance from local microfinance institutions to increase access to hygienic toilets in low-income rural areas. The project has facilitated over $1 million in small business loans to local construction firms responsible for installing the toilets.

[6] What Impedes Efficient Adoption of Products? Evidence from Randomized Variation in Sales Offers for Improved Cookstoves in Uganda https://escholarship.org/uc/item/7qk8m53w

	2) In rural Bangladesh[7], households interested in financing a SHS enter into a purchase contract under a microfinance scheme with a local partner organisation (PO). The household makes a down payment covering around 10 to 15 percent of the system cost, and repays the balance over a period of two to three years at interest rates of 12 to 15 percent. In some instances, POs then enter into a contract with renewable energy technology suppliers to procure SHS equipment on credit; however, in many cases, POs act as both the lender and supplier, which helps streamline the process. POs cover the initial cost of the SHSs with their own resources, and ensure subsequent household installation.
Asset Financing	In its essence, the asset financing model is similar to the PAAG model described in section below. While demand for small-scale renewable energy products among low-income consumers around the world is growing, most of these potential clients are unable to pay the cost of the devices they desire upfront. Poor consumers need access to finance to enable these purchases. While partnership between an energy company and a financial institution offering a credit facility has certain advantages, some energy companies are pursuing in-house asset financing that offers consumers the convenience and simplicity of a one-stop shop for both clean energy products and finance necessary to afford them. Categories of asset financing - a. In-house asset financing b. Micro leasing through an MFI c. In-house credit model + MFI partnership (example Grameen Shakti in Bangladesh) - different down payment/ installment/ credit plans Case Study: Grameen Shakti in Bangladesh The renewable energy service provider offers financing packages for SHSs, improved cookstoves and biogas plants. It allows its customers to pay for their SHSs (which typically cost between US$150 and 300) in installments over a period of up to three years. This is achieved through a monthly service charge that combines the cost of the equipment, maintenance and financing. Customers are offered six different financing plans that require different down payments, payback times and service charge incentives.

[7] In 2003, the World Bank and the Global Environment Facility (GEF), in support of the government of Bangladesh's agenda for universal access to electrification, launched the Rural Electrification and Renewable Energy Development (RERED) project to increase access to renewable energy in rural areas through grid and off-grid options.4 Under RERED, an output-based financing approach was implemented through a SHS pilot program, which utilized a subsidy to buy-down the technology costs, thereby reducing the investment cost for households.
https://www.gprba.org/sites/gpoba/files/publication/downloads/2018-11/blendedfinance_bangladesh_solarhomes.pdf

	• Option 1: 35 percent down payment, remainder payable over 12 months at a flat rate service charge of 5 percent. • Option 2: 25 percent down payment, remainder payable over 24 months at a flat rate service charge of 6 percent. • Option 3: 15 percent down payment, remainder payable over 36 months at a flat rate service charge of 8 percent. • Option 4: 100 percent down payment with a 4 percent discount on the total package price. • Option 5: 10 percent down payment, remainder payable over 36 months at a flat rate service charge of 5 percent (only for a micro utility system of 20, 40 and 50 W). • Option 6: 25 percent down payment, remainder payable over 12 months with no service charge (only for a mosque, temple, pagoda, church). With respect to improved cookstoves, two products are offered, one for domestic cooking and one for commercial cooking, with two types of payment plans: • Option 1 for domestic cooking: 50 percent down payment, remaining 50 percent payable after installment. • Option 2 for commercial cooking: 50 percent down payment, remainder payable over 6 months at a flat rate service charge of 6 percent.
Employer loans	For clusters where there is a proportion of households that are formally employed, manufacturer can consider taking the route of employer loans to bridge the access to finance gap. According to this arrangement, the employer purchases the product on behalf of the customer. Small deductions are made from the employee's salary on a monthly basis until the entire amount of the device has been recovered. These loans would ideally be interest-free so as to not increase the burden on the customer.
Blended with community development projects	An interesting and potentially effective financing model could be engaging with local bodies engaged in community development projects (for example, construction related activities) in the identified geographic. The workers of this project could be handed out a stove, in exchange for providing their services in this ongoing project.
Pay-As-You-Go (PAYG) model	According to the World Bank, the Pay-As-You-Go (PAYG) model has emerged as one of the effective commercially viable solutions to provide decentralised energy access to rural and remote communities in

