The World Bank

Asia Sustainable and
Alternative Energy Program

EAST ASIA AND PACIFIC CLEAN STOVE INITIATIVE SERIES

Clean Stove Initiative Forum Proceedings

Phnom Penh, Cambodia

March 18, 2013

ASTAE

Australian AID

The International Bank for Reconstruction and Development/
The World Bank Group
1818 H Street, NW
Washington, DC 20433
USA

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Front cover: Yun Wu
Chapter 1: Yayasan Dian Desa
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Overview

Nearly half of the world's people still rely on solid fuels for cooking and heating, using traditional technologies and practices. The Global Burden of Disease Study 2010 estimates that household air pollution (HAP) from the use of solid fuels for cooking contributed to 4 million premature deaths in 2010, a doubling of previous estimates.[1] Achieving universal access to modern energy services by 2030, including clean cooking and heating solutions, is a key objective of Sustainable Energy for All (SE4All), the global initiative of the United Nations. The World Bank is fully committed to meeting this objective, which is central to its mission of poverty reduction and improving people's quality of life.

EAP CSI Forum Context

The East Asia and Pacific (EAP) Clean Stove Initiative (CSI) Forum is part of the World Bank's EAP CSI regional program, which focuses on achieving access to modern cooking and heating solutions in the EAP region, particularly through the scaled-up access to advanced cooking and heating stoves for poor, primarily rural households, who are likely to continue using solid fuels to meet their cooking and heating needs beyond 2030. The EAP CSI is a multi-country, multi-phase program, with funding support provided by the Australian Agency for International Development (AusAID) and the World Bank's Asia Sustainable and Alternative Energy Program (ASTAE). The initiative includes four country-specific programs (China, Indonesia, Lao People's Democratic Republic, and Mongolia) and a regional forum to promote collaboration, learning, and knowledge-sharing on access to modern energy at the household level.

The objectives of the EAP CSI Forum are twofold. The first is to share results from implementing the first phase of the CSI, including reports on initial stocktaking activities in the four participating countries and the proposed intervention strategies. The second is to promote collaboration, learning, and knowledge-sharing as the country initiatives move into their second phase.

The EAP CSI Forum (March 18, 2013) is held concurrently with the international Clean Cooking Forum (March 28–22, 2013), hosted this year by the Global Alliance for Clean Cookstoves (GACC).[2] This strategic scheduling offers a unique opportunity for delegates from EAP CSI countries to learn from and share knowledge and information with a large network of global experts and stakeholders. The Clean Cooking Forum includes some 500 participants from 60 countries and 165 invited speakers, as well as hosted field visits and cookstove demonstrations.

The EAP CSI Forum includes delegations from the four country programs, sector experts, donors, and regional and international partners; in all, there are about 45 participants. The morning session (Session I) is dedicated to country presentations, while the afternoon session (Session II) comprises four panel discussions. This publication documents the country presentations, which comprise the main body of the text,[3] as well as panel-discussion summaries (Appendix A) and a lessons-sharing activity initiated by Lao PDR delegates to the CSI Forum (Appendix B). Also included are speaker biographies (Appendix C), participants' contact information (Appendix D), and the CSI Forum itinerary (Appendix E).[4]

Lessons Learned

Subsidies will be needed to achieve universal access to modern cooking and heating solutions. Like universal access to electricity, which no country has achieved without some

1. S. S. Lim et al., "A Comparative Risk Assessment of Burden of Disease and Injury Attributable to 67 Risk Factors and Risk Factor Clusters in 21 Regions, 1990–2010: A Systematic Analysis for the Global Burden of Disease Study 2010." *Lancet* 380 (9859): 2224–60, 2012.

2. Further information is available at the Clean Cooking Forum website (http://www.cleancooking2013.org/ resources/proceedings).

3. Country presentations for Indonesia, Lao PDR, and China incorporate elements from the subsequently published EAP CSI reports, as follows: ASTAE (Asia Sustainable and Alternative Energy Program), *Indonesia: Toward Universal Access to Clean Cooking* (Washington, DC: World Bank, June 2013); ASTAE, *Pathways to Cleaner Household Cooking in Lao PDR: An Intervention Strategy* (Washington, DC: World Bank, May 2013); World Bank, *China: Accelerating Household Access to Clean Cooking and Heating* (Washington, DC: World Bank, September 2013).

4. The EAP CSI Forum Proceedings was edited by Norma Adams, Writer/Editorial Consultant for the World Bank.

form of subsidy, subsidies will be needed to achieve universal access to modern cooking and heating solutions and scaled-up access to clean stoves for the poor. Market forces and mechanisms are powerful tools for ensuring a sustainable supply of clean cooking stoves and should be harnessed in a way that helps the private sector develop, market, and deliver modern cooking solutions. However, if left to market forces alone, access will be limited by affordability and other constraints that affect mainly poor households, particularly in less developed and more remote areas. Thus, the CSI intervention strategy in each country needs to strike the right balance between market-based solutions, including innovative financing mechanisms (e.g., Results-Based Financing [RBF]), with appropriately targeted subsidies. Government policies are needed to (i) establish and maintain adequate levels of subsidies and (ii) design and implement effective subsidy allocation mechanisms to mobilize and sustain private-sector participation in scaling up access to clean stoves.

National standards are cornerstones for development of a broader set of international standards and testing protocols. Without significant progress in developing and adopting national standards for cooking stoves it will be difficult to make progress and reach agreement on international standards. National standards should be developed, taking into consideration local conditions and best international practices, but they should not wait for the adoption of international standards. Rather, the adoption of international standards will be facilitated by experiences gained through the development of national standardization processes and practices. Testing protocols and certification systems will take longer to develop, and international collaboration on these issues may facilitate the process.

Developing an institutional framework and building policy-making capacity are critical to achieving the CSI objectives. Without clear and sustained political commitment to the CSI objectives and accountable institutions with adequate capacity in program implementation, the risk of energy poverty in the EAP region could increase in the future, particularly among poor and vulnerable households in remote rural areas. This risk carries an unbearable human cost of many premature deaths and respiratory disease among those exposed to HAP linked to the inefficient burning of solid cooking fuels using traditional cooking methods. Fewer deaths and better health are a powerful platform for mobilizing political commitment and creating a strong institutional framework for eliminating the extreme energy poverty associated with the use of solid fuels and primitive cookstoves. The cost of the CSI and achievement of universal access to modern cooking and heating solutions in the participating EAP countries is insignificant compared to the cost of many lost lives and years of productive work.

By enriching our knowledge and experience, the EAP CSI Forum has better prepared us to move ahead to Phase 2 activities. The EAP CSI Forum has presented a unique opportunity for government officials, policy makers, and other key stakeholders to directly network and share ideas and experiences. For example, Lao delegates initiated lessons-sharing for Lao PDR from their participation in the CSI Forum and the global Clean Cooking Forum (Appendix B). Delegates from the four national CSI programs established direct contact with other clean cookstove promoters in the region, paving the way for regional cooperation. A meeting between the Chinese and Mongolian delegates resulted in the Chinese delegates inviting the Vice Mayor of Unlaanbaatar, leader of the Mongolian delegation, to the Clean Stove Expo in China. The CSI Forum also attracted non-participating countries from the region (e.g., Timor Leste). Such examples underscore the Forum's potential for opening up knowledge exchange between countries and regions (e.g., South-South exchanges).

The diversity of participants represented at the EAP CSI Forum has promoted public-private partnerships. The Forum provided an opportunity for representatives of governments, nongovernmental organizations (NGOs), private companies, academia, and international donor and development organizations to openly discuss issues on an equal footing. Bringing such a broad range of stakeholders from multiple sectors together is necessary to tackle the complex issue of clean cookstoves.

The strong interest shown in the first CSI Forum suggests that consideration be given to its institutionalization. The opportunities created by the Forum for discussion of national programs and cross-cutting issues confirm the value added from this regional event. The peer-to-peer dialogue and learning, as well as sharing of international knowledge and experience, particularly from South Asia and Africa, can fuel the momentum of the four national CSI programs. Thus, it is recommended that consideration be given to institutionalizing the CSI Forum through establishing a small, semi-permanent secretariat—possibly in conjunction with a national CSI program in one of

the larger participating countries (e.g., China or Indonesia)—and mobilizing grant funding from donors and other stakeholders interested in creating such a regional entity.

Based on the success of the EAP CSI Forum, it is recommended that the next one also be held in conjunction with a global forum, such as the GACC-hosted Clean Cooking Forum. As part of the larger Clean Cooking Forum, the EAP CSI Forum was able to present the CSI to other communities in the world. Conversely, other clean stove promoters were able to learn from and network with CSI Forum participants. By engaging directly with a large network of global experts and stakeholders, delegates from the four EAP CSI countries broadened their horizons on promoting clean stoves.

Looking Ahead

It is expected that the next EAP CSI Forum will focus on concrete lessons from implementing the Phase II pilot programs in the four participating countries. This will allow the World Bank team and delegates from the four countries to compare the approaches used and share ideas for scaling up the respective national clean stove programs. In the meantime, a regional CSI activity focused on a specific topic, such as stove testing, could be held to promote knowledge- and experience-sharing among the four EAP CSI countries, as well as other countries and regions (e.g., India, Central America, and Africa).

1

Indonesia: Toward Universal Access to Clean Cooking, Key Findings from the CSI (Phase I)

Yabei Zhang
The World Bank

The Indonesia Clean Stove Initiative (CSI) takes a phased approach to creating a thriving clean biomass cookstove market, with the goal of achieving universal access to clean cooking solutions in Indonesia by 2030. Phase I (FY2012–13), which is winding down, has included an initial stocktaking review and consultation, followed by development of the intervention strategy. Phase II (FY2013–14), now getting under way, focuses on technical assistance and capacity building. Specific objectives are institutional strengthening and policy support, including establishing stove standards and testing protocols; building a national clean stove alliance and public-private partnerships; raising public awareness; and designing and preparing for a scaled-up national program, whose rollout is envisioned in Phase III (FY2014). Finally, Phase IV, to be designed, will evaluate the impact of the CSI and share lessons learned.

Indonesia Context

Thanks to the Indonesian government's Kerosene-to-LPG Conversion Program, most households in Indonesia are shifting to modern cooking energy. Yet 40 percent of households still rely on traditional biomass cooking (map 1.1). Each year, an estimated 165,000 premature deaths

MAP 1.1 HOUSEHOLDS RELYING ON FUELWOOD AS PRIMARY COOKING ENERGY, 2010

Source: Bandan Pusat Statistik (BPS), "2010 National Socioeconomic Survey" (Jakarta: BPS, 2011).

in Indonesia can be attributed to household air pollution (HAP) from cooking with solid fuels. In recent years, various improved stove programs have been implemented by nongovernmental organizations (NGOs) and donors, yet such efforts have been fragmented and sporadic, with a only a limited number of stoves disseminated.

CSI Phase I Activities

Phase I of the Indonesia CSI encompassed in-depth assessments of the existing stove market (demand and supply) and a review of the sector's institutions, policies, and programs. The key market segments studied were biomass, LPG, and biogas. The national survey of the biomass stove supply chain covered 17 representative provinces, including about 200 producers, some 40 wholesalers, and about 400 retailers. In addition, in 2012, two national stakeholder consultations were held in May (Yogyakarta) and July (Jakarta).

Demand Mapping

LPG is well on its way to replacing kerosene as Indonesia's primary household cooking fuel as a result of the Kerosene-to-LPG Conversion Program. Yet extension of the LPG distribution network is limited mainly to urban and peri-urban areas. In more remote rural areas where it has not been economically feasible to extend the conversion program, subsidized kerosene use will continue. But the future for kerosene is quite limited, with only 10 percent of the population expected to continue relying on it as their primary cooking fuel. Sustained high levels of biomass cooking fuels, especially fuelwood, are expected to continue, and may even increase in certain areas (figure 1.1).

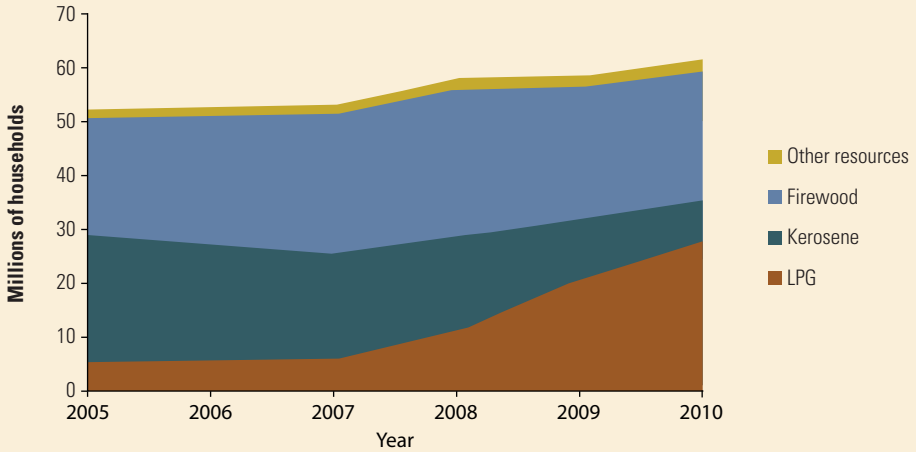
Household cooking fuel choices vary by region, and many use a mix of fuels. The main factors that drive households' selection of fuels and stoves are resource availability and accessibility, household affordability, and cultural acceptability. Most of the biomass used by rural households is renewably harvested and is abundant and affordable to the poor.

Household Biomass Stove Supply

Stove market and production capacity. The commercial market for biomass stoves is quite limited, with no markets in many rural and remote areas. Stove production is far less than the number of households using biomass stoves, suggesting that many households do not buy stoves available in the market. Many make their own rudimentary stoves and have more than one. Primary stoves, often made of mud, cement, or stone, are energy-inefficient and emit significant amounts of toxic smoke.

Stove-production capacity ranges from 5 to 10,000 units a month, and the rate of production varies widely by province. Production patterns differ by area, as do supply-and-demand relationships, which affect the supply chain's readiness to produce and distribute new models

FIGURE 1.1 NATIONAL TREND IN HOUSEHOLD COOKING FUEL USE, 2005–10



Source: BPS: year 2005 (Intercensal Population Survey [SUPAS]), years 2007–09 (National Socioeconomic Survey [SUSENAS]), year 2006 (estimated from 2005 SUPAS and 2007 SUSENAS), year 2010 (Laporan Bulanan Data Sosial Ekonomi 2012).

Note: Other resources include electricity, charcoal, other biomass, and biogas.

Woman producer making fired-clay (pottery) stove

and households' willingness to use them. Women dominate the stove business, accounting for about 40 percent of the producers interviewed.

Business models and limitations. All commercially sold biomass cookstoves are based on the Artisan Production Model, meaning they are individually made by hand. Production processes are slow, incurring high labor costs, and quality control is weak. Most businesses are family-owned. The supply chain is characterized by longstanding business relationships between producers, wholesalers, and retailers, with informal business agreements based on mutual trust. Who sells stoves to whom, how stoves are transported, and price margins taken at each level are deeply embedded in these relationships and traditional business practices.

There are strong regional variations in business and stove-purchasing practices, which reflect the country's geographic and cultural diversity. Factors that contribute to these variations include stove costs at each point of sale, final stove cost to users (i.e., what users are accustomed to paying), and the types of stoves primarily sold (including the types of materials used). The traditional supply chain generally lacks skills in business management, and there is little after-sales service.

Production costs and supplier profits. Production costs range from US$0.5 to $5.0. At each level of supply chain, profit margins are relatively low. Most producers do not record their time and labor spent on the stove business as part of production costs.

Knowledge and attitudes toward new stoves. The traditional supply chain generally lacks knowledge about better stove models, and a new model's acceptability depends on its potential to be sold. Producers, wholesalers, and retailers are more concerned with profit than which stoves might be more fuel-efficient or clean-burning. Thus, introducing new stove models would need to be linked to a higher profit margin and would require training supply-chain members in how to maximize their benefits from participating in selling the new stove models so they would be incentivized to continue with the trade.

Policies, Programs, and Institutions

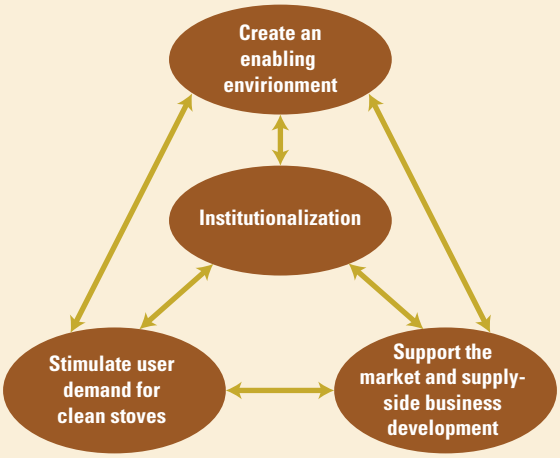
To date, Indonesia's policies and programs have failed to address household biomass cooking energy and health issues in an integrated manner. Although there is a high-level policy framework in place, it lacks specifics on biomass cooking energy and cookstoves. To date, efforts by various actors to introduce improved biomass cookstoves have been small, fragmented, and sporadic; in virtually all cases, programs ended when donor funding ceased. These programs have lacked an integrated focus on consumer awareness and demand, product affordability and availability, and producer capability to make uniform products according to standards. The agenda has not been institutionalized, and a clean biomass stove industry has yet to be established.

