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MONGOLIA - NATIONAL LOW EMISSION STOVE STRATEGY REPORT

Completing the Transition to a Sustainable Market for Cleaner Stoves in Mongolia

November 2014

The World Bank Group

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With generous support from the Australian Government

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ABBREVIATIONS

ADB	Asian Development Bank
aimag	Administrative region of Mongolia, equivalent to a province
ASTAE	Asia Sustainable and Alternative Energy Program
AQS	Air Quality Standard
AusAID	Australian Agency for International Development
CAF	Clean Air Foundation
CDM	Clean Development Mechanism
CHP	Combined Heating and Power
CSI	Clean Stove Initiative
DSA	Distribution and Sales Agent
duureg	Largest administrative district of Ulaanbaatar City
EAP	East Asia and Pacific
ger	Wood-framed, felt-covered dwelling traditionally used by nomadic households and households in high density areas of towns including Ulaanbaatar
hashaa	Small fenced-in plot typically occupied by a single household or family
IDA	International Development Association (The World Bank Group)
kheseg	Smallest administrative subdivision of Ulaanbaatar City below the level of Khoroo, about less than 100 households
khoroo	Administrative subdivision of Ulaanbaatar City below the level of duureg, about 1000 households
kW	Kilowatt
Low-e	Low-emission
LPB	Low Pressure Boiler, also SWHB
LPG	Liquefied Petroleum Gas
MASM	Mongolian Agency for Standardization and Metrology
MJ	Megajoule
MVR	monitoring, verification and reporting
PC	Product Center
PM	Particulate Matter
QAA	Quality Assurance Agent
REAP	Rural and Renewable Energy Access Project
SDC	Stove Development Center
SEET	Stove Emissions and Efficiency Testing laboratory owned by MUST
SMS	Short message system (texting on a mobile phone)
soum	Administrative division below the level of aimag, equivalent to a county or township
SSIA	State Specialised Inspection Agency
SWHB	Small water heating boiler, also LPB
Tg	Mongolian Togrog (currency)
UBCAP	Ulaanbaatar Clean Air Project
WHO	World Health Organization
µg	Microgram

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FOREWORD

2012 was declared the Year of Sustainable Energy for All by the United Nations and established universal access to modern energy services by 2030 as a key target set for this initiative. By that year, Mongolia already set out to achieve access to cleaner, affordable cooking and heating appliances in peri-urban ger areas of Ulaanbaatar. Despite initial success, a sustainable, clean stove market has not yet been established due to a number of challenges. The heating and cooking conditions in Mongolia are relatively unique in the world, combining a tradition to cook and heat with the same appliance in a climate with extremely low temperatures, poor households living in thinly insulated homes comprising mainly felt "ger" tents and small, cheaply constructed detached houses, and no affordable or securely supplied fuel alternatives to low quality coal. Because stoves are not efficient and clean burning, they cause severe winter air pollution making winter days some of the most polluted in the world in Ulaanbaatar. Some other Aimags have also reported winter air quality problems for the same reasons. Additionally, Mongolia achieved a very high penetration of cleaner, mainly imported, stoves in a very short period of time in its largest market, Ulaanbaatar. This contrasts it with more gradual market development approaches in other cookstove programs globally. With its unique challenges and near term success story, Mongolia's clean stove initiative also has the potential to significantly contribute to the international body of knowledge in development of cleaner cookstoves.

Reducing emissions from heating and cooking are part of the Mongolian Government and Ulaanbaatar Municipality's multi-year, multi-sector strategy to improve air quality in Ulaanbaatar. Lower emission stoves are considered a short term pollution abatement measure. Short term measures can move forward more quickly than More permanent solutions, such as improved housing, which take time to prepare and implement. Penetration of cleaner, low emission models in Ulaanbaatar over the past few years has indeed contributed to better air quality. This success came about with hard efforts from many ministries, central government agencies, the Ulaanbaatar municipality, Mongolian universities, laboratories, donors and international financial institutions.

However, the achievements and investments are at risk for a number of factors discussed in this report. The risks are sufficiently serious that they could even reverse hard-won air quality improvements. Stoves, fuels, users' habits, dwelling characteristics are key factors to determining fuel combustion and emissions. Prices, quality, reliable private sector supply chains, maintenance, standards and regulations are key building blocks for a commercial market. The right combination of these factors, adjusted to local conditions, can build a sustainable low emission stove market. The available technologies and fuels, supply chain capacities, market demand segments, user preferences, incentives and regulations are key features of stove switching programs. Designing a program that considers all these factors is not easy and requires strong coordination across central and local government agencies, reliable private sector participation, stable financing sources, and good program management. Monitoring and evaluation of stove switching programs is critical because technologies, suppliers, and market demand change over time.

Building on six years of technical assistance, policy dialogue and recent stove switching program experience in Ulaanbaatar, this report sets out a proposed national low-emission stove strategy for Mongolia The objective of the strategy is to establish a sustainable market for low emission stoves in Mongolia. The report focuses on clean heating and cooking stoves as well as small water heating boilers used in peri-urban ger areas of Ulaanbaatar and other Aimags and Soum centers.

The strategy is valid for the current clean stove market development situation and may change in the near future. Therefore, results should be monitored and fine-tuned when needed.

This report, it's asusumptions, suggestions and recommendations are valid for the clean stove market as of the time of writing this repor. Conditions are dynamic and can influence the design of the strategy. Recently, the Australian Government provided funds through the World Bank to sustain this dialogue through the Mongolia Clean Stove Initiative technical assistance project, which financed the development of this report.

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The co-authors of this report are Gailius J. Draugelis and Robert van der Plas with substantial contributions from Dr. Yun Wu. The report was prepared under the guidance of Gailius J. Draugelis, Task Team Leader of the Mongolia Clean Stove Initiative. The strategy also built upon previous research, analysis and studies of the Mongolia CSI team, including Voravate Tuntivate and Chris Sall, who were co-authors with Gailius Draugelis of the stocktaking report referenced in this strategy.

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This strategy builds upon the efforts, reports and discussions of many development partners including the Asian Development Bank, the United States Millennium Challenge Corporation, the Japan International Cooperation Agency, the EBRD, GIZ, the United States Agency for International Development, the Swiss Development Cooperation, among many others. The team is most grateful for their knowledge sharing and insights.

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EXECUTIVE SUMMARY

The Challenge to Sustaining Emissions Reductions from Low-Emission Stoves in Ulaanbaatar

Access to clean, affordable cooking and heating solutions currently is the key short-term measure to reduce the severity of Ulaanbaatar's (UB) air pollution. They can also help reduce air pollution in other urban cities of Mongolia where stoves are used for heating and cooking in the winter. Coal and wood burning for heating of individual residences, essential for survival in the harsh winters, contribute about 60 percent of the annual fine particulate (PM2.5) concentrations in Ulaanbaatar.[1] Observed high levels of exposure in the winter are extremely harmful to health and exceed World Health Organization (WHO) standards many-fold[2]. The potential benefits of lower emissions from stove switching are large. A 50% reduction in emissions from ger area stoves can yield economic benefits of an estimated US$28-52 million per year; and an 80% emission reduction can yield benefits of an estimated US$52-96 million per year. Even a 30% emission reduction can generate benefits of an estimated US$15-29 million annually (World Bank, 2011). These benefits appear to justify the estimated size of investment already made by the Government and donors in stove switching of about US$30 million.

Recent air quality improvements in UB coincide with the large scale switching to low emission (low-e) stoves in ger areas. Unfortunately, data from monitoring stations is not systematically collected for $PM_{2.5.}$ From available statistics, monthly average $PM_{2.5}$ concentrations decreased by 20 to 40 percent in coldest winter months of January and February, and by 20 to 30 percent in warmer months of March and April, compared to monthly averages in 2011.There are some data inconsistencies where some monitoring stations reported no large changes. These inconsistencies should be addressed with a better distribution and maintenance of stations across UB, including in ger areas, and ensuring that these monitor fine particulates. Nevertheless, the recorded reductions happened at a time of continued population growth in the ger areas[3]. In these 3.5 years by January 2014, a total of 135,193 stoves were purchased and 131,206 stoves have been installed. This is an impressive penetration rate by any measure internationally.

These results face important headwinds and have a better chance of being sustained and improved if a large part of urban stove users use low emission (low-e) stoves inside - and outside UB. There are seven important challenges:

- First, demand in all stove market segments continues to increase and shift toward higher energy consuming units, such as small water heating boilers.

1 Air Quality Analysis of Ulaanbaatar Improving Air Quality to Reduce Health Impacts; World Bank, December 2011

2 The highest average daily concentration of PM 2.5 in 2009 was over 4000 µg/m3, compared to average annual concentrations of 75-150 µg/m3 in the city center to 200-300 µg/m3 in ger areas. The Mongolian annual ambient air quality standards are 50 µg/m3 and 25 µg/m3 for PM10 and PM2.5, respectively, while the WHO interim targets for developing countries are 70 µg/m3 for PM10 and 35 µg/m3 for PM2.5.

3 About 128,000 people entered Ulaanbaatar between 2010 and 2014; source: MUB statistics

- Second, there are no qualified local stove models produced at scale thus far. Current list prices of imported stoves are unaffordable without high subsidies. Without the subsidy, traditional stoves will out-compete low-emission stoves at current prices to meet growing demand. The difficulty of adjusting this distortion should not be underestimated - consumers are now used to very high quality products at unreasonably low prices. Resistance from current low-e stove suppliers to changes in the subsidy mechanism can be substantial because it would introduce competition, force a change to the business model, and perhaps switch to different stove models to meet prices that households can afford without high subsidies.
- Third, there are high transaction costs relative to the market size outside Ulaanbaatar; therefore, under present conditions it is highly unlikely that clean stove production outside Ulaanbaatar is a viable business model.
- Fourth, there is a risk that the technical capacity and materials for maintenance of low-emission stoves that have already been sold will diminish considerably after warranty periods expire.
- Fifth, despite training, consumers have a hard time breaking traditional fuelling/cooking habits when using low emission stoves. Improper use of new stoves increases their emissions. While they don't have to, new models do not necessarily take into account traditional habits. This requires more training and awareness. And, it opens the door to competition for even more attractive models.
- Sixth, there are regulatory gaps and lapses in policy coordination to support low emission stoves, such as insufficient attention to small water heating boilers, a lack of enforcement of standards (which traditional stoves do not meet), and weak coordination between clean stove and alternative fuel programs.
- Seventh, stove markets, including the low-emission stove re-sale market, inside and outside Ulaanbaatar are intricately linked. This can be a challenge – traditional stove producers outside Ulaanbaatar could re-enter the UB market. If the Government decides to stop subsidies abruptly without a comprehensive policy that supports a transition to low-emission stoves, users may have no choice but to buy traditional stoves because they are available and affordable.

A Proposed Strategy for Transforming Mongolia's Stove Market – Building a Sustainable Market for Low Emission Stoves

In his meeting with the World Bank on January 28, 2014, Prime Minister Altankhuyag confirmed low-e stoves are the Government of Mongolia's priority short-term air pollution abatement measure and that the policy objective for the GOM and MUB is to transition to a sustainable low-e stove market so that their air pollution reduction benefits could be sustained. The World Bank was asked to lay out the challenges and propose measures that could help to achieve this objective. This report is the response to this request. The following package of policies and support measures is proposed to support this objective.

From the outset if a national strategy is pursued, the NCAPR and UB municipality should commit to continuous monitoring and evaluation of their strategy. Market conditions will change, and can do so quickly.

Promote sale of low-e stoves nationally to all urban areas, but with a strong focus on Ulaanbaatar's market as the foundation for innovation and private sector supply. Expanding nationally can address several problems simultaneously. First, it eliminates the need for a black market for low-emission stoves. Provided prices are comparable, it would reduce incentives for Ulaanbaatar ger-area residents to sell low-emission stoves to outside markets, which currently have no access to affordable low-e stoves. Second, it also contributes to addressing winter air quality problems in other cities. Air pollution is an issue not just in Ulaanbaatar but also for 10 other cities (where in 2014 state budget resources are allocated to support air pollution mitigation). Third, expanding the market nationally would reduce dependence on regulations that prohibit re-sale of stoves, which will still be needed but may be difficult to enforce. Fourth, it moves Mongolia closer to providing universal access to clean cooking energy especially to urban areas, complementing its other successful initiatives of providing access to electricity to 100,000 herders through the provision of solar PV home systems. A national market would be promoted by expanding the number of eligible households, providing supportive incentives and market-friendly regulations, and designing a small water heating boiler improvement program.

Currently, there is concern about the re-sale of stoves to users from outside Ulaanbaatar, mainly driven by the high subsidy levels and lack of access to stoves outside UB. This could be addressed through rigorous enforcement of anti-resale regulations, but it may be difficult to do so, for instance to impose fines on individual households, especially poor ger residents. The arbitrage opportunity for re-sale of stoves that are priced less than a traditional stove would be greatly eliminated if every household was eligible to buy a low-e stove nationally. Suppliers confirmed during stakeholder consultations that it is feasible to supply various models of low-e stoves that can meet current requirements for emissions performance but are at lower list prices of about US$150/unit. In October 2013, the black market price of a low-e stove was about US$200, or about half the current list price and about twice the price of a traditional stove.

Ulaanbaatar is able to sustain support for innovation through its research institutes, financing institutions, and infrastructure. In addition, the stove switching program has not reached a sufficient number of ger households, especially the ones living further away from the city center (but still affecting air quality in the city center), and in underserved market segments like heating walls and small water heating boilers. Other Aimags do not have this economy of scale. Based on consultations, it is clear the consensus is to use strengths of the UB program and maintain a central focus on UB while also serving other areas in Mongolia.

The strengths of the successful stove switching program in Ulaanbaatar should be maintained in a national program. The enlarged program would should maintain these design principles: (a) preserve consumer choice of many models; (b) encourage innovation and set transparent standards that can be supported through laboratory emissions performance testing at the Stove Emissions and Efficiency Laboratory of the Mongolian University of Science and Technology and the proposed Stove Development Center; (c) ensure professional supply and quality with strict program requirements; (d) create conditions to drive down list prices so that, eventually, subsidies will no longer be needed. UB's experience demonstrates

that an adjustment to the combination of incentives and regulations to encourage scale economies as much as possible, retain fair competition among different stove models, and reduce overall program implementation costs.

It should also retain the strengths of the current program: (i) only stoves and producers of high quality and capacity are eligible; (ii) trading in old stoves is required; (iii) after sales service is guaranteed by the producer for a limited period of time; (iv) a consumer-subsidy is applied for eligible households (one-time purchase); (v) a quality assurance mechanism that verifies installation and extra training in stove use by a third party; (vi) a strategic, public awareness campaign informs households of their responsibilities and reinforces government policies such as discouraging re-sale of stoves; (vii) financing plan of the program would remain a combination of both central and local government and private sector sources.

Modifications to the program should address its weaknesses and the characteristics of a national program. The strategy includes the following adjustments:

- Modify eligibility criteria for consumer subsidies to include all registered urban users of traditional heating stoves. The goal is to motivate households to voluntarily replace in 3-4 years the use of all traditional stoves and unqualified small water heating boilers with low emission models that meet national standards.
- Gradually start enforcing a ban on traditional stoves, first through strengthened public awareness about the health damages from traditional stoves (and benefits of low emission ones) and then through regulation.
- Gradually expand low emission stove supply chains to Aimags outside Ulaanbaatar starting with the ten Aimags that have reported winter air quality problems
- Maintain but simplify the consumer subsidy mechanism by setting a single fixed level of subsidy or a fixed percentage of the retail price for any eligible stove model. High performing stoves that are lower priced are available on the global market, but not in Mongolia. Encourage micro-credit financing of the larger household payments for low emission stoves.
- Maintain but simplify the quality assurance mechanism (verification through quality assurance agents) over about the next two years after stove suppliers are more firmly established. The system can move to a formal licensing system for suppliers with checking based on a sampling method rather than nearly 100 percent checking as it is now.

Strengthen coordination of policies to improve coherence and support national expansion. Follow the principle of evidence-based interventions. There are several key actions needed: First, the National Coordination Committee on Air Pollution Reduction (NCAPR) should be responsible for ensuring policies are well coordinated, and overlaps and conflicting ones avoided. The NCAPR includes representation of all main pollution abatement policy stakeholders, headed by the Prime Minister's office and is well placed to also oversee this strategy. Executive Summary Table 1 summarizes the key institutional roles and responsibilities proposed for implementing this strategy. Second, the Ulaanbaatar city should take the lead in ensuring the strategy is implemented in its city and coordinate closely with the NCAPR for implementation outside the city. Because Ulaanbaatar plays

a central role in the supply of low emission stoves, parts and services to markets outside UB, Ulaanbaatar city leadership should play an active role in the NCAPR to ensure coordination and policy coherence. If these two do not work together, there is a risk of failure.

Table 1: Suggestions on Institutional Responsibilities for the Nationwide Roll-out

	Possible Key Roles	Preparation	Implementation
Parliament	Enact legislation, make funding available	Order the strategy roll out and monitor progress	Monitor progress
NCAPR	Coordination of all activities ensuring policies and programs are coherent and avoid contradictions (including awareness campaign), oversight of implementation (oversight can also be done via smaller Steering Committee)	Coordinate with all stakeholders to prepare plan for roll out Oversee implementation, coordinate, review feedback, fine tune strategy and plan, ensure budget is available	Monitor results, fine tune strategy, and ensure budget is available
Ministry of Environment	Ensuring protection from harmful air pollution via policy and program support, including monitoring and reporting on air quality. Executing responsibility as Chairman of Board of the Clean Air Foundation	Develop and implement supportive policies, including improving $PM_{2.5}$ monitoring and reporting system in Ulaanbaatar and other cities and set up a system for analysis of results. Report on results to civil society periodically. Identify other opportunities for introducing emission control technologies.	Report on results and improvements of air quality improvement
Ministry of Energy	Ensuring expanded access to clean energy for heating and cooking via policy and program support, including coordination between clean fuel and clean stove policies	Develop and implement supportive policies, ensure monitoring and reporting system set up to monitor fuel and stove use. M&E system to follow progress of clean energy access and actual stove performance in terms of emissions and fuel consumption.	Report on results in terms of stoves disseminated, fuel use changes
Ministry of Finance (or, partially, Clean Air Fund)	Ensuring fiscal resources are provided under approved budgets and other approved fiscal measures are executed.	Develop and, once approved, implement range of fiscal and tax measures incentivizing clean technology use and preventing polluting technologies (i.e. import duty scheme, company tax, and VAT) Monitor budget execution comparing with results	Apply scheme and monitor implication on the national budget
MUB	Ensure strategy and stove switching is implemented in Ulaanbaatar, ensuring supporting policies and programs are coherent and well coordinated within UB and the national program.	Implement UBCAP project, develop and implement supportive measures, including ensuring good coordination between NAMHEM and Ulaanbaatar Air Quality Agency (increasing its capacity to for monitoring and analysis), assisting in development and enforcement of standards within the framework of the law	Assist SSIA with enforcing the standards

Khoroo and kheseg leaders	Oversee stove switching within their jurisdiction, provide support where necessary, participate in identifying eligible households and preventing fraud	Take stock of results and communicate potential market to PMU	Maintain family books, sensitize households to participate
Aimag Governor and local leaders	Oversee stove switching within their jurisdiction, provide support where necessary, participate in identifying eligible households and preventing fraud	Participate in public awareness campaign, develop lists of eligible households, help to identify PCs and QAA	Sensitize households, monitor results
MFIs and Donors	Can provide a wide range of resources, depending on donor country strategies and requests from the government	UBCAP and JICA are currently focused on Ulaanbaatar only. World Bank provides technical assistance to inform both Ulaanbaatar and national policy. Other agencies also providing important support.	Monitor results and IFIs/Donors respond to other requests for support if possible. Commercial Banks to participate in implementation where feasible.
Commercial Banks	Encouraged to participate in financial management of the stove switching program, replicating Ulaanbaatar system as much as possible, encouraged to offer micro-credits for (increased) down payments for low-emission stoves and potential supply side financing	Engage with government on possibility of managing PCs in Ulaanbaatar and establishing system of accepting HH payments across the country, managing subsidy funds flow to producers and, if role continues as PC, developing a nation-wide monitoring database of purchases, payments and installations	
Clean Air Fund	Manages and allocates funds for air pollution abatement measures.	Continue to finance subsidies and elements of the national strategy. If it still remains, CAF can be a stable funding source.	
Mongolian Agency for Standardization and Metrology	Set standards for heating systems	Together with SEET lab, MUB/ AQD, Min of Env, Min of Energy set standards for heating stoves, heating walls, and SWHBs	Fine tune standards if applicable, due to new technological innovation
State Specialised Inspection Agency	Enforce air quality standards for heating appliances	Prepare a plan for gradual application of the standards	Enforce the standards
PMU	Manage implementation	Prepare plan for rolling out to 10 aimags. Develop contracts between PC, QAA, PMU, suppliers, and local bank offices in soums. Possibly may need to maintain database of purchases, payments and installations	Coordinate between all stakeholders and provide management assistance when needed

Suppliers	Private sector investment and commercial skills to develop/ import and sell attractive stove models, contributing significantly to reduction in air pollution. Provide maintenance and repair services during warrantee period	Private sector invited to provide feedback on the implementation of the strategy also as part of their interests in corporate social responsibility. Current private sector suppliers work with government to develop viable plan for after sales services outside Ulaanbaatar and after warranties expire. Possible work with SDC to develop training program in servicing low-emission stoves targeting current traditional stove producers. Suppliers encouraged to diversify models and supply chains.	Set up sustainable supply chain of low-emission stoves
Media	Communicate the rationale for stove switching and behavioral change	Prepare households for the upcoming changes to the modalities of the stove witching program.	Maintain the messages and prepare for the changes in the program (removal of subsidy, enforcement of standards).
Households	Buy low-emission stove and use correctly		Phase out use of non-low-emission stoves and SWHB

Third, a well-funded, well-staffed and competent Project Management Unit should be appointed to manage the implementation of the strategy nationwide. The PMU reports to the NCAPR, which provides a governance structure that acts in concert across multiple agencies. The PMU should remain active until the market for low-emission stoves has been established. It should be able to communicate and interact regularly with high level politicians, technical Ministries and Municipality staff, and donor agencies. It should also have as strong procurement and administrative capacity. The main role of the PMU is to manage the implementation of all activities and coordinate between all actors to ensure that they all realize their tasks.