	developing nations. The paying ability of households is a critical challenge for energy enterprises, and PAYG, with its easy payment schemes makes RE units affordable and allows households to gradually own these systems. The model also offers user training, ongoing maintenance, and service blocking functionality that minimises investment risk. The PAYG model has demonstrated huge success in Sub-Saharan Africa where Kenya pioneered the model as a cost competitive modern alternative for kerosene. *More effective for solar and biogas products.*
Climate Bonds	Climate bond is a type of loan which companies, governments, and banks use to finance projects. The issuer of the bond (the borrower) owes the holder (the creditor) a debt and, depending to the terms they agree on, is obliged to pay back the amount lent within a certain amount of time and with a certain interest. India has become the second-largest market globally for green bonds with $10.3 billion worth of transactions in the first half of 2019.
Register for carbon credits	Purchasing carbon offsets or credits allows businesses to support low-carbon development in developing countries. In the clean cooking sector, offsets are helping to change the funding dynamic for cookstove projects from one that has traditionally relied on donor aid to one that attracts additional investment from the private sector. The revenues generated by the sale of offsets provides much needed funding to kick start the expanding clean cookstove market and helps to keep stove prices more affordable for the families using them. Marks & Spencer, a partner of the Global Alliance for Clean Cookstoves, has provided funds for 40,000 fuel efficient, lower pollution cookstoves to be manufactured, sold and maintained by local entrepreneurs in Bangladesh. The plan is for the emissions reductions to be certified under The Gold Standard Carbon Credit Methodology for Efficient Cookstoves. To help companies like M&S more easily navigate the carbon offset marketplace, the Global Alliance for Clean Cookstoves created the Clean Cooking Carbon Credit Catalog.[8]
Co-operatives	Co-operatives are organisations in which members have come together for a common purpose such as the purchase or sale of goods and services. Farmers' co-operatives are a widely used model in developing countries that facilitate access to markets. Co-operatives usually ensure high and reliable product quality by providing training and certification to their members. These bodies are therefore often interested in providing their members with ways to improve productivity. Co-operatives play an interesting role in the energy sector in two ways. On the one hand, they can be used as a partner for the distribution and sale of solar home systems or appliances such as lanterns. On the other hand,

[8] https://www.cleancookingalliance.org/about/news/06-04-2015-companies-warm-to-carbon-offsets-from-cookstoves.html

	co-operatives can also be formed to operate a mini-grid, or even to organise distribution and payments for grid connections.
Subsidies	Subsidies are a regular feature in energy markets. For energy provision, two main types are used. Subsidies for installation pay for each device installed or each household connected to the grid, thus reducing the high up-front costs of gaining access to energy. Subsidies for use are mostly seen in the case of grid connections, defraying the cost of each unit of energy distributed. In India, Unnat Chulha Abhiyan is perhaps one policy that HRS can look at for subsidies. This Programme aims to develop and deploy improved biomass cook-stoves for providing cleaner cooking energy solutions in rural, semi-urban and urban areas using biomass as fuel for cooking. It also strives to mitigate drudgery of women and children using traditional chulha for cooking. Finally, it targets to mitigate climate change by reducing the black carbon and other emissions resulting from burning biomass for cooking.
Corporate Social Responsibility	Case study: The Gaia Association is an Ethiopian resident charity and UNHCR implementing partner that works to increase access to clean cookstoves and fuels. CSR funding from HCCF and IKEA Foundation will enable Gaia to scale up ethanol and charcoal briquette cooking interventions to cover 4,000 households across the two camps, as well as to establish a women-led commercial fuel and stove business serving the camps and the host community. UNCHR plans to implement a voucher or cash transfer program that will provide refugees with the funds to purchase their desired stove and fuel. Gaia's initiatives will provide economic opportunities and improve the living conditions of refugees by improving access to cleaner, safer, and more efficient household energy for cooking.

Recommendations on way forward

Summarising the key highlights from community and institutional surveys

To deliver a clean cooking and heating device in an effective and scalable manner, it is critical to have a system with appropriate institutional frameworks, delivery mechanisms, business models, capabilities and outcome measurements tools which is a time taking process in remote areas like in the Himalayas.

Product-based recommendation

- The stove needs to have a long carrying handle to make it easy to move. This way the entire stove with the cooking pot can easily be carried around and placed in another location.
- The stove should have interlocking components and can be changed, if necessary. Welding should be minimal and damaged components should be replaceable without the need for replacing entire stove
- The Stove should be light in weight and easily portable

Fuel-based recommendation

The remote areas of the hill state are untouched to the development activities. Female is the nucleus of the family and they have to fulfill the requirements related with the collection of firewood in which most of time and energy goes. If alternative means for fuel is provided, the time and energy can be better utilized in some other activities that can lead this economically poor area towards development.
In addition, the recommended stove should be adept at accepting different sizes and types of traditionally used fuel which the community is habituated with.

Charcoal briquettes for fuel could be a convenient option as they generate less smoke and the heat source is easily transportable

Cost relevance

In order to create a heating product that would be economically acceptable, and thereafter widely used, is dependant on three factors which the consumer will consider simultaneously:

- Customers who are willing to pay for another heat source for cooking are limited in regions where firewood is easily available from nearby forests and farms. The value of the new energy source will increase if people living farther away from the wooded area are targeted who rely on purchasing firewood to keep themselves warm in winters.