Key principles from successful clean cooking programs in Indonesia can be adapted to a program designed to promote clean biomass cooking. The Kerosene-to-LPG Conversion Program has demonstrated the importance of strong government commitment and a firm policy objective, along with effective marketing and public-awareness campaigns, assured availability of an uninterrupted fuel supply, and effective monitoring and evaluation. The Indonesia Domestic Biogas Programme (IDBP) has underscored the value of adopting a market-based approach, combined with targeted financial support to help overcome high upfront system costs. The program has also emphasized the need for quality control and standards, verification of results and procedures, and local management.

Key Policy Recommendations

Integrated strategy. The Indonesia CSI recommends an integrated strategy to overcome the obstacles to developing a thriving clean biomass stove market. The proposed strategy comprises three interrelated pillars—creating an enabling environment, stimulating user demand for clean stoves, and supporting the market and supply-side business development—with institutionalization at the center (figure 1.2). Institutionalization of clean biomass cooking solutions requires establishing and strengthening an

FIGURE 1.2 OVERALL STRATEGY TO SCALE UP CLEAN BIOMASS COOKSTOVES IN INDONESIA



Source: Asia Sustainable and Alternative Energy Program (ASTAE), *Indonesia: Toward Access to Clean Cooking*, East Asia and Pacific Clean Stove Initiative Series (Washington, DC: World Bank, 2013).

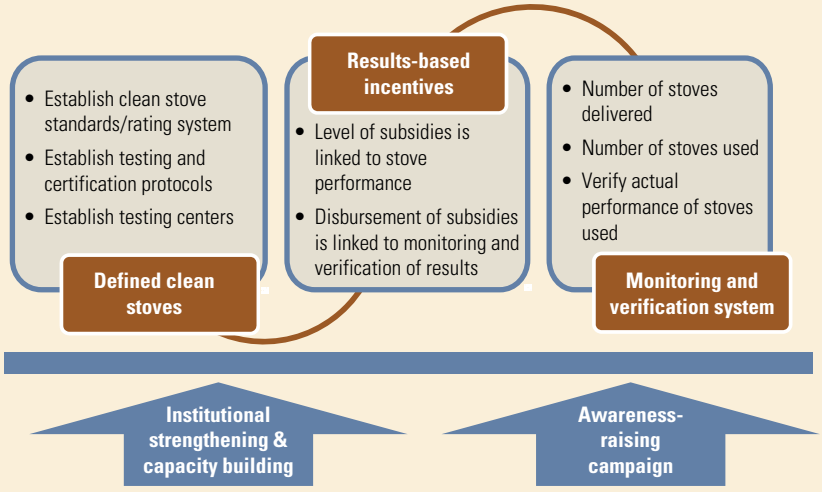
institutional champion; a cross-sector coordination mechanism; and a platform for communication, learning, and cooperation. Creating an enabling environment requires setting and strengthening stove standards, testing, and certification; conducting research and development on improved and advanced stoves and fuel-processing technologies; and developing a master plan for a national clean biomass stoves program.

Stimulating user demand for clean biomass stoves will require a large-scale, public-health campaign that must be far-reaching and comprehensive, involving multiple sectors. Without consumer demand coming to permanently influence the clean stove market supply, any market intervention is unlikely to be sustainable. If the public can be educated about the features and benefits of using modern, high-quality stoves over inefficient traditional technologies, changes in user preferences can change the direction of market development.

Government support of the market and supply-side business development needs to fit Indonesian conditions and target long-term sustainability. Where stove supply chains already exist, the CSI strategy recommends building awareness and capacity. However, in areas without stove supply chains, significant time and resources will need to be invested in building local supply chains and educating both producers and households in the use and benefits of the new stoves. Additional recommendations are to provide training within the cookstove supply chain, ensure quality control over clean cookstoves, develop and provide training on new business models and entrepreneurship, provide financial incentives for delivering clean cooking solutions to households, and support market research.

Results-Based Financing framework. The CSI strategy recommends using a Results-Based Financing (RBF) approach to promote clean stoves (figure 1.3). International experience has shown that more innovative

FIGURE 1.3 RBF FRAMEWORK WITH THREE BUILDING BLOCKS AND TWO SUPPORTING PILLARS



Source: Asia Sustainable and Alternative Energy Program (ASTAE), *Indonesia: Toward Access to Clean Cooking*, East Asia and Pacific Clean Stove Initiative Series (Washington, DC: World Bank, 2013).

subsidy schemes are required to develop a sustainable market and thus make government funding support more effective and efficient. One such scheme is RBF, which disburses public resources against demonstrated, independently verified outputs or outcomes instead of project inputs. This distinguishing feature can mean more effective and efficient use of public funds and improved support of market interventions. The conceptual framework for using RBF in programs to promote clean stoves could include three key building blocks—defined clean stoves, results-based incentives, and a monitoring and verification (M&V) system—supported by the pillars of institutional strengthening/capacity building and awareness-raising campaigns.

Next Steps

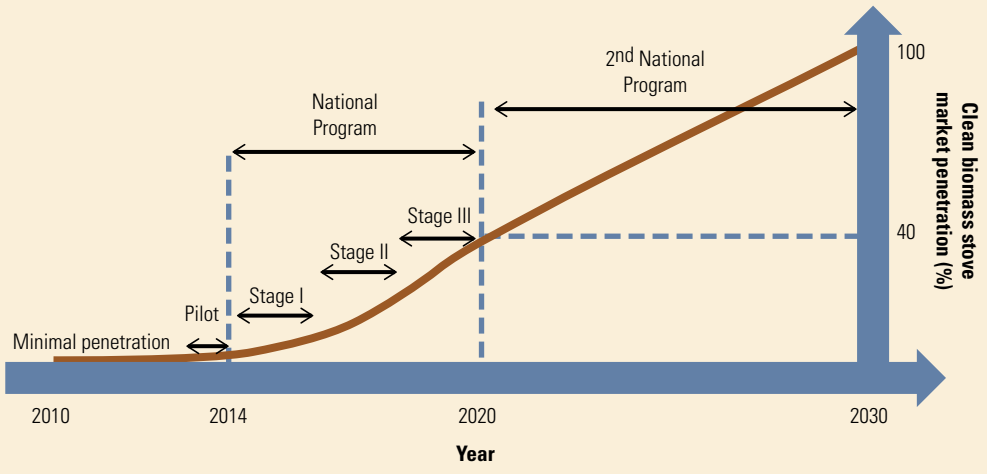
As Phase I of the Indonesia CSI winds down and the lead-up to the national program accelerates, Phase II will focus on four main areas: (i) establishing a stove standards, testing, and certification system; (ii) strengthening institutions and building stakeholder capacity; (iii) designing and implementing pilot programs; and (iv) designing and preparing the master plan for national program rollout, envisioned for FY2014.

A roadmap will be developed for setting up the stove standards, testing, and certification system. Testing and certification centers will need to be established, with support required to cover initial operating costs. In addition, stove competitions could be organized to identify top-performance stoves and advisory services supported to make design improvements. It is recommended that an Indonesia alliance for clean stoves be established, with support provided to key institutional players. Training activities should be conducted for key market players and regional or international learning activities should be organized. A pilot program will be implemented in two areas selected for their representativeness and scalability (e.g. the central Java area and Sumba Island). The design of the pilot program's RBF approach will include selecting eligible stoves for promotion based on a trial standards, testing, and certification system, allocating performance-based subsidies, and implementing a M&V system. A public campaign will be conducted to raise awareness and stimulate demand for clean cooking technologies, and advisory services will be provided to key market players.

Vision: Toward Universal Access to Clean Cooking

The scenario analysis conducted under this study assumed that, in 2030, about 18 million households will still use biomass as their primary cooking fuel. It estimated that at least 10 million clean biomass cookstoves will need to be delivered by 2020—representing 40 percent market penetration—to be on the path to 100 percent market penetration by 2030. To reach such an ambitious target, the study recommends implementing two consecutive national programs, using a phased approach with gradual geographic expansion (figure 1.4).

FIGURE 1.4 ROADMAP TO UNIVERSAL ACCESS TO CLEAN COOKING SOLUTIONS BY 2030



Source: Asia Sustainable and Alternative Energy Program (ASTAE), *Indonesia: Toward Access to Clean Cooking,* East Asia and Pacific Clean Stove Initiative Series (Washington, DC: World Bank, 2013).

Over the next 10-20 years, national economic development is expected to result in greater adoption of LPG. It is also expected that households who continue to use biomass cooking fuel will do so with a clean stove. The private sector—including stove designers, producers, wholesalers, and retailers—is in the best position to know its customers. Thus, the public sector will provide the private sector sufficient incentives and support to enable it to reach its customers. Ultimately, the market should decide which customers and locations to target and which types of technologies and fuels to focus on, with the freedom to innovate over time.

2

Indonesia Clean Stove Initiative Program: Government Perspective

Indonesia Delegation*
Presenter: Edi Wibowo, Directorate of Bioenergy, Ministry of Energy and Mineral Resources

The Government of Indonesia considers energy a basic right, which it is obligated to provide its citizens, as mandated under law (No. 30/2007). The government promotes equitable access to modern energy. By 2011, electricity had reached nearly three-quarters of households, yet electrification rates remained below 50 percent in such low-income provinces as Papua and East Nusa Tenggara (Nusa Tenggara Timur [NTT]), at about 29 percent and 40 percent, respectively. National energy consumption still relies heavily on conventional fossil fuels, with about 47 percent supplied by oil, and coal and natural gas accounting for 24 percent each. Renewable energy comprises just 5 percent of the national energy mix. About 40 percent of households still rely on traditional biomass.

National Energy Policies

By 2020, the Indonesian government aims to reduce greenhouse gas (GHG) emissions by 26 percent (767 million tons). With international support, that emissions-reduction target increases to 41 percent. The government's main national energy policies center on energy conservation and diversification. Energy conservation seeks to improve demand-side efficiencies in energy utilization across the industrial, transport, household, and commercial sectors. On the supply side, energy diversification seeks to increase the share of new and renewable energy in the national energy mix. Through implementing these two measures, it is envisioned that 15 percent primary energy conservation will be achieved by 2025, with new and renewable energy comprising one-quarter of the national energy mix. Renewable energy sources include bioenergy (envisioned to comprise about 9 percent of the energy mix by 2025), geothermal, hydropower, solar, wind, and wave. New energy sources will include liquefied coal, coal bed methane, gasified coal, nuclear, hydrogen, and other forms of methane.

Clean Household Cooking Solutions

The Indonesian government recognizes that society's access to clean energy is key to solving the multidimensional issues of poverty, health, gender equity, and environment. Clean household cooking programs are important to providing clean energy access. But there is no one-size-fits-all solution; rather, complementary clean cooking programs are being implemented, reflecting the country's diverse geography, culture, welfare level, and cooking practices. The main fuels represented are liquefied petroleum gas (LPG), biogas, and biomass.

LPG. The recent government-supported Kerosene-to-LPG Conversion Program (2007–12) has succeeded in replacing kerosene as the country's main household cooking fuel, targeting areas with high kerosene consumption levels. The benefits of the LPG conversion program include a better diversified energy supply to reduce oil dependency, reduced misuse of the kerosene subsidy, less fiscal pressure on the national budget, and a clean and efficient cooking fuel for households and Small and

*The Indonesia delegation includes Edi Wibowo, Ministry of Energy and Mineral Resources (MEMR); Fitria Yuliani, MEMR; and Prianti Utami, Asia Regional Cookstove Program (ARECOP).

Medium Enterprises (SMEs). As of 2011, the conversion program had saved the national budget IDR 29,975 trillion. The program has been implemented in five provinces (Sumatera Barat, Bangka Belitung, Kalimantan Tengah, Sulawesi Tengah, and Sulawesi Tenggara). It will not be implemented in provinces where it is not economically feasible (i.e., Papua, Papua Barat, Maluku, Maluku Utara, and East Nusa Tenggara [NTT]).

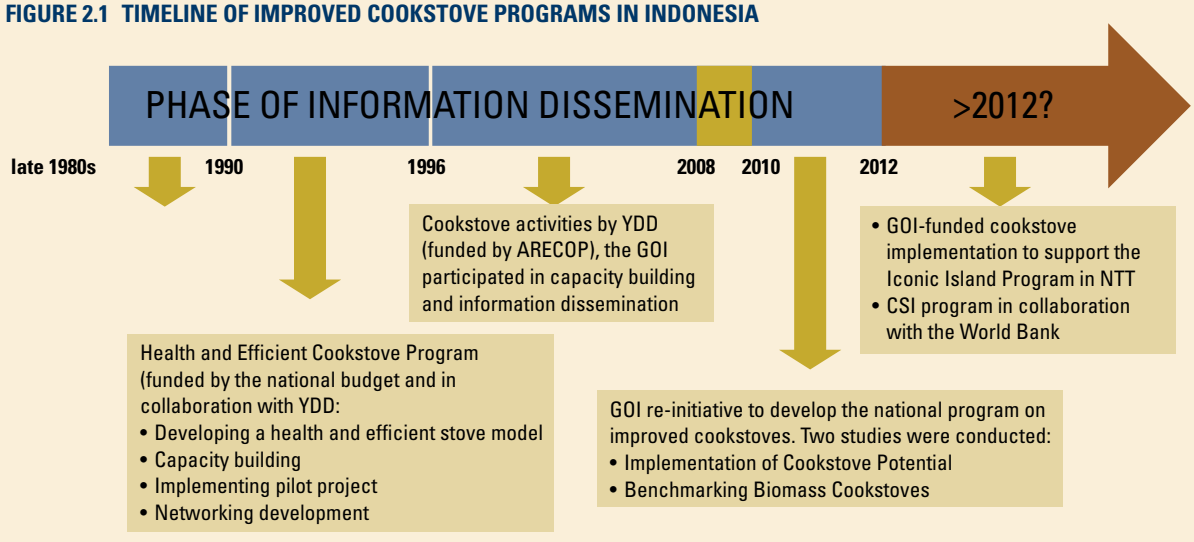
Biogas. Biogas cooking programs target regions where livestock (i.e., cows, pigs, and buffalo) and agricultural industry waste are available, using both individual and communal approaches. Funding sources include both the national budget and international donors. To date, more than 10,000 small-sized biogas plants for individual and communal use have been installed throughout the country. Nationally-funded activities include Biogas Energy Self Sufficiency Village and Biogas Implementation for Household and Small-Medium Scale Industry. The major internationally-funded effort is the Indonesia Domestic Biogas Programme (IDBP), locally known as the BIRU (*Biogas Rumah*) program.

The BIRU program was initiated by the Government of Indonesia under its bilateral cooperation with the Kingdom of the Netherlands. Funded by the Dutch government and facilitated by the Government of Indonesia, the BIRU program is a three-year effort with a one-year, no-cost extension (May 2009–December 2013). The Dutch government appointed the Humanist Institute for Development Cooperation (HIVOS) as Program Manager, with technical support provided by the Netherlands Development Organisation (SNV). The program aims to develop the national biogas market, with a target of 8,000 high-quality biogas units for household use. By the end of 2012, some 7,950 units had been installed. The BIRU program has succeeded more than other biogas programs owing to the extensive participation of rural people and the presence of provincial coordinators, as well as local unit contractors.

Improved Biomass Cookstove Programs

Limited past efforts. Improved biomass cookstove programs have been implemented in Indonesia since the late 1980s in collaboration with various research institutes, universities, and local nongovernmental organizations (NGOs) (figure 2.1). In 1990, for example, the Tungku Sehat dan Hemat Energi (TSHE) program was implemented in collaboration with Yayasan Dian Desa (YDD), an NGO based in Yogyakarta, with national support, as well as international funding through the Asia Regional Cookstove Program (ARECOP). Past programs have lacked specified national targets and activities have

FIGURE 2.1 TIMELINE OF IMPROVED COOKSTOVE PROGRAMS IN INDONESIA



Source: Authors.

been fragmented and sporadic, limited mainly to smaller areas. While some achievements have been made, most programs are still in their pilot phases, the total number of stoves disseminated remains limited, and a market for improved biomass cookstoves has yet to develop. More recently, some research institutes have developed a variety of improved stove designs. Yet few rural households use, or are even aware of, clean biomass cookstoves.

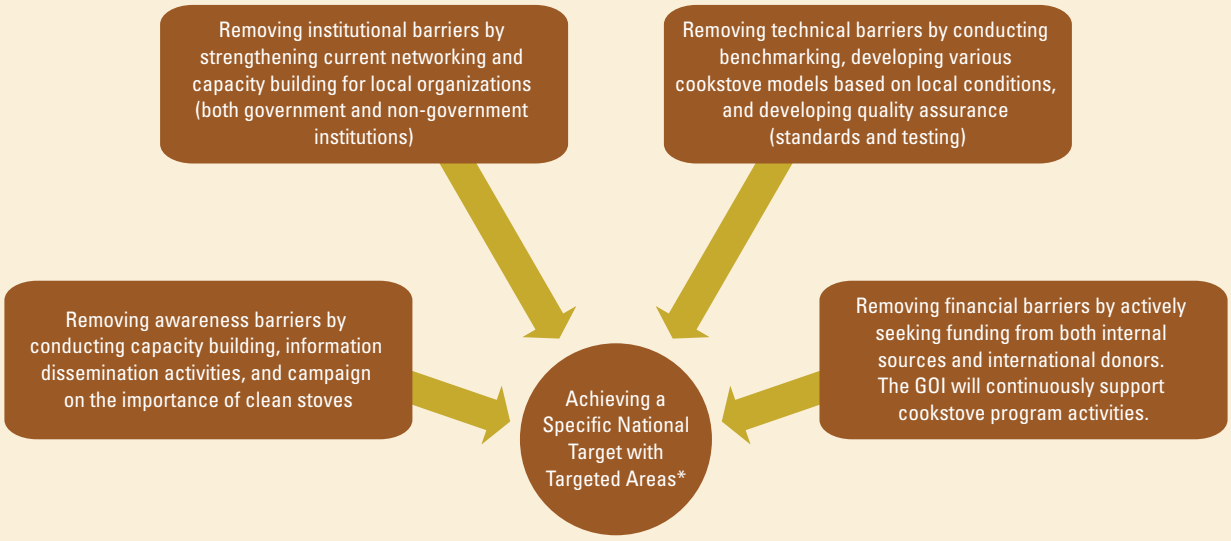
Current strategies. Today Indonesia's clean stove programs are non-commercially, semi-commercially, and commercially based. For non-commercial programs, development of the clean stove unit is fully funded by the Indonesian government, and the target is rural people with a low ability to pay. Based on an evaluation of the Clean Stove Based Energy Self-Sufficiency Village Program, the stove user's sense of ownership is usually low due to the purely grant-based nature of the scheme and lack of knowledge about better stove models. For semi-commercial programs, a partial subsidy is provided, while the rest of the development cost is paid for by the stove users; there is also development of local institutions. For commercial programs, development of the clean stove unit is fully funded by the private-sector developer.