Fourth, NCAPR and UB city should encourage international cooperation, scientific exchanges and knowledge sharing with other countries facing challenges in access to household cooking and heating solutions. Mongolia is a member of the Global Alliance for Clean Cookstoves and there have been initial contacts with the University of Johannesburg and Agriculture University in Beijing. These are important channels for scientific and policy knowledge sharing.

Fifth, both NCAPR and Ulaanbaatar city will also have an important role in coordinating an awareness campaign for continued public awareness of air quality issues, results, and building broad-based support and understanding of this program. The public awareness campaign needs to be more tightly planned and its key messages delivered consistently by key stakeholders, including members of the NCAPR and Ulaanbaatar city, so as to build and sustain both political and public support for the strategy. Ultimately the market is made up of customers who must be convinced of the science, the technology and the benefits of the stove switching program. It is they who need to be convinced to buy new stoves, even if their traditional polluting stove is working fine, and to change some behaviors on

fuelling and cooking to accommodate the new technology (so that the stoves emit particulates as little as possible). They need to be convinced that these actions contribute to the wellbeing of those who are important to them. They need to be convinced that these inconveniences are outweighed by the benefits. The awareness campaign should also be used to report back to the public what are the current results of air pollution reduction efforts so that they can feel connected to the effort to clean up the air.

Sixth, the policy making process for low emission stoves should follow a systematic and more disciplined framework. Emissions performance of stoves depends on three factors: stoves, fuels and users. The policy mix of incentives and regulations should consider how they impact any of these factors. Fuels should not be ignored. For example, Baganuur coal use in traditional stoves has been shown to double emissions compared to Nalaikh coal in traditional stoves. There are also practical considerations – it is not realistic to expect households who recently switched their stove, to switch again just because there is a new fuel.

Stove emissions testing – the result of burning the fuel in the stove – is critical to informing policy makers. Effects of different models or fuels need to be known before substantial public funds are allocated. Unlike many countries, Mongolia benefits from having a local laboratory, the Stove Emissions and Efficiency Testing Laboratory, that is owned by the Mongolian University of Science and Technology to carry out performance tests locally. However, these tests are conducted in a laboratory setting following user manuals strictly – this is not typical user behavior. Field tests could be conducted to help understand the differences. The SEET Lab is encouraged to provide such caveats in the report based on its judgment on the ease of use of the new technology. The SEET Lab should also develop a testing protocol for small water heating boilers (SWHB) as soon as possible to inform policy makers on the potential benefits of an improved SWHB program.

Seventh, the NCAPR and UB city should start introducing well-coordinated fiscal and regulatory policies that foster innovation, ensure spare parts, and protect the population from polluting stoves. Incentives and regulations should work together to make purchase of low emission stoves easier, while making supply and purchase of dirty stoves harder, eventually banning them altogether. It does not make sense to provide fiscal incentives such as consumer subsidies while dirty stoves are still allowed to be manufactured with no plan to phase them out. Minimum performance standards for stove-fuel combinations need to be established and approved by the relevant authorities – and these should apply equally to local products and imports. Enforcement of the policy to apply these standards will also need a comprehensive set of supportive measures to prevent the production, sale, and use of dirty stoves, and to encourage the production, sale and use of clean stoves.

Eighth, appropriate sequencing of policies is needed and this strategy includes a roadmap for its implementation. Additionally, monitoring and evaluation early and often is needed to ensure the mix of new policies is achieving desired results. Every strategy has inherent risks. The key risk of the strategy is the lack of response from the private sector. Very close cooperation and consultation with the private sector in calibrating the rules of the game for the next phase of Mongolia's clean stove initiatives will be needed. Another risk is the lack of political support for a continued program – the rapid success rate may incorrectly signal "mission accomplished". The role of the NCAPR

should address these views and ensure adequate awareness of the issues. The NCAPR should continually review policies to adjust to changing market dynamics, user preferences and program experience.

Ulaanbaatar is the coldest capital in the world, it does not need to be its most polluted

The main economic benefit from implementing the strategy is the fact that the current level of health benefits in Ulaanbaatar can be maintained and does not deteriorate, despite population growth. The largest cost element of implementing the strategy is the subsidy itself. The average 2009 economic costs of air pollution have been estimated at almost US$ 2000 per household. The benefits of USD 52-96 million per year (mean of 74 million) as estimated under the 80% AMHIB scenario are equivalent to USD 211 per year per household in Ulaanbaatar. The actual one-time subsidy paid so far ranged from US$ 250-350 per stove: this level of costs is far below the annual economic benefit obtained from using these stoves. Annex 2 of this strategy provides additional economic analysis.

While stoves are only part of the answer to solving Ulaanbaatar's air quality problems, the analysis in this strategy lead to a conclusion that a higher share of the urban population needs to have access to cleaner stoves in order to sustain and increase their contributions to air quality improvements especially in Ulaanbaatar. The strategy calls for not only expanding to other urban markets but also for introducing and enforcing standards for small water heating boilers, which have received little attention thus far. It recognizes there are links between stove markets in Ulaanbaatar and other aimag centers. This can be a threat, but it can also be an opportunity as described above. Building on the strengths of the current stove switching program, the strategy addresses 'sustainability gaps' that prevent the full transformation of the market for cleaner stoves. This includes national expansion, revising and gradually enforcing stove and SWHB standards, revamping fiscal incentives to help import needed spare parts and materials, supporting local producers including developing their skills for repair and maintenance of new technologies, revising the consumer subsidy mechanism and phasing it out over three years, and sharpening messages in a strengthened public awareness campaign. Monitoring and evaluation should be a norm at the NCAPR and UB city. All these actions would add up to a better and more sustainable effort to build up a sustainable clean stove market in Ulaanbaatar. If successful, cleaner, low emissions stoves will allow citizens of Ulaanbaatar and other cities breathe easier during winter months.

CHAPTER 1 - INTRODUCTION

Ulaanbaatar is the coldest capital of the world and it is also one of the most polluted. Coal and wood burning for heating of individual residences in ger areas, although essential for survival, contribute about 60 percent of the annual fine particulate ($PM_{2.5}$) concentrations in the city[4]. The remainder of the emissions comes from the CHP and HOB exhaust stacks, and suspended wind-blown dust. Observed high levels of exposure in the winter season are extremely harmful to health and exceed World Health Organization (WHO) standards many-fold[5].

With the objective to reduce Ulaanbaatar air pollution, the MUB laid out short-, medium-, and long-term measures (Smoke Free Ulaanbaatar, March 2010, Resolution 81)

a) short-term measures include implementing a population remigration policy; relocating the central market, the railway's freight terminal, and some factories and offices; to replace most firewood and coal heating stoves used by households in ger areas of Ulaanbaatar with a variety of alternatives (such as briquettes of compressed sawdust, processed coal, semi coked coal, electricity – and cleaner stoves); use electric appliance at night using a special electricity tariff in certain parts of the ger areas; and to start the supply of gas from coal as government's main policy.

b) medium-term measures include encouraging people to live in apartments, construction of university campuses, relocation of factories, and enhanced surfacing of roads; and

c) long-term measures include cleaner and larger power and heating plants, more apartment buildings and greening of the city through parks as well as a more comprehensive and efficient road network.

One of the key short-term measures is provide access to clean and affordable cooking and heating appliances, especially for poor, peri-urban residents who use stoves for cooking and heating in winter. The World Bank's study (World Bank 2011) estimates that a relatively rapid reduction of 80% of emissions from ger area heating could achieve a 48% reduction in population weighted exposure to PM2.5. The total estimated associated economic benefits (World Bank 2011) in terms of avoided health damage are estimated at 144 million USD per year. To achieve this, poor households need to permanently switch to less polluting heating solutions, an effort that will require a multi-year, coordinated set of policies and programs. Medium and long-term action will be required to make these improvements in air quality permanent, by moving away from individually heated homes and relocating industries.

Traditionally used stoves and coal fired stove-furnaces (called Small Water

[4] Air Quality Analysis of Ulaanbaatar Improving Air Quality to Reduce Health Impacts; World Bank, December 2011

[5] The highest average daily concentration of PM 2.5 in 2009 was over 4000 µg/m3, compared to average annual concentrations of 75-150 µg/m3 in the city center to 200-300 µg/m3 in ger areas. The Mongolian annual ambient air quality standards are 50 µg/m3 and 25 µg/m3 for PM10 and PM2.5, respectively, while the WHO interim targets for developing countries are 70 µg/m3 for PM10 and 35 µg/m3 for PM2.5.

Heating Boilers or SWHBs) used by wealthier households are the main sources of the severe ground-level wintertime pollution. Households use a stand-alone, hybrid heating/cooking stove in gers and small, wooden or brick detached houses. Traditional stoves are quite dirty. They emit as much as about 600-700 mg $PM_{2.5}$ per net MJ when using Nalaikh coal or about 1400-1500 mg $PM_{2.5}$ per net MJ when using Baganuur coal. In larger houses, these stoves can be attached to a heating wall (HW). The emission performance when stoves are attached to a heating wall has not been measured, but it is expected to be similar to that of stand-alone stoves. Additionally, in even larger detached houses, households use small water heating boilers (SWHBs) with rudimentary radiator and hot tap water systems. Emission performance of SWHB has not been carried out yet but households with SWHBs burn up to 3 times more coal than gers in a winter season.

The overwhelming majority of households in the ger areas of Ulaanbaatar (peri-urban settlements surrounding the city), however, are poor, and use stand-alone stoves or stoves connected to a heating wall. The poor population continues to grow as job prospects in Ulaanbaatar attract more migrants from the rest of the country. The influx of new entrants was some 30,000 persons annually from 2006-2008, and official statistics show that for every nine persons entering Ulaanbaatar one left over the period from 2000 to 2008[6]. The large number of new people entering Ulaanbaatar as well as the number of people upgrading their homes continues to pose challenges for air pollution reduction.

BOX 1: TERMINOLOGY

In this report, the term "clean stoves" and "low emission stoves" are used interchangeably, so are "dirty stoves" and "traditional stoves".

Traditional stoves: rectangular steel stoves, originally designed for burning wood. With Nalaikh coal, the SEET lab showed that traditional stove emit about 600-700 mg/net MJ of PM2.5; with Baganuur coal this is 1400-1500 mg/net MJ.

Low emission stoves: They emit less than 70 mg/net MJ of PM2.5, or a 90% reduction compared to traditional stoves operating on Nalaikh coal.

Heating wall: a hollow, heat retaining wall that is connected to the stove, consisting of a combination of horizontal and vertical flue channels.

Small water heating boilers: also called low pressure boilers. These are stoves with a heat exchanger and are used in somewhat larger houses; the working fluid is water that circulates through pipes and radiators to heat the house. More expensive systems use pumps to circulate the water, while others use the thermo syphon effect.

The Mongolian Government and UB Municipality's request for a stock taking of the stove program and preparation of a draft national clean stove strategy is very timely. Mongolia's recent experience with stove switching provides valuable experiences and lessons. The program thus far has made significant contributions towards achieving penetration of clean stoves and better air quality. However, re-sale of low emission stoves to households outside Ulaanbaatar has been observed and is seen as a major risk to these achievements. This report finds other 'sustainability gaps' that put the program at risk. Yet, it also finds that it is not too late to adjust the

[6] Capital Statistics Department; taken from the Air Pollution Costs of Ulaanbaatar, 2013

program's design to transform the stove market.

This strategy has three sections following this introduction. Chapter 2 is an analysis of strengths and challenges of the stove switching programs. Chapter 3 presents the strategic objectives and plan. Chapter 4 presents a road map for implementing the strategy.

The strategy relies on several missions observing Ulaanbaatar stove market as well as one mission conducting a rapid assessment of the stove market outside Ulaanbaatar. In particular, the strategy relies on the findings of a 1000 household survey (referred to in the report as the CSI survey) in the ger areas of Ulaanbaatar as well as the rapid assessment in areas outside Ulaanbaatar. The findings are published in Mongolia: Heating Stove Market Trends in Poor, Peri-Urban Ger Areas of Ulaanbaatar and Selected Markets Outside Ulaanbaatar (December 2013) and translated into Mongolian. The 1000 household survey made use of a similar 1000 household survey conducted by the Bank in 2009 (before any major stove switching program). These two surveys help to detect and describe impacts of the stove switching program on the market and user characteristics. The Survey's findings are reflected in this analysis.

CHAPTER 2 – STRENGTHS AND CHALLENGES OF THE LOW EMISSION STOVE PROGRAMS IN MONGOLIA

An analysis of strengths and challenges is helpful analytical approach to organize the myriad of lessons and experience on stoves generated since 2011. There are clear overlaps, depending on the perspective - a challenge can be turned into an opportunity. Missed opportunities can turn into risks to the benefits gained from the current stove switching program. Therefore, it is important to understand the context in which the analysis is conducted. Thus, this introductory section summarizes the history of the stove switching program from 2009 and compares and contrasts different phases. The analysis follows. Based on the analysis, it is clear that Mongolia is at a critical crossroads. Policies can help Mongolia complete its stove market transformation or risk a rebound of traditional stove use in Ulaanbaatar, overturning difficult-to-obtain health benefits.

As part of a major short-term effort to reduce outdoor air pollution in Ulaanbaatar, the donor community organized small pilots in 2009-2011 and established a stove emissions laboratory. In 2011-2012, Millennium Challenge Account (MCA)-Mongolia financed a scale-up of its pilot program in selected sub-districts (khoroo) of the five districts that comprised Ulaanbaatar City's Air Pollution Reduction Zone. This mainly consisted of the provision of subsidies for the purchase of low-emission stoves and applying better insulation in gers and houses, and the replacement of several poorly performing HOBs.

As a result of previous efforts, the switch out of stoves is a big success as a large number of households have been reached. In total as result of all supporting activities combined, some 110,000 low-emission stoves have been supplied (out of a total of about 170,000 ger households. What is more, as reported by NAMHEM, general pollution levels were some 30% lower in January 2013 compared to the year before - despite population growth: there is measureable reduction in air pollution as a result.

In order to continue the momentum toward a sustainable market transformation to low emission stoves, a new stove switching campaign started in October 2013, which takes into consideration of experience and some lessons from past programs and the stocktaking survey. The program is implemented by the Municipality of Ulaanbaatar and supported by the Clean Air Foundation and the UBCAP project[7], with a goal of disseminating 45,000 stoves during this winter. If all stoves are sold, the overwhelming majority of households in Ulaanbaatar will then have a stove that is significantly cleaner than the traditional model. Those without are either very recent new entrants or households with a SWHB.

[7] Ulaanbaatar Clean Air Project; The Project Development Objective of the Ulaanbaatar Clean Air Project is to connect consumers in ger areas of Ulaanbaatar to heating services producing less particulate emissions and to develop selected medium-term particulate abatement measures in Ulaanbaatar. The UBCAP has three components: A. Ger Area Particulate Matter Mitigation; B. Central Ulaanbaatar Particulate Matter Migration; and C. Public Awareness Raising, Program Coordination and Project Management. The results of the project will be measured by: (i) coverage of remaining HHs with eligible stoves; (ii) the number of studies for medium term pollution abatement measures prepared; (iii) number of days an air pollution coordination mechanism is functioning.

Compared to the past programs, a few modifications were made to the approach in this program starting in winter 2013. First and importantly, the stove switching is now managed by Ulaanbaatar city itself (for the first time). Second, the stove performance criteria are published and stove models solicited for eligibility testing[8] through an open competition. The origin of the stove is not relevant, as long as it satisfies the published performance criteria. Some 15 different stove models were proposed by 11 suppliers, among which were 8 Mongolian producers. Only four stove models satisfied all criteria and although only one was locally manufactured, it was the first time a Mongolian stove was eligible. These stove models are able to reduce $PM_{2.5}$ emissions by as much as 95% - if the stoves are used properly. Although the stoves are still priced at low levels, and below the price of a traditional stove, they are more expensive than in the past. Third, the stove program focuses resources on building capacity in a local laboratory which could provide objective information on stove-fuel emissions performance.

Third, the previous program did not support the laboratory, which had been designed under a cooperative project financed by the Asian Development Bank with the World Bank and the Ministry of Mineral Resources and Energy. This laboratory now receives support from the UBCAP project and the Mongolian University of Science and Technology's Institute for Heating and Industrial Ecology. It is a source of scientific information for policy makers to understand the emissions performance, and therefore potential impact on air pollution reduction, of proposed new fuels and stoves. Fourth, verification of installation and support on training households in proper use of the stove is strengthened through the use of a third party which visits households twice (once upon installation and once after a few months). The third party ensures households are trained in using the clean technology and indeed are still using the stove after a few months. Fifth, there is a strong partnership between JICA and the Ulaanbaatar City and the World Bank in coordinating support to strengthen air quality management, which is essential for monitoring the most important result of the stove switching – reduction of exposure to harmful ambient concentrations of particulate matter.

The UB city has set a target of 45,000 low emissions stoves, partially supported by UBCAP, and as of January 22, 2014 and as of January 22, 2014, over 29,710 orders were made after the formal start of the program on October 7, 2013, of which 25,193 households have already made payment and 21,206 have clean stoves installed already.

Strengths of the Low-emission Stove Switching Program and Low-emission stove Market Opportunities

The eight key strengths of the stove switching system are:

Strength 1: Government policies support a market-based, results-focused approach to market transformation. They reward results and promote quality products.

The stove replacement program is results-based, providing consumer subsidies that disbursed only upon sale and verified installation of eligible stoves. The Government has also done a good job letting the market know that the currently

[8] Main criteria: power of stove > 3 kW; max $PM_{2.5}$ emission of 70 mg/net MJ; max CO emission of 7 g/net MJ; and thermal efficiency > 70%. The monthly production capacity was another criterion.

high subsidies are temporary.

The results-based approach allows for competition among producers on the basis of the quality and attractiveness of their product. It avoids major problems associated with other approaches such as government procurement of stoves (i.e., when the government makes the choice for consumers when it procures stoves which goes against the principle of consumer choice) or giving away stoves for free (although the current subsidy brings down the price to very low prices it does not give stoves away for free). The market based approach places government in the appropriate role of ensuring standards are met to achieve public policy objectives (lower emissions from heating, and safety), and the private sector in a role that is its competitive advantage – selling attractive, innovative products to the market.

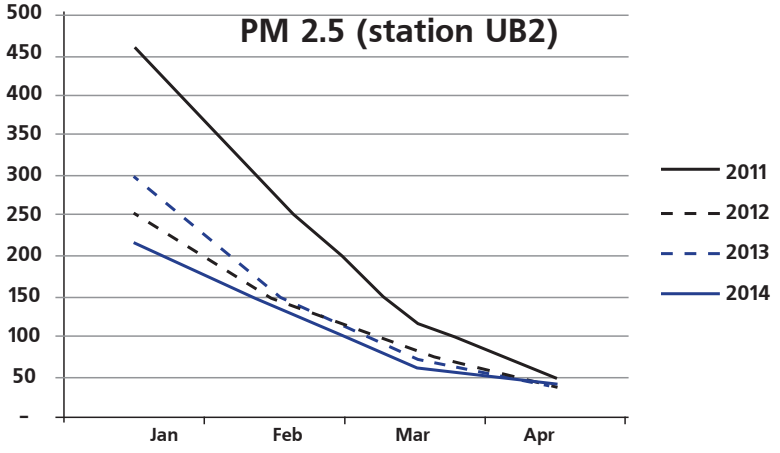
Strength 2: The stove switching initiative yielded rapid and high penetration of low-emissions stoves.