- The price a customer wants to pay for an alternative energy source depends largely on the level of comfort the person receives from using that heat source. For example, electricity or gas for cooking is very convenient but comes at a higher cost. Therefore an affordable heating solution which is convenient to use would be the first choice.
- The additional product-related costs are also relevant, such as transport, storage, easy replacement, availability, equipment needed, matches, dirt, smoke exhaust, pots and pans, cleaning, etc. These factors should be taken into consideration while determining the cost of the product.

Eco Micro - Product Proposition

About Eco Micro/ Eco Camp Heater

Himalayan Rocket Stove (HRS) is in the prototype development stage of a new product, Eco Micro, designed for the IHR. The product will be priced in the sub- Rs. 6000 category at the time of market introduction, making it an attractive option for low income consumers who are currently using traditional methods of heating and cooking. Not only would this solution address the health impacts of inefficient, traditional cooking and heating methods, they would also benefit these households through lower fuel costs and significantly higher heat efficiency. The target customers for this product are marginalised households with no heating devices, nomadic communities, the floating population of urban poor and migrant workers in urban and semi urban areas.

This is a small, lightweight cookstove and heater concept (approx. 11kgs to 12kgs) that has evolved as a merger of 2 parallel streams of product development at HRS. Being light weight adds to the portability aspect. Once the heating jacket is removed, the cookstove will weigh as light as about 4kgs and hence can be easily moved around for cooking.

As is discussed in the earlier sections of the report, space heating is a critical need for Himalayan communities and also some communities of the Indian plains. However, most underserved communities are deprived of an efficient solution primarily functioning as a heating device due to lack of awareness, available options and fuel scenario. Eco Micro (to be priced within the range of INR 6000) could find a niche market within these communities if the product acquisition strategy is carefully thought through.

The product will need to consider a ***flexible positioning strategy*** in terms of its core functionality of Heating & Cooking depending on geography, communities and the behaviour being practiced for these key needs.

For instance, "***an efficient heating device which also provides a dual pot cooking function***" could generate interest in matured heating markets like Ladakh and Himachal Pradesh. However, these markets have multiple devices available to compete, and hence Eco Micro will need to gradually build its place as a preferred option between the price range of Rs5000 to Rs8000 category.

While in North Eastern states & parts of Uttarakhand, although space heating is a critical need, it might be the efficient cooking function that could be a lead proposition to gain user interest.

An efficient, clean and dual pot cook stove which will provide heating with the same fuel source.
Based on the above two flexible positioning, it will be crucial to test this through the product trial period with the communities of different regions.

Potential Geographies

SEGMENT 1

Below 2000 meters - North Eastern States, Uttarakhand (Almora, Chamoli, Pithoragarh, Tehri); Himachal Pradesh (Kinnaur, Manali)

- Many of these geographies do not have much penetration of an efficient heating device (except in some areas of HP) as cooking is considered a more relevant need to cater too in terms of both options and expenditure (Fuel+Device)
- Easy access to firewood and hence, biomass based heating and cooking solutions will always be considered as preference
- Most communities use the same device for heating and cooking and hence it may not seem as two distinct needs
- With a strong marketing highlighting the clear product proposition weighing more on cooking as a primary function and heating as an additional function could be a starting point

SEGMENT 2

Above 2000meters (6500 feet) - Kashmir, Ladakh, Upper Uttarakhand, Spiti

- While very high altitudes, above 2000meters (6500 feet) may have the highest need for an efficient and effective space heating device, the size and hence the heat output of Eco Micro may be not ideally suitable and sufficient
- However, in the absence of any alternate efficient space heating devices for a small room size, Eco Micro can be put to trial for the purpose of feedback
- Additionally, this stove could work as a good 2nd or 3rd stove for smaller rooms in a bigger homes
- If the stove has modular elements (which could be detached and then easily attached); this could be option for the nomadic communities within the higher altitudes

SEGMENT 3

Northern Plains specifically during winter months (NCR Region, Select geographies like Mt. Abu in Rajasthan; select areas in Uttar Pradesh and Upper West Bengal like Darjileeng, Bihar)

This could be looked as an experimental geography in the product trial phase as communities living in these areas experience temperatures as low as sub zero in parts of Bihar and around 5 degrees in some of the other areas of Rajasthan. The duration of the winter season is much shorter than the Himalayan region though. Once again, it is seen that the underserved and marginalised communities in these regions typically burn wood and whatever else is available easily. These small bonfires outside their homes are the cause of a lot of pollution and harmful health effects.

Since these communities are not habituated to use a heating device, an introduction of such a device would be about initiating a behaviour change and shift in habit.

While it might be tough to position Eco Micro as a heating device which also provides the functionality of cooking might be a far fetched proposition to the communities in these regions, positioning it as a two pot cooking device which provides efficient heating as well, can be a much more attractive proposition. Although effective usage of Eco Micro would not be more than 3 months and it may not be suitable for use in summer months due to its heat output while cooking..