Indonesia Clean Stove Initiative. The Indonesia Clean Stove Initiative (CSI), a collaborative effort of the Indonesian government and the World Bank, takes an integrated approach to creating the enabling conditions for developing a sustainable clean cookstove market.

Conclusion

To continue increasing access to clean household cooking solutions, the Government of Indonesia is working on several fronts: kerosene-to-LPG conversion, biogas, and improved cookstoves. These complementary programs target different household groups, depending on resource availability, societal needs, and geographic conditions. It is expected that the Indonesia CSI program can set specific targets and be implemented as an integrated national program, including integration with the cookstove program on Iconic Island, so that a sustainable market for clean biomass stoves can be established (figure 2.2). Results of the initial stocktaking review will provide input for setting national targets; formulating stove standards, policies, and regulations; establishing a local management unit; building institutional capacity; and enhancing socialization activities.

FIGURE 2.2 EXPECTATION FOR THE INDONESIA CLEAN STOVE INITIATIVE



Source: Authors.

* It is expected that a specific target will be set after completion of the initial CSI stocktaking review.

3

Clean Stove Initiative Implementation Activity in Lao PDR

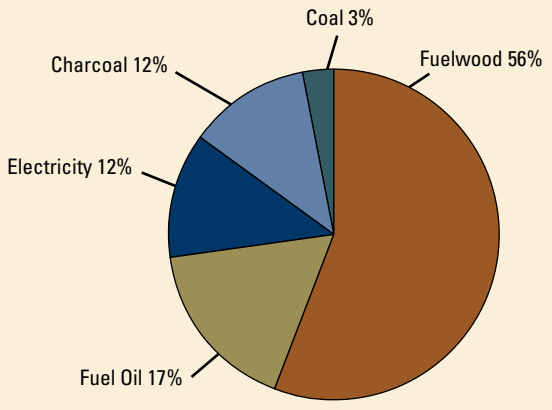
Lao PDR Delegation*
Presenter: Hatsady Sisoulath, Institute of Renewable Energy Promotion, Ministry of Energy and Mines

The Lao People's Democratic Republic (PDR) is a landlocked country in Southeast Asia with a total land area of 236,800 km^2. The country is bordered by China to the north, Vietnam to the east, Cambodia to the south, Thailand to southwest, and Myanmar to the northwest. Lao PDR has 17 provinces, and its capital and largest city is Vientiane, situated near the border with Thailand. The total population is nearly 6.4 million, with a density of 24 persons per km^2 and a population growth rate of 2.5 percent a year. Nearly three-quarters of people reside in rural areas. Agriculture accounts for 80 percent of jobs, consisting mainly of subsistence farming. The average life expectancy is 61 years (63 for women and 59 for men). The adult literacy rate is 74 percent for men and 50 percent for women. There are more than 11,000 small villages, with poor access by road. The country has 47 ethnic groups, with 120 ethnic subgroups and languages. Buddhism is the main religion.

Energy Development Overview

The Government of Lao PDR recognizes that developing renewable energy is a key component in ensuring national energy security, socioeconomic development, and environmental and social sustainability. In 2008, fuelwood accounted for 56 of total primary energy consumption, compared to only 12 percent for electricity (figure 3.1). The residential sector comprised 51 percent of energy consumption, followed by transport (26 percent), industry (20 percent), and agriculture (2 percent). Because household demand for biomass will likely predominate well into the future (figure 3.2), with major implications for human health, quality of life, and the global climate, the government's Renewable Energy Development Strategy (2011–25) has developed a roadmap for the development and market deployment of the most energy-efficient, culturally appropriate cookstoves.

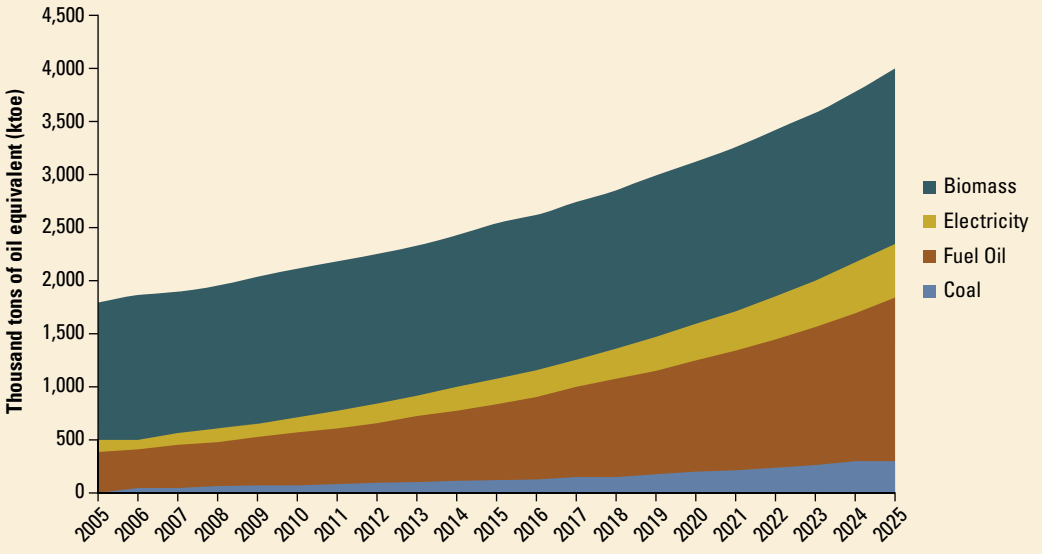
FIGURE 3.1 PRIMARY ENERGY CONSUMPTION IN LAO PDR, BY TYPE, 2008



Source: Authors.

*The Lao Delegation includes Hatsady Sisoulath, Institute of Renewable Energy Promotion (IREP), Ministry of Energy and Mines (MEM); Khammanh Sopraseurth, IREP, MEM; Khamphone Nanthavong, National University of Laos (NUOL); Boulay Vongvisith, Ministry of Science and Technology (MOST); and Tayphasavanh Fengthong, Ministry of Health (MOH).

FIGURE 3.2 PROJECTED ENERGY DEMAND IN LAO PDR BY 2025



Source: Authors.

Potential Demand for Improved Cookstoves

Key findings of desk and field studies on Lao PDR cooking practices show that the vast majority of households still rely on fuelwood (firewood and charcoal) as their main source of cooking energy, using inefficient cookstoves. Despite the steady rise in electricity service coverage over the past two decades, prospects for using modern fuels as alternative sources of household cooking energy remain quite limited. Among urban households, electricity used as the main source of cooking energy declined by 6.6 percent (from 10.4 percent to just 3.8 percent) between 1995 and 2005, reflecting the rising retail electricity tariff for cost recovery.

All liquefied petroleum gas (LPG) must be imported, and the distribution network is limited to major cities along the Thai and Vietnam borders. As a result, the price of LPG fuel is high relative to household income, limiting use to a small segment of financially better-off urban households. By contrast, firewood is abundant and can often be freely collected, suggesting that the switch to modern forms of cooking energy may not be easily achieved.

Improved cookstoves are not yet available on the market; however, current patterns, trends, and preferences of cookstove ownership are favorable for promoting and marketing better stoves. Most households purchase their cookstoves, many own and use more than one stove, and household income is positively associated with the total number owned. Most households could afford improved cookstoves, even if prices doubled.

Clean Stove Initiative Activities

The Lao PDR Clean Stove Initiative (CSI) intervention strategy (Phase I) was delivered to the Government of Lao PDR in July 2012.[5] Through stakeholder consultation, it was agreed on October 3, 2012 that an inter-ministerial CSI task force should be established by the Ministry of Energy and Mines (MEM) and headed by the Director General of the MEM's Institute of Renewable Energy Promotion (IREP), which will serve as the CSI focal point and coordinating agency. The task force will ensure that CSI policy and strategic directives are in line with national policy and the country's Renewable Energy Development Strategy.

5. Under Phase I of the CSI, initial stocktaking activities included a field survey, while development of the intervention strategy comprised stakeholder consultations and two consultation workshops. The CSI field survey, conducted in Vientiane capital and the provinces of Bolikhamsi, Khammouane, and Vientiane, consisted of (i) a household cooking energy survey conducted separately in peri-urban and rural areas and (ii) a market survey of biomass cookstoves and the supply chain.

Key intervention areas are (i) advising staff of national and local governments and academic institutions on establishing and enforcing national technical standards; (ii) establishing facilities for stove testing, development, and labeling; (iii) building supply-chain capacity by providing stove producers technical assistance in new technologies, techniques, and processes; ensuring producers' access to financing; and improving efficiency of the market chain (e.g., by helping producers develop business plans and a network to gain access to market information and intelligence); and (iv) building public awareness and education on fuel-efficiency and durability standards that customers should expect from various stove types and models to promote household use.

Stakeholders agreed to establish a national alliance for clean cookstoves to promote sharing of knowledge and information, experience, and technology. Members can share knowledge and experience with other alliances in the region and globally (e.g., through the Global Alliance for Clean Cookstoves [GACC]). Partnerships and cooperation will be fostered to develop and implement public-awareness campaigns on the links between cookstove use and the health impacts of household air pollution and marketing campaigns for retailers on improved cookstoves.

Phase II of the CSI program, supported by World Bank–executed trust funds, will be coordinated with existing and emerging activities to fill gaps and strengthen areas, as needed. These include (i) the current improved cookstove (ICS) program—supported by the European Union (EU), Netherlands Development Organisation (SNV), Oxfam, other nongovernmental organizations (NGOs), and the Government of Lao PDR—which aims to deliver 100,000 stoves within four years; (ii) the GACC contract with the Renewable Energy, Environment, and Solidarity Group (GERES) for establishing regional testing centers; and (iii) Asian Development Bank (ADB)-supported technical assistance, led by SNV, for gender mainstreaming of improved cookstoves.

Thai bucket stove, for charcoal

Key activities that could be included under Phase II of the CSI program include (i) an in-depth assessment of stove utilization, focusing on clean cookstove performance, quality, and user acceptance; (ii) technical and policy backstopping support to the inter-ministerial task force, particularly the committee on clean cookstoves standards in Lao PDR; and (iii) introducing new clean cookstoves, especially firewood stoves, in rural and/or urban and peri-urban areas in the North, where firewood use still predominates as the main cooking fuel for the vast majority of households.

Government of Lao PDR: Additional Priorities

In addition to the intervention areas described above, the Government of Lao PDR has identified several other priority activities for implementation: (i) development of regulations and guidelines for clean cookstove implementation and further study on the need to provide incentives; (ii) logistics support to allow government agencies to fulfill their role (software and hardware) for monitoring and managing ICS activities; and (iii) establishment of a fund to provide the supply chain (i.e., producers, retailers, and other actors) low-interest financing.

National University of Laos: Past Participation and Lessons Learned

Although past efforts to promote the use of improved cookstoves in Lao PDR have been fragmented, such programs have had a good track record in commercially disseminating stoves without requiring subsidies. The first program, albeit small, was initiated in 1997 by Thailand's Naresuan University through the Council for Renewable Energy and NUOL. With US$10,000 in financial support from the Food and Agriculture Organization's Regional Wood Energy Development Programme in Bangkok, NUOL worked in close cooperation with the Council and the Participatory Development Training Center to

organize technology transfer to produce the improved charcoal bucket stove (ICBS), with training provided by Thailand's Department of Alternative Energy Development and Efficiency (DEDE).

Thailand's Royal Forest Department had developed the ICBS in the 1980s. Commonly referred to as the Thai bucket stove, the ICBS has a conversion efficiency of 26–30 percent, compared to only 5–20 percent for the traditional bucket stove, resulting in 30–50 percent fuel savings.

NUOL has also participated in research and training activities related to the Rocket stove, developed by the Aprovecho Research Center. With support from the Promotion of the Efficient Use of Renewable Energies in Developing Countries (REEPRO) project, NUOL trained both trainers and users of the stove. Also, student research projects have centered on constructing and testing various types of gasification stoves.

NUOL has learned that a successful clean cookstove program requires a variety of key ingredients. These include meeting the specific requirements of local cooking traditions and customs (e.g., space warming, food drying, protection from insects, and housing material conservation). It is important that cookstove research and development (R&D) focus on developing stoves that fit local cooking traditions and requirements, as well as users' behavior. Education, including technology demonstrations and knowledge- and experience-sharing, is essential. It is important to build people's awareness and knowledge of the many benefits of clean cookstoves, including fuel and time savings, a cleaner kitchen, and better health. Promotional campaigns should have appropriate, targeted messages for both the stove users and other household members.

Role of Renewable Energy and New Materials Institute

The proposed CSI intervention strategy calls for the Renewable Energy and New Materials Institute (RENMI), Ministry of Science and Technology (MOST), along with the NUOL Faculty of Engineering, to establish the first national cookstove testing laboratory. The laboratory will be used to assist the government in establishing cookstove testing protocols to ensure that standards and methods are uniformly applied throughout the country. The laboratory will also function as a center for R&D on improved cookstoves and a training center for national and provincial governments to test existing cookstoves in national and local markets and new ones about to be introduced to the market.

Ministry of Health: Case Study Results and Recommendations

Many households in Lao PDR—particularly those that use fulewood as their cooking energy—exhibit high concentrations of HAP, often many times higher than the World Health Organization (WHO) guidelines. A recent case study (2005–06) on the effects of HAP in Lao PDR, conducted by the Ministry of Health (MOH), concluded that cooking is a significant determinant of pollutant concentrations within household dwellings. Although cigarette smoking is also a potential source of indoor air emissions, it is not as significant as cooking. The MOH case study demonstrated that exposure to indoor biomass burning increased the risk of acute respiratory infections (ARI) in children and women, which is consistent with results of previous studies.

Based on the case-study results, the MOH developed the following recommendations:

- It is critical to take measures to minimize pollutant concentrations within household dwellings, with the aim of reducing the burden of adverse health effects on women and children.
- Stove design should be improved to prevent pollution emissions in the vicinity of the stove.
- Children should be kept away from the fire as much as possible, and mothers should be made aware of the health risk.
- Ventilation of the cooking area should be as efficient as possible, particularly if the area is small.
- Community education should be considered to increase public awareness of the risks associated with cigarette smoking for both smokers and passive smokers (i.e., women and children exposed to smoking).
- Further investigations should be conducted to quantify the contributions to "dust" from particulate matter other than cooking and smoking, particularly outdoor sources, as well as dirt floors, in order to identify the best strategies for reducing contributions from these sources, thus lowering the risk.
- The community should be made aware of the risks related to increased dampness while drying clothes indoors. In addition, further research is needed to identify prevalence of the problem, as well as causal relationships with health outcomes.

4

China: Toward Universal Access to Clean Cooking and Heating, Key Findings from the CSI (Phase I)

Yabei Zhang
The World Bank

China Context

More than half of China's population still relies on solid fuels (coal and biomass) for cooking and heating; many of these households, located mainly in rural areas, are likely to continue using solid fuels in the near future. In China, household air pollution (HAP) causes more than a million premature deaths each year.[6] Most biomass waste is burned in the field, contributing significantly to air pollution. Most of the improved stoves promoted during the 1980s and 1990s have been damaged or are already obsolete.

Clean Stove Initiative: Phase I Overview

The China Clean Stove Initiative (CSI) aims to scale up access to clean cooking and heating solutions for poorer, primarily rural households who are likely to continue relying on solid fuels beyond 2030. The program consists of four phases: (i) initial stocktaking and development of the proposed strategy; (ii) institutional strengthening, capacity building, and piloting of the strategy; (iii) scaled-up program implementation; and (iv) program evaluation and dissemination of lessons learned. Phase I activities focus on in-depth assessments of China's existing stove market (demand and supply) and review of the sector's institutions, policies, and key programs. To better inform the design and implementation of the scaled-up clean cooking and heating program, case studies were carried out on four key market segments in specific local contexts: biomass, coal, biogas, and solar cookers. To gain a better understanding of the current status of China's stove market, a national survey was conducted of the biomass stove supply chain, including 89 manufacturers (about 72 percent of total production). In addition, two national stakeholder consultations were held in 2012: the first in Gaobeidian city (April 24), and the second in Beijing (July 20).