As noted above in 3.5 years by January 2014, 135,193 stoves were purchased and 131,206 stoves have been installed, which is an impressive penetration rate by any measure internationally. Taking into account the estimates of additional stoves not captured in official statistics, this is a penetration rate of 65% of the estimated market of 208,400 stoves for gers/houses and stoves for heating walls.

Strength 3: Average particulate matter concentrations in winter months have decreased in Ulaanbaatar.

As shown in Figure 1, Government of Mongolia's statistics show that $PM_{2.5}$ emissions in the first four months of the year have considerably decreased between 2011 and 2014. Monthly average of the most harmful, $PM_{2.5}$ fine particulates was reduced by 20% - 50% in peak cold winter months of January and February, and by 20% - 30% in the end of winter months of March and April. This is measured in the UB2 station located West cross road /Baruun 4 zam/ along Peace avenue that is the only station that consistently has recorded $PM_{2.5}$ data at a rate of up to 3000 points per month. There is only one other station that measures PM2.5, UB4 station that is located near East Cross Road /13 Khoroo, but data are only intermittently available. For a more consistent and meaningful analysis, more stations throughout the city will need to start monitoring fine particle emissions.

Figure 1: Comparison of ambient $PM_{2.5}$ microgram per m^3 from 2011 – 2014, UB2 station



Source: NAMHEM, 2014, adapted by UBCAP Project Coordinator

Strength 4: There is a proven and reliable supply chain for low-emission stoves. The supply chain includes reliable suppliers, Product Centers, a screening system for suppliers and models, and a verification system for quality assurance.

Product Centers (PCs) are government-financed and private sector-managed sales centers set up exclusively for the sale of eligible stove products. They also provide marketing and other product information. The high sales figures show people trust the system and rely on it to provide reliable products and information. Suppliers also trust the system because they sell products through it. A transparent screening system of suppliers and models strengthens perceptions of reliability. Currently, clear and publicly available stove and producer eligibility criteria, supported by emissions tests at the Stove Emissions and Efficiency Testing laboratory, are used by the Ulaanbaatar city. A verification system for quality assurance includes: (a) confirmation of installation and training in the use of stoves at each household, recorded by SMS in an electronic database by the private sector PC manager and by written documentation by an independent Quality Assurance Agent hired by Ulaanbaatar city; (b) confirmation on the use of the stove by the Quality Assurance Agent by a second visit to households and reporting back to the Ulaanbaatar city; (c) regulations and a system of penalties, included in a Producers Agreement signed by each eligible Producer with the Ulaanbaatar city, for sales of poor quality products and failure to rectify failures.

Strength 5: There is a system for removing old, polluting stoves.

The government has an interest in removing traditional stoves from use because they are heavily polluting. Stoves are in-kind contribution by households towards the purchase of the stove and are removed by stove producers when new stoves are installed in households. Stoves are collected by an agent that ships them to the steel mill in Darkhan where they are destroyed and recycled for scrap metal. The system can be improved to avoid households providing spare stoves rather than their primary ones and ensuring more systematic disposal of the stoves, the system is important to remove products that threaten public health.

Strength 6: There is local experience and management capacity in managing large-scale, market-based, results-focused distribution of stoves.

This capacity did not exist before. The National Committee on the Coordination (NCAPR) of Air Pollution Reduction in Ulaanbaatar, the MCA program staff and contractors, the Clean Air Foundation under the chairmanship of the Ministry of Nature, Environment and Tourism, the UBCAP Project Management Unit (PMU, which has hired some of the same staff and contractors), suppliers, and consumers now have awareness and experience in stove switching. Importantly, the leaders in the NCAPR are now using elements of the program, including the Stove Emissions and Efficiency Testing Laboratory

Strength 7: Though small by international standards, there is a sufficiently large market nationally that should attract good quality private sector participation.

Altogether, it is estimated that the total potential market size of low-emission stoves (including small water heating boilers) is 500,000 in Mongolia, which is not large by international standards but can be sufficiently large to attract good quality private sector participation. This excludes the number of stoves that needs repair and

maintenance each year. The estimation for each category is specified in Annex 1. In summary, according to XacBank's records, as of Oct 2013 there are still about 64,000 households without low emission stoves installed as their primary heating appliance in Ulaanbaatar, of which 17,100 in gers and small houses, 27,400 in houses with heating walls, and 19,100 in houses with SWHB.

Based on discussions with stove program participants, there are more traditional stoves in use within Ulaanbaatar that these statistics suggest. Stoves across Mongolia can be categorized into the following three groups of household heating stoves: (1) in Ulaanbaatar, "non-primary" stoves[10] (other stoves used by households who already use a low emission stove as their main stove) or primary stoves in "non-eligible" households[11] (generally, households without proper registration or those that live in a hashaa where a household has already received a subsidy for a low emission stove); (2) heating stoves in other towns (Aimag, Soum and Bag Centers); and (3) heating stoves in herder households.

Table 2: Households with a low-emission stove, October 2013 ('000)

	Total in Ulaanbaatar	With low-emission stove	% remaining without
Total nr of households Ulaanbaatar	350	Na	Na
Apartment	175	Na	Na
Ger	76.5	73.0	19% (or 17.1)
House	13.6		
house with HW	54.3	26.9	50% (or 27.4)
house with SWHB	19.7	0.6	97% (or 19.1)

Source: XacBank

Strength 8: Stove suppliers report there are lower cost models that can be sold nationally.

Based on consultations with stove suppliers, it is likely that eligible models could be supplied at a lower list prices. According to these discussions, lower-cost models exist in the price range of 150 USD. Suppliers indicated their interest to submit such stove models for testing to the SEET laboratory in the future. However, they reportedly held back these models favoring higher cost ones due to the high subsidy program.

In early May 2014 one company has established an assembly plant in Ulaanbaatar with a daily production capacity of about 300 stoves per day. The plant assembles clean stoves from imported parts that cannot be produced in Mongolia, and is able to spray paint and finish with enamel. It expects to sell eligible stoves for around USD 130.

[10] A primary stove is the main heating source for the household's main residence. If the household has more than one dwelling on the hashaa, it also has secondary heating sources that would not be eligible for financial support. A summer house with a heating stove is also considered a secondary heating stove.

[11] Households not officially registered with the Khoroo or municipality; multiple households sharing the same hashaa have been ineligible under the previous stove dissemination efforts are eligible to receive financial support under the UBCAP program.

Challenges of the Low-emission stove Switching Program and Threats to the Low-emission Stove Market

Generally, despite the excellent results of the stove replacement efforts in Ulaanbaatar and its positive impact on air quality, there are significant weaknesses in the program that threaten to stop and even reverse the obtained benefits. An analysis of the following risks of the program also offers insights into possible solutions.

Challenge 1: Demand in all stove market segments continues to increase and shift toward higher energy consuming units.

Changing demographics and household dwelling situations are driving continued growth in all stove market segments, whether stoves for individual homes, stoves for heating walls, or small water heating boilers. This is an opportunity as well as a threat to the program. In 2012, compared with 2007, the markets have grown in absolute numbers and have changed in line with evolving household preferences for larger and more comfortable housing, driven by rising incomes.

BOX 2 LOW-EMISSION STOVE MARKET SEGMENTS

In order to successfully meet market demands, market segments need to be clearly defined. Markets for heating appliances, both in and outside Ulaanbaatar, consist of three distinct market segments: (i) stand-alone stoves used in gers (felt tents) and detached homes (made from wood and/or brick, occasionally with two levels, often poorly insulated); (ii) stoves attached to heating walls in medium-size detached homes; and (iii) SWHBs in larger detached homes with radiators and/or piped hot water systems in most rooms, which is the high-end of coal-fired heating appliances. Households in general use their heating stoves for most of their cooking, especially during the winter months, although some households with SWHBs also have another cooking appliance.

From 2007-2012, the number of households in the six central ger area districts has grown by 36 percent or 43,990 households. In the same period, the average size of dwellings has increased in all market segments, correlating with increases in income. According to the CSI household survey, about 44 percent of households have a ger in their hashaa (a small fenced-in plot), about 42 percent have a detached home of one or two levels, and about 14 percent have both a ger and a detached home. The average floor area of a five-walled ger is 28m2. The averaged detached house without a heating wall that relies on a space-heating ger stove has a living area of 39 m2. The average home with a heating wall is slightly larger, with an area of 41 m2, and homes with SWHBs are the largest (73 m2).

With more wealth, households move into larger dwellings and upgrade their heating systems. This is important because fuel use correlates with dwelling size: ger homes reported using 3.9 tons of coal per year, compared to 4.84 tons for homes with heating walls and 6.3 tons for homes using SWHBs. Heating walls continue to be the most common form of heating system, although the proportion of detached homes with heating walls dropped from 70 percent in 2007 to 62 percent in 2012. This market share was almost entirely taken by SWHBs, which increased from 16 percent to 23 percent. Homes with stand-alone stoves without heating walls, a step above living in gers, maintained a stable share at 15 percent of total detached-home households.

The CSI survey furthermore shows that around 67% of traditional stove users are interested in switching to a low-emission stove and that fewer households are buying traditional stoves–the average age of traditional stoves in use by households has risen significantly to 9 years, from 6 years in 2007. Because stoves have an average lifecycle of 10 years, many of the remaining households with traditional stoves will likely buy replacement stoves in the near term. There continue to be large, un-served segments of the ger-area market that use relatively more coal.

In summary, when incomes rise, households want larger homes and more comfortable heating solutions, i.e., more heat, less refueling, lower fuel consumption. Efforts to promote cleaner air in Mongolia should take this into account by providing low-emission heating solutions for all different market segments, not just individual stoves.

Challenge 2: There are no qualified local stove models produced at scale thus far and consumers are now used to very high quality products at distorted low prices. Resistance from current low-e stove suppliers to changes in the subsidy mechanism can be substantial because it would introduce competition, force a change to the business model, and perhaps require them to switch to different stove models to meet prices that households can afford without high subsidies.

There is a risk of traditional heating stoves out-competing higher priced low-emission alternatives, reversing the tremendous penetration of clean stove technologies. In the absence of continued subsidies, most households in need of a stove will revert back to purchasing traditional stoves. As noted above only one model was selected under the Ulaanbaatar city's program that is supported by UBCAP and CAF. However, it has encountered production issues. Low capacity of local production is a function of a lack of interest from serious private sector investors, who need a stable regulatory environment and confidence in the viability of the market of low-emission stoves and SWHBs.

Current low-e stoves are very high quality generally. Lower priced models might have less appealing finishes or other features. A transition to a sustainable market without subsidy may require an adjustment in consumer expectations in what they get for their money. However, the private sector is innovative and may deliver very high quality at lower prices, if given a chance to do so. Changing the subsidy model may therefore trigger strong resistance from both users and suppliers of low-e stoves. The appearance of a local assembly plant appears to proof this point.

Challenge 3: There are high transaction costs relative to market size outside Ulaanbaatar, challenging the viability of local production of low-emission stoves outside Ulaanbaatar.

The structure of the stove markets outside Ulaanbaatar is similar to those in Ulaanbaatar, but they are of a smaller scale and more dispersed in nature. This seriously challenges the viability of local production of low-emission stoves, unless models are redesigned to significantly lower production and supply costs. Stoves are currently supplied by artisanal producers, who would have difficulties ensuring consistent quality when producing at large scale needed to address the growing concerns over air pollution exposure in the provincial capitals (aimag centers) and larger soum centers.

Challenge 4: Technical capacity and materials for maintenance of low-emission stoves are at risk after warrantee periods are over

The imported low-emission stoves are expected to have a useful service life of 5-10 years. Some parts of the stoves cannot be produced in Mongolia and must be imported. Current low-emission stove suppliers are expected to provide a minimum of 2 years of warranty, but during this period stoves are expected to perform properly. Maintenance is expected to be needed when the stoves mature in the future and solutions should be found for the lack of imported spare parts.

Entrepreneurs supplying traditional stoves before could possibly provide the necessary skills, spare parts inventories, and eventually replacement stoves allowing for repair and maintenance of low-emission stoves in Mongolia. This additional business could help to them to refrain from producing traditional stoves, or could help them survive if the manufacturing of traditional stoves will be prohibited. This maintenance and repair infrastructure is missing at the moment but will need to be developed so that the supply and use of low-emission stoves has a chance to become sustainable. It is likely that skills of the artisanal producers throughout the country would need to be upgraded through training in order to supply these technical services.

Challenge 5: Stove Markets, including the low-emission stove resale market, in and outside Ulaanbaatar are intricately linked

Like stove demand, linkages between markets are both an opportunity and a threat to the low-emission stove market in Ulaanbaatar. Results of the rapid assessment of markets outside Ulaanbaatar indicate that clear linkages exist between the stove market in Ulaanbaatar and markets in other cities, especially the aimag centers. Most stoves or stove parts are sourced from Ulaanbaatar. This suggests that the a scaled-up clean stove program to reach areas outside the capital will depend on Ulaanbaatar as a supply base be useful in creating a sustainable supply of low-emission stoves in Ulaanbaatar. In addition, linkages flow both ways -- even if traditional stove makers in Ulaanbaatar go out of business, producers outside Ulaanbaatar could potentially fill the market with cheaper, traditional stoves when subsidies on low-emission stoves are lifted.

Some of the low-emission stoves initially purchased by households in Ulaanbaatar will flow out of the city through resale markets, and that those households are most likely to buy traditional stoves as replacements if they are unable to access affordable clean stoves. A visit to Narantuul market found 20-30 low-emission stoves of all models for sale in October 2013. Retailers indicated that most of these will be sold to households in the country side (especially commercial properties like guest houses); observed prices for these stoves were 60-75% of the unsubsidized price of the stove. Even if they sell 20 low-emission stoves per day, this would only represent a leakage of about 6%.

Challenge 6: Despite training, consumers have a hard time breaking traditional fuelling/cooking habits when using low-emission stoves. Improper use of new stoves increases their emissions. While they don't have to, new models do not necessarily take into account traditional habits and this requires more training and awareness efforts.

Emissions performance depends heavily on consumer practices and preferences. Indeed, not all households with a low-

emission stove know how to use it properly. This is understandable as new technologies can require a change in behavior. An education and awareness campaign should be continued so that all households with a low-emission stove start and continue to use it properly. Households are receptive to awareness campaigns, as illustrated by the fact that when there were a few exploding heating walls, the intensified awareness campaign was very effective in passing the right messages and even households outside Ulaanbaatar - without low-emission stove - had understood the main messages of this campaign.

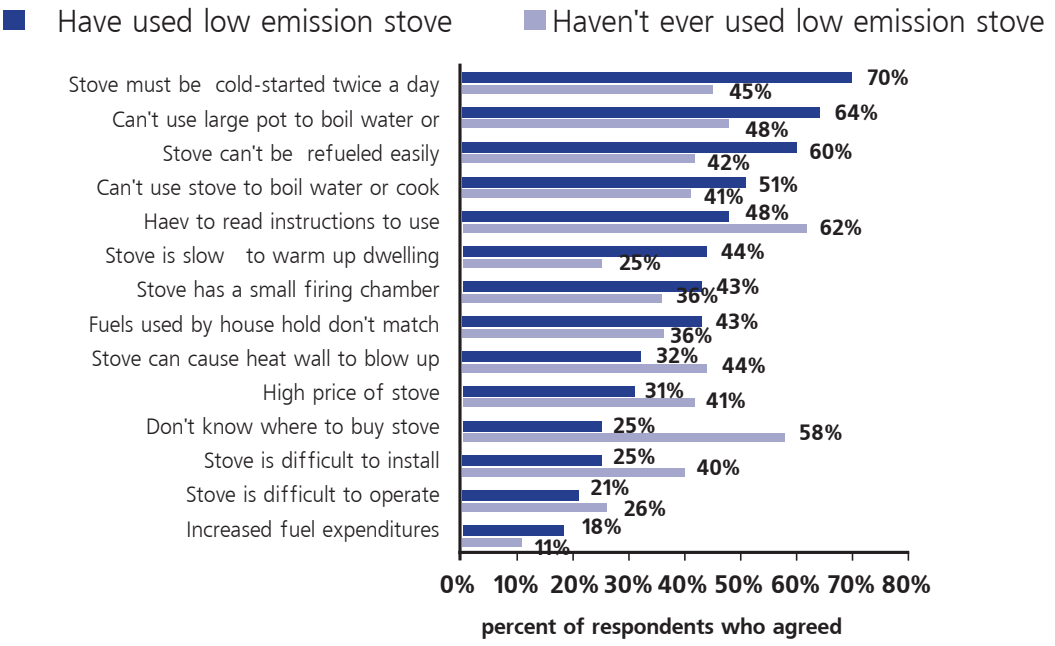
Based on observations made in the World Bank study, spikes in particulate matter concentrations correspond to the fuelling and re-fuelling cycle - most of the pollution stems from cold-starting the fire and refueling the stove. Therefore, knowing how to do this properly this can considerably help to reduce emissions. The user of the stove is thus also important, or his/her behavior, and educating and informing users should be part of any program to promote low-emission stoves. Even if the users' instructions explicitly state that pollution can substantially increase if a fresh load of coal is placed on top of the burning coal, users may be inclined to do so in an effort to extend the heating period. They should be made aware that the stove they bought has certain operational aspects that need to be adhered to, and it may take time and effort to have this message sink in.

Inasmuch as improper use is a threat, it is also an opportunity – although four different types of stoves are offered in the current program, room for more competition exists. Naturally, consumer preferences must guide stove development and marketing of clean stove technologies. Consumer cooking and heating habits heavily influence the emissions performance of the stove development, marketing, and stove replacement initiatives. The ger household heating and cooking preferences and habits can inform the development, market entrance, or introduction of new stove types. New technologies are more readily accepted by ger-area consumers- and more properly used-when they align more closely with the traditional patterns of cooking and heating behavior.

Apart from producing less pollution, low-emission stoves are also seen by their users as saving fuel, one of the characteristics that consumers ranked as being most important in their preferences for stoves. However, while about two-thirds of low-emission stove users in the survey were satisfied with the ability of their new stoves to heat their homes, the same was not true for cooking. Only 52 percent of low-emission stove users agreed their stoves were easy to cook with, compared to nearly 90 percent of traditional stove users, and during the winter, households with low-emission stoves tend to cook more with electric hot plates (33 percent) than traditional stove users (13 percent).

Among the top difficulties perceived by users of low-emission stoves are the need to make a fire twice per day (70 percent compared to 45 percent of traditional stove users), difficulties with refueling (60 percent compared to 42 percent of traditional stove users) and time required to heat dwelling (44 percent compared to 25 percent of traditional stove users). This is particularly important because the survey results also indicate that the ability of the stove to heat a room and stay warm (meaning also less refueling, not a popular task) is seen as its most important aspect by consumers.

Figure 2: Perceived Difficulties with Using a Low-emission Stove



One way to increase comfort levels in detached houses is to install a heating wall. Low-emission stoves can be attached to a heating wall with appropriate connecting pipes. The Municipality of Ulaanbaatar carried out a research on the construction of heating walls and the safe installation of low-emission stoves connected to heating walls. Different internal configurations of the heating wall's flue channels exist and some are not suitable for connecting to a low-emission stove. The research found that there are simple technical solutions to ensure the safety of the users. MUB is encouraged to currently identifying how this knowledge can be transformed into enforceable regulation, for existing heating walls as well as heating walls to be constructed.

SWHBs are not well researched in Ulaanbaatar and there are currently no clear criteria for "clean" SWHBs. A recent initiative involved the government directly supplying new, "clean" SWHBs which was not successful and has been stopped. New criteria need to be developed so that the market can respond with clean solutions.

In sum, while the current low-emission stove offerings have been accepted by the market, a wider range of product offerings will be needed to maintain the program's penetration rates, while heating wall stoves and SWHBs need to fully be incorporated.

Challenge 7: Regulatory gaps and lapses in policy coordination on low-emission stoves.

The current Mongolian stove emission standards have been adapted from European stove standards that are far more restrictive than the standards that were replaced. However, eligible stoves out perform these new standards. This would, at least in theory, allow stoves to be sold that perform less well than the low-emission stoves that are currently used. Traditional stoves that do not meet the old or the current standards are still allowed to be sold in the market. Once sufficient and affordable alternatives are available, the standard should be enforced. Thus a considerable effort to replace traditional stoves with low-emission stoves is made

less effective because traditional stoves remain available for those who want to purchase it.