Demographics of target user

Based on three segments mentioned above, Eco Micro will need to find a market amongst the following target profiles :

I. **Mid income segment** looking for a new option, additional stoves for other rooms. These could be in service sectors, small business owners or farm owners. This segment tends to have heating and cooking as an overlapping phenomenon where the product could be seen as a distinctive need for them.
II. **Low income & a section of marginalised community** with monthly income of Rs 10,000 and above. These communities may find a stretch to pay for the entire amount of the stoves as based on their feedback. Most community members indicated a sum of upto Rs2000 (which amounts to approx. 40% of the product cost) as the community contribution. The remaining amount will need to be recovered through innovative financial models of installments, carbon credits offset, subsidy, grants etc. These could be in service sectors(Skilled labour), farmers, farm employees or small entrepreneurs
III. **Lifestyle based users** who may consider a travel/ camping stove or an outdoor cooking device in farm houses

Business Model

Business to customer	Business to Business	Business to Government	Business to Donors
Direct sales through HRS distribution network (Direct retail and Distributor retail) *Supported through Digital Marketing (website, FB, whatsapp)*	- Localised tandoor sellers with an already existing customer base - Small community entrepreneurs (women) *Word of Mouth & Whatsapp Marketing, consumer testimonials*	- Exploring a subsidy on stove cost for marginalised communities - Tax incentives/ Carbon credit benefits upon usage of a clean stove - Shifting fuel subsidies to biomass based pellets *Advocacy and collaborative model with SCF, CLEAN, Social Alpha, IITD, TERI, WWF & other like minded organisations*	- Identify opportunities for CSR donations looking to sponsor clean cookstove programmes within Himalayan Community - Grant & Social Impact funding opportunities *Collaborative model with SCF, Clean, Social Alpha, NGOs*
Direct HRS implementation as part of its model expansion strategy		Partnership Model through collaborative strategy	

Roadmap for the early stage community feedback project *(basis for Sustain Plus engagement)*

Early stage community feedback project for HRS' Eco Micro needs to be designed keeping the following aspects in mind:

Stairway to Scale model. Stairway to Scale by Nexleaf Analytics was designed on the principle that CCS (Clean cooking solution) should be tested for basic usability at the community levels (10 households) in any given setting before increasing gradually to larger distributions (100, then 1000) only when adoption is maintained and proven. The results of this pilot support the belief that a cautious distribution model is important. Had any of the low performing cookstoves been immediately distributed to thousands of households,

the adoption would have likely been low, thus preventing climate and health impact. The intervention may also have been detrimental to women if their own financing were involved.
(Sourced from : CCAC-RUWES-Nexleaf-Abuja-pilot-report-anon.pdf)

- The product could have different propositions in terms of needs and priority interchangeable between cooking & heating in diverse locations and hence the trials should be conducted at least 4 different geographies & communities.
- Product application will require training aids for complete adaptability and the trial period can act as a efficacy test for the training aids as well
- A short field trial period should be designed with 10 to 12 community users providing test results on the efficacy of the product for a period of 2 to 4 weeks.
- Towards the community usage phase, at least 125 to 150 units should be handed to households across identified geographies in order to get a comprehensive usage feedback
- Minimum monitoring period should be 6 to 8 months to establish an understanding of the product usage through the complete duration of colder months.
- There could be some feedback on the original design based on user feedback which HRS should be prepared to take on board
- Safety aspects of the stove usage should also form a key component of monitoring and documenting the usage experience
- Certain quantities of biomass based pellets could be considered as part of the project roll out to study the mixed fuel usage patterns
- Should be targeted in the region where traditional fuel is hard to collect and users have to pay a substantial amount to procure firewood.

Aspects to study & monitor during the pilot phase (Referenced from NexLeaf Analytics Model)

- **Adoption**: Long-term use of clean cooking technologies, as measured by sensors. Nexleaf defines adoption as the use of the CCS for 1 hour or more per day averaged over the most recent 60 days.
- **Adoption rate**: % of households that are adopting the CCS. Our target is to see 80% of households adopting the CCS.
- **Responsible scale**: Starting with 30 households per identified cluster for 6 months to evaluate initial use and acceptance of the stove based on sensors and ensure the stove doesn't break within that time; then scaling up to 120 households to evaluate sustained use and durability; then 1,000 households to evaluate for air quality improvements.