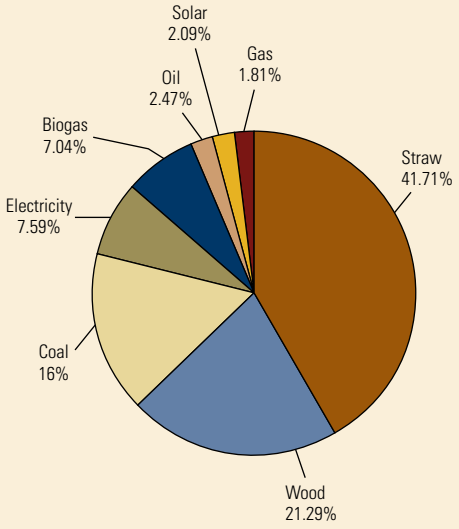
Demand Mapping: Overview

The rapid growth of China's rural economy in recent years has changed rural households' concept of consumption and quality of life. By 2010, cooking and heating accounted for 90 percent of rural household energy use (figure 4.1). As living standards have improved, rural households have begun diversifying the types of fuels they rely on to meet their daily cooking and heating needs. Eighty-six percent of rural households use solid fuels as their primary cooking energy. Biomass (wood and straw) comprises more than three-fifths of rural household energy for cooking, while coal accounts for one-quarter. Heating accounts for more than one-third of rural energy consumption. Demand for heating continues to rise, along with improving living standards and greater demand for comfort.

Solid fuels for cooking. In six provinces—Henan, Hunan, and Anhui (Central China); Hebei and Shandong (East China); and Sichuan (West China)—the vast majority of rural households rely on biomass and coal for cooking, with Henan and Hunan exhibiting the highest proportions, at 97 percent each (20 million and 15 million households, respectively). In terms of number of households, Sichuan exhibits the highest reliance on biomass, at 15

6. World Health Organization and United Nations Development Programme (WHO and UNDP), *The Energy Access Situation in Developing Countries* (New York: UNDP, 2009).

FIGURE 4.1 STRUCTURE OF CHINA'S RURAL HOUSEHOLD ENERGY, 2010



Sources: China Agriculture Statistical Yearbook (Beijing: China Agriculture Press, 2010); China Energy Statistical Yearbook (Beijing: China Statistics Press, 2011).

million households, while the greatest reliance on coal is found in Henan, at 10 million households (table 4.1). The least reliance on solid fuels for household cooking is found in the more developed municipalities, including Shanghai, Tianjin, and Beijing (map 4.1).

The use of biomass to meet rural households' cooking needs varies widely by province. The least dependence on biomass cooking energy is generally found in the East; in the municipality of Beijing, for example, only 15 percent of households rely on biomass to meet their cooking needs, compared to 93 percent in Jilin. In the Northeast, the vast majority of households rely on biomass. In addition, the western province of Sichuan, the eastern province of Shandong, and the central province of Henan have significant numbers of rural households that depend mainly on biomass for cooking.

Coal is used by more than one-quarter of rural households, with the highest adoption rate for coal stoves (38.4 percent) found in Central China. More than half of rural households in the central provinces of Shanxi and Hunan and the western provinces of Ningxia and Guizhou rely on coal as their primary source of cooking energy. In the western province of Shaanxi, approximately 5.6 million households—more than four-fifths of rural households—use coal as their main cooking fuel. The lowest adoption rate for coal stoves (7.4 percent) is found in the Northeast, where biomass use predominates.

Solid fuels for heating. Household heating energy, predominantly coal and wood, constitutes a substantial portion of China's total energy consumption, especially in colder climates. Approximately half of China's land area requires winter heating, particularly in northern-latitude regions, where temperatures typically fall below the freezing point during the colder season (October–March). More than 70 percent of households in the Northwest (Inner Mongolia, Shaanxi, Gansu, Qinghai, Ningxia, and Xinjiang) rely on coal for heating and about half of households in the Southwest (Yunnan, Guangxi, Chongqing, Sichuan, and Guizhou) depend on wood for heating. There are notable differences in the heating fuels used by urban and rural households, particularly in the Southwest (figure 4.2).

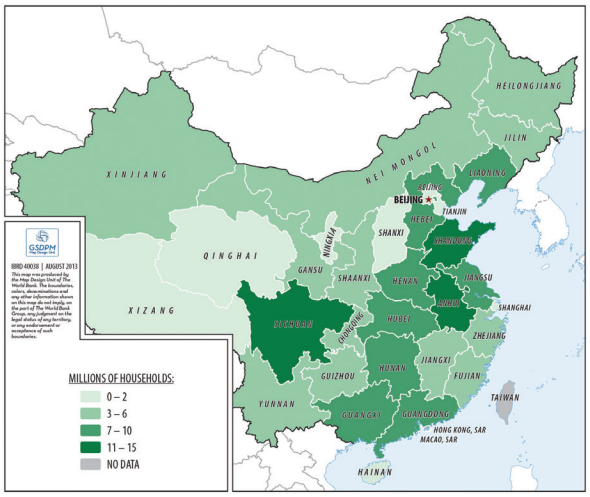
TABLE 4.1 TOP SIX PROVINCES RELYING ON SOLID FUELS FOR RURAL HOUSEHOLD COOKING

	Biomass		Coal		Solid fuel use	
Province	Households (million)	%	Households (million)	%	Households (million)	%
Henan	10	47	10	50	20	97
Hunan	7	46	8	51	15	97
Sichuan	15	73	4	21	19	94
Anhui	11	80	2	13	13	93
Hebei	7	49	7	44	14	93
Shandong	14	65	5	24	19	89

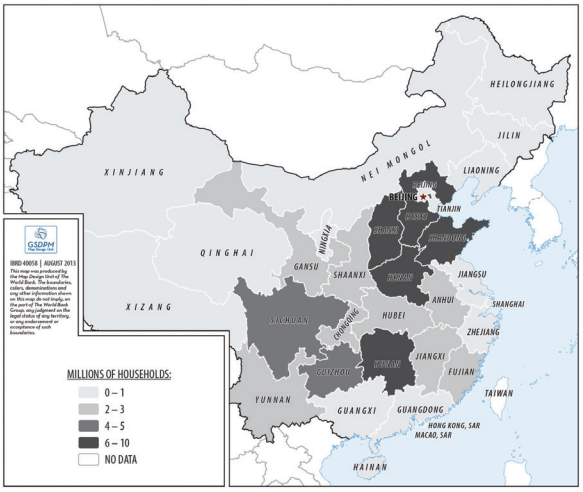
Source: National Bureau of Statistics, "Second National Agriculture Census, 2006," 2008.

MAP 4.1 DISTRIBUTION OF RURAL HOUSEHOLDS USING SOLID FUELS AS PRIMARY COOKING ENERGY

a. Biomass



b. Coal



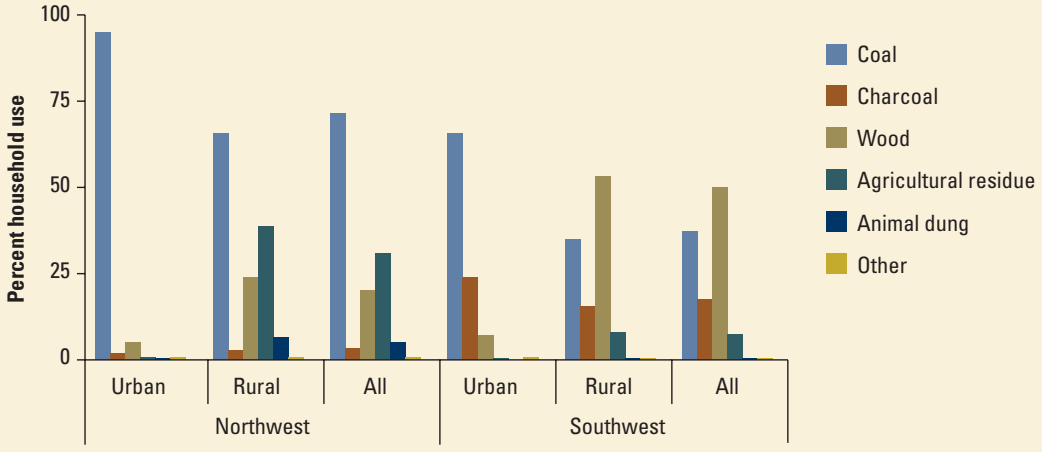
Source: National Bureau of Statistics 2008.

In the Northwest, where urban households in particular, as well as rural ones, rely heavily on coal, an appreciable portion of rural households also depends on wood and agricultural residues. By contrast, in the Southwest, wood is the most common heating fuel among rural households, while urban residents depend primarily on coal. Rural households in the Southwest rely less on agricultural residues than do their Northwest counterparts, instead using more coal and charcoal.

Drivers of Household Fuel and Stove Selection

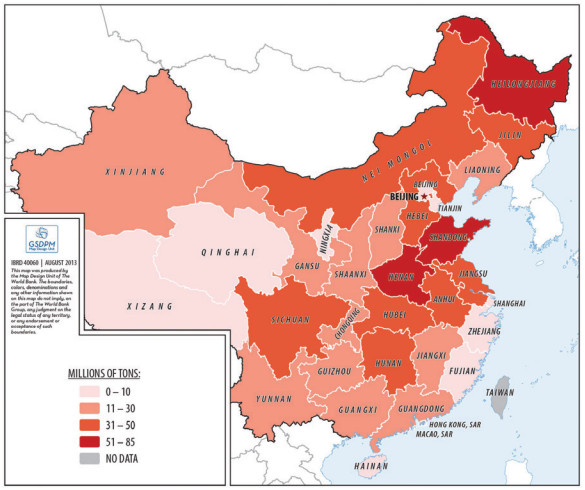
Households' selection of energy sources for cooking and heating depends, in large part, on the interdependent factors of fuel availability, accessibility, affordability, and cultural acceptability. Availability of fuels is a primary consideration for fuel and stove selection. For example, in agricultural areas, biomass straw is the primary cooking

FIGURE 4.2 HEATING FUELS USED BY URBAN AND RURAL HOUSEHOLDS IN NORTHWEST AND SOUTHWEST CHINA



Source: National Research Center for Science and Technology for Development and Fafo Institute for Applied International Studies (NRCSTD and Fafo IAIS), *Life in Western China: Tabulation Report of Monitoring Social and Economic Development in Western China* (Beijing: China Statistics Press, 2006).

MAP 4.2 DISTRIBUTION OF AGRICULTURAL RESIDUE, 2010

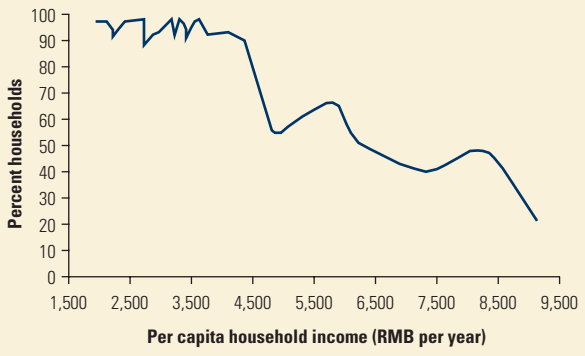


Source: China Agriculture Statistical Yearbook (Beijing: China Agriculture Press, 2010).

fuel. Provinces with large amounts of straw resources also exhibit high demand for biomass stoves. Henan, Shandong, Sichuan, and Anhui provinces, all of which are richly endowed with straw resources, each has more than 10 million households that rely on biomass for cooking (map 4.2).

In addition to fuel availability, households must select their fuels from those that are accessible. For example, households might be prevented from collecting fuelwood or agricultural residues in certain areas owing to natural physical limitations (e.g., difficult terrain or topography) or environmental and other policies and regulations (e.g., protected nature reserve) that restrict households' access to available fuels. Another key factor is fuel affordability, which depends on households' income level and stove and fuel cost (figure 4.3). Finally, fuels must be culturally acceptable; they must meet households' preferences for food taste and fit well with local cooking habits, cultural traditions, and climate. For example, the widespread use of solar cookers in Tibet is driven not only by the region's abundant solar energy and shortage of other energy resources, such as coal and biomass. Tibetan farmers and herdsmen lead a nomadic way of life and are dispersed across the province. They prefer cooking fuels that are portable and easily obtained. Thus, solar cookers fit well with their lifestyle.

FIGURE 4.3 PERCENTAGE OF RURAL HOUSEHOLDS RELIANT ON SOLID FUELS BY INCOME LEVEL



Sources: National Bureau of Statistics, "Second National Agriculture Census, 2006," 2008; China Statistical Yearbook (Beijing: China Statistics Press, 2007).

While higher-income households will likely switch to or continue using modern energy fuels, an estimated 280 million people, mainly in rural areas, will still rely on solid fuels for cooking and heating in 2030.[7]

Supply Mapping: Key Market Segments

China has one the world's largest **biomass stove industries**. In 2011, production totalled 1.6 million, with about 300 manufacturers. Yet reliance on government procurement and subsidies is heavy, with little commercialization. Some procurement programs have paid more attention to stove price than quality. Delays in setting product standards have meant that some stove products have been on the market for several years without having national or industry standards. Also, the quality and performance of stoves on the market vary significantly, and pirating of quality brand names is not uncommon. In addition, after-sales service and training are insufficient, small enterprises often lack technological innovation, and some stove designs are inferior. A top concern among producers is the lack of a biomass briquette supply chain, owing to high cost and a low technology level.

China's **coal stove market** is highly commercialized, having developed rapidly due to the large market potential. In 2011, production totalled 20 million, with about 1,500 manufacturers. At the same time, product quality is patchy, performance varies considerably, and household

7. International Energy Agency (IEA), *World Energy Outlook 2010* (Paris: Organization for Economic Co-operation and Development (OECD)/IEA, 2010).

demand can be widely dispersed. Since poorer families tend to prioritize stove price over concerns of safety, efficiency, and pollution, demand is met with low-quality, lower-priced products. Since the market is insufficiently regulated, it is flooded with shoddy imitation products. Simple, low-efficiency stoves still comprise about four-fifths of coal cookstoves in most parts of China.

Development of China's **household biogas industry** has been impressive. As of 2010, 40.27 million farming households were biogas users, representing one-third of all potential users. The sharp rise in the number of users over the past decade has resulted, in large part, from government-supported efforts. However, recent years have witnessed a diminishing enthusiasm among farming households for constructing and using biogas systems. The service system has lagged far behind the needs of biogas users. Decreased individual cultivation of livestock has led to a decline in the raw materials used for generating biogas and thus the number of qualifying households for installation. The required upfront investment is large, while the subsidy level cannot compensate for the increasing cost of system construction; and slow technological progress has restricted innovation.

China has the largest stock of **solar cookers** in the world. In 2010, production totalled 0.2 million, with about 20 manufacturers. However, sales rely mainly on government procurement and subsidies. The purely commercial market for solar cookers accounts for less than one-fifth of sales because demand is centered in poorer regions, where profitability is low. Also, the quality of solar cookers varies greatly, suggesting a strong need for better production technology and greater capacity in standardizing product performance.

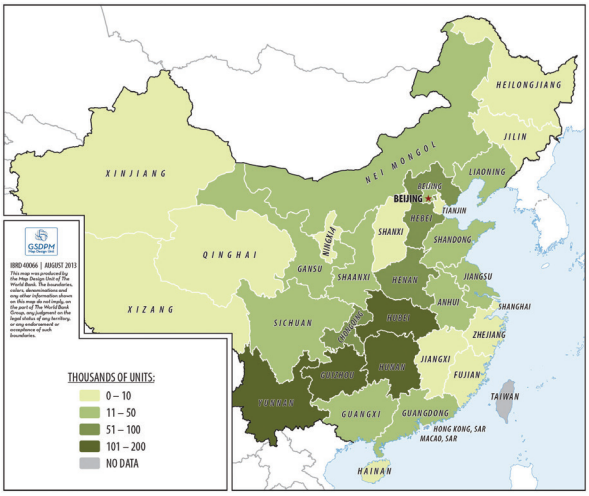
Focus: Biomass Stoves Industry

Production distribution. To understand the current status of China's biomass stove market, the first-ever large-scale survey of the biomass stove industry, combined with field visits, was conducted in March–May 2012. Respondents included 89 biomass stove manufacturers throughout the country, who together accounted for 72 percent of total production in 2011 (i.e., 1.15 million stoves). The stoves covered by the survey were mostly mass-produced, referred to as clean biomass stoves.

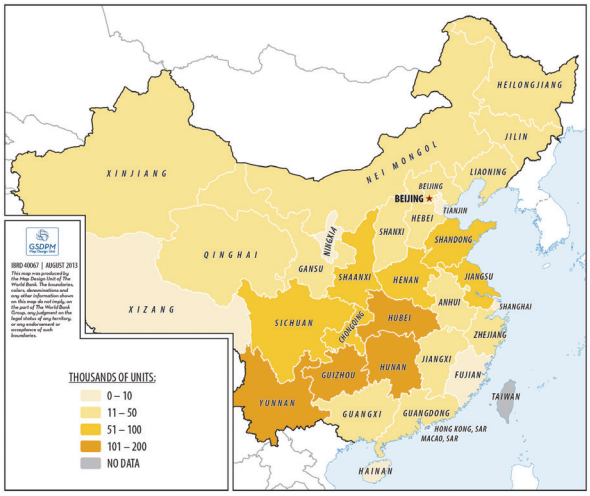
Provinces with larger stove production levels are distributed throughout the south (especially South Central China) (map 4.3). Guizhou and Hunan provinces have the highest levels, each producing more than 181,000 units each year, followed by Yunnan. The large stove output in these poorer provinces, with the exception of Hunan, is linked to preferable government policies that include large subsidies. In 2011, the Guizhou government disseminated at least 120,000 biomass cooking and heating stoves as part of China's Grain for Green Program, while the Yunnan provincial government disseminates at

MAP 4.3 DISTRIBUTION OF BIOMASS STOVE PRODUCTION AND SALES, 2011

a. Production

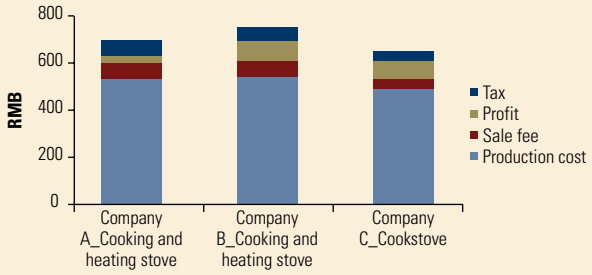


b. Sales



Source: China CSI survey.