Also, the increased use of small water heating boilers (SWHBs) requires urgent attention as there currently are no clear emission test results and market studies which can identify the emissions performance criteria that would define "low emission SWHBs". Once defined, regulations and incentives could be designed to phase out unqualified SWHBs and promote low-emission ones. SWHBs are like coal fired furnaces distributing hot water through pipes. Some SWHBs are pre-fabricated in China while others are made by local artisans; there is no information about their PM emission performance. SWHBs are completely different technologies than stoves and need to be tested and evaluated separately to set minimum requirements for their emissions performance in the next phase of stove replacement activities.

While there is an emerging consensus among policy makers to base decisions on scientifically determined laboratory testing of stove-fuel emissions performance, some policies remain unsubstantiated or contradict each other. Emission performance of different fuel-stove combinations varies and reliable laboratory emissions performance tests are essential to determine their potential contributions to air pollution reduction objectives. The impact that low-emission stoves have on air pollution essentially depends on three elements: (i) the stove; (ii) the fuel; and (iii) the user. The combination of the three determines how cleanly the stove performs. A fourth element exists that however is not considered in this strategy: insulation and heat retention characteristics of the dwelling. Emissions performance test results may differ from reality, when stoves are used by households due to a lack of user education and ingrained habits. Emission performance can only be tested reliably in a well-equipped laboratory that uses a standard testing protocol to characterize the performance of the stove according to the user instructions and in relation to the fuel used.

Most of the PM emissions come from starting the fire or refueling it; a continuously fueled stove would most likely have lower PM emissions than a batch fueled stove. As soon as the stove is hot and the fire is well established, most stoves emit only very limited PM or none at all. Thus, being able to easily start the fire - and knowing how to do this - are two important elements in reducing air pollution. Some stove models are able to do this better and easier than others, and it is therefore important to use only stove models that have shown to be able to burn with low emissions in standard laboratory tests .

It also matters which fuel is burnt in the stove. As an example, after the Government recently closed the Nalaikh mines, most households started using Baganuur coal. Unfortunately, Baganuur coal burns less cleanly than Nalaikh coal: the SEET laboratory showed that the traditional stove roughly doubles $PM_{2.5}$ emissions. Depending on the number of traditional stoves in use, this may have negative consequences on air quality in Ulaanbaatar. Currently tested, low emission stoves will also be affected, though less so than traditional stoves. Some low-e stoves remain very clean and can still reduce emissions by over 90% compared to a traditional stove using Nalaikh coal.The "+90% criteria" is one of the eligibility criteria for support under the current stove switching program. However, after switching the dominant coal type, one of the low-emission stove models that had been widely sold, could not any longer meet the +90% criteria. As a result, it is not supported in the current phase of the

stove switching program.

If policies to introduce alternative fuels such as semi-coke coal are pursued, it is imperative that the alternative fuels are tested for emissions when burned in a stove and that the results are made public. This information helps evaluate estimated impacts on emissions against program costs. Mandating new fuels may also require introducing new types of stoves that are designed specifically for those fuels. If the right stove is not paired with the right fuel, emission reductions will differ. So far, the government has provided significant support to alternative fuel producers (especially for semi-coke coal). Yet, the CSI survey reveals that only 5 percent of all households reported using semi-coke coal on a regular basis. These include only 49 percent of households in the Bayangol District where raw coal is formally banned. Comparatively, 98 percent of households in the six districts report using raw coal, while 6 percent burn dried animal dung.

In summary, support for different possible air pollution solutions should be based on PM emission performance of fuel and stove combinations, in addition to quality and fuel consumption criteria. However, air pollution performance is more stringent and takes precedence over other criteria, which are normally satisfied for well designed and built stoves. Households should continue to be reminded that their stoves need to be operated appropriately to minimize emissions and maximize fuel efficiency.

CHAPTER 3 - TRANSFORMING MONGOLIA'S STOVE MARKET

Mongolia's stove market is at a crossroads – clean stoves have been purchased by 64% of Ulaanbaatar's ger and heating wall market, but the use of traditional, polluting stoves and SWHBs can easily increase without a comprehensive strategy of completing the transformation to a low-emission technology stove market. This chapter presents the proposed strategy to move towards a sustainable low-emission stove market. Since the approach for reducing PM emissions from heating stoves and from SWHBs is similar, they are examined simultaneously.

Expand the stove switching program nationally

There are three main benefits in developing a sustainable supply chain of low-emission stoves and extending the switch-out program to the entire country: (i) Sustain air quality improvement benefits in UB; (ii) Expand access to clean stoves; and (iii) Reduce air pollution in some other aimags.

Expanding nationally addresses several problems simultaneously. It eliminates the need for a black market for low-emission stoves, reducing incentives for Ulaanbaatar ger-area residents to sell low-emission stoves to outside markets. The black market exists because households only in Ulaanbaatar benefit from the current program (and the price of the stove is too low – see next section). It also contributes to addressing winter air quality problems in other cities. Air pollution is an issue not just in Ulaanbaatar but also for 10 other cities (where 2014 state budget is allocated to support air pollution mitigation). It also moves Mongolia closer to providing universal access to clean cooking energy especially to urban areas, complementing its other successful initiatives of providing access to electricity to 100,000 herders through the provision of solar PV home systems.

The strengths of the successful stove switching program in Ulaanbaatar should be maintained with modifications addressing its weaknesses and characteristics of a national program. In summary, the design of the national program should:

a) Enlarge low-emission stove market If the total number of traditional stoves in the country is taken as an indication for the potential low-emission stove market, this could be an interesting market to supply. The total number of low-emission stoves that potentially can be sold is larger than the number that has been distributed so far, see Annex 1. A national market could be supported by expanding the number of eligible households, providing supportive incentives and market-oriented regulations, and designing a SWHB improvement program.

b) Preserve consumer choice of many models: Consumer preferences for specific stove models or specific features could provide guidance to producers in developing, producing, or selecting stove models.

c) Encourage innovation: It should be easy to introduce new models provided they strictly meet standards for emissions performance, safety and other Mongolian legal regulations. Standards should be applied to all stoves, without exceptions.

d) Ensure professional supply and quality preferably over the lifetime of the stoves: Producers should have the capacity to produce high quality products, at scale, and provide after sales service.

e) Create incentives to drive down list prices so that eventually a subsidy is no longer needed. The following options can be considered:

   i. A large market requires less price margins and allows for scale-economies to take place;

   ii. Healthy price competition will further reduce prices once several different low-emission models are available at the market;

   iii. The production cost of stoves could be reduced through research and development activities; and

   iv. Reduction in program cost is also likely to lead to lower list price. For example, the monitoring cost could be reduced. The current Ulaanbaatar program includes an extensive, but coordinated monitoring system, which is needed to address the leakage risks of the current low-emission stove subsidy policy. However, it will be cost-prohibitive to expand this monitoring system nationally in the same way. Thus, simplification of the system is recommended for the national program

Through technological innovation, further market creation and scale-economies, and households' willingness to pay a small premium for low-emission stoves, a market could be sustained and the subsidy can be scaled down and phased out in the future. Well-designed regulations should support this by phasing out the production and use of traditional stoves and polluting SWHB over the next few years.

Modify eligibility criteria to include all urban users of traditional heating stoves

In the past, only registered households in Ulaanbaatar who have not yet benefitted from any stove program associated subsidy are eligible to obtain a low-emission stove with a consumer subsidy. Since air pollution benefits can only be maintained or improved when as many households as possible use low-emission stoves, it is recommended that all urban households using traditional stoves become eligible, including temporary residents and households with more than one stove. In order to monitor this, a national database should be established, reconciling all kheseg and soum family books with national systems (to take into account movement of households in and out of Ulaanbaatar and other areas).

Based on preliminary estimates, the total potential market for low-emission stoves nationally (households without a low-emission stove) could be around 220,000 units (Annex 1), which amounts to a market value of about US$20-30 million. This does not distinguish between stoves and low pressure boilers outside Ulaanbaatar but excludes 160,000 herder households who also use stoves. Low pressure boilers are used by about 11% of total households in the ger districts of Ulaanbaatar (about 20000 households), but they use an significantly more coal. In addition, if all high emission SWHBs are replaced nationally, the estimated market value would be about US$16-20 million. The potential market size is relatively substantial but most likely not enough to attract large international suppliers. It is likely to draw small and medium enterprises, such as those currently participating in the stove switching program.

Temporarily maintain but simplify the consumer subsidy mechanism

Although the current subsidy mechanism has been highly successful in rapidly penetrating the Ulaanbaatar market with low-emission stoves, adjustments are needed for the next phase of the stove switching program for the following reasons:

a) Suppliers confirmed through interviews that it is feasible to supply different models of low-emission stoves under current requirements for emissions performance at list prices of around US$150/unit; the unsubsidized price of the current low-emission stoves ranges from US$ 250 – 350;

b) There is too much asymmetrical information between the government and the suppliers on unit costs, which makes it difficult for the government to adjust consumer subsidies to perfectly match stove prices with a user's willingness to pay. It should get out of discussing subsidy levels with suppliers. It would be better to get out of direct discussions on subsidy levels with suppliers; and

c) The current subsidized price of low-emission stoves is lower than traditional stoves; this means that (i) the government would need to continue its program to sustain benefits for the indefinite future; (ii) it would also need to continue a rigorous quality control and verification system, which may be cost prohibitive when expanded nationally; and (iii) some households could have an incentive to sell their low-emission stove on the black market.

Nevertheless, a consumer subsidy appears to be necessary in the short-term to gradually adjust distorted consumer expectations so as to promote further stove switching. Eliminating it in the short term will not lead to market development because there currently are no identified products whose price can be brought down to affordable levels. In addition, shocking the market with massive price increases relative to those today could be counterproductive as consumers are used to unreasonably low prices for relatively high quality products. Yet, high subsidies are unsustainable and only perpetuate a distorted market dependent on government subsidies. Maintaining, temporarily, an adjusted subsidy mechanism also is a win-win for households inside and outside Ulaanbaatar – a stove switching subsidy program for citizens outside Ulaanbaatar will benefit citizens in Ulaanbaatar because it will remove incentives to sell stoves in Ulaanbaatar and thus sustain air quality benefits.

There might be resistance from households and from suppliers of low-emission stoves when subsidies are substantially reduced. Users have grown accustomed to high quality stoves for very low prices, and suppliers to high subsidies without price competition. In order to overcome these distortions, subsidy levels should be reduced as soon as possible.

BOX 3 REASSESSING PRINCIPLES OF THE CURRENT SUBSIDY SCHEME

The current subsidy comprises 3 elements in principle; the value is justified based on future economic health benefits, which are considerable. In addition to air pollution benefits, these elements could be brought out more in public relations campaigns to raise public awareness of the rationale for the subsidy:

(i) Replacement component; households hand in their old stove which represents a value to them;

(ii) Equalization component; to render the price of the low-e-stove similar to the traditional stove; households are able to purchase a traditional stove, so they should be able to buy a low-emission stove at that price level too;

(iii) Promotional component; to convince households to buy a low-emission stove now rather than in the future.

One option to consider is that the subsidy would be a fixed amount that is the same for all stove models (alternatives could include a percentage of the end-user price). This new subsidy would be phased out over a transition period. The subsidy should avoid end user prices that are lower than current traditional stove models, taking into account transport costs. The level of the subsidy should be set carefully as not to introduce further market distortions, but should consider transportation costs to supply markets outside Ulaanbaatar (see below). In the past, prices were offered by suppliers with proposed subsidy levels for a fixed period - subsidies varied by model. This should be discontinued and replaced by the proposed approach. Box 3 provides a description of the current general principles of the subsidy and how they should be changed. Annex 2 provides a program cost benefit analysis of various subsidy models.

In a free market, end user prices are a key determining factor for the level of sales. Suppliers of good quality stoves with the lowest prices are likely to obtain the largest market share, and therefore the largest amount of subsidy payment. The adjusted subsidy scheme is expected to give strong incentives to suppliers for reducing the price of their low-emission stoves.

The level of subsidy needs to be lower than now, staying consistent with the Government's current message that high subsidies are not to last past this winter season. Yet, by keeping the adjusted consumer subsidy, the Government will also give a signal to households that it is still important to switch their stoves.

If this option is chosen, the subsidy should be made available only for a limited period of time, for instance about three years. Thereafter the subsidy should be dramatically reduced or entirely discontinued.

In addition, the NCAPR should work with commercial financiers to identify favorable consumer financing programs, like micro-credits, which could smooth out payments for new, but higher priced low-emission stoves. Payment streams could be partially offset by any fuel savings realized from the use of low-e stoves. Use of commercial, consumer financing should be part of a transition to a sustainable market.

Discussions with suppliers suggest that low-emission stoves satisfying the current performance criteria could be available at prices around 150-200 USD, although the stove's quality and some features may be different. Traditional stoves are available for about 80 USD and the secondary 'black' market for low-emission stoves appears to support a retail price of 200 USD. A new subsidy level of 20% of the retail price gives a price reduction of 30-40 USD, which might be enough to convince

households to give up their currently used traditional stove if these new models indeed are guaranteed to show good performance. However, this does not work out well for stoves outside Ulaanbaatar because of the incremental costs for stove transport and QAA at long distance. Therefore, the subsidy program should be adjusted to cover part of these incremental costs. Annex 3 provides cost estimates for programs outside Ulaanbaatar.

Because the market is dynamic, it will be difficult to establish the perfect level of subsidy. The subsidy level should be monitored closely through market studies and supplier consultations allowing its level to be changed according to market conditions.

Simplify the quality assurance mechanism

The Government will complete its audit of stoves under the previous (2012-2013) program this summer (2014). Its conclusions should influence any modifications to the current verification process.

Quality assurance contains several elements: (a) a reliable laboratory that tests emissions performance, which provides important public information; (b) a reliable supply chain of stove producers under an obligation to supply good quality products (currently each stove producer signs a producer's agreement which sets out their obligations and defines penalties for non compliance; (c) a reliable sales center that avoids copy cats through official Product Centers (which are the only place to go to buy eligible stoves and receive consumer subsidies); (d) a reliable database and sales installation system, verified by SMS and recorded in a database of consumers; (e) a list of households who are eligible for consumer subsidies; (f) a third party verifier, which not only comes a few weeks after the sale to check on stove use, but also check on household satisfaction, and their proper use of the stove; (g) a Project Management Unit where complaints can be sent.

The third party verification could be simplified. The remaining system should be retained.

First, it is important to maintain and improve transparency, which is the strongest tool for verification: (a) the list of eligible stove models and eligible stove suppliers should be made public; (b) maintain and improve product labelling; (c) monitor performance of suppliers and stoves by the proposed PMU (see below) and publicize results. and (d) publicize all laboratory testing results.

Second, it is proposed to maintain but simplify the quality assurance system for Ulaanbaatar, and introduce a simplified quality assurance system in markets outside Ulaanbaatar. (If the pricing is right and less dependent on subsidies, the quality assurance will be less needed.)

Inside and outside Ulaanbaatar, the national quality assurance system should maintain two key features: (i) allowing the sales of low-emission stove only in a number of visible outlets (Product Centers), and (ii) maintaining an independent monitoring agency.

Inside Ulaanbaatar, PCs should be kept, but their number could reduced, or moved to districts once certain districts are saturated. Third party verification should continue and be adjusted based on the findings of the NCARP's audit of the stoves sold in the previous program.

Outside Ulaanbaatar, in addition to establishing PCs, the verification process can adopt a sampling method rather than visiting every single household (current approach in Ulaanbaatar). Of each batch of stoves sold, the QAA will visit only a sample of households to verify that the supplier

indeed has installed the stoves. As the experience and confidence with suppliers grows, the number of households can be reduced as appropriate. The QAA could be contracted by the project management unit (PMU) and closely coordinated with the PC. The QAA can be an existing, viable local organization that is already active at the location. The proposed sampling method described for markets outside Ulaanbaatar could be considered to reduce compliance costs.

There is currently no quality control for Small Water Heating Boilers (SWHB) and once scientific evidence is obtained on their performance and appropriate criteria are defined, new regulations on SWHBs should be introduced. SWHB are purchased by middle class households and not the poor. Establishing and enforcing emission standards in the short term will ensure that all new SWHB are low-emission models. In the future suppliers could be licensed to manufacture, assemble, import and sell only low-emission models. As quality and performance standards for SWHB do not currently exist, they should be developed and enforced quickly.

For the entire national program, the PMU should maintain a Complaints Center where households can report their problems either by telephone or in person. This does not need to be a fancy center, just a dedicated telephone number and someone assigned to answer the phone. This helps with the flow of experiences, and can be directed to the suppliers who supplier underperforming stoves. The information will allow the QAA to better request suppliers to provide after sales services and monitor the performance of the stoves.

As the program expands nationally, information technologies and databases should be expanded to accept households outside Ulaanbaatar. Currently, households are verified based on family books maintained by kheseg leaders in Ulaanbaatar. Households only with official registration numbers and verification of residence in Ulaanbaatar are eligible, and only one stove can be supported per households. Similar registration systems exist at soum level outside Ulaanbaatar that can be used for this, as was the case with the solar home system program. It is proposed to establish a similar system outside Ulaanbaatar, which would require the creation of a data base combining data from the entire country so that the principle of one subsidy per households can be maintained. Households would be verified by local leaders and included in a national list. This is similar to what was implemented under the 100,000 solar ger program. The list can be modified if households move and local leaders confirm their residency in ger areas or areas where stoves are used. Official registration numbers would track individuals who have received the subsidy.

Provide fiscal and regulatory policies to foster innovation, ensure spare parts and protect the population from polluting stoves

Coordinated incentives and regulations could help to make purchasing low-emission stoves easier, while making supply, purchase and use of dirty stoves harder, and eventually banning them altogether. The necessary 'carrots and sticks' are needed to facilitate sustainable market development of low-emission stoves. Current fiscal incentives are not completely coherent. For example, a profit tax exemption exists for clean stove sales and import duty exemptions are granted for import of entire stoves. It does not make sense to allow dirty stoves to be manufactured and sold while simultaneously investing heavily in switching these for low-emission stoves. But such incentives are not available

for parts even though these cannot be manufactured in Mongolia.

The public investment in low-emission stoves is less effective as long as dirty stoves remain available and used.

Imports and locally produced stoves should be treated even handedly. The Government indicated that local production and assembly of low emission stoves is desirable for employment generation and cost reduction. However, imports of parts and entire low emission stoves should be allowed because some parts and raw materials for low-emission stoves are not available in Mongolia. China, for example, also has a large manufacturing capacity for stoves, including SWHBs (which are currently exported to Mongolia) that can have the economies of scale to produce high quality, low cost stoves.

Minimum performance standards need to be established and approved by the relevant authorities – these would apply equally to local products and imports. Enforcement of the policy to apply these standards will also need a comprehensive set of supportive measures to prevent the production, sale, and use of dirty stoves, and to encourage the production, sale and use of clean stoves. Some of these measures may be politically sensitive and the NCAPR should monitor this closely and intervene as needed. The following sections discuss this package in more detail.

Other than consumer subsidies, the tools commonly used as fiscal incentives are favorable import duties, VAT reductions or exemptions, reductions in company taxes, and fines. Table 2 shows an example how these could be applied over a three year period to promote the production and sale of low-emission stoves and SWHBs, and discourage those of traditional stoves and ineligible SWHBs. The use of traditional stoves and ineligible SWHB will be more difficult to prohibit because people may find that their equipment is still in good working condition for heating their homes and does not need premature replacement just as an air pollution reduction measure. Imposing fines on relatively poor households is difficult to enforce, especially if they are not offered affordable low emission alternatives.

In the example in Table 2, households could have a three year period[13] to switch to a low-emission stove. The Government would provide a consumer subsidy in the same period (although the subsidy can be shorter than the transition period). After the three year transition period, only low-emission stoves would be allowed to be imported, assembled or manufactured locally, and used. The subsidy for switching would be no longer available. Revenues obtained from fines could be recycled back to incentives and other measures to help foster a clean stove market.

This transition period would be widely announced and explained to the public. It also needs to be carefully coordinated with improved and ever stricter standards enforcement (refer to the section on enforcement of standards below).

[13] The precise period should be chosen by the NCAPR; South Africa applied this mechanism to switch over in three years to more safe and efficient kerosene cooking stoves. It simultaneously worked with the kerosene stove manufacturers association to improve stove models and raised awareness among households for the need to buy betters stoves.