- **Potential Climate Credit *(a question posed)*** : Based on Nexleaf's published methodology in Nature Climate Change, can we give women climate credits based on their emissions reductions of short-lived climate pollutants, as quantified through the methodology ?. This helps them pay off the loan for their CCS. This is generally not applied till the stove proves initial adoption. For the first phase of the project, households received a flat rate as a precursor for Climate Credits. This however can be replaced with pellets or briquettes as incentives to use the stove

➔ **Considerations for market readiness based on willingness to pay for the solution**
➔ **Fuel cost and availability**
➔ **Culture of food**
➔ **Culture of space heating**
➔ **Size: Capacity to cook meals**
➔ **Convenience: Two stoves are better than one**
➔ **Overlapping/ dual functionality of Eco Micro vis-a-vis current option**

Proposed Framework & Geographies

Location	Region	No. of participating HH	Proposed project partners
Manipur (Upper hills)/ Meghalaya	North East of India	30	1. NEDSSS (North East Diocesan Social Service Society) 2. NESFAS 3. SNL Energy
Munisyari in Pithoragarh District or a cluster in Tehri District	Uttarakhand	30	Himmotthan
Spiti Valley	Himachal Pradesh	30	Spiti Ecosphere (A Rural enterprise)
Mt. Abu tribal belt	Rajasthan	30	Jan Chetana

Based on the above, SCF team will develop:

- Baseline indicators,
- Monitoring parameters,
- Feedback loop with HRS team & implementing partners,
- Impact evaluation study
- Final report with recommendations from the users

Basis for scale using innovative financial models in a social impact project

- Part subsidy generated through carbon offsetting
- SHG based roll out with remaining 60% of the product cost is equated for repayment
- 60% of the cost is paid under a CSR project in partnership with an NGO
- Loans
- Carbon credits offsetting a percentage of the stove cost
- Decentralised production or assembly (also an income generator at a local level)

Our Recommendations for scale-up model with community participation

Model 1 : Carbon Credits offset *(this is a highly recommended model for a scaling up a cookstove intervention)*
40% cost of the unit borne by the community member + 60% percent of the cost offset through carbon credits generated being passed on to the community as a cost waiver over a period of 5 years. *(Carbon credits waivers is subjected to the emissions reduction and efficiency of the stoves vis-a-vis the traditionally used stove/ method by the user)*

Model 2 : SHG based financing (*Reference Grameen Shakti in Bangladesh*)

- Option 1: 35 percent down payment, remainder payable over 12 months at a flat rate service charge of 5 percent.
- Option 2: 25 percent down payment, remainder payable over 24 months at a flat rate service charge of 6 percent.
- Option 3: 15 percent down payment, remainder payable over 36 months at a flat rate service charge of 8 percent.

An additional percentage can be waived off in lieu of labour or service cost towards an ongoing development project by a social impact organisation or SHG.

This suggestion is based on **Goonj's model of 'Dignity for Work'** - a relief package in lieu of service efforts.

“Under Goonj’s DFW (Dignity for Work) initiative, our Karnataka team and our partner organization motivated 53 individuals from Pandathimnahalli village in Kolar to clean a pond which was left unattended for years. Situated en route the village temple, the pond, which was once frequently used for religious rituals, was in a state of complete neglect. Now, having heard from our team the importance of practising hygienic ways in the time of this pandemic, and the need to revere Mother Nature, the villagers unanimously agreed to work towards the cleaning of the pond. Goonj rewarded their efforts with the Rahat Kits, which according to the villagers have lifted a heavy load off their shoulders in these lockdown days” (https://goonj.org/dignity-for-work/)

Annexure 1

Summary of fuel consumption & costs patterns from community and organisations

State	Community feedback	institutional feedback
Jammu & Kashmir	-40-50 kg firewood daily with a monthly expense of INR 5000 for Kashmiri *hamaam* system. - Coal usage in traditional Kangri is around 5-6 kg per day amounting to monthly expense of INR 1600	-Fuelwood provided by Govt. on subsidy at a rate of INR 7-8 per Kg.
Ladakh	Fuelwood provided by the government on subsidy at a rate of INR 7-8 per Kg which is exported from J&K region. -Average daily firewood consumption is approx. 8 Kg's as reported by the respondents	**NA**
Himachal Pradesh	Mixed fuel use such as combination of wood with cow-dung or crop residue is also prevalent - Average firewood consumption is approx. 8 kgs per household	There is an indication of bulk firewood collection prior to the monsoons and winter season in most areas
Uttrakhand	The only cost of fuelwood collection is physical efforts and the time taken.	The per day fuel consumption is generally indicated at 8kgs to 12kgs per household and this is cumulative for both cooking and heating requirements
North-east	One sack of Charcoal costs INR 450 and it lasts for 2-3 weeks depending on the family size. -Average daily consumption of a small family is 3kg and a large family is 5 kg's.	Some regions see a sharp variation in per day usage like in Manipur where the communities in hills are burning upto 40kgs per day

Willingness to pay for HRS micro as per the community

State	Willingness to pay for HRS micro as per the community (INR)
Jammu & Kashmir	3000
Ladakh	4000-5000
Himachal Pradesh	<2000
Uttrakhand	2000-3000
Meghalaya (North-east)	NA