FIGURE 4.4 TYPICAL COST COMPOSITIONS FOR BIOMASS STOVES



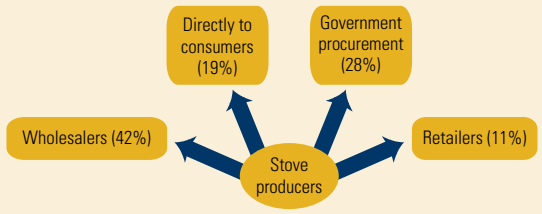
Source: China CSI survey.

least 100,000 fuel-saving stoves each year. In addition, the Hubei government has included biomass stoves in its Agricultural Machinery Subsidy List.

Production cost and sales price. Producers' profit margin is low. The cost of production comprises about 70–90 percent of the sales price that stove companies charge for all types of manufactured, clean biomass stoves. The four types of biomass stoves are quite similar in terms of the cost share in the sales price, whereas cooking and water-heating stoves and heating-only stoves have a wider range of cost share. But the sales price can differ from the purchase price by end users for government-supported subsidized stoves sold to poor regions.

To further illustrate, we use three stove companies (A, B, and C) as examples. Companies A and B, which sell cooking and heating stoves, have a slightly higher sales price for their stoves, compared to Company C, which sells cookstoves at RMB 650 per stove (figure 4.4). While the share of cost components varies by company, production cost constitutes the largest portion of the price and profit comprises 10–15 percent of the stove price, followed by marketing expenses and tax.

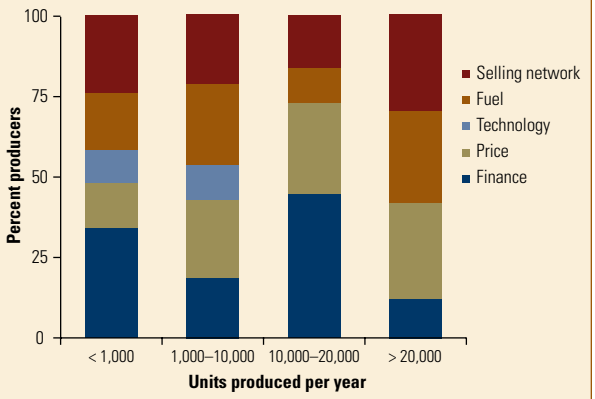
FIGURE 4.5 MAIN STOVE SALES MODELS



Source: China CSI survey.

Note: Most sales to wholesalers and using own sales network fall under the government procurement program.

FIGURE 4.6 MAIN OBSTACLES FOR BIOMASS STOVE PRODUCERS AT DIFFERENT SCALES



Source: China CSI survey.

Sales models. Stove producers can reach end users through wholesalers, government procurement, their own sales network, or retailers. Wholesalers account for 42 percent of producer sales. Government procurement—the model that uses subsidies, with enterprises directly participating in government tenders—accounts for 28 percent, own sales network comprises 19 percent, and retailers only 11 percent (figure 4.5). It should be noted that most sales to wholesalers and using own sales network also fall under the government procurement program, meaning that public procurement, whether direct or indirect, accounts for more than 80 percent of all producer sales.

Under the government procurement scheme, there are three subsidy levels. For extremely poor regions (about one-third of cases), nearly 100 percent of the sales price is subsidized by the government. For relatively poorer regions, which represent another one-third of cases, 50–80 percent of the sales price is subsidized. Finally, other poor regions receive a 50 percent subsidy. In addition, the source of subsidies varies, with a 2:3 average ratio of central government to other levels of government.

Market barriers. The enterprises surveyed considered access to financing as their main market barrier, closely followed by sales network, availability of fuel biomass briquette, and stove price. Due to the low technology and high price of biomass briquette, no supply chain for briquettes has been established. Only 8 percent of respondents considered producers' low technological level a major barrier. Furthermore, enterprises at different scales vary significantly in their main production and sales concerns (figure 4.6).

Small-scale enterprises, which account for 62 percent of the enterprises surveyed, pay more attention to accessing financing and building or expanding their sales network. However, enterprises with production levels above 10,000 units focus mainly on expanding the scale of financing and tackling stove pricing, rather than dealing with technical issues. For large-scale enterprises with annual production above 20,000 units, financing pressure is small and technical issues have been resolved; thus, they are more concerned with expanding their sales network and cutting prices, as well as ensuring fuel availability.

Lessons from Key Market Segments

Stove promotion strategies must be based on local conditions, including fuel availability, climatic conditions, income level, and lifestyle. Also, a market-based approach to promoting stoves should be explored to ensure sustainability. In addition, product standardization and quality control are needed to build an enabling environment for market development. Furthermore, strong government commitment is required, while the subsidy scheme must be designed carefully to ensure sustainable development. Finally, by integrating stove promotion into broader programs (e.g., energy efficiency and conservation, poverty alleviation, and health improvement) that include awareness-raising campaigns, multiple issues can be targeted to generate co-benefits.

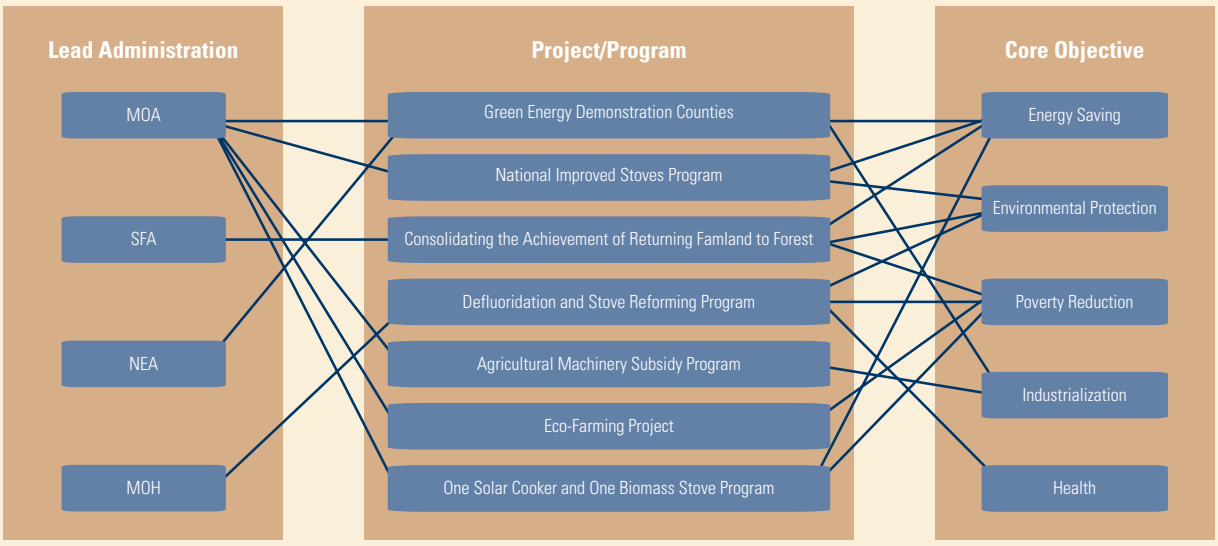
Policies, Programs, and Institutions

China's government has made significant efforts at various levels in issuing policies and implementing programs to promote clean rural energy solutions. These policies and programs have covered a wide array of topics, ranging from renewable energy development, utilization of crop residues, rural energy development, and poverty reduction to improving rural households' quality of life and health and preventing deforestation. Various ministries have invested in such efforts, with each project/program having its core objectives (figure 4.7).

China's stove dissemination and household energy policies have achieved a number of positive results. At the same time, issues remain that impede the potential for larger-scale success and longer-term sustainability. Meeting these key challenges will require (i) more systematic programs, (ii) strengthened cooperation and coordination among key departments at all levels, (iii) more flexible subsidy schemes that incorporate monitoring and evaluation (M&E), and (iv) more effective awareness-raising campaigns and support for technology research and development (R&D).

To make government funding support more effective and efficient, Results-Based Financing (RBF) is recommended. This innovative approach disburses public resources against demonstrated, independently verified outputs or outcomes instead of project inputs. This

FIGURE 4.7 CHINA'S CLEAN STOVE PROGRAMS STRUCTURE



Source: World Bank, *China: Accelerating Household Access to Clean Cooking and Heating*, East Asia and Pacific Clean Stove Initiative Series (Washington, DC: World Bank, 2013).

distinguishing feature can mean better use of public funds and improved support of market interventions. The conceptual framework for using RBF in programs to promote clean stoves could include three key building blocks—defined clean stoves, results-based incentives, and a monitoring and verification (M&V) system—supported by the pillars of institutional strengthening/capacity building and awareness-raising campaigns. The RBF framework not only integrates all of the strategy's intervention priorities; it also helps to clarify the roles of government and the private sector in delivering the results; that is, the government plays a facilitating role, providing policy support and financial incentives to motivate market development, while the private sector responds to the incentives and delivers the results.

Next Steps

Under Phase II of the China CSI, four major areas of activity are proposed for supporting strategy implementation to scale up access to clean stoves, as follows:

- **Improving stove standards, testing, and verification system.** Since defining "clean stoves" is a priority for promoting them, a thorough review of China's current system and international experience in this area will be conducted to identify gaps and opportunities for improvement. In addition, coordination with the Global Alliance for Clean Cookstoves, which currently supports the establishment of regional testing and knowledge centers, will be strengthened to ensure China's participation in the process, help it build a regionally recognized stove-testing center, and contribute to regional knowledge-sharing. Furthermore, as international standards for clean stoves are being formulated, efforts will be made to encourage China to actively participate in the process and consider the compatibility of its national standards with the international framework so that certified national clean stoves can be recognized internationally.
- **Strengthening institutions and building the capacity of key market players.** China has already established a good institutional setup, having selected the Ministry of Agriculture as the institutional focal point, with the National Development and Reform Committee taking the lead on cross-sectoral coordination and the China Association of Rural Energy Industry (China Alliance for Clean Stoves) CAREI (CACS) serving as a platform for communication, learning, and cooperation. The next step is to further strengthen these institutional arrangements. As the RBF approach relies on market players to deliver the results, training activities will be provided to build the capacity of key market players through the CAREI (CACS) platform. In addition, activities for international knowledge exchange and learning will be planned.
- **Supporting pilots.** The CSI will identify areas that are representative and scalable for piloting the RBF approach to promote clean stoves. Preparations are under way to identify pilot areas and develop the program's implementation plan.
- **Supporting preparation of China's second national clean stoves program and Hebei Rural Energy Project.** The second national clean stoves program represents a significant step toward achieving universal access to clean cooking and heating solutions. The China CSI will work closely with the Ministry of Agriculture, the lead agency, to provide needed support. In addition, Hebei province, which is preparing a large-scale rural energy project that will provide rural households clean cooking and heating solutions, has requested US$100 million in IBRD loan support. The CSI will support preparation activities and provide a learning platform for provincial rural energy projects that target increased access to clean cooking and heating solutions.

5

Development of Clean Stoves in China

China Delegation*
Presenter: Fang Fang, Ministry of Agriculture

Today 700 million people live in rural China. Seventy percent of households use solid fuels for cooking and heating. Most biomass waste is burned in the open field, contributing to air pollution. Household burning of solid fuels is also a major health hazard in China, accounting for more than half a million premature deaths each year, affecting mainly women and children. The thermal efficiency of traditional stoves is only 12 percent. Mitigating the health hazards associated with household burning of solid fuels will require developing and implementing strategies for scaling up the dissemination of clean-burning, fuel-efficient stoves for cooking and heating that rural households are willing to adopt.

Woman collecting firewood in Xiaoxing township in rural Songpan county, Sichuan province.

Rural Household Energy Structure

In 2010, traditional, non-commercial biomass dominated the structure of China's rural household energy, while the rapid growth of other renewable energy sources, along with a significant role for modern fuels, was evident. Straw accounted for more than two-fifths of rural household energy use (41.7 percent), while wood comprised more than one-fifth (21.3 percent), followed by coal (16.0 percent), electricity (7.6 percent), and biogas (7.0 percent). The remainder consisted of oil, solar energy, and gas, at 2.5, 2.1, and 1.8 percent, respectively.

Biomass Stoves Industry Overview

China has one of the largest biomass stove industries in the world, with a substantial supply of improved stoves currently in use. As early as the 1980s, "Stoves Revolution and Energy Conservation" was codified in China's Sixth Five-Year Plan. The National Improved Stoves Program (NISP), which by the late 1990s had installed some 180 million improved stoves in rural households, is the world's most successful national improved stoves program. The period from 1980 through the mid-1990s witnessed stove improvements and promotion, followed by a period characterized by innovation (mid-1990s–2005). Since 2005, development in both the production and

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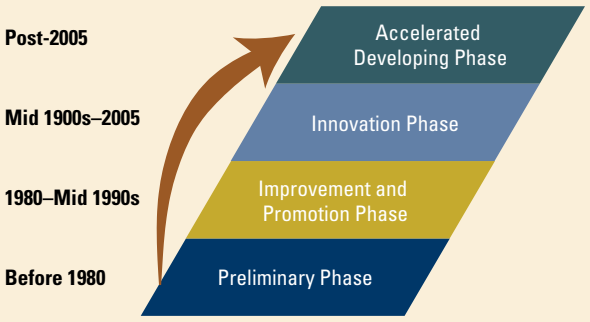
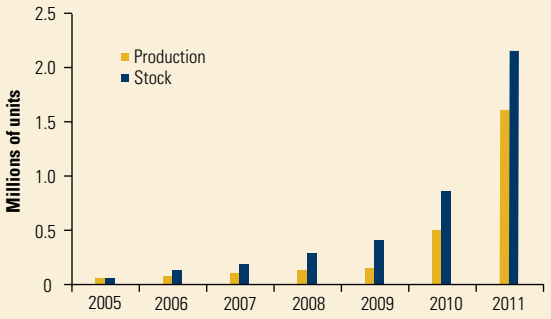
FIGURE 5.1 TIMELINE OF BIOMASS STOVES DEVELOPMENT IN CHINA



Source: Authors.

FIGURE 5.2 GROWTH IN PRODUCTION AND STOCK OF CLEAN BIOMASS STOVES, 2005–11



Source: China Association of Rural Energy Industry (CAREI), *Energy-Saving Stoves Industry Development Report* (Beijing: CAREI, 2011).

stock of high-efficiency, low-emission biomass stoves, also known as "clean biomass stoves," has accelerated. Despite this late starting point, biomass stove production increased eightfold within five years, reaching 0.5 million in 2010, 11 times greater than in 2005 (figure 5.1).

By 2011, more than 300 biomass stove manufacturers were producing 1.6 million stoves a year, with total ownership at 2.15 million (26 and 30 times greater than in 2005, respectively) (figure 5.2). This sharp increase can be attributed to the government's substantial efforts to invest in the industry, along with the rise in fossil-fuel prices and technology improvements observed in recent years.

Both biomass stove technologies and product quality have greatly improved as a result of continuous research and development (R&D) efforts. Stove manufacturers, particularly coal stoves companies, have been dedicated to developing clean biomass stoves, with substantial support from the government, and developing countries have recognized this technology as a leader. In addition, industrial organizations have played an important role in developing China's biomass stove industry. Prior to the NISP, the thermal efficiency of cooking stoves was only about 10 percent and that of improved stoves promoted in the mid-1990s was about 25 percent. Today, however, thermal efficiency can exceed 35 percent.

Major Government-Supported Programs

Various ministries have invested in clean stoves programs, with each project/program having its core objectives. Major projects and programs include the following: NISP, Demonstration of Biomass Pellet Fuel, Solar Cooker and Biomass Stove Program, Eco-home Project, National Program for Rural Biogas, Agricultural Machinery Subsidy

Lighting the household cooking fire in Xisuo village, Maerkang county, Sichuan province.

Women attending clean stoves training session in Yu county, Shanxi province.

Program, Green Energy Demonstration Counties, Defluoridation and Stove Reforming Program, and Grain for Green Program.