Table 3: Example of a Fiscal Measures to Phase Out the Use of Dirty Stoves and SWHBs

	Traditional stove and SWHB	Low-emission stove and SWHB
VAT on sale of stove	Apply	Exempt
Import duty	High, or prohibit import completely	Exemption or low; could consider increasing slowly if and when local production capacity exist and suffices to meet demand; distinguish between import of entire systems and parts; local assembly could be preferred over import of entire systems, as some parts cannot be produced in Mongolia (yet).
Company tax on production of stove and SWHB	High	Low or Exemption, tax credit
Fine for using after 3 year transition period	High	None

Strengthening, Expanding and Enforcing Standards

Currently, there are two different sets of criteria: (i) legal stove standards and (ii) eligibility criteria for consumer subsidies for stove switching. There are some differences which need to be unified gradually. Currently, all traditional stoves do not meet the current legal standards while all stoves eligible for consumer subsidy support exceed it. It is proposed to currently maintain the eligibility criteria, especially the emissions performance criteria, used by UB city for consumer subsidies. It is also proposed to simultaneously review the current stove emission standard, comparing it with the stove switching eligibility criteria and field experiences. The current standard is based on European standards but does not take into account the local experience with low-emissions stoves sold in Mongolia. Local characteristics and experience should be considered to ensure the desired emissions performance can be achieved in the local market. Consultations should take place with different manufacturers but the Government should be very careful to not dilute the emissions performance standard without strong objective analysis. It is important to note that a significant large local investor, which is currently importing stoves, has invested in a local production line to produce stoves with the current stove emissions performance.

The timing of the review is appropriate now with over three years' experience with a stable set of low-emission stoves. The State Standards Inspectorate should work with the SEET Laboratory and other authorities to initiate formal review procedures to update the standard. The State Standards Inspectorate should also be brought into the development of the testing and standards development of SWHBs.

Standards for SWHBs currently do not exist and are needed. The SWHBs is one of the fastest growing market segments for heating systems, and includes imported,

[14] Not a single unit has been sold so far of the one locally manufactured stove model that is eligible because of quality control issues.

locally produced, and do-it-yourself systems. The UBCAP is supporting local consultants in developing a testing protocol for SWHBs.

It is proposed to aim to issue standards for all heating appliances, to update existing standards to reflect the current situation, and in the future to regularly update standards to reflect technological innovations. In addition, it is recommended to gradually increase the coverage and scope of enforcement over several years as presented in the table below. This process could be explained to households through the awareness campaign, so that users of dirty stoves and SWHBs are aware that they have 3 years to replace their equipment before the standards will be mandatory and dirty equipment cannot be used anymore.

Although there is a clear preference among many government officials to promote local production, the regulatory framework should treat all producers and models, whether imported or domestic, even handedly. This will foster competition, innovation and keep open doors to new technologies and materials unavailable in Mongolia. Currently, all low-emission stoves are imported (except for one model) and all dirty stoves are manufactured locally[14].

Stricter regulation will be easier to apply for SWHB than for stoves. The prices of SWHB are already fairly high and any incremental costs due to regulation are likely to be relatively low. Since many SWHB are imported, it would be fairly simple to immediately stop imports of dirty SWHBs. It will be more difficult to stop the local manufacturing of dirty SWHB models, although it would fit well in an effort to professionalize the heating equipment market. A licensing procedure is recommended to professionalize local producers of SWHB and start manufacturing only low-emission SWHB models. The manufacturers can obtain and maintain their license as long as they only sell low-emission equipment. This requires them to agree and submit all new models to the SEET lab for compliance testing.

By the end of a transition period (proposed 3 year transition period), traditional stoves or SWHBs that do not meet the standard would no longer be sold and preferably no longer used. If there is a decision to enforce prohibitions in use it is especially important that affordable low-emission stove alternatives are available and that the Government enlists support from Kheseg leaders who would be asked to help to explain and convince the few remaining households to switch to low emission stoves and SWHBs.

Table 4.

Timing	Heating stoves with/without HW connection	SWHB
Immediately	Update standard	Develop standard through literature search and testing in SEET lab
0–6 months	Apply standards for imported stoves: no more dirty stoves can be imported	Apply standard for imported SWHB: no more dirty SWHB can be imported
0–12 months	Request local stove producers to get in touch with the SDC and start developing low-emission stoves that satisfy the standard.	Request manufacturers to obtain a license and only manufacture (or import) and sell equipment that satisfies the standard. Sales of low-emission SWHB are VAT exonerated.
1–2 years	Apply standards on the production of stoves; start taxing production of traditional stove (VAT) and exonerate low-emission stoves	Licensed suppliers manufacture or import clean SWHB; VAT applied on locally manufactured dirty SWHB (for non-licensed suppliers); import duty reduction on parts or entire low-emission SWHB; DIY is no longer allowed;
Year 3	Mandatory switching of traditional stoves	Mandatory switching of dirty SWHB.

Assistance to Stove Producers to Promote Innovation

The transition period for enforcing new standards is important also to foster innovation – clearly advertising a standard and giving it time for full compliance allows the market to respond. In addition to transparent and competitive selection as well as continued consumer subsidy program for eligible models, stove producers can be supported more directly with technical assistance. This is especially important if the government's objective remains to foster local innovation of stoves rather than relying on imports.

What is important is to encourage ways to sustainably reduce costs in order to remove subsidies eventually – it is likely that commercial local production (even of imported technologies) will be part of the solution. It is unlikely that government-owned and operated manufacturing will fit this market-based strategy because (a) government-owned facilities will receive unavoidable preferences because regulator and owner will be the same; (b) with preferences government-owned suppliers will gain unfair market advantage, thus risking objectives of competition and innovation. The private sector will critical to the success of this strategy.

On the one hand, most producers of traditional stoves are not able to design low-emission stove models or to supply high quality stoves and in large quantities. However, the large number of traditional stove producers have market knowledge and basic technical skills that can be used to service a transformed market. On the other hand local manufacturers and very few private investors know little about the market and stove products. Their commercial capacities need to be harnessed to deliver high quality, innovative products at prices households can afford.

BOX 4 LOCAL MONGOLIAN MANUFACTURING CAPACITY

There are several different types of stove suppliers in Mongolia: (i) backyard/garage type of operators with a minimum of equipment and able to manufacture a few stoves per day; (ii) semi-industrial operators with a small metal workshop that is used for the production of stoves and other products, and able to manufacture a few 10s of stoves per day; and (iii) industrial operators. The industrial operators have modern production facilities and can easily produce different stove models at a capacity of 100 per day; their core business is to produce other products.

The one Mongolian stove model that is eligible for support under UBCAP is produced in such an industrial production facility. The backyard/garage operators are not likely to be able to provide the quality and quantity required for large-scale dissemination of low-emission stoves. In general traditional stoves do not necessarily have quality issues even though they are produced in several backyard/garage facilities throughout town: the earlier 1000 household survey found that the typical life time of traditional stoves is 10 years. However, the production capacity is limited. Given the small number of new models over the years, innovative, small scale production is not possible from the existing backyard/garage producers. The suppliers will also not be able to quickly satisfy demand at scale.

It may be worthwhile to explore if a production facility could be opened to a consortium of smaller producers that have developed eligible models. This idea has floated among stove producers and MUB for some time but was never realized. With the assistance of SDC, however this is an idea to pursue.

During the transition period, a Stove Development Center can assist local producers with the design of cleaner models. The SDC can assist local stove producers in: (i) developing cleaner stove models by modifying the combustion characteristics of the stoves; (ii) producing higher quality stoves at lower costs by improving both stove design and the manufacturing process; (iii) working with current eligible suppliers to retrain traditional stove producers who will eventually find their products illegal to learn how to service low-emission stoves. The MUST has committed to establishing a SDC with the support of MUB/UBCAP (for equipment only) and its own resources (for facilities operation and maintenance and staffing). This should be accelerated to help foster local innovation - and be a place where producers who fail to meet criteria can better understand and improve their models.

The Stove Development Center and SEET Lab, under MUST, can also be centers for research and development, if they have funding to do so. The heating and cooking conditions in Mongolia appear unique in the world, combining extremely low temperatures with poorly insulated homes such as ger and small cheaply constructed detached houses. This causes more heating energy to be used than necessary, and better insulation materials may help to improve this. In fact, the heat loss characteristics of the dwelling are the fourth factor determining fuel consumption and PM emissions: the stove, the fuel, and the user are the other three. R&D combining the four factors is likely to produce even better results in terms of fuel consumption and PM emissions.

In addition, R&D can possibly develop specific solutions for summer and/or winter cooking. Longer-term solutions for innovation consist of the next generation of clean fuel technologies, such as coal to gas or coal to liquid. These may become viable as the technology improves and provide solutions for heating and cooking under Mongolian conditions. This is particularly important since Mongolia's main source of energy by far is coal, and the viability of connecting individual homes to the central district heating system is poor.

If local manufacturers are able to

demonstrate that they can produce eligible stoves in important quantities, the government should consider the introduction of licenses for them also. They would then agree to only manufacture or import low-emission stoves meeting the standard, and also agree to submit new models for compliance testing by the SEET laboratory. A program to promote stove switching would then no longer be necessary as all stove and SWHB producers in the country are necessarily licensed and dirty stoves and SWHB, at least in theory, are no longer supplied.

Strengthen coordination and policy coherence to enhance national expansion

Policy and Program Coordination

This strategy will require strong coordination of national policies and programs in addition to strong program management. Introducing clean technologies to essentially the poorer households in Mongolia's urban areas cut across several jurisdictions, including environment, energy, finance, central and local governments.

The National Coordination Committee on Air Pollution Reduction (NCAPR) has been introduced by the Government to coordinate all air pollution measures. It has been attached to the President's office, but since 2014 it is restructured under the Prime Minister's office. The NCAPR includes representation of all main pollution abatement stakeholders, such as the Ministry of Nature, Environment and Green Development; The Ministry of Energy; the Municipality of Ulaanbaatar, and is headed by the Prime Minister's office. The NCAPR is well placed to oversee the implementation of the strategy. To maximize the impact of all air pollution reduction measures combined, the NCAPR should ensure that there are no overlapping or conflicting policies. As an example, in the past, fuels were promoted without stoves that could properly use these fuels. The NCAPR should ensure the consistency of the entire package of short, medium, and long-term measures to combat air pollution.

At the Ulaanbaatar city level, the MUB should be responsible for managing the program in Ulaanbaatar but coordinate with the government at aimag level and NCAPR on elements of the national strategy. Both NCAPR and MUB will also have an important role in coordinating an awareness campaign to address air pollution issues to the public and inform the public of results achieved. The media and awareness campaign can be used more and better to bring about key messages required for households to take their responsibility.

A strong project management unit should be identified. The main role of the PMU is to manage the implementation of all activities and coordinate between all actors to ensure that they all realize their tasks. The PMU will prepare a plan for the roll out to 10 aimag or soum centers, identify the PC and QAA in each location, and provide training. Then the PMU will monitor the operations of the PC and the QAA, and intervene if and when necessary. The PMU will also analyze the results of implementation and report back to the NCAPR. It should remain active until the market for low-emission stoves has been established. It should be able to communicate comfortably with high level politicians, technical Ministries and Municipality staff, and donor agencies. It should also have as strong procurement and administrative capacity.

Framework for Informing Policy Decisions on Stoves

Emissions performance of stoves depends on a combination of three factors: stoves, fuels, and users. The Government has made it a primary objective to reduce air pollution in Ulaanbaatar, and stoves are properly considered a key short-term mitigation measure. However, the type of fuel should not be ignored. The recent policy that promoted use of Baganuur coal could double PM emissions in traditional stoves. Before different fuels are promoted in Ulaanbaatar, proof should be available that these are compatible with the current low emission stove criteria. There are also practical considerations – it is not realistic to expect households who recently switched their stove, to switch again in the near future just because there are new fuels, which require new stoves to burn cleanly.

Unlike many countries, Mongolia benefits from having a local laboratory, the SEET laboratory that is owned and operated by MUST to carry out stove performance tests locally. The SEET Lab has developed protocols for testing ger household stoves, but has not yet developed a protocol for testing SWHBs. The emission performance of different combinations of stoves and fuels can be tested to determine if certain stoves or fuels can contribute to further air pollution reductions. Such test information can be very useful for the government's decision making on the estimated benefits of proposed interventions, comparing them to implementation costs.

All over the world, users deviate from stove user manuals. This will affect stove emissions performance in the field compared to that measured in a laboratory. The SEET Lab should carry out field investigations to understand user behaviors with new technologies. Deviations should be taken into account when reporting test results so that public and policy expectations are properly informed. Such field investigations could be undertaken by others but it is proposed such efforts are coordinated with SEET Lab because there are very few local professionals – working together across institutions would build needed experience and capacity to improve testing.

The NCAPR should regularly be informed of a summary of all test results, and should be briefed by the PMU if certain issues arise with the introduction of new fuels, new stoves, or user requirements for properly operating stoves.

International knowledge sharing

The strategy will also require continuous monitoring and adjustment to respond to market dynamics and external factors. Maintaining connections with the international cookstove community will also be essential to share knowledge, maintain networks with the scientific community, and stay up to speed on best practices.

Access to clean cooking energy is an important global agenda. Many countries-such as China, Indonesia, Kenya, Lao PDR, and Nigeria-have launched a program to obtain universal access to clean cooking solutions in their country by 2020, and many more contemplate to launch such programs in the near future. The NCAPR should ensure that important stakeholders in Mongolia are aware of the ongoing stove programs elsewhere and stimulate exchange of experiences.

The SEET laboratory is an increasingly internationally recognized as one of the few laboratories that are able to reliably measure real-time PM emissions from stoves. It is in touch with the SeTAR Centre of the University of Johannesburg that operates a similar laboratory and also seek contact with universities or research

institutes that are setting up their own laboratories, such as in China (Agricultural University) and in Indonesia (an NGO Yayasan Dian Desa).

The Global Alliance of Clean Cookstoves (GACC) is a public-private partnership that seeks to save lives, improve livelihoods, empower women, and protect the environment by creating a thriving global market for clean and efficient household cooking solutions. It is recommended to maintain contact with the GACC for coordination, knowledge exchange, and potential future cooperation.

In addition, there are other players in this field, such as GERES, GIZ, ADB, etc. The coordination and collaboration are important in moving the clean stove agenda and achieving common objectives.

Coordinated and Intensified Awareness Raising and Community Engagement

The objective of entirely replacing traditional heating stoves with low-emission stoves will not be easy to achieve without public support. While many households have already replaced their stove and it is expected that many more will do so in the near future, there might also be households who cannot or do not want to replace their stoves. They could either be culturally or socially attached to their stove, or they do not want to replace it before it gets old, or they could simply be too poor to even buy a subsidized low-emission stove. Awareness raising is a key element of building a foundation of support for enforcing stricter regulations and more broadly the objectives of this strategy. Ultimately, once the transition period is over a strict enforcement regime, with penalties, will need to be in place. This will be difficult to implement without the support and understanding of the public.

The public awareness campaign needs to be more tightly planned and its key messages delivered consistently by key stakeholders, including members of the NCAPR and Ulaanbaatar city, so as to build and sustain both political and public support for the strategy. Market transformation requires sacrifices, changing longstanding behaviors, and can challenge interest groups. It also has new champions and stakeholders. Ultimately the market is made up of customers who must be convinced of the science, the technology and the benefits of the stove switching program. It is they who need to be convinced to buy new stoves, even if their traditional polluting stove is working fine, and to change some behaviors on fuelling and cooking to accommodate the new technology (so that the stoves emit particulates as little as possible). They need to be convinced that these actions contribute to the wellbeing of those who are important to them. The awareness campaign should also be used to report back to the public what are the current results of air pollution reduction efforts so that they can feel connected to the effort to clean up the air.

Television media and word-of-mouth appear to be the most effective channels for delivering messages but there can be other ways to reach stakeholders. Because there currently are limits to the capacity of public relations departments especially at the city level (and no specific person responsible for PR at the NCAPR at the time of writing), professional public relations advice can be very helpful to help the National Coordination Committee and the Ulaanbaatar Municipality develop a well-focused campaign. The UBCAP has some financing to design a PR campaign and provide some training, but it may be useful to supplement this work with additional resources in the future.

In addition, international experience suggests that there are non-traditional channels that can reach ger area residents in Ulaanbaatar and other Aimags. These can be identified by the PR experts. For instance, information on the effects of air pollution on health can be provided at preventative health clinics visited by ger area residents. Information can also be provided on how people can find ways to reduce pollution, including the use of low emission stoves. Generally, there are two ways of convincing households to voluntarily switch their stoves are:

- Maintaining a focused awareness campaign emphasizing key messages on proper stove use, health risks associated with using traditional stoves, implications of reselling low-emission stoves and reverting to traditional, polluting stoves, that subsidies will be temporary, that stricter regulations will be enforced against a clear timeline, and that air pollution will not be solved overnight, requiring both short term and long term solutions. Stoves provide short term relief from extreme exposure to wintertime pollution but will need to be complemented with other abatement measures that will more permanently reduce exposure to harmful particulates. These messages can increase peer pressure and maintain a broad base of public support which is essential not only to transforming the stove market but also to sustainably reducing air pollution to Mongolia Air Quality Standards.
- More direct consultation with civil society, including through Khoroo and kheseg leaders. Also, NCAPR could organize public hearings to solicit public input. Finally, air quality monitoring results, good or bad, should be transparently and regularly reported with comparative analysis that shows the public whether air quality is improving. Feedback on stoves, supplier services and other issues can help improve the program and, if their concerns are effectively addressed, convince civil society they have a critical stake and role in helping transform the stoves market and reduce air pollution.

Although the Government will mandate the use of standards, it does not necessarily mean that everyone immediately or automatically complies. It is recommended to carry out a number of activities prior to enforcement in order to prepare the general public for the enforcement: (i) announce the intention to enforce standards ahead of time; (ii) explain the action that will be taken to enforce the standards; (iii) ensure that households understand that a subsidy program can be used to replace dirty stoves before enforcement; and (iv) regular updates on progress with the action leading to enforcement through the awareness campaign.

Another priority is the extended coverage of lighting and re-fuelling so that households eventually adopt appropriate techniques. Based on experience gained thus far, households seem able to fully adopt fire starting practices required for clean operation of the new stoves – but it takes time and much effort to get them to adopt these methods. The main pollution emitted from heating stoves and SWHB is related with start-up and refueling procedures. Households continue to follow procedures they have traditionally applied, which is likely to increase air pollution substantially.

The expanded national program and transition period to stricter standards will also need to be explained very well – how this affects people and why is this done. The Government was effective in signaling to the market that the 2013-2014 Winter is the last season for the subsidy as it is

structured now. The market responded favorably. Likewise, the new subsidy structure and mechanism will need to be described and a clear timeline will need to be established that coincides with the transition to stricter standards. That is, the subsidy will be phased out over 3 years and later it becomes mandatory to use a low-emission stove or SWHB.

Financing Preparation and Implementation

There have been numerous donor initiatives to combat air pollution that have been mobilized by the Government of Mongolia since 2007 with assistance from the World Bank. About $63 million were mobilized from various donor and MFI resources thus far and about $39 million has been used to support stove switching. The investment has helped yield tangible benefits but it also is at risk of losing these benefits if resources are abruptly cut off for further building a sustainable low e stove and SWHB markets.

A cost and benefit analysis is conducted to shed lights on the cost of the envisioned program. As illustrated in Scenario 1 of Annex 2, if stoves were provided a subsidy level of 20% in Ulaanbaatar or 30% in aimags, excluding SWHBs, additional subsidies over three years would amount to $5.8 million. On top of the subsidies, other program cost items, such as Quality Assurance Agents, market development support, and program operation cost across the country would need to be paid over three years, amounting to an estimated $2.6 million. Through 2015 the SDC and SEET Lab should be fully funded by UBCAP and the MUST, though gradually commercial payments should help to offset decreases in UBCAP funding over time. The PMU will need to be supported with government funding.

Aside from the UBCAP and the MUST, the only other stable source of funding to implement the strategy is the Clean Air Foundation. The UBCAP support is limited strictly to Ulaanbaatar city by legal agreement. Only the CAF currently has a national reach. Recognizing that there are discussions underway to close the fund, it is proposed to keep the CAF open because it is the only relatively stable source of financing for this kind of support. As the program details are further defined, other financing sources should be made available.

Economic Benefits

The economic cost of air pollution in Ulaanbaatar in 2009 have been estimated at USD 687 million; an updated number for 2014 is not known. The benefits of USD 74 million as estimated under the 80% AMHIB scenario are equivalent to USD 211 per year per household in Ulaanbaatar. The actual one-time subsidy paid until now ranged from USD 250-350 per stove: this level of costs is far below the annual economic benefit obtained from using these stoves.

Therefore, the main economic benefit from implementing the strategy is the fact that the current level of health benefits in Ulaanbaatar can be maintained and does not deteriorate. Health benefits in the aimags, fuel savings for all households with low-emission stoves, and employment generation from setting up the supply chain of low-emission stoves should be added to the Ulaanbaatar health benefits. This level of benefits (USD 74 million/year) is far higher than the costs for implementing the entire strategy, which does not surpass USD 13 million. Even if the total costs of switching 135,000 stoves under the current and past programs are added to the costs for the national stove switching strategy, the costs for stove switching are far lower than the sustained health benefits in Ulaanbaatar. As shown in Annex 2, the net present value of the costs amount to USD 94 million and are indeed far lower than

the net present value of just the health benefits in Ulaanbaatar, USD 703 million.