Annexure 2

List of organisations who formed part of the respondent pool

1. **Junaili** - a social enterprise based in Rautakhet, Uttarakhand
2. **Sagg Eco Village**, NGO with base and operations in J&K
3. **Pollinate Group**, an International Social impact organisation working with urban slum based and migrant communities across multiple locations
4. **INHERE**, NGO working in Uttarakhand
5. **Jan Chetna Sansthan**, NGO working with tribal communities in Mt. Abu, Rajasthan
6. **Teedi Forest Garden**, Rural Enterprise based in North East of India running multiple responsible tourism and conservation initiatives
7. **Bhima Enterprises**, social enterprise based in Rampur, Himachal Pradesh having close association with HRS range of products
8. **TARE** - Tirambhapur Askote Raj Ecosystem, working largely in Pithoragarh District of Uttarakhand supporting multiple SHGs in livelihood related projects
9. **JOSH Foundation** - NGO operating in J&K, Himachal Pradesh and Uttarakhand

10. **Earth Day Network** - International NGO with Pan India operations related to Clean energy access for the marginalised communities
11. **SNL Energy solutions** - a social enterprise, implementing solar based solutions for income communities in Manipur
12. **AAROHI, NGO** based in Nainital District of Uttarakhand working across Education, Health, Environment and Livelihood themed projects for the local communities
13. **NESFAS, NGO** working in the area of slow food and agro-bio diversity in NE states
14. **Jansamarth - NGO**, implementing community run solar solutions in Himachal Pradesh and Uttarakhand
15. **Gregory Shadow**, an individual working in Mahrishi Ashram working in Uttarkashi. He has been a supporter of Smokeless chulahs based on Rocket Stove technology and is carrying on the community work of awareness around clean energy access
16. **Envo Renewable** , a rural energy enterprise working for the underserved communities of the North- Eastern Region of India. They are working in the most remote and vulnerable areas of the Entire Region of N.E.

Questionnaire for institutions and experts

Demographics		
1	Name	
2	Name of institution	
3	Category of institution	❑ NGO ❑ Academic ❑ Think tank ❑ Government ❑ Rural enterprise ❑ Others (please specify)_____
4	Region of expertise or area of operations (choose all that apply)	❑ J&K, Himachal, HP, Uttarakhand ❑ Northern plains and Rajasthan ❑ North-eastern states ❑ Nepal
5	Category of the ecosystem most engaged with (select all that apply):	❑ Low-income rural households ❑ Low-income urban/ semi-urban households ❑ Tribal communities ❑ Sub-national governments and panchayats ❑ Manufacturers of clean cooking/ heating products ❑ Self-Help Groups ❑ Financial institutions ❑ Corporate sustainability ❑ Others (please specify)_____
6	What is the source of livelihood of the communities that you engage with?	Agriculture Craft Tourism

		Service MNREGA Others (please specify)_____
7	What is the average household size of the communities that you work with?	
8	What is the average monthly income of these households?	❑ 4000-6000 ❑ 6000-8000 ❑ 8000-10000 ❑ 10000 and above
9	Do they belong to any tribal groups?	❑ Yes (please name the tribal group, if possible)_____ ❑ No
Heating habits		
10	Do you think there is a need for an efficient heating device in this area?	❑ Yes ❑ No
11	In your experience with these households, are the cooking and heating devices the same?	❑ Always yes ❑ Sometimes yes ❑ Mostly no ❑ Never the same
12	What is the primary heating device used in the households in this region?	❑ Saggar ❑ Bukhari ❑ Sigri ❑ Chulha ❑ Angeethi ❑ Hamaam ❑ Others (please specify)_____
13	What is the secondary heating device used in the households in this region?	❑ Kerosene heater ❑ Electric heater

		❏ Halogen heater ❏ Others (please specify)_____
14	How many months in a year are heating devices used in this region?	❏ 2 months ❏ 3 months ❏ 4 months ❏ 5 months ❏ More than 5 months
15	Who is responsible for the collection and preparation of fuel for the heating device?	
16	Typically, which cooking method is most commonly used by the household:	❏ Kerosene stove ❏ LPG ❏ Mud stove ❏ Others (please specify)_____
17	What was the average cost incurred on heating devices in this region?	
18	Where are heating devices procured from?	
Improved heating solutions		
19	On a scale of 1 to 5 (1 being the lowest), how do you rate the availability of improved cooking/ heating solutions in this region?	❏ 1 ❏ 2 ❏ 3 ❏ 4 ❏ 5
20	If improved devices are available, which are the types of improved devices that you have seen in the region? Please specify names.	
21	Where are these devices available/ sold?	