Institutional Arrangements and Major Policies

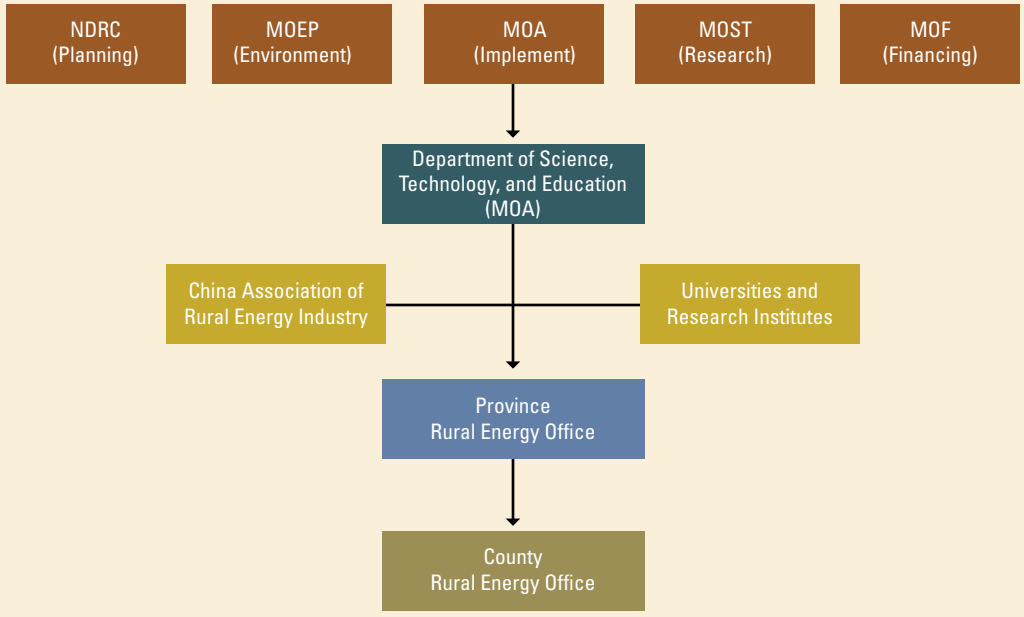
Since the early 1980s, China's government has been involved at all levels (national, provincial, and local) in issuing policies and implementing programs covering a wide array of topics related to clean stoves (figure 5.3). With regard to renewable energy development, major policies have included the following:

- **Renewable Energy Law of People's Republic of China** (2006, amended in 2009). This policy sets a national renewable-energy target and context.
- **Agricultural Bioenergy Industry Development Plan, 2007.** This plan codifies having 60 million rural households adopt biogas by 2015 (as of 2007, there were 22 million household biogas users), with 23.3 billion m^3 in annual biogas production.
- **Medium- and Long-Term Program of Renewable Energy Development, 2007.** The overall objective is to establish targets to produce 1 million metric tons (MT) of biomass solid fuels by 2010 and 50 million MT by 2020.
- **Eleventh Five-Year Plan for Renewable Energy Development.** This plan's guidelines emphasize the necessity of developing renewable energy in rural areas to promote a new socialist countryside construction.

In addition to these policies and programs, a series of related policies and regulations were issued in 2011, as follows:

- **Twelfth Five-Year Plan (2011–15).** General Office of the State Council.
- **Notification of Implementing Multipurpose Use of Agricultural Straw, Twelfth Five-Year Plan ([2011] 2615).** National Development and Reform Committee (NDRC), Ministry of Agriculture (MOA), and Ministry of Finance (MOF).
- **Interim Measures for Administration of Subsidy Funding for Construction of Green Energy Demonstration County ([2011] 113).** MOF, National Energy Administration (NEA), and MOA.
- **Notice of Comprehensive Work on Energy Conservation and Emissions Reduction, Twelfth Five-Year Plan (State Council [2011] 26).** General Office of the State Council.
- **Notice of Implementing Action Plan for Energy Conservation and Emissions Reduction.** NDRC and 17 ministries.

FIGURE 5.3 INSTITUTIONAL ARRANGEMENTS FOR PROMOTING CLEAN HOUSEHOLD ENERGY SOLUTIONS



Source: Authors.

A review of these policies confirmed that laws are in place at the national level to promote and upgrade stoves for rural households, especially improved biomass stoves, as well as biogas and other clean rural energy. Moreover, these regulations have started to emphasize the benefits of improved indoor air quality, low carbon emissions, and better quality of life resulting from using clean stoves, along with the fuel savings and rural energy solutions recognized in the past.

Major Programs

Key among the major programs that have promoted clean household energy solutions in China are Green Energy Demonstration Counties, National Improved Stoves Program, and One Solar Cooker and One Biomass Stove Program. Program highlights, including program objectives, institutional players, achievements/challenges, and lessons learned, are highlighted here:

Green Energy Demonstration Counties. Since 2011, the NEA, together with the MOF and the MOA, has implemented the Green Energy Demonstration Counties program, which aims to solve or mitigate household energy problems using green energy. The range of renewable energy sources includes biomass, solar, wind, geothermal, and hydropower. Biomass energy is applied through three projects: (i) biomass briquetting, (ii) centralized biogas, and (iii) biomass gasification. Subsidy qualification criteria include a green-energy production capacity of more than 50,000 tons of standard coal equivalent and more than 20,000 newly added household users. The central government subsidizes demonstration counties through direct subsidies, rewards, and low-interest loans, while local government arranges matching funds for strengthening program sustainability and scaled-up impact. In November 2011, the first group of 26 green demonstration counties each received a subsidy of RMB 25 million. It is expected that 200 green energy counties will be constructed by 2015.

National Improved Stoves Program (NISP). China's NISP, the world's largest such program, was initiated by the MOA and the NDRC in the 1980s. By the late 1990s, the NISP had successfully promoted 180 million improved stoves, benefiting more than 500 million farmers. The thermal efficiency of improved stoves was 15 percent higher than that of traditional stoves, resulting in fuel savings of 33–50 percent, on average. Key ingredients of the program's success included the government's firm commitment to stoves promotion, the organization of national stoves competitions and adoption of unified standards and testing protocols, integration of the program into rural development planning, and investment by related departments and research institutes in R&D on stove technology and formation of a specialized technical team. The NISP has also faced important challenges, including low level of technology and commercialization; high subsequent breakage and damage to stoves (more than 70 percent); and lack of funding, which has impeded further promotion. Planning for the launching of the second round of a national improved stoves program is under way. Within this framework, rural energy efficiency, health, emissions reduction, and quality of life will all be improved.

One Solar Cooker and One Biomass Stove Program. Initiated by the MOA in 2007, the One Solar Cooker and One Biomass Stove Program was implemented in the Tibet areas of Sichuan, Qinghai, Gansu, and Yunnan. The program provided each participating rural household one solar cooker and one efficient biomass stove. The products were selected through unified and public bidding and were purchased from the stove enterprises. Specific responsibilities were assigned at all levels of government. The program successfully promoted 79,833 biomass stoves and 244,474 solar cookers. As a result, rural sanitary conditions have improved and the income of herdsmen and farmers has increased. Lessons in program success include the careful integration of local conditions, energy consumption, and lifestyle into program design; the technical training provided in project counties by experts and enterprises; activities to raise households' awareness about clean stoves; and setting up after-sales service networks in project counties.

Stove Standards

To control product quality and guide stove industry development, clean stove standards have been issued and applied at various scales by the corresponding authorities. Stove standards can be grouped into four levels: national, industry, regional, and enterprise. Associated with stove standards are testing protocols that specify how testing should be conducted to evaluate stove performance. Stoves entering the market or public bidding above the provincial level must be tested at legitimate testing centers to certify that they meet certain standards. Those that fail the tests are considered inferior products and are denied market entry.

China's existing household stove standards and testing protocols, which encompass a broad array of stove types and technologies, form the foundation for clean stove R&D, production, promotion, and utilization (table 5.1). These standards and protocols are the government's

TABLE 5.1 CHINA'S HOUSEHOLD STOVE STANDARDS

Standard number	Standard name	Type
GB6412-2009	Testing protocol for domestic coal use and household stove	National
GB16154-2005	General technical specification for household water heating coal stove	National
GB/T16155-2005	Testing protocol for heating performance of household heating coal stove	National
NY/T1001-2006	Technical specification for household improved stove and Kang	Industry
NY/T8-2006	Testing protocol for thermal performance of firewood stove	Industry
NY/T1703-2009	Specification for installation and acceptance of water heating stove of heating system	Industry
NB/T34006-2011	General specifications for household densified biofuel heating stove	Industry
NB/T34005-2011	Testing protocol for household densified biofuel heating stove	Industry
NB/T34007-2012	General specification for biomass cooking and heating stoves	Industry
NB/T34008-2012	Testing protocol for biomass cooking and heating stoves	Industry
NB/T34009-2012	General specification for biomass cooking and radiant heating stoves	Industry
NB/T34010-2012	Testing protocol for biomass cooking and radiant heating stoves	Industry
To be approved	General technical specification for household biofuel cookstove	Industry
To be approved	Testing protocol for household biomass cookstove	Industry
DB11/T540-2008	General technical specification for household biomass stove	Regional (Beijing)

Source: China Alliance for Clean Stoves (CACS), Background report prepared for the China CSI (Beijing: World Bank, 2012).
Note: GB = national standards, NY = agricultural industry standards, NB = energy industry standards, DB = regional standards.

technical means for guiding and regulating the household stove industry; yet they are not systematic, requiring improvements in both methodology and coverage. They lag in relation to technology improvements and the emergence of new products. Various required standards and testing protocols are not yet in place. For example, emission standards, design and safety guidelines, and the rating of thermal efficiency and emissions levels for both biomass and coal stoves are missing at every level of the standards system. Furthermore, standards are seldom implemented or enforced strictly, meaning that some inferior stoves may enter the market or government-supported programs, hindering development of the stoves sector and program implementation.

The goal toward which progress is being made is to improve the current standards, testing, and certification system in terms of methodology, scope, implementation, and enforcement. As the formulation of international stove standards and testing protocols progresses, China needs to actively participate in the process and consider the compatibility of its national standards with the international framework so that certified national clean stoves can be recognized internationally.

International Cooperation

Various programs funded by international donor agencies have been implemented to promote clean biomass cooking and heating solutions in China. Key among them are the following:

- Promotion of Rural Renewable Energy in Western China (Sino-Dutch co-project).
- Promotion of Technology Innovation and Dissemination for High-Efficiency, Low-Emissions Biomass Household Stoves in China and Abroad (Shell Foundation).
- Scale-Up of High-Efficiency, Low-Emissions Biomass Household Stoves in Western China (U.S. Environmental Protection Agency [U.S. EPA]).
- Clean Stoves Program in Guizhou (U.S. EPA).
- Deforestation Prevention and Habitat Protection Program in Yunnan (U.S. EPA).
- Stoves Program in Four Provinces of China (World Bank).
- China Stoves Initiative (World Bank).

Next Steps

Preparing for the scaled-up access to clean cooking and heating solutions in China will require six major areas of activity. The first one encompasses institutional strengthening, building a cross-sectoral coordination mechanism, and integrating project planning. The second one involves setting up the assessment and monitoring mechanism and system. The third centers on launching the second NISP and exploring the optimal subsidy model. The fourth is accelerating the pace of standardization and active participation in the development of international standards to ensure quality control of clean stoves. The fifth focuses on clean stoves marketing and public-awareness campaigns to catalyze behavioral change in rural households' energy use. Finally, international cooperation will be enhanced to promote Chinese advanced stove technologies and products in other developing countries.

6

Millennium Challenge Account: Mongolia Energy and Environment Project (2010–13)

Mongolia Delegation*
Presenter: Mangal Sovd, Millennium Challenge Account, Mongolia

Ulaanbaatar, the world's coldest capital, is also one of its most polluted. Household burning of raw coal and wood for space heating and cooking in *ger* areas (informal peri-urban settlements) is essential for survival. However, it contributes about three-fifths of the city's concentrations of fine particulate matter ($PM_{2.5}$). Such exposure levels, which far exceed guidelines set by the World Health Organization (WHO), are linked to severe health problems. The overwhelming majority of households in ger areas are poor, and the population continues to grow as job prospects in the capital attract more migrants. Typically, traditional heating stoves have been in use for generations and are quite fuel-inefficient. An additional source of pollution is the increasing use of coal-fired stove furnaces, known as low pressure boilers (LPBs), used by wealthier families when constructing larger homes.

Recent Efforts to Tackle Pollution

In 2009–11, the donor community organized small pilot programs as part of a major effort to reduce outdoor air pollution in Ulaanbaatar. In 2011–12, the Millennium Challenge Account (MCA)-Mongolia financed a scale-up of its pilot program in selected *khoroo* (subdistricts) of the five districts that comprise Ulaanbaatar's Air Pollution Reduction Zone. After launching the 2011 scale-up, the Clean Air Fund (CAF) provided additional subsidies for stoves.

A major activity of the MCA-Mongolia Energy and Environment Project is the Millennium Challenge Energy Efficiency Innovation Facility (MCEEIF). The goal is to reduce air pollution in Ulaanbaatar by increasing the adoption of energy-efficient products and homes in the ger districts and supporting the development of renewable energy. The MCEEIF provides consumer subsidies for the purchase of energy-efficient stoves and homes certified as meeting a set standard or otherwise demonstrating a superior efficiency over previous models. The Facility also provides technical assistance to support product testing and market and economic analysis.

Promoting Energy-Efficient Stoves

Key steps in promoting energy-efficient stoves are (i) developing a testing protocol, conducting stove performance tests, and developing stove test data; (ii) conducting market and economic analysis and setting subsidies; (iii) conducting public-awareness and social-marketing activities; (iv) establishing product centers and a sales process; (v) distributing and installing stoves; (vi) collecting old stoves; (vii) implementing the subsidy-transfer process; (viii) and monitoring.

Testing protocol, stove performance tests, and stove test data. Fuels and wood were weighed separately before burning. Stoves were weighed after filling with fuel. During the testing, stoves were weighed every 10 minutes. Each minute, Testo 350 measured the amount of excess air; flue gas temperature; and levels of carbon monoxide (CO), carbon dioxide (CO_2), nitrogen oxides (NO_x), sulfur dioxide (SO_2), and hydrogen (H). Test results for main indicators of stoves emission factors were determined using

*The Mongolia Delegation includes Mangal Sovd, Millennium Challenge Account (MCA), Mongolia; Khurelsukh Nyamgarav, Mongolia Clean Air Foundation; Bat-Erdene Togooch, City of Ulaanbaatar; Tsendsuren Dorjgotov, Ulaanbaatar Clean Air Project (UBCAP); and Chimed-Erdene Baatar, Clean Air Foundation.

TABLE 6.1 TEST RESULTS (OVERALL AVERAGE) COMPARING ENERGY-EFFICIENT STOVES FOR KEY PARAMETERS (PERCENT)

GTZ-7.4	Ulzii	Khas	Dul	Golomt
Index of poison-gas emissions from stove chimney (compared to traditional stove)				
45.16	89.47	70.94	83.04	87.08
Fuel savings in heating season				
21	26	11	19	21
				

Source: Authors.

two proximate analyses: (i) moisture and ash-free fuel and (ii) received basis (table 6.1).

The Dul stove had about twice the energy efficiency of a traditional stove (71 percent versus 36 percent) on average. The Ulzii stove had 65 percent energy efficiency, followed by the Khas stove, at 62 percent. In terms of flue gas CO, the Dul exhibited only 61 g per kg mass air flow (maf), compared to 161 for the Ulzii, 204 for the Khas, and 767 for the traditional stove. In terms of flue gas total suspended particulates (TSP), the traditional stove had more than six times TSP as the Dul (3.41 g per kg maf versus 0.53 g per kg maf) and more than three times TSP as the Ulzii (0.91) and Khas (1.04). In terms of daily fuel consumption, the Ulzii exhibited the lowest amount (18 kg), followed by the Dul (19 kg), Khas (21 kg), and traditional stove (24 kg).[8]

Market and economic analysis and subsidy-setting. Technical-support consulting services were provided in 2011–12 for conducting market and economic analysis and setting the subsidy levels for various energy-efficient stoves (table 6.2).

8. The Energy and Environment Project has received numerous requests—mainly from local manufacturers—to accept new solid-fuel stoves into its program. Many requests are for R&D prototype stoves, which, though interesting, are not suitable for the project.

TABLE 6.2 SETTING THE SUBSIDY LEVELS FOR THREE SELECTED ENERGY-EFFICIENCY STOVES

Stove type	Stove market price without VAT (US$)	MCA-subsidy per case		Consumer price (US$)
		US$	Percent	
Ulzii	263.87	205	78	58.87
Khas	359.82	164	46	195.82
Dul	283.36	179	63	104.36

Stove type	Stove market price without VAT (US$)	MCA-subsidy per case		Government bonus (CAF)		Total subsidy		Consumer price (US$)
		US$	Percent	US$	Percent	US$	Percent	
Ulzii	263.87	205	78	38.4	15	243.25	92	20.61
Khas	359.82	164	46	152.4	42	316.57	88	43.25
Dul	283.36	179	63	83.5	29	262.14	92	21.21

Source: Authors.

Note: Based on a currency exchange rate of US$1 = MNT 1,334; price proposals from producers by May 18, 2012.

TABLE 6.3 SALE OF ENERGY-EFFICIENT STOVES AND HOUSEHOLD COVERAGE

District	Subdistricts (khoroo), number	Total stoves sold, number	Total households, number	Coverage, percent
Bayanzurkh	16	24,835	38,255	65
Chingeltei	13	22,680	29,031	78
Khan-Uul	4	5,602	18,300	31
Songinokhairkhan	22	31,337	44,963	70
Sukhbaatar	11	13,423	22,731	59
Total	66	97,877	153,280	64

Source: Authors.

Policy and Regulatory Environment

The Law of Mongolia on Air, enacted June 24, 2010, aims to coordinate the various elements related to implementing activities to reduce air pollution, including air pollution payment (June 24, 2010) and air pollution reduction in the capital city (February 10, 2011). The Law on Air was revised May 17, 2012.

Public Awareness and Social Marketing

To raise public awareness and thus generate demand for more energy-efficient stoves, public-awareness and social marketing activities were conducted on the improved performance, benefits, and functionality of the better stoves. The activity also included a broader goal of raising awareness about energy efficiency and renewable energy and their role in air quality improvement. Household members were asked such questions as "What is the largest source of air pollution?," "What can you do to help reduce air pollution?," and "What is energy efficiency (e.g., energy-efficient stove, ger insulation, and energy-efficient home)?" They were also asked about how to use energy-efficient products, especially energy-efficient stoves.

Establishing Product Centers and Sales Process

During 2011-13, 72 product centers were established in five districts of Ulaanbaatar: Bayanzurkh, Chingeltei, Khan-Uul, Songinokhairkhan, and Sukhbaatar (table 6.3).