Although the precise benefits from implementing the national stove switching strategy are difficult to estimate, it is clear that they far exceed the costs. Therefore, these estimates indicated that the economic benefits exceed by a comfortable margin the estimated costs of the proposed strategy.

CHAPTER 4: SUGGESTED ROAD MAP FOR TRANSFORMING THE STOVE MARKET

Establish road map to implement the strategy

This chapter presents an indicative roadmap for implementing the proposed strategy for building a sustainable market for clean stoves. The strategy calls for multiple actions to be taken concurrently – actions that will help make a transition from short-term objectives of reducing air pollution in Ulaanbaatar through rapid penetration of low-emission stoves to a long term sustainable low-emission stove market nationally. This requires a clear governance and management structure that oversees a well-coordinated plan.

The following is an indicative road map for consideration. It will need to be adjusted to fit with conditions at the time of the adoption of the strategy. Once approved, the strategy and road map will need to be transformed into a detailed implementation plan. It will also need to be adjusted by NCARP based on feedback during monitoring and evaluation. The strategy is not cast in stone and should be reviewed periodically and adjusted if needed.

The strategy aims to sustain emissions reductions from low emissions stoves in Ulaanbaatar, as well as provide universal access to clean cooking and heating solutions. Figure 3 below shows an indicative flow chart of major steps. The steps are further elaborated in this Chapter, including suggested assignments of tasks for the main responsible organizations.

Figure 3: Time table for roll-out

	year 1				year 2				year 3				year 4			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Ten steps for completing the transformation																
1 Establish Institutional Arrangements																
2 Maintain & set up new PCs in UB																
3 Develop standards																
4 Assist local stove producers																
5 Set up supply chain outside UB																
6 Set up quality control system																
7 Expand & adjust awareness campaign																
8 Adjust subsidy mechanism, 3 years																
9a Enforcement of standards SWHBs																
9b Enforcement of standards producing traditional stoves																
9c Enforcement of standards using traditional stoves																
10 Monitor and evaluate results																

Ten steps for completing the transformation to a cleaner stove market

Step 1 Establish institutional arrangements

Preparing for the national rollout will take approximately one year as shown in Figure 3 above. Table 3 below shows the main stakeholders for the nationwide roll-out and their responsibilities in preparation and implementation of the rollout. The two most important stakeholders are the PMU and the NCAPR: The Project Management Unit manages implementation and reports to the NCAPR that functions as the Steering Committee; their roles are specified below. Many other stakeholders have a specific role to play which is summarized in Table 3. Due to the number of agencies and jurisdictions involved in implementing several actions, a clear governance and management structure is needed to oversee, coordinate and manage the implementation of the strategy.

It is proposed that the NCAPR, under the leadership of the Prime Minister, receive a mandate to oversee the implementation of the strategy and in particular be responsible for ensuring coordination across agencies. The Ministry of Energy has primary responsibility for ensuring access to clean energy. The Ministry of Environment and Green Development is responsible for environmental protection. The Ulaanbaatar city has experience in stove switching, the largest stove market and the base for private supply of clean stoves for the rest of the country. Other agencies will be responsible for other critical aspects, such as standards and enforcement. Academia can be the frontline of innovation. Key Parliamentarians will also need to support the strategy. The private sector and households are ultimately critical to success. A lead ministry should be selected to lead implementation of the national strategy and the Ulaanbaatar city should remain responsible for implementation of the strategy in its city.

A well-funded, well-staffed and competent Project Management Unit should be appointed to manage the implementation of the strategy nationwide. The PMU reports to the NCAPR, which provides a governance structure that acts in concert across multiple agencies. The PMU should remain active until the market for low-emission stoves has been established. It should be able to communicate and interact regularly with high level politicians, technical Ministries and Municipality staff, and donor agencies. It should also have as strong procurement and administrative capacity. The main role of the PMU is to manage the implementation of all activities and coordinate between all actors to ensure that they all realize their tasks. The PMU will prepare a plan for the roll out to about the 10 aimag or soum centers, identify the PC and QAA in each location, and provide training. Then the PMU will monitor the operations of the PC and the QAA, and intervene if and when necessary. The PMU will also analyze the results of implementation and report back to the NCAPR.

The UBCAP PMU is one of the organizations that could handle these tasks comfortably as it is a logical extension of currently carried out activities within Ulaanbaatar. The PMU should be relatively autonomous, reporting to a Steering Committee comprised of the main institutional stakeholders, such as the NCAPR.

Table 5: Institutional responsibilities for the nationwide roll-out

	Possible Key Roles	Preparation	implementation
Parliament	Enact legislation, make funding available	Order the strategy roll out and monitor progress	Monitor progress
NCAPR	Coordination of all activities ensuring policies and programs are coherent and well coordinated (including awareness campaign), oversight of implementation (directly or via Steering Committee)	Coordinate with all stakeholders to prepare plan for roll out Oversee implementation, coordinate, review feedback, fine tune strategy and plan, ensure budget is available	Monitor results, fine tune strategy, and ensure budget is available
Ministry of Environment	Ensuring protection from harmful air pollution via policy and program support, including monitoring and reporting on air quality. Executing responsibility as Chairman of Board of the Clean Air Foundation	Develop and implement supportive policies, including improving $PM_{2.5}$ monitoring and reporting system in Ulaanbaatar and other cities and set up a system for analysis of results. Report on results to civil society periodically. Identify other opportunities for introducing emission control technologies.	Report on results and improvements of air quality improvement
Ministry of Energy	Ensuring expanded access to clean energy for heating and cooking via policy and program support, including coordination between clean fuel and clean stove policies	Develop and implement supportive policies, ensure monitoring and reporting system set up to monitor fuel and stove use. M&E system to follow progress of clean energy access and actual stove performance in terms of emissions and fuel consumption.	Report on results in terms of stoves disseminated, fuel use changes
Ministry of Finance (or, partially, Clean Air Fund)	Ensuring fiscal resources are provided under approved budgets and other approved fiscal measures are executed.	Develop and, once approved, implement range of fiscal and tax measures incentivizing clean technology use and preventing polluting technologies (i.e. import duty scheme, company tax, and VAT) Monitor budget execution comparing with results	Apply scheme and monitor implication on the national budget
MUB	Ensure strategy and stove switching is implemented in Ulaanbaatar, ensuring supporting policies and programs are coherent and well coordinated	Implement UBCAP project, develop and implement supportive measures, including ensuring good coordination between NAMHEM and Ulaanbaatar Air Quality Agency (increasing its capacity to for monitoring and analysis), assisting in development and enforcement of standards within the framework of the law	Assist SSIA with enforcing the standards

Khoroo and kheseg leaders	Oversee stove switching within their jurisdiction, provide support where necessary, participate in identifying eligible households and preventing fraud	Take stock of results and communicate potential market to PMU	Maintain family books, sensitize households to participate
Aimag Governor and local leaders	Oversee stove switching within their jurisdiction, provide support where necessary, participate in identifying eligible households and preventing fraud	Participate in public awareness campaign, develop lists of eligible households, help to identify PCs and QAA	Sensitize households, monitor results
MFIs and Donors	Can provide a wide range of resources, depending on donor country strategies and requests from the government	UBCAP and JICA are currently focused on Ulaanbaatar only. World Bank provides technical assistance to inform both Ulaanbaatar and national policy. Other agencies also providing important support.	Monitor resuls and IFIs/Donors respond to other requests for support if possible. Commercial Banks to participate in implementation where feasible.
Commercial Banks	Encouraged to participate in financial management of the stove switching program, replicating Ulaanbaatar system as much as possible, encouraged to offer micro-credits for (increased) down payments for low-emission stoves	Engage with government on possibility of managing PCs in Ulaanbaatar and establishing system of accepting HH payments across the country, managing subsidy funds flow to producers and developing a nation-wide monitoring database of purchases, payments and installations	
Clean Air Fund	Manages and allocates funds for air pollution abatement measures.	Continue to finance subsidies and elements of the national strategy. If it still remains, CAF can be a stable funding source.	
Mongolian Agency for Standardization and Metrology	Set standards for heating systems	Together with SEET lab, MUB/ AQD, Min of Env, Min of Energy set standards for heating stoves, heating walls, and SWHBs	Fine tune standards if applicable, due to new technological innovation
State Specialised Inspection Agency	Enforce air quality standards for heating appliances	Prepare a plan for gradual application of the standards	Enforce the standards
PMU	Manage implementation	Prepare plan for rolling out to 10 aimags. Develop contracts between PC, QAA, PMU, suppliers, and local bank offices in soums	Coordinate between all stakeholders and provide management assistance when needed

Suppliers	Private sector investment and commercial skills to develop/ import and sell attractive stove models, contributing significantly to reduction in air pollution. Provide maintenance and repair services during warrantee period	Private sector invited to provide feedback on the implementation of the strategy also as part of their interests in corporate social responsibility. Current private sector suppliers work with government to develop viable plan for after sales services outside Ulaanbaatar and after warranties expire. Possible work with SDC to develop training program in servicing low-emission stoves targeting current traditional stove producers. Suppliers encouraged to diversify models and supply chains.	Set up sustainable supply chain of low-emission stoves
Media	Communicate the rationale for stove switching and behavioral change	Prepare households for the upcoming changes to the modalities of the stove witching program.	Maintain the messages and prepare for the changes in the program (removal of subsidy, enforcement of standards).
Households	Buy low-emission stove and use correctly		Phase out use of non-low-emission stoves and SWHB

The NCAPR comprises of high level representatives of all main stakeholders. Its role is to coordinate at high Government level, monitor implementation and motivate all stakeholders to realize their responsibilities, analyze results and fine tune the strategy, and ensure that budget is available for implementation of the strategy. The NCAPR should also be actively involved in the design and realization of the awareness campaign and refine messages when needed at different phases of implementation.

Step 2: Maintain and set up new PCs in Ulaanbaatar

With the implementation of the strategy initial focus will be on remaining eligible households still without clean stoves in Ulaanbaatar. Therefore, new PCs at strategic locations should be set up. These PCs should be set up early on so that low-emission stoves remain available at all times. The number of PCs should be examined regularly so that when business declines, certain PC can be combined, moved to locations where larger numbers of households without low emission products live, or closed.

Step 3: Develop standards for heating appliances

Developing the heating and emission standards discussed in the strategy in Chapter 3 will most likely take at least one year. There are three main types of standards for domestic heating systems in Mongolia: (i) for individual heating stoves, for ger and small detached homes; (ii) for heating stoves connected to a heating wall in detached homes; and (iii) small water heating boilers for larger detached homes.

For heating stoves, standards exist but these are not stringent enough and the current low-emission stoves outperform them. As an example, the current emission standard for heating stoves is based on European standards, but the currently supported eligible stoves are far cleaner because the eligibility criteria for consumer subsidies use a stricter emissions performance requirement. For stoves used with heating walls the same emission standards apply but in addition there are safety issues that need to be regulated as well. There no emission standards for SWHB, although there are likely similar standards in other countries, e,g, in China for SWHB.

It is proposed that the PMU initiates and coordinates the following actions with relevant authorities to develop and enforce stricter standards as outlined in the table below.

Table 6: Roadmap of the Development and Enforcement of Standards

	Heating stoves	Heating stoves with heating wall connection	Small water heating boilers
Within 6 months	Update the standards with current performance data and start the process to approve the standard	Review literature, develop testing protocol	Review literature, develop testing protocol
Within 12 months	Standard updated	Testing completed, develop standard, start process to approve standard	Testing completed, develop standard, start process to approve standard
Start of Year 2	Enforce standard for imported models	Enforce standard for imported models	Enforce standard for imported models
Start of Year 3	Enforce standard for locally produced models	Enforce standard for locally produced models	Enforce standard for locally produced models
Start of Year 4	Enforce standard for end-user stoves	Enforce standard for end-user stoves	Enforce standard for end-user SWHB

The standards need to be developed in a concerted effort between the NCAPR, the MUST SEET laboratory, and the standards organization, the Mongolian Agency for Standardization and Metrology. The NCAPR should be involved in overseeing the setting of the rules for how strict the standards should be. The NCAPR should agree how clean is realistically possible for Mongolia, and it should be assisted in this effort by the testing laboratory of MUST.

Step 4: Assist local stove producers

Assisting stove producers to improve the quality and performance of the locally produced stoves should take place as soon as possible. Producers may need time to develop new models. As noted in Chapter 3, local stove producers are supported by: (a) being eligible to submit models that would be eligible for purchasing with a consumer subsidy; (b) transparent and unbiased screening process that chooses only eligible models and suppliers; (c) supportive regulations and fiscal/tax incentives for eligible models (both local and imported); (d) a (so far) free of charge laboratory testing service to determine emissions performance of stove models. Technical assistance can be provided through the Mongolian University of Science and Technology's Stove Development Center.

As noted in Chapter 3, local stove producers have not been able to develop stoves that meet the UBCAP eligibility criteria, which are stricter than the current standard. The exception is one Mongolian company that was able to be included in the current selection of eligible stoves. Out of the 15 stove models submitted for eligibility testing, only 4 qualified. Out of the 8 submitted Mongolian stove models, only one met the eligibility criteria. In the past Mongolian stove suppliers experienced a common production problem: the production capacity is not high enough to quickly satisfy the demand, and there are issues with quality control of their stoves due to the nature of the non-automated production process.

MUST has encountered delays in setting up the Stove Development Center, but it should now be established shortly. Once operational, it can provide assistance to stove suppliers in modifying and improving their models into low-emission stoves, as well as advice on the production process. It is recommended to quickly include current traditional stove producers in this process as they would be out of a job once the enforcement starts.

Step 5: Set up supply chain of low-emission stoves outside Ulaanbaatar

Towards the end of the first year, such distribution chain could be set up. Once the suppliers have diversified the supply of low-emission stoves in Ulaanbaatar, these stoves should also become available outside the capital. The state of the market is not advanced enough to expect stove suppliers to set up their own supply chain. Until now, users knew that they could only get a trusted low-emission stove for a fixed price at a PC. The concept of Product Centers should therefore be used until users understand the quality difference between low-emission and traditional stoves. PCs will be set up at strategic locations, in Ulaanbaatar as well as in other Aimag or Soum centers in accordance to the priorities as indicated by the NCAPR.

With the assistance of local leaders, the PMU will identify the most suitable business or organization to host a PC in the selected location and sign an agreement. The PC should be attached to an existing, viable business or organization that may have an interest in operating the PC to increase his own business, e.g., hardware stores. The latter could, if interested, create even more PC in different locations nationwide. At a PC all eligible stove models are on display and can be purchased. Users can place purchase orders at the PC, which will record orders in the electronic database and process paperwork as in the current program. Households will deposit their contribution at a participating commercial bank branch at their location. The PMU will need to approach commercial banks, such as XacBank, to participate and willing to offer microcredits. The PC will combine and group orders and communicate these with the suppliers for the delivery of the stoves. The participating commercial bank will also arrange for payment of the buyers' deposit into the supplier's bank account and request release of the subsidy from the PMU once the stoves have been installed.

The PC will thus place bulk orders with the suppliers of eligible stoves, while coordinating closely with the PMU. The PC owner is paid for services rendered including transferring client deposits to suppliers via the local bank branch, installing the stove and training the user, removing the old stove, liaising with the QAA (see below). The supplier will transport the stoves to the PC and will truck out the old stoves. All costs for these operations[15] will be built into the price of the stove. Initially a few PCs will be set up in Ulaanbaatar, and as quickly as some experience is obtained with these new style PCs, the 10 cities where air pollution problems have been reported will also be equipped. More PCs can be identified and set up if there is particularly strong demand for low-emission stoves in a particular region or location.

In the long-run, if and when suppliers become more professional, the Government may wish to set up a licensing system to replace the PC distribution system and the quality control mechanism along the lines as proposed for SWHBs. This would guarantee quality at entry, i.e., stoves sold by a licensed supplier are necessarily low-emission stoves Stove suppliers can obtain and maintain their license as long as they only sell clean stoves, and provide good services to their clients. They should submit new models for testing the by SEET laboratory before putting them on the market. There should be checks and balances to verify compliance, for which the SSIA and MUB are responsible.

It is proposed to gradually extend the sales and distribution system to make low-emission stoves available in other Aimags. The sales and distribution system using Product Centers should be preserved but modified. PCs are exclusive, trusted sales centers that prevent illegal copycat models from being sold. Retaining this system as it is would incur continued costs to the government, but would preserve a key part of the quality control system. See Box 5 for more details about the sales and distribution mechanism applied in Ulaanbaatar.

[15] Average transport costs for 800 km nationwide; transport to and installation at the client; training of the client; taking away the old stove; service fee for operations of the PC; cost of QAA.

BOX 5 THE SALES AND DISTRIBUTION SYSTEM IN UB

Producers and stove models are selected competitively, against specific criteria. Once selected, Producers sign a Producers Agreement with the Project Management Unit. The Producers Agreement sets the rules and responsibilities of suppliers, including minimum service standards, installation responsibilities and penalties for non-compliance. Producers have the right to sell their eligible models through Product Centers. Ineligible models and producers are excluded from the Product Centers.

Product Centers are managed by a Distribution and Sales Agent (DSA). The DSA is XacBank who places representative in each PC to process paperwork, offer microloans for down payments, and record sales. In addition, NGO staff are available at each PC to provide consumers with product information. Customers make payments at XacBank branches, which transfer funds to producers. XacBank also collects emission reduction rights from customers and sells these rights to carbon markets. This covers only part of the costs of the PCs and the government, through the Clean Air Fund, pays an additional fee for its services. XacBank representatives at the PC also make an electronic record of installation (and removal of old stoves) by SMS when stoves are installed, recording the location. It maintains a database (accessible to the PMU) of sales, installations by model number and location that is frequently updated. Paperwork is forwarded to the Project Management Unit which is used as evidence, together with the electronic verification, for paying the consumer's subsidy to the eligible stove supplier. The roles and responsibilities of the DSA are defined in a DSA Agreement signed between the DSA and the PMU. Verification of installation will be impossible for stoves sold during Phase 1 of the expansion program.

Customers sign a User Agreement which defines the roles and responsibilities of households, including following the user manual, allowing the QAA to visit, and promising to use the stove and not resell it.

Upon verified down payments by households, lists are sent to suppliers by the DSA and delivery schedules are arranged. As a part of their agreement, suppliers visit each household, install the new stove, train customers in lighting, refueling and use, and remove old stoves. Old stoves are deposited at collection sites managed by a company that transports them to a scrap metal and recycling facility in Darkhan. The installation and removal costs are included in the price of the stove. Stove disposal is commercially based with no additional charges to consumers or the government.

A Quality Assurance Agent (QAA) is hired by the PMU to independently verify installation. It visits households at the point of installation, verifies their training and sends a separate report to the PMU. It also visits households a few months after installation to check on proper use and household satisfaction. It also makes spot checks by sending random units to the SEET laboratory for testing. Monitoring reports are provided to the PMU.

A Project Management Unit is proposed to be established for the national program to supervise the program. The Ulaanbaatar city maintains a Steering Committee to govern the program.

A phased approach is proposed to expand coverage by reducing the cost via making use of the PC based distribution system in the short run. In the long run however, as the market matures, licensed suppliers should take over the sale of eligible stoves from PCs and operate their own distribution chains. The national expansion is proposed in three phases.

Phase 1 – Consolidate PCs in Ulaanbaatar and Open Access in Ulaanbaatar to Households Residing Outside UB

A few PCs should continue to operate in UB's ger areas to continue to sell stoves to ger area households, while one PC, possibly at the Narantuul market where shoppers come from outside Ulaanbaatar, could be open to start the sales of stoves nationally. The latter would not only serve the demand in Ulaanbaatar, but also the rest of the country until PCs are set up in the country side (Phase 2), but does not include the submission of old stoves outside Ulaanbaatar. Quality control should continue in Ulaanbaatar as it is now to continue to strictly enforce regulations

so that air quality improvements can be sustained. However, similar quality control for stoves sold to households outside Ulaanbaatar in this way will become very costly. Warrantees for stoves sold to households outside Ulaanbaatar will need to clearly describe the contact numbers and service standards their customers can expect in case of defective products. A Project Management Unit (PMU) is proposed to be established for the national program. The PMU should be available to help households contact suppliers.

Phase 2 – Maintain Ulaanbaatar PCs and Establish Product Centers in Selected Aimags

PCs could be identified in other Aimags, prioritizing those where winter air pollution is a concern (reportedly, about ten cities). Eligible suppliers would be free to price their models based on transport and installation costs. Additionally, depending on the expressed demand for low-emission stoves from certain regions, licensed PCs and QAA could be set up in locations where additional demand is concentrated.