22	What according to you pose as barriers for locals in the region to make the switch to improved devices?	❏ Availability of device ❏ Awareness of benefits ❏ Cost ❏ Poor after-sales ❏ Others (please specify)_____
23	What should manufacturers of improved heating devices do in order to deepen their penetration in the region?	❏ Devices should be available locally ❏ Devices should be available at a low cost ❏ After-sales services should be made available by the manufacturer ❏ The heating products should be durable ❏ Others (please specify)_____
24	Do you think that the community will be interested in buying an efficient heating stove that can also be used as a cooking device?	❏ Yes ❏ No ❏ Maybe
25	*If yes*: which of these costs is closest to what the consumers will be willing to pay for such a device?	❏ 2000 ❏ 3000 ❏ 4000 ❏ 5000 ❏ Others (please specify)_____
26	*If no:* what are the reasons?	
27	What would inspire consumers in the region to move to an improved heating device?	❏ Easy availability at a local store ❏ Positive feedback from trusted community members who use the device ❏ Availability at a subsidised cost ❏ Innovative financing solutions

		❏ Others (please specify)_____
Third party interventions		
28	Which government interventions can best support a move to improved heating methods?	
29	What is the role of corporates in helping in the growth of this sector?	
30	Name the corporates and large organisations that are active in your area.	
31	Are they running any CSR programmes? If yes, what kind?	
32	Which third party is the most effective in bridging the gap between the need and access to improved solutions in the region?	❏ NGOs ❏ Academic institutions ❏ Corporate donors ❏ Local government ❏ Others (please specify)_____
Fuel		
33	What is the primary cooking fuel used by households in the region?	❏ Cow dung ❏ Firewood ❏ Crop residue ❏ Others (specify)_____
34	What is the monthly expenditure on primary fuel?	
35	What is the average daily usage of firewood (in kg)?	
36	Where is firewood procured from?	❏ Farm ❏ Nearby forest ❏ Purchased locally

		❏ Others (please specify)_____
37	What is the time spent on a daily basis in the collection of firewood (in hours)?	
38	Who is responsible for the collection of fuel in the household?	
Health and environment		
39	Have there been sufficient awareness programmes on the health impacts of traditional cooking methods in this region?	❏ Yes ❏ No
40	Which of these health issues are amplified due to increased exposure to cold climate during the winter months?	❏ Coughing and cold ❏ Body aches and soreness ❏ Severe skin dryness ❏ Swelling in limbs ❏ Breathing issues ❏ Others (please specify)_____
41	Is the community aware of the environmental impact of emissions from the traditional methods of heating and cooking?	❏ Yes ❏ No
Engagement with HRS		
41	Would you be interested in partnering with Himalayan Rocket Stove (HRS) to introduce our low cost heating and cooking stove to your community?	❏ Yes ❏ No ❏ Maybe
42	If yes, how would you like to partner with us?	

List of respondents who formed the community respondents pool (Ladakh, Himachal Pradesh, Uttarakhand)

1. Asha Kaira
2. Anshuman Sen
3. Jitender Singh
4. Megha Negi
5. Swami Gango Sridhar
6. Goverdhan Lal
7. Asha Kohli
8. Deki Dolma
9. Narendra Kumar (Son of Bachi Ram)
10. Khim Singh Karki
11. Narender Singh karki
12. Bachi Ram
13. Deshraj
14. Arjun Thakur
15. Draupdi Devi
16. Seema Devi
17. Bilap Lakhim
18. Sonam Tayshi
19. Phunchok Dolma
20. Sonam Ladol
21. Stanzin Dolma
22. Tsering Butit
23. Tsering Dolma
24. Tsering Dorjay
25. Yangchan Dolma
26. Rigzin Dorjay
27. Skarma Dolma
28. Padma Namdol
29. Phuntsok Angmo
30. Jigmet Mentok

31. Sonam Nurboo
32. Tashi Dolma
33. Tsering Lhanzes

Questionnaire for communities

Demographics		
1	Name	
2	Number of family members	
3	Location (village/ city name)	
4	*To be input by interviewer: Altitude of this location*	
5	Do you belong to a local tribe or are you native of this location?	Yes/ No
6	What are the coldest months in this location where you use the heating device?	❏ Dec/ Jan ❏ Jan/ Feb ❏ Nov/ Jan ❏ Nov/ Mar
7	What kind of temperatures do you experience during winters? (in degree Celsius)	❏ <10 ❏ <5 ❏ 0 ❏ Sub-zero ❏ Others (please specify)_____
8	What is your average monthly income? Are you the only earning member in your household?	❏ 4000 - 6000 ❏ 6000 - 8000 ❏ 8000 - 10000 ❏ 10000 - 12000 ❏ Others (please specify) _____

9	Do you have access to electricity? If yes, how many hours a day do you have electricity access for?	
10	Source(s) of livelihood	❑ Agriculture ❑ Craft ❑ Tourism ❑ Service ❑ MNREGA ❑ Others (please specify)_____
11	Are you a member of a Self-Help Group/ Farmer Producer Group? If yes, please specify.	❑ Yes_____ ❑ No
12	What method of heating do you use for home heating during the winter months?	❑ Traditional heating device ❑ Charcoal ❑ Bonfire ❑ No heating device used ❑ Chulha ❑ Others (please specify)_____
13	What is the size of the room where you have installed the heating device?	
14	When do you use the heating device?	❑ Only at night ❑ Throughout the day ❑ A few hours in the day and a few hours again at night ❑ As and when required/ no specific time
15	Is your cooking and heating device the same?	
16	*In case of different devices for heating and cooking:* What is your primary heating device?	❑ Saggar ❑ Bukhari ❑ Sikri ❑ Chulha ❑ Angeethi