An unprecedented 97,877 energy-efficient stoves were sold between June 2011 and November 2012. By the end of that period, about 55 percent of all households living in the central ger areas of Ulaanbaatar had purchased energy-efficient stoves, including 69 percent of those households in the targeted subdistricts (khoroo) where subsidized stoves were sold. The MCC-funded stove replacement project was results-based, meaning that the consumer subsidies provided were disbursed only upon sale and verification of the installation of eligible stoves.

Looking Ahead

With funding from the World Bank, the city of Ulaanbaatar is beginning the next major phase in activities to fill the remaining gaps in the ger-area market for low-emission heating stoves. The Ulaanbaatar Clean Air Project (UBCAP) and the CAF will co-finance consumer incentives for a target of another 45,000 low-emission stoves in the winter of 2013. The UBCAP is establishing a stove development center and testing facility to provide training and technical assistance to stove producers and repair-service providers.

Lessons Learned and Recommendations

Experience of the MCA-Mongolia Energy and Environment Project has highlighted the importance of informed decision-making; clear roles and responsibilities for the public and private sectors; strong program management, which complex, decentralized projects require; and adaptation to local contexts.

Need for continued subsidies. Results from stocktaking activities, including the survey of households in the ger areas of Ulaanbaatar and the rapid assessment of stove markets outside the capital city, suggest that the significant results shown to date in stove-replacement

efforts could be jeopardized if the subsidy program were discontinued. The demographic forces driving growth in demand for stoves in the ger areas are still at play. Supply chains for low-emission stoves continue to depend heavily on the subsidy program; and the traditional stove market, though clearly reduced in Ulaanbaatar, continues to thrive outside Ulaanbaatar without subsidies. If a longer-term intervention is not put in place, the number of traditional stoves used by ger-area households, along with emissions, will start pushing upward again.

The study's findings, summarized below, support this conclusion:

- Demographics and household-dwelling situations are changing.
- Consumer preferences must guide stove development, marketing, and stove-replacement initiatives.
- Heating-fuel expenses remain a high proportion of monthly income, especially for very low-income families.
- Markets in and outside Ulaanbaatar are intricately linked, suggesting the possible need for a scaled-up program to reach areas outside the capital.
- Technical capacity and materials for maintenance of low-emission stoves are needed.

Roadmap. To ensure long-term program success, the following actions are recommended:

- Estimate the impact of the proposed mitigation measures on overall air pollution to ensure the government's investment will meet expectations.
- Develop a testing program for equipment, with a focus on safety and emissions rather than fuel consumption alone, and set interim performance targets that can eventually be accepted, after practical experience is gained, as new standards, following the Mongolian regulatory process.
- Set up an enforcement mechanism to address noncompliant products and manufacturers.
- Establish a targeted and well-justified subsidy program to make new systems affordable.
- Establish credible supply chains, in partnership with the private sector, and use a third-party verification system for installation and use of new stoves.
- Remove old equipment from use.
- Use market-based approaches—preferred over such nonmarket-based approaches as stove giveaways—to disseminate cleaner heating systems.

APPENDIX A

Panel Discussion Notes: Cross-Cutting Issues in Scaling Up Access to Clean Cooking and Heating Solutions

The afternoon session (Session II) of the EAP CSI Forum consisted of panel discussions focused on four cross-cutting issues: (1) private-sector development and the role of financing; (2) technology and quality assurance; (3) institutions, cross-sector coordination, and partnerships; and (4) intervention strategy and next steps.

1. Private-Sector Development and the Role of Financing

Moderator: Yabei Zhang; Panelists: Santosh Kumar Singh, Iwan Baskoro, Guangqing Liu, and Khurelsukh Nyamgarav.

Key questions: How can one attract and sustain the private sector? Which financing instruments could be used? How promising is the Results-Based Financing (RBF) approach?

In the case of **India**, the decision was made to remove barriers that made the cookstove sector appear less attractive than others and to promote end-user demand for clean cookstoves. Other options considered were green-financing lines of commercial banks and social-venture funding. In the case of **China**, the perspective of the China Alliance for Clean Stoves (CACS) was to subsidize a yearly production of 1.6 million stoves. In **Mongolia**, the Clean Air Foundation required that mining companies contribute to a fund. In **Cambodia**, subsidies have been successfully applied to the supply chain, with some 31,000 units sold each month. One challenge is that cookstove production is still considered an informal business, which makes getting loans more difficult. In **Lao PDR**, The World Bank is exploring the feasibility of a health-linked RBF approach. A Lao Delegation member representing the Ministry of Health suggested raising the issue of financing advanced cookstove programs at the next inter-ministerial meeting of the Association of Southeast Asian Nations (ASEAN). It is broadly accepted that some subsidies are needed when starting clean stove programs.

2. Technology and Quality Assurance

Moderator: Robert van der Plas; Panelists: Crispin Pemberton-Pigott, Xiaofu Chen, Mangal Sovd, and Christoph Messinger.

Key questions: What are the key principles for setting up a stove standards, testing, and certification system? What are good practices and lessons learned? How can national systems be harmonized with the ISO process?

The panel discussion concluded that standards need to be adapted to local cooking customs; however, it would help to have an international standard in place on criteria for setting standards. Local and/or international testing and certification organizations will be required.

3. Institutions, Cross-Sector Coordination, and Partnerships

Moderator: Leslie Cordes; Panelists: Marlis Kees, Christina Aristanti Tijondro, Natsuko Toba, and Khammanh Sopraseurth.

Key questions: What type of domestic institutional framework/setup is needed to promote sustainable stove programs? How can we work more effectively across sectors and with other partners? What are good practices and lessons learned?

One of the main ideas expressed was the need for a strong focal person.

4. Intervention Strategy and Next Steps

Moderator: Dejan Ostojic; Panelists: Fang Fang, Bat-Erdene Togooch, Edi Wibowo, and Hatsady Sisoulath.

Key questions: What are the plans to achieve scaled-up clean cooking and heating solutions in each CSI country? What are the common themes and interests that we need to work together on? How can we continue cross-country learning and exchanges?

Plans were to establish national cookstove standards and explore the option of subsidies, if required. It was agreed that similar regional forums should be hosted in the future to facilitate cross-country learning and exchanges; in addition, hosting of the EAP CSI website and other communication and dissemination methods should be used.

APPENDIX B

Clean Cooking Forum: Lessons for the Lao Clean Stove Initiative

Delegates to the Clean Cooking Forum from the Lao PDR Inter-Ministerial CSI Task Force initiated a discussion on lessons from the forum that could be applied to the Lao CSI as it moves into its second phase. The ideas exchanged cut across multiple sectors and included key CSI partner organizations, ministries, and team members. Input was provided by **Tayphasavanh Fengthong**, Director, Environmental and Occupational Health and Safety Division, Ministry of Health (MOH); **Khammanh Sopraseurth**, Deputy Director, Energy Efficiency and Conservation Division, Institute of Renewable Energy Promotion (IREP), Ministry of Energy and Mines (MEM); **Boulay Vongvisith**, Deputy Head, Bio Gas Division, Institute of Energy and New Construction Materials, Ministry of Science and Technology (MOST); **Khamphone Nanthavong**, Professor, Mechanical Engineering, National University of Lao PDR (NUOL); **Aurelie Phimmasone**, Managing Director, Lao Institute for Renewable Energy (LIRE); **Julien Jacquot**, Stove*Plus* Manager, Renewable Energy, Environment, and Solidarity Group (GERES), Cambodia; **Bastiaan Teune**, Sector Leader, Renewable Energy, Netherlands Development Organisation (SNV), Lao PDR; **Patricia Ramos Peinado**, Infrastructure Analyst Consultant, World Bank; **Voravate Tuntivate**, Senior Energy Specialist Consultant, World Bank; and **Natsuko Toba**, Senior Economist, World Bank. Highlights of the lessons sharing are summarized below.

Demand-Side Issues

Solutions must be adapted to local conditions. The cooking practices and variety of fuels and appliances used by households in rural, urban, and peri-urban areas must be carefully analyzed so that the technologies selected fit the local socioeconomic and cultural contexts, particularly in rural areas. Households often use a mix of fuels (e.g., wood and charcoal or LPG and charcoal), depending on their price and availability, and usually have more than one stove. Financial analysis must account for the number of stoves per household since this will have a significant effect on the cost of switching to more modern fuels and stoves.

Preventing household air pollution is not the main driver of households' uptake of clean stoves. Cooking is primarily a cultural activity, and the kitchen is the most culturally definitive part of any house, including those in rural areas. Not surprisingly, cultural cooking habits prevent massive uptake of clean stoves in the free market. Cooks are accustomed to using a variety of fuels and stoves that may pollute the household air. Both the willingness and ability to pay for clean stoves are considerably lower than the stove price. To date, successful interventions have focused on incremental stove improvements geared to fuel savings. Lessons from biogas programs show that a

household's decision to purchase a biogas digester/stove facility is driven by issues other than preventing smoke in the kitchen (e.g., animal sanitation, fuel substitution value, and comfort).

Promotional campaigns should be adapted to the Lao context. Traditionally, the Lao population, particularly less educated people, is accustomed to following others rather than taking individual risk. Thus, campaigns to build public awareness might be more successful if integrated with traditional events, such as festivals, where many people join in. Such events could also serve as a venue for knowledge-sharing between stove producers and household users.

Gender is a vital factor in raising public awareness. To effect behavioral change for a better quality of life, the roles of both women and men in cooking and purchasing fuels and stoves must be carefully studied. In this way, social marketing and public-awareness campaigns, including technology demonstrations, can deliver the right messages to the appropriate audiences to catalyze wider stove adoption. Special efforts should be made to educate men on the benefits of clean cookstoves, even if they are not the primary users, so that they will support women's purchasing decisions.

What are the social-sensitive drivers of households' selection of stoves and fuels? Typically, demand for better stoves is not generated directly from public good–oriented messages about women's health advantages or environmental benefits. Indeed, many factors that drive households to purchase stoves are more emotional than rational. These include a stove's design, its feeling of modernity, and a sense of having a sophisticated "product for the rich," as well as envy vis-à-vis neighbors.

Stove sales can be promoted by extending a period of free use. Experience from the Vietnamese Women Union's ICS program shows that stove sales can be increased by allowing consumers to use the stoves at no charge for a limited (two-week) period. Households were more likely to purchase the stoves after experiencing their economic and health benefits.[9] Similarly, in Cambodia, solar cookers were promoted by allowing families to use the new technology for a free, two-week trial period in combination with training on system framing and installation.

Not limiting interventions to the lowest segment of the population could lead to wider adoption of clean stoves over time. The reality in Lao PDR is that most households cannot afford clean stoves that meet WHO emission standards. Since even wealthier households use fuel-inefficient stoves, the focus of interventions should not be limited to the lowest income groups. By offering a range of stove products, higher-income households could adopt more advanced stoves, while lower-income households could still afford better stoves with significant fuel- and time-saving benefits, gradually shifting to cleaner models over time. Once the basic infrastructure for the clean stoves is in place, it might be possible to reduce the price or use cross-subsidies to make the stoves more affordable to the poor.

Supply-Side Issues

Value-chain inefficiencies need to be addressed. There is no clear responsibility for the value chain, mainly because of geographical rather than social boundaries. Thus, roles, activities, and effectiveness gaps need to be carefully analyzed.

How can stove producers gain access to financing? Because the traditional stove sector is, in large part, informal, it is difficult for stove producers who want to upgrade their skills to access financing for even modest amounts of investment. A subsidy mechanism will need to be developed so that producers can gain financial access. In addition, establishment of a clean cookstove revolving fund or an energy development fund, with a collection and distribution mechanism, should be considered. Furthermore, producers could benefit from Small and Medium Enterprises (SME) funds from various sources, which support social enterprises.

Stove producers need to make a profit to stay in business. If, for reasons of cultural acceptance, customers cannot be charged for better stoves in proportion to the benefits they gain (e.g., a household pays only 5 percent more for a stove that is 25 percent better than its traditional one), then stove producers will have to work much harder to make more complex stoves for little profit. This situation may cause the producers to cut the cost of existing stove designs to gain market share, which, in turn, could harm efforts to introduce better stoves.[10] Since there is no guarantee that the price of traditional stoves will not be reduced, donors will need to fill the funding gap between the premium price customers are willing to pay for the benefits they perceive and the true price of the better stove.

9. Further information on lessons learned is available at http://energypedia.info/index.php/GIZ_HERA_Cooking_Energy_Compendium.

10. In the Cambodia ICS program, the ICS Producers and Distributors Association agreed on a minimum ICS price in order to avoid an inefficient price war.

Women's participation in technical training should be a priority. The Cambodia ICS program concluded that technical training should focus on women since they are more efficient in ICS production, produce better-quality stoves, save a higher percentage of their salaries for future family needs, and spend their money more wisely. The Cambodia experience also reveals gender-related challenges that prevent women from pursuing higher attainments (e.g., lacking access to higher education and married women having to obtain their husbands' endorsement of their request for a loan). In Kenya, gender-related challenges were overcome by conducting technical training sessions next to village households so that women could more easily attend. In India, it was important to make family members aware that the lady stove producer worked for the entire family, not just herself; it was also important that she earn more from stove production than her previous occupation to gain the family's support and earn more than the male head of household to gain his support.

Institutional and R&D Issues

Coordinated efforts are required to change the cooking game. Strong government commitment, institutional coordination, a strong focal point, and a last-resort decision maker are all critical to success. Institutional support must be consistent in terms of regulatory and enforcement measures. In Lao PDR, government support through the MEM's IREP, which serves as the CSI focal point and coordinating agency, will play an essential role in this effort. In addition, the MOH may have a key role to play in addressing the health-risk exposure of women and children linked to household air pollution.

Development of national stove standards and labeling (e.g., design, durability, technical features, and pricing) should take local cooking traditions and cultural acceptability into account. Establishing a national alliance for clean cookstove producers will be more useful if stove standards, market regulations and control, and public awareness of health-related issues are already in place. Technology demonstrations and setting up a clean stoves testing center or learning centers may be needed.

Deciding whether to take a direct or indirect approach to adopting clean stoves should be governed by local context. If the donor community envisions tackling the health issue of premature deaths from toxic cooking smoke directly, then the public sector will need to finance the gap in willingness and ability to pay. Alternatively, an indirect approach might entail incremental reduction in solid fuel use (e.g., 20–25 percent, as in the successful Cambodia improved cookstoves [ICS] program). It is recommended that the dual approach currently followed by the banks and bilateral donors be continued.

Research and development (R&D) is critical to program success. Deciding which of the many practical ICS designs available fit the Laos context must consider diverse populations and differences in cooking behaviors. An especially challenging task is finding the right trade-off between better air quality and a stove's commercial viability. Improving fuel quality, especially for charcoal, should be a focus of research given that fuel quality is vital to stove efficiency and thus cleanliness of the kitchen.

Inexpensive technologies can be used to collect data. Small temperature data loggers can indicate if and when the stove is being used. A smart phone can photograph the black carbon particulate matter collected and send it to a server that compares it with a scale and sends back an accurate estimation of the concentration amount. The water boiling test, a commonly used laboratory test for clean cookstoves, has been suggested as a benchmark.

Who pays for monitoring? No affordable standardized monitoring methodology is available. While monitoring stove sales and impact is an important component, it is costly; thus, it is difficult to make the buyers, especially those who purchase low-cost stoves, pay for it.

How fast can community-led efforts move forward? Community-level organizations, which have a good understanding of local conditions, are well-positioned to overcome many of the culture-specific headwinds to household uptake of clean stoves. But experience shows that patience is required to learn the market and respond to it as the program moves along. The speed at which a program can be effectively moved ahead is not easy to assess, which can be difficult for donors to work around.

Need for a Holistic Approach

The main question is how to ensure that stove producers can meet and maintain the standards of the cookstoves they produce. The key lesson from the Clean Cooking Forum in Phnom Penh is the need to work on three fronts. First, clean cookstove standards, labeling, and certification should be developed. Second, strategies to enforce rules and regulations must be developed. Third, strategies to raise public awareness and educate consumers must be developed.

Lessons from the Forum confirm our initial thinking that standards should account for existing levels of stove production technology and pricing to ensure local producers can meet standards and customers can afford to buy the stoves. Also, flexibility should be built in so that standards can be raised as production technologies improve and more models and options for clean cooking become commercially available. This means that standards will be regularly reviewed and updated to reflect changing conditions. With regard to enforcing rules and regulations, strict enforcement without taking into account local stove-making capability will not work. Rather, implementing education, training, and capacity building is important to ensure that stove producers can comply with the standards. In this regard, it may be useful to review Cambodia's experience in maintaining cookstove standards. Finally, detailed planning should be clearly laid out for implementing education and public-awareness campaigns.

APPENDIX C

Speaker Biographies

Aristanti Tjondro, Christina

Christina Aristanti Tjondro is Deputy Director of Yayasan Dian Desa (YDD) (Light of the Village Foundation), where she has worked since 1980. Christina has been involved in biomass energy and improved cookstove programs and activities since the 1990s. In 1991, she became manager of the Asia Regional Cookstove Program (ARECOP), a position she held until 2010, when ARECOP was adjourned. In addition, she has provided consultancy services in biomass energy and gender and energy-related issues.

Baatar, Chimed-Erdene

Chimed-Erdene Baatar is Officer of Project, Program, and Relationship, Clean Air Initiative-II Project of the Clean Air Foundation. She is an economist with a Master's Degree in Business Administration (MBA) and has more than eight years of experience in foreign-invested mining companies.