It is proposed to follow the sales and service center model used successfully for selling solar home systems under the 100,000 herder program (See Box 5). A selection procedure would be used to identify appropriate organizations or businesses to operate as PCs or QAAs. PCs could be general stores in Aimags where customers come to buy other household needs, for instance. They could also be space in Aimag municipal government office buildings as they are now in Ulaanbaatar. In the former case, less staff is needed because commercial stores would be provided the right to sell eligible models as part of their normal business (with a commission on every purchase). They would be required, through a signed agreement, to refuse to sell ineligible models. They would be required for collecting orders and transmitting these to the suppliers of eligible stoves. The details of the financial management system and information system (to be functioning at each PC) will need to be further developed, depending on the availability and willingness of local financial services.

BOX 6. DISTRIBUTION AND INSTALLATION OF SOLAR HOMES SYSTEMS IN AREAS OUTSIDE ULAANBAATAR

Under the Rural and Renewable Energy Access Project (REAP) subsidized solar home systems (SHS) were sold and distributed to rural households. Service centers were set up in selected aimag and soum centers. The SHS were transported by suppliers to the service centers, and local technicians were used for the installation of the systems. The service centers were paid for the services rendered.

Under the current program, stoves are only available through PCs and all households are visited by the independent QAA to verify that the stoves have actually been installed. This ensures the quality but administration cost is high. Under the modified approach, it is proposed that a combination of measures is taken to ensure the quality of the stoves.

(i) A few PCs are set up throughout the country; these are attached to existing and viable commercial establishments that may have an interest to operate a PC; as an example, hardware stores would be potential candidates[16]. At the PC, all eligible stoves are on display, and

[16] This follows the REAP experience, whereby Service and Sales Centers were set up in selected aimag and soum centers to facilitate the supply of solar home systems to herders.

the operator of the PC will take orders for the suppliers on a commission basis; the PC will install the stoves and supply evidence of installation. The PC could also provide maintenance and repair services, which during the warrantee period is covered by the supplier;

(ii) Eventually eligible suppliers could operate their own distribution system, as long as they have an established good track record with regards to the quality of stoves. The introduction of licensed low-emission stove suppliers will help to further professionalize the stove market.

As with the 100,000 herder solar home system program, the sales and service centers would be responsible for placing orders with suppliers, receiving stoves supplied by suppliers, then distributing and installing stoves. Delivery schedules would be determined based on order numbers and established trucking deliveries to the Aimag from Ulaanbaatar. The PCs would collect old stoves, which would be trucked back by stove suppliers.

At each PC outside Ulaanbaatar, a separate Quality and Assurance Agent (QAA) should be established. It is assumed that the distances between PCs are too great for one QAA to cover the entire country or even a region, and a locally based QAA is therefore more appropriate. Training for PC and QAA staff would be provided by the national PMU staff. Close coordination with the PMU in Ulaanbaatar is required as subsidy disbursement will be triggered once confirmed by PMU of information provided by the QAA in the aimag. It is thinkable that a few soum centers with a large demand for low-emission stoves could host a PC in the future too.

Phase 3 -- Regulated market with licensed suppliers

It is expected that several suppliers will offer low-emission stoves in the future. Two issues that need to be addressed to facilitate dissemination of low-emission stoves: (i) how to inform potential clients which stove models are eligible; and (ii) where are locations for purchasing eligible stoves. The use of PCs was justified to introduce low-emission stoves to the market. Once the market matures and professionalizes in the future, PCs may no longer be necessary as licensed suppliers could sell eligible stoves from their own location.

The final phase is regulated market, whereby licensed suppliers sell and install low-emission stoves and are monitored by the normal inspection authorities. Depending on the business model of the supplier, PCs that in fact acted as licensed suppliers in Phase 2, could now become licensed suppliers or dealers for, or franchisees of licensed suppliers. The PMU is no longer needed and can cease to exist.

Step 6: Set up quality control system

For each PC outside of Ulaanbaatar, the PMU together with soum or aimag governor, will identify and select the most suitable organizations to act as QAA and sign an agreement. The alternative would be one QAA per region, or for the country as a whole. The logistic and cost implications will need to be analyzed further. For now, let's assume that there will be one QAA per remote PC. The QAA and the PC in that location should be able to work closely together. The QAA is paid for services rendered (See Annex 3), which includes visiting households with an eligible stove following a statistical sample that is communicated from the PMU based on earlier experience with the particular supplier of the stoves. The better

the experience with a particular supplier, the fewer households receiving his stove will need to be visited. Eventually, no visit should be necessary, as is the case in a fully mature market. The QAA also sets up a Complaints Center, where people can visit or call in to lodge any complaints they may have. The QAA remains in close contact with the PMU to share and learn from experiences with other PCs throughout the country.

Step 7: Expand and coordinate the awareness campaign

The NCAPR should hire a professional PR agency to help put together a coordinated public awareness campaign, budget and implementation plan. The awareness campaign should be considered an integral part of the program and not merely as an added-on requirement: it is a necessary activity for the success of the program. People need to be informed consistently over a longer period because it involves changing customary habits and practices. The campaign should be rolled out early on in the first year so that households and suppliers know the approach for stove dissemination.

Raising awareness of the general public (users) and suppliers of stoves is essential to explain and gain support for regulatory changes and policies that may affect their habits, product choices, pocketbooks and in some cases jobs. Consultations should be a part of reaching out especially to affected stakeholders like traditional stove producers, to understand their concerns and build up plans together on transitions away for producing unqualified and polluting models (e.g. serving clean models). Success can be achieved only through such an approach.

The awareness campaign should play an even larger role than before. Messages need to be coordinated by the NCAPR and should not only address stoves, but air pollution reduction issues in general and people's responsibilities. The NCAPR should take a stronger role in identifying which messages should be disseminated to the public. Special training for high-level NCAPR staff in dealing with the media should be provided. Different channels should be used, from ranging from public & private television, newspapers and written articles, and social media.

Step 8: Adjust the subsidy mechanism and phase it out over three years

It is proposed that during the initial awareness campaign the message is passed that all urban households have 3 years to switch their current dirty stove to a clean stove. During these three years, the subsidy mechanism will continue to be available for users but the amounts provided are far less than before. After the 3 year period, the subsidy will no longer be provided but instead a ban on the use of traditional stoves will be enforced. It is suggested that the period leading to the ban and the period that the subsidy is available is the same, but this is not necessary: it is up to the NCAPR to decide.

The suggested subsidy mechanism is similar to before, but simpler and with lower subsidy levels. The user visits a PC to sign a purchase order and deposits his initial payment. He will get the subsidy assigned once the stove is installed. The subsidy is a fixed percentage of the retail price. The PC staff assumes the responsibility to communicate with the PMU in Ulaanbaatar to request releasing the subsidy. The PC staff also communicates with the suppliers and the involved bank, and makes the necessary financial transfers. The PMU release the subsidy once the PC provided proof of installation of the stove. The purchaser may opt for a micro-financing loan from the financial institution involved

in the deal. Households in Ulaanbaatar did not find it necessary due to the low price of the clean stove and less than 10% made use of the micro financing offered by XacBank.

The proposed subsidy level is proposed to be either a fixed amount or a fixed percentage of the retail price; the NCAPR should decide which one is the preferred mechanism.

Under these conditions, micro-finance may become more attractive to households. The market will decide which stoves will be sold most, and the price is likely to be a determining factor. Previously the retail price paid by the users was decided by a committee consisting of MUB, the PM's office and a few other ministries, which did not give an incentive for suppliers to provide low-cost models.

See Table 5 below for more details about possible price levels. The first line shows the retail price and subsidy level for stoves supported under the UBCAP project. The second line shows the price of a traditional stove during the same period; although there are different traditional stoves, one with a relatively good quality was sold for this price. This is not expected to change in the future. The third line shows proposed price levels for new low-emission stoves that will be sold after the summer of 2014. Two different subsidy levels (25% and 30%) for low-emission stoves are presented here, which bring the price close to the retail price of traditional stoves. This is based on the assumption, confirmed by low-emission stove suppliers, that it is indeed possible to bring eligible low-emission stoves to the market for about US$ 150.

Table 7: Comparison of stove prices to end users with and without subsidy

USD	Retail price	Combined subsidy	End-user price
Low-emission stove prior to 2014	300	275	25
Traditional stove prior to 2014	80	0	80
Low e-stove from 2014, with two possible subsidy levels:			
– subsidy US$ 50	150	50	100
– subsidy US$ 30	150	50	120
Traditional stove expected from 2014	80	0	80

The NCAPR should determine the actual subsidy level. It is necessary to closely monitor the adoption rate and possible fine-tune the subsidy level in case of need. Annex 5 provides more information about different subsidy possibilities.

Step 9: Enforce of emission performance standards

As indicated in Table 4 a series of interventions is needed at different times. Enforcement of the standards is an essential part for successfully convincing users to switch to cleaner stoves and refrain from using dirty stoves (and SWHB). Enforcement in Ulaanbaatar will be realized by MUB in collaboration with the State Specialized Inspection Agency of the Regulatory Agency of the Government of Mongolia. In other parts of the country, the aimag or soum governor should be involved in the enforcement jointly with the SSIA. SWHBs standards should be set after vigorous testing of emissions performance (currently underway). SWHB standards can be more easily enforced because they

reach middle income households and much of the market is reported to be served by imports. Traditional stove production should be phased out first, and after that prohibition of stove use can be implemented gradually. The PMU should coordinate activities. Related agencies will need to not only develop the standards, based on the last three years' experience and other data, but also assess the capacity of SSIA and other agencies to enforce these standards. The standards will be ineffective if they are unrealistic in three aspects: (a) they create barriers the private sector cannot meet; (b) the SSIA does not have the capacity to enforce them (c) traditional producer issues are not adequately addressed.

Step 10: Monitor and evaluate results, identify and manage risks

Monitoring will take on a new meaning during the market transformation as it becomes integral part of the program. Feedback should be given to users, in terms of how many low-emission stoves have been sold, how many traditional stoves still in use, and how much time there still is before traditional stoves will be banned. This may give households a sense of urgency and accept changing their stoves. Users should get a feeling that they belong to the program and are part of the solution.

Normal monitoring of results, as carried out before, should take place as well and managed by the PMU. Specialized firms can be hired to carry out survey work and an impact assessment one year after the enforcement starts. In addition, dissemination information will be increasingly based on supplier and PC data, and may be complemented by data from the aimag or soum governor. It is proposed that the Ministry of Energy also becomes more involved in monitoring of the number of stoves and the fuel savings obtained. The Ministry of Environment and the MUB should work together to monitor $PM_{2.5}$ in Ulaanbaatar. The Ministry of Finance should monitor the use of the fiscal incentives put in place to promote the manufacturing and assembly of low-emission stoves.

It is critically important that the NCAPR identifies and manages risks during implementation. A key risk is the lack of private sector response. As it plans to roll out this strategy, very close consultation will be needed with the private sector to ensure the subsidy scheme and regulatory regime are something they will respond to. This includes consulting with commercial banks as it is their business to assess credit risk – if they are willing to lend to the sector for working capital or capital improvements, it means the market potential and rules of the game are clear and likely to be viable. An additional key risk is political. Some officials may see that the rapid and high penetration of clean stoves is a "mission accomplished", and there is no further need for such involved efforts to build a clean stove market. Moreover, impacts on traditional stove producers must also be carefully addressed. The NCAPR will be tasked with awareness raising among these stakeholders to listen to their concerns and build up a mutual understanding of the issues and challenges to ensuring results that have been achieved will be preserved and expanded.

CHAPTER 5: CONCLUSION

This proposed strategy and the December 2013 stocktaking reports find that a higher share of the urban population needs to have access to cleaner stoves to sustain and increase their contributions to air quality improvements in Ulaanbaatar. The strategy calls for not only expanding to other urban markets, but also introducing and enforcing standards for small water heating boilers, which have lacked attention thus far. It recognizes that there are links between stove markets in Ulaanbaatar and other aimag centers, which can be both a threat (where local producers in aimag centers could easily start selling dirty stoves in Ulaanbaatar) and an opportunity (where established supply chains can be strengthened to distribute low emission stoves).

Building on the strengths of the current stove switching program, the strategy addresses 'sustainability gaps' that prevent the full transformation of the market for cleaner stoves. In addition to expanding nationally, this includes revising and gradually enforcing stove and SWHB standards, revamping fiscal incentives to help import needed spare parts and materials, supporting local producers including developing skills for repair and maintenance of new technologies, revising the consumer subsidy mechanism and phasing it out over three years, and sharpening messages in a strengthened public awareness campaign. Monitoring and evaluation is required to continually adjust to a dynamic market, user preferences and program experience.

The institutional and financing arrangements need to be solidly in place to ensure the strategy takes advantage of built-up capacity in managing and financing stove programs. Policy makers also should ask to be informed with scientifically based emissions test results when evaluating new fuels and/or new stove models, comparing their benefits to the program implementation costs. Selling clean technology to the poor sustainably is not an easy market transformation, requiring many and well-coordinated policy actions and a willing private sector.

Ulaanbaatar is the coldest capital of the world – it does not need to be its most polluted. Stoves are not a magic bullet to solving Ulaanbaatar's air quality but they can be an effective short term abatement measure. Low emission stove programs also disproportionately help the poorest segments of the market. The poorer households have fewer options to adapt to poor air quality and their winter heating costs represent a larger share of income compared to their richer counterparts. Therefore, providing access to cleaner heating/cooking solutions presents a win-win opportunity for a broad range of society – it helps the poor by reducing fuel bills with more efficient stoves using cleaner technologies and it helps everyone with lower health risks from better air quality.

REFERENCES

Smoke Free Ulaanbaatar, March 2010, was originally proposed to the Parliament but did not result in a Resolution; it was included later in the New Construction "medium term target program", published January 12, 2012.

Ulaanbaatar Statistics Department, http://statis.Ulaanbaatar.gov.mn/.

Ulaanbaatar Services Improvement Project II Project Implementation Unit. "Mongolia: Ulaanbaatar

Clean Air Project Safeguards Report" (management unit internal report, September 29, 2011).

World Bank and Public-Private Infrastructure Advisory Facility. Mongolia: Foundation for Sustainable Development: Rethinking Infrastructure Services in Mongolia. June 2007.

World Bank, Mongolia – Heating in Poor, Peri-urban Ger Areas of Ulaanbaatar. ASTAE (Asia Sustainable and Alternative Energy Program) Report, Washington, DC, 2009.

World Bank and Cities Alliances. Mongolia- Managing Urban Expansion in Mongolia; Best Practices in Scenario-Based Urban Planning. Washington, DC: World Bank, 2010.

World Bank. "Clean Stove Initiative in the East Asia and Pacific Region." World Bank Concept Note,Washington, DC, 2011.

World Bank. Mongolia - Air Quality Analysis of Ulaanbaatar; Improving Air Quality to Reduce Health Impacts Vol 1 and 2. World Bank Sustainable Development Series Discussion Paper, December 2011.

World Bank. Rapid Assessment of Stove Markets outside Ulaanbaatar – Trip Report. Internal report for the project. Washington DC: World Bank, 2012.

XacBank. "Market Mechanisms for MCA Energy and Environment Project." Presentation delivered in Ulaanbaatar, Mongolia, March 15, 2010.

ANNEX 1: ESTIMATION OF THE POTENTIAL MARKET

The objective of the national stove program strategy is to establish a sustainable low emission stove market in Mongolia. This would help to achieve the universal access to modern energy services by 2030 goal that is set by the UN, which declared the Year 2012 as the Year of Sustainable Energy for all goal to be achieved by 2030, access to modern energy must be scaled up massively in Mongolia. In this report, stand-alone heating stoves for gers and small detached houses, heating wall stoves, and SWHBs are addressed only.

Having access to clean and modern cooking energy does not necessarily mean that users actually enjoy the full benefits of clean and modern energy: they need to know how to operate their stoves properly. If they don't use their stove properly, they could jeopardize the clean aspects of this access. Because old habits are hard to break and since the fire in low-emission stoves need to be started differently, the strategy to disseminate low-emission stoves therefore needs to include an integral and sustained element of awareness raising. The Ulaanbaatar market heavily relies on imported clean stove products which have high retail prices. Some imported products are successfully sold without subsidies – Chinese made small water heating boilers compete effectively with locally manufactured models, even in cities outside Ulaanbaatar.

First, the total number of traditional stoves that are currently in use in Mongolia are estimated, not distinguishing between heating wall stoves and stand-alone stoves. This would be the theoretical maximum number of low-emission stoves that can be replaced. Since there are no heating equipment statistics other than through the Stocktaking Report and a recent survey by MCA, this estimation is for illustrative purposes only. The Stocktaking Report shows that there are currently some 20000 SWHB in Ulaanbaatar in use at the moment, or 11.6% of all heating appliances reported in use; this is 3% higher than in the winter of 2007/2008 when there were only about 10000 in use.

The following Table shows the actual low-emission stove sales per type as of October 2013 as presented in XacBank's records: some 19% of household living in a ger or a small house without heating wall still do not have a low-emission stove, and 50% of the households with a heating wall currently have a low-emission stove. MUB imported 600 new SWHBs that are expected to be low-emission models, but this has not been confirmed yet through laboratory tests. For completing modern heating energy access in Ulaanbaatar, the focus should be on heating walls and SWHBs as penetration rates in these segments are the lowest.

Table 8: households with a low-emission stove, October 2013 ('000)

	Total in Ulaanbaatar	With low-emission stove	% remaining without
Total nr of households Ulaanbaatar	350	Na	na
Apartment	175	Na	na
Ger	76.5	73.0	19% (or 17.1)
House	13.6		
house with HW	54.3	26.9	50% (or 27.4)
house with SWHB	19.7	0.6	97% (or 19.1)

Source: XacBank

These estimates show that about 17.1 thousand gers and small houses in Ulaanbaatar, plus 27.4 thousand houses with heating walls currently do not have a low emission model installed as their primary heating system. In addition to the above, in reality there are more traditional stoves in use, both within Ulaanbaatar and outside. It is important to analyze these as they reduce the impact that clean stoves can have on the air quality. Individual clean heating stoves will reduce air pollution by over 90% if properly operated, but the impact of clean stoves is greatly reduced if many traditional stoves remain in use.

Three categories of traditional stoves that continue to be used are the following: (i) In Ulaanbaatar in one hashaa, more than one household may live, each with its own stove; until recently, the second household would be non-eligible to receive the subsidy; similarly, households may have more than one ger or house that each have a stove; (ii) heating stoves in other towns (Aimag, Soum and Bag Centers); and (iii) heating stoves in herder households.

Additional market for traditional stoves in Ulaanbaatar

In Ulaanbaatar there are four categories of additional stoves: (i) in households with more than one stove per household; (ii) in summer homes; (iii) in households of new entrants or non-eligible households; and (iv) households which gave away or sold their clean stove.

Experience suggests that quite a few Ulaanbaatar households operate more than one stove in their household, or have dwellings in more than one location: households may live on a hashaa with more than one (heated) building, and quite a few households have a summer place that may also occasionally be used in the winter time. Although the majority of households in Ulaanbaatar will soon have changed their primary heating stove, if they have more than one stove, the second stove will be a traditional model. They cannot benefit from the financial support more than once to purchase a clean stove at low prices. It is doubtful that they will buy in the short run a second low-emission stove because the unsubsidized price of a clean stove is so much higher than the subsidized price.

It is uncertain if recent new entrants into the city are able to quickly meet residency requirements of the stove replacement program. It is not unthinkable that 20000 additional households or more enter Ulaanbaatar every year, which all need to use at least one stove. Thus, even today in Ulaanbaatar there are households living in the city but without the possibility to buy a low-emission stove. Assuming 170,000 ger district households in Ulaanbaatar and this year another 20,000 new households arrived. The total number of low-emission stoves disseminated by the end of the 2013 winter is 110,000 (previous efforts) plus 45,000 (current effort), leaving about 35,000 households with a SWHB system (20,000) or a traditional stove (15,000).

There is no reliable estimate for the number of secondary stoves; the Stocktaking report found that 9% of the households reported 2 or more stoves, which would be an additional 16000 traditional stoves. Moreover, a number of households living in apartments or in the ger districts have a summer home that most likely has a stove as well. Based on discussions with PMU, MUB and MUST staff, as a first order estimation it has been assumed that 10% of the population living in apartments owns a summer house in the surroundings of Ulaanbaatar. Due to the rapid expansion of the city, many of these summerhouses are now located in the outskirts of town and could actually contribute to air pollution. One thing is beyond doubt: how many summer homes

have a stove is not known, but it is certain that all of them are traditional stoves.