		❏ Hamaam ❏ Others (please specify)_____
17	What is the weight of this device?	
18	What fuel do you use for heating purposes?	❏ Firewood ❏ Animal dung ❏ Coal ❏ Kerosene ❏ LPG ❏ Electricity ❏ Crop residue ❏ Others (please specify)_____
19	Who is responsible for the collection and preparation of fuel for the heating device?	
20	How was this heating device procured?	❏ Self-built ❏ Gift from family ❏ Received from an institution (NGO/ religious institution) ❏ Purchased ❏ Other (please specify)_____
21	*If not self-built or gifted:* When did you purchase this heating device?	
22	*If not self-built or gifted:* What was the cost of this heating device?	
23	*If not self-built or gifted:* Where did you buy this heating device from?	
24	Do you burn plastic for heating and/ or cooking?	❏ Yes

		❑ No
25	How often do you need to repair the device?	
26	Do you repair the device by yourself?	
27	What is the cost incurred by you on each repair?	
28	Is it easy for you to repair this device?	❑ Yes ❑ No
29	Are you satisfied with the heating device?	❑ Yes ❑ No
30	What do you like about the heating device?	❑ Heating capacity ❑ Ease of usage ❑ Affordable ❑ Easily available ❑ Weight ❑ Heat retention ❑ Others (please specify)_____
31	What do you dislike about the heating device?	❑ Heating capacity ❑ Quality of product ❑ High smoke emissions ❑ Costly ❑ Heat retention ❑ Others (please specify)_____
32	Have you heard of any improved heating and cooking devices which consume lower fuel and emit less smoke?	❑ Yes ❑ No
33	If yes, which are the types of improved devices that you know?	
34	Would you consider moving to alternate/ improved solutions for heating?	❑ Yes

		❏ No ❏ Maybe
15	If yes, what are the reasons nudging you towards this switch?	
35	If no, why not?	
36	What would encourage you to move to an improved heating device?	❏ Availability at a local store ❏ Positive feedback from trusted community members who use the device ❏ Availability at a subsidised cost ❏ Others (please specify)_____
37	Where is the kitchen in your house located?	❏ In the living area ❏ Outdoor but attached to the house ❏ Separate kitchen outside ❏ Separate area
38	What is the size of the kitchen?	
39	Is the kitchen ventilated?	❏ Yes ❏ No
40	Which of these cooking/ heating methods is used by the household?	❏ Kerosene stove ❏ LPG ❏ Mud stove ❏ Improved cookstoves ❏ Induction stove ❏ Electric heater ❏ Others (please specify)_____
41	What is the primary cooking fuel used by the household?	❏ Cow dung ❏ Firewood ❏ Crop residue

		❏ Others (please specify)_____
42	What is the monthly expenditure on primary fuel?	
43	What is the average daily usage of firewood (in kg)?	❏ <5 ❏ <8 ❏ <10 ❏ >10
44	Where is firewood procured from?	❏ Farm ❏ Nearby forest ❏ Purchased locally ❏ Others (please specify)_____
45	What is the time spent on a daily basis in the collection of firewood (in hours)?	
46	Do you or your family members face health issues due to exposure to cold during winter months?	❏ Coughing and cold ❏ Body aches and soreness ❏ Severe skin dryness ❏ Swelling in limbs ❏ Breathing issues ❏ Others (please specify)_____
47	Do you or your family members face other issues in the winter months, such as:	❏ Unable to work due to extreme cold weather ❏ Children unable to study ❏ Discomfort to senior/ old family members ❏ Impact on livelihood ❏ Winter months have no major impact on your life
48	Are you aware of the health impacts of traditional methods of cooking and heating?	❏ Yes ❏ No ❏ Somewhat

49	Are you aware of the environmental impact of smoke through the traditional methods of heating and cooking?	❏ Yes ❏ No ❏ Somewhat
50	Would you be interested in a stove/ device that allows you to cook all through the year and can also be used as a heating device during the winter months?	❏ Yes ❏ No ❏ Maybe
51	If yes, how much are you willing to pay for this device?	❏ 2000 ❏ 3000 ❏ 4000 ❏ 5000 ❏ Others (please specify)_____
52	Any additional comments or insights to be added by the interviewer:	

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Smokeless Cookstove Foundation, (SCF) is a 100% non-profit venture Licensed under section 8 (1) of the Companies Act, 2013; SCF has received 12AA and 80G. (Donation to Smokeless Cookstove Foundation is exempt as per the provisions of Section 80 G of The Income Tax Act, 1961 vide Certificate No. CIT(E)/80G/2997/2019-20 dated 28th May, 2019 valid from A.Y. 2019-2020 onwards until rescinded.)

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SMOKELESS COOKSTOVE REVOLUTION

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