Baskoro, Iwan

Iwan Baskoro is Technical Advisor for the Renewable Energy, Environment, and Solidarity Group (GERES). An Indonesian mechanical engineer, Iwan joined the GERES team in Cambodia in late 1997 to launch and manage implementation of the Cambodian Wood Fuel-Saving Project, phase 1 (1998–2001) and monitoring of phase 2 (2002–06). In 2005, he was appointed GERES Director in Cambodia to manage various projects to develop biomass energy in the country. Currently, he serves as GERES Technical Advisor, supporting various ICS projects in the region.

Chen, Xiaofu

Xiaofu Chen is Executive Director of the China Alliance for Clean Stoves (CACS), in which capacity he leads the large-scale promotion of clean stoves in China and conducts international cooperation projects. Xiaofu also serves as Secretary General of the Technical Committee on Rural Energy Standardization of China. He has more than 30 years of experience in the fields of solar energy, energy efficiency, and other renewable energy and has held senior management positions at the Chinese Academy of Agriculture Engineering and the China Association of Rural Energy Industry (CAREI), affiliated with the Ministry of Agriculture.

Cordes, Leslie

Leslie Cordes is Senior Director of Strategic Partnerships for the Global Alliance for Clean Cookstoves (GACC). In this capacity, she leads the development of GACC strategic partnerships and fundraising efforts and manages donor relations; she also has oversight for GACC communications and advocacy activities. Leslie has more than 25 years of experience in the fields of clean energy, energy efficiency, and climate change, having held senior management positions at the U.S. Environmental Protection Agency (U.S. EPA), Alliance to Save Energy, and U.S. Agency for International Development (USAID). She has also served on the professional staff of the U.S. Senate Committee on Energy and Natural Resources.

Dorjgotov, Tsendsuren

Tsendsuren Dorjgotov is Operations Manager for the UBCAP in Mongolia. In 2004, she joined the Project Management Unit under the Municipality of Ulaanbaatar to work on a World Bank–financed water project. Since 2004, she has served as Operations Manager for UBCAP-supported projects and grants that aim to improve the living conditions of ger-area residents. Previously, she worked for Public Utility Construction Trust, a publicly owned company in Mongolia. Tsendsuren graduated from the Technical University of Slovakia, Bratislava in 1987 with a major in heating engineering.

Fang, Fang

Fang Fang is Counselor in the Department of Science and Technology's Division of Energy and Ecology within China's Ministry of Agriculture. Fang Fang is mainly responsible for the management of biogas and straw energy utilization, development of rural renewable energy, dissemination of firewood and coal-saving stoves, rural energy savings and emissions reduction, and various ecological agriculture projects and other technical guidance activities in China.

Fengthong, Tayphasavanh

Tayphasavanh Fengthong is Director of the Environmental and Occupational Health and Safety Division, Department of Hygiene and Health Promotion within Lao PDR's Ministry of Health. He also serves as Head of the Health Impact Assessment Team and Lecturer on Environmental Health at the University of Health Sciences. In 2001–12, he authored a study on the health impacts of climate change in Lao PDR and has co-authored case studies on the links between household air pollution, housing characteristics, and the respiratory health of women and children.

Iyer, Vijay

Vijay Iyer is Director of the World Bank's Sustainable Energy Department, where he guides the Bank's policies, programs, and strategies in the energy sector. Before June 2011, Vijay was Manager of the Bank's Africa Energy Group, where he led initiatives for Sub-Saharan African countries to support energy access through investments in hydropower, geothermal energy, and electrification projects, as well as such innovative programs as Lighting Africa. Previously, Vijay worked in private industry, project finance, and banking. He served as a senior official in the Indian Civil Service, holding several positions in public administration and economic development. He holds a Master's Degree in Business Administration (MBA) from Yale University and a Master's Degree in Chemistry from Jabalpur University, India.

Kees, Marlis

Marlis Kees is Manager of the Poverty-Oriented Basic Energy Services Programme, known as HERA, supported by the Gesellschaft für Internationale Zusammenarbeit (GIZ). An agricultural economist, Marlis joined the GIZ in the 1980s and has led HERA at GIZ's German-based headquarters since 2005. Together with her team and international partners, she advocates for access to modern energy services, with a strong focus on access to cleaner, sustainable, and affordable cooking energy. Currently, she backstops household energy projects in more than 20 countries, further strengthening concept development and knowledge management. Marlis began working in the cooking energy sector in the late 1990s when setting up the Regional Programme for Biomass Energy Conservation in Southern Africa (ProBEC) in cooperation with the SADC (Southern African Development Community).

Liu, Guangqing

Guangqing Liu is Associate Professor and Deputy Director of the Biomass Energy Center at the Beijing University of Chemical Technology. He also serves as Executive Secretary-General of the China Alliance for Clean Stoves (CACS) and Director of the China Regional Testing and Knowledge Center. Guangqing has substantial experience in technical and management research in the fields of biomass energy, including biomass stoves; biogas; pyrolysis syngas; and carbon financing. He has published some 30 papers and 4 books and holds 4 China patents. He has served as principal investigator or co-principal investigator for more than 10 national clean-stoves research projects in China and international clean-stoves programs funded by the World Bank and the UN Foundation.

Messinger, Christoph

Christoph Messinger is Component Manager for Cooking Energy for the global Energising Development (EnDev) program supported by the German Gesellschaft für Internationale Zusammenarbeit (GIZ). During 2004–08, Christoph began work on improved cookstoves in several African countries (Malawi, Tanzania, and Zambia). His experiences are summarized as chapters in the HERA/GIZ "Cooking Energy Compendium." Since 2010, he has supported the EnDev cookstove programs in Benin, Burkina Faso, and Senegal and currently is responsible for EnDev's global improved cookstove processes.

Nanthavong, Khamphone

Khamphone Nanthavong is Professor and Assistant Dean of the Faculty of Engineering at the National University of Lao PDR (NUOL). He is also a member of the Lao Renewable Energy for Sustainable Development Association (RESDA Lao) and the Community and Environment Development Association (CDEA). Khamphone has extensive experience in the fields of renewable energy, energy efficiency, and conservation, with expertise in assessment of energy policies, capacity, and knowledge. He has also served as a training advisor on various projects related to renewable-energy strategy development and strategic environmental impacts assessments.

Nyamgarav, Khurelsukh

Khurelsukh Nyamgarav is Executive Director of the Clean Air Foundation in Mongolia. He is an economist with a Master's Degree in Public Administration Management. Previously, he was Advisor to the First Deputy Prime Minister of the Mongolian Government and Deputy Finance Director of the Mongolian Airline Shareholding Company. He has experience in air pollution issues in Mongolia and has worked closely with national and international donor organizations to decrease air pollution in the capital city of Mongolia.

Ostojic, Dejan

Dejan Ostojic is Energy Sector Leader in the World Bank East Asia and Pacific (EAP) region. Dejan's extensive energy-sector experience includes institutional, regulatory, and technical aspects of the electric power and gas industries and municipal utilities. His diverse experience in sustainable energy and infrastructure development—Europe and Central Asia, East Asia, the Middle East, Latin America, and the United States—includes 14 years at the World Bank (5 based in country offices), 6 years as manager and consultant for a leading U.S. energy and water resources company, and 8 years in academia in Europe and the U.S. His responsibilities included high-level policy dialogue and complex sector reform; business development for public- and private-sector projects; design, preparation, and implementation of major investment projects; coordination of infrastructure operations across organizational boundaries; and task-team management in IDA and IBRD countries.

Pemberton-Pigott, Crispin

Crispin Pemberton-Pigott is an industrial designer and owner of New Dawn Engineering, Swaziland. A co-founder of the Eastern Cape Appropriate Technology Unit, the Renewable Energy Association of Swaziland, and the Industrial Designers Association of South Africa, he designs clean stove projects and testing laboratories around the world. Attached to the SeTAR Centre, University of Johannesburg, Crispin serves on the South African Bureau of Standards Technical Committee TC1054 co-writing national stove standards and testing protocols. He received the Design Institute of South Africa's Chairman's Award 2004 for the Vesto biomass stove and an innovation award from the Southern Africa Stainless Steel Development Association (SASSDA).

Singh, Santosh

Santosh Singh is Technical Expert for the Indo German Energy Programme, supported by the Gesellschaft für Internationale Zusammenarbeit (GIZ) in India. In this capacity, Santosh develops market-based solutions for increasing rural energy access. The scope of his work includes creating sustainable markets for clean cooking solutions and developing innovative business models and financial access for renewable energy enterprises. Prior to joining the GIZ, he worked as Head of Rural Market Insight Group at IFMR Research in Chennai, where he led various research projects and consulted on Base of Pyramid (BoP) businesses in clean energy, health and sanitation, affordable housing, and vocational training. Santosh holds a Master's Degree in Business Administration (MBA) from the Indian Institute of Forest Management, Bhopal, and has more than 10 years of experience working in such areas as development finance, emerging markets, and commodity trading.

Sisoulath, Hatsady

Hatsady Sisoulath is Director General of the Institute of Renewable Energy Promotion (IREP) within Lao PDR's Ministry of Energy and Mines (MEM).

Sopraseurth, Khammanh

Khammanh Sopraseurth is Deputy Director of the Energy Efficiency and Conservation Division of the Institute of Renewable Energy Promotion (IREP) within Lao PDR's Ministry of Energy and Mines (MEM). In this capacity, he is in charge of policy and strategy development on energy efficiency and conservation. In addition, Khammanh serves as IREP's Coordinator for the East Asia and Pacific (EAP) Clean Stove Initiative in Lao PDR.

Sovd, Mangal

Mangal Sovd is Project Director for the Millennium Challenge Account (MCA)-Mongolia. Since 2010, he has served as Director of the Energy and Environment Project (EEP), financed by the Millennium Challenge Corporation (MCC). For the past decade, he has worked on reducing air pollution in the capital city of Ulaanbaatar through improving fuel quality and the efficiency of stoves and boilers. Previously, Mangal held positions as Director and Chief Engineer at the Mining Research Institute of Mongolia. His experience in mining technology, solid fuel processing, and engineering design includes technical design of mineral deposits' exploitation, as well as analysis of mineral exploitation, processing, and mining operations in Mongolia. Mangal earned degrees in Mining Engineering and holds a PhD in Technical Science from the State University of Mongolia. He has also taken graduate economics and financial management courses at the Economics Institute in Boulder, Colorado.

Toba, Natsuko

Natsuko Toba is Senior Economist at the World Bank, where she specializes in infrastructure, particularly links between energy and poverty, environment (including climate change), social and economic development, regulation, governance, and political economy. She has extensive experience as team leader and has worked independently on operational and analytical projects with the Asian Development Bank, World Bank/International Finance Corporation, and other international organizations in some 20 countries across Central, East, and South Asia; the Pacific Islands; Africa; and Latin America. Her work has focused on carbon finance and innovative project design and financial, policy, and strategy instruments. She is a formal reviewer of *Energy Policy* journal and is Coordinator for the Asia Sustainable and Alternative Energy Program (ASTAE). Natsuko has a PhD in Economics from the University of Cambridge and is an Honorary Cambridge Overseas Trust Scholar and Fellow.

Togooch, Bat-Erdene

Bat-Erdene Togooch is Vice Mayor of Ulaanbaatar and Chairman of the Steering Committee for the capital city's Clean Air Project, in charge of ecology and green development. In this capacity, Bat-Erdene is responsible for resolving the city's ecology and green development problems and building more comfortable living conditions for its citizens. He is also in charge of implementing the action plan of the Mongolian government and city mayor. Agencies and departments under his supervision include the Air Quality Agency, Department of Ecology Protection, and Department of Industry and Agriculture.

Tuntivate, Voravate

Voravate (Tig) Tuntivate is Senior Energy Specialist at the World Bank. He has more than 20 years of experience working in the fields of household energy access, including household access to cooking and heating and electrification, in Asia, Africa, and South America. His areas of expertise include sampling; survey research, particularly related to household energy; and social marketing. Previously, he served as lecturer at the United Nations Statistical Institute for Asia and the Pacific (SIAP). Tig holds a degree in economics and a PhD in urban studies and energy policy.

van der Plas, Robert

Robert van der Plas is Director of the Netherlands office of MARGE Sarl, a European consulting firm specializing in the nexus of energy and environment. Previously, Robert worked at the World Bank for more than 16 years, where his last position held was Senior Energy Planner. Robert was instrumental in adding rural energy to the development assistance agenda. He has extensive experience in household, rural, and renewable energy issues in Africa and Asia, with two areas of focus: (i) biomass energy management, use, and conversion and (ii) decentralized rural electrification. His recent work includes developing a biomass energy strategy for Mozambique, a national stove program for Nigeria, and a national rural electrification program for Haiti; assisting private firms and the Government of Rwanda to develop micro-hydro plants in that country; and acting as Team Leader for the Asian Development Bank's Energy for All Partnership. Robert holds Master's Degrees in Applied Physics and Development Studies from the University of Twente in the Netherlands.

Vongvisith, Boulay

Boulay Vongvisith is Deputy Head of the Bio Gas Division of the Institute of Energy and New Construction Materials, Ministry of Science and Technology (MOST) in Lao PDR. In this capacity, he is responsible for research activities that involve the development of improved cookstoves, biodiesel production, domestic biogas technology, and organic fertilizer production. In 2007, Boulay earned his Master's Degree in the Science of Food Engineering and Bio-processing Technology from the Asian Institute of Technology (AIT) in Thailand; he also holds a Bachelor's Degree in Science from the National University of Lao PDR (NUOL).

Wibowo, Edi

Edi Wibowo is Deputy Director of the Department of Bioenergy Engineering and Environment, Directorate General of New Renewable Energy and Energy Conservation within Indonesia's Ministry of Energy and Mineral Resources (MEMR). In this position, which he has held since February 2011, Edi is responsible for policies and regulations related to the engineering and environmental aspects of bioenergy development, including standards, safety, and quality and environmental monitoring. From 2009 to 2011, he headed the facilitation of energy utilization policy for the Secretary General's National Energy Council. He previously worked for the Research and Development Center for Oil and Gas Technology, "Lemigas," beginning in 1993. Edi holds a Master's Degree in Mechanical Engineering from the University of Indonesia in Depok and a Bachelor's Degree in Agricultural Engineering from Bogor Agricultural University.

Yuliani, Fitria

Fitria Yuliani is an analyst in the Bioenergy Cooperation and Investment Subdirectorate, Directorate General of New Renewable Energy and Energy Conservation within Indonesia's Ministry of Energy and Mineral Resources (MEMR). She is responsible for developing policies and regulations to enhance the development of bioenergy, focusing on investment-related aspects. Fitria received a Degree in Industrial Engineering from the University of Indonesia in 2010.

Zhang, Yabei

Yabei Zhang is Energy Economist in the World Bank's Water and Energy Unit, East Asia and Pacific Region. She joined the World Bank as a Young Professional in 2008 and has worked on energy, urban, and climate-change issues with a focus on energy efficiency, urban energy, and household energy. She is part of the core team for the EAP Clean Stove Initiative (CSI) program and the task team leader for the China and Indonesia CSI country programs. Prior to joining the World Bank, Yabei worked at the Joint Global Change Research Institute (a joint program of the Pacific Northwest National Lab and the University of Maryland). She holds a PhD in Economics from the University of Maryland, College Park and a Master's Degree in City Planning from the Massachusetts Institute of Technology (MIT). She did her PhD dissertation on household energy, indoor air pollution, and health impacts in India.

APPENDIX D

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APPENDIX E

Itinerary: EAP CSI Forum

March 18, 2013, Phnom Penh Hotel, Phnom Penh, Cambodia

Time	Topic	Presenter(s)
8:30–9:00	Registration	
9:00–9:15	Opening Remarks	Dejan Ostojic
Session I: Country Programs		
9:15–9:45	Indonesia	Yabei Zhang Indonesia Delegation (Edi Wibowo)
9:45–10:15	Lao PDR	Natsuko Toba Lao PDR Delegation (Hatsady Sisoulath)
10:15–10:30	Q&A	
10:30–11:00	Coffee break	
11:00–11:30	China	Yabei Zhang China Delegation (Fang Fang)
11:30–12:00	Mongolia	Voravate Tuntivate Mongolia Delegation (Mangal Sovd)
12:00–12:15	Q&A	
12:30–2:00	**Joint Lunch with ADB E4All Program** • Welcome Remarks by Vijay Iyer, Director, Sustainable Energy Department, World Bank • Asian Development Bank (Program Scope, Countries, Expected Outputs, and Timetable): ADB representative (5–10 minutes) • Brief Overview of EAP Clean Stove Initiative (5 minutes)	
Session II: Cross-Cutting Issues in Scaling Up Access to Clean Cooking and Heating Solutions (Panel Discussions)		
2:00–2:45	Private-Sector Development and the Role of Financing	Moderator: Yabei Zhang Panelists: Santosh Singh, Iwan Baskoro, Guangqing Liu, and Khurelsukh Nyamgarav
2:45–3:30	Technology and Quality Assurance	Moderator: Robert van der Plas Panelists: Crispin Pemberton-Pigott, Xiaofu Chen, Mangal Sovd, and Christoph Messinger
3:30–4:00	Coffee break	
4:00–4:45	Institutions, Cross-Sector Coordination, and Partnerships	Moderator: Leslie Cordes Panelists: Marlis Kees, Christina Aristanti Tjondro, Natsuko Toba, and Khammanh Sopraseurth
4:45–5:30	Intervention Strategy and Next Steps	Moderator: Dejan Ostojic Panelists: Fang Fang, Bat-Erdene Togooch, Edi Wibowo, and Hatsady Sisoulath
5:30–6:00	Closing Remarks	Dejan Ostojic

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