A final Ulaanbaatar category of households not using low-emission stoves has earlier benefitted from the subsidy but sold off their stove or gave it to relatives outside the city. They most likely reverted back to using traditional stoves. There are no data on this practice, although a survey by MUB is underway. Assuming that this is 9%, then another 16000 households are without low-emission stoves and should ideally replace these.

To summarize, the market in Ulaanbaatar for additional low-emission stoves shows the following technical potential:

List of household categories	Estimated numbers
Households in ger areas with more than one stove	16000
Summer homes	17000
Currently non-eligible households	15000
Reverted back to traditional stoves	16000
Total to be supplied low-emission stoves	64000

It is noted that this number is only a rough estimate of the technical potential Ulaanbaatar market, combining ger stoves and stoves for detached homes with or without heating wall. However, it does illustrate that the technical potential market for more low-emission stoves in Ulaanbaatar could be large. It also means that if these stoves are not with low-emission models, air pollution will always remain high[17].

Market for traditional stoves outside Ulaanbaatar

Another category of households lives outside Ulaanbaatar and has not benefited from the program. They heard about the benefits for the households and the air quality, and could be interested in replacing their stove(s). In certain larger soum centers and aimag centers air pollution is noticeable as well and at least 8 cities have requested funds to develop an action plan against air pollution. There are as many households in Ulaanbaatar as outside. Taking into account an estimated number of 160000 herder households, this leaves 190000 households in aimag, soum and bag centers.

The Stocktaking Report identified a total technical potential market of about 27 thousand households out of 42 thousand living in Bayankhongor, Darkhan, Khovd and Ondorkhaan. It can roughly be assumed that the percentage of households with ger stoves, heating wall stoves, and SWHB are the same in these four cities as in Ulaanbaatar.

An estimation for the number of households in other aimag and soum centers is 148000 (i.e., 190000 minus the population of the 4 cities surveyed in the Stocktaking Report). Assuming that there are much less SWHB and relatively more gers and homes without heating wall, a rough estimation for the total number of existing traditional stoves is 130000.

In summary, the following technical potential for low-emission stoves is found in aimag and soum centers:

[17] Based on the number of stoves and an emission reduction potential of 90% for low-emission stoves, overall air pollution from ger district heating could be reduced by about 60% if these secondary stoves continue to be used. If they were replaced too, air pollution could be reduced by 90%.

Aimag and soum centers	Estimated numbers
Bayankhongor, Darkhan, Khovd and Ondorkhaan:	27000
Other cities	130000
Total	157000

Again, this total is for illustrative purposes only; a real market study needs to be carried out for more reliable numbers.

Market for traditional stoves in the country side

A final category of households lives in the country side, isolated from other households. They could possibly be interested in low-emission stoves because of the benefits of the stove (no indoor air pollution, longer burn time, less fuel), but currently use traditional stoves. They noticed the awareness campaign and advertisements for these stoves and are fully aware of the benefits. There are 160000 herders, and the trend is observed that they become less sedentary and also start to construct winter homes, while in summer they move around the country side with their ger.

However, many of these households use mainly animal dung, which may require a different stove type than for using coal. The experience of households in Ulaanbaatar now using Baganuur coal has demonstrated that it matters which type of fuel is used. Thus, research into different fuels and stoves should be launched and results made known to consumers so that they buy the optimal stove for their prevailing fuel situation.

While rural households can purchase low emission stoves from Product Centers, they should not be eligible for the subsidy.

Summary of market for traditional stoves

The theoretical market for better stoves could be large indeed: the total number of low-emission stoves and traditional stoves combined is about 155000 and 38000 respectively, or 535000 This is a rough estimate only, not taking into account several other potential markets such as summer homes for households outside Ulaanbaatar, tourist camps, and small shops. The total number could therefore even be higher.

With an average useful life of 10 years, the potential annual replacement market could therefore be more than 50000 stoves. These numbers should be high enough to attract private sector suppliers to step in and innovate, particularly now that there is so much attention to low-emission stoves.

The market size remains small (relative to other stove markets worldwide), but should be high enough to attract private sector suppliers to step in and innovate. The transition to a sustainable clean stove market in Mongolia will require supporting policies, even without large-scale subsidies offered in the past.

In the following sections, the market for stoves and low-emission stoves is further analyzed and a strategy is presented to transform this into a sustainable supply of low-emission stoves.

ANNEX 2: PROGRAM COST AND BENEFIT ANALYSIS ON SELECTED SCENARIOS

Costs for rolling out the strategy

The estimated costs for implementing the national stove strategy are broken down in the (i) operational costs for realizing the stove sales, such as awareness campaign, training, testing, certification, and PMU costs; and (ii) subsidy costs. Two different levels of sales have been assumed, in Ulaanbaatar to cover the annual inflow of 15,000 households who should buy a low-emission stove to maintain the current air pollution benefits, and an increasing number per year in the aimags: a total of 75,000 stoves distributed over 15 aimags. This results in the establishment of a low-emission stove market with an annual value of about USD 6 million.

The subsidy level is a percentage of the retail price of the stove in Ulaanbaatar plus the costs of installation; the subsidy thus covers the costs of installation, transport, the costs of operating the PC, and quality control plus a buy-down for the end-user. One potential option for the subsidy level could be 20% in Ulaanbaatar and 30% in the aimags (see table below). This subsidy level is low compared to the level applied to previous years, when the subsidy was 90% of the price (that created unrealistic market expectations of what a clean stove might cost). The lower subsidy level is suggested with the intention to especially avoid market distortions and give impetus to a sustainable supply. Without a sustainable low-emission stove supply, continued financial assistance will be needed continuously and this should be avoided. It is also based on cost information obtained from stove suppliers who confirmed that less expensive stove models are available that can meet UB's current eligibility criteria. These costs need to be kept updated in pace with inflation and other factors. Based on economic health benefits, the justified subsidy level could be higher (see chapter below).

The study team was informed that some stakeholders are suggesting to subsidize the clean stove price down to the level of traditional stoves. If the end-user price were to be equal to the retail price of a traditional stove, subsidy levels of 50% and 40% are needed (see Scenario 2). The study team does not recommend this strategy as it depends on a benchmark traditional stove that will be phased out. The price of that stove is likely to fall sharply once this policy is understood in the market. Nevertheless, it provides figures to compare with alternatives.

The costs of the program in the Scenario 1 (market based subsidy model) are USD 8.4 million. They rise by 54% to USD 13.0 million in the Scenario 2 (price fixing subsidy model; price equal to traditional stove). The total costs of the program per stove are USD 70 and USD 109 respectively.

Scenario 1 –low subsidy level	y1	y2	y3
Stove sales			
Aimags	20,000	25,000	30,000
UB	15,000	15,000	15,000
Subsidy Aimag	1,140,000	1,425,000	1,710,000
Subsidy UB	510,000	510,000	510,000
Awareness campaign	350,000	262,500	262,500
Training, testing, certification	200,000	200,000	200,000
PMU operations	250,000	250,000	250,000
Misc	122,500	132,375	146,625
Total costs	2,572,500	2,779,875	3,079,125

Scenario 2–intermediate subsidy level (price paid equals traditional stove)	y1	y2	y3
Stove sales			
Aimags	20,000	25,000	30,000
UB	15,000	15,000	15,000
Subsidy Aimag	1,900,000	2,375,000	2,850,000
Subsidy UB	1,020,000	1,020,000	1,020,000
Awareness campaign	350,000	262,500	262,500
Training, testing, certification	200,000	200,000	200,000
PMU operations	250,000	250,000	250,000
Misc	186,000	205,375	229,125
Total costs	3,906,000	4,312,875	4,811,625

Net Economic Benefits of implementing the strategy

The costs for implementing the stove switching activities leading to about 135,000 households with a clean stove in Ulaanbaatar are not known but can be estimated. MCC allocated about USD 30m mainly for stove switching, which was matched by CAF to yield about 110,000 stoves. Under UBCAP some 25,000 stoves were disseminated for a total cost of about USD 4m. The unknown costs for program management should be added to this. Assuming that not more than 1m USD was spent on program management per year and that in total there have been 5 years of stove switching activities, total estimated costs spent so far on stove switching are USD 69m.

According to the World Bank study[18], the annual economic health costs resulting from air pollution amount to USD 687 million in Ulaanbaatar in 2009. Three intervention scenarios of stove switching are considered, whereby the highest scenario assumes that 80% of the stoves are switched, leading to annual economic health benefits of USD 74m[19]. It is noted

[18] Air Quality Analysis of Ulaanbaatar Improving Air Quality to Reduce Health Impacts, World Bank, 2011

[19] Three scenarios are used: 30%, 50% and 80% success rate; the corresponding annual benefits are USD 22m, 40m, and 74m.

that the actual performance of the current low-emission stoves is higher than what was assumed in the World Bank study[20]. The same report estimates the estimated present value of health benefits from intervention over a 13 year period from stove switching to be USD 1605m. In this scenario, $PM_{2.5}$ reductions are 65% in terms of estimated population weighted average concentration reduction. There are no estimates for 2013 or 2014. In the absence of actual data, the current analysis cannot give precise results but can show the boundaries.

Assuming that the economic costs of air pollution are the same in 2014 as in 2009, this translates into an average cost of almost USD 2000 per household. The benefits of USD 74 million as estimated under the 80% AMHIB scenario are equivalent to USD 211 per year per household in Ulaanbaatar, or USD 463 per year per low-emission stove in use[21]. The actual one-time subsidy paid until now ranged from USD 250-350 per stove: this level of costs is far below the annual economic benefit obtained from using these stoves.

The main economic benefit from implementing the strategy is the fact that the current level of health benefits in Ulaanbaatar can be maintained and does not deteriorate. This level of benefits (USD 74m/year) is far higher than the costs for implementing the entire strategy, which does not surpass USD 13m. Even if the total costs of switching 135,000 stoves under the current and past programs are added to the costs for the national stove switching strategy, the costs for stove switching are far lower than the sustained health benefits in Ulaanbaatar.

Year	0	1	2	3
Costs (million USD)				
Past programs combined + UBCAP so far	97			
Strategy rural		2.6	2.8	3.1
Total	97	2.6	2.8	3.1
NPV costs	94			
PV benefits from AMHIB 2010-2023	1406			
Assume 50% for period 2010-2014	703			
Total nr low-emission stoves	110000	145,000	185,000	230,000

The above table shows estimated costs of all past + current + proposed national program together, compared to the present value of the health benefits in Ulaanbaatar only over the period 2010-2014. Health benefits in the aimags, fuel savings for all households with low-emission stoves, and employment generation from setting up the supply chain of low-emission stoves have not been incorporated. It is shown that the net present value of the costs, USD 94m, are indeed far lower than just the health benefits in Ulaanbaatar, USD 703m.

Although the precise benefits from implementing the national stove switching strategy are difficult to estimate, it is clear that they far exceed the costs. It is highly justified to implement the strategy as proposed in this document.

[20] The study considered maximum PM 2.5 reductions of 90%, while the stoves yield > 96% reductions.

[21] There are about 135,000 low-emission stoves disseminated so far.

ANNEX 3 COST OF INSTALLING STOVES IN THE AIMAG AND ASSUMPTIONS

Summary costs of transport, installation, QAA, PC	costs per stove, MNT
Transport costs per stove	17,846
Return old stoves	17,846
Training costs	401
Supervision costs (from UB)	2,232
Operational costs PC	1,932
Staff costs PC	312
Stove installation costs	13068
QAA costs	1,941
Miscellaneous	8,337
	63,915
Exchange rate	1750
Total costs USD	36.5

Assumptions		
Truck	5	Ton
Number of stove for trip	65	
Number of households per aimag	5,000	
Distance of aimag	800	Km
Transportation rate per ton/km	290	MNT per t.km
Number of PCs -3 per aimag	3	
Number of QAA staff	16	
Number of supervisors 2 persons	3	time per aimag
Number of trainers	2	time per aimag
Duration of stove sale	3	Months
Sales per day	56	stoves sold/d in total
Sales per day	19	per PC
Days per month	30	
Total	5,040	
Description of expenditures	Training cost /MNT/	
Trainer's salary (2 persons)	700000	
Travel cost (by flight)	1100000	
Hotel and perdiem (2 nights)	180000	
Training tools	24000	
Total	2004000	
Cost per stove	400.8	
Description of expenditures	Supervision cost /MNT/	
Supervisors (2 persons) 3 times	2100000	
Travel cost (by flight)	3300000	
Hotel and perdiem (2 nights)	3780000	

Laptop/modem/camera/telephone	1980000	
Total	11160000	
Cost per stove	2232	
Description of expenditures	Operation cost of 3 PCs /MNT/	
Computer	4800000	
Printer	1450000	
Stationary	670000	
GPS android cell phone	900000	
Broshur	1500000	
Poster	90000	
Placat	180000	
Board	72000	
	9662000	
Cost per stove	1932.4	
PC staff	2	
Staff per PC	65000	per month
Salary	4	Months
Duration	3	
Number of PC	1560000	
Total	312	
Per stove	QAA cost /12 persons/ /MNT/	
Description of expenditures	12	
Number of staff per PC	5000	
Number of hh to visit	2	
Duration /months/	4,680,000.00	
Salary of QAA staff	5,000,000.00	
Transport costs	24000	
Communication	9,704,000.00	
	1940.8	
Cost per stove		
Installation costs	3	
Number of months	8	
Stoves per day installed per team	2	
Teams per PC	16	
Stoves per day installed	2	
Persons per team	1	
Trucks per team	65000	per month
Cost staff	175000	per day
Costs truck		
Cost overview 1 PC permonth	780000	
Staff	21000000	
Transport	21780000	
Total	13068	
Per stove		

ANNEX 4 STOVE SUBSIDIES

Why should the subsidy mechanism change?

In order to sustain and increase the air quality benefits in UB and in polluted Aimags, (i) a reliable supply of low-e stoves is needed; and (ii) households need to be motivated to switch from using their traditional stoves to a new clean stove even before the end of the life-cycle of the traditional stove. The Government of Mongolia decided to complement the MCA's consumer subsidy so as to further accelerate stove switching in Ulaanbaatar. This brought about unrelistic market expectations for a secondary market for re-selling stoves to residents outside Ulaanbaatar. In addition, the subsidy mechanism used in the past now forces the UB municipality to negotiate retail prices and subsidy levels for each stove model with stove suppliers. While targeted subsidies can be a useful tool to promote large-scale switching, the current subsidy mechanism should not be used for the following reasons:

(i) The information on unit costs is asymmetrical – the suppliers always have more information than the government on the production and distribution costs of their products. As a possible consequence, the current subsidy mechanism may have driven list prices of currently eligible stoves higher than they would be if sold on the market without a subsidy. Suppliers enjoy other benefits such as tax breaks and import duty exemptions also.

(ii) The lack of price competition creates no incentives to bring down costs and prices. The applied end-user prices for different models, even with different sizes, shapes, finishes, etc., are practically the same[22].

(iii) The lack of incentives to supply lower cost models poses a significant risk to UB air quality. If the high level of subsidy is abruptly stopped and not replaced with a modified subsidy mechanism, and there are no alternative models, traditional stoves will regain market share. In the absence of a modified approach, this is the current most likely scenario that will be realized.

(iv) Suppliers confirmed that it is feasible to supply different models of low-e stoves with good emission performance but at lower list prices. Some current models might not be suitable to produce locally, but the private sector should be able to find ways to modify models to meet regulations and market needs.

(v) A larger variety of low-e stoves would be beneficial to more quickly promote switching of stoves.

In principle, the current subsidy comprises 3 separate elements that each motivates the end-user in its own rights; the value of the subsidy is justified based on future economic health benefits that are considerable:

(i) Replacement component; households hand in their old stove which represents a value to them;

(ii) Equalization component; to render the price of the low-e-stove similar to the

[22] Stoves with list prices that range from US$ 167 – 254 are sold to end-users for USD 17.6 – 22.0.

traditional stove; households are able to purchase a traditional stove, so they should be able to buy a low-e stove at that price level too;

(iii) Promotional component; to convince households to buy a low-e stove now rather than in the future.

How would a revised subsidy mechanism work?

This report suggests a strategy and options for a strategy for the UB municipality and the Government of Mongolia of negotiating directly with stove suppliers and offer a fixed subsidy amount irrespective of list prices. In this way, the government protects its public interest by: (i) ensuring any stove model purchased from now on complies with its emissions reduction targets and other regulations; (ii) stays out of commercial considerations and leaves this entirely to the private sector; (iii) yet provides an incentive to stimulate demand for clean stoves. Stove suppliers would submit stoves for performance testing, the SEET lab would report test results to producers and the UB city/NCARP, and the UB city/NCARP would evaluate the tests and other documentation to determine if the models and suppliers meet their eligibility criteria.

The table below presents different scenarios for the reformed subsidy mechanism using the same fixed amount of subsidy for all clean stoves. The NCARP and UB municipality would need to use its own judgment, informed by discussions with suppliers and its own research, as to the retail prices needed to stimulate demand. It is recommended to phase out the subsidy over a transitional period of 2-3 years.

The table below shows approximate list prices of different low-e stoves and the effect of the new subsidy: both stoves that have been supported under earlier phases of the switch-out program as well as new stoves that have not yet been formally tested for eligibility are presented in the table. It is noted that black market low-e stoves are currently sold for approximately 50% of the list price, around USD 200. The NCAPR and MUB should no longer negotiate prices with suppliers but simply fix the subsidy level. Retail prices should be used as benchmarks that should be monitored regularly as basis for further modifications to the subsidy level.

The justification for the subsidy is based on health, fuel savings and comfort benefits for households buying the stove, as well as on the benefits of improving the air quality in the aimag or soum center and also for maintaining the air quality benefits in UB.

Overview of list and end-user prices

Stove type	Subsidy level	list price (USD)	Subsidy (USD)	end-user price (USD)
low-e stove	90%	300	270	30
	2010 - 2014 seasons	250	225	25
	30 USD	175	30	145
	Option A season 2014/2015	125	30	95
	50 USD	175	50	125
	Option B season 2014/2015	125	50	75
Traditional stove	-	80	-	80
		60	-	60
Illegally sold Low-e stove	-	200	-	200

The first line in Table 1 illustrates applied subsidy levels during the earlier phases of the stove switching program, with a subsidy level of around 90% and stoves with list prices between 250 and 300 US$. End-users paid far less than the cost of a traditional stove. For the next heating season, it is proposed to apply a fixed subsidy level for all stoves. The second line uses US$ 30 per stove and the third line US$ 50 per stove. Depending on the list price of the low-e stove, the end-user price is around the price of a traditional stove. The price fixing of the subsidy level is expected to yield a downward trend of the list prices of low-e stoves.

Although the end-user price of low-e stoves under the new subsidy mechanism is higher, this is fully justified as other benefits prevail that are associated to the use of these stoves that could be enough to convince them to switch: longer duration of the heating period of the stove on a load of coal, reduced fuel consumption/ higher efficiency, and better heat output controllability.

Subsidy Mechanism Options

All stove suppliers with stoves that satisfy the eligibility criteria can be supported. Three different options are distinguished.

Option a: fixed percentage subsidy

Households receive a fixed subsidy percentage for a low-e stove purchase although this is paid directly to the supplier to buy down the price. Suppliers need to transport the stove to the household, install it, and provide training in the proper use of the stove. The supplier needs to provide proof of payment by the household and evidence that the stove is installed before he can collect his subsidy. He can request subsidy payment after a certain number of stoves have been installed (i.e., 100). Prices of the stoves would need to be checked from time to time.

Option b: fixed subsidy

This is similar to option a except that the subsidy level is the same for all stoves. This may have the added benefit that even lower-cost stoves are identified by suppliers. Very low-priced stoves could occur. In addition, it is less important or necessary to monitor stove prices.

The advantage is that this system is simple to administer. A QAA should check part of the installations, with a larger sample early on in the program and a smaller sample once it is established that the supplier operates correctly; monitoring requirements are less stringent than under the current program because the subsidy level is much lower and in principle all households are eligible. If the quality of stoves from a certain supplier declines, he will be warned and eventually disqualified if the problems persist.

Option c: incentive package

In this scenario, support is provided to suppliers during six month campaigns for competitively selected stove models. This might stimulate suppliers and keep them alert, and it is simpler to control the quality of the stoves. The variety of stoves available for dissemination might be more limited, and could change after every six months. The price of the stoves to end-users is likely to be lowest from the three options.

Six contracts are issued to the lowest bidders, two each for three different supply quantities over a 6 month period: 10,000 stoves, 5,000 stoves, and 1,000 stoves. For each supply level, the supplier who requests the lowest amount of subsidy will be selected as well as the runner up. They can sell their stoves during 6 months; the sales levels are capped at the supply level for which they submitted a bid, and they receive their subsidy once they provided proof of sale and installation of batches of 100 stoves. The added advantage is that the subsidy level may change (reduce) after six months.